FPL Energy
Seabrook Station

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September 22, 2005

Docket No. 50-443
SBK-L-05205

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Seabrook Station
Facility Operating License NPF-86
License Amendment Request 05-04
Application for Measurement Uncertainty Recapture Power Uprate

In accordance with the requirements of 10 CFR 50.90, FPL Energy Seabrook, LLC (FPL Energy Seabrook) requests amendments to the facility operating license, NPF-86, and the plant Technical Specifications for Seabrook Station. This Measurement Uncertainty Recapture (MUR) power uprate license amendment request (LAR) will increase the licensed reactor core power level by 1.7 percent from 3587 megawatts thermal (MWt) to 3648 MWt.

FPL Energy Seabrook developed this LAR consistent with the guidelines in Nuclear Regulatory Commission Regulatory Issue Summary, 2002-03, "Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications".

The LAR for the Seabrook Station MUR is provided in the attachments to this letter. The attachments are summarized in the table below:

A001

LAR 05-04 ATTACHMENT DESCRIPTION	
Attachment 1	Technical assessment, regulatory analysis, and environmental evaluation
Attachment 2	Facility operating license and technical specifications pages marked up to reflect the proposed changes
Attachment 3	Revised (clean copies) of the facility operating license and technical specifications pages
Attachment 4	List of regulatory commitments associated with this LAR
Attachment 5	Proposed Schedule
Attachment 6	No Significant Hazards Consideration Determination
Enclosure 1	Seabrook Uprate System Impact Study

As discussed in Attachment 1, Section 1.4, and Attachment 6 to this letter, the proposed amendment does not involve a significant hazards consideration pursuant to 10 CFR 50.92. A copy of this letter and the enclosed LAR have been forwarded to the New Hampshire State Liaison Officer pursuant to 10 CFR 50.91(b).

FPL Energy Seabrook requests a six-month NRC review and approval of this proposed amendment to support the refueling outage currently scheduled to begin in early Fall 2006. Approval for this refueling outage allows FPL Energy Seabrook to take advantage of the economic benefits of the MUR as soon as possible. The requested approval date is consistent with the NRC review schedule for MURs. In addition, FPL Energy Seabrook requests 12 months to implement the LAR.

FPL Energy Seabrook has determined that the information for the proposed amendment does not involve a significant hazards consideration, authorize a significant change in the types or total amounts of effluent release, or result in any significant increase in individual or cumulative occupational radiation exposure. Therefore, the proposed amendment meets the categorical exclusion requirements of 10 CFR 51.22(c)(9) and an environmental impact appraisal need not be prepared.

The Station Operation Review Committee and the Company Nuclear Review Board have reviewed LAR 05-04.

Should you have any questions concerning this LAR, please contact Mr. Stephen T. Hale, Power Uprate Project Manager, at (603) 773-7561.

Very truly yours,

FPL Energy Seabrook, LLC

Gene St. Pierre
Site Vice President

Attachments (6)
Enclosure

cc: S. J. Collins, NRC Region I Administrator
V. Nerses, NRC Project Manager, Project Directorate 1-2
G. T. Dentel, NRC Resident Inspector

Mr. Bruce G. Cheney, ENP, Director, Division of Emergency Services
N.H. Department of Safety
Division of Emergency Services, Communications, and Management
Bureau of Emergency Management
33 Hazen Drive
Concord, NH 03305

Oath and Affirmation

I, Gene St. Pierre, Site Vice President of FPL Energy Seabrook, LLC hereby affirm that the information and statements contained within this license amendment request are based on facts and circumstances which are true and accurate to the best of my knowledge and belief.

Sworn and Subscribed
Before me this

22nd day of September 2005

Victoria Susan Robertson
Notary Public

Gene St. Pierre
Site Vice President

VICTORIA SUSAN ROBERTSON
MY COMMISSION EXPIRES JAN. 15, 2008
NOTARY PUBLIC
NEW HAMPSHIRE

SEABROOK STATION

FACILITY OPERATING LICENSE
NPF-86

LICENSE AMENDMENT REQUEST 05-04

MEASUREMENT UNCERTAINTY RECAPTURE
POWER UPRATE

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ATTACHMENT 1
TECHNICAL ASSESSMENT, REGULATORY ANALYSIS, AND ENVIRONMENTAL EVALUATION

1.0 INTRODUCTION

Like most nuclear units, Seabrook Station was originally designed with feedwater flow instrumentation and analytical techniques that were appropriate at that time. Since then, improvements have occurred in feedwater flow measurement instrumentation and associated power calorimetric uncertainty values. Based on the installation of new feedwater flow instrumentation and the associated reduction in reactor core power uncertainty values, FPL Energy Seabrook, LLC (FPL Energy Seabrook) is proposing to increase the core rated thermal power by 1.7 percent. The proposed increase in the rated thermal power will not involve significant hazards consideration.

FPL Energy Seabrook proposes to amend the Seabrook Station Facility Operating License, NPF-86, and the Technical Specifications to increase the licensed thermal power. Seabrook Station is currently licensed to operate at a maximum reactor core power level of 3587 megawatts thermal (MWt). FPL Energy Seabrook is requesting that the licensed reactor core power level be increased by 1.7 percent to 3648 MWt (3667 MWt NSSS power level). Modifications required for this uprate include the replacement of the feedwater flow instrumentation, and reliability enhancements to the electrical generator, generator exciter, and feedwater pump turbines.

FPL Energy Seabrook developed this LAR consistent with the guidelines in Nuclear Regulatory Commission Regulatory Issue Summary, 2002-03, "Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications" [Reference 1.0-1].

1.1 PURPOSE AND SCOPE

FPL Energy Seabrook submitted License Amendment Request 04-03 "Application for Stretch Power Uprate" [Reference1.1-1] which contained the revised safety analyses summary for an analyzed core power level of 3659 MWt (3678 MWt NSSS power level). This analyzed core power level is 2.0 percent greater than the current licensed core power level of 3587 MWt and 0.3 percent greater than the proposed measurement uncertainty recapture (MUR) core power level of 3648 MWt. The scope of License Amendment Request 04-03 included the reanalysis and/or evaluation of each Seabrook Station UFSAR Chapter 15 accident analyses, evaluation of major nuclear steam supply system (NSSS) components (e.g., reactor pressure vessel, pressurizer, reactor coolant pumps, and steam generators), balance of plant (BOP) components, (e.g., turbine generator, and condensate and feedwater pumps), and major systems and subsystems (e.g., safety injection, emergency feedwater, residual heat removal, electrical distribution, emergency diesel generators, and containment systems). Control systems (e.g., rod control, pressurizer pressure and level, turbine overspeed, steam generator level, and atmospheric steam dump) were evaluated for operation at the analyzed core power level conditions. The NRC approved a revision Facility Operating License NPF-86 and the Seabrook Station Technical Specifications (Amendment 101) with its safety evaluation report [Reference1.1-2] based on the revised safety analyses.

FPL Energy Seabrook evaluated the impact of the MUR from a licensed core power of 3587 MWt to 3648 MWt for the applicable systems, structures, and components, and safety analyses at Seabrook Station. The MUR core power level conditions are bounded by the current analyses of record. Reactor trip and engineered safety features actuation setpoints have been evaluated for the MUR conditions. The results of the analyses and evaluations have yielded acceptable results and demonstrate that all design basis acceptance criteria will continue to be satisfied at MUR conditions.

1.2 METHODOLOGY AND ACCEPTANCE CRITERIA

Analyses and evaluations were performed for the Seabrook Station stretch power uprate (SPU) at an analyzed core power level of 3659 MWt (3678 MWt NSSS core power level). Seabrook Station License Amendment Request 04-03 [Reference1.1-1] submitted the reanalysis to the NRC for review. The NRC issued Amendment 101 to Facility Operating License NPF-86 and the Seabrook Station Technical Specifications [Reference1.1-2] approving the increase in licensed core power level to 3587 MWt. The safety evaluation report for the amendment addressed the NRC's review and approval of the revised safety analyses.

The current analyses of record approved in Amendment 101 to Facility Operating License NPF-86 are 2.0 percent greater than the current licensed core power level of 3587 MWt, and 0.3 percent greater than the proposed MUR core power level of 3648 MWt. FPL Energy Seabrook evaluated the applicable systems, structures, components, and safety analyses at the MUR core power level against the conditions for the analyzed core power level. The results indicated that applicable systems, structures, components, and safety analyses for the MUR analyses are bounded by the analyzed core power level analyses, except as noted below.

The following systems, components, and evaluations have been determined to require an evaluation:

- Main feedwater pump turbines – replacement of the last stage buckets and diaphragms to reduce long-term fatigue stresses
- Main generator – generator rewind and exciter replacement for increased generator output and reliability
- Grid stability – increased output to the electrical gird
- Impact on operations – minor changes to various Operations Department procedures

1.3 REGULATORY GUIDANCE

This power uprate is less than a seven percent increase and other than the feedwater flow measurement instrumentation and certain reliability enhancements, requires no major modifications. Therefore, this uprate is considered to be an MUR.

FPL Energy Seabrook developed this LAR with the guidelines in Nuclear Regulatory Commission Regulatory Issue Summary, 2002-03, "Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications" [Reference 1.0-1].

LAR Section 2.0 contains a discussion of the Feedwater Flow Measurement Technique and Power Measurement Uncertainty.

LAR Sections 3.0 through 7.0 contain a summary review cross-reference for systems, structures, components, programs, and transients/accidents potentially affected by the MUR.

LAR Section 8.0 contains miscellaneous topics, including: Nuclear Steam Supply System (NSSS)) design operating parameters, impact on operations, environmental evaluation, description of the modifications, and post-installation testing.

LAR Section 9.0 contains a description of the changes to the facility operating license and technical specifications. The marked up and retyped pages for the facility operating license and technical specifications are contained in LAR Attachments 2 and 3, respectively.

LAR Attachment 4 contains the List of Regulatory Commitments.

LAR Attachment 5 contains the Proposed Schedule for License Amendment and Issuance.

LAR Attachment 6 contains the No Significant Hazards Consideration Determination.

1.4 NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION BASIS

FPL Energy Seabrook has evaluated the proposed facility operating license and technical specification changes identified in LAR Section 9.0 and Attachments 2 and 3 pursuant to 10 CFR 50.91 against the standards in 10 CFR 50.92 and has determined that the operation of Seabrook Station in accordance with the proposed LAR presents no significant hazards. The FPL Energy Seabrook evaluation against each of the criteria in 10 CFR 50.92 is provided in Attachment 6 of this LAR.

Analyses and evaluations were performed by FPL Energy Seabrook and approved by the Nuclear Regulatory Commission for the Seabrook Station stretch power uprate at an analyzed core power level of 3659 MWt (3678 MWt NSSS core power level) [References1.1-1 and 1.1-2]. A review of the accident analyses, component and system analyses, and radiological dose consequences at the MUR core power level of 3648 MWt (3667 MWt NSSS power level) was performed. Analyses satisfied the appropriate acceptance criteria, as discussed in the no significant hazards determinations in Attachment 6 to this LAR. Therefore, operation of Seabrook Station in accordance with the proposed amendment will not result in a significant increase in the probability or consequences of any accident previously analyzed; will not result in a new or different kind of accident from any accident previously analyzed; and will not result in a significant reduction in margin of safety. Therefore, the proposed LAR does not involve a significant hazards consideration.

1.5 CONCLUSIONS

The analyses and evaluations presented in this LAR conclude that Seabrook Station can safely operate within licensed parameters at the MUR power level.

1.6 REFERENCES

1.0-1 NRC Regulatory Issue Summary, 2002-03, "Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications," January 31, 2002.

1.1-1 FPL Energy Seabrook letter (NYN-04016) to NRC Document Control Desk, License Amendment Request (LAR) 04-03, "Application for Stretch Power Uprate," March 17, 2004.

1.1-2 NRC Letter to FPL Energy Seabrook, License Amendment 101, "Seabrook Station, Unit No. 1 – Issuance of Amendment RE: 5.2 Percent Power Uprate," February 28, 2005.

2.0 FEEDWATER FLOW MEASUREMENT TECHNIQUE AND POWER MEASUREMENT UNCERTAINTY (RIS 2002-03 Section I)

2.1 FEEDWATER FLOW MEASUREMENT DEVICES

The feedwater flow measurement system to be installed at Seabrook Station is a Caldon Leading Edge Flow Measurement (LEFM) CheckPlus™ ultrasonic, multi-path, transit time flowmeter. The design of this advanced flow measurement system is addressed in detail by the manufacturer in Topical Reports ER-80P and ER-157P [References 2.1-1 and 2.1-2, respectively]. NRC approved the use of these Topical Reports in safety evaluation reports [References 2.1-3 and 2.1-4, respectively].

The Caldon LEFM CheckPlus™ System at Seabrook Station will consist of one flow element installed in a common portion of the feedwater flow loops and an electronic unit installed in the Turbine Building. The inlet to this flow element will be installed approximately eight pipe diameters downstream from the centerline of a 24" x 24" to 36" lateral and approximately three pipe diameters upstream from the centerline of 36" x 24" to 24" lateral. The planned installation location of this flow element conforms to the requirements of Topical Reports ER-80P and ER-157P.

The Seabrook Station flow measuring device will be installed in accordance with FPL Energy Seabrook procedures in an existing straight horizontal pipe run approximately 40 feet in length. The location will be over 30 pipe diameters upstream from the nearest external (Caldon 2-path chordal) flow measurement device. The Feedwater System venturies are located downstream from the external flow measurement devices. The design and location of the feedwater flow measurement devices is such that there will be no hydraulic communication between these instruments that would cause interference due to the installation of the Caldon LEFM CheckPlus™ System.

The Caldon LEFM CheckPlus™ System will be permanently installed in Seabrook Station in accordance with the requirements of Topical Reports ER-80P and ER-157P and FPL Energy Seabrook procedures. This system will be used for continuous calorimetric power determination by digital link with the main plant computer system and will incorporate self-verification features to ensure that hydraulic profile and signal processing requirements are met within its design basis uncertainty analysis.

The Caldon LEFM CheckPlus™ System will communicate with the plant computer via an Ethernet digital communications interface. Transmittal to the main plant computer will be via fiber optic cables and data converters. Dual data outputs will provide redundant information sources for the main plant computer. These communications links will provide raw and conditioned data, as well as diagnostic and quality information that will be used as inputs to the secondary calorimetric calculation. Hard-wired alarms will provide additional assurance of operator notification of a system failure.

The Seabrook Station Caldon LEFM CheckPlus™ System will be calibrated prior to installation in a site-specific model test at Alden Research Laboratories. The calibration will be confirmed during in-situ site acceptance testing. All calibration standards will be traceable to National Institute of Standards and Technology standards. The Caldon

LEFM CheckPlus™ System will be installed and commissioned in accordance with FPL Energy Seabrook procedures and Caldon procedure installation and test requirements. The procedures will include, but not be limited to, verification of Reynolds Number, ultrasonic sound quality, and hydraulic velocity profiles.

2.2 TOPICAL REPORTS CRITERIA

In approving Caldon Topical Reports ER-80P and ER-157P, the NRC established four criteria to be addressed by each licensee. The four criteria and a discussion of how each will be satisfied for Seabrook Station follow:

Criterion 1

Discuss maintenance and calibration procedures that will be implemented with the incorporation of the LEFM, including processes and contingencies for inoperable LEFM instrumentation and the effect on thermal power measurements and plant operation.

Response to Criterion 1

Implementation of the MUR license amendment will include developing the necessary procedures and documents required for operation, maintenance, calibration, testing, and training at the MUR power level with the new Caldon LEFM CheckPlus™ System. Plant maintenance and calibration procedures will be revised to incorporate Caldon's maintenance and calibration requirements prior to declaring the Caldon LEFM CheckPlus™ System operational and raising core power above 3587 MWt. The incorporation of, and continued adherence to, these requirements will assure that the Caldon LEFM CheckPlus™ System is properly maintained and calibrated.

System maintenance is discussed in LAR Section 2.4 and contingency plans for operation of the plant with the Caldon LEFM CheckPlus™ System out of service are described in LAR Section 2.5.

Criterion 2

For plants that currently have LEFMs installed, provide an evaluation of the operational and maintenance history of the installed instrumentation and confirmation that the installed instrumentation is representative of the LEFM system and bounds the analysis and assumptions set forth in Topical Report ER-80P.

Response to Criterion 2

Seabrook Station currently has flow measurement venturies on the Feedwater System, and differential pressure instrumentation on the Main Steam System which are used to calculate reactor core power based on secondary calorimetrics. The Feedwater System flow venturies and the Main Steam differential pressure instrumentation will serve as backup inputs to the calorimetric to be used when the Caldon LEFM CheckPlus™ System is not available. The new Caldon LEFM CheckPlus™ System will be independent of the Feedwater System venturies, the Main Steam System flow instrumentation, and the Caldon 2-path chordal devices. Operational and maintenance history associated with the Caldon 2-path chordal devices is not applicable to the new Caldon LEFM CheckPlus™ System.

Criterion 3

Confirm that the methodology used to calculate the uncertainty of the LEFM in comparison to the current feedwater instrumentation is based on accepted plant setpoint methodology (with regard to the development of instrument uncertainty). If an alternative approach is used, the application should be justified and to both venturi and ultrasonic flow measurement instrumentation installations for comparison.

Response to Criterion 3

The total power calorimetric accuracy using the Caldon LEFM CheckPlus™ System is determined by evaluating the reactor thermal power sensitivity to deviations in the process parameters used to calculate reactor thermal power. Uncertainties for parameters that are not statistically independent are arithmetically summed to produce groups that are independent of each other, which can be statistically combined. Then all independent parameters/groups that contribute to the power measurement uncertainty are combined using a statistical summation to determine the total power measurement uncertainty.

Criterion 4

For plants where the ultrasonic meter (including LEFM CheckPlus™ System) was not installed and flow elements calibrated to a site-specific piping configuration (flow profiles and meter factors not representative of the plant-specific installation), additional justification should be provided for its use. The justification should show that the meter installation is either independent of the plant-specific flow profile for the stated accuracy, or that the installation can be shown to be equivalent to known calibrations and plant configurations for the specific installation including the propagation of flow profile effects at higher Reynolds numbers. Additionally, for previously installed calibrated elements, confirm that the piping configuration remains bounding for the original LEFM CheckPlus™ System installation and calibration assumptions.

Response to Criterion 4

Criterion 4 does not apply to Seabrook Station. The calibration factor for the Seabrook Station spool piece will be established by tests of this spool at Alden Research Laboratory to standards traceable to National Institute of Standards and Technology standards. These tests will include a full-scale model of the Seabrook Station hydraulic geometry and tests in a straight pipe. An Alden Research Laboratory data report for these tests and a Caldon engineering report evaluating the test data will be provided to the Seabrook Station. The calibration factor used for the Caldon LEFM CheckPlus™ System at Seabrook Station will be based on these reports. The uncertainty in the calibration factor for the flow meter spool will be based on the Caldon engineering report. The site-specific uncertainty analysis will document these analyses. This document will be maintained on file, as part of the technical basis for the Seabrook Station MUR.

Final acceptance of the site-specific uncertainty analyses will occur after the completion of the commissioning process. The commissioning process will verify bounding calibration test data and provide final positive confirmation that actual performance in the field will meet the uncertainty bounds established for the instrumentation. Final commissioning is expected to be completed by the Fall 2006 refueling outage.

2.3 RATED THERMAL POWER CALCULATION

LAR Table 2.3-1 summarizes the core thermal power measurement uncertainty for Seabrook Station and compares the uncertainties identified in Caldon Topical Report ER-157P for the Caldon LEFM CheckPlus™ System [Reference 2.1-2] to the Seabrook Station plant-specific uncertainties. Differences between the Seabrook Station uncertainties and the uncertainties identified in the Caldon Technical Report ER-157P are a result of plant-specific calculations and parameter uncertainties.

TABLE 2.3-1
TOTAL POWER UNCERTAINTY DETERMINATION

	Parameter(1)	ER-157P Uncertainty	Seabrook Station Uncertainty
1.	Hydraulics: Profile factor	0.25%	0.20%
2.	Geometry: Spool dimensions, alignment, thermal expansion	0.09%	0.10%
3.	Time Measurements: Transit times and non fluid time delay	0.045%	0.07%(6)
4.	Feedwater Density:(2) LEFM temperature determination, pressure input, and correlation(5)	0.07%	0.07%
5.	Subtotal: Mass flow uncertainty (Root sum square of items 1, 2, 3, and 4 above)	0.28%	0.24%
6.	Feedwater Enthalpy:(3) LEFM temperature determination, pressure input, and correlation(5)	0.08%	0.08%
7.	Steam Enthalpy: Pressure input and moisture uncertainty	0.07%	0.08%
8.	Other Gains and Losses	0.07%	0.03%
9.	Total Power Determination Uncertainty	0.33%(4)	0.30%

NOTES:

1. Items 1 through 6 are directly associated with the Caldon LEFM CheckPlus™ System device. Items 7 and 8 are based on other plant process inputs discussed below.
2. Density errors due to the density correlation, the LEFM feedwater temperature determination and the feedwater pressure measurement.
3. Enthalpy errors due to the enthalpy correlation, the LEFM feedwater temperature determination and the feedwater pressure measurement.
4. ER-157P demonstrates that the Caldon LEFM CheckPlus™ System can support uncertainties as small as ±0.3%.
5. The bounding uncertainties in pressure and temperature are ±15 psi and ±0.6°F, respectively.
6. Caldon plant-specific calculation.

