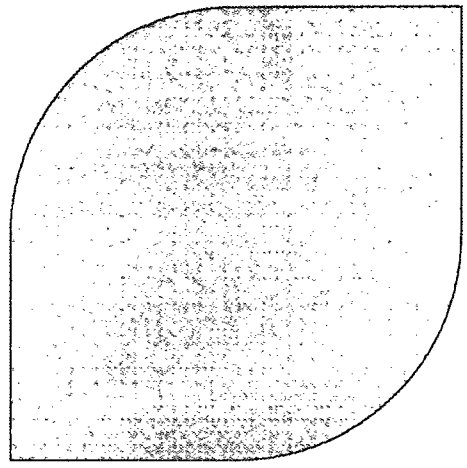


U.S. EPR
Design Certification Review
RLBLOCA Methodology

AREVA NP Inc. and the NRC
October 8, 2009

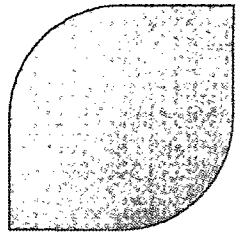
EPR™ by AREVA

AREVA

Objective

Obtain NRC feedback on proposed RLBLOCA analysis approach to support initiation of revised Chapter 15 calculations and preparation of Revision 1 of ANP-10278P

Topics



- Initial stored energy in hot rod and hot assembly
- Initial stored energy in average and peripheral assemblies
- FUELK adjustment
- Accumulator/containment temperature
- Accumulator nitrogen injection
- Decay heat
- Lower plenum refill and oscillations

U.S.NRC

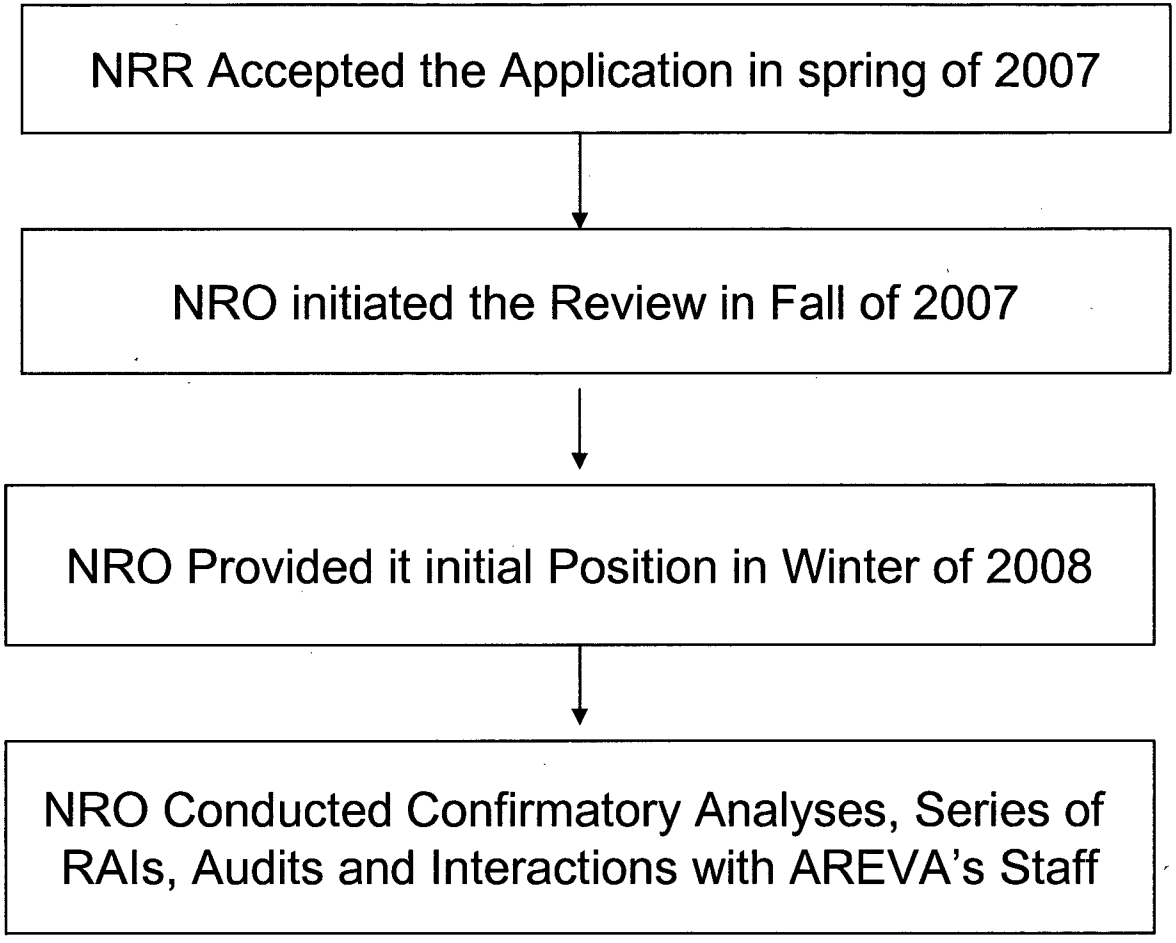
United States Nuclear Regulatory Commission

