From: Alan Wang
To: Jared Wermiel
Date: Fri, Jan 17, 2003 9:49 AM
Subject: Re: 1/22 meeting on GE Revised Chapter 1 of CPPU Topical

Sorry about that. Here is the attachment

CC: Brian Benney; Ralph Caruso; Stephen Dembek; William Ruland

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Subject:	Re: 1/22 meeting on GE Revised Chapter 1 of CPPU Topical
Creation Date:	Fri, Jan 17, 2003 9:49 AM
From:	Alan Wang
Created By:	ABW@nrc.gov

Recipients

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1.0 INTRODUCTION

Previously, General Electric (GE) submitted a set of generic guidelines to be met and a general approach to be followed for plants that extended reactor thermal power up to 120% of their original licensed thermal power. These guidelines and subsequent evaluations were based on the assumption that the maximum operating reactor pressure also would be increased. These guidelines and evaluations, together with associated Nuclear Regulatory Commission (NRC) position and Safety Evaluation Reports, are provided in References 1 and 2 (ELTR 1/2) and have been applied to all extended power uprate submittals since their NRC approval.

Subsequent to the submittal of these licensing topical reports for approval, GE has developed a different approach to uprating reactor power. This approach maintains the current plant maximum operating reactor pressure. The power uprate with no pressure increase has been utilized at several plants and will be pursued for most of the future power uprate applications. GE's current experience base with power uprate is provided in Table 1-1. By performing the power uprate with no pressure increase, there is a substantially smaller effect on the plant safety analysis and system performance. This constraint allows a more streamlined approach to power uprate analyses and evaluations.

The purpose of this Licensing Topical Report (LTR) is to document the approach to be followed and provide the basis for future Constant Pressure Power Uprate (CPPU) applications. The overall approach has been streamlined consistent with the constant pressure assumption. In addition, experience with previous power uprate applications, new generic evaluations, and the standard reload analysis process, have been factored into the overall approach to simplify the required plant specific documentation while maintaining a rigorous and systematic licensing and safety evaluation. Further, the focus of the evaluation has been placed on the safety evaluations required for power uprate to allow for a more comprehensive and streamlined review process.

For this report, it is assumed that the only change to the plant licensing and design basis is an increase of up to 20% in the plant 100% Original Licensed Thermal Power (OLTP). The following constraints assure that the CPPU effects are properly quantified and the basis for the dispositions in this report is preserved:

- No change in the current maximum normal operating reactor dome pressure,
- No change in the maximum licensed core flow,
- ARTS/MELLLA or MEOD power flow map expansion must precede the CPPU,
- Maximum Extended Load Line Limit Analysis Plus (MELLLA+) power flow map expansion must follow the CPPU,
- No change to source term methodology,
- Use of approved GE fuel designs through GE 14,
- No increase in operating cycle length, and
- No additions to currently licensed margin improvement or operating flexibility options.

Deleted: To further enhance the evaluation and review associated with the CPPU approach, changes other than the thermal power increase are minimized and may be separately submitted for NRC approval, as required. Therefore, for

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The CPPU analyses and evaluations provided in the plant specific submittal will be performed consistent with the current license basis of the plant and include all previously submitted applicable license amendment requests pending NRC approval. The CPPU operating map is an extension of the current MELLLA or MEOD operating map. Therefore, this report is applicable only to plants that are licensed to operate with the MELLLA or MEOD operational margin improvement option. A typical power/flow map showing the CPPU change in allowable operating conditions is shown on Figure 1-1.

Changes to the plant licensing and design basis necessary to support the licensing of the power uprate will be reported and justified in a plant specific power uprate submittal. The plant specific submittal will include changes to the analysis basis methodology identified in References 1 and 2 unless this methodology is revised by this report. Applicable new methods that are approved by the NRC independent of this LTR may be used after this approval is received.

Because of the reduced effect of a CPPU on many safety evaluations, a number of generic evaluations are provided to support the plant specific submittals. In addition, some generic assessments from References 1 and 2 can be utilized because they bound the effect of the CPPU approach. This report provides the results of these evaluations, assessments, and dispositions for NRC approval, thus simplifying the plant specific NRC review required for each new CPPU submittal.

To further simplify future NRC reviews of plant specific CPPU submittals, the format of the Power Uprate Safety Analysis Report (PUSAR) to be used for each plant specific CPPU submittal will be based on the format of this report. The PUSAR is based on the above assumptions and includes consideration of the evaluations, assessments, and dispositions provided in this report. Any deviations from the bases and evaluations provided in this report will be included and justified in the plant specific submittal and will be summarized in Section 1 of the plant specific submittal. The level of information to be provided for each plant specific submittal and the format for providing that information will be consistent with past extended power uprate submittals. However, for those analyses and evaluations that are generically dispositioned in this report, the plant specific PUSAR is only required to provide the basis for the generic dispositions and confirm the applicability of these generic dispositions for the specific plant application.