The uncertainties noted above were determined utilizing the calculational methodology described in Caldon Topical Report ER-80P [Reference 2.1-1] as amended by ER-157P.

In addition to the process inputs provided by the Caldon LEFM CheckPlus™ System, the main plant computer system uses the following process inputs to calculate the contribution of items 7 and 8 from Table 2.3-1 above to the determination of core thermal power:

- Steam pressure
- Blowdown flow
- Charging flow
- Seal injection flow
- Letdown flow
- Pressurizer pressure
- Charging pressure
- Letdown pressure
- Charging temperature
- Letdown temperature
- Reactor Coolant System Loop 3 cold leg temperature (T_{cold})
- Volume control tank outlet temperature

These process inputs are obtained from analog instrumentation channels that are maintained and calibrated in accordance with required periodic calibration procedures. Configuration of the hardware associated with these process inputs is maintained in accordance with the Seabrook Station change control process.

2.4 SYSTEM MAINTENANCE

Instruments that affect the power calorimetric, including the Caldon LEFM CheckPlus™ System inputs, are monitored by Seabrook Station Engineering Department personnel. Equipment problems for plant systems, including the Caldon LEFM CheckPlus™ System equipment, fall under the site work control process. Conditions that are adverse to quality are documented under the corrective action program. Corrective action procedures, which ensure compliance with the requirements of 10 CFR 50, Appendix B, include instructions for notification of deficiencies and error reporting.

The following information addresses specific aspects of calibration and maintenance procedures relating to the Caldon LEFM CheckPlus™ System.

- Calibration and maintenance will be performed by the Seabrook Station Maintenance Department Instrumentation and Controls personnel working under the site work control processes, using site-specific procedures. The site-specific procedures will be developed using Caldon technical manuals.
- Routine preventive maintenance activities will include physical inspections, power supply checks, backup battery replacements, and internal oscillator frequency verification. Ultrasonic signal verification and alignment will be performed automatically by the Caldon LEFM CheckPlus™ System. Signal verification will be determined by reviewing the signal quality measurements performed and displayed by the Caldon LEFM CheckPlus™ System. Selected Instrumentation and Controls personnel in the Maintenance Department will be trained and qualified per the FPL Energy Seabrook Institute For Nuclear Power Operations (INPO) accredited training program before maintenance or calibration is performed and prior to increasing power above 3587 MWt. This training will include lessons learned from industry experience. Initially, formal training by Caldon will be provided to Seabrook Station personnel.
- The LEFM CheckPlus™ System is designed and manufactured in accordance with Caldon's 10 CFR 50, Appendix B, Quality Assurance Program and its Verification and Validation Program. Caldon's Verification and Validation Program fulfills the requirements of ANSI/IEEE-ANS Standard 7-4.3.2 and ASME-NQA-2a [References 2.4-1 and 2.4-2, respectively]. In addition, the program is consistent with guidance for software verification and validation in EPRI TR-103291S [Reference 2.4-3]. Specific examples of quality measures undertaken in the design, manufacture, and testing of the Caldon LEFM CheckPlus™ System are provided in Caldon Technical Report ER-80P, Section 6.4 and Table 6.1.
- Corrective action involving maintenance will be performed by Maintenance Department Instrumentation and Controls personnel, qualified in accordance with FPL Energy Seabrook's Instrumentation and Calibration Training Program, and formally trained on the Caldon LEFM CheckPlus™ System.

- Reliability of the Caldon LEFM CheckPlus™ System will be monitored by Seabrook Station System Engineering Department personnel. Equipment problems for all plant systems, including the Caldon LEFM CheckPlus™ System equipment, will fall under the site work control process. Conditions that are adverse to quality will be documented under the corrective action program.
- The Seabrook Station Caldon LEFM CheckPlus™ System will be included in Caldon's Verification and Validation Program, and procedures are maintained for user notification of important deficiencies. The Caldon LEFM CheckPlus™ System purchase agreement with the FPL Energy Seabrook included requirements that Caldon inform FPL Energy Seabrook of any deficiencies in accordance with Caldon's maintenance agreement and/or 10 CFR Part 21 reporting requirements.

2.5 OUT OF SERVICE REQUIREMENTS

The Seabrook Station Technical Requirements Manual will be revised to include a Limiting Condition for Operation (LCO) and Action Statements for the Caldon LEFM CheckPlus™ System.

The proposed allowed outage time for operation at any power level in excess of the current licensed core power level (3587 MWt) with the Caldon LEFM CheckPlus™ System out of service, is 48 hours, provided steady-state conditions persist (i.e., no power changes in excess of 10 percent) throughout the 48-hour period. The bases for the proposed allowed outage time are:

- There will be alternate plant instruments (feedwater venturies and main steam flow) to be used if the Caldon LEFM CheckPlus™ System is out of service for a longer period. Specifically, the main steam flow instruments will be normalized to the Caldon LEFM CheckPlus™ System, and their accuracy will gradually degrade over time as a result of nozzle fouling and transmitter drift. However, values of drift are typically in the range of tenths of a percent of the calibrated span over 18 to 24 months or more. This typical drift value will not result in any significant drift for the instrumentation associated with the calorimetric measurements over a 48-hour period.
- Most repairs to the Caldon LEFM CheckPlus™ System can be made within an eight-hour shift. Forty-eight hours will give plant personnel time to plan the work, make repairs, and verify normal operation of the Caldon LEFM CheckPlus™ System within its original uncertainty bounds at the same power level and indications as before the failure.
- Operations personnel will operate the plant based on the calibrated alternate plant instruments when the Caldon LEFM CheckPlus™ System is not available. The reduction in power could, and in many cases, will be avoided altogether since repairs would typically be accomplished prior to the expiration of the 48-hour period.
- If the plant experiences a power change of greater than ten percent during the 48-hour period, then the permitted maximum power level will be reduced to the current licensed core power level of 3587 MWt, since a plant transient may result in calibration changes to the alternate instruments.
- As described in ER-157P, the Caldon LEFM CheckPlus™ System will consist of two sections (eight paths) of transducers. Administrative controls will be developed to specify that if the Caldon LEFM CheckPlus™ System has experienced an outage of only one section (four paths) of the system, plant operations will be consistent with a complete Caldon LEFM CheckPlus™ System out-of-service condition. Although, in accordance with Caldon Report ER-482, a loss of one section results in 0.43 percent uncertainty vs. 0.30 percent uncertainty with two sections operable.

For the Caldon LEFM CheckPlus™ System out-of-service condition, the 48-hour "clock" will start at the time of the failure. Failure will be annunciated in the control room. The status of the Caldon LEFM CheckPlus™ System power calorimetric will be determined based on the status of the system data points. The method of identifying the status of the Caldon LEFM CheckPlus™ System data by the electronic unit and the alarms to the operator are described in the Caldon documentation located in the Seabrook Station vendor documentation program and the software design descriptions for the data link and the calorimetric program.

The Caldon LEFM CheckPlus™ System electronic unit and central processing unit will continuously monitor, test, and/or verify the following attributes of the system operation:

- Acoustical processing units
- Analog inputs
- Test paths
- Signal quality
- Path-to-path sound velocity
- Velocity profiles
- Watchdog timer
- Flowrate calculations uncertainty verified against specified system uncertainty thresholds
- Meter path operation (i.e., signal quality, sound velocity to specified thresholds)
- Meter velocity profile (i.e., changes to hydraulic profile, verified against specified thresholds)

If the 48-hour outage period is exceeded, then the plant will operate at a power level consistent with the accuracy of the alternate plant instruments. The procedures for power reduction will be in accordance with current operating procedures, such that the plant will be operating at or below the current licensed core power level of 3587 MWt by the time the 48 hours has elapsed. The 48-hour limit will not apply for loss of the main plant computer system as described in LAR Subsection 2.5.2 below.

The Caldon LEFM CheckPlus™ System at Seabrook Station will consist of a single feedwater measurement spool piece installed in the feedwater header, and the associated electronics unit. Failure of the Caldon LEFM CheckPlus™ System will result in a calculation of thermal power based on the operation of the feedwater venturies or main steam flow instrumentation and resistance-temperature detectors in the feedwater lines. Operation during this period will be at a power level consistent with operation entirely on these calibrated alternate instruments. With the Caldon LEFM CheckPlus™ System out-of-service for greater than 48 hours, the thermal power uncertainty increases, such that the justifiable core power level is reduced from 3648 MWt to 3587 MWt. Plant operating procedures will be revised to ensure that the plant will be at or below the current licensed core power level, 3587 MWt, within 48 hours in the event of a loss of the Caldon LEFM CheckPlus™ System.

2.5.1 FLOWMETER CALIBRATION FOLLOWING LOSS OF THE CALDON LEFM CHECKPLUS™ SYSTEM

The power calorimetric flow inputs using the alternate instrumentation (feedwater venturies or main steam flow) and the Caldon LEFM CheckPlus™ System calorimetric are completely separate, and the calculations of core thermal power are performed independently by the main plant computer system.

The preferred alternate method to provide flow input to the calorimetric is the main steam flow instruments normalized to the Caldon LEFM CheckPlus™ System flow. The steam flow normalization is performed by taking the ratio of total steam flow to the feedwater flow from the Caldon LEFM CheckPlus™ System. In addition, the flow input can be provided by either the main steam flow normalized to the venturies, or the feedwater venturies directly. All three methods are bounded by the 2 percent uncertainty for a core power level of 3587 MWt.

Plant operating procedures will be revised to ensure that should the Caldon LEFM CheckPlus™ System out-of-service condition not be corrected, core thermal power will be reduced to or below the pre-uprate core power level of 3587 MWt prior to exceeding the 48 hours.

2.5.2 POWER LEVEL ADJUSTMENT FOLLOWING A MAIN PLANT COMPUTER SYSTEM FAILURE

A main plant computer system failure will be treated as a loss of both the Caldon LEFM CheckPlus™ System and the ability to obtain a corrected calorimetric power using alternate plant instrumentation. Operation at the MUR core power level of 3648 MWt may continue until the next required Nuclear Instrumentation heat balance adjustment which could be up to 24 hours. The main plant computer system failure will result in reducing core thermal power to the current licensed core power level of 3587 MWt, as needed, to support the manual calorimetric measurement. The 48-hour time period will not apply in this specific case, as a manual calorimetric will be required.

2.6 REFERENCES

2.1-1 ER-80P, Revision 0, "Improving Thermal Power Accuracy and Plant Safety While Increasing Operating Power Level Using the LEFM√™ System," Caldon, Inc., March 1997.

2.1-2 ER-157P, Revision 5, "Supplement to Topical Report ER-80P: Basis for a Power Uprate with the LEFM√™ System," Caldon, Inc., October 2001.

2.1-3 Project Directorate IV-I, Division of Licensing Project Management, Office of Nuclear Reactor Regulation, letter to C. L. Terry, TU Electric, "Comanche Peak Steam Electric Station, Units 1 and 2 – Review of Caldon Engineering Topical Report ER 80P, 'Improving Thermal Power Accuracy and Plant Safety while Increasing Power Level Using the LEFM System' (TAC Nos. MA2298 and 2299)," March 8, 1999.

2.1-4 S.A. Richards, NRC letter to M. A. Krupa, Entergy, "Waterford Steam Electric Station, Unit 3, River Bend Station, and Grand Gulf Nuclear Station – Review of Caldon, Inc. Engineering Report ER-157P (TAC Nos. MB2397, MB2399, and MB2468)," December 20, 2001.

2.4-1 ANSI/IEEE-ANS Standard 7-4.3.2, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations," Annex E, 1993.

2.4-2 ASME NQA-2a-1990, "Quality Assurance Requirements for Nuclear Facility Applications, 1990.

2.4-3 EPRI-TR-103291S, "Handbook for Verification and Validation of Digital Systems, December 1994.

3.0 ACCIDENTS AND TRANSIENTS FOR WHICH THE EXISTING ANALYSES OF RECORD BOUND PLANT OPERATION AT THE PROPOSED UPRATED POWER LEVEL (RIS 2002-03 Section II)

3.1 EVALUATION

LAR Table 3.1-1, "Accident/Transient Analyses Review Summary," addresses the accident and transient analyses for Seabrook Station, and documents whether each analysis of record remains valid and bounds plant operation at the MUR core power level of 3648 MWt (3667 MWt NSSS power level. There are no accident or transient analyses that require re-analysis to produce analytical results that bound the MUR power level.

The Inadvertent Operation of Emergency Core Cooling System During Power Operations event analysis submitted with the Seabrook Station SPU license amendment request [Reference 3.1-1] bounds plant operation at the MUR power level. However, this analysis was not approved by the NRC and in accordance with Facility Operating License NPF-86 Condition 2K, it will be addressed prior to startup from the next refueling outage. Interim approval of the Inadvertent Operation of Emergency Core Cooling System During Power Operations event analysis was provided in the NRC Safety Evaluation Report for Seabrook Station Facility Operating License and Technical Specification Amendment 101 [Reference 3.1-2].

3.2 CONCLUSION

A review of the accident and transient analyses was performed that included the Seabrook Station UFSAR Chapter 15 and other analyses and evaluations required to support the Seabrook Station current licensing bases. The current analyses of record are based on an analyzed core power level of 3659 MWt (3678 MWt NSSS power level). The MUR core power level of 3648 MWt (3667 MWt NSSS power level) is bounded by the analyses of record. Therefore, the accident and transient analyses are bounding and remain valid for the MUR.

3.3 REFERNCES

3.1-1 FPL Energy Seabrook letter (NYN-04016) to NRC Document Control Desk, License Amendment Request (LAR) 04-03, "Application for Stretch Power Uprate," March 17, 2004.

3.1-2 NRC Letter to FPL Energy Seabrook, License Amendment 101, "Seabrook Station, Unit No. 1 – Issuance of Amendment RE: 5.2 Percent Power Uprate," February 28, 2005.

TABLE 3.1-1
ACCIDENT / TRANSIENT ANALYSES REVIEW SUMMARY
(RIS 2002-03 Section II)

Accident / Transient (II.1.A)		Seabrook UFSAR Section	Existing Analyses Are Bounding(1) and Approved (II.1.B. i. and ii.)	Bounding(1) Determinations Continue To Be Valid (II.1.C.)	Reference To NRC Approval Of Analyses (II.1.D)
3.1	Large Break LOCA	15.6.5	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.1.1	Reference 3.1-2 Safety Evaluation Report
3.2	Small Break LOCA	15.6.5	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.1.2	Reference 3.1-2 Safety Evaluation Report
3.3	Post-LOCA Subcriticality and Long-term Cooling	15.6.5	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.1.3	Reference 3.1-2 Safety Evaluation Report
3.4	Containment Sump pH Control	6.5.2	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.1.4	Reference 3.1-2 Safety Evaluation Report
3.5	Hot Leg Switchover	15.6.5	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.1.5	Reference 3.1-2 Safety Evaluation Report
3.6	Post-LOCA Hydrogen Generation	6.2.5	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.1.6	Reference 3.1-2 Safety Evaluation Report
3.7	LOCA Hydraulic Forces	15.6.5	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.1.7	Reference 3.1-2 Safety Evaluation Report
3.8	Steam Generator Tube Rupture	15.6.3	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Section 6.2	Reference 3.1-2 Safety Evaluation Report
3.9	Excessive Heat Removal due to Feedwater System Malfunctions	15.1.1 15.1.2	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.2.1	Reference 3.1-2 Safety Evaluation Report
3.10	Excessive Increase in Secondary Steam Flow	15.1.3	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.2.2	Reference 3.1-2 Safety Evaluation Report
3.11	Inadvertent Opening of a Steam Generator Dump, Relief, or Safety Valve	15.1.4	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.2.3	Reference 3.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

TABLE 3.1-1 (continued)
ACCIDENT / TRANSIENT ANALYSES REVIEW SUMMARY
(RIS 2002-03 Section II)

Accident / Transient (II.1.A)		Seabrook UFSAR Section	Existing Analyses Are Bounding[1] and Approved (II.1.B. i. and ii.)	Bounding[1] Determinations Continue To Be Valid (II.1.C.)	Reference To NRC Approval Of Analyses (II.1.D)
3.12	Steam System Piping Failure	15.1.5	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.2.4	Reference 3.1-2 Safety Evaluation Report
3.13	Loss of External Load / Turbine Trip	15.2.2 15.2.3	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.3.1	Reference 3.1-2 Safety Evaluation Report
3.14	Loss of Normal Feedwater Flow	15.2.7	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.3.2	Reference 3.1-2 Safety Evaluation Report
3.15	Loss of Nonemergency AC Power to the Plant Auxiliaries	15.2.6	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.3.3	Reference 3.1-2 Safety Evaluation Report
3.16	Feedwater System Pipe Break	15.2.8	Bounded and Approved	Remains Valid Reference 3.1-1 Attachment 1 Subsection 6.3.3.4	Reference 3.1-2 Safety Evaluation Report
3.17	Partial Loss of Reactor Coolant Flow	15.3.1	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.4.1.1	Reference 3.1-2 Safety Evaluation Report
3.18	Complete Loss of Forced Reactor Coolant Flow	15.3.2	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.4.1.2	Reference 3.1-2 Safety Evaluation Report
3.19	Reactor Coolant Pump Locked Rotor / Shaft Break	15.3.3 15.3.4 15.3.5	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.4.2	Reference 3.1-2 Safety Evaluation Report
3.20	Uncontrolled Rod Cluster Control Assembly Bank Withdrawal from a Subcritical Condition	15.4.1	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.5.1	Reference 3.1-2 Safety Evaluation Report
3.21	Uncontrolled Rod Cluster Control Assembly Bank Withdrawal at Power	15.4.2	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.5.2	Reference 3.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

TABLE 3.1-1 (continued)
ACCIDENT / TRANSIENT ANALYSES REVIEW SUMMARY
(RIS 2002-03 Section II)

Accident / Transient (II.1.A)		Seabrook UFSAR Section	Existing Analyses Are Bounding[1] and Approved (II.1.B. i. and ii.)	Bounding[1] Determinations Continue To Be Valid (II.1.C.)	Reference To NRC Approval Of Analyses (II.1.D)
3.22	Rod Cluster Control Assembly Misoperation	15.4.3	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.5.3	Reference 3.1-2 Safety Evaluation Report
3.23	Startup of an Inactive Reactor Coolant Pump	15.4.4	Three loop operation not permitted by Seabrook Station Technical Specifications		
3.24	Chemical and Volume Control System Malfunction that Results in a Decrease in Boron Concentration in the Reactor Coolant	15.4.6	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.5.5	Reference 3.1-2 Safety Evaluation Report
3.25	Inadvertent Loading and Operation of a Fuel Assembly	15.4.7	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.5.6	Reference 3.1-2 Safety Evaluation Report
3.26	Spectrum of Rod Cluster Control Assembly Ejection Accidents	15.4.8	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.5.7	Reference 3.1-2 Safety Evaluation Report
3.27	Inadvertent Operation of Emergency Core Cooling System During Power Operation	15.5.1	Bounded and Not Approved[2]		

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

(2) Inadvertent Operation of Emergency Core Cooling System During Power Operations analysis submitted in the Seabrook Station stretch power uprate license amendment request [Reference 3.1-1] bounds the MUR, but was not approved by the NRC and in accordance with Facility Operating License NPF-86 Condition 2K, will be addressed prior to startup from the next refueling outage. Interim approval of the Inadvertent Operation of Emergency Core Cooling System During Power Operations event analysis was provided in Reference 3.1-2 Safety Evaluation Report. Operation at the MUR core power of 3648 MWt (3667MWt NSSS power level) will not alter the Inadvertent Operation of Emergency Core Cooling System During Power event remedies addressed in References 3.1-1 and 3.1-2.