Protecting People and the Environment

EPR RLBLOCA Presentation
Redacted Public Version

8 October 2009

EPR RLBLOCA History



EPR RLBLOCA History

NRC Audit.- RODEX2 and RODEX3A	Dec. 3-4, 2008
First set of responses to 3rd round RAIs	Dec. 19, 2008
4th round RAIs issued	Jan. 28, 2009
5th round RAIs issued	March 11, 2009
Second set of responses to 3rd round RAIs	March 31, 2009
Response to 4th round RAIs	April 2, 2009
Response to 5th round RAIs	April 9 2009
NRC audit	April 22-23, 2009
Draft 6th round RAIs received	May 21, 2009
Status meeting	July 9, 2009
Third scheduled DSER date	Sept. 16, 2009
NRC audit	October 8, 2009

RLBLOCA PCT Position

Item	Proposed ΔPCT July-09-2009	Potential ΔPCT October-08-09
A- Accumulator Initial temperature	TBD	~25 °F
B- Burnup-dependent Initial stored energy for hot rod and assembly	100 °F	~75 °F
- Initial stored energy in average and peripheral assemblies	50 °F	
- Burnup-dependent fuel conductivity in the transient analysis	50 °F	
C- Accumulator N_2 Injection	Minor	Minor
D- Modified decay heat treatment	100 °F	~50 °F
E- Lower plenum refill and core flow oscillation	200 °F	TBD (**<50 °F**)
F- Number of cases (124 vs. 59)	100 °F	~100 °F
CUMULATIVE EFFECT	**~600 °F**	**~250 °F**
PCT (current FSAR value = 1,512 oF)	**~2,100 °F**	**~1,750 °F**

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EPR RLBLOCA Presentation

Closed Session

A- Open Issue: Accumulator Initial Temperature

Staff Initial Position: Inappropriate temperature range

AREVA's Proposed Resolution:

Sample from [ ]

Evaluation: Accept AREVA's proposal

Estimated PCT Impact: ~ 25 F

B- Open Issue: Initial Stored Energy

Staff Initial Position: 200 F penalty to compensate for underprediction of hot rod and other core regions temperatures

AREVA's Proposed Resolution (Hot Rod):

Three options for hot rod per September 15 presentation:

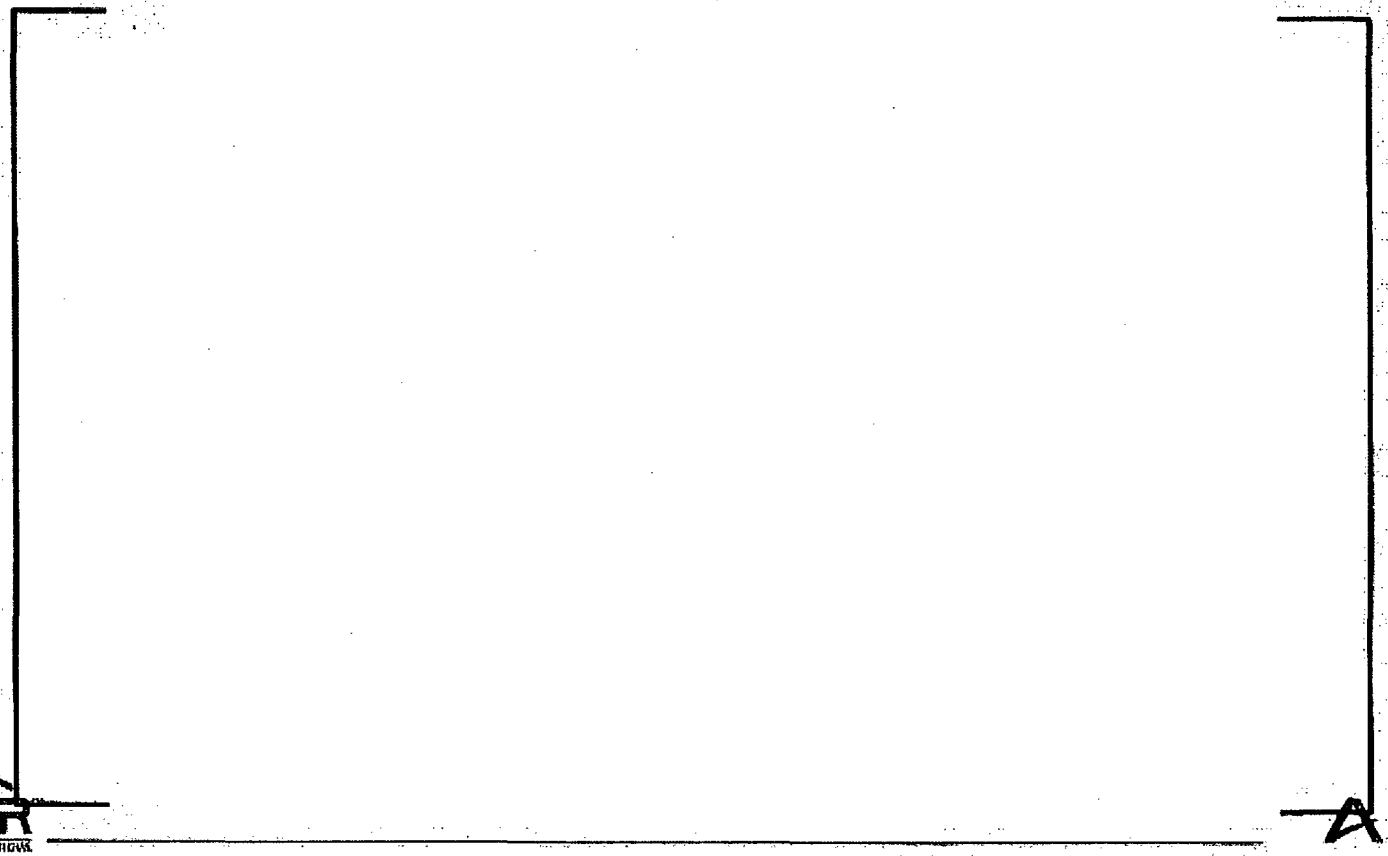
1. Use revised FUELK from RODEX3A fit to data
2. Use more conservative FUELK based on FRAPCON estimate of centerline temperatures or
3. Apply a PCT penalty of 50 F

Evaluation:

Use second approach of FUELK for hot rod and hot assembly* unless audit can justify first approach

* Hot assembly not discussed by AREVA

RODEX3 Comparison to Data Base



B- Open Issue: Initial Stored Energy (contd)

Staff Initial Position: 200 F penalty to compensate for underprediction of hot rod and other core regions temperatures

AREVA's Proposed Resolution (Core):

Three options for core regions (other than hot rod) per presentation:

1. No change
2. [ ]
3. Model average core and periphery region based on reasonable estimated burnups and FUELK at these burnups
   - average core modeled as 2 rods (fresh and once burned)
   - periphery region modeled as twice burned

Evaluation:

- Represent the fuel core other than hot rod and hot assembly by 3 regions of surrounding, average core, periphery (twice burned fuel) assemblies (same as third approach except surrounding assembly added)
- Apply FUELK correction to all the above core regions

B- Open Issue: Initial Stored Energy (contd)

Use of FUELK in Transient Calculation (contd)

Staff Initial Position: Realistic use of FUELK burnup dependence is appropriate

AREVA's Proposed Resolution: Will include FUELK in transient analysis

Evaluation: Accept use of FUELK in transient analysis

Estimated Total Initial Store Energy Related PCT Impact: ~ 75 F

C- Open Issue: Accumulator N_2 Injection

Staff questioned whether S-RELAP appropriately predicts the critical flow in the presence of nitrogen

