FRAMATOME
TECHNOLOGIES

Integrated Nuclear Services

January 15, 1997
JHT/97-4

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: NRC/TVA/FCF Meeting on Mixed Core Thermal-Hydraulic Compatibility for Sequoyah

Gentlemen:

Enclosed is the information to be discussed with the NRC Staff on January 16, 1997. Framatome Cogema Fuels (FCF) requests that this information be considered "Proprietary" in accordance with 10CFR2.790. An affidavit supporting this request is included as Attachment 1. Attachment 2 is the "Proprietary" version of the material and Attachment 3 is the "Non-Proprietary" version.

Very truly yours,

J. H. Taylor, Manager
Lice ng Services

JHT/bcc
Attachments

c: R. C. Jones/NRC
L. E. Phillips/NRC
T. L. Huang/NRC
C. P. Jackson/NRC
R. W. Hernan/NRC
J. L. Birmingham/NRC
J. F. Burrow/TVA
R. Huston/TVA
R. B. Borsum/FTI-MD82
C. F. McPhatter/FCF-OF12

Hr Encl
Change PDR 1 w/out Prop

1007 1 Prop
1 NP

RD-8-2 Framatome

3315 Old Forest Road, P.O. Box 10935, Lynchburg, VA 24506-0935
Telephone: 804-832-3000 Fax: 804-832-3663

TDP

Attachment 1

Proprietary Affidavit for Framatome Cogema Fuels
Presentation to the NRC on Thermal-Hydraulic Analysis
Methods for Evaluating the Transition from Vantage 5H
Fuel at TVA's Sequoyah Plant, January 16, 1997

AFFIDAVIT OF JAMES H. TAYLOR

A. My name is James H. Taylor. I am Manager of Licensing Services for Framatome Technologies, Inc. (FTI). Framatome Cogema Fuels is administratively responsible to Framatome Technologies, Inc. Therefore, I am authorized to execute this Affidavit.

B. I am familiar with the criteria applied by FTI to determine whether certain information of FTI is proprietary and I am familiar with the procedures established within FTI to ensure the proper application of these criteria.

C. In determining whether an FTI document is to be classified as proprietary information, an initial determination is made by the Unit Manager, who is responsible for originating the document, as to whether it falls within the criteria set forth in Paragraph D hereof. If the information falls within any one of these criteria, it is classified as proprietary by the originating Unit Manager. This initial determination is reviewed by the cognizant Section Manager. If the document is designated as proprietary, it is reviewed again by Licensing personnel and other management within FTI as designated by the Manager of Licensing Services to assure that the regulatory requirements of 10 CFR Section 2.790 are met.

D. The following information is provided to demonstrate that the provisions of 10 CFR Section 2.790 of the Commission's regulations have been considered:

(i) The information has been held in confidence by FTI. Copies of the document are clearly identified as proprietary. In addition, whenever FTI transmits the information to a customer, customer's agent, potential customer or regulatory agency, the transmittal requests the recipient to hold the information as proprietary. Also, in order to strictly limit any potential or actual customer's use of proprietary information, the substance of the following provision is included in all agreements entered into by FTI, and an equivalent version of the proprietary provision is included in all of FTI's proposals:

"Any proprietary information concerning Company's or its Supplier's products or manufacturing processes which is so designated by Company or its Suppliers and disclosed to Purchaser incident to the performance of such contract shall remain the property of Company or its Suppliers and is disclosed in confidence, and Purchaser shall not publish or otherwise disclose it to others without the written approval of Company, and no rights, implied or otherwise, are granted to produce or have produced any products or to practice or cause to be practiced any manufacturing processes covered thereby.

Notwithstanding the above, Purchaser may provide the NRC or any other regulatory agency with any such proprietary information as the NRC or such other agency may require; provided, however, that Purchaser shall first give Company written notice of such proposed disclosure and Company shall have the right to amend such proprietary information so as to make it non-proprietary. In the event that Company cannot amend such proprietary information, Purchaser shall, prior to disclosing such information, use its best efforts to obtain a commitment from NRC or such other agency to have such information withheld from public inspection.

Company shall be given the right to participate in pursuit of such confidential treatment."

(ii) The following criteria are customarily applied by FTI in a rational decision process to determine whether the information should be classified as proprietary. Information may be classified as proprietary if one or more of the following criteria are met:

a. Information reveals cost or price information, commercial strategies, production capabilities, or budget levels of FTI, its customers or suppliers.

b. The information reveals data or material concerning FTI research or development plans or programs of present or potential competitive advantage to FTI.

c. The use of the information by a competitor would decrease his expenditures, in time or resources, in designing, producing or marketing a similar product.

d. The information consists of test data or other similar data concerning a process, method or component, the application of which results in a competitive advantage to FTI.

e. The information reveals special aspects of a process, method, component or the like, the exclusive use of which results in a competitive advantage to FTI.

f. The information contains ideas for which patent protection may be sought.

The document(s) listed on Exhibit "A", which is attached hereto and made a part hereof, has been evaluated in accordance with normal FTI procedures with respect to classification and has been found to contain information which falls within one or

more of the criteria enumerated above. Exhibit "B", which is attached hereto and made a part hereof, specifically identifies the criteria applicable to the document(s) listed in Exhibit "A".

(iii) The document(s) listed in Exhibit "A", which has been made available to the United States Nuclear Regulatory Commission was made available in confidence with a request that the document(s) and the information contained therein be withheld from public disclosure.

(iv) The information is not available in the open literature and to the best of our knowledge is not known by Combustion Engineering, EXXON, General Electric, Westinghouse or other current or potential domestic or foreign competitors of Framatome Technologies, Inc.

(v) Specific information with regard to whether public disclosure of the information is likely to cause harm to the competitive position of FTI, taking into account the value of the information to FTI; the amount of effort or money expended by FTI developing the information; and the ease or difficulty with which the information could be properly duplicated by others is given in Exhibit "B".

E. I have personally reviewed the document(s) listed on Exhibit "A" and have found that it is considered proprietary by FTI because it contains information which falls within one or more of thecriteria enumerated in Paragraph D, and it is information which is customarily held in confidence and protected as proprietary information by FTI. This report comprises information

utilized by FTI in its business which afford FTI an opportunity to obtain a competitive advantage over those who may wish to know or use the information contained in the document(s).

JAMES H. TAYLOR

State of Virginia)
) SS. Lynchburg
City of Lynchburg)

James H. Taylor, being duly sworn, on his oath deposes and says that he is the person who subscribed his name to the foregoing statement, and that the matters and facts set forth in the statement are true.

JAMES H. TAYLOR

Subscribed and sworn before me
this 15th day of January 1997.

Brenda C. Cardona
Notary Public in and for the City
of Lynchburg, State of Virginia.

My Commission Expires July 31, 1999

EXHIBITS A & B

EXHIBIT A

Framatome Cogema Fuels Presentation to the NRC on Thermal-Hydraulic Analysis Methods for Evaluating the Transition from Vantage 5H Fuel to Mark-BW Fuel at TVA's Sequoyah Plant, January 16, 1997.

EXHIBIT B

The above listed document contains information which is considered Proprietary in accordance with Criteria b, c, and d of the attached affidavit.

Attachment 3

Non-Proprietary Version of Framatome Cogema Fuels Presentation to the NRC on Thermal-Hydraulic Analysis Methods for Evaluating the Transition from Vantage 5H Fuel at TVA's Sequoyah Plant, January 16, 1997

Framatome Cogema Fuels
Presentation to the NRC on
Thermal-Hydraulic Analysis Methods For
Evaluating The Transition From Vantage 5H Fuel to Mark-BW Fuel
At
TVA's Sequoyah Plant

January 16, 1997

Transition to Mark-BW Fuel at Sequoyah

AGENDA

▪ Introduction – Review of Licensing History	Frank McPhatter
▪ Mark-BW Experience Base – BWCMV Applicability	George Meyer
▪ LYNXT Code Application to Mixed Cores – Applicable code benchmarking	John Jones
▪ Sequoyah Mixed Core Analyses – Thermal margins – Transition core penalty basis	Jeff Griffith

Meeting Objectives

- Discuss mixed core thermal-hydraulic analyses supporting the transition of Sequoyah to Mark-BW17 fuel
- Identify thermal margins preserved in core safety limits for transition cores
- Provide the magnitude and basis for the transition core penalty

Mark-BW Transition Experience

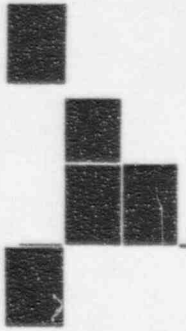
- McGuire LTAs
- Trojan LTAs
- One batch at Trojan - transition from W STD
- Full core transitions at Catawba (2 units), McGuire (2 units) - transition from W OFA
- First batch at Sequoyah (1997) - transition from W V5H

Mark-BW Operating Experience

- Designed for compatibility with Westinghouse 17x17 fuel
- 1244 fuel assemblies have been delivered and loaded in core
- 772 fuel assemblies are currently operating
- All fuel is operating failure-free

BWCMV CHF Correlation

- Developed from W, NFI data
  - BWC form with added mixing factor
  - 1418 data points (950 W)
- Licensed for W 15x15 and 17x17 STD and OFA, plus VANTAGE 5H and Mk-BW17 (BAW-10159)
- Extended to BW17 thru extensive testing, producing 20% improvement in DNBR (BAW-10189)



LYNXT

What is it?

Where did it come from?

What is it used for?

How do we justify its application?