TABLE 3.1-1 (continued)
ACCIDENT / TRANSIENT ANALYSES REVIEW SUMMARY
(RIS 2002-03 Section II)

Accident / Transient (II.1.A)		Seabrook UFSAR Section	Existing Analyses Are Bounding[1] and Approved (II.1.B. i. and ii.)	Bounding[1] Determinations Continue To Be Valid (II.1.C.)	Reference To NRC Approval Of Analyses (II.1.D)
3.28	Chemical and Volume Control System Malfunction that Increases Reactor Coolant Inventory	15.5.2	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.6.2	Reference 3.1-2 Safety Evaluation Report
3.29	Inadvertent Opening of a Pressurizer Safety or Relief Valve	15.6.1	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.7.1	Reference 3.1-2 Safety Evaluation Report
3.30	Anticipated Transient Without Scram	15.8	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.8	Reference 3.1-2 Safety Evaluation Report
3.31	Station Blackout	8.4	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.3.9	Reference 3.1-2 Safety Evaluation Report
3.32	Long-term LOCA Mass Energy Release Containment Response	6.2.1.3	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.4.1.1	Reference 3.1-2 Safety Evaluation Report
3.33	Short-term LOCA Mass Energy Release Containment Response	6.2.1.3	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.4.1.2	Reference 3.1-2 Safety Evaluation Report
3.34	Subcompartment Analysis	6.2.1.2	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.4.2	Reference 3.1-2 Safety Evaluation Report
3.35	LOCA Long-term Containment Response	6.2.1.1	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.4.3	Reference 3.1-2 Safety Evaluation Report
3.36	Main Steamline Break Mass Energy Releases Inside Containment	6.2.1.4	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.4.4	Reference 3.1-2 Safety Evaluation Report
3.37	Steamline Break Containment Response	6.2.1.1	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 6.4.5	Reference 3.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

TABLE 3.1-1 (continued)
ACCIDENT / TRANSIENT ANALYSES REVIEW SUMMARY
(RIS 2002-03 Section II)

Accident / Transient (II.1.A)		Seabrook UFSAR Section	Existing Analyses Are Bounding(1) and Approved (II.1.B. i. and ii.)	Bounding(1) Determinations Continue To Be Valid (II.1.C.)	Reference To NRC Approval Of Analyses (II.1.D)
3.38	Steamline Break Outside Containment	Appendix 3I Section 3.3	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Section 6.5	Reference 3.1-2 Safety Evaluation Report
3.39	Appendix R and Safe Shutdown Cooldown	Appendix R	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 4.1.4.3.3	Reference 3.1-2 Safety Evaluation Report
3.40	Margin to Trip Analysis	NA	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 4.3.3.2	Reference 3.1-2 Safety Evaluation Report
3.41	Application of Leak-Before-Break Methodology	NA	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Section 5.12	Reference 3.1-2 Safety Evaluation Report
3.42	Mid-Loop Operation	4.4.6.6	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Section 10.1	Reference 3.1-2 Safety Evaluation Report
3.43	Natural Circulation Cooldown	15.2.6	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Section 10.2	Reference 3.1-2 Safety Evaluation Report
3.44	Internal Flooding	3.6 and Appendix 3A	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Section 10.3	Reference 3.1-2 Safety Evaluation Report
3.45	High Energy Line Break / Jet Impingement	3.6(B) 6.2	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Section 10.4	Reference 3.1-2 Safety Evaluation Report
3.46	Probabilistic Safety Assessment	NA	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Section 10.5	Reference 3.1-2 Safety Evaluation Report
3.47	Spent Fuel Pool Cooling	9.1.3	Bounded and Approved	Remains valid Reference 3.1-1 Attachment 1 Subsection 8.4.9	Reference 3.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

4.0 ACCIDENTS AND TRANSIENTS FOR WHICH THE EXISTING ANALYSES OF RECORD DO NOT BOUND PLANT OPERATION AT THE PROPOSED UPRATED POWER LEVEL (RIS 2002-03 Section III)

There are no accident and transient analyses that require re-analysis to produce analytical results that bound the MUR power level.

5.0 MECHANICAL / STRUCTURAL / MATERIAL COMPONENT INTEGRITY AND DESIGN (RIS 2002-03 Section IV)

5.1 EVALUATION

LAR Table 5.1-1, "Component and Program Review Summary," addresses the review of the effect of the MUR core power level of 3648 MWt (3667 MWt NSSS power level) on the structural integrity of the major plant components and on the programs that demonstrate that topical areas comply with various design and licensing requirements.

5.2 CONCLUSION

Evaluations of the effect on the MUR on the structural integrity of the major plant components and on programs that demonstrate that topical areas comply with various design and licensing requirements were performed at the MUR core power level of 3648 MWt (3667 MWt NSSS power level). The evaluations performed for the Seabrook Station SPU, based on an analyzed core power level of 3659 MWt (3678 MWt NSSS power level), bound the MUR core power level. Therefore, these evaluations of the components and programs are bounding and remain valid for the MUR.

5.3 REFERENCES

5.1-1 FPL Energy Seabrook letter (NYN-04016) to NRC Document Control Desk, License Amendment Request (LAR) 04-03, "Application for Stretch Power Uprate," March 17, 2004.

5.1-2 NRC Letter to FPL Energy Seabrook, License Amendment 101, "Seabrook Station, Unit No. 1 – Issuance of Amendment RE: 5.2 Percent Power Uprate," February 28, 2005.

TABLE 5.1-1
COMPONENT AND PROGRAM REVIEW SUMMARY
(RIS 2002-03 Section IV)

System / Component / Program		Parameters With Potential Impact	Existing Analyses Are Bounding(1) and Approved	Bounding(1) Determinations Continue To Be Valid	Reference To NRC Approval Of Analyses
5.1	Reactor vessel Vessel Nozzles Supports	Pressurized thermal shock Fluence evaluation Heatup and cooldown pressure temperature limit curves Low temperature overpressure protection Upper shelf energy Surveillance capsule withdrawal schedule	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Section 5.1	Reference 5.1-2 Safety Evaluation Report
5.2	Vessel Internals Core support structures	Thermal-hydraulic	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Section 5.2	Reference 5.1-2 Safety Evaluation Report
5.3	Fuel	Thermal-hydraulic	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Sections 5.3 and 7.0	Reference 5.1-2 Safety Evaluation Report
5.4	Control rod drive mechanisms	Pressure Temperature	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Section 5.4	Reference 5.1-2 Safety Evaluation Report
5.5	Reactor Coolant Loop Piping Pipe supports Branch nozzles	Stress Temperature Pressure	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Section 5.5	Reference 5.1-2 Safety Evaluation Report
5.6	NSSS Piping Supports	Stress Temperature Pressure	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 8.5.2	Reference 5.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

**TABLE 5.1-1 (continued)
COMPONENT AND PROGRAM REVIEW SUMMARY
(RIS 2002-03 Section IV)**

System / Component / Program		Parameters With Potential Impact	Existing Analyses Are Bounding And Approved	Bounding[1] Determinations Continue To Be Valid	Reference To NRC Approval Of Analyses
5.7	BOP Piping Supports	Stress Temperature Pressure	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 8.5.1	Reference 5.1-2 Safety Evaluation Report
5.8	Steam generator Tubes Secondary side internal support structures Shell Nozzles	Thermal-hydraulic Stress Pressure High cycle fatigue (NRC Bulletin 88-02)	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Section 5.7	Reference 5.1-2 Safety Evaluation Report
5.9	Reactor coolant pumps Pumps Motors	Temperature Pressure	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Section 5.8	Reference 5.1-2 Safety Evaluation Report
5.10	Pressurizer Shell Nozzles Surge line Spray valves Safety valves Power-operated relief valves	Stress Fatigue Pressure Temperature	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Section 5.6	Reference 5.1-2 Safety Evaluation Report
5.11	Pressurizer Control Component Sizing Power-operated relief valves Safety valves Heaters Steam dump valves	Pressure Flow Temperature	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 4.3.3.1	Reference 5.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

TABLE 5.1-1 (continued)
COMPONENT AND PROGRAM REVIEW SUMMARY
(RIS 2002-03 Section IV)

System / Component / Program		Parameters With Potential Impact	Existing Analyses Are Bounding And Approved	Bounding(1) Determinations Continue To Be Valid	Reference To NRC Approval Of Analyses
5.12	Cold Overpressure Mitigation System	None	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 4.3.4	Reference 5.1-2 Safety Evaluation Report
5.13	Chemical and Volume Control, Residual Heat Removal, and Emergency Core Cooling Systems Tanks Heat exchangers Pumps Valves Instrumentation	Pressure Flow Temperature Cooldown rate	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 4.1.4 and Section 5.9	Reference 5.1-2 Safety Evaluation Report
5.14	Bottom Mounted Instrumentation	Pressure Temperature	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Section 5.10	Reference 5.1-2 Safety Evaluation Report
5.15	Containment Structure	Pressure Temperature	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 8.6.1	Reference 5.1-2 Safety Evaluation Report
5.16	Containment Sub-Compartments	Temperature	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 8.6.2	Reference 5.1-2 Safety Evaluation Report
5.17	Fire Protection Program	None	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 9.1.1	Reference 5.1-2 Safety Evaluation Report
5.18	Valve Programs Motor-operated valves Air-operated valves Solenoid valves	None	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 9.1.2	Reference 5.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

TABLE 5.1-1 (continued)
COMPONENT AND PROGRAM REVIEW SUMMARY
(RIS 2002-03 Section IV)

System / Component / Program		Parameters With Potential Impact	Existing Analyses Are Bounding And Approved	Bounding(1) Determinations Continue To Be Valid	Reference To NRC Approval Of Analyses
5.19	Flow Accelerated Corrosion Program	None	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 9.1.3	Reference 5.1-2 Safety Evaluation Report
5.20	Equipment Qualification Program	None	Bounded and Approved	Remains valid Reference 5.1-1 Attachment 1 Subsection 9.2	Reference 5.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

6.0 ELECTRICAL EQUIPMENT DESIGN (RIS 2002-03 Section V)

6.1 EVALUATION

LAR Table 6.1-1, " Electrical Equipment Review Summary," addresses the review of the effect of the MUR core power level of 3648 MWt (3667 MWt NSSS power level) on the electrical equipment.

The following reliability enhancement modifications will be completed:

- Rewinding of the main generator stator
- Replacement of the Alterrex exciter with a solid-state static exciter.

These modifications will increase the generator reactive load (MVA) maximum capability to support 1318 megawatts electric (MWe) with 375 MVA lagging. As a result, evaluations of the main generator, generator exciter, and grid stability are provided below.

6.1.1 MAIN GENERATOR

The rewound main generator stator will support the increased reactive load associated with the increased electrical output. Evaluation of the main generator was based on completion of both modifications and the assumption that the maximum real power output is 1318 MWe.

The evaluation was based on a comparison between the generator capability curve and the anticipated operating requirements at MUR conditions. The main generator real output of 1318 MWe bounds the expected generator electrical output corresponding to the MUR core power level of 3648 MWt (3667 MWt NSSS power level), which is determined based on heat balance model calculations.

The rewound generator will have a rating of 1373.1 MVA and will be capable of providing 1318 MWe with a reactive power of 375 MVAR. This will satisfy the ISO-New England (ISO-NE) reactive power requirements. The generator operation at the specified values corresponds to a generator lagging power factor of 0.960 at MUR conditions and 75 psig hydrogen pressure.

6.1.2 GENERATOR EXCITER

The Alterrex excitation system is being replaced with a solid-state excitation system. The new excitation system will have a high initial response system with a field forcing voltage of 200 percent that supports the MUR and Seabrook Station's commitments to ISO-NE.

6.1.3 GRID STABILITY

Power flow and stability studies are discussed in Seabrook Station UFSAR Sections 8.2.2.3 and 8.2.3. A "Seabrook Uprate System Impact Study" [Reference 6.1-3] has been completed to evaluate the system impacts in accordance with "New England

Power Pool (NEPOOL) Reliability Standards" and "NEPOOL Minimum Interconnection Standards." A copy of the study is included as an enclosure to this submittal.

The approach used in the study was to utilize NEPOOL study models, updated for the year 2007. It compares performance of the system before and after MUR to demonstrate the impact under a prescribed set of initial conditions and contingencies established in cooperation with the NEPOOL transmission owners and ISO-NE. The evaluation considered a calculated electrical output of 1318 MWe. This is 23 MWe above the present generator capability of 1295 MWe, however, the generator rewind discussed in LAR Section 6.1.1 will provide the additional capability to meet the calculated electrical output of 1318 MWe. This electrical output bounds the predicted heat balance conditions/electrical generation at the MUR core power level.

The study demonstrates system performance with and without MUR for pre-contingency and post-contingency voltages and line loading, and for dynamic response to system disturbances. The system impact study has demonstrated that the steady state and dynamic performance of the Seabrook Station at MUR conditions is acceptable without any required hardware modifications. Seabrook Station's design will continue to meet the intent of General Design Criterion 17 at MUR conditions.

6.2 CONCLUSION

As a result of modifications to the main generator and generator exciter, evaluations were performed on the main generator, generator exciter, and grid stability as described in LAR Subsections 6.1.1, 6.1.2, and 6.1.3. The evaluations were based on an MUR core power level of 3648 MWt (3667 MWt NSSS power level). The evaluations of the electrical equipment performed for the Seabrook Station SPU, based on electrical output corresponding to a core power level of 3659 MWt (3678 MWt NSSS power level), bounds the MUR core power level. The evaluations verified that this equipment remains bounded and that the current analyses of record are valid.

Evaluations of the effect of the MUR were performed on the remaining electrical equipment as indicated in LAR Table 6.1-1. The evaluations of the electrical equipment performed for the Seabrook Station SPU, based on an analyzed core power level of 3659 MWt (3678 MWt NSSS power level) bound the MUR core power level of 3648 MWt (3667 MWt NSSS power level). Therefore, these evaluations are bounding and remain valid for the MUR.

6.3 REFERENCES

6.1-1 FPL Energy Seabrook letter (NYN-04016) to NRC Document Control Desk, License Amendment Request (LAR) 04-03, "Application for Stretch Power Uprate," March 17, 2004.

6.1-2 NRC Letter to FPL Energy Seabrook, License Amendment 101, "Seabrook Station, Unit No. 1 – Issuance of Amendment RE: 5.2 Percent Power Uprate," February 28, 2005.

6.1-3 W. W. Price and D. Chatterjee, GE Energy, "Seabrook Uprate System Impact Study," Phase 2, Final Report, Revision 5, August 16, 2004.

TABLE 6.1-1
ELECTRICAL EQUIPMENT REVIEW SUMMARY
(RIS 2002-03 Section V)

System / Component		Parameters With Potential Impact	Existing Analyses Are Bounding[1] And Approved	Bounding[1] Determinations Continue To Be Valid	Reference To NRC Approval Of Analyses
6.1	AC Distribution System	None	Bounded and Approved	Remains valid Reference 6.1-1 Attachment 1 Subsection 8.4.16.1	Reference 6.1-2 Safety Evaluation Report
6.2	Power Block Equipment Generator Exciter Transformers Isolated phase bus duct Circuit breakers	Generator output (MWe)	Bounded and Approved except for the Generator and Exciter See Subsections 6.1.1 and 6.1.2	Remains valid except for the Generator and Exciter Reference 6.1-1 Attachment 1 Subsection 8.4.16.2	Reference 6.1-2 Safety Evaluation Report
6.3	DC System	None	Bounded and Approved	Remains valid Reference 6.1-1 Attachment 1 Subsection 8.4.16.3	Reference 6.1-2 Safety Evaluation Report
6.4	Emergency Diesel Generators	None	Bounded and Approved	Remains valid Reference 6.1-1 Attachment 1 Subsection 8.4.16.4	Reference 6.1-2 Safety Evaluation Report
6.5	Switchyard Circuit breakers	Generator output (MWe)	Bounded and Approved	Remains valid Reference 6.1-1 Attachment 1 Subsection 8.4.16.6	Reference 6.1-2 Safety Evaluation Report
6.6	Grid Stability	See Subsection 6.1.3			

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

7.0 SYSTEM DESIGN (RIS 2002-03 Section VI)

7.1 EVALUATION

LAR Table 7.1-1, " System Design Review Summary," addresses the review of the effect of the MUR core power level of 3648 MWt (3667 MWt NSSS power level) on the major plant systems.

7.1.1 MAIN FEEDWATER PUMP TURBINES

The main feedwater pump turbines are being modified to replace the last stage buckets and diaphragms to reduce long-term fatigue stresses. The modifications do not change the performance of the main feedwater pumps and the main feedwater pump turbines. The evaluations for the Feedwater and Condensate Systems performed in Reference 7.1-1, Subsection 8.4.3 at an analyzed core power level of 3659 MWt (3678 MWt NSSS power level), are bounding and remain valid for the MUR core power level of 3648 MWt (3667 MWt NSSS power level). The evaluations were approved by the NRC in the Safety Evaluation Report for Reference 7.1-2.

7.2 CONCLUSION

Evaluations of the effect on the MUR on major plant systems were performed at the MUR core power level of 3648 MWt (3667 MWt NSSS power level). The evaluations performed for the Seabrook Station SPU, based on an analyzed core power level of 3659 MWt (3678 MWt NSSS power level), bound the MUR core power level. Therefore, these evaluations of the major plant systems are bounding and remain valid for the MUR.

7.3 REFERENCES

7.1-1 FPL Energy Seabrook letter (NYN-04016) to NRC Document Control Desk, License Amendment Request (LAR) 04-03, "Application for Stretch Power Uprate," March 17, 2004.

7.1-2 NRC Letter to FPL Energy Seabrook, License Amendment 101, "Seabrook Station, Unit No. 1 – Issuance of Amendment RE: 5.2 Percent Power Uprate," February 28, 2005.

TABLE 7.1-1
SYSTEM DESIGN REVIEW SUMMARY
(RIS 2002-03 Section VI)

System / Component		Parameters With Potential Impact	Existing Analyses Are Bounding[1] and Approved	Bounding[1] Determinations Continue To Be Valid	Reference To NRC Approval Of Analyses
7.1	Main Steam System Safety valves Atmospheric dump valves Isolation valves Isolation bypass valves Steam dump valves Moisture separator reheaters Emergency feedwater pump turbine supply Supply to Auxiliary Steam Drains	Pressure Temperature Flow	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsections 4.3.2 and 8.4.1	Reference 7.1-2 Safety Evaluation Report
7.2	Extraction Steam Isolation valves Non-return valves	Pressure Temperature Flow	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.2	Reference 7.1-2 Safety Evaluation Report
7.3	Turbine System	Pressure Temperature	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.3.1	Reference 7.1-2 Safety Evaluation Report
7.4	Turbine Auxiliary Systems	Temperature	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.3.1	Reference 7.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

**TABLE 7.1-1 (
SYSTEM DESIGN REVIEW SUMMARY
(RIS 2002-03 Section VI)**

System / Component		Parameters With Potential Impact	Existing Analyses Are Bounding(1) and Approved	Bounding(1) Determinations Continue To Be Valid	Reference To NRC Approval Of Analyses
7.5	Condensate and Feedwater Systems Condensate pumps Feedwater pumps Feedwater pump turbines Feedwater control valves Backup feedwater control valves Feedwater isolation valves Feedwater heaters	Pressure Temperature Flow	Bounded and Approved except for the feedwater pump turbines See Subsection 7.1.1	Remains valid except for the feedwater pump turbines Reference 7.1-1 Attachment 1 Subsection 8.4.3	Reference 7.1-2 Safety Evaluation Report
7.6	Emergency Feedwater System Condensate storage tank Emergency Feedwater pumps	Pressure Temperature Flow	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.4	Reference 7.1-2 Safety Evaluation Report
7.7	Steam Generator Blowdown System Valves	Pressure Temperature	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.5	Reference 7.1-2 Safety Evaluation Report
7.8	Main Condenser Evacuation System Shell-side evacuation subsystem Water box priming subsystem	None	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.6	Reference 7.1-2 Safety Evaluation Report
7.9	Main Condenser and Circulating Water System Circulating water pumps Main condenser	None	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.7	Reference 7.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

TABLE 7.1-1 (continued)
SYSTEM DESIGN REVIEW SUMMARY
(RIS 2002-03 Section VI)

System / Component		Parameters With Potential Impact	Existing Analyses Are Bounding(1) and Approved	Bounding(1) Determinations Continue To Be Valid	Reference To NRC Approval Of Analyses
7.10	Heater Drains Heater drain tanks Reheater drain tanks Feedwater heaters Level control valves Drain lines	Flow Temperature	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.8	Reference 7.1-2 Safety Evaluation Report
7.11	Spent Fuel Pool Cooling System Cooling pumps Heat exchangers	Heat load	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.9	Reference 7.1-2 Safety Evaluation Report
7.12	Containment Building Spray Pumps Heat exchangers Spray ring Nozzles	Heat load	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.10	Reference 7.1-2 Safety Evaluation Report
7.13	Ultimate Heat Sink	Heat load	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.11	Reference 7.1-2 Safety Evaluation Report
7.14	Service Water System	Heat load	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.12	Reference 7.1-2 Safety Evaluation Report
7.15	Primary Component Cooling Water System	Heat load	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.13.1	Reference 7.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

**TABLE 7.1-1 (continued)
SYSTEM DESIGN REVIEW SUMMARY
(RIS 2002-03 Section VI)**

System / Component		Parameters With Potential Impact	Existing Analyses Are Bounding[1] and Approved	Bounding[1] Determinations Continue To Be Valid	Reference To NRC Approval Of Analyses
7.16	Secondary Component Cooling Water	Heat load	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.13.2	Reference 7.1-2 Safety Evaluation Report
7.17	Control Room Heating, Ventilation, and Air Conditioning System	None	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.14	Reference 7.1-2 Safety Evaluation Report
7.18	Fuel Storage Building Heating, Ventilation, and Air Conditioning System	None	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.14	Reference 7.1-2 Safety Evaluation Report
7.19	Primary Auxiliary Building Heating, Ventilation, and Air Conditioning System	None	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.14	Reference 7.1-2 Safety Evaluation Report
7.20	Containment Structure Heating, Cooling, and Purge System	Heat load	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.14	Reference 7.1-2 Safety Evaluation Report
7.21	Containment Enclosure and Adjoining Areas Cooling and Ventilation System	Heat load	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.14	Reference 7.1-2 Safety Evaluation Report
7.22	Turbine Building Heating, Ventilation, and Air Conditioning System	Heat load	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.14	Reference 7.1-2 Safety Evaluation Report
7.23	Additional Heating, Ventilation, and Air Conditioning Systems	None	Bounded and Approved	Remains valid Reference 3.0-1 Attachment 1 Subsection 8.4.14	Reference 7.1-2 Safety Evaluation Report
7.24	Radioactive Waste	None	Bounded and Approved	Remains valid Reference 7.1-1 Attachment 1 Subsection 8.4.15	Reference 7.1-2 Safety Evaluation Report

NOTES:

(1) Bounded – Existing analyses of record establishes continued acceptability of operation at the proposed uprated power level without the need for re-analysis.

