

ENCLOSURE 2

BWROG-09091

Redacted Presentation

Non-Proprietary Information

IMPORTANT NOTICE

Enclosure 2 is a non-proprietary version of the Draft Technology Update Presentation from Enclosure 1, which has the proprietary information removed. Portions that have been removed are indicated by open and closed double brackets as shown here [[]].



NRC / BWROG Meeting

BWR LOCA Long Term Cooling Fuel Effects to Debris Blockages

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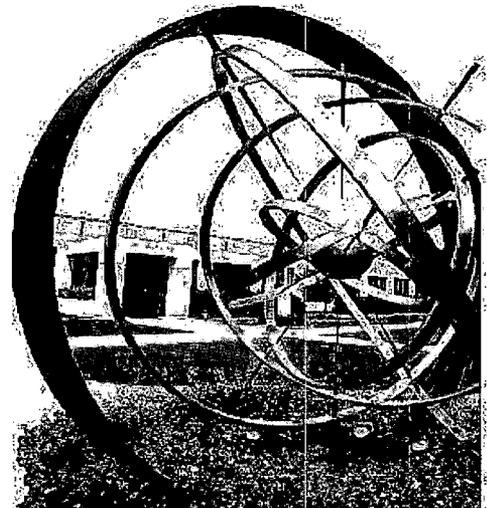
Curt Robert
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GE-Hitachi

October 21, 2009



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Agenda

- Review of Previous Presentation (~10 min)
 - Limiting LOCA Scenario Selection
 - Limiting Bundle Blockage Case
- TRACG LOCA Simulation Results (~ 25 min)
 - Sensitivity of PCT to Blockage Scenarios
 - Reference Limiting Case for Long Term Cooling
- Maximum Blockage Criteria (~ 10 min)
 - Lower Tie Plate Grid
 - Spacers and Upper Tie Plate Grid
- Boundary Conditions for Fuel Testing (~ 10 min)
 - Bottom Reflood
 - Natural Circulation
 - Bypass Region Refill
 - Top Channel Downflow



Review of Previous Presentation

TRACG-LOCA Simulation Results

Maximum Elongation Criteria

Boundary Conditions for Fuel Temperature

Review of Previous Presentation

Limiting LOCA Scenario Selection

- Largest Pipe Break
- Early Uncovery and Late Recovery

Debris Flow Paths

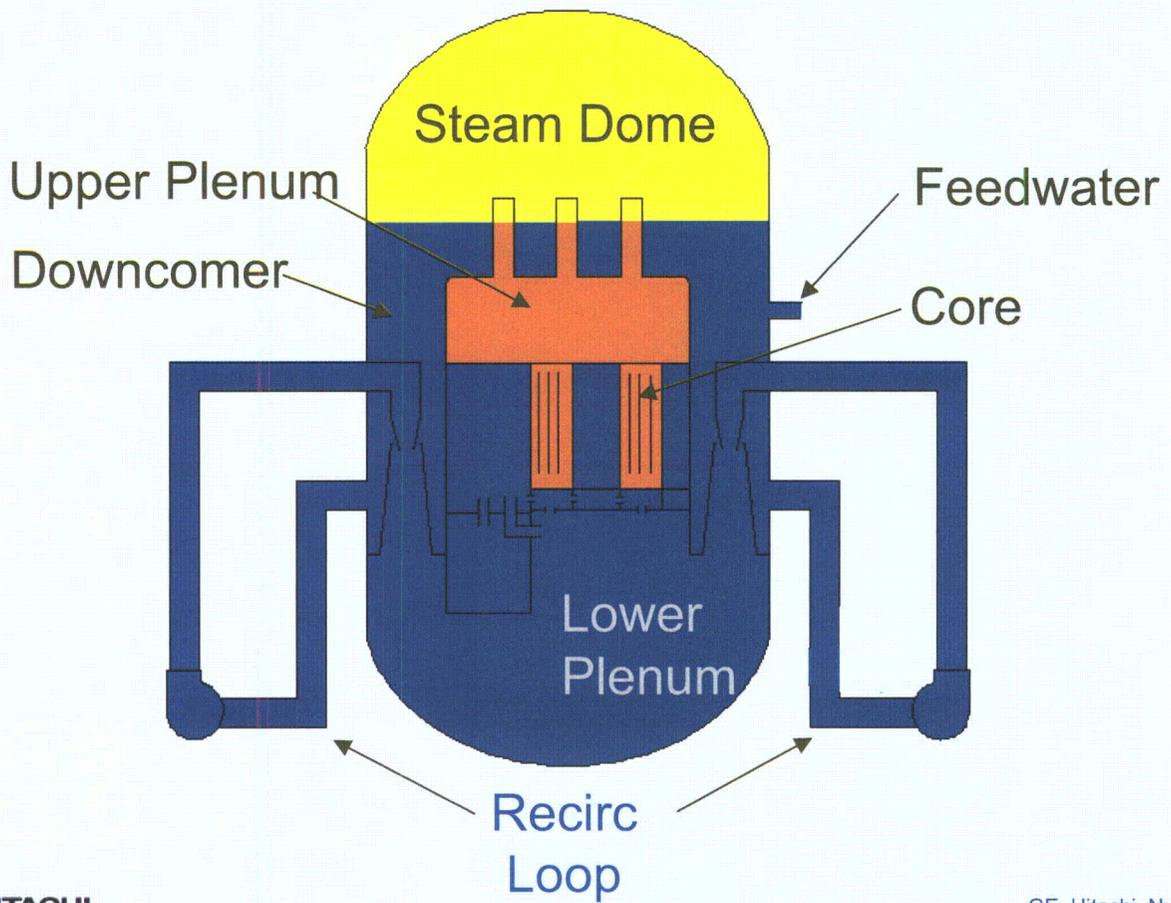
- Level and Bypass Refill, Secondary Effects
- Inlet Natural Circulation, Short Term
- Outlet Downflow, Long Term