LYNXT History

- Based on COBRAIV-I (developed by ERDA and NRC)
- Modified by Framatome Cogema Fuels (FCF)
- Benchmarked to experiments, FCF codes (LYNX1, LYNX2) and industry codes (COBRA3C)
- Submitted/approved topicals
  BAW 10156A, March 1986
  BAW 10156A, Rev. 1, August 1993
- Used to successfully license ~30 15-by-15 (FCF) and 17-by-17 (Westinghouse) reload cores, since 1984

Benchmarks

- Comparison to LYNX1 (BAW 10129A, July 1985) and LYNX2 (BAW 10130A, July 1985)
- Comparison to COBRA3C
- Comparison to isothermal and heated tests
- Comparison to VIPRE (EPRI) and FLICA III-F (Framatome) codes

Isothermal Tests

- Interbundle Diversion Crossflow (IBDCF) tests (results in BAW 10156A and BAW 10156A, Rev. 1)
- Marignan tests from CEA's Hermes facility

Figure 6-1. Two-Bundle Isothermal Crossflow Test Apparatus

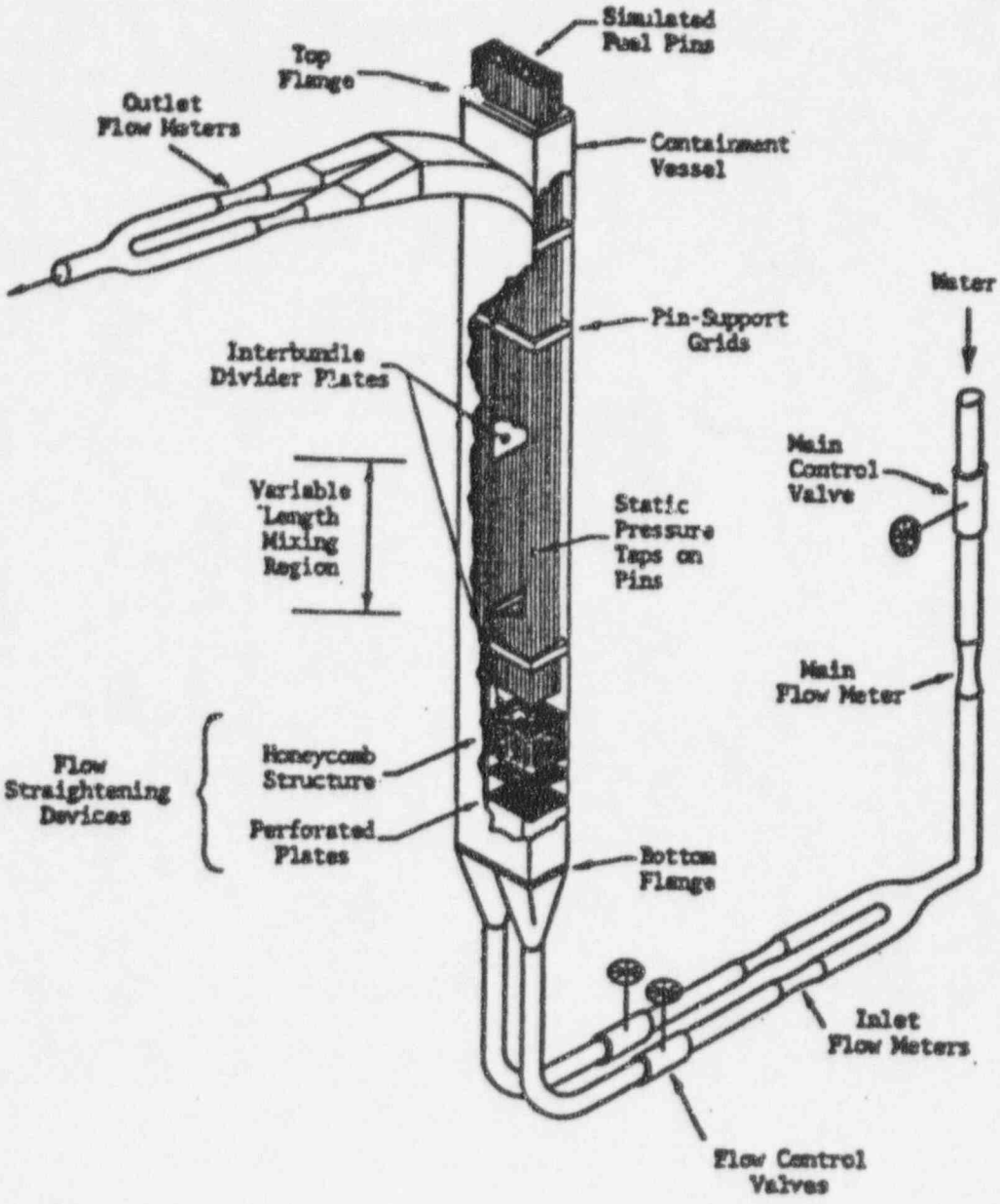
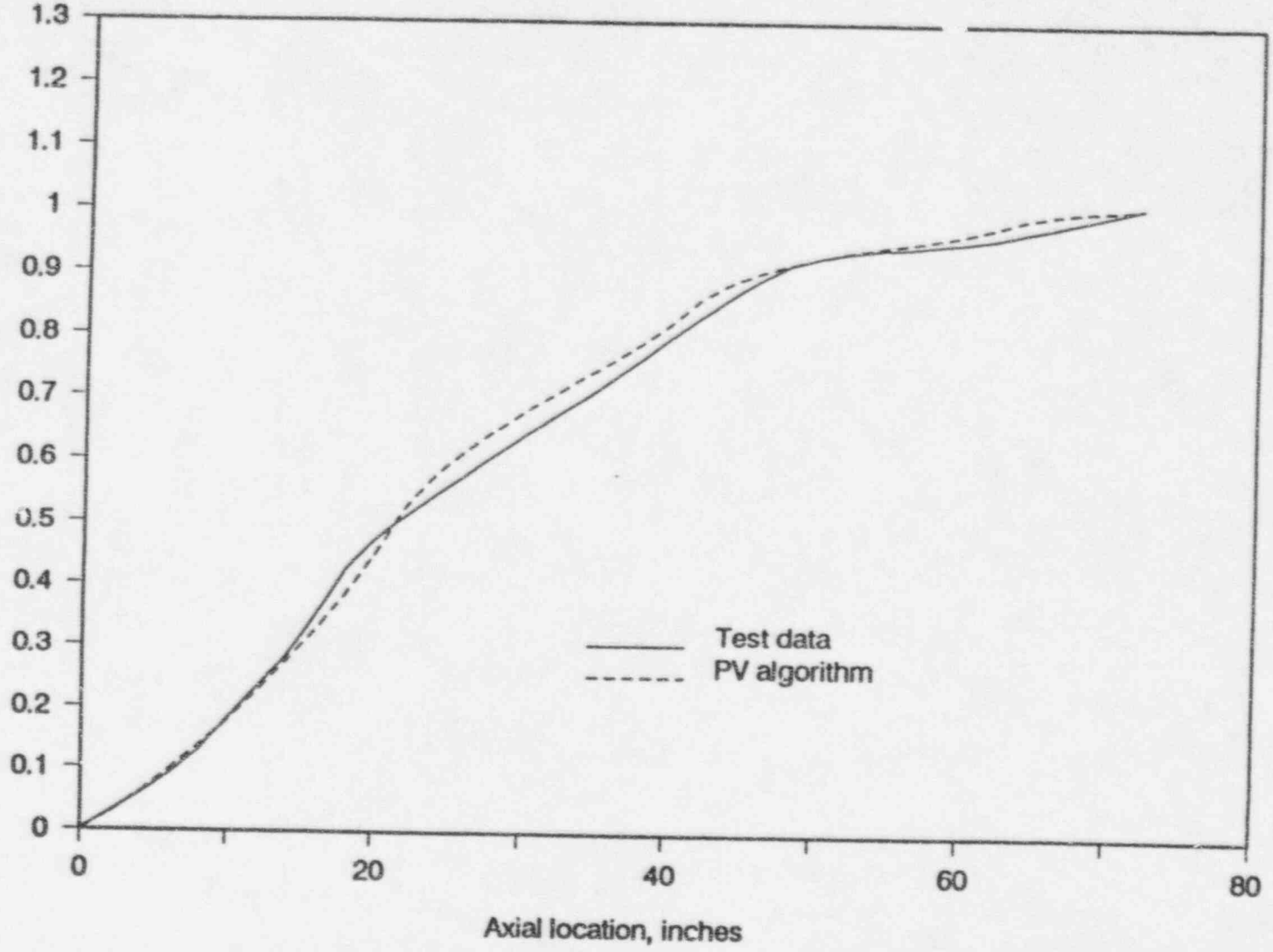