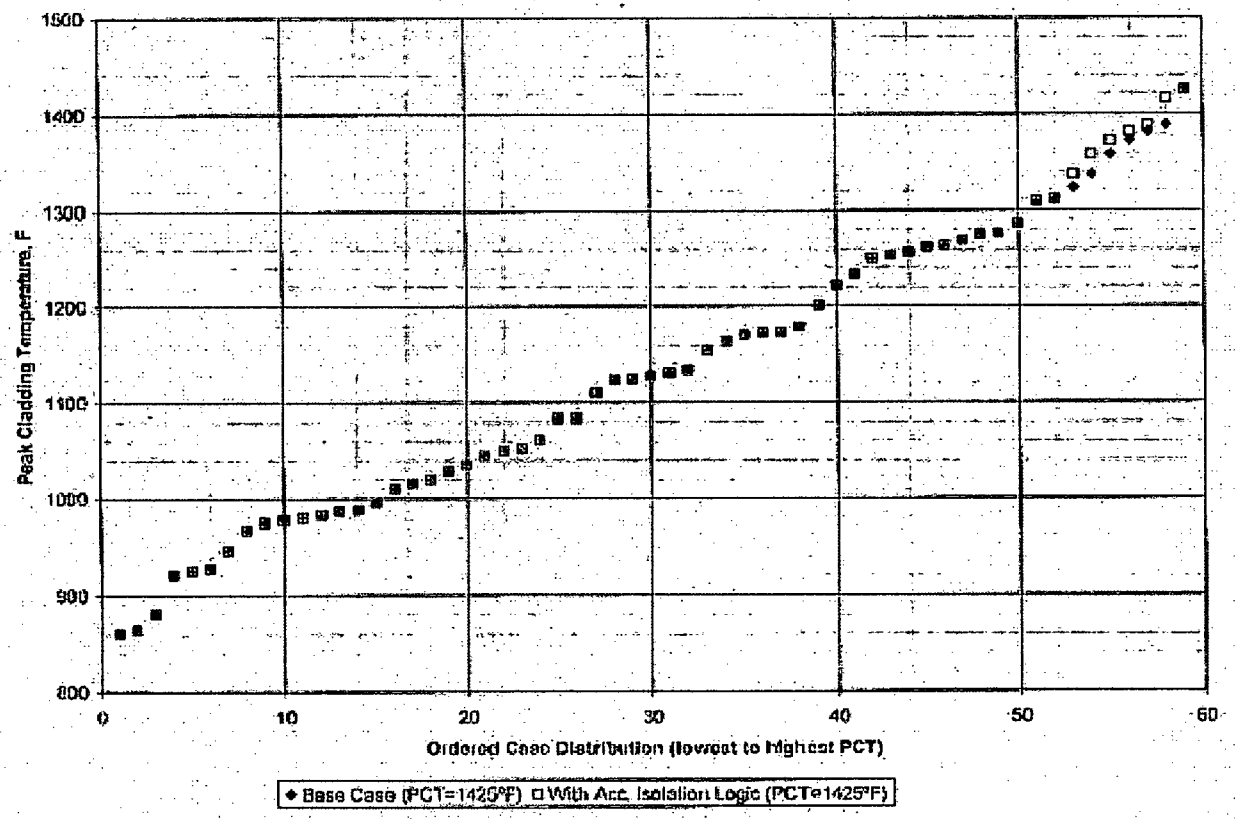
AREVA's Proposed Resolution:

1. Allow nitrogen injection or
2. [ ]

Evaluation: Allow nitrogen Injection

Estimated PCT Impact: minor

Nitrogen Injection – Sorted Results for 59 Cases



D- Open Issue: Decay Heat

Staff Initial Position: Use ANS 79 nominal + 2σ

AREVA's Proposed Resolution:

1. Use the approach as it was originally presented in RLBLOCA methodology.
2. Use nominal only

Evaluation:

1. Sample between nominal and nominal + 2σ (σ=1.8%)
2. Use nominal multiplied by 1 + 2σ (σ=1.8%)

Estimated PCT Impact: ~ 50 F

E- Open Issue: Lower Plenum Refill and Core Flow Oscillations

Staff Initial Position: 200 F penalty

AREVA's Proposed Resolution:

Code is conservative in its calculation of beginning of reflood. Therefore, no change to code and no penalty.

Evaluation:

Accept AREVA's position on lower plenum refill.

Address separately oscillations impact.

