NRC FORM 658
(9-1999)

U.S. NUCLEAR REGULATORY COMMISSION

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DATE OF MEETING
04/16/2002

The attached document(s), which was/were handed out in this meeting, is/are to be placed in the public domain as soon as possible. The minutes of the meeting will be issued in the near future. Following are administrative details regarding this meeting:

Docket Number(s)	**50-338 and 50-339**
Plant/Facility Name	**North Anna Power Station**
TAC Number(s) (if available)	**MB4643 and MB4644**
Reference Meeting Notice	**Accession No. ML020840200**
Purpose of Meeting (copy from meeting notice)	**Discussion of the Framatome fuel transition program at North Anna Power Station.**

NAME OF PERSON WHO ISSUED MEETING NOTICE	TITLE
Stephen R. Monarque	**Project Manager**

OFFICE
Office of Nuclear Reactor Regulation

DIVISION
Division of Licensing Project Management

BRANCH
Project Directorate II

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DF03

Dominion

FRAMATOME ANP

North Anna Fuel Transition Program

Review Status Meeting

NRC-One White Flint North
April 16, 2002

Dominion

Meeting Participants

FRAMATOME ANP

- Dominion
  - G. L. Darden - Program Manager/Nuclear Safety Analysis
  - E. T. Shaub - Nuclear Licensing
- Framatome ANP
  - J. R. Biller - LOCA Analysis
  - B. M. Dunn - LOCA Analysis
  - R. J. Lowe - LOCA Analysis
  - J. S. Holm - Manager, Product Licensing
  - C. K. Nithianandan (Nithian) - LOCA Analysis
  - R. D. Williamson - Project Manager
  - G. J. Wissinger - LOCA Analysis

Dominion *Introductory Remarks* FRAMATOME ANP

Meeting Objectives
Presentation Topics
Status of Transition Program Activities

G. L. Darden - Dominion

April 16, 2002 - 3

Dominion *Presentation Topics* FRAMATOME ANP

- *Status of Transition Program Activities*
- *North Anna-Specific LOCA Licensing Needs*
  - BEACH Submittal
  - North Anna Plant-Specific Items/EM Departures
- *Integrated Transition Program Review Schedule*
- *Questions/Action Items*

April 16, 2002 - 4

Dominion

Status of Transition
Program Activities

FRAMATOME ANP

- *Summary Content of Dominion License Amendment Request Issued 3/28/02*
  - Design Features—Advanced Mark-BW Fuel Product
  - Evaluations Performed
    - Mechanical Design
    - Structural Design (Normal Operation and Faulted Conditions)
    - Thermal-Hydraulic Analysis
    - Compatibility (Mechanical, Interface and Neutronic)
    - Non-LOCA Accident Evaluations
    - LOCA Analyses [Ongoing—Detailed Discussion to Follow]
    - Spent Fuel Pool Criticality
    - Impact on Radiological Consequences of Accidents

April 16, 2002 - 5

Dominion

Status of Transition
Program Activities

FRAMATOME ANP

- *TS Changes Requested*
  - Safety Limits (TS 2.1.1)—Define Separate Fuel Centerline Melt Relationship for W & Framatome ANP Fuel, as Follows:

    "The peak fuel centerline temperature shall be maintained < 5080°F, decreasing by 58°F per 10,000 MWT/MTU of burnup, for Westinghouse fuel and < 5173°F, decreasing by 65°F per 10,000 MWD/MTU of burnup, for Framatome ANP fuel."

  - Design Features (TS 4.2.1)—Add Framatome ANP M5™ Alloy to List of Cladding Materials
  - Core Operating Limits Report (TS 5.6.5b)—Add References for Framatome ANP Methodologies

April 16, 2002 - 6

Dominion | *Status of Transition Program Activities* | FRAMATOME ANP

- *Regulatory Exemptions for Use of M5™ Clad Alloy*
  - Requested Since Existing Language Does Not Specifically Accommodate Use of M5™ (Only Zircaloy and ZIRLO™ Cited)
  - 10CFR50.44(a)—Addresses Post-LOCA Hydrogen Gas Control
    - Baker-Just Model Conservative for M5™
    - Existing North Anna Hydrogen Analyses Not Impacted
  - 10CFR50.46(a)(1)(i)—Addresses ECCS Performance
    - Acceptance Criteria of 10CFR50.46(b) Applicable to M5™
    - North Anna Analyses Will Conform to Acceptance Criteria
- *Intent of Each Regulation is Met for North Anna*

