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### Potential BELOCA Upgrades Under Consideration by Westinghouse

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### **Meeting Objectives**

- Review BELOCA Initiatives Under Consideration
- Discuss Regulatory Interpretations Supporting Implementation
- Present Target Schedule
- Solicit NRC Feedback/Concurrence

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### Current W BELOCA Methodology

- Approved by USNRC in 1996 for 3-/4-loop plants with cold leg ECCS injection (WCAP-12945-P-A)
- Patterned after CSAU (NUREG/CR-5249)
- Based on <u>WCOBRA/TRAC</u> computer code
- Code validation against ~ 100 experiments used to define code model uncertainty distributions
- Uncertainty methodology uses response surfaces, Monte Carlo sampling techniques

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## Extension to 2-loop Plants with Upper Plenum ECCS Injection

#### Approved by USNRC in 1999 (WCAP-14449-P-A)

- Code validation against 10 additional experiments used to define UPI-specific code model uncertainty distributions
- Uncertainty methodology used response surfaces, Monte Carlo sampling techniques





## Westinghouse Monitoring of Industry Developments

Several Interesting Concepts Published at International Conferences (e.g., Barcelona and BE-2000 in 2000)

- Non-parametric statistical methods
- Uncertainty method based on accuracy extrapolation
- Code internal assessment of uncertainty





### CSNI-Sponsored Comparative Study (BE-2000)

#### **Contributions from 5 European countries**

- England (AEA Technologies, using RELAP5/MOD3.2)
- France (IPSN, using CATHARE 2)
- Germany (GRS, using ATHLET )
- Italy (University of Pisa, using RELAP5/MOD2 & CATHARE 2)
- Spain (ENUSA, using RELAP5/MOD3.2)





### GRS Method Has Features Attractive to <u>W</u>

#### Simultaneous Variation of All Uncertainty Parameters

- Eliminates need for response surfaces
  - Reduce analysis focus on extreme conditions
  - Eliminates need to track multiple time periods (BD, R1, R2)
- Eliminates need for "superposition" correction factor and uncertainty
- Can be automated, reducing data transfer and calendar time
- Future reanalyses much easier

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### Challenges, Unknowns

### Significant Effort Required for Automation

- Steady state balancing
- Automated restart

#### Cost/benefit analysis unclear

- PCT margin?
- Licensing costs?

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### <u>W</u> Expectations of Scope of USNRC Review

### Focus Should be on Revisions to Uncertainty Methodology

- No need to revisit approved computer code models, correlations
- No need to revisit approved uncertainty distributions (break flow rate, heat transfer coefficients, etc.)
- <u>W</u> recognizes that some exceptions may be warranted
- Any Requests for Revised Regulatory Interpretations also Would Warrant Additional Scrutiny

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# Revised Regulatory Interpretations Under Consideration (EMF-2103(NP))

### **Treatment of Limiting Break Type & Size**

- Current <u>W</u> method uses deterministic approach
  - Limiting split break size defined via break spectrum
  - Limiting break type determine by uncertainty analysis
- Random sampling of break type and size expected to reduce 95<sup>th</sup> percentile PCT ~ 200+°F
- Regulatory guidance in10 CFR 50.46(a)(1)(i) and Reg Guide 1.157 will need to be interpreted/considered

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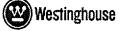


#### **Guillotine Break Size**

- Current <u>W</u> method uses nominal break area (total A =  $2A_{CL}$ ), with break flow uncertainty based on Marviken
- Reduced break flow typically benefits 4-loop plants

   Ranging of DEGB area from A<sub>CL</sub> 2A<sub>CL</sub> expected to reduce 95th percentile PCT
- Justification for reduced DEGB break size will need approval

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#### Split Break Analyses

- Current <u>W</u> method identifies limiting split break size up to total area =  $2A_{CL}$
- No break flow uncertainties applied to limiting split break
- Random sampling of break flow sizes from 0.1A<sub>CL</sub> A<sub>CL</sub>, and application of Marviken-based uncertainties, expected to substantially reduce 95th percentile PCT
- Reg Guide 1.157 will need to be interpreted/considered
- Justification for applying uncertainties will need approval

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### Limiting Time in Life

- Current <u>W</u> method uses limiting point in life (max stored energy)
- Pellet-cladding gap closure during first cycle can reduce initial fuel temperatures by ~ 300+°F

– PCT reduction on the order of 100°F

• Reg Guide 1.157 will need to be interpreted/considered

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### Limiting Time in Life (cont'd)

- Current <u>W</u> method assumes worst FQ, worst axial shape, lowest local peaking can occur at limiting burnup
- Use of typical core depletions to generate BU-dependent values consistent with stored energy would reduce 95th percentile PCT further
- Justification for not performing cycle-specific analyses will need approval

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### **Cladding Deformation Effects**

- Current <u>W</u> method accounts for swelling, rupture, blockage and pellet fragment relocation
- Low probability cases likely to benefit from use of nominal cladding dimensions throughout transient
- Reg Guide 1.157 and GI-92 will need to be interpreted/considered
- Future results of planned research programs will need to be considered (ANL, Halden, PHEBUS)

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#### **Offsite Power Availability**

- Current <u>W</u> method identifies limiting assumption
- Random sampling of availability assumption would reduce 95th percentile PCT
- GDC-35, 10 CFR 50.46 and Reg Guide 1.157 will need to be interpreted/considered





### Target Schedule

Phase 1 Feasibility (95/50, no automation)CompletePhase 2 Feasibility (automation)9/30/02Methodology/Regulatory Decisions10/31/02Submittal12/31/02RAIs Issued by NRCTBDW Resolves RAIsTBD + 2 moSERTBD + 4 mo

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### Summary

- Potential Upgrades to <u>W</u> BELOCA Uncertainty Methodology Currently Focused on GRS Method
- Cost/Benefit a Key Consideration for Implementation
- Regulatory Interpretations Affecting PCT Margin Generation Have Significant Effect on Cost/Benefit
- NRC Review Should be Facilitated by Strategy to Not Alter Existing Models/Correlations, or Uncertainty Distributions

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