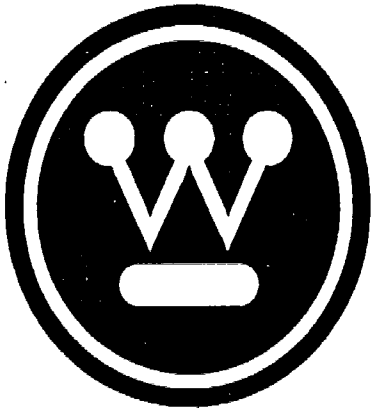

Westinghouse

A BNFL Group company

BEACON™-COLSS Integration

NRC/Westinghouse Meeting
Pittsburgh, PA
August 18, 2004

Introduction

- Westinghouse currently has 2 PWR core monitoring systems with online power distribution and thermal hydraulic models
  - –COLSS (Core Operating Limit Supervisory System)
    - –Last topical on uncertainty methodology approved in 1987
    - –Operating at 12 C-E designed plants (7 in the US)
  - –BEACON™ (Best Estimate Analyzer for Core Operation - Nuclear)
    - –Topical report approved in 1994
    - –Topical report addendums approved in 1999 and 2002
    - –Operating at ~50 W and C-E plant types (25 in the US)

COLSS

- Developed to help maintain selected C-E plant types within LCOs
  - –Digital core monitoring system
  - –Uses data from plant computer with analytical model to determine reactor power, measured power distribution & power operating limits
  - –Provides measured information on DNBR, LHR, ASI, tilt & core power level to verify against Tech. Spec. limits
  - –Displays margin to limits and provide alarms upon approach to limits

BEACON

- Developed to help maintain W, C-E and other PWR plant types within LCOs
  - –Digital core monitoring system
  - –Uses data from plant computer with analytical model to generate measured power distribution
  - –Provides measured information on DNBR, LHR (F_Q), Fr ($F_{\Delta h}$) and ASI (AO) to verify against Tech. Spec. limits
  - –Provides predictive functions for estimated criticality, load maneuvers and reactivity balance calculations
  - –Provides core analysis and incore flux map analysis capability

BEACON-COLSS Project

- Project started in 2002 to merge COLSS and BEACON™ core monitoring systems
  - –Each have some features that are not in the other
  - –Combine the best parts of BEACON & COLSS to develop an upgrade for COLSS

a, c

Functional Design

- BEACON-COLSS Functional Design Requirements

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BEACON-COLSS Overview

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BEACON Measured Power Distribution

- Receives current core information from plant computer

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BEACON Measured Power Distribution

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COLSS Merged Functions

- Core Flow
- Reactor Power Function

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[redacted]

CETOP-D Code

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BEACON-COLSS Product Level

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BEACON-COLSS Uncertainty Methods

a, c

Power Peaking Uncertainty Methodology

- Compares BEACON "measured" results with "true" 3-D results

a, c

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DNBR POL Uncertainty Methodology

- Compares BEACON "measured" results with "true" 3-D results

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Application of Uncertainty Methodology

- Two C-E designed plants analyzed for uncertainties
- Previously analyzed using standard COLSS methods

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Application of Uncertainty Methodology

- Pairs of "true" and "predicted" 3-D power distributions generated with following bounding conditions

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Application for Power Peaking Limits

a, c

Application for Power Peaking Limits

a, c

Application for Power Peaking Limits

a, c

Power Peaking Uncertainty 95/95 UTL

a, c

Application for Power Peaking Limits

I. Measured Power Peaking Factor and Uncertainty a, c

Application of Methodology for DNBR POL

II. DNBR POL and Uncertainty

a, c

Results for LHR POL

Plant A Measured LHR Uncertainty 95/95 UTL

a, b, c

Results for LHR POL

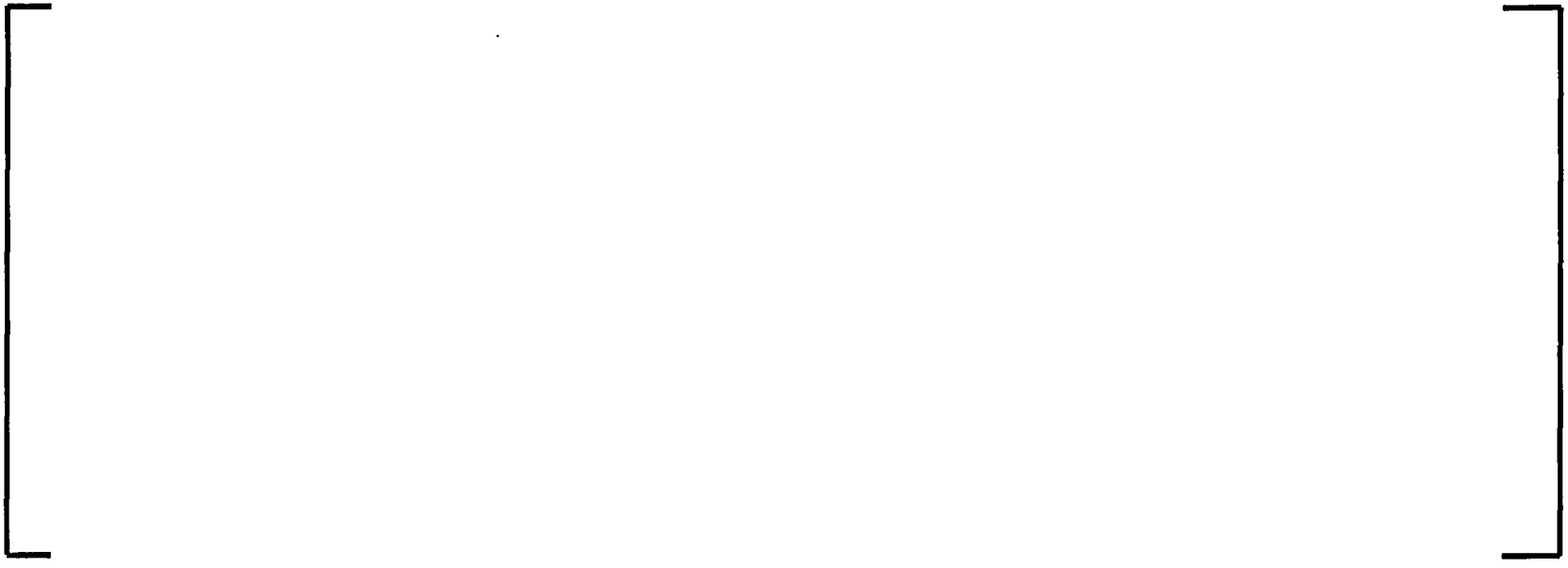
Plant B Measured LHR Uncertainty 95/95 UTL