Dominion | *Status of Transition Program Activities* | FRAMATOME ANP

- *Documentation of Framatome ANP Mixed-Core Analysis Methodology*
  - General Approach
    - Thermal-Hydraulic Analysis Performed for Various Core Configurations and Plant Operating Conditions
    - Bounding Mixed-Core DNB Effect Explicitly Quantified
    - Allows Separate Assessment of W and Framatome ANP Fuel Using CHF Correlations Applicable for Each Design
  - Analyses Support Key Operating Limits
    - Core Power (Including Measurement Uncertainty Up-Rating)
    - $F_{\Delta H}$ Limit: 1.538 (1^{ST} Transition Cycle) and 1.587 (2^{ND} Cycle)
    - Current Core Thermal Limits

Dominion | *Status of Transition Program Activities* | FRAMATOME ANP

- *Dominion Topical Changes*
  - VEP-FRD-42, Revision 2—Submitted **10/8/01**
    - Qualification of Reload Methodology for Framatome ANP Fuel
    - Discussed in **March 11** Teleconference with NRC Staff
    - Draft RAI Responses Discussed with NRC Staff on **April 15**
  - VEP-NE-1, Revision 1—Relaxed Power Distribution Control
    - Revisions to Address Use of Framatome ANP Fuel
    - Scheduled Revision per 10CFR50.59 by **7/31/02**

April 16, 2002 - 9

Dominion | *Introductory LOCA Remarks* | FRAMATOME ANP

LOCA Licensing Needs

J. S. Holm – Framatome ANP

April 16, 2002 - 10

Dominion — LOCA Licensing Needs — FRAMATOME ANP

- BEACH Topical Report
  - Initial Reflood Temperature
  - Reflood Rate
- North Anna Plant-Specific Items/EM Departures
  - Core Peaking for LOCA Evaluation
  - Energy Deposition
  - Average Core Energy Representation
  - Minimum Containment Backpressure
  - REFLOD3B Carryout Rate Fraction
  - End of Transient Justification
  - Oxide Calculations
  - SBLOCA Noding

April 16, 2002 - 11

Dominion — Introductory LOCA Remarks — FRAMATOME ANP

LOCA Evaluation Model Review Issues and Status

J. R. Biller – Framatome ANP

[Closed Session—Framatome ANP Proprietary Information]

April 16, 2002 - 12

Dominion

LOCA Topics

FRAMATOME ANP

- *North Anna-Specific LOCA Licensing Needs*
  - LOCA Submittals—Status
    - Fuel Temperature Uncertainty (Completed 4/9/02)
    - BEACH Revision
  - The North Anna Analysis Challenge
  - Overview of North Anna-Specific Items
  - Detailed Discussion of North Anna-Specific Items

April 16, 2002 - 13

Dominion

North Anna-Specific LOCA Licensing Needs

FRAMATOME ANP

- *LOCA Submittals*
  - Current Approved Evaluation Model

    RSG EM: BAW-10168PA-03
    RELAP5: BAW-10164PA-03
    REFLOD3B: BAW-10171PA-03
    BEACH: BAW-10166PA-04
  - Fuel Temperature Uncertainty

    EM Letter: FTI-00-551, 2/29/00
    RELAP5: BAW-10164P-04, 9/99
    Completed: SER 4/9/02
  - BEACH Revision

    BEACH: BAW-10166-05, 12/01

April 16, 2002 - 14

Dominion — *BEACH Revision* — FRAMATOME ANP

- *BEACH Appendix H and I*
  - BEACH Approved Applicability Ranges Limited
  - Appendix H Requests Increase of Initial Clad Temperature
    - 1,640 F to 2,045 F
  - Appendix I Requests Change of Lower Flooding Rate
    - 0.5 in/s to 0.3 in/s
  - BEACH is Mechanistic with Extensive Experimental Benchmarks
  - Extensive Benchmarks Provided for These Changes
  - Information Sufficient for Ready Approval