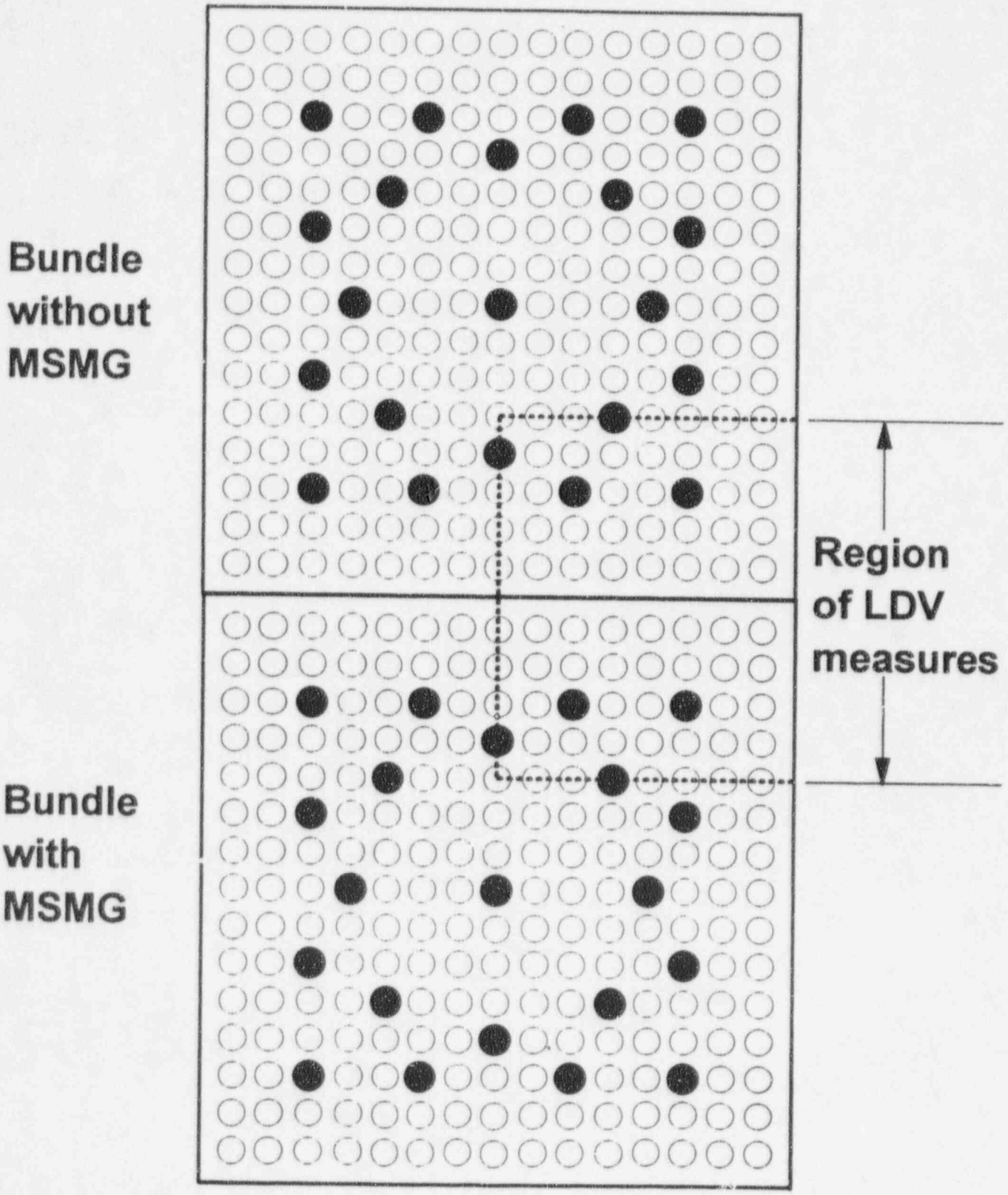
Figure 4-4. Bundle axial velocity ratio profiles for the IF F experimental data and the PV algorithm predictions.



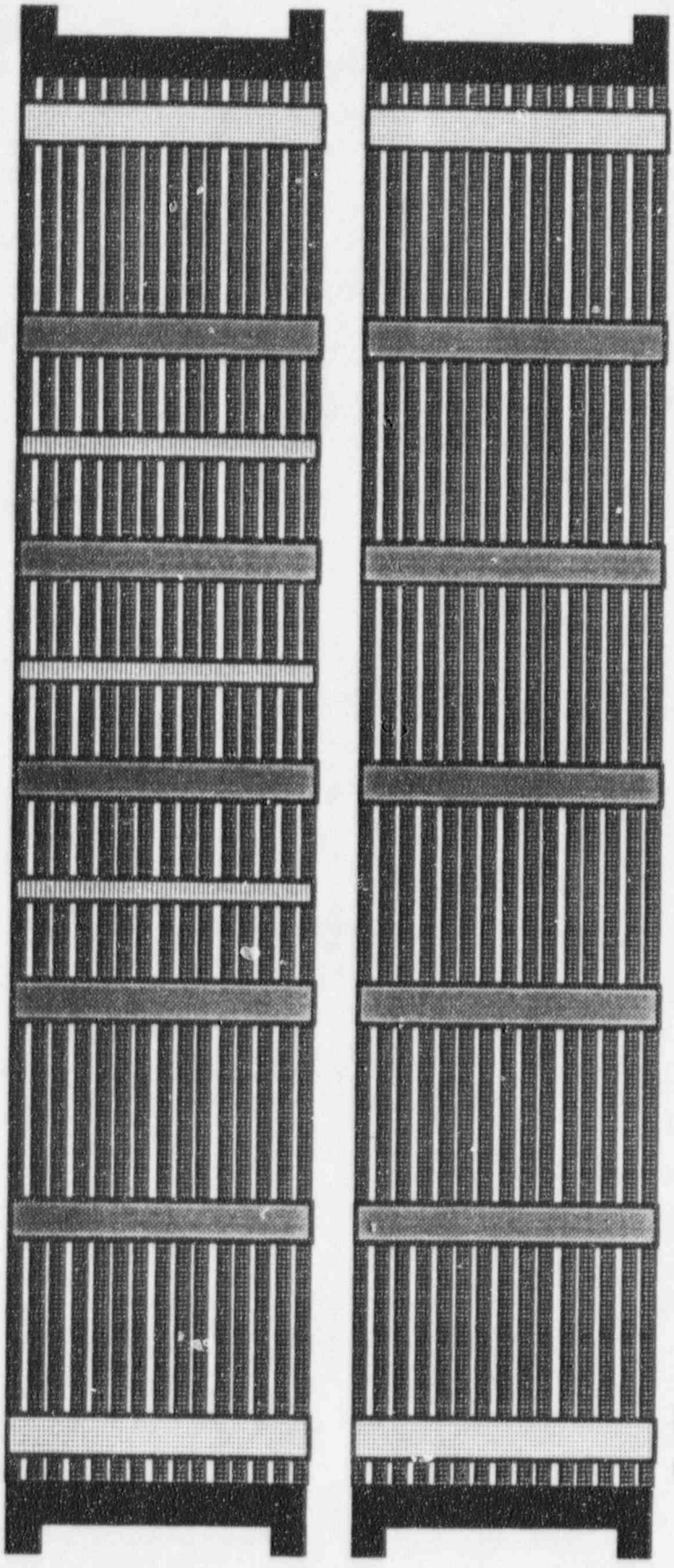
Marignan Tests

- 15-by-15 AFA-2G fuel assembly (FA)
  - 2 Nonmixing grids
  - 5 Mixing vane grids
  - 3 Midspan mixing grids (one FA)
- Fuel rod OD = 0.422 in
- Fuel rod pin pitch = 0.563 in
- Fuel pin length = 157.2 in

Marignan Test Configuration



Marignan Test Schematic



Mid Span Mixing Grid (MSMG)

