



NRC – PPL

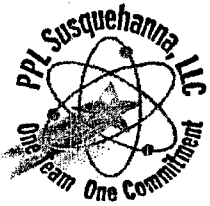
Extended Power Uprate

Pre-Submittal Meetings

Start-Up Testing/Large Transient Testing Process Topics

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John J. Geosits
John M. Oddo

Susquehanna Steam Electric Station
November 21, 2005



Purpose of the Meetings

Describe PPL Susquehanna approach to:

- Start-up Testing/Large Transient Testing**
- Process Topics**

Understand staff positions/expectations



Specific Meeting Objectives

Start-Up Testing/Large Transient Testing

- **CLTR Basis**
- **SRP 14.2.1 Adherence**
- **Basis for not performing large transient test**
- **Describe Licensing Basis change: ability to withstand condensate/feedwater pump trip**



Specific Meeting Objectives

Process Topics

- **CLTR/ELTR Basis for EPU Submittal**
- **Basis for Framatome Fuel Evaluations**
- **RS-001:**
 - ◆ **Correlation Matrix**
 - ◆ **Template Safety Evaluation Mark-Up**



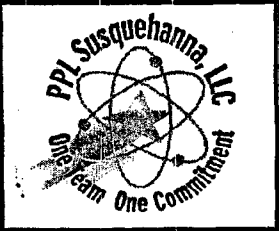
EPU Related NRC Submittals

| | |
|---|------------------------------------|
| PRNMS | 06/27/2005 |
| AST | 10/13/2005 |
| ARTS/MELLLA | 11/2005 |
| EPU | 03/2006 |
| Recirc Pump Seizure* | 03/2006 |
| Steam Dryer Evaluations Supplement 1 | 2nd Quarter 2006 |
| Steam Dryer Evaluations Supplement 2 | 3rd Quarter 2006 |
| License Renewal | 09/2006 |
| MELLLA+ | 2007 |



Recirculation Pump Seizure Licensing Basis Elimination

- * Current licensing basis**
- * Alternative Source term (AST) would require evaluation**
- * Revision of SSES licensing basis discussed with NRC. Separate submittal planned.**
- * EPU submittal contingent upon approval of AST and Recirculation Pump Seizure NRC submittals.**



EPU NRC Submittal Outline

- A. License Change Request Letter**
- B. Enclosure: PPL Susquehanna Evaluation of the Proposed Changes**
 - 1. Description**
 - 2. Proposed Change**
 - 3. Background**
 - 4. Technical Analysis**



EPU NRC Submittal Outline

(cont.)

5. Regulatory Safety Analysis

5.1 No Significant Hazards Consideration

5.2 Applicable Regulatory Requirements/Criteria

6. Environmental Consideration

7. Summary

8. References



EPU NRC Submittal Outline

(cont.)

C. Attachments:

- 1. Technical Specification Mark-up**
- 2. Technical Specifications Bases Mark-up**
- 3. List of Regulatory Commitments**
- 4. Supplemental Environmental Report**
- 5. PUSAR (GE Proprietary, Framatome Proprietary)**



EPU NRC Submittal Outline

(cont.)

- 6. PUSAR (Non-proprietary)**
- 7. Plant Modifications**
- 8. Startup Test Plan (Including Justification
for Exception to Large Transient Testing)**
- 9. Flow Induced Vibration Extent of
Condition Review**
- 10. Steam Dryer Report**



EPU NRC Submittal Outline

(cont.)

- 11. Grid Stability**
 - 12. RS-001 – Correlation Matrices**
 - 13. RS-001 – Template Safety Evaluations**
- Mark-ups**



General Electric BWR Extended Power Uprate Licensing Topical Reports (LTR)

- **Similar to LTR for Stretch Uprates
(~5% Uprates)**
- **Defines the overall scope of safety analyses**
- **Reviewed and accepted for reference for BWR
EPU submittals**
- **PPL is using the LTR structure as basis for the
non-fuel-dependent safety analyses**



BWR Extended Power Uprate Safety Analysis Basis Licensing Documents

Generic Guidelines for General
Electric Boiling Water Reactor
Extended Power Uprate

ELTR-1

Generic Evaluations of General
Electric Boiling Water Reactor
Extended Power Uprate

ELTR-2

Generic Evaluations of General
Electric Boiling Water Reactor
Extended Power Uprate
Supplement 1, Volume I

**ELTR-2
Supplement 1, Vol I**

Generic Evaluations of General
Electric Boiling Water Reactor
Extended Power Uprate
Supplement 1, Volume II