8.0 MISCELLANEOUS TOPICS

8.1 NUCLEAR STEAM SUPPLY SYSTEM (NSSS) PARAMETERS

The design operating parameters are used as inputs in the NSSS analyses. They provide Reactor Coolant System and secondary system conditions (temperatures, pressures, and flows) that are used as the basis for the design transients and for systems, components, accidents, and fuel analyses and evaluations.

The parameters are established using conservative assumptions to provide bounding conditions to be used in the NSSS analyses. The design operating parameters were determined to provide FPL Energy Seabrook with operating flexibility.

The major input parameters and assumptions are summarized below:

- Analyzed core power level of 3659 MWt (3678 MWt NSSS power level)
- Thermal design flow of 93,600 gpm/loop
- Steam generator tube plugging values of 0% and 10%
- Design core bypass flow of 8.3%
- Full power, normal operating T_{avg} from 571.0°F to 589.1°F
- Feedwater temperature (T_{feed}) from 390°F to 452.4°F
- 17 X 17 robust fuel assemblies with intermediate flow mixers

LAR Table 8.1-1, "Design Operating Parameters," provides the NSSS design parameter cases in the current safety analyses and evaluation of record from LAR 04-03 Seabrook Application for Station Stretch Power Uprate (Reference 8.1-1) and used as the basis for the Seabrook Station MUR. Cases 1 and 2 were based on the maximum T_{avg} of 589.1°F with 0% and 10% steam generator tube plugging levels, respectively. Likewise, Cases 3 and 4 were developed for the minimum T_{avg} of 571.0°F with 0% and 10% steam generator tube plugging levels, respectively.

The existing and MUR parameters are shown in LAR Table 8.1-1 for comparison purposes.

TABLE 8.1-1
DESIGN OPERATING PARAMETERS

	Current Operating Values	MUR Expected Operating Values	Design Parameters Cases			
			Case 1	Case 2	Case 3	Case 4
Thermal Design Parameters						
NSSS power (MWt)	3606	3667	3678 (1)	3678 (1)	3678 (1)	3678 (1)
NSSS power (10^6 BTU/hr)	12,303	12,511	12,550	12,550	12,550	12,550
Reactor power (MWt)	3587	3648	3659 (2)	3659 (2)	3659 (2)	3659 (2)
Reactor power (10^6 BTU/hr)	12,239	12,447	12,485	12,485	12,485	12,485
Thermal design flow, loop (gpm)	103,300 (3)	103,300 (3)	93,600 (4)	93,600 (4)	93,600 (4)	93,600 (4)
Thermal design flow, loop (10^6 lbm/hr)	149.7	149.7	139.4	139.4	143.0	143.0
Core bypass (%)	7.0 (5)	7.0 (5)	8.3 (6)	8.3 (6)	8.3 (6)	8.3 (6)
Reactor Coolant Temperatures						
Vessel outlet (°F) – T_{hot}	619.6	620.1	621.4	621.4	604.3	604.3
Vessel average (°F) – T_{avg}	589.1	589.1	589.1	589.1	571.0	571.0
Vessel inlet (°F) – T_{cold}	558.7	558.2	556.8	556.8	537.7	537.7
Zero load temperature (°F)	557.0	557.0	557.0	557.0	557.0	557.0
Steam Generators						
Steam temperature (°F)	545.2	544.6	540.0 (7,8)	537.5 (7,8)	520.3 (7,8)	517.8 (7,8)
Outlet steam pressure (psia)	1005	1002	962 (7,8)	943 (7,8)	815 (7,8)	797 (7,8)
Steam flow (10^6 lbm/hr) total	16.0	16.3	16.52 / 15.17	16.51 / 15.16	16.42 / 15.08	16.41 / 15.07
Feed temperature (°F)	443.8	446.4	452.4 / 390.0	452.4 / 390.0	452.4 / 390.0	452.4 / 390.0
Steam generator tube plugging (%)	0	0	0	10	0	10
Hydraulic Design Parameters						
Mechanical design flow (gpm) total	416,800	416,800	416,800	416,800	416,800	416,800
Minimum measured flow (gpm) total	383,800	383,800	383,800 (9)	383,800 (9)	383,800 (9)	383,800 (9)

Notes:

1. Reactor coolant pump heat addition was rounded from 18.4 MWt to 19 MWt. This assumption is more conservative and bounds the specified operating conditions.
2. Represents upper limit on core thermal power.
3. Best estimate Reactor Coolant flow.
4. Reduced thermal design flow is conservatively set for 10% tube plugging.
5. Best estimate value with thimble plugs removed.
6. Core bypass flow includes 2.0% for thimble plug removal. Seabrook Station currently has thimble plugs installed, but could elect to remove them in the future. The analyses address thimble plugs in or out.
7. 18 psi steam generator internal pressure drop incorporated.
8. Design values for analyses. Where high steam generator pressure and/or temperature are more conservative, best estimate or bounding values are used.
9. Reflects Technical Specification flow measurement uncertainty of 2.5%. Supports 10% steam generator tube plugging level and reduced thermal design flow.

8.2 IMPACT ON OPERATIONS (RIS 2002-03 Section VII)

8.2.1 PROCEDURES

The impact of the MUR on operator actions has been identified and evaluated. Only minor procedure changes will be required. In addition, the time required to perform operator actions has been evaluated and no changes to operator actions times are required. The applicable procedures will be revised and operator training will be conducted prior to implementation of the MUR. Operating procedures will be revised to address a reduction in power to the pre-MUR core power level when applicable, as described in LAR Section 2.5.

8.2.1.1 EMERGENCY AND ABNORMAL OPERATING PROCEDURES

A summary of the changes to the Emergency Operating Procedures and the Abnormal Operating Procedures is provided below:

Emergency Operating Procedures

- There will be no changes to Emergency Operating Procedures required by the MUR.

Abnormal Operating Procedures

- Applicable NSSS instrument failure abnormal operating procedures are being changed to support new MUR setpoints.
- Applicable balance of plant instrument failure abnormal operating procedures are being changed to support new MUR setpoints.
- Applicable abnormal operating procedures are being changed to reflect the new MUR megawatt thermal value.
- Applicable abnormal operating procedures are being revised with new MUR calorimetric values.

8.2.1.2 OPERATION AND MAINTENANCE PROCEDURES

The discussion below addresses all systems other than the Caldon LEFM CheckPlus™ System. Operation and maintenance of the Caldon LEFM CheckPlus™ System is discussed in LAR Attachment 1, Section 2.0.

Basic system operation and monitoring will not be affected by the MUR. There are no new systems except for the Caldon LEFM CheckPlus™ System, required by the MUR. There are no new operating and maintenance procedures except for those required for the Caldon LEFM CheckPlus™ System, required by the MUR. There will be one-time use procedures created for MUR post-outage power ascension testing. The one-time use procedures are intended to control power ascension and test the uprated plant in a safe and conservative manner. The balance of plant performance testing will be carried out to confirm the actual thermal and electrical plant secondary side parameters are consistent with engineering predictions.

8.2.1.3 OPERATOR ACTIONS

There are no new operator actions required for the abnormal or emergency operating procedures

8.2.2 MODIFICATIONS

All modifications required for the MUR will be completed prior to LAR implementation. These modifications have been evaluated to ensure that there is no decrease in the defense in depth or the safety margins for the following:

- Emergency and abnormal operating procedures

  See Subsection 8.2.1 above

- Control room controls, displays (including the safety parameter display system) and alarms

  No changes to the layout, monitoring, or use of the Safety Parameter Display System are required to support the MUR.

- Control room simulator

  The simulator will be upgraded in both hardware and software to match the MUR design in accordance with the simulator controlling standard ANSI/ANS 3.5-1998. The simulator core model and secondary plant models will be revised as required based upon MUR design data. These changes will be incorporated into the simulator prior to implementation in the plant to allow for operator familiarization training. The modifications to the simulator will be completed such that licensed and non-licensed operator training on MUR modifications can be conducted prior to implementation.

- Operator Training Program

  See Section 8.2.3 below.

8.2.3 TRAINING

The Operations Department has been integrated into the uprate process. An Operations Department representative joined the uprate team at an early stage. The design change process requires Operations Department reviews and signoffs on the design change packages.

The Operations Department staff will be trained on the modifications, technical specification changes, and procedural changes prior to implementation of the MUR. This will assure that the Operations Department staff receives the required training for continued safe and reliable operations.

Training on operation and maintenance of the Caldon LEFM CheckPlus™ System, will be developed and carried out prior to implementation of the MUR. MUR related training for other departments needs will be developed and carried out as appropriate.

8.3 ENVIRONMENTAL IMPACT (RIS 2002-03 Section VII)

FPL Energy Seabrook has evaluated this license amendment request for Seabrook Station against the criteria for identification of licensing and regulatory actions requiring environmental assessment in accordance with 10 CFR 51.21. FPL Energy Seabrook has determined that this license amendment meets the criteria for a categorical exclusion set forth in 10 CFR 51.22(c)(9). This determination is based on the fact that this change is being proposed as an amendment to a license pursuant to 10 CFR 50 that changes a requirement with respect to installation or use of a facility component located within the restricted area, or that changes an inspection or a surveillance requirement, and the amendment meets the following specific criteria:

(i) The amendment involves no significant hazards consideration.

As demonstrated in LAR Attachment 6, No Significant Hazards Consideration Determination, this proposed amendment does not involve a significant hazards consideration.

(ii) There is no significant change in the types or significant increase in the amounts of any effluent that may be released offsite.

Previous analyses of heat discharge bound the effects of the Seabrook Station MUR. [References 8.1-1 and 8.3-1]. The MUR will not alter or increase the inventory of radionuclides previously analyzed in the Reactor Coolant System, nor will it alter the fuel cladding in a way that affects its mechanical or structural integrity or affects its leakage characteristics. This power uprate will not alter or increase the primary pressure or temperature, so there is no additional challenge to the Reactor Coolant System or other fission product barriers. Additionally, increasing core thermal power by 1.7 percent will not affect or increase water production or inventory use in any way that will affect effluent volume or production. Therefore, this change will not result in a significant change in the types or significant increase in the amounts of any effluent that may be released.

(iii) There is no significant increase in individual or cumulative occupational radiation exposure.

The MUR thermal power increase will not alter or increase the inventory of radionuclides previously analyzed in the Reactor Coolant System. Previous analyses of radionuclide production bound the effects of the Seabrook Station MUR. [References 8.1-1 and 8.3-1]. The radionuclide source terms applicable to personnel dose were calculated assuming a core thermal power of 3659 MWt, which bounds the MUR core power level of 3648 MWt (3667 MWt NSSS power level). This change will not alter the fuel cladding in a way that affects its mechanical and structural integrity or affects its leakage characteristics; therefore, there is no additional challenge to the Reactor Coolant System or other fission product barriers. Finally, no new effluents or effluent release paths are created by the MUR. Therefore, this change will not result in an increase in individual or cumulative occupational radiation exposures.

Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed license amendment.

8.4 MODIFICATIONS

As part of the Seabrook Station MUR, modifications to support the MUR and to improve station performance are being implemented.

8.4.1 MODIFICATIONS REQUIRED FOR THE MUR

- Feedwater flow instruments - Caldon LEFM CheckPlus™ System will be installed to provide input to the on-line calorimetric with a reduced measurement uncertainty margin.

8.4.2 ADDITIONAL MODIFICATIONS

- Feedwater pump turbines – The last stage buckets and diaphragms will be replaced to reduce long-term fatigue stresses.
- Generator stator rewind – The generator stator rewind will eliminate the susceptibility of the stator core to crevice corrosion leaks and will increase the generator capacity for the MUR.
- Exciter replacement – The solid-state static exciter will support the ISO-NE grid stability analysis for the MUR.
- Adjust the Heater Drain Tank controller permissive setpoint pressure to reflect 100% tank operating pressure at MUR conditions.
- Re-scale of turbine impulse pressure loops to reflect the new high pressure turbine first stage impulse pressure at MUR conditions.
- Re-scale the main feed pump differential pressure program.
- Re-banding of main control board steam pressure indicators.
- Miscellaneous main plant computer system application programs, graphics, and alarms.

8.5 TESTING

Tests will be carried out to demonstrate that the Seabrook Station MUR and plant modifications have been adequately designed and implemented. A power ascension testing procedure will be developed and executed to provide assurance that the plant can be operated safely at the MUR power level. The test procedure results will be documented and submitted to the Nuclear Regulatory Commission in a startup report consistent with the requirements of the Seabrook Station Technical Specifications Section 6.8.1.1. The test procedure will address the performance of the modifications on an individual and integrated plant basis. Individual modification test procedures will be developed in conjunction with vendors performing these modifications. The test procedures will be reviewed as directed by the site quality program.

The initial startup test program for Seabrook Station is summarized in Table 14.2.5 of the Seabrook Station UFSAR. The integrated test program for the Seabrook Station MUR will be developed using this table and the startup test program used in the Seabrook Station SPU as guides. Note that the individual tests identified below may differ in scope from those of the same name identified in Table 14.2.5 of the Seabrook Station UFSAR or in the SPU startup test program. The test program will consist of a combination of normal surveillances, startup testing, and special testing for the MUR. Testing will include:

- Core loading prerequisites
- Initial core loading
- Rod drop time measurements
- Rod position indication
- Reactor Coolant System flow measurement
- Operational alignment of nuclear instrumentation
- Operational alignment of process temperature instrumentation
- Startup adjustments of the Reactor Control System
- Calibration of steam and feedwater flow instrumentation
- Initial criticality
- Boron endpoint measurement
- Isothermal temperature coefficient measurement
- Control rod worth measurement
- Thermal power measurement and statepoint data collection including calorimetric normalization
- Core performance evaluation
- Axial flux difference instrumentation calibration
- Loss of offsite power testing (integrated safeguards testing)
- Post-modification testing as required by the design change process including setpoint verification

- Turbine generator testing
- Flow-induced vibration monitoring
- Secondary system monitoring

8.6 REFERENCES

8.1-1 FPL Energy Seabrook letter (NYN-04016) to NRC Document Control Desk, License Amendment Request (LAR) 04-03, "Application for Stretch Power Uprate," March 17, 2004.

8.3-1 NRC Letter to FPL Energy Seabrook, License Amendment 101, "Seabrook Station, Unit No. 1 – Issuance of Amendment RE: 5.2 Percent Power Uprate," February 28, 2005.

9.0 CHANGES TO TECHNICAL SPECIFICATIONS, PROTECTION SYSTEM SETTINGS, AND EMERGENCY SYSTEM SETTINGS (RIS 2002-03 Section VIII)

9.1 FACILITY OPERATING LICENSE

9.1.1 DESCRIPTION OF CHANGE

Seabrook Station Facility Operating License NPF-86, Section 2.C (1) Maximum Power Level will be revised to change from "3587 megawatts thermal" to "3648 megawatts thermal," such that it reads:

> "FPL Energy Seabrook, LLC is authorized to operate the facility at reactor core power levels not in excess of 3648 megawatts thermal (100% of rated power)."

9.1.2 ANALYSES AFFECTED

LAR Sections 3.0 and 4.0 contain the review of the accident and transient analyses and determined that the analyses are bounded by the current analyses of record and remain valid for the MUR.

9.2 TECHNICAL SPECIFICATIONS

9.2.1 DESCRIPTION OF CHANGE

Seabrook Station Technical Specification 1.28, RATED THERMAL POWER will be revised to change from "3587 megawatts thermal" to "3648 megawatts thermal," such that it reads:

> "RATED THERMAL POWER shall be a total reactor core heat transfer rate to the reactor coolant of 3648 MWt."

9.2.2 ANALYSES AFFECTED

LAR Sections 3.0 and 4.0 contain the review of the accident and transient analyses and determined that the analyses are bounded by the current analyses of record and remain valid for the MUR.

9.3 PROTECTION SYSTEM SETTINGS

There are no protection system setting changes required to support the Seabrook Station MUR.

9.4 EMERGENCY SYSTEM SETTINGS

There are no emergency system setting changes required to support the Seabrook Station MUR.

ATTACHMENT 2
MARKUP OF PROPOSED CHANGES TO THE FACILITY OPERATING LICENSE AND TECHNICAL SPECIFICATIONS

LIST OF PAGES CONTAINING PROPOSED CHANGES

Page	Current Amendment
Facility Operating License	
3	101
Technical Specifications	
1-5	101

The attached marked pages reflect the currently issued revision of the Facility Operating License NPF-86 and the Seabrook Station Technical Specifications. Pending changes are not reflected in these marked pages.

(4) FPL Energy Seabrook, LLC, pursuant to the Act and 10 CFR 30, 40, and 70, to receive, possess, and use at any time any byproduct, source, and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(5) FPL Energy Seabrook, LLC, pursuant to the Act and 10 CFR 30, 40, and 70, to receive, possess, and use in amounts as required any byproduct, source, or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components;

(6) FPL Energy Seabrook, LLC, pursuant to the Act and 10 CFR 30, 40, and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility authorized herein; and

(7) DELETED

C. This license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

FPL Energy Seabrook, LLC, is authorized to operate the facility at reactor core power levels not in excess of ~~3587~~ megawatts thermal (100% of rated power). 3648

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. ~~101~~, and the Environmental Protection Plan contained in Appendix B are incorporated into Facility License No. NPF-86. FPL Energy Seabrook, LLC shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(3) License Transfer to FPL Energy Seabrook, LLC

a. On the closing date(s) of the transfer of any ownership interests in Seabrook Station covered by the Order approving the transfer, FPL Energy Seabrook, LLC, shall obtain from each respective transferring owner all of the accumulated decommissioning trust funds for the facility, and ensure the deposit of such funds and additional funds, if necessary, into a decommissioning trust or trusts for Seabrook Station established by FPL Energy Seabrook, LLC, such that the amount of such funds deposited meets or exceeds the amount required under 10 CFR 50.75 with respect to the interest in Seabrook Station FPL Energy Seabrook, LLC, acquires on such dates(s).

* Implemented

PHYSICS TESTS

1.23 PHYSICS TESTS shall be those tests performed to measure the fundamental nuclear characteristics of the reactor core and related instrumentation: (1) described in Chapter 14.0 of the FSAR, (2) authorized under the provisions of 10 CFR 50.59, or (3) otherwise approved by the Commission.

PRESSURE BOUNDARY LEAKAGE

1.24 PRESSURE BOUNDARY LEAKAGE shall be leakage (except steam generator tube leakage) through a nonisolable fault in a Reactor Coolant System component body, pipe wall, or vessel wall.

PROCESS CONTROL PROGRAM

1.25 The PROCESS CONTROL PROGRAM (PCP) shall contain the current formulas, sampling, analyses, tests, and determinations to be made to ensure that processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10 CFR Parts 20, 61, and 71, State Regulations, burial ground requirements, and other requirements governing the disposal of solid radioactive waste.

PURGE - PURGING

1.26 PURGE or PURGING shall be any controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is required to purify the confinement.

QUADRANT POWER TILT RATIO

1.27 QUADRANT POWER TILT RATIO shall be the ratio of the maximum upper excore detector calibrated output to the average of the upper excore detector calibrated outputs, or the ratio of the maximum lower excore detector calibrated output to the average of the lower excore detector calibrated outputs, whichever is greater. With one excore detector inoperable, the remaining three detectors shall be used for computing the average.

RATED THERMAL POWER

1.28 RATED THERMAL POWER shall be a total reactor core heat transfer rate to the reactor coolant of ~~3587~~ 3648 Mwt.

REACTOR TRIP SYSTEM (RTS) RESPONSE TIME

1.29 The RTS RESPONSE TIME shall be the time interval from when the monitored parameter exceeds its RTS Trip Setpoint at the channel sensor until loss of stationary gripper coil voltage. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and methodology for verification have been previously reviewed and approved by the NRC.

ATTACHMENT 3
RETYPED PAGES FOR PROPOSED CHANGES TO THE FACILITY OPERATING LICENSE AND TECHNICAL SPECIFICATIONS

LIST OF PAGES CONTAINING PROPOSED CHANGES

Page	Current Amendment
Facility Operating License	
3	101
Technical Specifications	
1-5	101

The attached retyped pages reflect the currently issued revision of the Facility Operating License NPF-86 and the Seabrook Station Technical Specifications. Pending changes are not reflected in these retyped pages.

(4) FPL Energy Seabrook, LLC, pursuant to the Act and 10 CFR 30, 40, and 70, to receive, possess, and use at any time any byproduct, source, and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;

(5) FPL Energy Seabrook, LLC, pursuant to the Act and 10 CFR 30, 40, and 70, to receive, possess, and use in amounts as required any byproduct, source, or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components;

(6) FPL Energy Seabrook, LLC, pursuant to the Act and 10 CFR 30, 40, and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility authorized herein; and

(7) DELETED

C. This license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

FPL Energy Seabrook, LLC, is authorized to operate the facility at reactor core power levels not in excess of 3648 megawatts thermal (100% of rated power).