Limiting Bundle Blockage Case

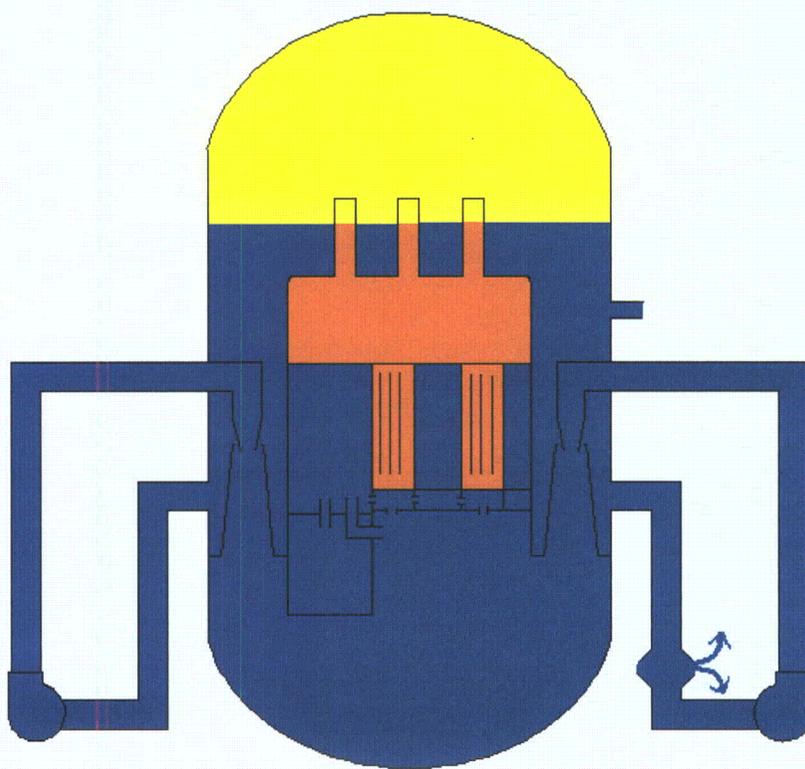
- Full Blockage at Inlet
- Partial Blockage at Exit