**ELTR-2
Supplement 1, Vol II**

Constant Pressure Power Uprate
Licensing Topical Report

CLTR

**Susquehanna Steam
Electric Station**

**Power Uprate Safety
Analysis Report**

PUSAR

Office Of Nuclear Reactor
Regulation

Review Standard For
Extended Power Uprates

RS-001



BWR Extended Power Uprate Safety Analysis Basis Licensing Documents

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Supplement 1, Volume I

**ELTR-2
Supplement 1, Vol I**

Generic Evaluations of General
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Extended Power Uprate
Supplement 1, Volume II

**ELTR-2
Supplement 1, Vol II**

Constant Pressure Power Uprate
Licensing Topical Report

CLTR

Office Of Nuclear Reactor
Regulation

Review Standard For
Extended Power Upgrades

RS-001

Susquehanna Steam
Electric Station

Power Uprate Safety
Analysis Report

PUSAR



BWR Extended Power Uprate Safety Analysis Basis Licensing Documents

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Licensing Topical Report

CLTR

**Susquehanna Steam
Electric Station
Power Uprate Safety
Analysis Report
PUSAR**

Office Of Nuclear Reactor
Regulation

Review Standard For
Extended Power Uprates

RS-001



BWR Extended Power Uprate Safety Analysis Basis Licensing Documents

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CLTR

Office Of Nuclear Reactor
Regulation

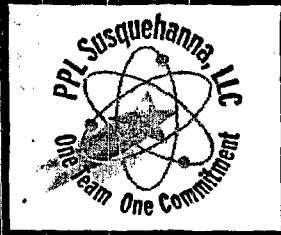
Review Standard For
Extended Power Uprates

RS-001

Susquehanna Steam
Electric Station

Power Uprate Safety
Analysis Report

PUSAR



CLTR

Constant Pressure Power Uprate Licensing Topical Report

- ◆ **Overall scope of analysis with no increase in maximum steam dome pressure**
- ◆ **Other EPU assumptions**
- ◆ **Builds on of generic dispositions in ELTR-1 & ELTR-2**
- ◆ **Format and content for Susquehanna's Power Uprate Safety Analysis Report (PUSAR)**



BWR Extended Power Uprate Safety Analysis Basis Licensing Documents

Generic Guidelines for General
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Extended Power Uprate

ELTR-1

Generic Evaluations of General
Electric Boiling Water Reactor
Extended Power Uprate

ELTR-2

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Supplement 1, Volume I

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CLTR

Office Of Nuclear Reactor
Regulation

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RS-001

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Electric Station
Power Uprate Safety
Analysis Report
PUSAR**



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Electric Station**

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Analysis Report**

PUSAR

Office Of Nuclear Reactor
Regulation

Review Standard For
Extended Power Uprates

RS-001



Evaluation Control Process

- ◆ **Matrix of tasks**
- ◆ **Individual Tasks:**
 - **Safety analyses**
 - **System/component impacts**
 - **Programs**
 - **Task Evaluations**



Evaluation Control Process

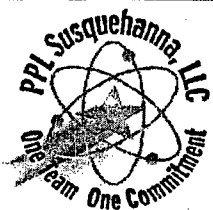
- ◆ **Task Evaluations controlled process**
 - **Design Input Requests**
 - **Task Scoping Documents**
 - **Task Reports**
 - **PUSAR**

- ◆ **Tasks performed by external and internal organizations**
 - **Similar task evaluation control process used for EPU-related work**



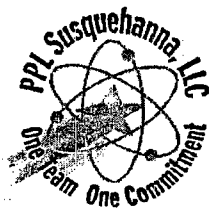
Evaluation Control Process

- ◆ **Task evaluations become PPL calculations**
- ◆ **Audits of organizations' evaluations will be performed**



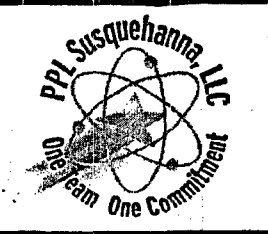
Approach for Fuel Dependent Analyses In the Safety Analysis Report

- ◆ **Both SSES Units contain full cores of Framatome ATRIUM-10 fuel. Framatome fuel used for almost two dozen cycles of operation**
- ◆ **GE LTRs will not be used as the basis for fuel related analyses**
- ◆ **Fuel dependent safety analysis basis and applicability of the methods for EPU conditions provided for the analyses**



Approach for Fuel Dependent Analyses In the Safety Analysis Report

- ◆ **Several EPU, NRC and Framatome methodology meetings**
- ◆ **Limiting events for EPU conditions determined by Framatome through evaluation of FSAR events**
- ◆ **Evaluation of transients performed**



Approach for Fuel Dependent Analyses In the Safety Analysis Report

Safety analysis events:

- ◆ **Generator Load Rejection with Bypass Failure**
- ◆ **Feedwater Controller Failure**
- ◆ **Recirculation Flow Run-up**
- ◆ **Loss of Feedwater Heating**
- ◆ **Single Feedwater Pump Trip**
- ◆ **Loss of All FW flow**
- ◆ **Over Pressurization**
- ◆ **Loss of Coolant Accident**
- ◆ **Control Rod Drop Accident**
- ◆ **Anticipated Transient Without Scram**