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. *, and the Environmental Protection Plan contained in Appendix B are incorporated into Facility License No. NPF-86. FPL Energy Seabrook, LLC shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(3) License Transfer to FPL Energy Seabrook, LLC

a. On the closing date(s) of the transfer of any ownership interests in Seabrook Station covered by the Order approving the transfer, FPL Energy Seabrook, LLC, shall obtain from each respective transferring owner all of the accumulated decommissioning trust funds for the facility, and ensure the deposit of such funds and additional funds, if necessary, into a decommissioning trust or trusts for Seabrook Station established by FPL Energy Seabrook, LLC, such that the amount of such funds deposited meets or exceeds the amount required under 10 CFR 50.75 with respect to the interest in Seabrook Station FPL Energy Seabrook, LLC, acquires on such dates(s).

* Implemented

PHYSICS TESTS

1.23 PHYSICS TESTS shall be those tests performed to measure the fundamental nuclear characteristics of the reactor core and related instrumentation: (1) described in Chapter 14.0 of the FSAR, (2) authorized under the provisions of 10 CFR 50.59, or (3) otherwise approved by the Commission.

PRESSURE BOUNDARY LEAKAGE

1.24 PRESSURE BOUNDARY LEAKAGE shall be leakage (except steam generator tube leakage) through a nonisolable fault in a Reactor Coolant System component body, pipe wall, or vessel wall.

PROCESS CONTROL PROGRAM

1.25 The PROCESS CONTROL PROGRAM (PCP) shall contain the current formulas, sampling, analyses, tests, and determinations to be made to ensure that processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10 CFR Parts 20, 61, and 71, State Regulations, burial ground requirements, and other requirements governing the disposal of solid radioactive waste.

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RATED THERMAL POWER

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ATTACHMENT 4
LIST OF REGULATORY COMMITMENTS

There are no regulatory commitments associated with approval and implementation of the license amendment requested.

ATTACHMENT 5
PROPOSED SCHEDULE FOR LICENSE AMENDMENT AND ISSUANCE

FPL Energy Seabrook requests a six-month review and approval of this proposed amendment for licensed thermal power which is consistent with NRC review schedules for measurement uncertainty recapture uprates. The requested implementation period is 12 months. Approval based on the requested cycle would support the refueling outage currently scheduled for Fall 2006. This date allows Seabrook Station to take advantage of the economic benefits of the power uprate as soon as possible.

ATTACHMENT 6
NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

The proposed license amendments will revise the Seabrook Station Facility Operating License NPF-86 and the Technical Specifications to increase the licensed core thermal power by approximately 1.7% from 3587 MWt to 3648 MWt. The proposed changes are described in detail below and in LAR Section 9.0 and are also indicated on the marked up and retyped pages for the Facility Operating License and Technical Specifications contained in LAR Attachments 2 and 3. The changes to the Facility Operating License and Technical Specifications have been grouped and evaluated pursuant to the requirements of 10 CFR 50.92.

1. RATED THERMAL POWER CHANGE

a. Description Of The Proposed Change

- Facility Operating License NPF-86, paragraph 2.C(1), "Maximum Power Level," will be revised to authorize operation at reactor core power levels not in excess of 3648 MWt.
- Technical Specification 1.0, paragraph 1.28, "Rated Thermal Power," will be revised to increase power from 3587 MWt to 3648 MWt.

b. Significant Hazards Consideration

The Seabrook Station evaluations discussed in LAR Section 3.0 demonstrated that this increased thermal power still allows safe operation of the plant and will not affect the health and safety of the public. Based on the evaluations of the MUR conditions, the following conclusions can be reached with respect to 10 CFR 50.92. The proposed changes will not:

1. Involve a significant increase in the probability or consequences of an accident previously evaluated.

   Seabrook Station performed evaluations of the Nuclear Steam Supply System (NSSS) and balance of plant systems, components, and analyses that could be affected by the proposed change. A power uncertainty calculation was performed, and the effect of increase core thermal power by 1.7 percent to 3648 MWt on the Seabrook Station design and licensing basis was evaluated. The result of the evaluations determined that all systems and components continue to be capable of performing their design function at the MUR core power level of 3648 MWt. An evaluation of the accident analyses demonstrates that the applicable analyses acceptance criteria continue to be met. No accident initiators are affected by the MUR power uprate and no challenges to any plant safety barriers are created by the proposed change.

   The proposed change does not affect the release paths, the frequency of release, or the analyzed source term for any accidents previously evaluated in the Seabrook Station Updated Final Safety Analysis Report (UFSAR). Systems, structures, and components required to mitigate transients continue to be capable of performing their design functions, and thus were found acceptable. The reduced uncertainty in the feedwater flow input to the power calorimetric measurement ensures that applicable accident analyses acceptance criteria continue to be met, to support operation at the MUR core power level of 3648 MWt. Analyses performed to assess the effects of mass and energy remain valid. The source term used to asses radiological consequences have been reviewed and determined to bound operation at the MUR core power level.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Create the possibility of a new or different kind of accident from any accident previously evaluated.

   No new accident scenarios, failure mechanisms, or single failures are introduced as a result of the proposed change. The installation of the Caldon LEFM CheckPlus™ System has been analyzed, and failures of the system will have no adverse effect on any safety-related system or any systems, structures, and components required for transient mitigation. Systems, structures, and components previously required for the mitigation of a transient continue to be capable of fulfilling their intended design functions. The proposed change has no adverse affect on any safety-related system or component and does not change the performance or integrity of any safety-related system.

   The proposed change does not adversely affect any current system interfaces or create any new interfaces that could result in an accident or malfunction of a different kind than previously evaluated. Operating at a core power level of 3648 MWt does not create any new accident initiators or precursors. The reduced uncertainty in the feedwater flow input to the power calorimetric measurement ensures that applicable accident analyses acceptance criteria continue to be met, to support operation at the MUR core power level of 3648 MWt. Credible malfunctions continue to be bounded by the current accident analyses of record or evaluations that demonstrate that applicable criteria continue to be met.

   Therefore, the proposed changes do not create the possibility of a new or different kind of accident from any previously evaluated.

3. Involve a significant reduction in a margin to safety

   The margins of safety associated with the MUR are those pertaining to core thermal power. These include those associated with the fuel cladding, Reactor Coolant System pressure boundary, and containment barriers. An engineering evaluation of the 1.7 percent increase in core thermal power from 3587 MWt to 3648 MWt was performed. The current licensing bases analyzed core power is 3659 MWt. The analyzed core power level of 3659 MWt bounds the NSSS thermal and hydraulic parameters at the MUR core power level of 3648 MWt. The NSSS systems and components were evaluated at the MUR core power level and it was determined that the NSSS systems and components continue to operate satisfactorily at the MUR power level. The NSSS accident analyses were evaluated at the MUR core power level of 3648 MWt. In all cases, the accident analyses at the MUR core power level of 3648 MWt were bounded by the current licensing bases analyzed core power level of 3659 MWt. As such, the margins of safety continue to be bounded by the current analyses of record for this change.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

ENCLOSURE

SEABROOK UPRATE SYSTEM IMPACT STUDY

PHASE 2

FINAL REPORT

Rev. 5

Energy Consulting

Seabrook Uprate System Impact Study

Phase 2 Final Report

Rev. 5

W.W. Price
D. Chatterjee

August 16, 2004

GE Energy

Foreword

This document was prepared by GE Energy through its Energy Consulting group in Schenectady, NY. It is submitted to ISO New England. Technical and commercial questions and any correspondence concerning this document should be referred to:

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Executive Summary

FPLE has requested Section 18.4 approval for the Phase 2 uprate of the Seabrook nuclear plant by 23 MW from the approved[1] Phase 1 uprate gross rating of 1295 MW. The Seabrook uprate is planned in two stages. Phase 1 will increase the unit output by 86 MW in the spring of 2005, and Phase 2 will further increase the output by 23 MW in the fall of 2006. In addition to the increase in gross plant output, the Phase 2 uprate will include the following:

1. A generator rewind that will increase the generator MVA rating from 1350 MVA to 1373.1 MVA.

2. Replacement of the Alterrex excitation system with a high-initial-response static system with a ceiling of at least 200% and with capability for a power system stabilizer (PSS). (Note: The PSS was not modeled in this study. Activation of the PSS will require Section 18.4 approval.)

The only relevant queued resource for this project is the Vermont Yankee uprate, to which the Seabrook uprate is subordinate. The study included the Vermont Yankee uprate in all cases. The associated VY transmission upgrades were included in critical cases. Therefore, no additional analysis will be required to lift Seabrook's subordinate status once VY is no longer itself a subordinate study. The study did not include the Northeast Reliability Interconnection.

The overall conclusion from this study is that the thermal, voltage, short circuit and stability performance of the Phase 2 uprate is satisfactory and requires no mitigating measures. The uprate has no significant adverse impact on thermal, voltage, short circuit or stability performance of the NEPOOL system.

The following conditions on approval of the uprate are recommended:

1. The completion of additional analyses and implementation of any mitigation of significant adverse effect upon the reliability or operating characteristics of the NEPOOL system as a result of the Northeast Reliability Interconnect Project associated with 18.4 Applications BHE-03-T01, BHE-03-T02, CMP-03-T01, CMP-03-T02, and CMP-03-X01.

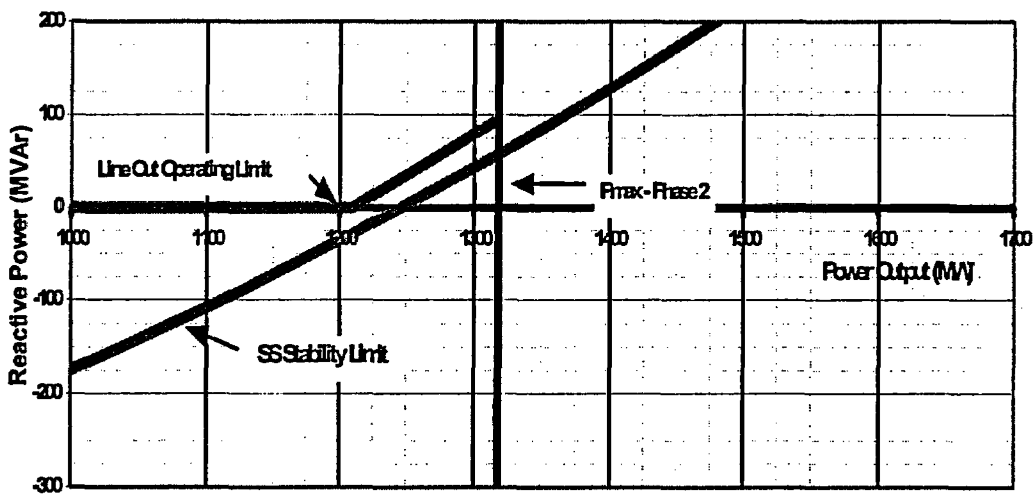
2. Since the output of Seabrook after the uprate may be greater than the 1200 MW loss of source limit for design contingencies:

   The Seabrook unit, with implementation of its proposed 1,318 gross MW uprate or any lesser uprate, will be required to limit its gross output level in real-time operation such that the net loss of source that results from a contingent Seabrook generator trip is at or below the real-time-based maximum allowable net source loss for the NEPOOL control area. Any reductions to the gross output of

[1] The first phase of the Seabrook uprate was conditionally approved under Section 18.4 of the NEPOOL agreement by ISO New England in its February 11, 2004 notification letter to FPL Energy. ISO New England removed Condition 3 of the February 11, 2004 conditional approval in its May 10, 2004 notification letter to FPL Energy.

Seabrook to meet this requirement will be required within 30 minutes of being directed to do so by ISO-NE.

3. For operation with one of the key 345kV lines out of service (307, 394, 363, 369), the minimum reactive output of Seabrook shall be limited to operating within the "Line Out Operating Limit" shown below. If such a line out condition occurs, the System Operator may require Seabrook to operate with its gross power output as low as 1209 MW. This will allow the reactive output to be as low as 0 MVAr to aid in reducing any unacceptably high voltage conditions on the transmission system. Future operating studies may relax this requirement if the steady-state stability limit is determined to be lower than shown.



1. Introduction

FPLE has requested Section 18.4 approval for the Phase 2 uprate of the Seabrook nuclear plant to a gross output capability of 1318 MW. The Seabrook uprate is planned in two stages. Phase 1 will increase the unit output by 86 MW in the spring of 2005, and Phase 2 will further increase the output by 23 MW in the fall of 2006. The Phase 1 uprate has already received Section 18.4 approval. In addition to the increase in gross plant output, the Phase 2 uprate will include the following:

1. A generator rewind that will increase the generator MVA rating from 1350 MVA to 1373.1 MVA.
2. Replacement of the Alterrex excitation system with a high-initial-response static system with power system stabilizer.

The purpose of this study is to evaluate the system impacts of the Phase 2 uprate in accordance with "NEPOOL Reliability Standards" and "NEPOOL Minimum Interconnection Standards" and to identify any necessary facility upgrades to meet these standards. The study adheres to relevant sections of the "NEPOOL Planning Procedures".

Relevant queued resources for this project are the Vermont Yankee uprate and the Second NB Tie and Orrington South Expansion. The Seabrook uprate is subordinate to all of these. The present study was performed with the approved VY uprate and associated transmission upgrades. Therefore, no additional analysis will be required to lift Seabrook's subordinate status once VY is no longer itself a subordinate study.

The steady-state plant data, as supplied by FPLE, is shown in the following table:

	Present	**Phase 1 uprate**	**Phase 2 uprate**
Generator (gross)			
MVA rating	1350 MVA	1350 MVA	1373.1 MVA
Pmax*	1209 MW	1295 MW	1318 MW
Pmin	360 MW	360 MW	360 MW
Qmax	560 MVAr	367 MVAr	375 MVAr $^{\&}$
Qmin	-75 MVAr^{+}	0 MVAr^{++}	0 MVAr $^{\&}$
Station Service Load			
P	48 MW	49 MW	52.6 MW**
Q	28 MVAr	29 MVAr	34 MVAr**

* Summer and winter Pmax are essentially the same.
** Changes from Phase 1 due to static excitation system consumption at full load.
$^{+}$ Q_{min} = 0 if a nearby 345kV line is out of service
$^{++}$ Q_{min} = +75 if a nearby 345kV line is out of service
$^{\&}$ Reactive capability with all lines in will be no less than this range of values at full load. See Appendix C.

Dynamic modeling of the plant is discussed in Section 2.2, and complete modeling data is provided in Appendix B.

2. Analysis Approach

Using NEPOOL study models, updated for the year 2007, this study compares the performance of the system before and after the proposed Phase 2 uprate in order to demonstrate the system impact under a prescribed set of initial conditions and contingencies established in cooperation with the NEPOOL transmission owners and ISO New England.

The study demonstrates system performance with and without the uprate for pre-contingency and post-contingency voltages and line loading and for dynamic response to system disturbances.

2.1 Steady-state Analysis Approach

The thermal criteria require branch loading to be less than 100% of normal rating for pre-contingency conditions and less than the long term emergency (LTE) rating for post-contingency conditions. Any branch loading greater than the LTE rating requires mitigation.

Thermal criteria for N-2 testing of contingencies involving breaker failure and outages of lines sharing a common tower will consider mitigation required for any branch loading greater than the STE rating.

The pre-contingency power flow solution allows static VAr devices (SVDs), including automatically switched capacitors, phase angle regulators (PARs), and on-load tap changing transformers (LTCs) to move. The post-contingency solution allows only SVDs and LTCs to move. Post-contingency swing bus power changes are reallocated to all generators in proportion to their MVA ratings to simulate inertial load pickup.

The voltage criteria are summarized in Table 2-1.

SPS Modeling

The only Special Protection Schemes (SPS) modeled for the steady-state contingencies were the Y151 and 326 SPSs. In most cases, if it was likely that a contingency might activate the SPS, contingencies were run both with and without the SPS. The modeling of these SPS is as follows:

Y151 SPS – Trip the Pelham51 (71833) to G192 TAP (72715) segment of line Y151 if its loading exceeds the LTE limit.

326 SPS – Trip Newington G1 and/or WF Wyman #4 if section 326 exceeds its LTE limit. Contingencies were run tripping Newington G1 only, WF Wyman #4 only, and tripping both. New Brunswick generation that may be armed for this SPS were not tripped. This SPS was only included for the T2 cases.

Table 2-1 Voltage Performance Criteria for Power Flow Analysis.

Region	kV	Pre-contingency Voltage Criteria	Post-contingency Voltage Criteria
BHE	115kV	0.90 pu < Vbus < 1.05 pu	0.90 pu < Vbus < 1.05 pu
CMP, NSTAR, PSNH	115kV to 345kV	0.95 pu < Vbus < 1.05 pu	0.95 pu < Vbus < 1.05 pu
NGRID	345 & 230kV	0.98 pu < Vbus < 1.05 pu	0.95 pu < Vbus < 1.05 pu, $\Delta V < 5\%$ 0.90 pu < Vbus < 1.05 pu, $\Delta V < 10\%$ severe cont.
	115kV	0.95 pu < Vbus < 1.05 pu	0.90 pu < Vbus < 1.05 pu, $\Delta V < 10\%$
Chester	345kV	0.97 pu < Vbus < 1.042 pu	0.97 pu < Vbus < 1.042 pu
Seabrook	345kV	1.035 pu < Vbus < 1.05 pu	1.00 pu < Vbus < 1.05 pu
Vt Yankee	345kV 115kV	1.00 pu < Vbus < 1.05 pu	1.00 pu < Vbus < 1.05 pu
Vermont	115kV	0.95 pu < Vbus < 1.05 pu	0.92 pu < Vbus < 1.05 pu
Other NE	115kV	0.95 pu < Vbus < 1.05 pu	0.90 pu < Vbus < 1.05 pu
	345kV	0.95 pu < Vbus < 1.05 pu	0.95 pu < Vbus < 1.05 pu

2.2 Dynamic Analysis Approach

The criteria defining stable transmission system performance for normal contingencies (3-phase faults cleared by the slower of the two fastest protection groups or 1-phase faults with backup clearing) are as follows:

- All units must be transiently stable except for units tripped for fault clearing
- A 50% reduction in the magnitude of system oscillations must be observed over four periods of the oscillation
- A loss of source less than 1200 MW is acceptable
- Keswick GCX entry is not acceptable

The criteria defining stable transmission system performance for extreme contingencies (3-phase faults with breaker failure) are as follows:

- Transiently stable with positive damping
- A loss of source less than 1400 MW is acceptable
- A loss of source between 1400 MW and 2200 MW may be acceptable depending upon a limited likelihood of occurrence and other factors
- A loss of source above 2200 MW is not acceptable

- A 50% reduction in the magnitude of system oscillations must be observed over four periods of the oscillation

Selected bus voltages around Seabrook and in eastern Massachusetts were monitored. The generator angle, field voltage, terminal voltage, machine speed, real and reactive power output were also be monitored for all units in the area, as well as units with a power output of at least 40MW in the rest of New England. Essex voltage and Q, and Highgate voltage, P and Q were monitored. Signals pertaining to the operation of relevant SPS were also monitored.

The dynamic modeling, including modeling of SPS, that was used for the Vermont Yankee Uprate Study were used for this analysis. Dynamic modeling of the Seabrook generator and its excitation system used the data currently in the NEPOOL database, with the following modifications:

- The maximum turbine power (Pmax) in the original data was set to 1215 MW (0.9 p.u. of the generator MVA base). For the uprate, this value was increased to 1301 MW for Phase 1 and 1324 MW for Phase 2. These values each represent the maximum generator output plus the I^2R losses (6 MW) at rated current. Therefore, when the model is initialized at rated power output, the turbine power will be very nearly at its maximum. The unit will thus have essentially no upward response capability for decreases in system frequency. This is consistent with the operation of the plant on "Load Limit". The unit can respond downward for increases in system frequency.

- For both Phase 1 and Phase 2 cases, the power plant auxiliary loads were modeled in more detail as described in Appendix B.

- For the Phase 2 uprate cases, the dynamic model data for the Seabrook generator and excitation system were updated to reflect the preliminary design data for the rewound generator and the new static excitation system. A power system stabilizer (PSS) model was added using typical parameter settings consistent with the generator and excitation system. The modeling data is listed in Appendix B. If the final design and field tuning of the new equipment results in parameters significantly different from those given in Appendix B, the impact of these changes on critical cases must be evaluated.

- The PSS was turned off for all cases for a conservative estimate of oscillation damping.

The following Special Protection Schemes (SPS) were modeled for the stability analysis:

Maxcys Over-Current SPS

The purpose of this SPS is to protect the underlying 115kV system for loss of 345kV line 392. The Maxcys over-current SPS trips the Maxcys 345/115kV autotransformer when current flow on the Maxcys-Mason 115kV line (68) exceeds 960A (equivalent to 191 MVA at 1.0pu voltage) for 0.2 seconds.

Bucksport Over-Current SPS

The purpose is to protect the underlying 115kV system for loss of 345kV lines 392 and 388. The Bucksport over-current SPS trips the Bucksport-Detroit (203) and Bucksport-Belfast (86) 115kV lines as well as the Bucksport and MIS generators when total flow on the Orrington-Bucksport (65) and Betts Rd-Bucksport (205) 115kV lines exceeds a threshold for a specified amount of time.