April 16, 2002 - 15

Dominion — *North Anna-Specific LOCA Licensing Needs* — FRAMATOME ANP

- *The North Anna Analysis Challenge*
  - Reactor Vessel Upper Head Geometry
    - Traps Water—Unavailable for Core Cooling
    - Plugs Spray Nozzles
  - T_{HOT} Plants with Sub-Atmospheric Containments
    - Reduced Flooding Rates
      - Spray Nozzle Sizes Promotes Steam Binding
      - Low Containment Backpressure Promotes Added Steam Binding

April 16, 2002 - 16

Dominion

North Anna-Specific
LOCA Licensing Needs

FRAMATOME ANP

- *North Anna Plant-Specific Items/EM Departures*
  - Core Peaking for LOCA Evaluation
  - Energy Deposition
  - Average Core Energy Representation
  - Minimum Containment Backpressure
  - REFLOD3B Carryout Rate Fraction
  - End of Transient Justification
  - Oxide Calculations
  - SBLOCA Noding

April 16, 2002 - 17

Dominion

LOCA Overview
Concluding Remarks

FRAMATOME ANP

- *LOCA Submittals*
  - All Been Issued
  - Are Under NRC Review
  - <u>No Additional Topical Report Revisions Planned</u>

- *North Anna Plant-Specific Items/EM Departures*
  - Issued by LOCA LAR Supplement "OR"
  - Issued by Letter Prior to LOCA LAR Supplement
  - "NRC CHOICE"
  - **NRC FEEDBACK AT MEETING END**

- ***<u>Transition Requires Both LOCA Submittals and North Anna-Specific Items</u>***

April 16, 2002 - 18

Dominion | *North Anna-Specific LOCA Licensing Needs* | FRAMATOME ANP

North Anna Plant-Specific Items/EM Departures

X Core Peaking for LOCA Evaluation — Bert Dunn

Energy Deposition
Average Core Energy Representation
Minimum Containment Backpressure
REFLOD3B Carryout Rate Fraction
End of Transient Justification
Oxide Calculations
SBLOCA Noding

April 16, 2002 - 19

Dominion | *Core Peaking for LOCA Evaluation* | FRAMATOME ANP

- *LOCA Core Modeling*
  - Hot Pin
  - Hot Assembly
  - Average Core
- *Preserve North Anna Operational Flexibility*
  - LOCA Assumptions Should Follow and Support Existing Limiting Conditions of Operation (LCO) Control Methodology
  - North Anna LCO Methodology Controls
    - F_Q
    - $F_{\Delta H}$

April 16, 2002 - 20

Dominion | Core Peaking for LOCA Evaluation | FRAMATOME ANP

North Anna Power Distribution Determinants

- LCO Methodology
  - Develop Set of "Normal" Power Distributions—Condition I Events
  - Screen Set of Shapes to Those Allowed Axial Imbalances that Support Plant F_Q and $F_{\Delta H}$ Limits with Peaking Uncertainty Applied
  - Compliance with F_Q and $F_{\Delta H}$ is Surveyed During Operation
- Reload Check
  - From Screened Power Distributions Determine Maximum Assembly Power (Including any Methods Bias)
  - If Maximum Assembly Power is > LOCA Assumption
    - Further Reduce Imbalance, or
    - LOCA Calculations (Evaluation/Rerun)

April 16, 2002 - 21

Dominion | Core Peaking for LOCA Evaluation | FRAMATOME ANP

Peaking Distribution Characteristics:

- Hot Pin at Maximum Local Peaking (F_Q) Allowed by Tech Specs with Provision for Calculation and Measurement Uncertainties
- Full Uncertainties Applied to Hot Pin Calculation Regardless of Elevation at Which Peak Cladding Temperatures Occurs
- Fluid Conditions for Cooling Hot Pin are Most Severe Expected
- Liquid Entrainment and Coolant Vapor Velocities Not Exaggerated

April 16, 2002 - 22

Dominion | *Core Peaking for LOCA Evaluation* | FRAMATOME ANP

Peaking for North Anna Reload LOCA Calculations

- F_Q, $F_{\Delta H}$, and Hot Assembly Radial Selected by Dominion

- Peaking Results

		Value
– Hot Pin		
• Radial	= $F_{\Delta H}$ (LCO)	1.60
• Axial	= F_Q (LCO) / $F_{\Delta H}$	1.37
– Hot Assembly		
• Radial	= DG-Supplied (Reload Check)	1.45
• Axial	= Hot Pin Axial	1.37
– Average Core		
• Radial	= ~1.0	0.997
• Axial	= Hot Pin Axial	1.37

