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FRAMATOME
TECHNOLOGIES

June 25, 1996
JHT/96-43

Mr. R. C. Jones, Chief
Reactor Systems Branch
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

References:

1. J. H. Taylor, B&W Nuclear Technologies to USNRC, B&W Topical report BAW-10159P-A, "BWCMV Correlation of Critical Heat Flux in Mixing Vane Fuel Assemblies," JHT/95-44, April 24, 1995.
2. J. H. Taylor, B&W Nuclear Technologies to USNRC, Request for Extension of Applicability of BWCMV to Vantage-5H Fuel Without Intermediate Flow Mixers," JHT/95-118, December 4, 1995.
3. J. H. Taylor, Framatome Technologies to USNRC, Request for Extension of Applicability of BWCMV to Vantage-5H Fuel Without Intermediate Flow Mixers, JHT/96-11, February 1, 1996.
4. J. H. Taylor, Framatome Technologies to USNRC, Request for Extension of Applicability of BWCMV to Vantage-5H Fuel Without Intermediate Flow Mixers, JHT/96-32, May 6, 1996.

Dear Mr. Jones:

In reference 1 BWFC requested an extension of the applicability of the BWCMV critical heat flux correlation to Vantage-5H fuel. References 2, 3 and 4 included additional information to support that request. The correlation has previously been approved for use with the Mark-BW, Westinghouse Standard, and Westinghouse OFA fuel assemblies.

On June 20, 1996 representatives from TVA and FCF met with the NRC Project Manager and members of the Reactor Systems Branch to discuss that request. In that meeting FCF presented technical material that was proprietary. NRC requested that the material be submitted in both proprietary and non-proprietary versions so

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per Ron Hernan

that it could be entered into the public record. Attachment 1 is the proprietary version of the presentation and Attachment 2 is the non-proprietary version. A discussion of the hydraulic flow testing that was performed for the Vantage-5H fuel is included in the Attachments.

In the meeting all technical issues concerning the applicability of BWCMV to Vantage-5H fuel were resolved. The NRC agreed to issue an SER granting the extension of the correlation to Vantage-5H for Sequoyah Units 1 and 2 by August 31, 1996. Since the correlation will be used in design calculations that are currently being performed, approval is needed by that date. Questions related to the specific application to Sequoyah will be addressed in the review of topical report BAW-10220P, "Mark-BW Fuel Assembly Application for Sequoyah Units 1&2." FCF is planning a submittal to address cross flow effects between different types of fuel assemblies in support of that topical. Review of BAW-10220P is scheduled to be completed in February 1997.

In accordance with 10CFR2.790, Framatome Technologies Inc. requests that the information in Attachment 1 be considered proprietary. An affidavit supporting this request was included with the May 12, 1986 submittal of BAW-10159P.

Very truly yours,

C F McPhatter for

J. H. Taylor, Manager
Licensing Services

cc: L. E. Phillips, NRC
T. L. Huang, NRC
C. P. Jackson, NRC
R. W. Hernan, NRC
J. F. Burrow, TVA
R. Huston, TVA
R. B. Borsum

Attachment 2

Non-Proprietary Version of Material

Presented at Meeting on June 20, 1996

Application of BWCMV CHF Correlation

to

Westinghouse VANTAGE 5H Fuel

meeting - NRC/FCF/TVA

June 20, 1996

AGENDA

Meeting Objectives	George Meyer
Summary of Licensing Activities	Frank McPhatter
The BWCMV CHF Correlation	David Farnsworth
Application to Sequoyah Core Analysis	Jeffrey Griffith
Conclusions	George Meyer

Objective

Obtain NRC Approval for the Application of BWCMV to the VANTAGE 5H Fuel Design (w/o *IFMs*)

Purpose

Limitations

The application of BWCMV to VANTAGE 5H fuel will be limited to:

Other considerations

Expected Conclusion

The Application of BWCMV to the VANTAGE 5H Fuel Design (w/o *IFMs) is Acceptable within the limitations discussed.*

CHRONOLOGY FOR APPLICATION OF BWCMV TO VANTAGE 5H

Application to V5H for Sequoyah Requested	April 24, 1995
Telecon to Discuss April 24 Submittal	August 17, 1995
Basis for Application to V5H Submitted	Dec. 4, 1995
Additional Basis for Application Submitted	Feb. 1, 1996
Limitations of Applicability Submitted	May 6, 1996

Critical Heat Flux
Correlation Applicability

INTRODUCTION

CORRELATION COMPATIBILITY

Number and Types of Tests
Distribution of Data Correlated
Variable Ranges Correlated

DESIGN COMPATIBILITY

Dimensional Parameters
Previous Testing
Proposed Application

REPRESENTATION of VANTAGE 5H by BWCMV

Based on the Demonstrated Compatibility
between BWCMV and WRB-1
and the Approved Representation
of the Vantage 5H Design by WRB-1,
Applicability of the BWCMV Correlation
to the Vantage 5H Design Follows

