



**BEST ESTIMATE SMALL BREAK LOCA METHODOLOGY FOR
IP2**

PRESENTED BY

ENTERGY NUCLEAR OPERATIONS

AND

WESTINGHOUSE

FEBRUARY 13, 2003

ROCKVILLE, MARYLAND



AGENDA

- Introduction
- Background and Schedule
- Overview BE SBLOCA Methodology
- Technical Approach for WCAP-14936 (PROPRIETARY)
 - Code Scaling, Applicability, and Uncertainty (CSAU) methodology
 - Comparison to Best Estimate Large Break LOCA Methodology (previously reviewed and approved by NRC)
 - Code Revisions and Validation
 - Results for Indian Point 2
 - Statistical Methodology
 - Conclusions
 - Questions and Discussion



BACKGROUND

- 1996
 - NRC approves BE LBLOCA methodology (June)
 - Con Ed contracts Westinghouse to develop BE SBLOCA methodology (June)

- 2001
 - Westinghouse completes BE SBLOCA development (August)
 - Con Ed submits WCAP-14936 for NRC review and approval (August)
 - Entergy suspends request for NRC review (September)

- 2002
 - Entergy initiates project for Power Uprate of IP2 to 3216 MWt (November)

- 2003
 - Entergy re-submits WCAP-14936 for NRC review and approval (January)
 - Kick-off meeting with the NRC (February)



Appendix K versus Best Estimate

- Appendix K SBLOCA at 3071MWt

$$\text{PCT} = 2116^{\circ}\text{F}$$

- BE SBLOCA at 3216 MWt

$$\text{PCT} = 1328^{\circ}\text{F}$$

Best Estimate Small Break LOCA Methodology

Overview

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BESBLOCA Overview

Best Estimate Small Break LOCA Program

- Westinghouse received approval of its best estimate large break LOCA methodology in 1996.
- The same advanced T/H code, WCOBRA/TRAC, has been applied to small break LOCA analysis.

Program Major Objectives

- Develop and license a best estimate small break methodology generically applicable to conventional Westinghouse 3- and 4-loop PWRs.
- Perform a plant specific application for Indian Point Unit 2.

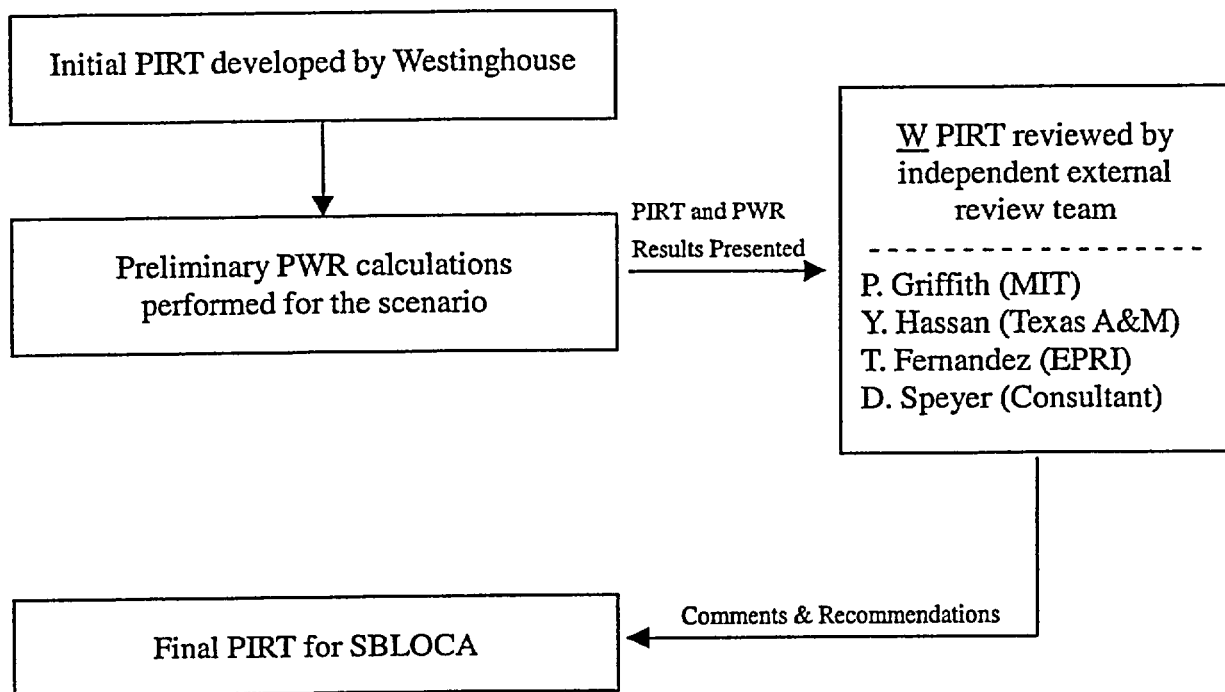
BESBLOCA Overview

Code scaling, applicability and uncertainty (CSAU) approach followed:

- Westinghouse review of NUREG/CR-5249 concluded that the CSAU approach is generically applicable to many types of problems.
- NRC has provided some guidance applicable to SBLOCA events in Reg. Guide 1.157.
 - Specific concerns (Reg. Guide 1.157) include consideration of system-wide inventory distribution, break location & orientation, operating state of RCPs.
 - Some important phenomena also identified in Reg. Guide 1.157, including level swell, “reflux,” and heat transfer to uncovered core.

BESBLOCA Overview

PIRT Process for Best Estimate Small Break LOCA



BESBLOCA Overview

PIRT for Small Break Processes

SBLOCA transient is composed of five periods:

- **Blowdown Period:** Short initial period as RCS depressurizes to near-equilibrium condition with the secondary.
- **Natural Circulation Period:** Break flow continues to be low quality and system drains from top – down. Heat transfer is from primary to secondary.
- **Loop Seal Clearance Period:** Loop seal(s) begin to vent and break quality becomes high. Heat transfer reverses, as secondary becomes a heat source.
- **Boil-Off Period:** Vessel inventory boils away and core uncover can occur while RCS depressurization continues. Minimum inventory and PCT typically occur at the end of boil-off period.
- **Recovery Period:** Vessel inventory increases as SI flows exceed break flow. PCT is decreasing.

Rankings assigned as:

H (high), M (medium), L (low), N/A (not applicable)