Estimated PCT Impact:

No penalty associated with lower plenum refill.

Additional assessment work within the next two weeks using S-RELAP5 and test data (LOFT).

F- Open Issue: Number of Cases (124 vs. 59)

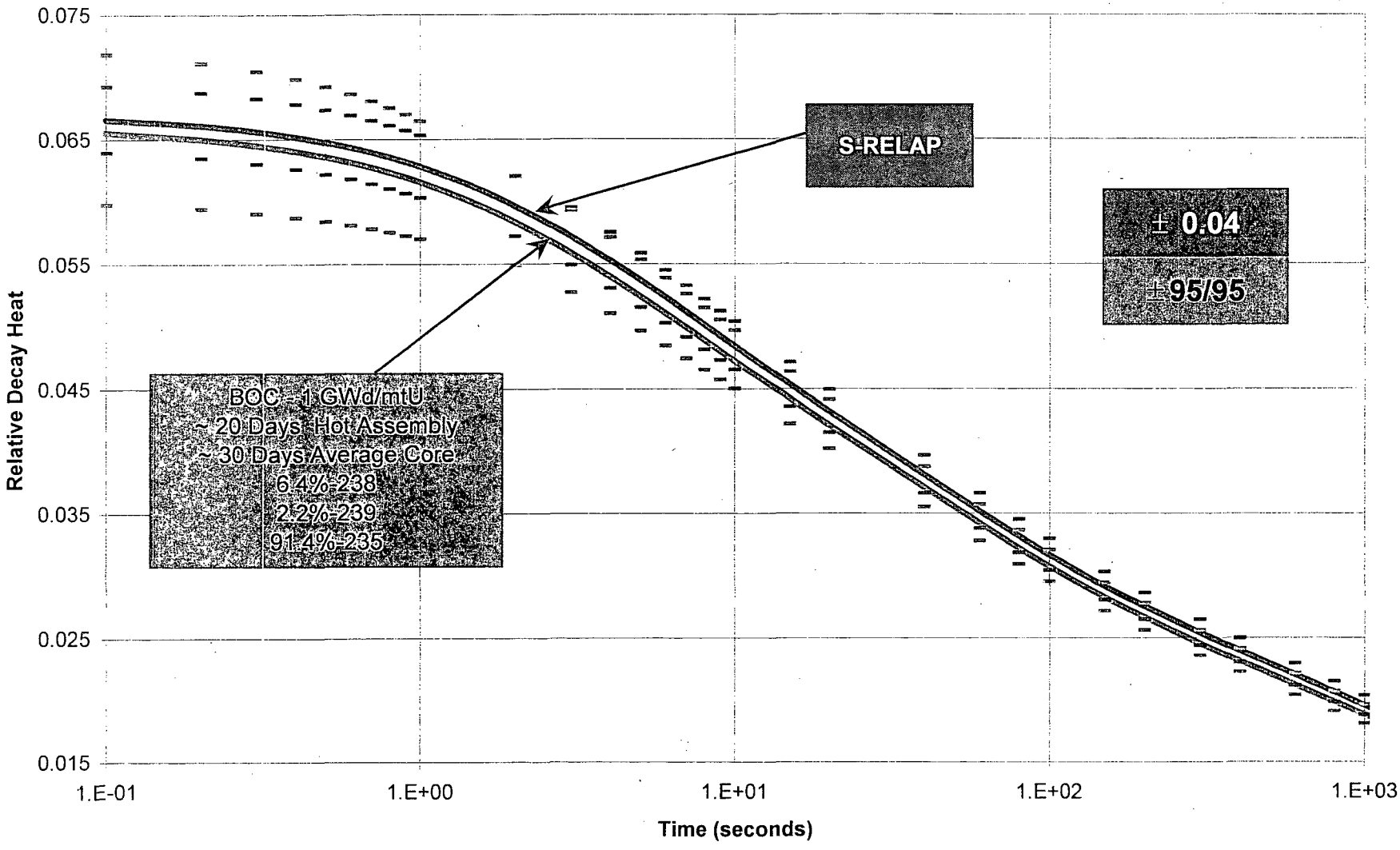
Staff Initial Position: Run 124 cases instead of 59 cases