Dominion | *North Anna-Specific LOCA Licensing Needs* | FRAMATOME ANP

North Anna Plant-Specific Items/EM Departures

X	Core Peaking for LOCA Evaluation	Bert Dunn
X	Energy Deposition	Bert Dunn
	Average Core Energy Representation	
	Minimum Containment Backpressure	
	REFLOD3B Carryout Rate Fraction	
	End of Transient Justification	
	Oxide Calculations	
	SBLOCA Noding	

Dominion | *Energy Deposition* | FRAMATOME ANP

- *Energy Deposition Factor (EDF)*
  - Approved EM: 0.95 Both Steady State and Transient
  - EDF Calculations for North Anna Resulted in Higher Values
  - North Anna LOCA Will Use the More Conservative Calculated Values:
    - Steady State = 0.974 for Hot Pin
      = 0.974 for Hot Assembly
    - Transient = 0.974 for Hot Pin
      = 1.0 Hot Assembly

Dominion | *North Anna-Specific LOCA Licensing Needs* | FRAMATOME ANP

North Anna Plant-Specific Items/EM Departures

X	Core Peaking for LOCA Evaluation	Bert Dunn
X	Energy Deposition	Bert Dunn
X	Average Core Energy Representation	Bert Dunn
	Minimum Containment Backpressure	
	REFLOD3B Carryout Rate Fraction	
	End of Transient Justification	
	Oxide Calculations	
	SBLOCA Noding	

Dominion

Average Core Energy Representation

FRAMATOME ANP

➢ *Average Core Energy Representation*

- Core Comprised of Categories of Fuel Assemblies
  - Fresh Assemblies
  - Once-Burned Assemblies
  - Twice-Burned Assemblies
- Average Core Representation for Energy Content (Initial Fuel Temperature and Transient Actinide Power) Conservatively Evaluates and Combines the Differences for Each Category
  - Category Radial Peaking
  - Category Burnup Effect on Fuel Temperature
  - Category Burnup Effect on Actinide Concentration

April 16, 2002 - 27

Dominion

North Anna-Specific LOCA Licensing Needs

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<u>North Anna Plant-Specific Items/EM Departures</u>

X	Core Peaking for LOCA Evaluation	Bert Dunn
X	Energy Deposition	Bert Dunn
X	Average Core Energy Representation	Bert Dunn
X	Minimum Containment Backpressure	John Biller
	REFLOD3B Carryout Rate Fraction	
	End of Transient Justification	
	Oxide Calculations	
	SBLOCA Noding	

April 16, 2002 - 28

Dominion | *Minimum Containment Backpressure* | FRAMATOME ANP

- *Approved EM: Use FSAR Backpressure*
  - UFSAR Backpressure Curves Stop at 240 sec
    - Not Proper to Extrapolate
  - PCTs Occur in 200 sec Neighborhood
- *Need Prediction Beyond 240 sec*
  - Perform Backpressure Calculation
    - EM Departure
  - North Anna Containment—Normal Components
    - Dry Containment
    - Domed Cylinder w/Painted Steel Liner
    - ECC Spray Safety Systems
    - Typical Equipment and Materials Within Containment

Dominion | *Minimum Containment Backpressure* | FRAMATOME ANP

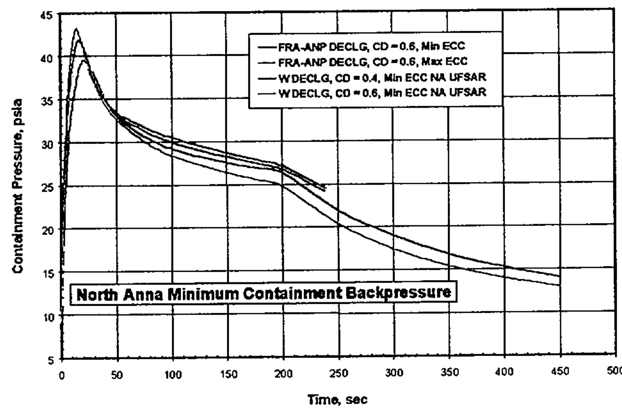
- *Use B&W RELAP5 EM Method*
  - NRC-Approved
    - B&W EM: BAW-10192PA, Revision 0
    - CONTEMPT: BAW-10095A, Revision 1
    - Follows CSB 6-1
  - North Anna Comparable to B&W Containments
    - No Applicability Issues
    - Same Backpressure Trends as Westinghouse Calculation
      - FRA-ANP Backpressure Slightly Under-Predicts Westinghouse
- *Conclusion*
  - CONTEMPT Model Appropriate Method for North Anna Use
  - Appendix-K Compliant