Mixing Vane Grid

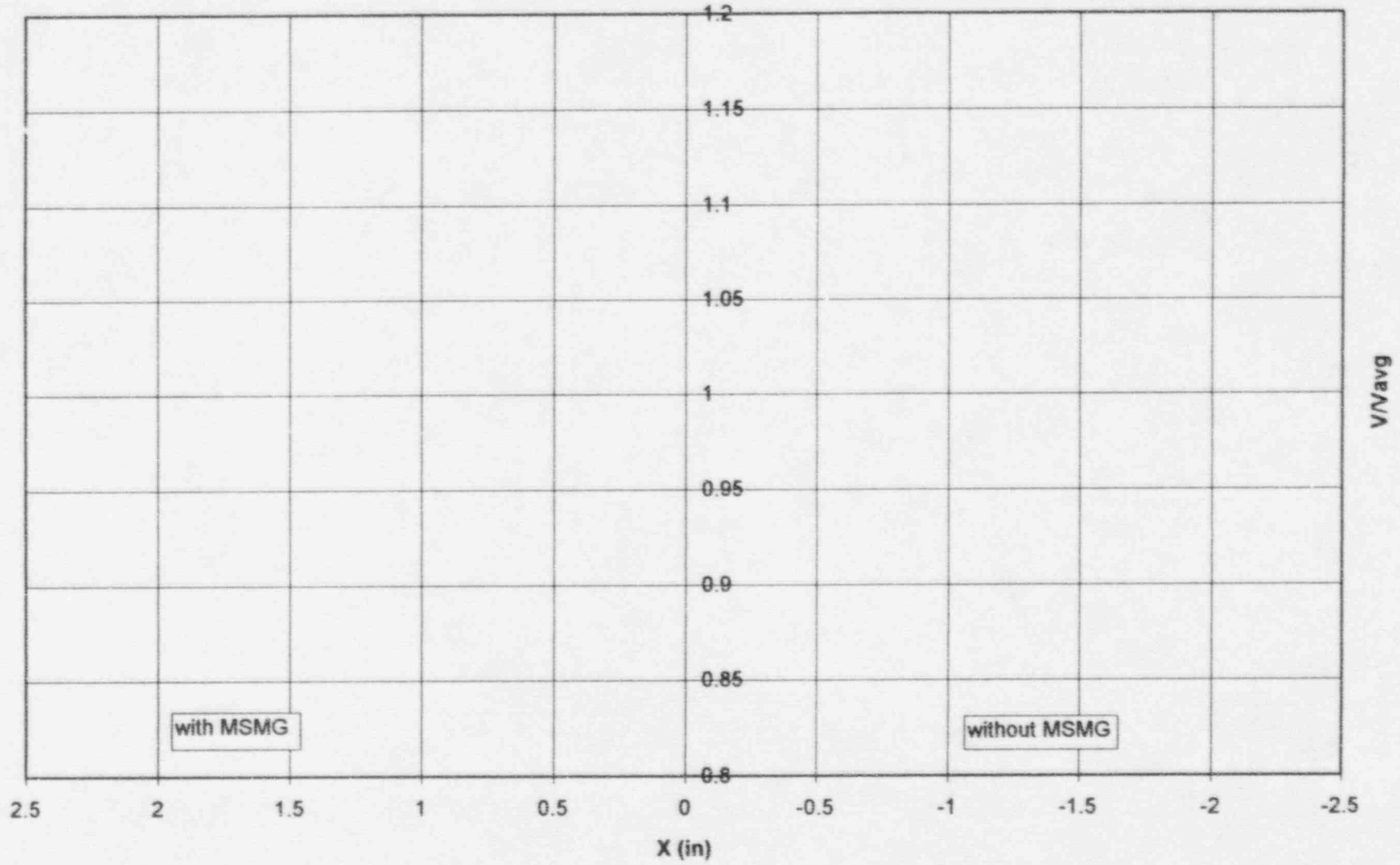
Bundle with MSMG

Bundle without MSMG

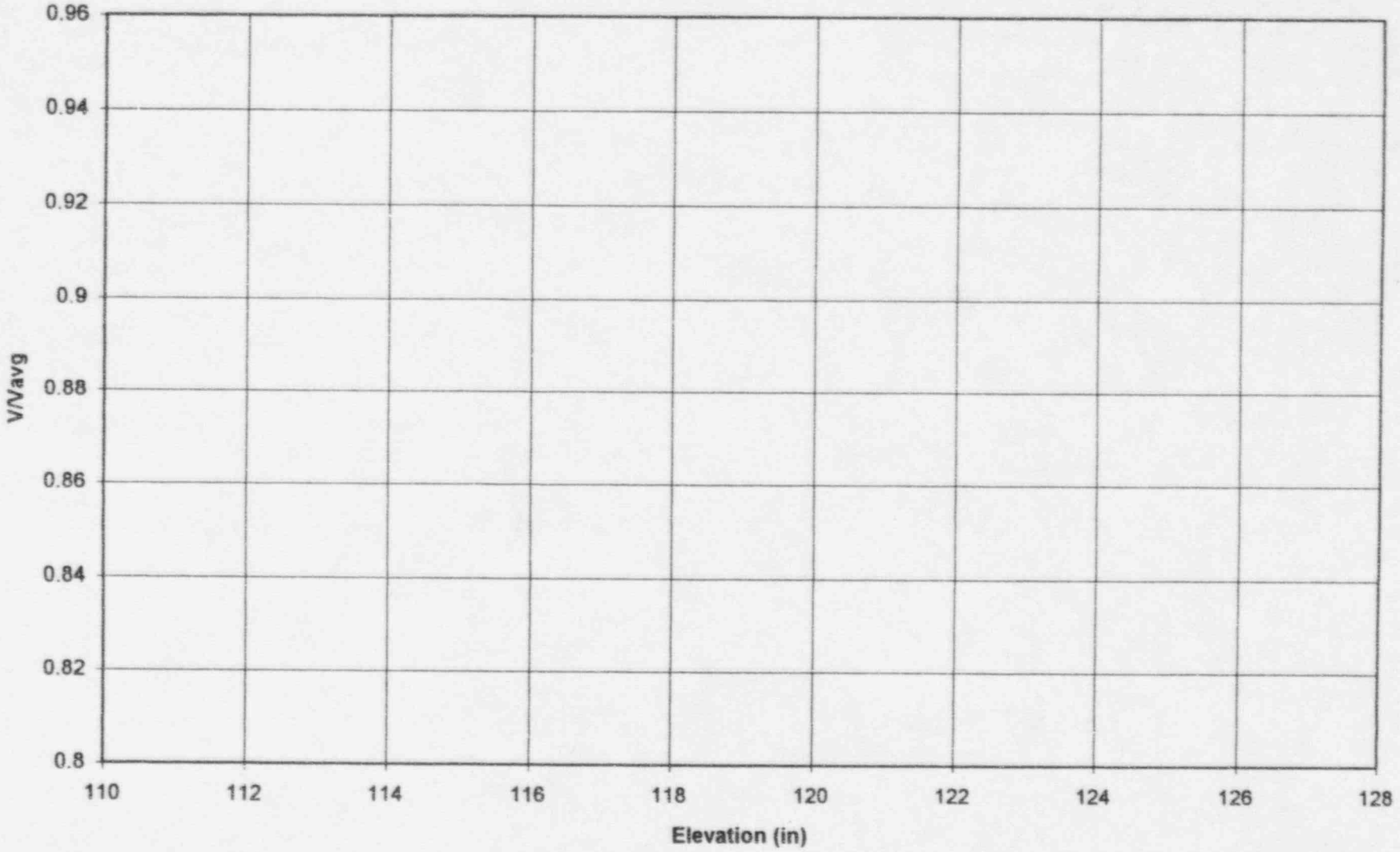
Nonmixing Grid

Schematic is not to scale.

Comparison of Measured and Predicted Axial Velocity
Axial Position: 7.5 mm Below 3rd MSMG



Comparison of Measured and Predicted Average Axial Velocity



Summary / Conclusions

- LYNXT approved by NRC.
- LYNXT extensively benchmarked to industry and NRC-approved codes.
- LYNXT compared to IBDCF and Marignan crossflow tests.
- LYNXT properly predicts the axial flow distribution when there are large hydraulic mismatches.
- LYNXT can be applied with confidence to mixed core situations.

Outline

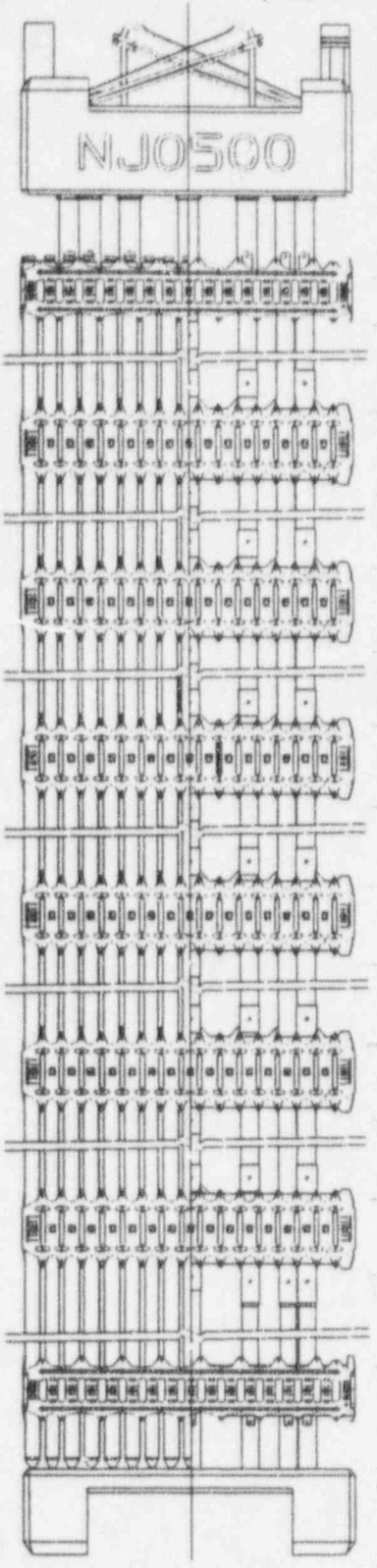
- Resident Fuel Characterization Program and Past Transition Core Experience
- Review of Sequoyah Specific Hydraulic Analyses
- Review of Sequoyah Specific DNB Analyses
- Transition Core Penalty
- Conclusions

Vantage 5H Characterization Program

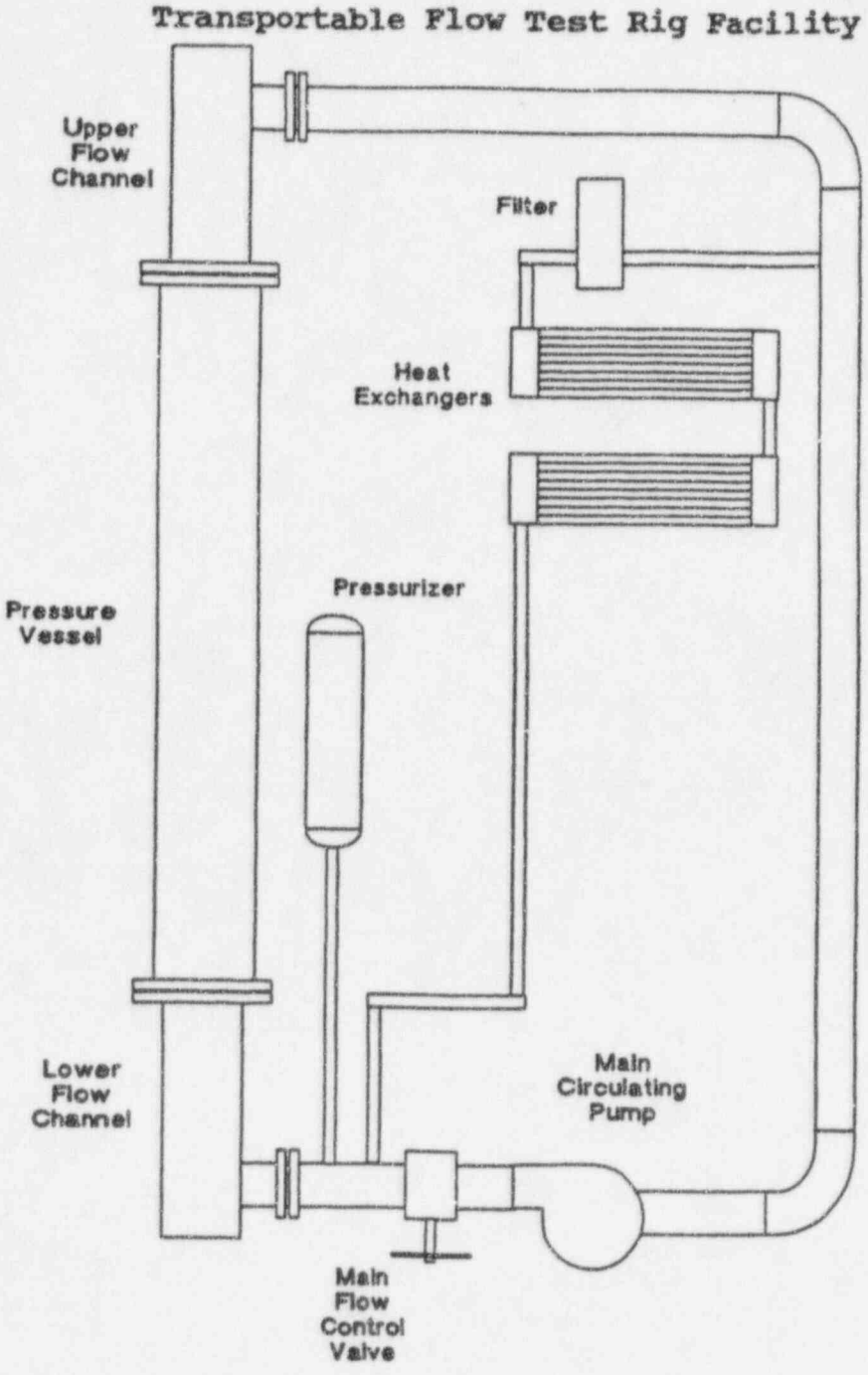
- March 1994 Received two fresh V5H assemblies at FCF's LMF
- Performed Extensive Dimensional Characterization
- Performed Hydraulic Testing Using FCF's Transportable Flow Test Rig (TFTR)