Typical BWR Normal Operation

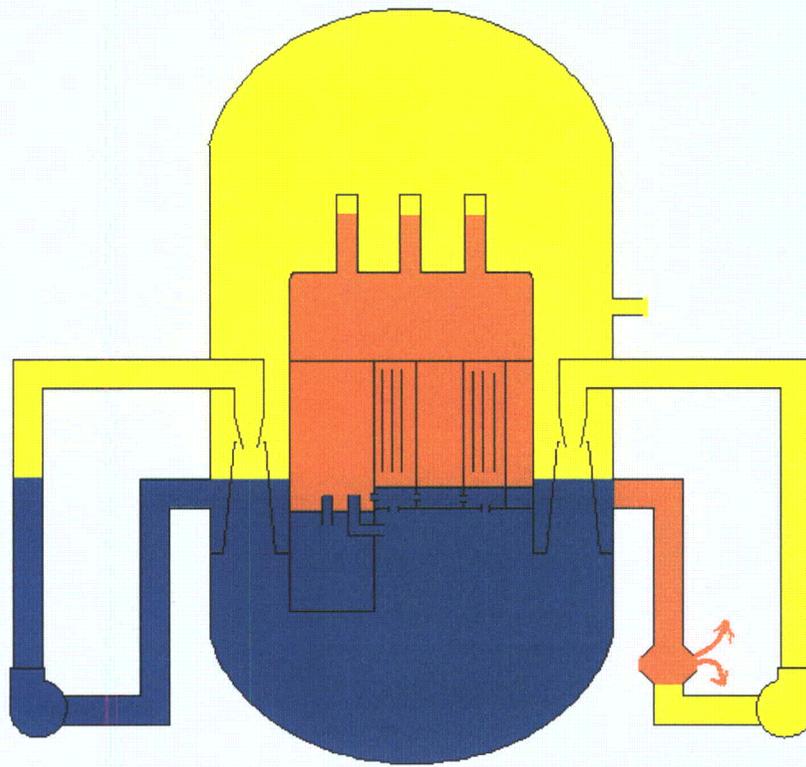


BWR LOCA Event – Initial Pipe Rupture



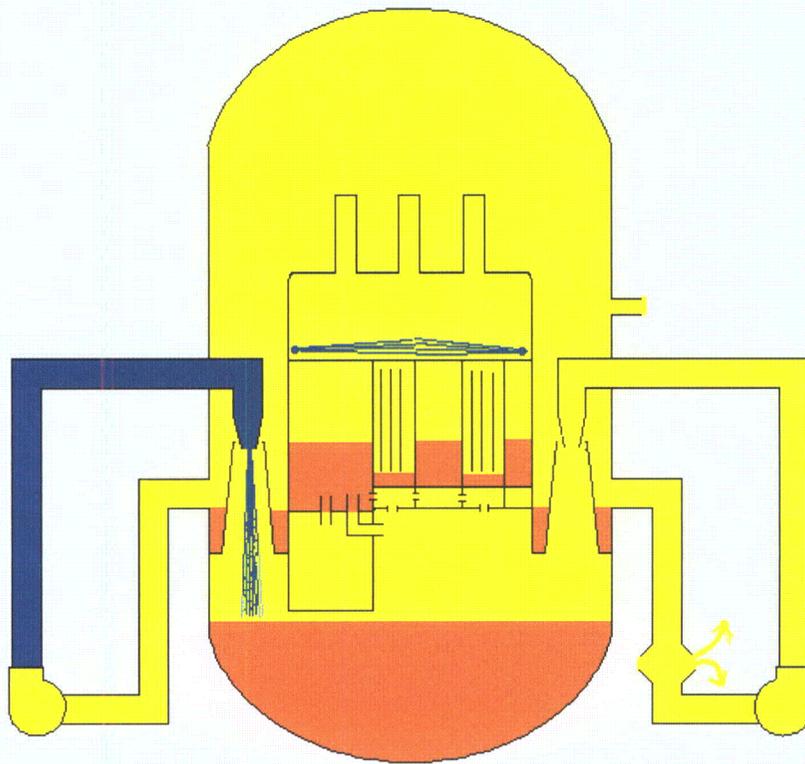
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BWR LOCA Event – Prior to ECCS Injection