In this LTR, the acronym for an assessment or equipment name is typically provided with the first use of the name (a table of acronyms is provided).

1.1 REPORT APPROACH

The report sections correspond to those previously used on plant specific, extended power uprate submittals. Each of the evaluations included in those submittals have been reviewed and assigned one of the two disposition categories:

- Generic assessment
- Plant Specific evaluation

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Deleted: This assumption specifically includes the following plant specific exclusions:¶
¶
<#>No increase in maximum normal operating reactor dome pressure¶
<#>No increase to maximum licensed core flow¶
<#>No increase to currently licensed Maximum Extended Load Line Limit Analysis (MELLLA) or Maximum Extended Operating Domain (MEOD) upper boundaries¶
<#>No change to source term methodology¶
<#>No new fuel product line introduction¶
<#>No change to fuel cycle length¶
<#>No additions to currently licensed operational enhancements¶
¶

Comment: Page: 1
GE-74 RLH Added "and will be summarized in Section 1 of the plant specific submittal" from I Nir email

Comment: Page: 1
GE-75 RLH Changed reference to Appendix A since Appendix A was deleted and the acronym list was moved to just prior to Section 1.0

Each top level section of this report begins with a summary disposition table for all of the principal evaluations included in the section. A principal evaluation is a thermal-hydraulic, nuclear, mechanical (e.g., vessel integrity), or system design (e.g., ECCS) analysis or evaluation that is potentially limiting with respect to safety considerations relative to power uprate. Each principal evaluation is included in a separate subsection, which includes a table with the following information:

- Evaluation topic
- Primary effect of CPPU on topic
- Disposition category for the assessment

The justification of the categorization is included after the table. This justification includes current experience with extended power uprate and the basis for the disposition, as applicable.

The technical dispositions are contained in Sections 2 through 10. General information has also been provided in Section 11 to support utility licensing documentation required for the plant specific CPPU submittal. This general information provides a template to the utility for development of the environmental report, plant technical specification changes, and significant hazards assessment. This information is provided for use by the utility, and NRC review is only requested for the level of detail presented. The utility may elect to reference some or all of the information given in Section 11 in the documentation supporting the plant specific licensing CPPU submittal.

The term "Constant Pressure Power Uprate" refers, in this report, to the general approach for power uprate outlined above, including all disposition categories and the exclusions identified in Section 1.0.

1.1.1 Generic Assessments

Generic assessments are those safety evaluations that can be dispositioned for a group or all BWR plants by:

- A bounding analysis for the limiting conditions,
- Demonstrating that there is a negligible effect due to CPPU, or
- Demonstrating that the required plant cycle specific reload analyses are sufficient and appropriate for establishing the CPPU licensing basis.

Bounding analyses may be based upon either a demonstration that previous pressure increase power uprate assessments provided in Reference 1 or 2 are bounding or upon specific generic studies provided for the CPPU. For these bounding analyses, the current CPPU experience is provided along with the basis and results of the assessment. If the generic assessment is fuel design dependent, this assessment is applicable only to GE/GNF fuel designs up through GE 14, analyzed with GE methodology. The effect of CPPU on future GE/GNF fuel designs is addressed during the assessment of the new fuel design consistent with the requirements of Reference 3.

Deleted: If another vendor fuel design is considered as part of the power uprate, fuel design dependent generic assessments will be separately evaluated and justified.

For those CPPU assessments having a negligible effect, the current CPPU experience plus a phenomenological discussion of the basis for the assessment is provided. Reference 1 or 2 is referenced if the information in these reports supports the conclusion of negligible effect. Any plant system design that falls outside of the current experience base for a generic analysis will be addressed in the plant specific submittal.

Some of the safety evaluations affected by CPPU are fuel operating cycle (reload) dependent. Reload dependent evaluations require that the reload fuel design, core loading pattern, and operational plan be established so that analyses can be performed to establish core operating limits. The reload analysis demonstrates that the core design for CPPU meets the applicable NRC evaluation criteria and limits documented in Reference 3.

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Therefore, the reload fuel design and core loading pattern dependent plant evaluations for CPPU operation will be performed with the reload analysis as part of the standard reload licensing process. No plant can implement a power uprate unless the appropriate reload core analysis is performed and all criteria and limits documented in Reference 3 are satisfied. Otherwise, the plant would be in an unanalyzed condition. Based on current requirements, the reload analysis results are documented in the Supplemental Reload Licensing Report (SRLR), and the applicable core operating limits are documented in the plant specific Core Operating Limits Report (COLR).