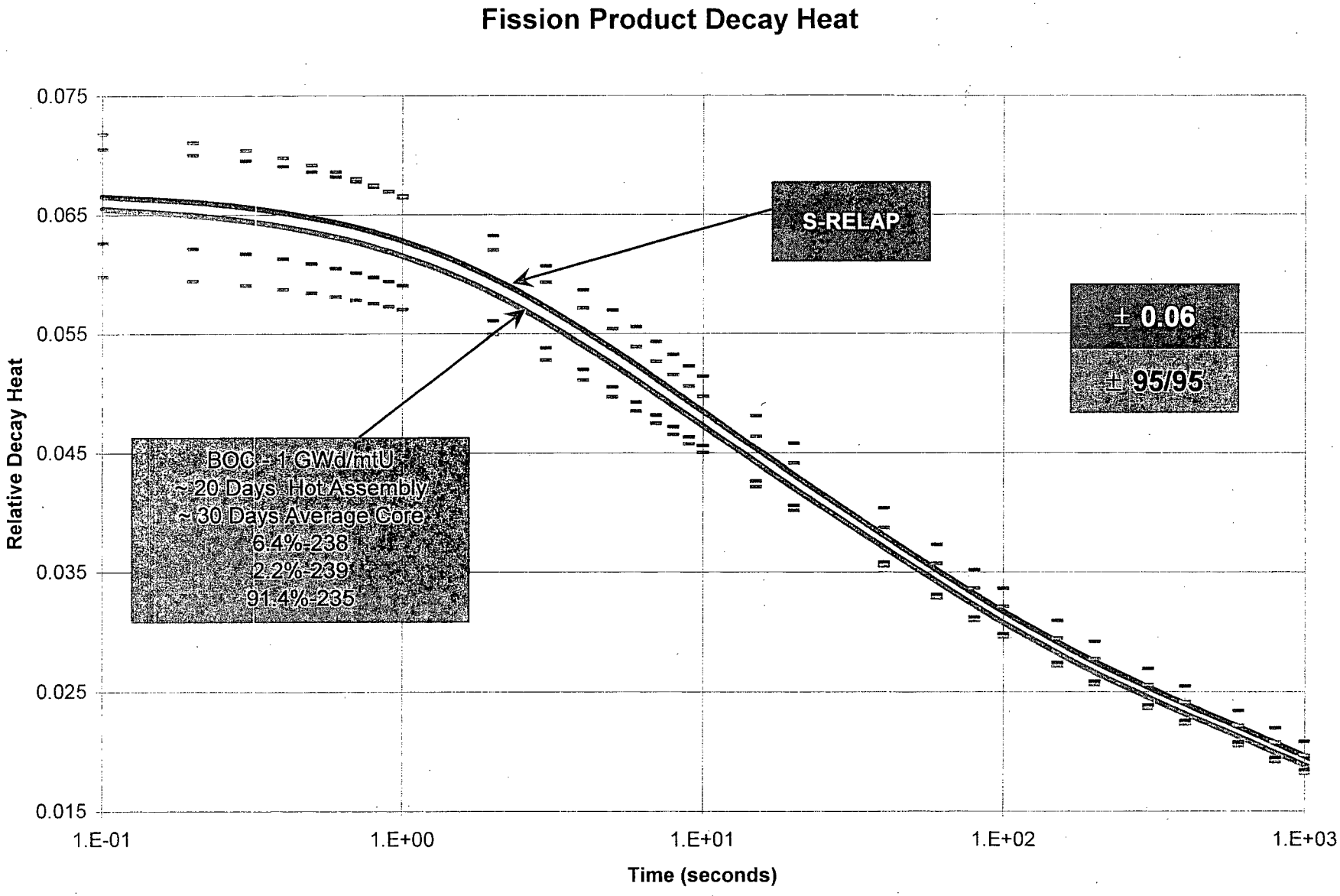
AREVA's Proposed Resolution: Agreed with the staff position

Evaluation: Accept AREVA's proposal to run 124

Estimated PCT Impact: ~ 100 F

Fission Product Decay Heat




Fission Product Decay Heat
0.075
0.065
0.055
0.045
0.035
0.025
0.015
Relative Decay Heat
1.E-01
1.E+00
1.E+01
1.E+02
1.E+03
Time (seconds)
S-RELAP
± 0.06
± 95/95
BOC - 1 GWd/mtU
~ 20 Days Hot Assembly
~ 30 Days Average Core
6.4%-238
2.2%-239
91.4%-235