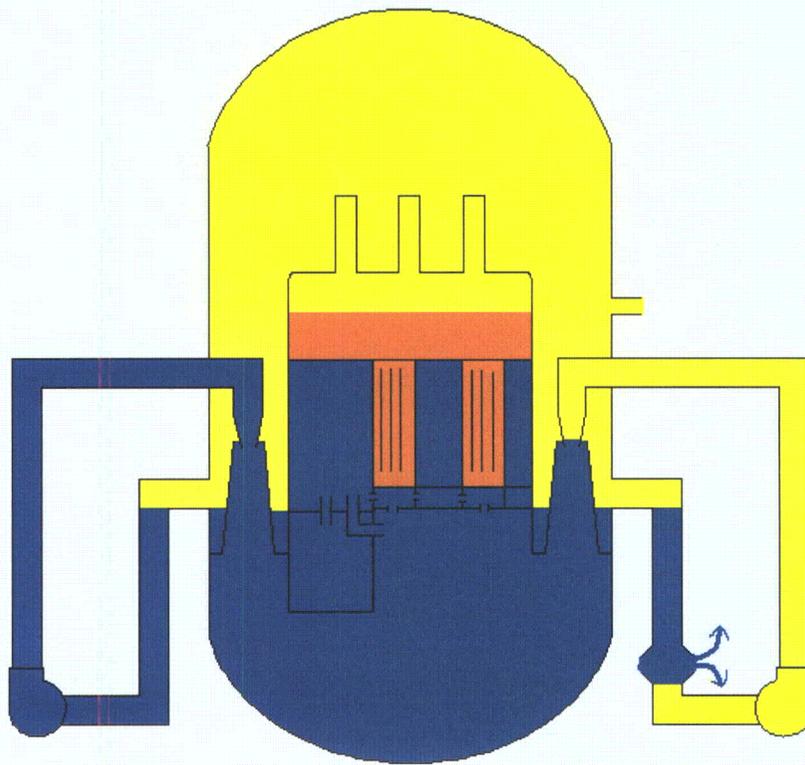
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BWR LOCA Event – Initial ECCS Injection



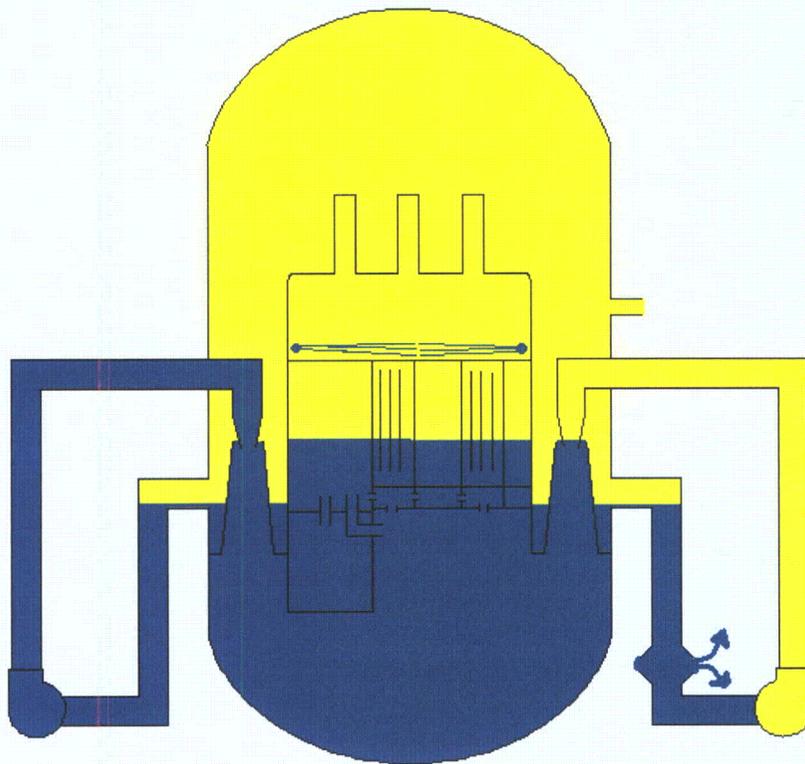
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BWR LOCA Event – Core Reflood



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BWR LOCA Event – Long Term Cooling



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Review of Previous Prediction of
TRACG LOCA Simulation Results

Maximum Blockage Criteria

Boundary Condition for Steam

TRACG LOCA Simulation Results

- Sensitivity of PCT to Blockage Scenarios
 - Plant Types and Break Size
 - Blockage Magnitude and Time
- Reference Limiting Case for Long Term Cooling
 - Full Inlet Blockage
 - Partial Outlet Blockage
 - Coolant Flow Magnitude



