AREVA

BHTP CHF Correlation Extensions and Extrapolations

BAW-10241P, Rev. 1

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Agenda

- *Comparison of BAW-10241P, Rev.1 to Previously Approved EMF-92-153, Rev.1*
- *Technical Review Schedule Need*

? EMF-92-153, Revision 1

- *Correlation range extensions and extrapolations deemed necessary for supporting plant operation*
- *HTP: Departure From Nucleate Boiling Correlation for High Thermal Performance Fuel*
- *Application T/H Code: XCOBRA-IIIC*
- *SER: January 2005*

? HTP Range Extensions

- [ ] CHF data points from [ ] CHF tests in original correlation
- 1.141 CHF Design Limit
- [ ] additional CHF data points examined for 1400, 1000, and 600 psia covering [ ] of [ ] CHF tests
- 1000 and 600 psia data dropped because of limited coverage across only 5 CHF tests, leaving [ ] data points
- 3 data points for 1400 psia dropped, leaving [ ] data points
  - 2 points at low flow
  - 1 point at high thermodynamic quality
- Extensions Granted in SER
  - Low Pressure
  - Low Mass Flow Rate
  - High Thermodynamic Quality

? HTP Range Extrapolations

- Demonstrated the conservative behavior of the correlation predictions under high thermodynamic quality conditions below the original lower quality limit
  - SER granted the elimination of the lower quality limit

- Demonstrated the conservative behavior of the correlation predictions under pressures greater than the original high pressure limit
  - The proposed extension was modified during the review process
  - SER granted the specific and limited application of the correlation above the higher pressure limit
  - "When pressures greater than the upper pressure limit of 2425 psia but less than 2600 psia are encountered, all of the local coolant conditions are calculated at the upper pressure limit of 2425 psia using the NRC-approved thermal-hydraulic code and then used in the calculation of the HTP CHF."

? BAW-10241, Revision 1

- BHTP DNB Correlation Applied with LYNXT
- Application T/H Code: LYNXT
- Submitted: March 2005

? BHTP Range Extensions

- [ ] CHF data points from [ ] CHF tests in original correlation
- 1.132 CHF Design Limit
- [ ] additional CHF data points examined for 1400, 1000, and 600 psia covering [ ] of [ ] CHF tests
- 1000 and 600 psia data dropped because of limited coverage across only 5 CHF tests, leaving [ ] data points
- 3 data points for 1400 psia dropped, leaving [ ] data points
  - 2 points at low flow
  - 1 point at high thermodynamic quality
- Extensions requested, using data
  - Low Pressure
  - Low Mass Flow Rate
  - High Thermodynamic Quality

? BHTP Range Extrapolations

- The original HTP CHF correlation application for the additional [ ] data points was ~10% conservative.
- The BHTP CHF correlation application for the additional [ ] data points was roughly ~24% conservative.
- Therefore, the analytical conclusions observed for the HTP correlation are appropriate for the BHTP correlation extensions in lower quality and higher pressure.
- Framatome ANP is requesting the same extensions for lower quality and higher pressure.
  - Elimination of the lower thermodynamic quality limit.
  - "When pressures greater than the upper pressure limit of 2425 psia but less than 2600 psia are encountered, all of the local coolant conditions are calculated at the upper pressure limit of 2425 psia using the NRC-approved thermal-hydraulic code and then used in the calculation of the BHTP CHF."

Range Comparison Summary

? ***The requested application ranges for the BHTP correlation are consistent with those granted for the HTP correlation***

		HTP EMF-92-153, Rev.1 (Granted in SER)	*BHTP BAW-10241, Rev.1 (Requested in Submittal)*
Extensions			
System Pressure	*psia*	***1385** - 2425*	***1385** - 2425*
Mass Flow Velocity	*Mlb_m/ft^2*	***0.498** - 3.573*	***0.492** - 3.549*
Thermodynamic Quality		***Up to 0.515***	***Up to 0.512***
Extrapolations			
High Pressure	*psia*	***Limited and Specific Application up to <2600 psia*** [1]	***Limited and Specific Application up to <2600 psia*** [1]
Thermodynamic Quality		***No Lower Limit*** [2]	***No Lower Limit*** [2]

[1] : *When pressures greater than the upper pressure limit of 2425 psia but less than 2600 psia are encountered, all of the local coolant conditions are calculated at the upper pressure limit of 2425 psia using the NRC-approved thermal-hydraulic code and then used in the calculation of the HTP (or BHTP) CHF.*

[2] : *Any other extrapolation requires a plant-specific review (according to SER)*

Technical Review Schedule Need

- *Entergy's ANO-1 Cycle 20 (startup Fall 2005) will contain the Mark-B-HTP fuel design requiring the use of the BHTP CHF correlation*
- *The generation of the 2 RC pump operating condition DNB-based safety limits (Tech Specs) revealed some situations where the local coolant mass velocity fell below the 0.897 $Mlb_m/hr\text{-}ft^2$ lower velocity limit from BAW-10241(A) Revision 0.*
- *Framatome ANP has requested in BAW-10241, Rev.1 the same correlation extensions and extrapolations for the BHTP correlation that were granted for the HTP correlation.*
- *Framatome ANP has requested an NRC review with an SER by August 1, 2005 to support plant operation.*