Critical Heat Flux
Correlation Applicability

TEST CONFIGURATIONS

	BWCMV (BAW-10159-A)	WRB-1 (WCAP-8763-A)
Number of Tests	26	24
W-H Tests	22	24
NFI Tests	4	0
Heated Lengths	3	2
Grid Spacings	6	5
Grid Designs	5	3
Axial Flux Shapes	6	4
Geometries	4	4

Critical Heat Flux
Correlation Applicability

DISTRIBUTION OF DATA

	BWCMV (BAW-10159-A)	WRB-1 (WCAP-8763-A)
Number of Data	1418	1147
Non-Uniform	1091	748
Uniform	327	399
Unit Cell	878	895
Guide Tube	540	252
Large Pin	783	646
Small Pin	635	501
8 Ft Length	464	411
12 Ft Length	468	0
14 Ft Length	486	736
Design Limit DNBR	1.21	1.17

Critical Heat Flux
Correlation Applicability

VARIABLE RANGES

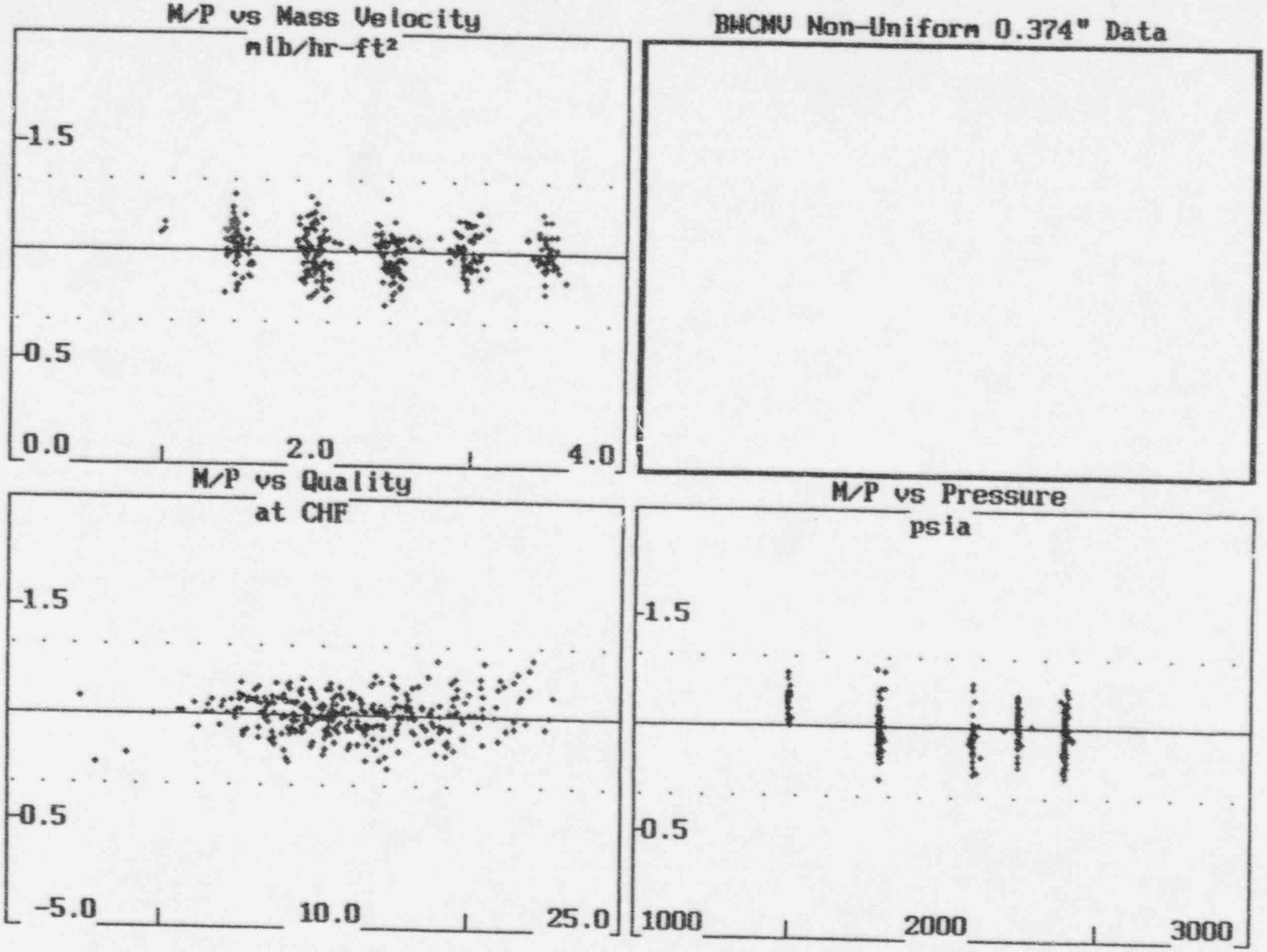
	BWCMV (BAW-10159-A)	WRB-1 (WCAP-8763-A)
Pressure, psia	1485 to 2455	1440 to 2490
Mass Velocity, mlb/hr-ft^2	0.95 to 3.74	0.9 to 3.7
Thermodynamic Quality @ CHF	-22 to +22	-20 to +30
Hydraulic Diameter, inches	.3747 to .5355	.37 to .60
Grid Spacing, inches	13 to 32	13 to 32