Specifically, this SPS begins timing if the current flow on Section 65 exceeds 678 A (135 MVA) and the current flow on Section 205 exceeds 693 A (138 MVA) simultaneously, or if the Section 65 current exceeds 960 A (191 MVA), or if the Section 205 current exceeds 960 A (191 MVA). When the timer reaches 0.2 seconds, Sections 203 and 86 and the Bucksport generator are tripped. In addition, a transfer trip is started and the MIS plant is tripped after 15 cycles.

Bucksport Reverse Power SPS

The purpose is to protect BHE from low voltages for loss of section 388 or 392 as well as section 396 with low internal generation. The Bucksport reverse power SPS monitors the flows on the Bucksport-Orrington (65) 115kV line and the Bucksport-Betts Road (205) 115kV line, and trips either line when the south-to-north power flow on that line exceeds 25 MW for 0.3 seconds.

In addition, there is an under-voltage supervisory function which prevents operation of this SPS if the Bucksport 115kV bus voltage remains above 0.92 pu and allows operation when the voltage has been below 0.92 pu voltage for 0.1 seconds.

Saco Valley Under Voltage Load Shed

Although not an SPS, its purpose is to relieve local undervoltage problems in the vicinity of Saco Valley. This protection system trips the loads at the Saco Valley and Intervale 34.5kV buses when the Saco Valley 115kV bus voltage has been below 0.94 pu for 4 seconds.

Maine Double Circuit Tower Outage SPS

The purpose of the DCT SPS is to relieve overloads on the underlying 115kV system for loss of the two 345kV lines south of Maine Yankee (375 and 377) or the Maxcys-Maine Yankee and Maine Yankee – Buxton (392 and 375) 345kV lines. The DCT SPS trips the MIS station for these two events.

Keswick Loss of 3001 SPS

The purpose of the Loss of L3001 SPS is to detect islanding of the Maritimes due to trips of any one of the series of 345kV connections to southern New England, i.e., line 3001 or sections 388 or 392. This SPS rejects generation in New Brunswick and/or reduces import in response to a sudden drop in power flow on the Keswick-Orrington 345kV line simultaneous with an increase in frequency at the Keswick 345kV bus. This SPS is only armed when the initial power flow on line 3001 is greater than 180MW.

The SPS begins when the power flow on Section 3001 falls below 330MW and the first timer is started. If the power flow falls below 260MW before this first timer reaches 3 seconds, then a second timer is started. If the Keswick 345kV bus frequency exceeds 60.3Hz and the second timer has not reached 1.25seconds, then generation is tripped in New Brunswick. The amount of generation tripped approximates the initial flow on section 3001 less 200MW.

The system operator selects sufficient generation and/or HVDC imports from the list below to trip about 200 MW less than the initial flow on L3001/396.

NB Power Generation Rejection Option List

Facility	Operational Choices
Madawaska 350MW HVDC link	Runback to 175MW or block to zero
Eel River 350MW HVDC link	Runback to 270 ,200, 160, 120, 80 or 40MW
Mactaquac Hydro plant	Up to four of six 110MW units can be tripped
Beechwood Hydro plant	All three 35MW units can be tripped
Coleson Cove Steam plant	One of three 350MW units can be tripped
Belledune	One 480MW unit can be tripped
Dalhousie	Unit 2 (200MW) can be tripped
Lingan Steam plant (NS)	One or two of four 160MW units can be tripped

Keswick GCX SPS

The purpose of the GCX SPS is to provide overload protection to line 3001 such that it does not trip because of a large load loss in the Maritimes when it is already running near its maximum export (from NB) capability. The GCX SPS has frequency supervision so that it will not operate for a large source loss in New England. The characteristics of the Keswick GCX relay are shown below, where the distance and angle determine the center point and the reach defines the diameter of the impedance circle.

Keswick Zone 1, Zone 2, and GCX Relay Characteristics

Zone	Reach (pu)	Center Distance (pu)	Angle (deg)	Operating Time (sec)
1	0.0440	0.0220	75	0.0
2	0.0723	0.0672	75	0.3
3	0.1060	0.0530	60	If over-frequency conditions are satisfied.

Zone 1 and 2 and the line protection are always armed. When the apparent impedance of line 3001 enters zone 1 or 2, it trips the line (instantaneously in zone 1 and after 0.3 sec. in zone 2). Loss of L3001/396 causes a Northern Maine Type I SPS to operate to trip the MIS plant.

The zone 3 portion represents the GCX circle of the SPS, and is armed or blocked based upon the Keswick 345kV bus frequency. If the Keswick bus frequency exceeds 60.06Hz for more then 0.1 seconds and with a rate of change in excess of 0.1Hz/sec, then the GCX relay is armed on the basis of over-frequency for 8 seconds. If the bus frequency falls below 59.94Hz for more then 0.1 seconds and with a rate of change in excess of 0.1Hz/sec, then the GCX relay is blocked on the basis of under-frequency for 10 seconds.

If the apparent impedance enters the GCX circle (zone 3 of the model) and the overfrequency conditions are satisfied, the GCX sends a signal to reject some amount of pre-selected generation in New Brunswick according the rules of the Loss of 3001 SPS as described above. A 6-cycle delay is allowed between generation rejection and the instant where both the overfrequency conditions are satisfied and GCX entry occurs.

Keswick Power Relay

A different SPS called Keswick Power Relay (KPR), is normally out-of-service and armed only when the Chester SVC is out of service and flows are high (i.e. > 550MW). This SPS causes runback of import from Eel River HVDC link, if the real power flow from Keswick to Orrington exceeds 650 MW and the reactive power flow exceeds 200 MVAr. For the purposes of this study it was assumed that this SPS was out-of-service.

Chester SVC Low Voltage Blocking Function Model

The dynamic modeling of the Chester SVC consists of a voltage regulating SVC (vwscc), which regulates to the scheduled voltage from the power flow, a power oscillation damping control (pss2a) and a supervisory low voltage blocking function. This blocking function reduces the SVC output to 0 MVAr when the Chester 345kV bus voltage is below 0.60 pu. Voltage control is restored to the SVC when the 345kV bus voltage is above 0.68 pu.

Capacitor Switching Model

The shunt capacitors at five Maine 345/115kV substations (Orrington, Maxcys, Mason, South Gorham, and Surowiec) are allowed to switch during transient stability simulations.

In the power flow, these capacitor installations are modeled as SVDs with the appropriate number of banks. Specifically, three 67MVAr banks are represented at Orrington, three 50MVAr banks at Surowiec, and two 50MVAr banks at each of the other three substations.

The generic control logic for dynamic simulations is as follows:

- If the 345kV voltage exceeds the upper voltage threshold for a specified amount of time, then a single bank is switched off.
- If the 345kV voltage falls below the lower voltage threshold for a specified amount of time, then a single bank is switched in.
- If either the 115kV voltage or 345kV voltage exceeds the specified over-voltage thresholds, then all capacitor banks at that location are instantaneously tripped.

The specific voltage switching thresholds are shown below.

Generic Switching Logic for Maine Mechanically Switched Capacitors.

Parameter	**Description**	**Maxcys Mason South Gorham Surowiec**	**Orrington**
vmax	upper voltage threshold	1.044 pu	1.043 pu
vmin	lower voltage threshold	0.988 pu	0.986 pu
tdelay	time delay before switching	4 sec	5 sec
vinrg	345kV bus instantaneous overvoltage threshold	1.159 pu	1.159 pu
vinlo	115kV bus instantaneous overvoltage threshold	1.191 pu	1.191 pu

The control logic and values were originally derived from a combination of sources. The logic is a simplified version of the Surowiec capacitor bank control as described in an E/PRO document from 1999. The same logic and parameter values were then used for the Maxcys, Mason and South Gorham banks as well. The logic is again the same for the Orrington capacitor banks, and the parameter values were derived from the minimum and maximum voltages shown in that old power flow database as well as from the E/PRO document.

PV20 OMS

This system is designed to protect the phase angle regulators between Plattsburg and Sandbar from overcurrent. If the current at the Sandbar end exceeds 1250 amps for 5 seconds, a series reactor is inserted. If the MVA flow at the Sandbar end exceeds 274 MVA for 10 seconds the breaker at the Sandbar end is tripped.

3. Interconnection

No changes in the existing interconnection of the Seabrook plant are included in this project.

4. Short Circuit Current

The short circuit current available from the Seabrook unit at the high side of the generator step-up transformer was calculated for the existing generator, which will continue to be in use for Phase 1, and the rewound generator for Phase 2. For the rewound generator, the preliminary values of MVA rating and subtransient impedance given in Appendix B were used. The results are as follows:

Uprate Phase	**MVA rating**	**Subtransient Z (p.u. on MVA rating)**	**Short circuit current (Amps)**
Phase 1	1350	0.0041 + j0.320	5877
Phase 2	1373.1	0.0041 + j0.345	5672

The results indicate that the available short circuit current will be reduced by 3.5% as a result of the rewind.

5. Case Descriptions

The starting points for base case development were NEPOOL data sets in GE-PSLF format that were used for the Second NB Tie SIS. These data set were originally derived from the "2000 New England Library" summer peak and light load cases. The following updates were made to these data sets in consultation with the transmission owners and ISO-NE staff:

1. Increase NEPOOL load levels to the following 2007 levels:

Peak Load	28,384 MW	(10^{th} percentile summer peak)
Light Load	11,980 MW	(45% of 50^{th} percentile peak) (for stability)
Light Load	10,650 MW	(40% of 50^{th} percentile peak) (for thermal/voltage)

2. Add the following projects to the data sets:
   a. Vermont Yankee uprate
   b. Mystic 8 & 9 generation
   c. Edgar/Fore River generation
   d. AES Londonderry generation
   e. Kendall 4 generation
   f. Chestnut Hill caps
   g. New Scobie autotransformer and 115kV bus reconfiguration
   h. Cross sound dc link
   i. Section G146 upgrade
   j. New Merrimack 230/115kV transformer
   k. Series reactors on the S Agawam-N Bloomfield lines
   l. Central Mass. upgrades including Wachusetts 345kV substation
   m. Third PAR at Waltham
   n. Line rating changes, series reactors, etc. in Boston area
   o. New capacitors at Northboro Road and Millbury
   p. Shunt reactors at Scobie (for light load case)
   q. NH seacoast changes including caps, addition of substations at Portsmouth, Brentwood, and Great Bay, second xfmr at Rochester and load estimates for 2007 peak. Note: These changes result in a significant reduction in the load supplied from the Timber Swamp 345kV bus. This results in reduced requirements for reactive power from Seabrook than would have been required using previous forecasts of this load.
   r. Millstone #3 turbine uprate and excitation system upgrade

Based on FPLE's request, queued resources were treated as follows for all cases:

- With Vermont Yankee uprate
- Without 2nd NB Tie and Orrington South Expansion

5.1 Steady-State Base Cases

The previous Seabrook Phase 1 uprate steady-state analysis was performed using power output levels corresponding to the Phase 2 uprate without the generator rewind and excitation system upgrade. Those output levels differed from currently projected values as follows:

1. Generator gross power output was 1314 MW rather than 1318 MW.
2. Auxiliary load level was 49 MW & 29 MVAr rather than 52.6 MW & 35 MVAr
3. Overexcited reactive limit was 309 MVAr rather than 375 MVAr.

The increase in active power output level is essentially offset by the increase in auxiliary load. Therefore, except for the increase in overexcited reactive limit due to the generator rewind, there is essentially no difference between the peak load cases used for the Phase 1 uprate SIS and those used for the current Phase 2 analysis.

The only other difference between the cases used for the Phase 1 analysis and the present Phase 2 analysis is that for the light load case, the load level has been reduced from 45% to 40% of peak and the load power factors have been adjusted to more nearly match the results of the 2003 load power factor survey.

The original Phase 1 SIS analysis showed that the performance was acceptable with the exception that pre-contingency voltages could not be maintained at required levels with 309 MVAr reactive capability. For the worst case, 364 MVAr were required. Thus, even with the addition of 5 MVAr of auxiliary load, the new reactive limit of 375 MVAr should be sufficient to satisfy the pre-contingency voltage requirements. This has been verified by recomputing the peak load base cases with the new P and Q values.

Seabrook real and reactive parameters used in the Phase 2 analysis are:

Pmax	=	1318 MW
Qmax	=	375 MVAr
Qmin	=	0 MVAr
Paux	=	49 (Station) + 3.6 (Static Exciter) = 52.6 MW
Qaux	=	29 (Station) + 5 (Static Exciter) = 34 MVAr

Cases with the Phase 1 uprate were created for used as reference cases. The real and reactive parameters used for these cases are:

Pmax	=	1295 MW
Qmax	=	367 MVAr
Qmin	=	0 MVAr
Paux	=	48 MW
Qaux	=	28 MVAr

A summary of the dispatches and interface flows is given in SBRK-p2-CasesumT.xls. A summary of the reactive power output of the generating plants, shunt capacitors, and static VAr devices (SVD) is shown on the second tab of that file. Voltages at 345kV buses are shown on the third tab.

T1 – Peak load

This case was intended to represent high North-South transfer, but below the level where the 326 SPS would reject generation for critical contingencies.

One-line diagrams of the NEPOOL 345kV system are in T1U-p1 and T1U-p2.

T2 – Peak load with 326 SPS armed

- N-S close to 3000 MW with AES on, Com.-Moore off, Merrimack on, and with Wyman 4 and Newington G1 in-service.

Starting with T1 case, WF Wyman #4 was turned on. In order to keep the NNE-Scobie+394 flow below 2900 MW; RPA, SEA STRN, and WF Wyman #2 were turned off and Harris #2 was turned on. To balance the East-West flow, Brayton Point units 1 & 2 and Salem Harbor G1, G2, & G3 were taken off-line and Salem Harbor G4 and one Kendall Jet were put on-line.

One-line diagrams of the NEPOOL 345kV system are in T2U-p1 and T2U-p2.

T3 – Peak load with UAE Tewksbury and Lowell projects

The original T3 case was included in the Phase 1 analysis to show the impact of the Seabrook uprate if the UAE Tewksbury and Lowell generation projects are completed and operating. Since these projects have been removed from the queue, this case is no longer considered.

T3 – Peak load with High South to North Flow

This case was developed from the T1 case by making the following changes:

- Most of the Maine generation was taken off, including MIS, RPA, Westbrook, Bucksport, one AEC unit, WF Wyman 2, and several Western Maine hydro units.
- NB-NE flow was reduced to 150 MW by reducing generation in New Brunswick.
- Generation was increased South of Maine by adding Comerford, Moore, UAE Tewksbury and Lowell, Mystic 7 (with Mystic 8 and 4 off), Salem 4 (with Salem 1,2,3 off), two remaining Schiller units.
- Other dispatch adjustments in Western NE to return NY-NE flow to 0.

One-line diagrams of the NEPOOL 345kV system are in T3U-p1 and T3U-p2.

T4 – All Newington units off-line

Starting with T1 case, Newington G1 and Con Ed Newington units were all taken off-line. The following other changes were made to compensate:

- WF Wyman 1, Harris #2, and all Schiller units were turned on
- All Comerford and Moore units were turned on
- Mystic G5 and G6 were turned on
- NEA was turned on at 300 MW.
- Salem G3 was turned off
- Bucksport output was reduced to 140 MW to avoid overload on S86

One-line diagrams of the NEPOOL 345kV system are in T4U-p1 and T4U-p2.

T1LT – Light-Load Case

In the Phase 1 analysis, a light load case was created with minimal flow on the Maine 345kV system to determine the impact of the Seabrook uprate on high voltages.

For the Phase 2 analysis, this case has been modified as follows:

1. Reduce load level from 45% to 40% of 2007 50^{th} percentile peak load
2. Modify load power factors to agree with December 2003 LPF Survey.
3. Adjust the generation and auxiliary P and Q levels to the revised Phase 2 levels.
4. Adjust generation dispatch to account for the above changes.

A one-line diagram of the NEPOOL 345kV system for T1LTU-p2 is in T1LTU-p2. A second version of this case with Seabrook generation and auxiliary P and Q values at the Phase 1 uprate values was also created for use as a reference for the performance of the Phase 2 case. A one-line diagram of the NEPOOL 345kV system for T1LTU-p1 is in T1LTU-p1.

5.2 Dynamic Base Cases

The dynamic base cases are the same as used for the Phase 1 analysis, except as indicated below. A summary of the dispatches and interface flows is given in SBRK-CasesumS-Phase2.xls. A summary of the reactive power output of the generating plants, shunt capacitors, and static VAr devices (SVD) is shown on the second tab of that file.

For each of the cases, the Phase 1 uprate case was used as the reference case and a corresponding Phase 2 uprate case was created by modifying the Seabrook generation and auxiliary load values and using the new dynamic data for the generator and excitation system upgrades. For both the Phase 1 and Phase 2 cases, the 345kV/115kV autotransformer tap at Mystic was changed to the current value of 0.958 (336.375kV tap with transformer nominal voltages of 345 / 117 kV). This tap had been set to 1.045 in previous Phase 1 cases.

It was also discovered that the load model used in the Phase 1 SIS, constant current for real power and constant admittance for reactive power, differed from the standard model used for New England studies. The load models were changed to the standard models for various areas as provided by the ISO. This had the effect of making many contingencies less severe.

The Phase 2 dynamic data modifications are given in Appendix B. These data are based on preliminary design data for the generator rewind and excitation system upgrade. Modifications to this data based on final design and parameter adjustments during commissioning will be provided to the ISO.

SLT1 – Light load

One-lines showing the NEPOOL 345kV system for cases SLT1-p1 and SLT1-p2 are in SLT1-P1 and SLT1-P2. The increased output for the Phase 2 uprate was balanced by taking off three small New Hampshire units: Smith Hydro, Garvin, and Ayers.

SLT2 – Light load with high NH / low ME generation

One-lines showing the NEPOOL 345kV system for cases SLT2-p1 and SLT2-p2 are in SLT2-p1 and SLT2-P2. The increased output for the Phase 2 uprate was balanced by taking off three small New Hampshire units: Smith Hydro, Garvin, and Ayers.

SLT4 – Light load with High ME/NH, North-South and Boston Export

This case was intended to show the impact of the Seabrook uprate with the ME/NH, North-South, and Boston Export interface flows near their limits.

Starting with SLT1-P1 case, two Westbrook units were taken off-line and WF Wyman 1, 2, & 3, RPA, Warren, and SDW#9 were put on-line to compensate; Merrimack G1 was added and Brayton Point # 1 was removed; and Salem 4 was removed and Salem 1, 2, &3 and SOM G6 were added; For the post-uprate case (SLT4-p2), the same changes were made as for SLT1-p2.

One-lines showing the NEPOOL 345kV system for cases SLT4-p1 and SLT4-p2 are in SLT4-p1 and SLT4-P2.

SPK1 – Peak load

For this case, 60MVAr of shunt capacitors were added at the Vermont Yankee 115kV bus to represent the upgrades for the VY uprate. One 30MVAr bank is connected such that it trips with the autotransformer. Two 15MVAr banks are connected to the 115kV bus such that they are available with the autotransformer out of service.

One-lines showing the NEPOOL 345kV system for cases SPK1-p1 and SPK1-p2 are in SPK1-P1 and SPK1-P2.

6. Contingency Description

6.1 Steady-State Contingencies

The steady-state contingency list is shown in Appendix A. A complete definition of the switching actions for each contingency can be found in the file Outage.pdf. Most of these contingencies were run for each case, except as follows:

1. The "Light Load Contingencies" were used only for case T1LT and only those contingencies were used for this case.
2. Contingencies 9, 10, 11, 45, 46, and 47, with the 326 SPS, were run only for Case T2.

6.2 Dynamic Contingencies

The following dynamic contingencies were analyzed for some or all of the base cases:

Normally cleared Three-Phase Faults:

nc307	Newington-Deerfield 345kV
nc326	Scobie-Sandy Pond 345kV
nc337	Tewksbury-Sandy Pond 345kV
nc343	Sandy Pond-Millbury 345kV
nc363	Seabrook-Scobie 345kV
nc369	Seabrook-Newington 345kV
nc379	Scobie-Vermont Yankee 345kV
nc385	Buxton-Deerfield 345kV
nc391	Buxton-Scobie 345kV
nc394	Seabrook-Tewksbury 345kV
nc396*	Orrington-Keswick 345kV – Transfer trip MIS
ms101	normally cleared fault on Mystic-Kingston 345kV

Tripping Events:

ph2	Phase II HVDC

Single Phase-to-Ground Faults with Stuck Breaker:

sc302	Mystic 105 sb	fault on Mystic-Cambridge 345kV
sc326	Scobie 9126 sb	fault on Scobie-Sandy Pond 345kV
sc374	Buxton 386-4 sb	fault on Buxton-Surowiec 345kV
sc381*	VT Yankee 381 sb	fault on VT Yankee-Northfield 345kV
sc391	Buxton K391/386 sb	fault on Buxton-Scobie 345kV
sc394	Seabrook 294 sb	fault on Seabrook-Tewksbury 345kV
sc394bus	Seabrook 941 sb	fault on Seabrook 345kV bus #1

Three Phase-to-Ground Faults with Stuck Breaker:

ec312*	Northfield 3T sb	fault on Northfield-Alps 345kV
ec326*	Scobie 9126 sb	fault on Scobie-Sandy Pond 345kV
ec328*	Sherman Rd 142 sb	fault on Sherman Rd.-W. Farnum 345kV
ec368	Card 2T sb	fault on Card-Manchester 345kV
ec374	Buxton 386-4 sb	fault on Buxton-Surowiec 345kV
ec391	Buxton K391/386 sb	fault on Buxton-Scobie 345kV
ec394*	Seabrook 294 sb	fault on Seabrook-Tewksbury 345kV
ec394bus	Seabrook 941 sb	fault on Seabrook 345kV bus #1
ec8x	VY381	fault on VY autotransformer
ms302	Mystic 105 sb	fault on Mystic-Cambridge 345kV
ms1stk	Mystic 102 sb	fault on Mystic-Kingston 345kV

7. Steady-State Results

Voltage violations and LTE overloads for all of the cases are tabulated in the file Seabrook-ResultsT.xls. Three tabs are included for each case:

1. VVs – Voltage violations; solution failures are also noted on this tab
2. LTE OL's – Line loading relative to LTE limit
3. Gens – Reactive output of Seabrook for each contingency

Three sets of results are shown on each tab:

1. Reference (R) case with the Phase 1 uprate
2. Uprate (U) case with the Phase 2 uprate

Entries appear in the violations tables only if one or more of the cases showed a violation for that contingency.