Approach for Fuel Dependent Analyses In the Safety Analysis Report

**Reload analysis report for first uprate
core will be available for NRC audit prior
to first EPU power ascension step**



Hybrid Task Approach – ATWS Analysis for ATRIUM-10 Fuel

- ◆ **Apply GE ATWS methodology to Framatome ATRIUM-10 fuel for EPU conditions consistent with past ATWS**
- ◆ **Process controlled as previously discussed -
Design Input Requests and Task Reports**



Hybrid Task Approach – ATWS Analysis for ATRIUM-10 Fuel

- ◆ **ATRIUM-10 thermal hydraulic design and performance data provided to GE to model ATRIUM-10 fuel with GE methods**
- ◆ **Nuclear composition of representative EPU core design provided to GE to model core design with GE methods**
- ◆ **GE ATWS methodology used to produce SSES specific ATWS analysis for ATRIUM-10 fuel**



Process Topics

RS-001

Review Standards for Extended Power Uprate

1. NRC RS-001 Scope and Associated Technical Review Guidance matrices

- **RS-001/CLTR**
- **CLTR based EPU submittal**
- **Correlation matrix of:**
 - ◆ **RS-001 and**
 - ◆ **Submittal**
- **Example RS-001 correlation matrix**

MATRIX 5

SCOPE AND ASSOCIATED TECHNICAL REVIEW GUIDANCE

Plant Systems

| Areas of Review | Applicable to | Primary Review Branch | Secondary Review Branch(es) | SRP Section Number | Focus of SRP Usage | Other Guidance | Template Safety Evaluation Section Number | | Cross Reference to | | |
|---|--|-----------------------|-----------------------------|--------------------------|--------------------|----------------|---|------------|-----------------------|-----------|-------|
| | | | | | | | BWR | PWR | PUSAR | CLTR | OTHER |
| Flood Protection | EPU's that result in significant increases in fluid volumes of tanks and vessels | SPLB | | 3.4.1 Rev. 2 July 1981 | GDC-2 | | 2.5.1.1 .1 | 2.5.1.1 .1 | 10.1.2 SSES NOTE X | 10.1.2 | |
| Equipment and Floor Drainage System | EPU's that result in increases in fluid volumes or in installation of larger capacity pumps or piping systems | SPLB | | 9.3.3 Rev. 2 July 1981 | GDC-2 GDC-4 | | 2.5.1.1 .2 | 2.5.1.1 .2 | 8.1 SSES NOTE X | 8.1 | |
| Circulating Water System | EPU's that result in increases in fluid volumes associated with the circulating water system or in installation of larger capacity pumps or piping systems | SPLB | | 10.4.5 Rev. 2 July 1981 | GDC-4 | | 2.5.1.1 .3 | 2.5.1.1 .3 | 6.4.2 SSES NOTE X | 6.4.2 | |
| Internally Generated Missiles (Outside Containment) | EPU's that result in substantially higher system pressures or changes in existing system configuration | SPLB | EMCB EMEB | 3.5.1.1 Rev. 2 July 1981 | GDC-4 | | 2.5.1.2 .1 | 2.5.1.2 .1 | 7.1, 10.1 SSES NOTE X | 7.1, 10.1 | |
| Internally Generated Missiles (Inside Containment) | EPU's that result in substantially higher system pressures or changes in existing system configuration | SPLB | EMCB EMEB | 3.5.1.2 Rev. 2 July 1981 | GDC-4 | | 2.5.1.2 .1 | 2.5.1.2 .1 | 10.1 ADD SSES NOTE X | 10.1 | |



Process Topics (cont.)

2. RS-001 BWR Template Safety Evaluation

- **Mark-ups (as required)**
- **Susquehanna GDC plant**

**NUCLEAR REGULATORY COMMISSION
EXTENDED POWER UPRATE
PRE-SUBMITTAL MEETING**

SUSQUEHANNA STEAM ELECTRIC STATION

STARTUP TESTING / LARGE TRANSIENT TESTING

11/21/2005



PPL SUSQUEHANNA EXTENDED POWER UPRATE

Plant Overview / Uprate History & Plans

PLANT OVERVIEW

- ◆ Two Unit Site - Berwick, Pa. (Northeast Pa.)
- ◆ BWR-4, Variable Speed Reactor Recirculation Pumps
- ◆ Mark II Pressure Suppression Containment
- ◆ Natural Draft (Closed Loop) Cooling Towers
- ◆ Commercial Operation: Unit 1 – July 1983
Unit 2 – February 1985