Figure 1
Axial Position Comparison of Primary Components

(Relative to Lower Nozzle seating surface, inches)

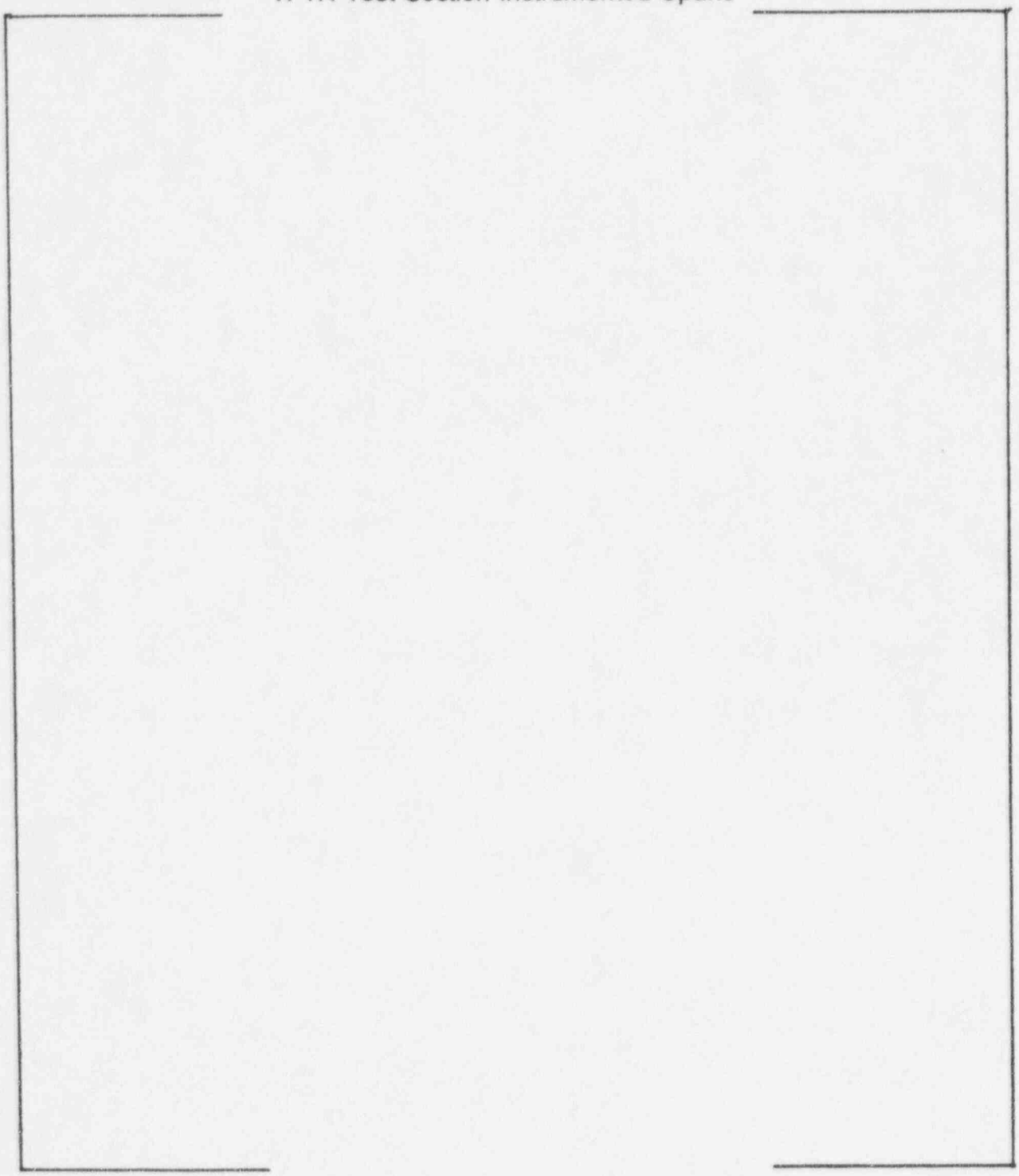


	Mark-BW	V-5H
Bottom of Upper Nozzle	156.3	156.5
Top of Fuel Rods	154.4	155.1
Top of End Grid	153.9	153.5
Bottom of End Grid	152.4	152.0
Top of Intermediate Grid	133.7	133.1
Bottom of Intermediate Grid	131.4	131.5
Top of Intermediate Grid	113.1	112.6
Bottom of Intermediate Grid	110.9	111.0
Top of Intermediate Grid	92.6	92.0
Bottom of Intermediate Grid	90.4	90.4
Top of Intermediate Grid	72.1	71.5
Bottom of Intermediate Grid	69.8	69.9
Top of Intermediate Grid	51.6	51.0
Bottom of Intermediate Grid	49.3	49.3
Top of Intermediate Grid	31.0	30.4
Bottom of Intermediate Grid	28.8	28.8
Top of End Grid	6.5	5.8
Bottom of End Grid	5.0	4.3
Bottom of Fuel Rods	2.6	2.9
Top of Lower Nozzle	2.6	2.4
	0.0	0.0



Non-Proprietary

TFTR Test Section Instrumented Spans

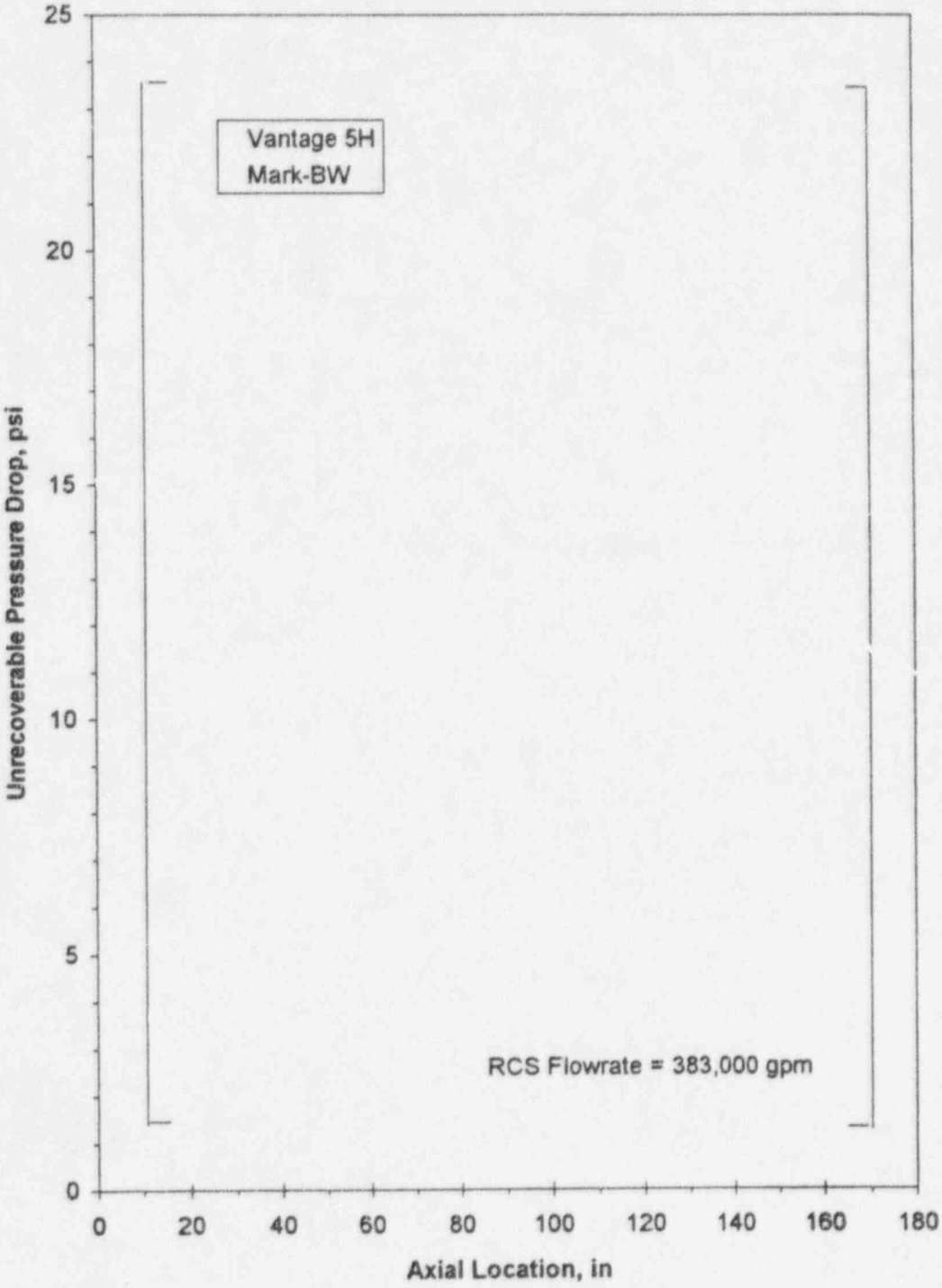


Non-Proprietary

TFTR Test Program

- Cold Flow Loop
  [ ]
- Tested [
  ]
- Acquired Assembly and Component Pressure Drop Data

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



Fuel Assembly Total Pressure Drop Comparison	
Assembly Type	Total Pressure Drop Difference (w.r.t. MK-BW)
Westinghouse Vantage 5H	[ ]
Westinghouse OFA	[ ]
FCF Mark-BW	--
Westinghouse Standard	[ ]