7.1 Pre-existing Violations

Several violations existing in the pre-uprate reference cases are discussed in this section. Generally, these are local problems which are unaffected by the Seabrook uprate.

7.1.1 NH Seacoast Voltage Violations

When the new 2007 load estimates for the NH seacoast area were added to the cases, low voltages were observed for several contingencies, most notably for the Deerfield stuck breaker 851, which trips the Deerfield 345/115 autotransformer, as well as Section 385 to Buxton. This causes much of the flow to the NH seacoast area to be diverted through the S. Gorham transformer and the southern Maine/NH 115kV system. Section 250 from Louden to the Biddeford tap is severely overloaded (122% of LTE) and voltages on 17 southern Maine and NH 115kV buses are below 0.95 pu, as low as 0.932. Since a very significant decrease in ME/NH flow would be required to mitigate this condition, it was decided a more reasonable solution for this study would be to run at least one Schiller unit for each case. This corrects all of the low voltages although there is still some overload on Section 250.

7.1.2 Section E131 – Bear Swamp to E131 Tap

This short line section is overloaded for most of the pre-contingency cases by 1 to 4 %. Since the LTE and normal ratings are equal, it is also overloaded for most of the contingencies. It is listed in the table only for contingencies where the OL was significantly worse than the pre-contingency value. The Phase 2 uprate does not have a significant adverse impact on this OL for any contingency.

7.1.3 Section J136S – Pratts Junction to Litchfield Tap (and P142N)

This line section shows significant overloading for loss of Section 340, loss of 340 & 379, and loss of the VY auto. It shows small overloads for many of the other contingencies. The Seabrook uprate has only a small affect on these overloads. For clarity, the contingencies with only small overloads were deleted from the table. Also, section P142N from Wachusetts to Sterling to Pratts Junction is overloaded by about 15% for Sandy Pond SB 314.

7.1.4 Contingency 108 (517-532N&S) non-solution

This contingency did not solve for any of the cases. A transformer feeding a 23kV load at Field 1 is tripped forcing the load to be supplied by a high impedance line from Field 2. This causes very low voltage at the load bus and non-solution. Since this contingency is very unlikely to be influenced by Seabrook, no fix was attempted.

7.1.5 Section 83C – SDW SOMS to S83C Tap for Light Load Case

This line is overloaded pre-contingency by excessive outlet power from the Warren generating units with the Warren load reduced. The LTE limit equals the normal limit, so the overload appears for all contingencies as well.

7.1.6 Coolidge, W. Rutland low voltages

In all peak load cases, the loss of Section 340 causes low voltages at the Coolidge and W. Rutland 345kV buses. The Seabrook uprate does not have any significant adverse impact.

7.1.7 Tewksbury 115kV Contingency low voltages

In all peak load cases, several contingencies (121, 131, 132) in the Tewksbury 115kV area cause low voltages on nearby 115kV buses. The Seabrook uprate does not have any significant adverse impact.

7.2 Pre-contingency Violations

The Seabrook uprate does not have a significant adverse impact on any pre-contingency line loadings or voltages. The specified reactive capability of the Phase 2 uprate (375 MVAr lagging, 0 MVAr leading) is adequate to maintain scheduled voltage at the Seabrook 345kV bus for all of the cases. The following table shows the reactive power output of Seabrook with the Phase 1 and Phase 2 uprates to maintain 1.035 p.u. (357 kV) for the peak load cases and 1.02 p.u. (352 kV) for the light load case:

Case	Phase 1 MVAr	Phase 2 MVAr
T1	334	345
T2	358	370
T3	142	151
T4	340	350
LT1	48	58

7.3 Post-Contingency Violations

7.3.1 T1 – Peak load

Voltage Violations – There are no voltage violations for either the reference or uprate case, except for those discussed in Section 7.1.6 and 7.1.7.

Overloads – Line overloads occur for several of the contingencies for both the reference and uprate cases. The Seabrook Phase 2 uprate causes no significant increase (< 0.3%) in the line overloads for any of the contingencies.

7.3.2 T2 – Peak load with WF Wyman #4 ON-LINE

Voltage Violations – There are no voltage violations for either the reference or uprate case, except for those discussed in Section 7.1.6 and 7.1.7.

Overloads – Line overloads occur for several of the contingencies for both the reference and uprate cases. The Seabrook Phase 2 uprate causes no significant increase (< 0.9%) in the line overloads for any of the contingencies.

7.3.3 T3 – Peak load with South to North Flow

Voltage Violations – Aside from those discussed in Section 7.1.6 and 7.1.7, the only contingency that causes voltage violations is the Buxton Stuck Breaker K386-4. Low voltages occur on many 115kV buses in the area for both the reference and uprate cases, and high voltage occur on some buses. The Seabrook Phase 2 uprate causes no adverse impact on these violations.

Overloads – Line overloads occur for several of the contingencies for both the reference and uprate cases. The Seabrook Phase 2 uprate causes no significant increase (< 0.3%) in the line overloads for any of the contingencies.

7.3.4 T4 – Peak load with all Newington units off-line

Voltage Violations – There are no voltage violations for either the reference or uprate case, except for those discussed in Section 7.1.6 and 7.1.7.

Overloads – Line overloads occur for several of the contingencies for both the reference and uprate cases. The Seabrook Phase 2 uprate causes no significant increase (< 0.4%) in the line overloads for any of the contingencies.

7.3.5 T1LT – Light load with minimal flow on Maine 345kV

Voltage Violations – There are no significant voltage violations for either the reference or uprate cases. Some small overvoltages (<= 1.052) occur in the Boston area for loss of Mystic 8. The Seabrook uprate does not adversely affect these overvoltages. Seabrook's reactive power output does not reach its lower limit (0 MVAr) for any of the contingencies. (Note: Since the Boston area overvoltages did not appear in the Phase 1 study and significant changes have been made in this case since the Phase 1 study, including changing load level and load power factors and correcting the tap setting of the

Mystic autotransformer, the pre-Phase 1 case was repeated with these changes. The voltage violations for this case are shown in the results speadsheet. Essentially the same overvoltages appear in the pre-Phase 1 case indicating that these overvoltages are no a result of either the Phase 1 or Phase 2 Seabrook uprate.)

Overloads – There are no significant overloads for either the reference case or uprate case, except the pre-existing overload discussed in Section 7.1.5

7.4 N-2 Operability Analysis

The only significant N-2 cases are where one of the 345kV lines in the North-South interface is out of service and one of the other lines trips. The various combinations of these line outages were analyzed in the previous Phase 1 thermal study using the T2U case since this case has the highest loading on the North-South interface lines.

The only case that required generation runback to relieve overloading was for outage of both Section 394 (Seabrook to Tewksbury) and Section 326 (Scobie to Sandy Pond). Generation runback of less than 600 MW, e.g. by tripping Westbrook units, was sufficient to relieve the overload on Section 381 (Vermont Yankee to Northfield).

Since the previous Phase 1 analysis was performed with essentially the Phase 2 Seabrook power output, the N-2 analysis was not repeated.

8. Dynamic Results

A summary of the results for all of the contingencies and cases is shown in the spreadsheet "SBRK-Results-Phase2.xls". Each tab includes results for a pair of cases: Seabrook Phase 1 uprate and Phase 2 uprate. The columns of the tables indicate operation of SPS and relays, loss of source (LOS), generator instability, oscillation damping, etc. The plots for each contingency are hyperlinked to the "fault id".

8.1 SLT1 – Light load without UAE Tewksbury & Lowell

The results are shown on tab SLT1 in "SBRK-Results-Phase2.xls". All contingencies show acceptable performance with the Phase 2 uprate. The results are essentially the same with and without the Phase 2 uprate, except as follows:

ms302 – Mystic 105 stuck breaker – The reference (Phase 1 uprate) case results in more unstable units and about 100 MW more loss of source than the Phase 2 uprate case.

8.2 SLT2 – Light Load with High NH, Low ME generation

The results are shown on tab SLT2 in "SBRK-Results-Phase2.xls". All contingencies show acceptable performance with the Phase 2 uprate. The results for this case are essentially the same with and without the Phase 2 uprate, except as follows:

ms302 – Mystic 105 Stuck Breaker – The reference (Phase 1 uprate) case results in operation of the GCX zone 3 as well as Bucksport Reverse Power SPS which results in loss of source of 600 MW due to New Brunswick generation rejection. The Phase 2 uprate case results in operation of the GCX zone 3, with corresponding 600 MW loss of source, as well as operation of the Bucksport Overcurrent SPS, which trips the Bucksport 191 MW unit. The Phase 2 case therefore results in greater loss of source than the Phase 1 case, but well below the limit for extreme contingencies.

8.3 SLT4 – Light Load with High ME/NH, North-South and Boston Export

The results are shown on tab SLT4 in "SBRK-Results-Phase2.xls". All contingencies show acceptable performance with the Phase 2 uprate. The results for this dispatch are essentially the same with and without the Phase 2 uprate, except as follows:

Western NE Contingences, ec312 and ec8x – The Phase 1 case results in a relatively large loss of source for both of these contingencies due to operation of the Loss of 3001 SPS and loss of synchronism of most units north of Surwowiec. The Phase 2 case results in no loss of source for either contingency.

Mystic 105 Stuck Breaker (ms302) – The Phase 1 case results in a relatively large loss of source (1424 MW), assuming separation of the Surowiec interface plus loss of WF Wyman units 1,2, & 3. The Phase 2 case results were similar except that WF Wyman 1 & 3 did not lose synchronism so the loss of source was 1242 MW.

Contingencies ec326, ec374, ec391 for both Phase 1 and Phase 2 result in a Maine – New Hampshire split. The tripping of lines between Maine and New Hampshire is not explicitly modeled, but it is inferred from the coherent loss of synchronism of most of the generators in Maine and the Maritimes with respect to the rest of the eastern interconnection. The resulting loss of source to the interconnection is the initial ME/NH interface flow 1422 MW. This is considered to be within acceptable limits for extreme contingencies, since ME/NH flow is supposed to be limited to 1400 MW, but was slightly over that limit for this dispatch. For ec374 and ec391, the two pumps that were on-line at Bear Swamp also tripped on loss of synchronism, reducing the effective loss of source by 560 MW.

8.4 SPK1 – Peak Load without UAE Tewksbury & Lowell

The results of this case and its corresponding reference case are shown on tab SPK1 in "SBRK-Results-Phase2.xls". All contingencies show acceptable performance with the Phase 2 uprate. The results are essentially identical for the reference (Phase 1) case and the Phase 2 uprate case. Both cases result in a Maine – New Hampshire split for contingencies ec374 and ec391.

8.5 Seabrook Auxiliary Bus Voltage Dip

The possibility of tripping the Seabrook plant due to excessive voltage dip at the plant auxiliary bus was identified a concern in the previous Phase 1 uprate analysis. The contingency that produced the most severe voltage dip was consistently ec394 (Seabrook 294 stuck breaker). Expanded plots of the Seabrook auxiliary and terminal bus voltages are shown on page 5 of the plots for each case.

The relays are set to trip the reactor coolant pumps (and thus the plant) if the voltage on the auxiliary bus stays below 0.652 p.u. for more than 20 cycles. In order to provide some margin, it was agreed in the Phase 1 analysis that the voltage should not go below 0.702 p.u. for more than 20 cycles. The column in the results table labeled **Vmax 20~** gives the value the voltage stays below for 20 cycles. These values are also shown in the following table for the light load cases.

Auxiliary Voltage Dip (Vmax 20~) – EC394 Contingency

Dispatch	Reference	Uprate
SLT1	0.859	0.858
SLT2	0.820	0.847
SLT4	0.859	0.859

As a result of the change to the standard load models, discussed in Section 5.2, the auxiliary voltage dip is no longer a cause for concern.

8.6 Seabrook ΔP for Line Switching

ΔP is the sudden change in generator power output resulting from line switching; it is measured in per unit of the machine MVA rating.

The analysis was performed on the light load case with high levels of Newington generation, because the highest levels of line flow near the Seabrook plant were observed under this condition. The intent was to calculate the highest ΔP under relatively stressed conditions, but within the existing transfer capability of the system. Stability simulations of line trip and reclose events were performed for each of the 345kV lines connected to Seabrook. None of the lines are equipped with automatic high speed reclosing, so the reclose event occurred 10 seconds after the trip. No faults were associated with any of the line trip and reclose events.

The ΔPs observed on the Seabrook unit with all lines in service, both with Phase 1 uprate and with Phase 2 uprate, are shown in *Table 7-2*. Values are shown in both MW and pu of machine MVA base.

Table 7-2 ΔP for Light Load Conditions (slt2) with All Lines In-Service.

	Phase 1		Phase 2	
Switching Action	MW	pu (on 1350MVA)	MW	pu (on 1373MVA)
Trip Section 369 (Seabrook-Newington 345kV)	80	0.059	60	0.044
Reclose Section 369 (Seabrook-Newington 345kV)	-100	-0.074	-100	-0.073
Trip Section 394 (Seabrook-Tewksbury 345kV)	-200	-0.148	-210	-0.153
Reclose Section 394 (Seabrook-Tewksbury 345kV)	280	0.207	270	0.197
Trip Section 363 (Seabrook-Scobie 345kV)	-130	-0.096	-140	-0.102
Reclose Section 363 (Seabrook-Scobie 345kV)	160	0.119	160	0.117

An additional ΔP analysis under line out conditions was also performed. Power flows were developed with either Section 394 (Seabrook-Tewksbury 345kV) or Section 326 (Scobie-Sandy Pond 345kV) out of service for the light load study conditions. The lineout power flows were solved with all SVDs, LTCs, and PARs active. No system redispatch was implemented.

The changes in power observed on the Seabrook unit with either Section 394 or 326 out of service, both with and without the uprate, are shown in *Table 7-3*. Values are shown in both MW and pu of machine MVA base.

Table 7-3 ΔP for Light Load Conditions (slt2) with One Line Out of Service.

Switching Action	Phase 1 MW	Phase 1 pu (on 1350MVA)	Phase 2 MW	Phase 2 pu (on 1373MVA)
Section 394 Seabrook-Tewksbury Out:				
Trip Section 369 (Seabrook-Newington 345kV)	10	0.007	10	0.007
Reclose Section 369 (Seabrook-Newington 345kV)	-30	-0.022	-25	-0.018
Trip Section 363 (Seabrook-Scobie 345kV)	-390	-0.289	-390	-0.284
Reclose Section 363 (Seabrook-Scobie 345kV)	500	0.370	490	0.357
Section 326 Scobie -Sandy Pond Out:				
Trip Section 369 (Seabrook-Newington 345kV)	100	0.074	100	0.073
Reclose Section 369 (Seabrook-Newington 345kV)	-160	-0.119	-155	-0.113
Trip Section 394 (Seabrook-Tewksbury 345kV)	-390	-0.289	-310	-0.226
Reclose Section 394 (Seabrook-Tewksbury 345kV)	600	0.444	590	0.430
Trip Section 363 (Seabrook-Scobie 345kV)	-75	-0.056	-75	0.055
Reclose Section 363 (Seabrook-Scobie 345kV)	80	0.059	80	0.058

The highest ΔP observed for Phase 2 with all lines in service was 0.197 pu, slightly lower than Phase 1, in response to reclosing Section 394 (Seabrook-Tewksbury 345kV). The highest ΔP observed for Phase 2 with a line out of service was 0.43 pu, slightly lower than Phase 1, in response to reclosing Section 363 (Seabrook-Scobie 345kV) with Section 394 out.

Also, with Section 326 out and no system redispatch, loss of Section 394 (Seabrook-Tewksbury 345kV) caused Seabrook and other units to loose synchronism both with and without uprate. Therefore a redispatch was performed for this line out condition. NNE-Scobie+394 flow was reduced by turning on Brayton Point 4 (446 MW) and turning off Newington G1 (442 MW). Following this, there were no unstable units for both Phase 1 and Phase 2 condition.

The level of delta P transients experienced with Phase 2 is more in some cases and less in most other cases compared with the Phase 1 condition. Overall, there does not seem to be any significant difference.

9. Conclusions

9.1 Steady-state Thermal, Voltage, and Short Circuit Performance

No significant degradation in thermal or voltage performance was found for the Phase 2 uprate compared with the Phase 1 uprate. Short circuit current available from the unit at the Seabrook 345kV bus will decrease by about 3.5% due to the generator rewind.

9.2 Dynamic Performance

The dynamic performance with the Seabrook Phase 2 uprate is acceptable and in some cases slightly better than the Phase 1 performance. For the most heavily stressed dispatch (SLT4), the following performance improvements were noted with the Phase 2 uprate:

- Oscillation damping was slightly better for most contingencies, even though the power system stabilizer, planned as part of the uprate, was not included in the analysis.
- For two extreme contingencies in western New England, the Phase 1 results showed significant loss of source, while the Phase 2 results showed no loss of source.

9.3 Overall Conclusion

The Seabrook Phase 2 uprate meets all system reliability criteria and requires no mitigating measures. As was the case for the Phase 1 uprate, since the output of Seabrook after the uprate may be greater than the 1200 MW loss of source limit for design contingencies, the following condition must be applied:

> The Seabrook unit, with implementation of its proposed 1,318 gross MW uprate or any lesser uprate, will be required to limit its gross output level in real-time operation such that the net loss of source that results from a contingent Seabrook generator trip is at or below the real-time-based maximum allowable net source loss for the NEPOOL control area. Any reductions to the gross output of Seabrook to meet this requirement will be required within 30 minutes of being directed to do so by ISO-NE.