PCT & RPV Level Response - No Blockage

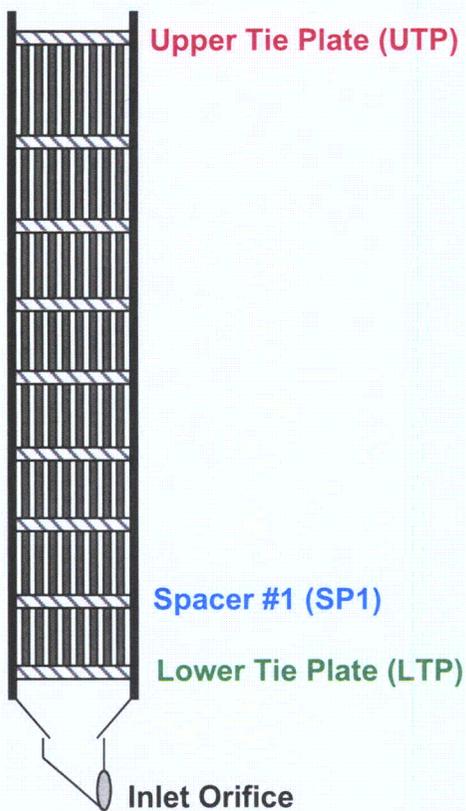
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Case Matrix



Percentage Blocked	Delay after ECCS Injection
25%	5 sec
50%	30 sec
75%	60 sec
100%	120 sec
	180 sec

Plant Type & Break Size PCT Sensitivity

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Plant Type & Break Size PCT Sensitivity

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Plant Type & Break Size PCT Sensitivity

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Plant Type & Break Size PCT Sensitivity

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PCT Sensitivity to Blockage at LTP

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PCT Sensitivity to 50% Blockage at UTP with 100% Blockage at LTP

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PCT Sensitivity to 50% Blockage at UTP with 100% Blockage at LTP

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High Power Bundle Flow after ECCS Injection – No Blockage

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High Power Bundle Flow after ECCS Injection – No Blockage

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High Power Bundle Flow after ECCS Injection – 50% UTP 100% LTP Blockage

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High Power Bundle Flow after ECCS Injection – 50% UTP 100% LTP Blockage

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High Power Bundle Flow after ECCS Injection – 50% UTP 100% LTP Blockage

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High Power Bundle Flow after ECCS Injection – 50% UTP 100% LTP Blockage

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High Power Bundle Flow after ECCS Injection – 50% UTP 100% LTP Blockage

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High Power Bundle Flow after ECCS Injection – 50% UTP 100% LTP Blockage

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Conclusions

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GE Hitachi Nuclear Energy
October 2009

Review of Previous Presentations

TRACE LOCA Simulation Results

Maximum Blockage Criteria

Boundary Conditions for Fuel Train

Maximum Blockage Criteria

- Lower Tie Plate Grid
 - Full Blockage applied after short term PCT
 - Allows early cooling from downflow, same as long term cooling and non-jet pump plant
- Upper Tie Plate Grid
 - Limited Blockage applied after flow reversal
 - Flow exceeds cooling requirements after quenching



Review of Previous Presentation
TRACG LOCA Simulation Results
Maximum Blockout Criteria

Boundary Conditions for Fuel Testing

Boundary Conditions for Fuel Testing

- Bottom Reflood
 - Initial Two Phase Level Recovery: Delay
- Natural Circulation
 - Natural Circulation Flow: Inlet Blockage
- Bypass Region Refill
 - Lower Plenum Refill: Bypass Flow Holes Blockage
- Top Channel Downflow
 - Core Spray Cooling: Outlet Blockage



Boundary Conditions for Fuel Testing

Flow Path	Criteria	Hydraulic Parameters
1 – Fuel Inlet Grid	Less than 95% free area blockage in three minutes of injection with debris	Maximum driving head of 7 psid
2 – Fuel Outlet Grid	Less than 50% free area blockage over long term injection with debris	Flow rate from 1 to 12 gpm
3 – Level Recovery	Insignificant delay in level recovery over 10 feet during initial two minutes of injection with debris	Level Rise rate corresponding to fastest in BWR
4 – Bypass Flow Refill	Insignificant flow reduction over initial 3 minutes of injection with debris	Maximum driving head of 7 psid



THANK YOU !



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Supporting Slides:

Cross section area for inlet filter, spacers and outlet grid



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LTP UTP and Spacers

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