Generic dispositions for reload analysis assessments are described in the appropriate sections of this report. For these assessments, a phenomenological discussion of the effect of CPPU on the expected analysis results is provided along with the relative experience base and reference to supporting information provided by either Reference 1 or 2.

The applicability of the generic assessments for a specific plant application will be evaluated. The plant specific submittal will either document the successful confirmation of the generic assessment or provide a plant specific evaluation, consistent with Section 1.1.2, if the applicability assessment is unsuccessful.

1.1.2 Plant Specific Evaluation

Plant specific evaluations are assessments of the principal evaluations that are not addressed by the generic assessments described in Section 1.1.1. The relative effect of CPPU on the plant specific evaluations and the methods used for their performance are provided in this report. Where applicable, the assessment methodology is referenced. If a specific computer code is used, the name of this computer code is provided in the subsection. If the computer code is identified in Reference 1, 2 or 3, these documents are referenced rather than the original report.

The plant specific evaluations will be reported in the plant specific submittal consistent with the level of detail of previous extended power uprate submittals or as indicated in this report.

1.2 EFFECT OF CPPU

1.1.3 Operating Domain

The upper bound of the operating domain is defined by the current MELLLA/MEOD upper boundary. The MELLLA/MEOD upper boundary remains unchanged with CPPU in terms of absolute power and core flow, and is extended up to the new 100% core power value.

Ex. 4

effect of CPPU on the other power flow map boundaries is provided in Table 1-2. No other changes in the plant operational flexibility options that affect the operating domain are assumed, as noted in Section 1.0.

1.1.4 Nuclear and Thermal-Hydraulic Evaluations

The change in the power level will affect the plant steady-state heat balance. The typical effect of a 20% increase in reactor power on plant operating parameters is shown in Table 1-3. This table shows the average change and range of heat balance parameter values for representative BWRs over the range of plant sizes and product lines. These results show that the effect of a 20% increase in power with no reactor pressure increase across the BWR fleet is fairly uniform. The plant specific submittal will include a summary of steady state parameters based on the plant specific CPPU heat balance.

Experience has demonstrated that CPPU may have an effect on thermal-hydraulic safety analyses.

Ex4

Ex 4

Several of the other thermal-hydraulic safety analyses can be performed on a generic basis, and the results are documented in this report. The remaining thermal-hydraulic safety analyses require plant specific evaluations. The plant specific evaluation or applicability confirmation will be provided in the plant specific submittal, as applicable.

The nuclear evaluation requirements and criteria for the limits are not changed as a result of CPPU. The shutdown margin and hot excess reactivity requirements identified in Reference 3 remain applicable. CPPU increases the average power density proportional to the power increase and has some effects on the core operating and design flexibility, reactivity characteristics and energy requirements. No changes in the fuel mechanical designs or fuel design limits are required to implement CPPU. The additional energy requirements for power uprate are met by an increase in bundle enrichment, an increase in reload batch size, and/or changes in fuel loading pattern to maintain the desired plant operating cycle length. The power distribution in the core is established to achieve increased core power while satisfying the core operating limits.

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GE-5 JFH Added Proprietary Bar

Ex 4

1.1.5 Mechanical Evaluations

The primary effects that require evaluation for mechanical components are an increase in fluence, reactor internal pressure differences (RIPDs), flow and temperature. Certain evaluations for the mechanical components are performed on a generic basis. However, there are some significant plant specific evaluations that are required. Increased fluence results in increased embrittlement of the reactor pressure vessel (RPV) requiring a plant specific evaluation. An increase in feedwater (FW) flow and temperature will result in an increase of stress and fatigue of the FW nozzle also.

For reactor internals, it is expected that the existing/original design basis loads bounds the CPPU loads;

. For example, an increase in RIPDs results in increased stress and fatigue of RPV internals, including the shroud attachment to the RPV. Increased flow rates of the main steam and FW result in increased vibration of piping; a vibration test program is recommended for these piping components. Flow-induced vibration of the RPV internals will be evaluated. The increase in flow and temperature of the FW and main steam line (MSL) piping will require

Ex 4

1.1.6 System Evaluations

Experience has demonstrated that the effect of CPPU on Nuclear Steam Supply System (NSSS) and Balance Of Plant (BOP) systems is system dependent. Overall, many NSSS and BOP systems are not significantly challenged by CPPU. Where appropriate, a generic disposition is provided for systems that are not significantly affected by CPPU.

For the remainder of the NSSS and BOP safety systems, there is typically sufficient capability that no system modifications are required. This capability is demonstrated by system-specific evaluations. If modifications are required to meet safety requirements, this will be noted in the plant specific submittals.