Mixing Grid Pressure Drop Across the Grid Comparison	
Assembly Type	Grid Pressure Drop Difference (w.r.t. MK-BW)
Westinghouse OFA	[ ]
FCF Mark-BW	--
Westinghouse Vantage 5H	[ ]
Westinghouse Standard	[ ]

Sequoyah Specific Hydraulic Analyses

- [ ]
- [ ]
- [ ]

Figure 3
LYNXT 31-Channel Bundle-By-Bundle Model

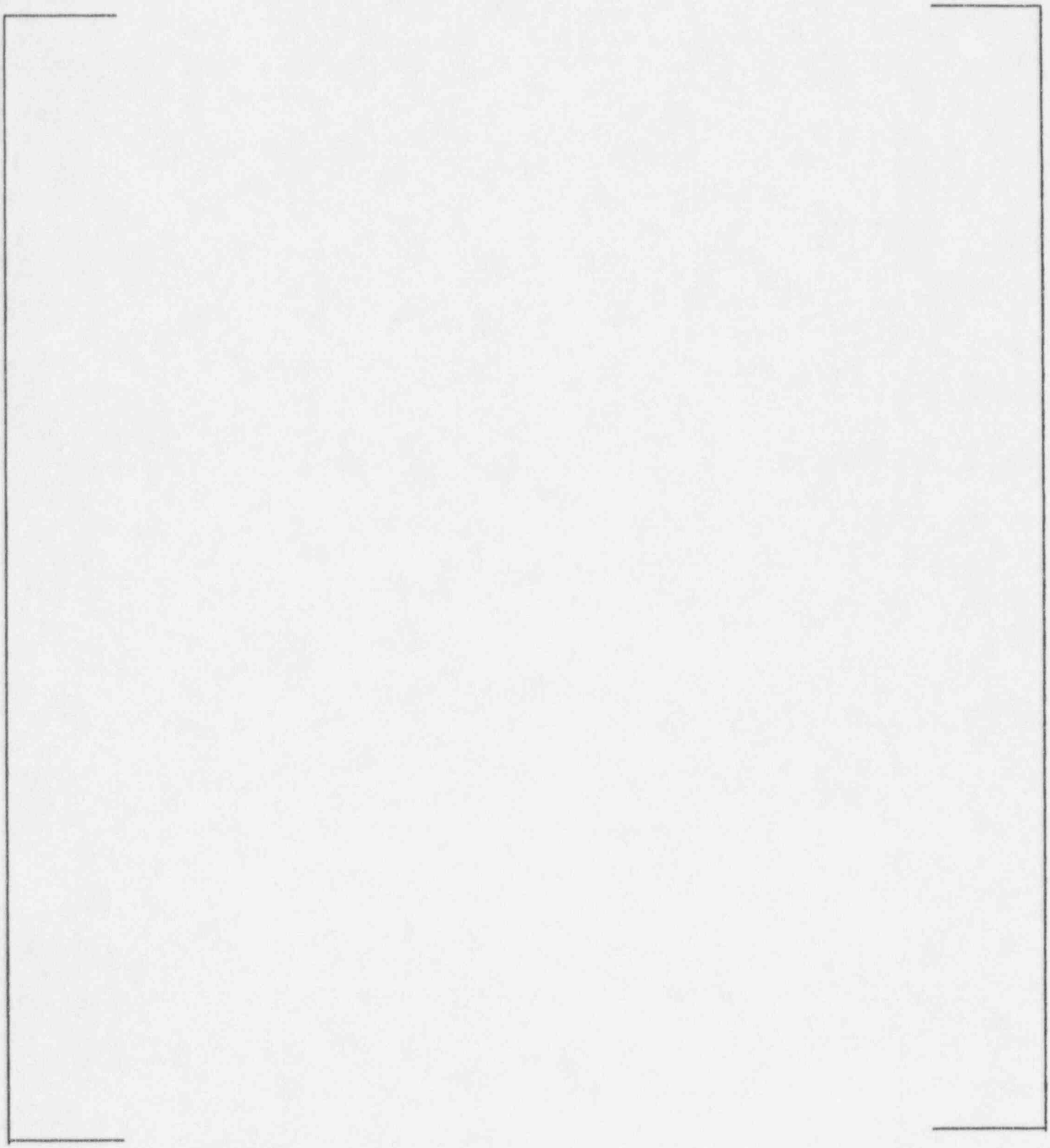


Figure 9
Mass Velocity Comparison - Mark-BW
Channel 1 (MK-BW) Mass Velocity

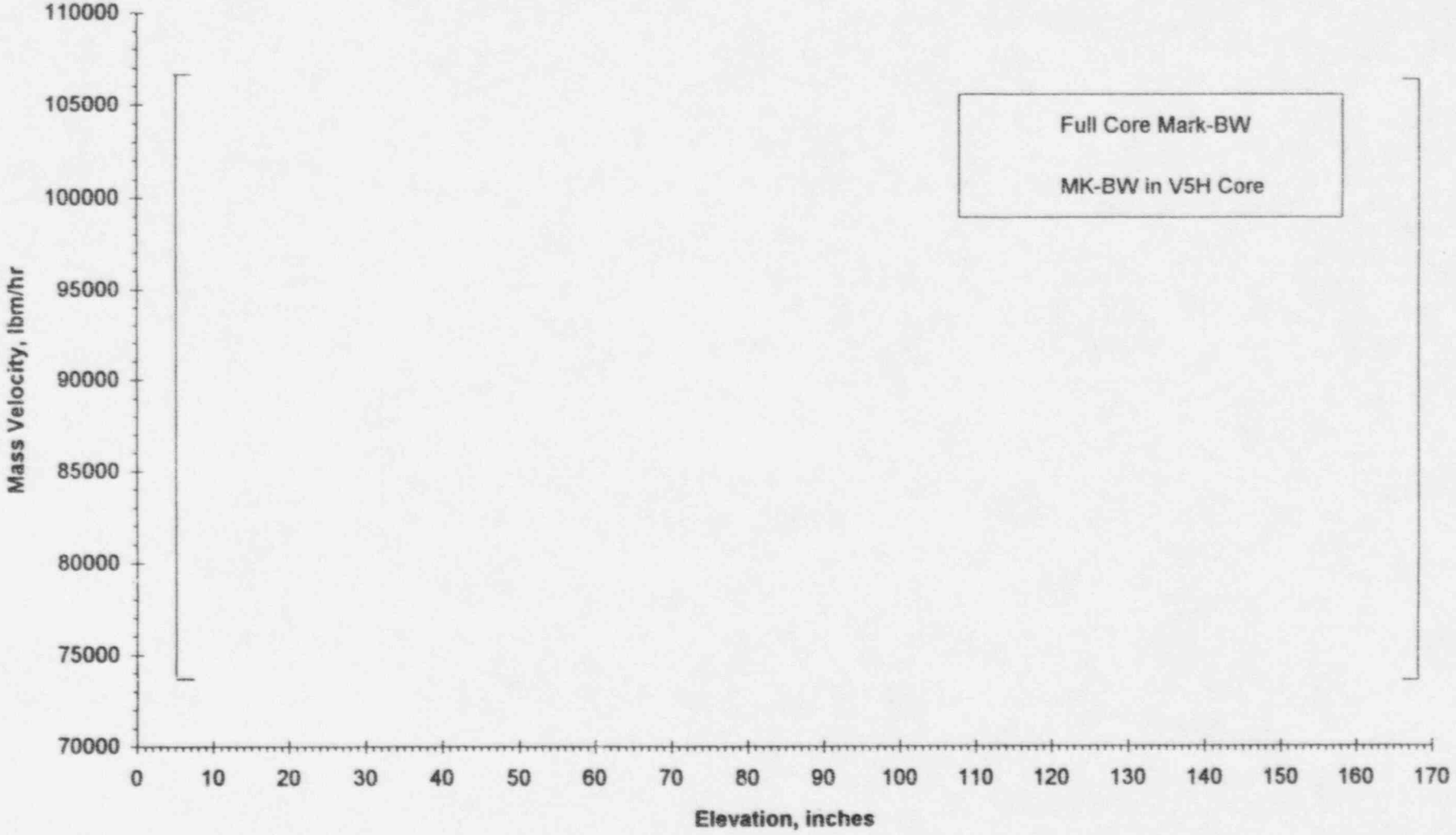
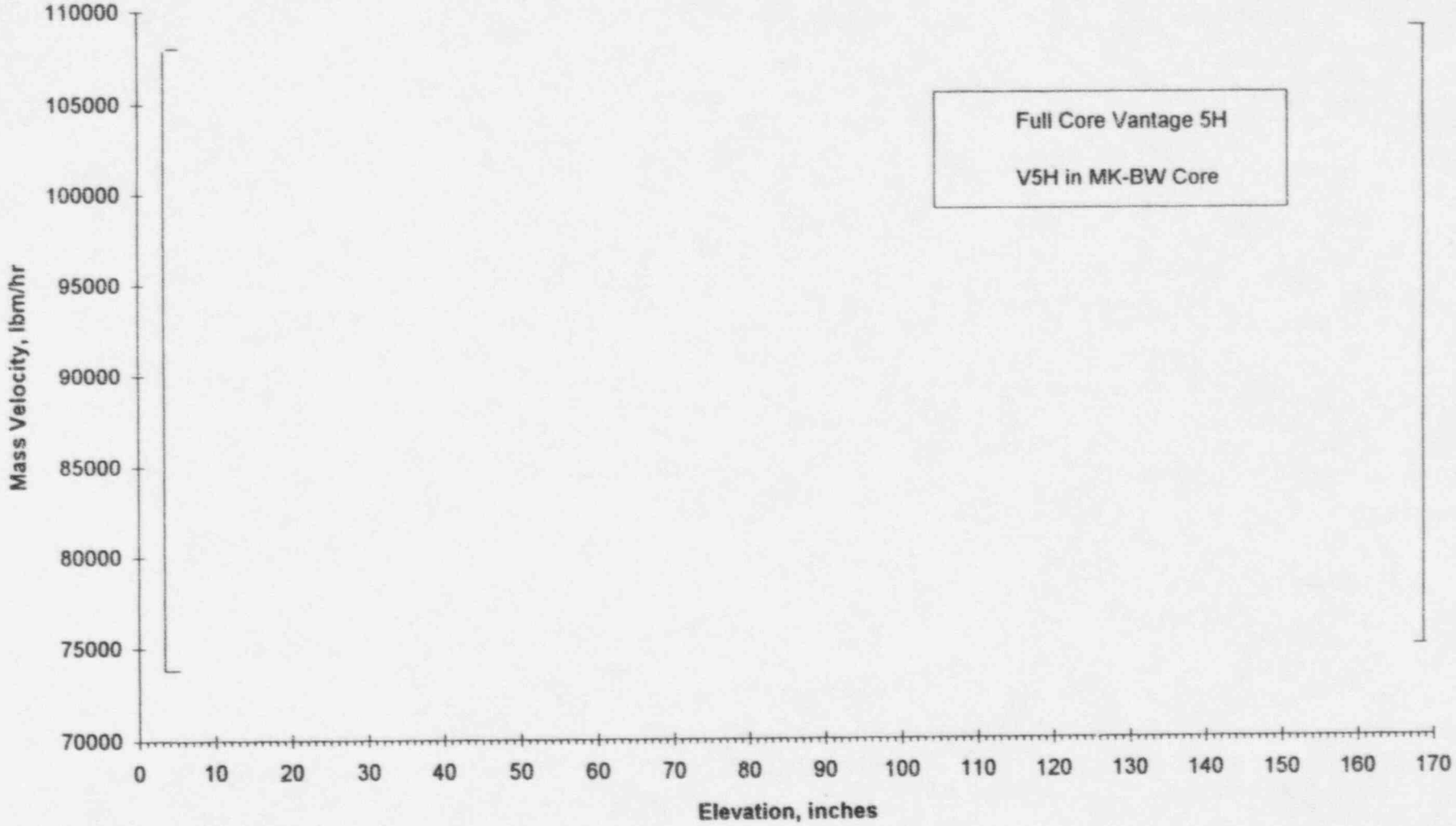