SUSQUEHANNA STEAM ELECTRIC STATION (SSES) POWER UPRATE HISTORY / PLANNED

- ◆ Original Licensed Thermal Power: **3293 MWth** (OLTP)
- ◆ Stretch Uprate: ~ 4.5% Thermal Increase To **3441 MWth** / 1993 – 1994 Timeframe
- ◆ Feedwater Measurement Uncertainty Recapture (MUR) Uprate: ~ 1.6% Thermal Increase To **3489 MWth** - Current Licensed Thermal Power (CLTP) / 2002 – 2003 Timeframe
- ◆ Turbine Retrofit Project (TRP): No Thermal Power Increase - ~ 50 MWe Increase / 2003 – 2004 Timeframe
- ◆ Extended Power Uprate (EPU) Project Current Plan
 - Currently At ~ 106% Of OLTP
 - Planning On Licensing Up To The Full 120% Of OLTP
 - Each Unit's Uprate To Be Implemented Over 2 Fuel Cycles
 - Unit 2 1st Step (~ 7% Thermal) - Spring 2007
 - Unit 1 1st Step (~ 7% Thermal) - Spring 2008
 - Unit 2 2nd Step (Generator Limited To 1300 MWe) - Spring 2009
 - Unit 1 2nd Step (Generator Limited To 1300 MWe) - Spring 2010
 - Normal Anticipated Power Level For Most Of The Year: ~ 116 – 117 % OLTP

PPL SUSQUEHANNA EXTENDED POWER UPRATE

Startup Testing / Large Transient Testing

◆ CLTR is Basis for Power Ascension and Startup Testing at SSES

- CLTR Testing Requirements are Similar to NRC Approved ELTR Testing Requirements with the Exception of the Elimination of Large Transient Testing
- CLTR Provides for a Stepped Approach to Power Ascension
- CLTR Testing Accepted by NRC Staff Except for Elimination of Large Transient Testing (LTT)
- CLTR SER Allows LTT Exemptions to be Considered on Plant-by-Plant Basis
- SSES CPPU Testing is Described in Power Uprate Safety Analysis Report (PUSAR) and License Change Request (LCR) Testing Attachment
- SSES LTT Exemption Justifications Provided in Testing Attachment
 - NRC Guidance for Exemptions Justifications per SRP 14.2.1

◆ SSES CPPU License Change Request: PUSAR / Testing Attachment

- Complies with SRP 14.2.1 Guidance
 - Comparison to Startup Testing
 - Evaluates Attachments to SRP 14.2.1
- Includes CPPU Post-Modification Testing
 - Aggregate Impact of Modifications
 - Integrated Operation of Multiple Structures, Systems, and Components
- Provides Justifications for Exemptions from Large Transient Testing
 - Feedwater Pump Trip
 - Condensate Pump Trip
 - Loss of Feedwater Heating
 - MSIV Closure Events
 - Turbine Trip/Generator Load Rejection
 - Recirculation Pump Trip
 - Relief Valve Testing
 - RCIC Functional Testing
 - HPCI Functional Testing
- Describes Operator Training/Large Transient Simulations on SSES Simulator
- Contains Large Transient Testing Risk Assessment
- Attaches Tabular Data
 - Startup Testing Comparison Tables
 - All Original Startup Tests
 - 4.5% Uprate (1993 to 1995)
 - CPPU
 - Post-Modification Testing Tables
 - Planned CPPU Power Ascension Testing Tables

PPL SUSQUEHANNA EXTENDED POWER UPRATE

Startup Testing / Large Transient Testing

◆ Current Status of LTT Exemption Justification

- Work in Progress/Best Estimates of Conclusions
 - Exemptions will be Technically Justified
 - Current Rationale Includes:
 - Events are well documented
 - EPU profiles are comparable
 - Gains do not justify the risks
 - Advanced analytical methods are applicable to EPU conditions

◆ Other Discussion Topics

- Two-step uprate
 - Full complement of tests for first step
 - Full complement of tests after second step
 - Full Power is defined as 95% to 100%
- RFP trip or condensate pump trip may cause Unit trip under some conditions
 - FW flow margin about 7% after first step increase (10% today)
 - Parametric studies being performed by NSSS Vendor
 - MELLLA+ operation makes these transients more susceptible to Unit trip
 - Administrative limits on low water level may result in a pre-emptive trip
- Steam Dryer Performance and Structural Testing
 - Stepped approach to power ascension
 - Moisture carryover and acoustic loading criteria included in acceptance criteria

◆ **SUMMARY**

- Testing per CLTR Test Program
- Testing Attachment will Supply Justification for LTT Exemptions
- Testing Attachment will Demonstrate Compliance with SRP 14.2.1
- Testing Exemptions will be Technically Justified
- Steam Dryer testing similar to recent submittals
- Change in Licensing Basis for Condensate and Feedwater Pump Trips in LCR