For BOP power generation systems required for normal operation, modifications (e.g., new turbine rotating elements and condensate or feedwater pump modifications) are typically required to accommodate the increased steam and feedwater flow. These modifications typically affect non-safety related power generating and supporting systems.

Limited Technical Specification setpoint changes are required as a result of CPPU. Typically, setpoint changes are limited to the Neutron Monitoring System, main steamline high flow, and turbine first-stage pressure.

Table 1-1 GE Power Uprate Experience

Plant	Stretch/Extended Power Uprate	Uprate Power (~ % OLTP)	Reactor Dome Pressure Increased
Duane Arnold	SPU	105	Yes
Cofrentes	SPU	105	Yes
Hatch - 1, 2	SPU	105	Yes
Susquehanna - 1, 2	SPU	105	Yes
WNP-2	SPU	105	Yes
Limerick - 1, 2	SPU	105	Yes
Peach Bottom - 2, 3	SPU	105	Yes
Fermi 2	SPU	105	Yes
FitzPatrick	SPU	105	Yes
Brunswick - 1, 2	SPU	105	Yes
NMP-2	SPU	105	Yes
Browns Ferry - 2, 3	SPU	105	Yes
River Bend	SPU	105	Yes
KKM	EPU	114	Yes
KKL	EPU	117	Yes
Laguna Verde - 1, 2	SPU	105	No
LaSalle - 1, 2	SPU	105	No
Perry	SPU	105	No
Hatch - 1, 2	EPU	113	No
Monticello	EPU	106	No
Cofrentes *	EPU	110	No
Duane Arnold *	EPU	120	No
Dresden - 2, 3 *	EPU	117	No
Quad Cities - 1, 2 *	EPU	117	No
Clinton *	EPU	120	No
Brunswick - 1, 2 *	EPU	120	No
Browns Ferry 2, 3 *	EPU	120	No

*In progress.

Table 1-2 Effect of 20% Power Uprate on Power Flow Map Boundaries

Ex. 4

Table 1-3 Change in Plant Operating Parameters for a 20% Increase in Core Thermal Power

Ex 4

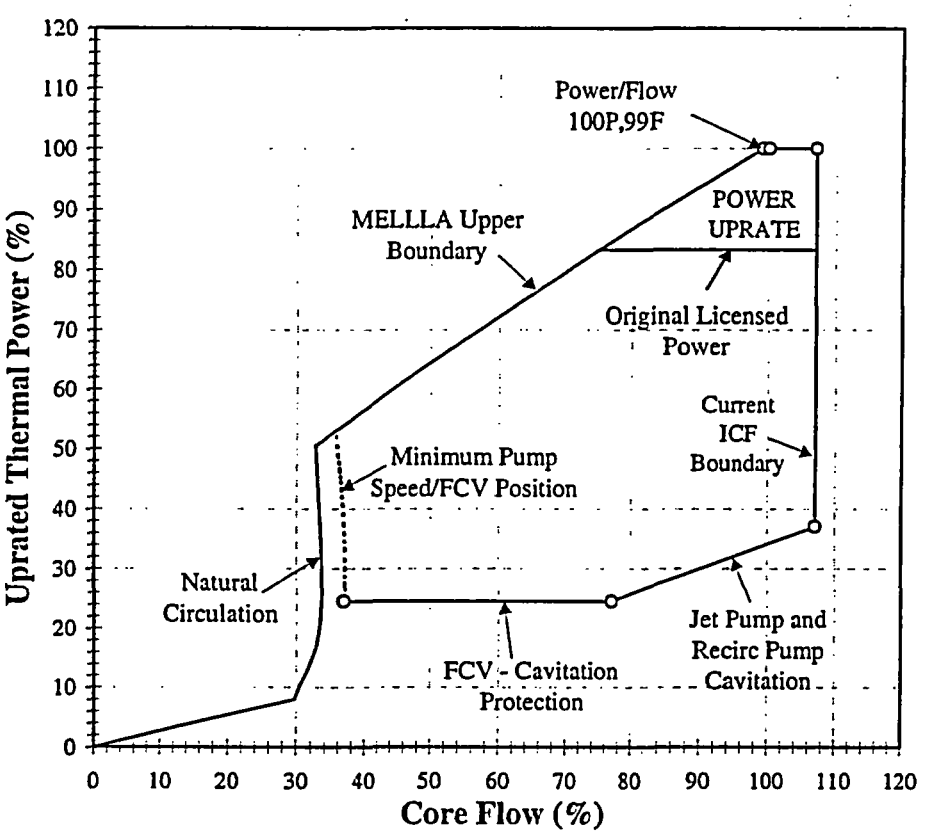

Figure 1-1. Typical CPPU-Based Power Uprate Power/Flow Map

Comment: Page: 11
GE-6 JFH Opened Up Text Boxes