Westinghouse

A BNFL Group company

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

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 WCOBRA/TRAC computer code
- Code validation against ~ 100 experiments used to define code model uncertainty distributions
- Uncertainty methodology uses response surfaces, Monte Carlo sampling techniques

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 W

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

Challenges, Unknowns

Significant Effort Required for Automation

- Steady state balancing
- Automated restart

Cost/benefit analysis unclear

- PCT margin?
- Licensing costs?

W 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.)
- W recognizes that some exceptions may be warranted

Any Requests for Revised Regulatory Interpretations also Would Warrant Additional Scrutiny

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

Treatment of Limiting Break Type & Size

- Current W 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 95th percentile PCT ~ 200+°F
- Regulatory guidance in10 CFR 50.46(a)(1)(i) and Reg Guide 1.157 will need to be interpreted/considered

Revised Regulatory Interpretations Under Consideration (cont'd)

Guillotine Break Size

- Current W 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_{CL} - $2A_{CL}$ expected to reduce 95th percentile PCT
- Justification for reduced DEGB break size will need approval

Revised Regulatory Interpretations Under Consideration (cont'd)

Split Break Analyses

- Current W 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 $0.1A_{CL}$ - A_{CL}, 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

Revised Regulatory Interpretations Under Consideration (cont'd)

Limiting Time in Life

- Current W 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

Revised Regulatory Interpretations Under Consideration (cont'd)

Limiting Time in Life (cont'd)

- Current W 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

Revised Regulatory Interpretations Under Consideration (cont'd)

Cladding Deformation Effects

- Current W 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)

Revised Regulatory Interpretations Under Consideration (cont'd)

Offsite Power Availability

- Current W 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)	Complete
Phase 2 Feasibility (automation)	9/30/02
Methodology/Regulatory Decisions	10/31/02
Submittal	12/31/02
RAIs Issued by NRC	TBD
W Resolves RAIs	TBD + 2 mo
SER	TBD + 4 mo

Summary

- Potential Upgrades to W 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