Figure 10
Mass Velocity Comparison - Vantage 5H
Channel 1 (V5H) Mass Velocity



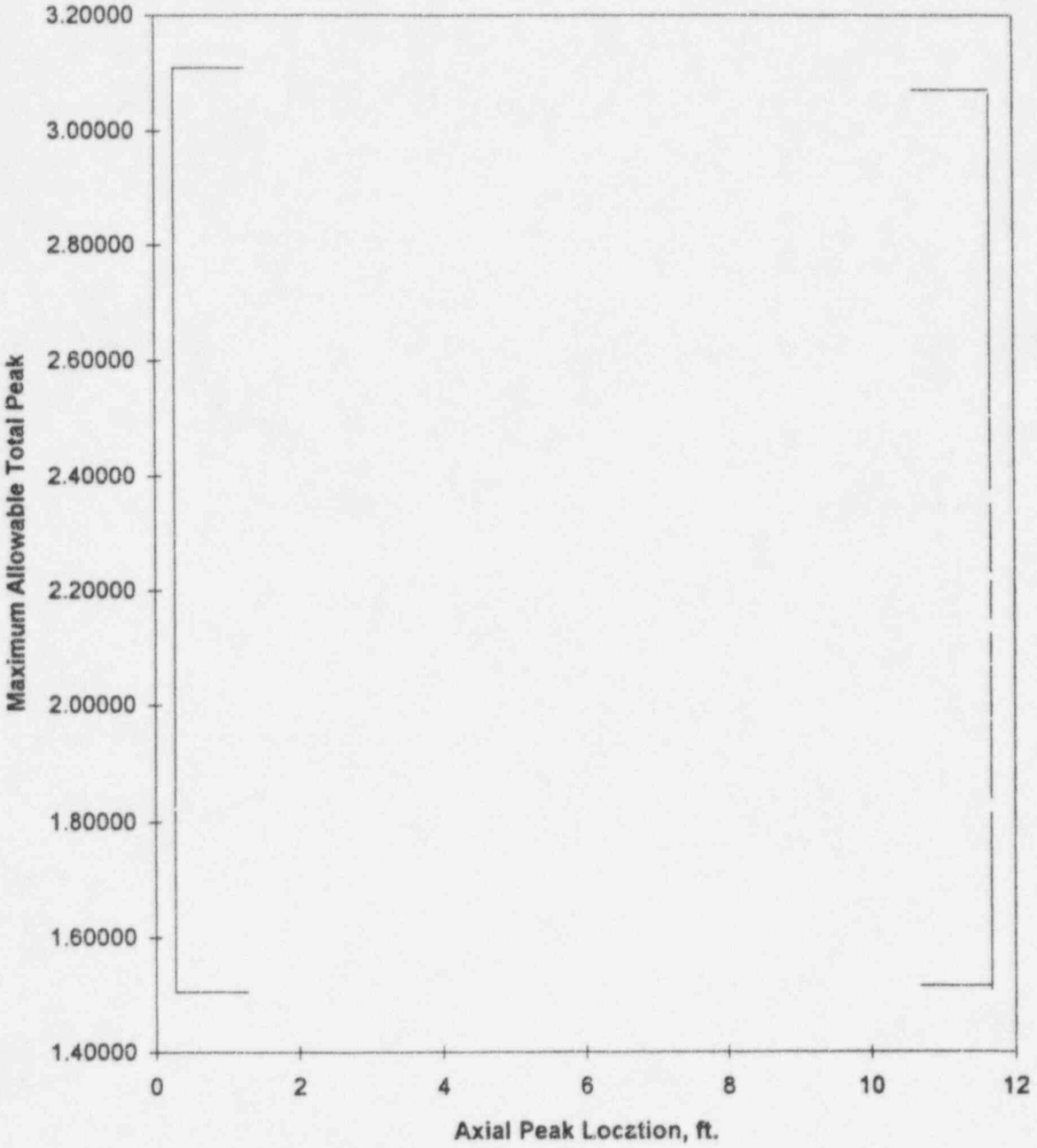
Sequoyah Specific DNB Analysis Ground Rules

- [ ]
- [ ]
  [ ]
- [ ]
  [ ]
  [ ]
  [ ]

What Constitutes FCF's DNB Analysis Package?

- [ ]
  - [ ]
  - [ ]
    [ ]

Typical 118% Power Safety Limit MAP Curves
Allowable Total Peak Versus Axial Peak Location
Mark-BW



Non-Proprietary

How Are MAP's Generated?

- For Vantage 5H
  - [ ]
    [ ]
  - [ ]
- For Mark-BW
  - [ ]
  - [ ]
    [ ]