BESBLOCA Overview

Indian Point 2 BE SBLOCA Analysis 3-INCH CL BREAK WITH LOOP Reactor Vessel Mass

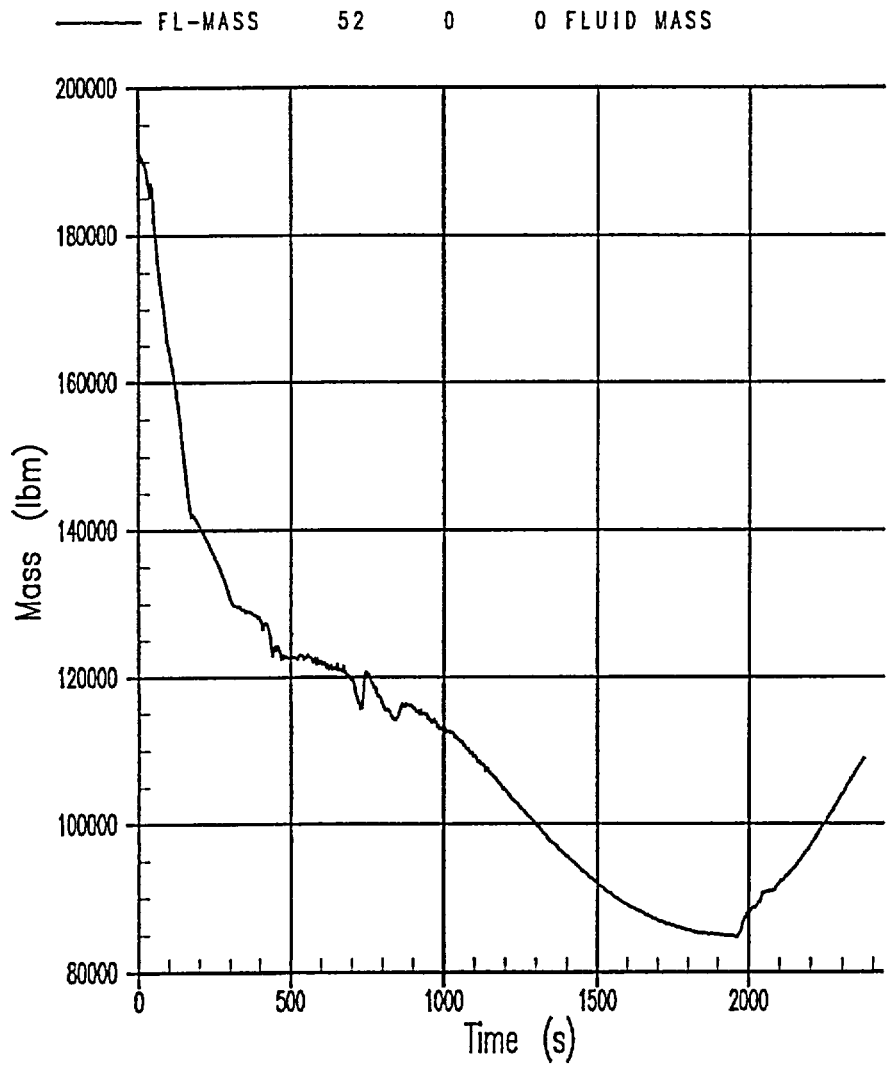


Figure 27-2-5. Reactor Vessel Mass, 3-Inch Break with LOOP

BESBLOCA Overview

Indian Point 2 BE SBLOCA Analysis 3-INCH CL BREAK WITH LOOP Peak Cladding Temperature

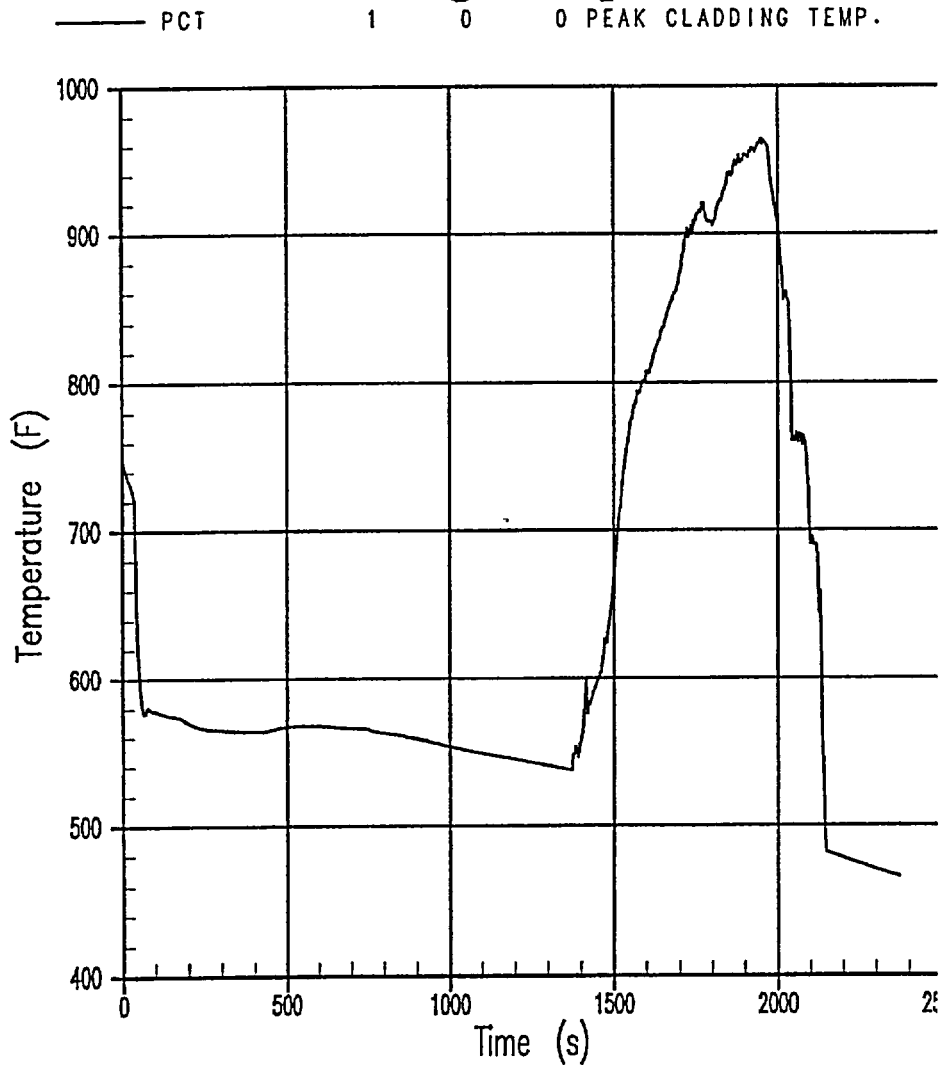


Figure 27-2-6. PCT, 3-Inch Break With LOOP