Uprating Westinghouse Plants .8 to 1.1% RTP with Existing or New Feedwater Venturi ΔP Measurement Devices

NRC/Westinghouse Meeting

March 30, 2000

Meeting Agenda

I. Overview and Meeting Purpose

II. Power Calorimetric Uncertainties

III. Relationship to Plant Safety Analyses

IV. Licensing Approach

V. Questions and Wrap-Up

Westinghouse Attendees

Mr. R. Easterling	Manager, Engineering Services Integration
Mr. J. Fasnacht	Technical and Licensing Lead, Safety Analysis Engineering
Mr. R. Tuley	Fellow Engineer, Setpoints

Purpose and Overview

Purpose

- Propose and discuss approach for applying NRC approved and accepted 95/95 uncertainty methodology to facilitate plant power uprate.

- Power Measurement uncertainty based in part on use of existing feedwater flow venturi measurement.

Purpose and Overview (Cont)

Overview of Approach

- Use existing power measurement uncertainty based on NRC approved methodology. For discussion purposes, assume that present uncertainty is x% and is less than 2%.

- Increase plant core power by (2-x)%.

- Safety analyses utilizing nominal full power conditions and statistical combination of uncertainties – evaluate analyses at the new power level.

- Analyses performed at nominal full power conditions – re-evaluate at new power level.

Purpose and Overview (Cont)

Overview of Approach

- Safety analyses performed with a 2% or greater power uncertainty - Do not re-perform analyses. Demonstrate intent of safety analysis is still met since actual power uncertainty is less than 2%.

- Prepare 10 CFR 50.92 evaluation and associated Technical Specification changes to increase plant power by (2-x)%.

Purpose and Overview (Cont)

Key Concepts for Approach

- NRC has accepted and approved methodology for 95/95 uncertainty calculations.
- Regulatory basis for 2% power uncertainty in applicable safety analyses is to solely account for power measurement uncertainty.
- The intent of the applicable safety analyses is also satisfied by other prescribed conservative features and requirements of the NRC approved and licensed evaluation models.

Purpose and Overview (Cont)

Key Concepts for Approach

- Approach is consistent with NRC proposed rule making to modify Appendix K.

Power Calorimetric Uncertainties with Existing or New Feedwater Venturi ΔP Measurement Devices (Cont)

Power Calorimetric Uncertainties - Single Venturi Tap Measurement per Loop

- 3 Loop - 1996 1.1% RTP
- 3 Loop - 1998 1.1% RTP
- 4 Loop - 1999 1.2% RTP
- 4 Loop - 1998 1.1% RTP
- 4 Loop - 1995 1.1% RTP
- 4 Loop - 1996 1.2% RTP

Power Calorimetric Uncertainties with Existing or New Feedwater Venturi ΔP Measurement Devices (Cont)

Power Calorimetric Uncertainties - Two Venturi Tap Measurement per Loop

- 3 Loop - 1996 0.9% RTP
- 3 Loop - 1998 0.9% RTP
- 4 Loop - 1999 1.0% RTP
- 4 Loop - 1998 1.0% RTP
- 4 Loop - 1995 0.9% RTP
- 4 Loop - 1996 1.0% RTP
- 3 Loop - 1998 1.1% RTP

Power Calorimetric Uncertainties with Existing or New Feedwater Venturi ΔP Measurement Devices (Cont)

Calculation Assumptions

- Existing Plant Installed Hardware
- 1 Venturi Tap ΔP Measurement per Loop
- 2 Venturi Tap ΔP Measurements per Loop
- Standard Westinghouse Uncertainty Calculation Methodology (95/95 results and in use in basic form since 1978)
- Consistent with NUREG/CR-3659

Power Calorimetric Uncertainties with Existing or New Feedwater Venturi ΔP Measurement Devices (Cont)

Potential Results - New Hardware

- 3 Loop - 1998 0.8 % RTP
- 4 Loop - 1999 0.8 % RTP

- Feedwater Temperature becomes significant contributor

Power Calorimetric Uncertainties with Existing or New Feedwater Venturi ΔP Measurement Devices (Cont)

Potential Result Assumptions

- Utilize More Accurate Feedwater Venturi ΔP Transmitters
- Incorporate Decreased Rack Drift (supported by plant data)
- Incorporate More Accurate Feedwater Temperature Measurement

Power Calorimetric Uncertainties with Existing or New Feedwater Venturi ΔP Measurement Devices (Cont)

Conclusions

- Westinghouse Uncertainty Calculations Easily Support approximately .8 to 1.1% Calorimetric Power Measurement Uncertainty with **NO** Change in Plant Hardware
- Utilization of More Accurate Feedwater ΔP and Feedwater Temperature Measurement Devices can Result in Total Uncertainty of ~0.8 % RTP or an Uprating of ~1.2 % RTP

Typical Relationship to Safety Analyses

Typical Analyses Performed at Nominal Full Power Conditions

- Evaluate analysis at new power level
- Confirm design basis performance at new power level
  - NSSS fluid systems and applicable components
  - NSSS/BOP interface systems
  - BOP fluid systems
  - NSSS control systems/Class I transients
  - Other plant support systems

Typical Relationship to Safety Analyses (Cont)

Typical Analyses Performed at Nominal Full Power Level

- Confirm acceptable fatigue/stress at new power level
  - Design transient review
  - Applicable NSSS primary and auxiliary support systems

Typical Relationship to Safety Analyses (Cont)

Analyses typically performed at 104.5% power

- No changes needed
- Radiological source term calculations
- Long-term LOCA mass and energy releases

Analyses typically performed at 102% power

- No changes needed
- Appendix K LBLOCA and SBLOCA analyses
- Selected non-LOCA transient analyses
- Long term SLB mass and energy releases
- Selected SGTR analyses

Typical Relationship to Safety Analyses (Cont)

Analyses using nominal full power conditions and statistical uncertainty combinations

- Evaluate analyses at new power level and/or power measurement uncertainty
- Non-LOCA transient - DNB related analyses
- Uncertainty analysis for applicable key safety analysis parameters and protection system setpoints
- Best estimate LBLOCA analysis

Licensing Approach

- Prepare Technical Specification changes
- Submit 10 CFR 50.92 evaluation
- No significant increase in probability or consequences of an accident previously evaluated
- No possibility of a new or different kind of accident from any accident previously evaluated

Licensing Approach (Cont)

- No significant reduction in margin of safety
  - NRC accepted and approved methodology used for 95/95 power measurement uncertainty calculation
  - Analyses appropriately account for power uncertainty measurement
  - Affected analyses have been re-evaluated at revised power level and/or uncertainty
  - Analysis presently performed at 102% power still account for power measurement uncertainties and retain existing conservative assumptions/modeling

Conclusions

- Present uncertainty calculations support a .8 to 1.1% Calorimetric Power Measurement uncertainty with no change to plant hardware

- Utilization of more accurate feedwater ΔP and feedwater temperature measurement devices can result in total uncertainty of approximately .8%

- Licensing approach consistent with NRC approved methodology