Dominion

Minimum Containment Backpressure

FRAMATOME ANP

➤ *FRA-ANP versus Westinghouse Prediction*



April 16, 2002 - 31

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North Anna-Specific LOCA Licensing Needs

FRAMATOME ANP

North Anna Plant-Specific Items/EM Departures

X	Core Peaking for LOCA Evaluation	Bert Dunn
X	Energy Deposition	Bert Dunn
X	Average Core Energy Representation	Bert Dunn
X	Minimum Containment Backpressure	John Biller
X	**REFLOD3B Carryout Rate Fraction**	**C. K. Nithianandan**
	End of Transient Justification	
	Oxide Calculations	
	SBLOCA Noding	

April 16, 2002 - 32

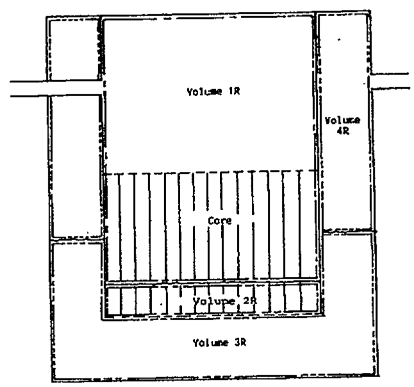
Dominion

REFLOD3B
Carryout Rate Fraction

FRAMATOME ANP

- *REFLOD3B RV Plant Model*

REACTOR VESSEL MODEL



Dominion

REFLOD3B
Carryout Rate Fraction

FRAMATOME ANP

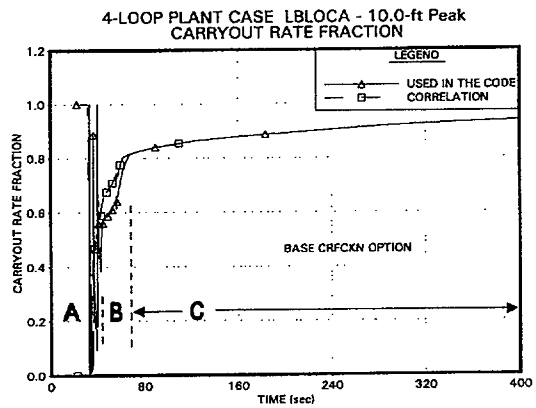
- *REFLOD3B—Approved Methodology*
  - During Quasi-Steady Period Core Exit Flow Calculated Using FLECHT/FLECHT-SEASET-Based NRC-Approved Carryout Correlation—**CRFCKN**
  - Upper Core Region (Volume 1R)—Thermal Equilibrium Fluid Condition Assumed
  - Entraining Liquid in Superheated Steam Causes Numerical Oscillations
  - To Avoid Numerical Problem Entrain Enough Liquid to Keep Upper Core Region Two-Phase
    - Conservative Artificiality Imposed for Numerical Purposes
  - Only Brief Departures from Carryout Correlation Expected

Dominion

REFLOD3B
Carryout Rate Fraction

FRAMATOME ANP

- *Illustration—Typical 4-Loop Case*
  - **A**—Developing Period; **B**—Transition Period; **C**—Quasi-Steady Period



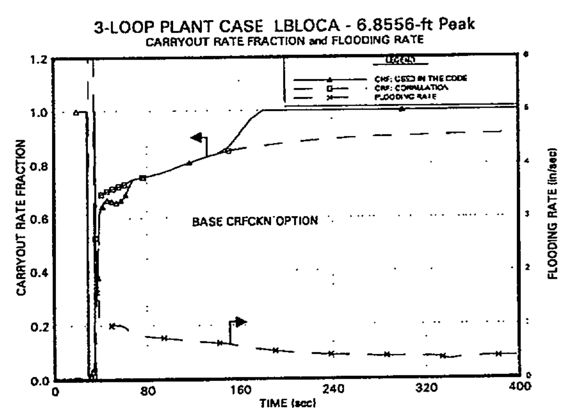
April 16, 2002 - 35

Dominion

REFLOD3B
Carryout Rate Fraction

FRAMATOME ANP

- *North Anna—Base CRFCKN Option*



April 16, 2002 - 36

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REFLOD3B
Carryout Rate Fraction