Critical Heat Flux
Correlation Applicability

DESIGN COMPATIBILITY

"from a DNB perspective the VANTAGE 5H Zircaloy grid design incorporated in the VANTAGE 5H assembly is virtually identical to the 17x17 inconel R-grid design in that the rod size, rod pitch, heated length and grid spacing are unchanged."

Addendum 2a to WCAP-10444-A, VANTAGE 5H Fuel Assembly, Westinghouse Electric Corporation, February, 1989.


BWCMV Non-Uniform 0.374" Data
M/P vs Mass Velocity
mlb/hr-ft²
1.5
0.5
0.0
2.0
4.0
M/P vs Quality
at CHF
1.5
0.5
-5.0
10.0
25.0
M/P vs Pressure
psia
1.5
0.5
1000
2000
3000

Critical Heat Flux
Correlation Applicability

SUMMARY and CONCLUSIONS

SINCE

In Number and Type of Test Configurations
WRB-1 is a Subset of BWCMV

AND

In the Distribution of Data Correlated
WRB-1 is a Subset of BWCMV

AND

The NRC Approved Independent Variable Ranges
of WRB-1 and BWCMV are Virtually Identical

THEN

If a Design is Represented by WRB-1
That Design can be Represented by BWCMV

Critical Heat Flux
Correlation Applicability

SUMMARY and CONCLUSIONS (Continued)

SINCE

The WRB-1 Correlation has been Shown
to Represent the Vantage 5H Design

AND

The BWCMV Correlation has been Shown
to Represent Designs Described by WRB-1

THEN

The BWCMV Correlation can be Used
to Represent the Vantage 5H Design

Licensing Vantage 5H Fuel At Sequoyah With BWCMV

Key Constraints Related to V5H Licensing

Analyzing V5H

Why is BWCMV Approval Needed?