a, b, c

Results for LHR POL

- Comparison of LHR POL total uncertainty from standard COLSS method and BEACON-COLSS method
- Comparison made with 2.0 % ICI variability and 40 % ICI detectors deleted

a, b, c



Application of Methodology for DNBR POL

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Application of Methodology for DNBR POL

a, c

Application of Methodology for DNBR POL

a, b, c

Application of Methodology for DNBR POL

a, c

Application of Methodology for DNBR POL

a, c

Application of Methodology for DNBR POL

- Shift distribution until positive with 95/95 UTL a, c

Uncertainty of DNBR POL

a, c

Application of Methodology for DNBR POL

I. DNBR POL and Uncertainty

a, c

Application of Methodology for DNBR POL

II. DNBR POL and Uncertainty

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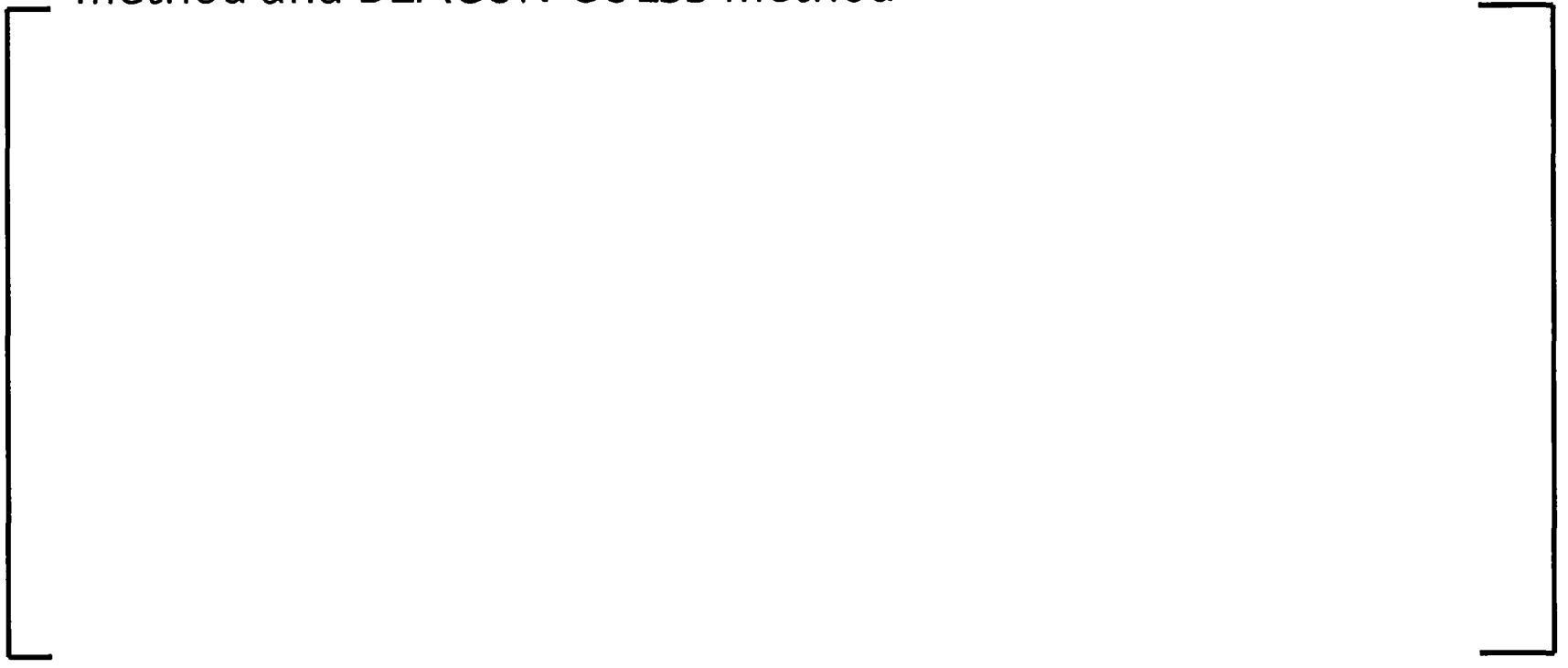
Results for DNBR POL

- Comparison of DNBR POL uncertainty from standard COLSS method and BEACON-COLSS method

a, b, c



Technical Specification Modifications

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Technical Specification Modifications

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Technical Specification Modifications

[a, c]

Westinghouse Licensing Submittal

- Submit licensing document as Addendum 3 to the BEACON Topical Report for COLSS application

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Status / Schedule

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