FRAMATOME ANP

- *North Anna—Low Flooding Rate Plants*
  - Forces Excessive Core Carryout
    - Well Above CRF Correlation
      - REFLOD3B Logic Maintains Upper Core Region Two-Phase
    - Self-Perpetuates
      - Increased Steam Binding
      - Lower Flooding Rate
      - Increased Core Carryout
    - Unintended Consequence of Two-Phase Logic
      - Non-Physical

Dominion

REFLOD3B
Carryout Rate Fraction

FRAMATOME ANP

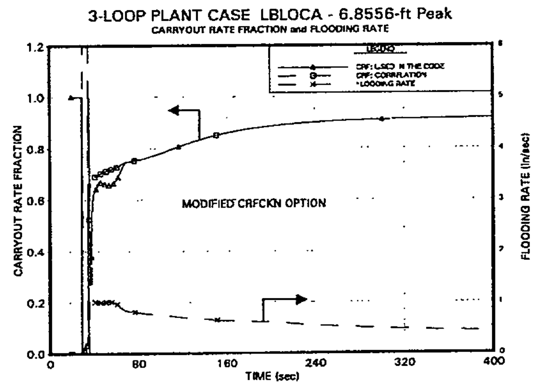
- *REFLOD3B—North Anna-Specific CRF Option*
  - Developing and Transition Periods
    - No Change
  - Quasi-Steady Period
    - Base Model:
      - Maximum—CRFCKN Correlation **OR** Needed to Keep Upper Core Region Two-Phase
    - North Anna-Specific Model:
      - Use CRFCKN Correlation—**AS IT SHOULD**
      - Numerical Issues Present Starting About 400 sec

Dominion

REFLOD3B
Carryout Rate Fraction

FRAMATOME ANP

- *North Anna-Specific CRFCKN Option*



April 16, 2002 - 39

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REFLOD3B
Carryout Rate Fraction

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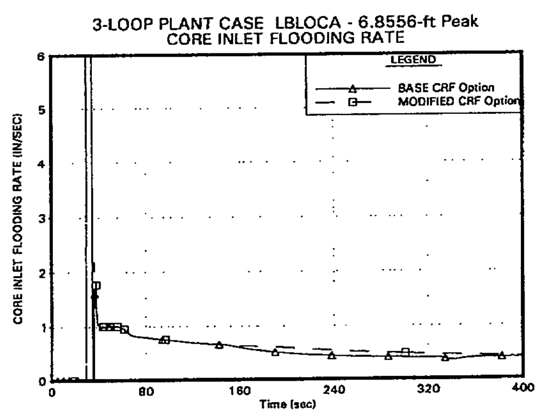
- *North Anna—Flooding Rate Comparison*

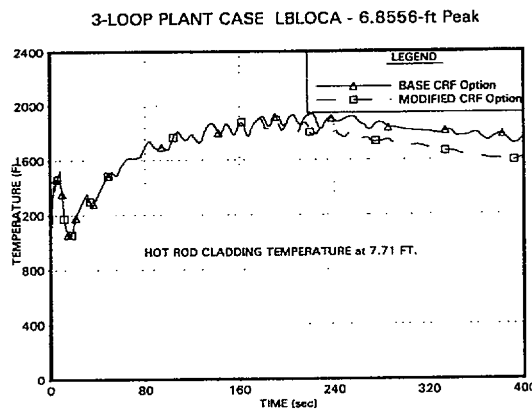


April 16, 2002 - 40

REFLOD3B
Carryout Rate Fraction

Dominion — FRAMATOME ANP

➢ *North Anna—Hot Rod Clad Temperature Comparison*



April 16, 2002 - 41

REFLOD3B
Carryout Rate Fraction

Dominion — FRAMATOME ANP

➢ *Impact on Benchmarks*

- Previous Benchmarks
  - FLECHT-SEASET Test 33338
  - Semi-Scale MOD-1 Test S-04-06

