

# ***ACE/ATRIUM-10*** ***Critical Power Correlation***

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## *Topics*

- > **Introduction**
- > **What has changed compared to SPCB correlation?**
- > **Formal methods of development**
- > **Theoretical model for correlation**
- > **Applicability**
  - ◆ **Range of applicability**
  - ◆
  - ◆
- > **Conclusions**

# *Introduction*

## *Why a New Correlation?*



## Overview Comparison of ACE/ATRIUM-10 to SPCB

Correlation Component	SPCB	ACE/ATRIUM-10
Correlation Form		
Rod peaking function		
Input Conditions		
Calculated Result		

ACE/ATRIUM-10 will be used in the same applications as SPCB, including

# ***Correlation Form*** ***What is different?***



# *Differences in Rod Centered Peaking Function*



# *Formal Methods of Correlation Development*



## ***Methods for Correlation Development Critical Power Correlation***

- > The correlation development followed the formal process described in EMF-2022(P) “Correlation Development Guideline” including:**
  - ◆ A correlation development plan**
  - ◆ Correlation theoretical model development**
  - ◆ Data qualification**
  - ◆ Partitioning of the data into defining and validating data sets**
  - ◆ Correlation fitting and assessment of curve fit**
  - ◆ Correlation validation with independent data set**

# ***Methods for Correlation Development Additive Constants***

# *Topical Report Structured on Development Process*

- > **Introduction (Section 1)**
- > **Summary (Section 2)**
- > **Definition of correlation (Section 3)**
- > **Correlation evaluation and behavior (Section 4)**
- > **Correlation validation (Section 5)**
- > **Critical power test data (Section 6)**
- > **Appendices**
  - ◆ **Derivation of theoretical form (Appendix A)**
  - ◆ **Rod centered peaking function examples (Appendix B)**
  - ◆ **List of symbols (Appendix C)**

# ***Theoretical Model for Correlation***

# *Theoretical Model*

# *Theoretical Model*

# *Theoretical Model*

# *Theoretical Model*

## *Where is the correlation equation?*





## ***Correlation Implementation***

- > A single point of implementation – a reusable computer code library – is used for implementing correlation in all production codes**
- > A single point of implementation provides**
  - ◆ Consistent means for checking correlation input**
  - ◆ Consistent treatment of nodalization**
  - ◆ Consistent treatment of fluid properties**
  - ◆ Single consistent treatment of correlation bounds**
  - ◆ Elimination of subtle differences between code implementations of the critical power correlation**