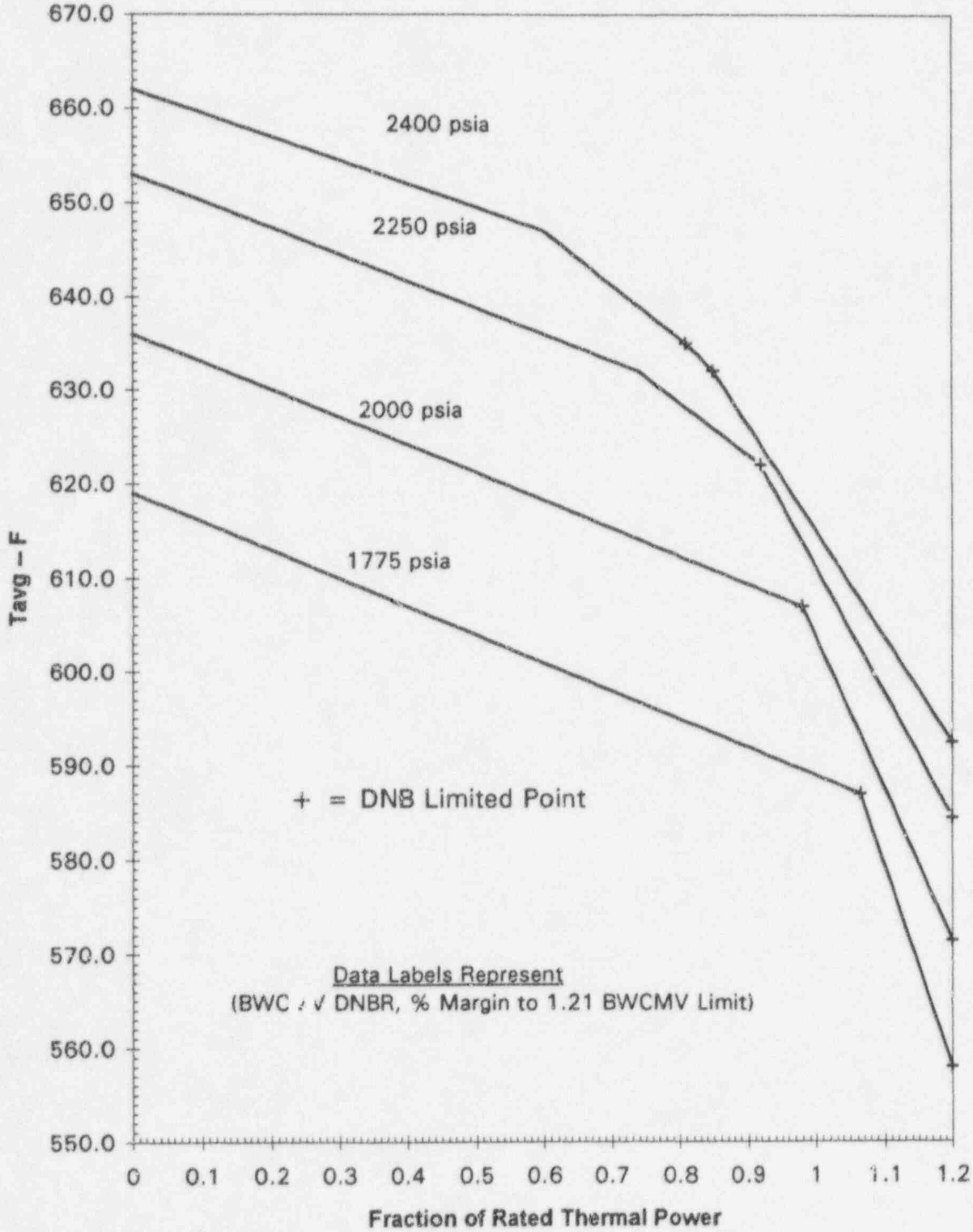
Existing Safety Limit Benchmark

- DNB Limit Statepoints Taken From Existing Safety Limits.

- Existing Design Power Distribution Employed
  Fdh = 1.62   Fz = 1.55 @ Midplane

- Deterministic Treatment of Uncertainties

Existing Sequoyah Core Safety Limits Benchmark
Source: Tech Spec Figure 2.1-1



Framatome Cogema Fuels

FCF's Intentions For Using BWCMV for V5H

Conclusions

The BWCMV CHF correlation is an acceptable correlation for use in the thermal-hydraulic analysis of fuel designs having VANTAGE 5H Spacer Grids,

1. For fuel assembly geometries without Intermediate Flow Mixers (IFMs),

3.3 Hydraulic Flow Testing

A series of flow tests was performed, using a transportable flow test rig (TFTR), to verify the compatibility between the Mark-BW fuel design and the Westinghouse VANTAGE 5H resident design. The TFTR is a "cold flow" loop, with typical test conditions encompassing water flow rates of [ ] gpm at pressures from [ ] psig and temperatures from [ ]. Pressure drop testing was performed on individual fuel assemblies, providing pressure drop characteristics for the VANTAGE 5H fuel design, as well as for the Mark-BW.

The TFTR was validated as a viable source for determining fuel assembly hydraulic characteristics in 1988, when, as part of the effort to license Mark-BW fuel for Duke Power Company's McGuire and Catawba Plants and for Portland General Electric Company's Trojan Plant, a preliminary set of flow tests was performed to qualify the TFTR and establish a benchmark for comparison to later tests. These tests were performed with the same Mark-BW prototype assembly that had been previously tested at the B&W Alliance Research Center, Alliance, Ohio, in the Control Rod Drive Line (CRDL) flow loop. The CRDL test spanned a wide range of pressure, temperature, and flow conditions encompassing those that occur during reactor operation. Core thermal-hydraulic analysis models for the Mark-BW fuel assembly design, including form loss coefficients for individual components, were developed from the CRDL test results. The measurements obtained with the TFTR demonstrated that the TFTR reproduces the CRDL results at comparable Reynolds numbers.

For the current test program, the goal was to first verify loop performance and then to hydraulicly characterize the VANTAGE 5H fuel through a series of lift and pressure drop tests. [ ]

[ ]

Using the measured pressure drops, form loss coefficients for the fuel assembly subcomponents were determined. These form loss coefficients were then incorporated into a LYNXT hydraulic model which showed that the total pressure drop of the Westinghouse VANTAGE 5H design is approximately [ ] than that of the Mark-BW. A plot of unrecoverable pressure drop versus axial elevation for the two designs at typical in-reactor conditions is provided on Figure 3-2.

Summary of Key Points Discussed at 6/20/96 Meeting

Axial Pressure Drop Variation Figure (Mark-BW Versus Vantage 5H)

Physical Differences

Grid Height

	End Grid	Mixing Grid
Mark-BW		
Vantage 5H		

*Approximate Height based on FCF Inspection

Figure 3-2
Mark-BW Versus Vantage 5H
Unrecoverable Pressure Drop Comparison
Full Core Analysis