Figure 4
LYNXT [ ] Model

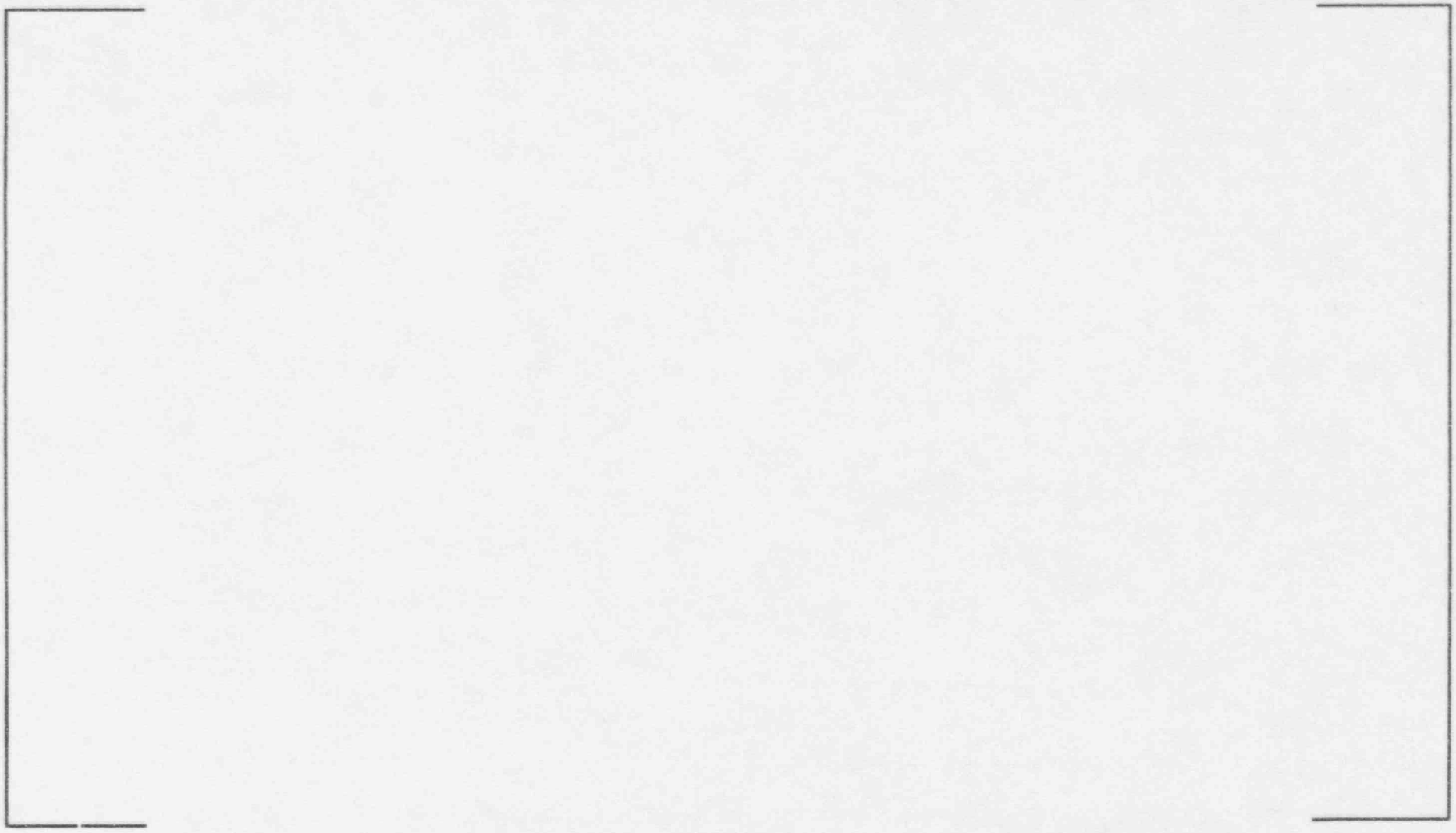
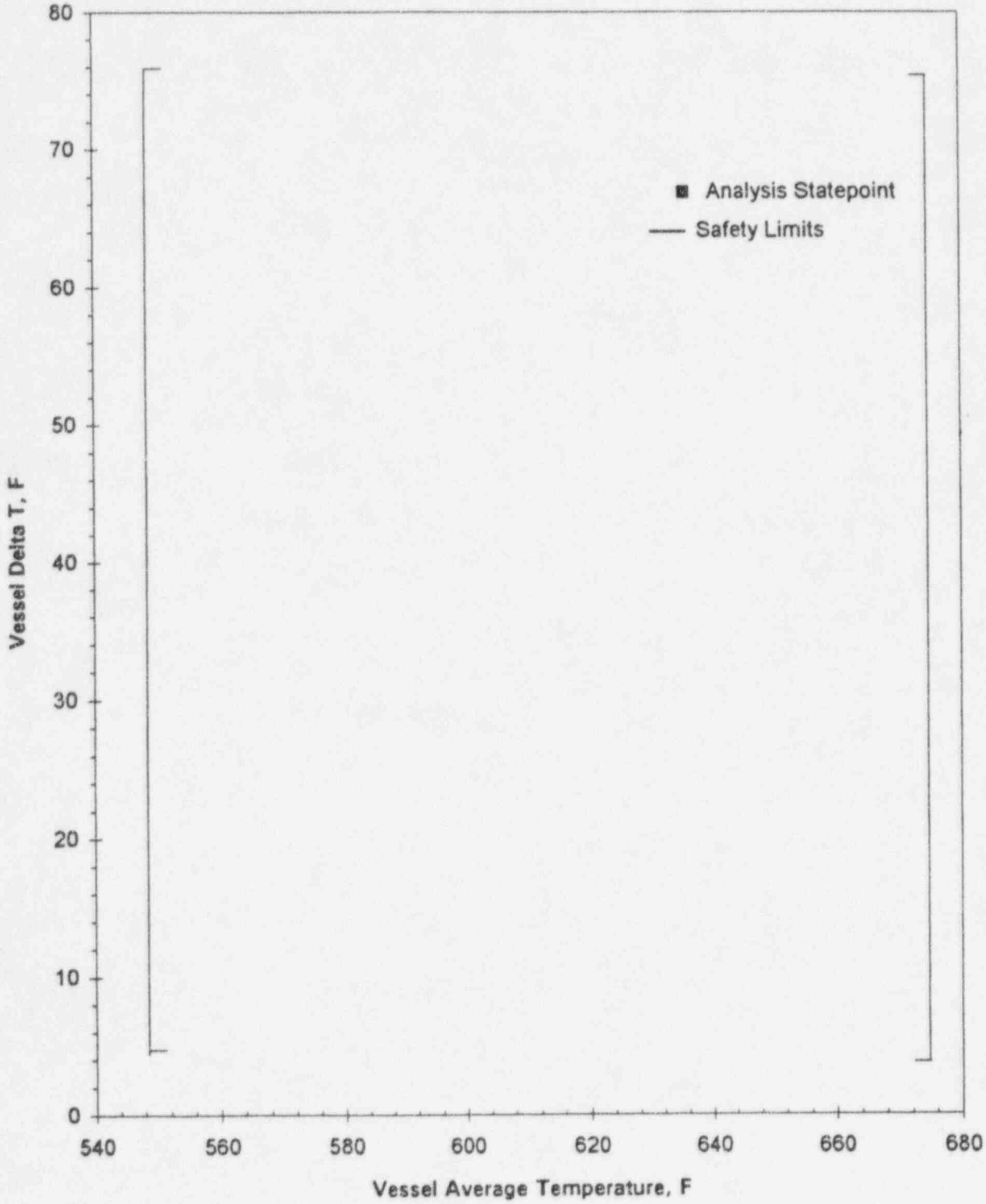


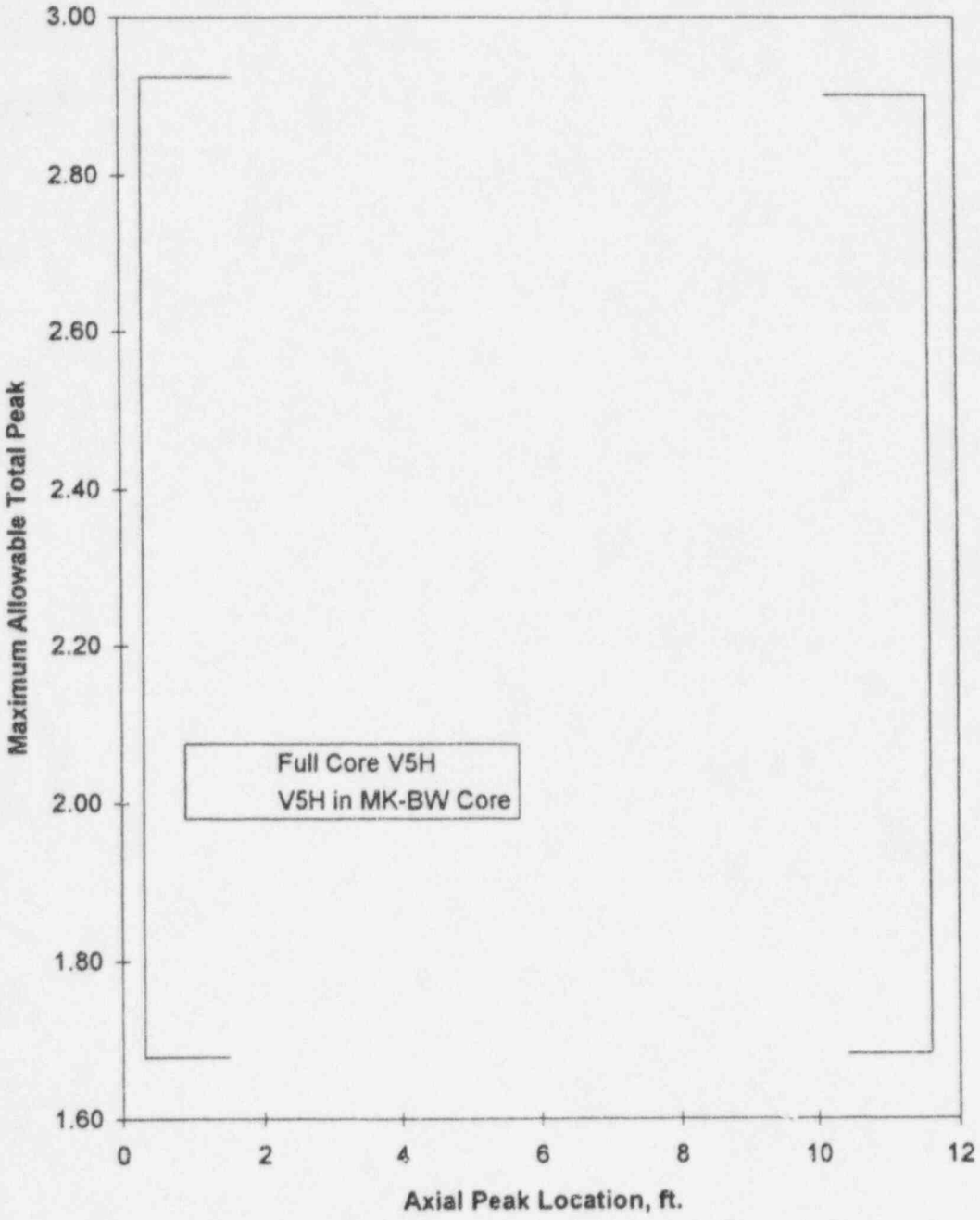
Figure 11
Sequoyah Reactor Core Safety Limits and
Statepoints for MAP Limit Analysis



Existing Safety Limit Evaluations

	Pressure (psia)	Power (%)	BWCMV MDNBR	Margin to TDL (1.50)	Margin to SDL (1.345)
Statepoint "A" 1775 psia, 118% Power					
Full V5H	1775 psia	118	[		]
V5H in BW	1775 psia	118	[		]
Full BW	1775 psia	118	[		]
BW in V5H	1775 psia	118	[		]
Statepoint "D" 1775 psia, 100% Power					
Full V5H	1775 psia	100	[		]
V5H in BW	1775 psia	100	[		]
Full BW	1775 psia	100	[		]
BW in V5H	1775 psia	100	[		]
Statepoint "B" 2400 psia, 118% Power					
Full V5H	2400 psia	118	[		]
V5H in BW	2400 psia	118	[		]
Full BW	2400 psia	118	[		]
BW in V5H	2400 psia	118	[		]
Statepoint "C" 2400 psia, 100% Power					
Full V5H	2400 psia	100	[		]
V5H in BW	2400 psia	100	[		]
Full BW	2400 psia	100	[		]
BW in V5H	2400 psia	100	[		]

Vantage 5H
MAP Limit Development Method



Summary and Conclusions

- Through Inspection and Testing, FCF has extensive data on resident Westinghouse Fuel.
- The transition at Sequoyah is similar to previous successful transitions at McGuire, Catawba and Trojan.
- FCF has demonstrated that the LYNXT code accurately predicts mixed core conditions.
- FCF has performed extensive Mixed Core Hydraulic and DNB analysis, demonstrating that Sequoyah's current safety limits are valid for the fuel transition.
- [ ]
  [ ]