***Range of applicability is appropriate***

# *Range of Applicability Pressure*



# *Range of Applicability Mass Flow Rate (Upper Limit)*



# *Range of Applicability Mass Flow Rate (Upper Limit)*



# *Range of Applicability Mass Flow Rate (Lower Limit)*



# *Range of Applicability Mass Flow Rate (Lower Limit)*

# *Range of Applicability Inlet Subcooling (Upper Limit)*

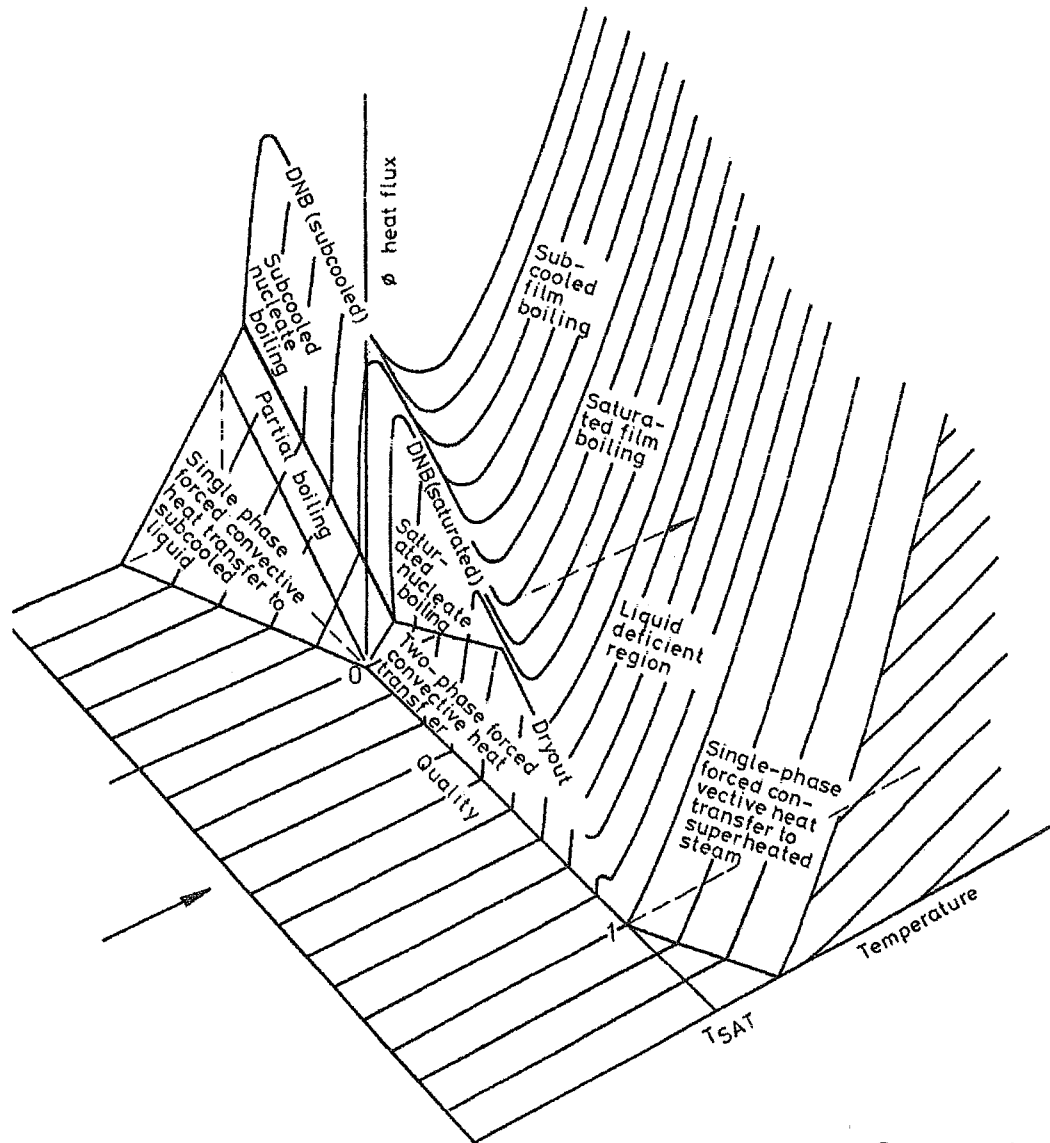


# *Range of Applicability Inlet Subcooling (Lower Limit)*





# 3D Boiling Map



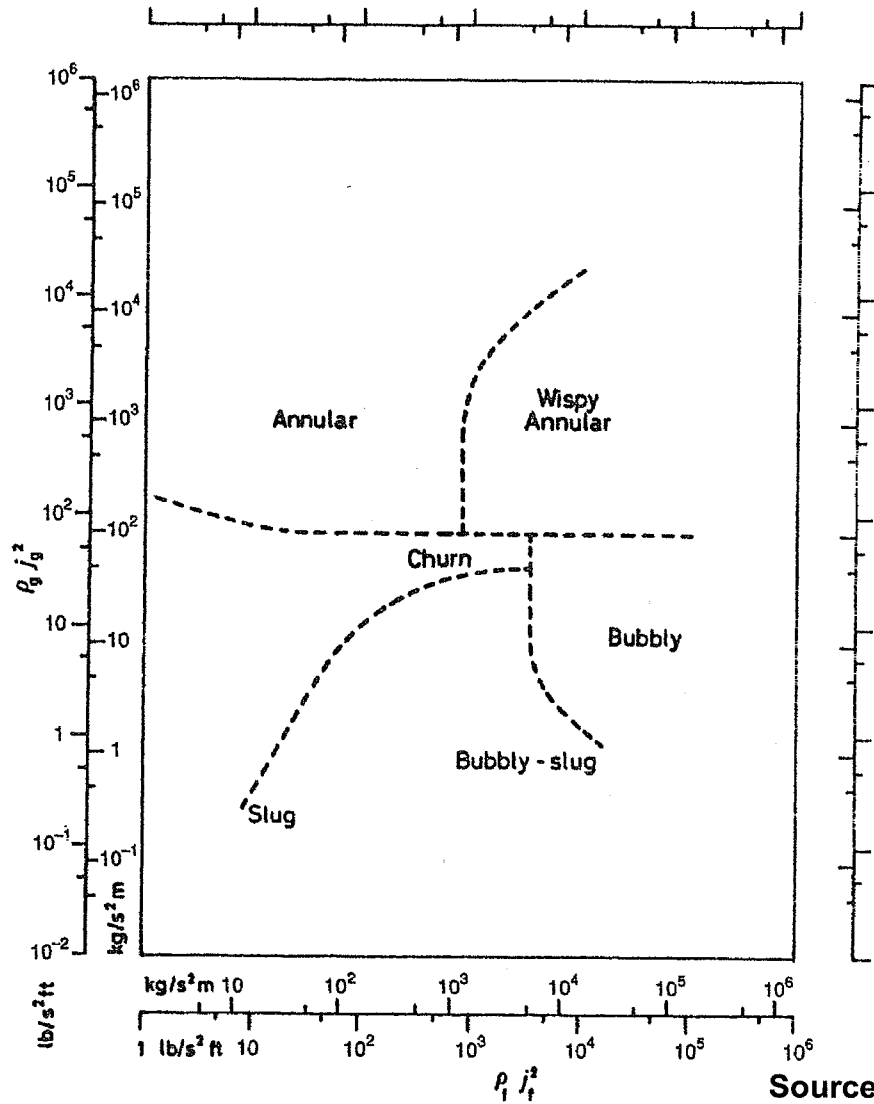
Source: Collier and Thome, Convective Boiling and Condensation, 3<sup>rd</sup> Edition, Page 174.







# JFlow Regime Map



Source: Collier and Thome, Convective Boiling and Condensation, 3<sup>rd</sup> Edition, Page 19.









# ***Correlation Applies to Transients***

# *Transient Applications*

# ***Transient Applications***

## Conclusions

> **The ACE/ATRIUM-10 correlation can be approved because:**

- ◆ **The range of applicability is both sufficient and adequate**
- ◆ **The correlation applies to all conditions that might be encountered within the range of applicability**