Appendix A

Load Flow Contingency List

New England 345kV lines

1 "Loss of Sandy Pond to Lawrence 345 (326)"
2 "Loss of Sandy Pond to Lawrence 345 (326) with Y151 SPS"
3 "Loss of Sandy Pond to Tewksbury 345 (337)"
4 "Loss of Sandy Pond to Tewksbury 345 (337) with Y151 SPS"
5 "Loss of Woburn to Tewksbury 345 (338)"
6 "Loss of Golden Hills to Tewksbury 345 (339)"
7 "Loss of Ward Hill to Seabrook 345 (394)"
8 "Loss of Ward Hill to Seabrook 345 (394) with Y151 SPS"
9 "Loss of Ward Hill to Seabrook 345 (394) with Y151 SPS & 326 SPS (Wyman 4)"
10 "Loss of Ward Hill to Seabrook 345 (394) with Y151 SPS & 326 SPS (Newington)"
11 "Loss of Ward Hill to Seabrook 345 (394) with Y151 SPS & 326 SPS (N & W)"
12 "Loss of (385) Buxton-Deerfield [n01]"
13 "Loss of (391) Buxton-Scobie [n03]"
14 "Loss of (307) Deerfield-Newington"
15 "Loss of (373) Deerfield-Scobie"
16 "Loss of (363) Scobie-Seabrook"
17 "Loss of (379) Scobie-Amhrst-V.Yankee"
18 "Loss of (369) Seabrook-Timber-Newington"
19 "Loss of (343) Sandy Pd-Millbury #1"
20 "Loss of (314) Sandy Pd-Millbury #2"
21 "Loss of (381) VT Yankee-Northfield"
22 "Loss of (346X) Woburn-No.Cambridge #1"
23 "Loss of (358) No.Cambridge-Mystic"
24 "Loss of (349X+Y) Mystic-G.Hills, Golden Hills TX"

New England 345kV transformers

25 "Loss of GLDN HILL TX 2"
26 "Loss of SANDY PD TX 1"
27 "Loss of SANDY PD TX 2"
28 "Loss of WARDHILL TX 3"
29 "Loss of WARDHILL TX 3 with Y151 SPS"
30 "Loss of (TB14) Deerfield 345-115 kV TX"
31 "Loss of (TB30) Scobie 345-115 kV TX"
32 "Loss of (T2) Golden Hills 345-115 kV TX"

345KV Stuck Breaker Contingencies

33 "Sandy Pond Stuck Breaker 314"
34 "Sandy Pond Stuck Breaker 337"
35 "Sandy Pond Stuck Breaker 337 with Y151 SPS"
36 "Sandy Pond Stuck Breaker 343"
37 "Sandy Pond Stuck Breaker 326"
38 "Sandy Pond Stuck Breaker 326 with Y151 SPS"
39 "Sandy Pond Stuck Breaker 2643"
40 "Sandy Pond Stuck Breaker 2643 with Y151 SPS"
41 "Tewksbury Stuck Breaker 3739"
42 "Tewksbury Stuck Breaker 3739 with Y151 SPS"
43 "Tewksbury Stuck Breaker 3894"
44 "Tewksbury Stuck Breaker 3894 with Y151 SPS"

45 "Tewksbury Stuck Breaker 3894 with Y151 SPS & 326 SPS (Wyman 4)"
46 "Tewksbury Stuck Breaker 3894 with Y151 SPS & 326 SPS (Newington)"
47 "Tewksbury Stuck Breaker 3894 (394) with Y151 SPS & 326 SPS (N & W)"
48 "Tewksbury Stuck Breaker 3894-2"
49 "Tewksbury Stuck Breaker 37-39"
50 "Deerfield Stuck Breaker 851"
51 "Deerfield Stuck Breaker 785"
52 "Deerfield Stuck Breaker 72"
53 "Deerfield Stuck Breaker 7310"
54 "Newington Stuck Breaker 0372"
55 "Newington Stuck Breaker 0163"
56 "Newington Stuck Breaker 0451"
57 "Newington Stuck Breaker SEI-New 1"
58 "Scobie Stuck Breaker 731"
59 "Scobie Stuck Breaker 631"
60 "Scobie Stuck Breaker 911"
61 "Scobie Stuck Breaker 7973"
62 "Scobie Stuck Breaker 6366"
63 "Scobie Stuck Breaker 9126"
64 "Scobie Stuck Breaker 262"
65 "Scobie Stuck Breaker 792"
66 "Buxton stuck breaker (K386-4)"

New England 230kV lines

67 "A-201N "
68 "A-201S "
69 "B-202N "
70 "B-202S "
71 "Loss of GRAN to COMERFRD (F-206) "

New England 230kV transformers

72 "Loss of TEWKSBRY TX 2"
73 "Loss of TEWKSBRY TX 3"
74 "Loss of TEWKSBRY TX 4"
75 "Loss of TEWKSBRY TX 3 and 4"
76 "Loss of TEWKSBRY TX 3 and 4 with Y151 SPS"

NGRID 115kV lines

77 "B-154N "
78 "C-155S "
79 "I-161W "
80 "J-162 "
81 "K137E "
82 "M-139 "
83 "O-167 "
84 "Q-169 "
85 "S-145 "
86 "T-146 "
87 "G-133E"
88 "G-133E+ Y151"
89 "G-133W"
90 "K-137+T4"
91 "K-137W+T6"
92 "L138E"
93 "N-140"

94 "Y-151"
95 "B-154S"
96 "C-155N"
97 "F-158N&S"
98 "F-158N"
99 "F-158S"
100 "A-153"
101 "I-161W"
102 "J-162"
103 "L-164"
104 "N-166"
105 "P-168 128518"
106 "Q-169"
107 "A-179"
108 "517-532N&S"
109 "517-533N&S"

NGRID double-circuit towers (DCT) 115 & 69kV - partial

110 "337+161wDCT"
111 "337+161w+151"

NGRID 115 kV STUCK BREAKERS

112 "GLDN H 45-58"
113 "GLDN H 46-69"
114 "GLDN H T-146"
115 "S.HBR 11-45"
116 "S.HBR 44-55"
117 "S.HBR 33-54"
118 "SDNVRS C-155"
119 "SNDYPD K137E"
120 "TEWKS 37-2 "
121 "TEWKS_K137 "
122 "TWKSK137+151"_
123 "WRD_HL_33-54"
124 "WH_33-54+151"
125 "SNDYPD L138E"
126 "SPD L138E151"
127 "TEWKS 4T"
128 "TEWKS 4T+151"
129 "TEWKS 2T"
130 "TEWKS 2T+151"
131 "TEWKS 39-46"
132 "TEWKS 40-45"
133 "SDNVRS B-154"
134 "WRD HL G-133"
135 "WH G-133+151"
136 "GLDN H F-158"
137 "GHF-158+Y151"
138 "GLDN H 46-69"

LOSS OF GENERATION

139 "LOSS OF MYSIC 8"
140 "LOSS OF CON ED NEWINGTON G1, G2 AND G3"
141 "Loss of Seabrook G1"
142 "Loss of Merrimack G2"

Additional Contingencies

143 "LOSS OF 340"
144 "LOSS OF 340 AND 379"
145 "LOSS VY AUTO"

Light Load Contingencies

1LT Loss of Chester SVC
2LT Loss of Mystic 7
3LT Loss of AES Londonderry
4LT Loss of Vermont Yankee
5LT Loss of one Scobie 345-115 TX plus one shunt reactor
6LT Loss of one Surowiec 345-115 TX plus one shunt reactor
7LT Loss of one Orrington 345/115 TX plus one shunt reactor

Appendix B

Phase 2 Dynamic Model Data

Customer			FPLE				
Unit			Seabrook				
Req./Des. Number			180X560				
Prepared By			Kirk O'Brien				
Date			26-Mar-04				
Comments			Rewound Generator - Preliminary Data				
MVA =	1373.1	kV =	25	pf =	0.94	RPM =	1800
Rfd(100C) =	0.088	IFAG =	1762	IFFL =	5540		
					Exciter	2810 kW	505 V

(Original data prior to Phase 2 rewind shown for reference.)

	d-axis	**PHASE 2**	**Original**
	MVA rating	1373.1	1350
Xd	Synchronous reactance	1.99	1.99
X'di	Transient reactance	0.455	0.435
X'dv	Transient reactance, saturated	0.410	
X"di	Subtransient reactance	0.345	0.320
X"dv	Subtransient reactance, saturated	0.285	
T'do	Transient O.C. time constant	9.166	7.50
T"do	Subtransient O.C. time constant	0.037	0.033
	q-axis		
Xq	Synchronous reactance	1.88	1.89
X'q	Transient reactance	0.655	0.630
X"q	Subtransient reactance	0.347	
T'qo	Transient O.C. time constant	0.426	0.436
T"qo	Subtransient O.C. time constant	0.059	0.050
R1	Armature resistance	0.0041	0.0043
Xlm	Armature leakage reactance	0.265	0.240
R2	Negative sequence resistance	0.0293	
X2	Negative sequence reactance	0.285	
S1.0	No-load saturation @ 1.0 p.u. voltage	0.13	0.12
S1.2	No-load saturation @ 1.2 p.u. voltage	0.4425	0.46

Resistances and reactances are per unit on generator MVA, kV base.

Original Rotating Excitation System Data.

AC3		IEEE Model Type
0.0	Tr	Filter time constant, sec.
0.0	Tb	Time constant, sec.
0.0	Tc	Time constant, sec.
63.9	Ka	Voltage regulator gain
0.013	Ta	Time constant, sec.
1.0	Vamax	Maximum control element output, p.u.
-0.95	Vamin	Minimum control element output, p.u.
4.67	Te	Exciter time constant, sec.
0.0	Klv	Minimum field voltage limiter gain, p.u.
5.93	Kr	Field voltage feedback gain, p.u.
0.052	Kf	Low level rate feedback gain, p.u.
1.06	Tf	Rate feedback time constant, sec.
0.05	Kn	High level rate feedback gain, p.u.
1.82	Efdn	Rate feedback gain break level, p.u.
0.124	Kc	Rectifier regulation factor, p.u.
1.06	Kd	Exciter internal reactance, p.u.
1.0	Ke	Exciter field resistance constant, p.u.
0.522	Vlv	Minimum excitation limit, p.u.
4.98	E1	Field voltage value, 1
0.2	S(E1)	Saturation factor at E1
6.64	E2	Field voltage value, E2
2.57	S(E2)	Saturation factor at E2
0.59	Kl1	Field current limit parameter (=.59)
0.052	Kfa	Field current limit parameter (defaults to Kf)

Phase 2 - 200% Ceiling Static Excitation System Data.

ST4B		IEEE Model Type
0.0	Tr	Voltage transducer time constant, sec.
7.5	Kpr	AVR Proportional Gain
7.5	Kir	AVR Integral Gain
1.0	VRmax	AVR Positive Limit
-0.87	VRmin	AVR Negative Limit
0.01	Ta	AVR Time Constant, sec.
0	Kg	FVR Feedback Gain
1.0	Kpm	FVR Proportional Gain
0	Kim	FVR Integral Gain
1.0	VMmax	FVR Positive Limit
-0.87	VMmin	FVR Negative Limit
6.67	Kp	Potential Forcing Term
0	Theta-P	Forcing Term Angle, deg.
0	Ki	Current Forcing Term
0	Kl	P-bar Leakage Reactance
8.33	VBmax	Limit on Forcing (XFMR sat.)
0.09	Kc	Commutation Loss Term

Phase 2 - Power System Stabilizer Data.

PSS2A		IEEE Model Type
2	Tw1	Washout time constant
2	Tw2	Washout time constant
2	Tw3	Washout time constant
0	Tw4	Washout time constant
0.2	T1	1st lead time constant
0.05	T2	1st lag time constant
0.2	T3	2nd lead time constant
0.05	T4	2nd lag time constant
0	T6	Filter time constant
2	T7	Filter time constant
0.5	T8	RTF numerator
0.1	T9	RTF denominator
1	N	RTF Order
5	M	RTF # poles
10	Ks1	PSS Gain
0.234	Ks2	Inertia Gain (=Tw/2H)
1	Ks3	Pe gain
0.1	VSTtmax	Positive output limit (pu)
-0.1	VSTmin	Negative output limit (pu)

Seabrook Auxiliary Load Model

The Seabrook auxiliary system is normally supplied by two 3-winding transformers from the generator terminals. The following data was supplied by the Seabrook plant staff:

Unit Auxiliary Transformers

Voltage (H-X-Y): 24.5 kV – 13.8 kV – 4.3 kV [taps set at nominal]
H – WDG. MVA: 27 / 36 / (45) OA/FA/(FOA)
X – WDG. MVA: 18 / 24 / (30)
Y – WDG. MVA: 12 / 16 / (20)

	X2A	X2B	
Z_{H-X} =	4.99%	5.05%	@ 18 MVA
Z_{H-Y} =	5.47%	5.48%	@ 12 MVA
Z_{X-Y} =	9.78%	9.80%	@ 12 MVA
Load Loss			
H-X =	41358	40842	W @ 18 MVA
H-Y =	41120	41268	W @ 12 MVA
X-Y =	46600	46285	W @ 12 MVA

Recorded Currents and Voltages – Dec. 15, 2003

V_{TERM} = 24.6 kV (0.984 pu) I_{TERM} = 27.8, 28.6, 28.5 kA (phase A,B,C)
V_{BASE} = 25 kV   MVA = 1206

Aux. Bus	V_{AUX} (kV)	I_{AUX} (A)	V_{AUX} (pu)	S_{AUX} (MVA)	V_{BASE} (kV)	Large Motors (HP)*
1	13.36	881	0.968	20.4	13.8	20,800
2	13.51	721	0.979	16.87	13.8	17,400
3	4.227	496	1.016	3.63	4.16	8,250
4	4.221	531	1.015	3.88	4.16	6,600
5	4.225	397	1.016	2.91	4.16	5,850
6		303	1.015	2.22	4.16	5,650
			Total MVA	49.91		

X2A supplies aux. buses 1 and 3
X2B supplies aux. buses 2, 4, 5, and 6
* Total of motor HP on each bus from station one-line diagram

Based on this information, the auxiliary system was modeled as follows:

One equivalent 3-winding transformer with the following winding voltages and impedances:

V_H = 24.5kV	X_{H-X} = 0.05	on 36 MVA base	all R's = 0.
V_X = 13.8kV	X_{H-Y} = 0.082	on 36 MVA base	
V_Y = 4.3kV	X_{X-Y} = 0.147	on 36 MVA base	

The load on the 13.8kV bus was modeled by a single equivalent induction motor consuming 32 MW and 16 MVAr.

The load on the 4.16kV bus was modeled by one equivalent induction motor consuming 10 MW and 5 MVAr (9 MW and 4.5 MVAr pre-uprate) and a static (constant impedance) load consuming 7 MW and 2 MVAr.

The MVA bases for the dynamic motor models for the 13.8kV and 4.16kV motors were set at 50 MVA and 15 MVA, respectively. The dynamic model parameters used for both motors were:

ls	2.5000	
lp	0.200000	
lpp	0.200000	
ll	0.120000	
ra	0.005000	
tpo	0.500000	
tppo	0.0	
h	1.000000	
d	2.0000	
se1	0.050000	
se2	0.300000	
vt	0.652000	voltage trip setting
tv	10.0000	voltage trip time (set high so tripping would not occur)

Appendix C

Underexcited Reactive Limit Analysis

The reactive output at the Phase 1 and Phase 2 maximum power output levels was specified by FPLE to be able to go in the underexcited (leading) direction to at least to 0 MVAr . For the Phase 1 uprate, an investigation determined that:

1. The present URAL (UEL) settings will permit operation down to at least 0 MVAr throughout the operating range of power output. At the Phase 1 maximum power output of 1295 MW, the URAL will limit the reactive power to approximately 40 MVAr leading.
2. The present URAL setting will provide protection from steady-state instability with sufficient margin up to the Phase 1 maximum power output of 1295 MW, based on initial operation with all lines in and the most severe line loss contingency.
3. For initial line out condition, the present operating limit of 0 MVAr may not provide sufficient protection from steady-state instability for operation above the pre-uprate power level of 1209 MW. It was recommended that the minimum reactive operating limit be increased to 75 MVAr lagging for power output in excess of 1209 MW.

For the Phase 2 uprate, this analysis has been updated to ensure that operation at 0 MVAr at full power output will not risk steady-state instability. Since the excitation system will be replaced during the Phase 2 uprate, the present UEL (URAL) settings are not of concern. Once the Phase 2 design is completed, a more detailed analysis of the steady-state stability performance should be performed to determine the UEL settings for the new excitation system. The new system may permit dual UEL setting to accommodate line-out conditions as well as all-lines-in.

The results of the analysis described below indicate the following:

1. For all-lines-in condition, operation down to –50 MVAr should be secure without risk of steady-state instability. The Qmin value of 0 MVAr specified for use in the Seabrook Uprate SIS is therefore a conservatively safe value.
2. For worst case line-out operation, the results indicate minimum reactive output should be restricted to +100 MVAr (lagging).
3. Since this analysis was based on 1991 values of system impedance, the results are almost certainly conservative. Prior to commissioning of the Seabrook Phase 2 uprate, it is recommended that a more detailed study be conducted of underexcited limits with updated values of system impedance to determine final settings of the UEL and line-out operational limits.

Steady-State Stability Limit

The present Seabrook URAL settings and reactive power operational limits were established based on the report "Seabrook Station Generator Reactive Capability Study" by Allen Scarfone, Public Service Company of New Hampshire, February, 1991. The procedure used in that study has been implemented in an Excel spreadsheet.

The steady-state stability limits for the Phase 2 power output levels were calculated using the same system data and limiting cases used in the 1991 study. This is felt to be conservative, since the 2007 system impedances should be lower, and therefore less severe, due to added generation and transmission in the interim since the 1991 study. The MVA base for the calculations was updated to the Phase 2 value (1373.1 MVA). As indicated in Appendix B, the generator reactance Xd, which is used in the calculations, is expected to be the same per unit value (1.99) as before the rewind.

All Lines In

For the all-lines-in condition, the steady-state stability limit was calculated for the worst single contingency, which is the loss of the 394 line from Seabrook to Tewksbury, where "worst" is the one that results in the highest system impedance. The system equivalent impedance at the Seabrook 345kV bus from the 1991 report is:

$$Z1 = 0.00104 + j\ 0.01617 \text{ p.u. (100MVA, 345kV base)}$$

This impedance, when expressed on the generator MVA base (1373.1 for Phase 2), and accounting for the GSU transformer effective tap ratio (353.625 * 25) / (345 * 24.5), gives a system reactance of 0.20 p.u. The GSU transformer reactance is 0.11 p.u. on the same base. Therefore, the total system impedance is 0.31 p.u. A system voltage of 1.04 p.u. was used as in the 1991 study.

The steady-state stability limit as a function of generator power output is plotted in Figure C.1. Following the procedure of the 1991 report, a margin of 10% of the generator MVA rating (137 MVAr) is added to this limit to give the minimum reactive power limit shown in the figure.

From this analysis, it appears that operation down to –50 MVAr (leading) at the Phase 2 maximum power output of 1318 MW would be acceptable without risk of steady-state instability. The Qmin value of 0 MVAr specified for use in the System Impact Study is therefore acceptable in relation to steady-state instability.

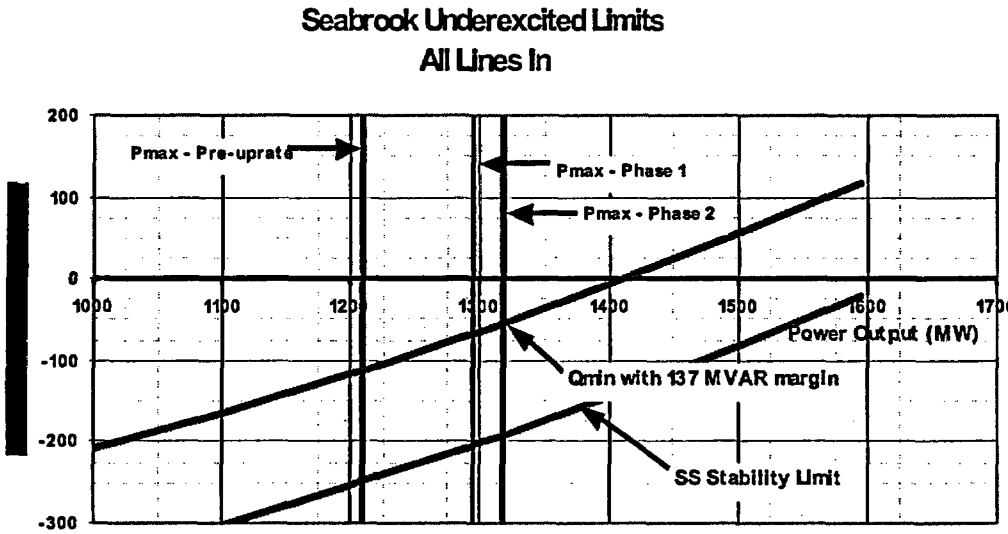


Figure C.1 Underexcited Limits – All Lines In

Line Out Condition

The worst line out condition is with either line 394 or 363 out of service plus the contingency loss of the other. The system equivalent impedance at the Seabrook 345kV bus from the 1991 report is:

Z1 = 0.00199 + j 0.0285 p.u. (100MVA, 345kV base)

This impedance, when expressed on the generator MVA base, and accounting for the GSU transformer effective tap ratio (353.625 * 25) / (345 * 24.5), gives a system reactance of 0.35 p.u. The GSU transformer reactance is 0.11 p.u. on the same base. Therefore, the total system impedance is 0.468 p.u. A system voltage of 1.04 p.u. was used as in the 1991 study.

The steady-state stability limit as a function of generator power output is plotted in Figure C.2. The "line out" operational limit was established in 1991 as 0 MVAr as indicated by the red line in the figure up to 1209 MW output.

For operation above 1209 MW, up to the Phase 1 maximum power output of 1295 MW, this operational limit was increased to 75 MVAR lagging to provide the same margin as at the pre-uprate maximum power.

For Phase 2 maximum power output of 1318 MW, this operational limit should be increased to 100 MVAr lagging to provide the same margin.

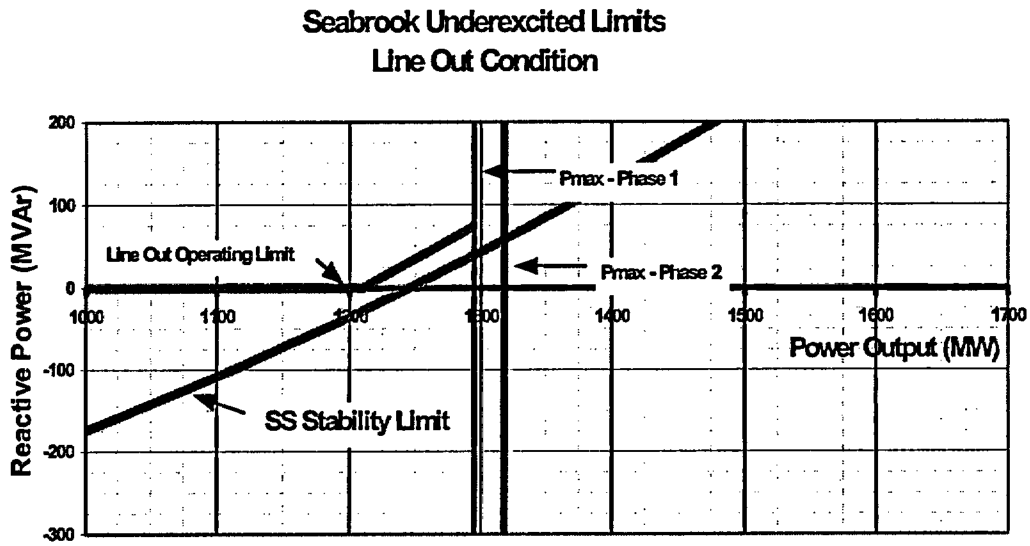


Figure C.2 Underexcited Limits – Line Out Condition