- In Both Cases Core Exit Flow Calculated Using CRF Correlation Sufficient to Keep Upper Core Region Two-Phase

- Conclusion: **CHANGE HAS NO IMPACT**

April 16, 2002 - 42

Dominion | REFLOD3B Carryout Rate Fraction | FRAMATOME ANP

REFLOD3B
Carryout Rate Fraction

- *Appendix-K Compliance*
  - CRF Calculated Using Approved Correlation
  - Option to Bypass Logic Added in Approved REFLOD3B to Avoid Potential Numerical Problem
- *Conclusion*
  - Change Necessitated by Unique Nature of North Anna Plants
  - Change Does Not Alter Benchmarks
  - **Change Consistent with Appendix-K Requirements**

April 16, 2002 - 43

Dominion | North Anna-Specific LOCA Licensing Needs | FRAMATOME ANP

North Anna-Specific
LOCA Licensing Needs

North Anna Plant-Specific Items/EM Departures

X	Core Peaking for LOCA Evaluation	Bert Dunn
X	Energy Deposition	Bert Dunn
X	Average Core Energy Representation	Bert Dunn
X	Minimum Containment Backpressure	John Biller
X	REFLOD3B Carryout Rate Fraction	C. K. Nithianandan
X	End of Transient Justification	C. K. Nithianandan
	Oxide Calculations	
	SBLOCA Noding	

April 16, 2002 - 44

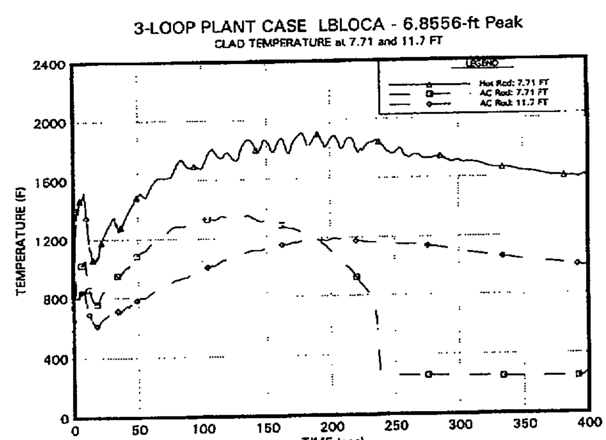
Dominion *End of Transient Justification* FRAMATOME ANP

- *REFLOD3B Calculation Terminates at 400 sec*
  - Code Numerical Issues
  - Approaching Code Applicability Limit
  - Prior to Calculated Core Quench
- *Justification to End Transient at 400 sec*
  - After Calculated Peak Cladding Temperature
  - Average Core Temperature Below Oxidation Potential (<1,200 F)
  - Average Core Quench Height Near 9 Foot Level
  - Hot Assembly Quench Height Should Also be Near 9 Feet with Low Cladding Temperatures
  - Experiments Show Core Quench Before 400 sec
  - Realistic Calculations Show Core Near Quench at 400 sec

April 16, 2002 - 45

Dominion *End of Transient Justification* FRAMATOME ANP

- *North Anna—Modified CRF Case*

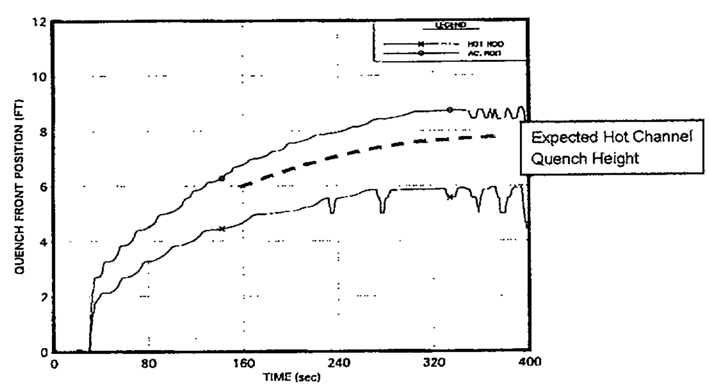


April 16, 2002 - 46

Dominion *End of Transient Justification* FRAMATOME ANP

- *North Anna—Modified CRF Case*

3-LOOP PLANT CASE LBLOCA - 6.8556-ft Peak

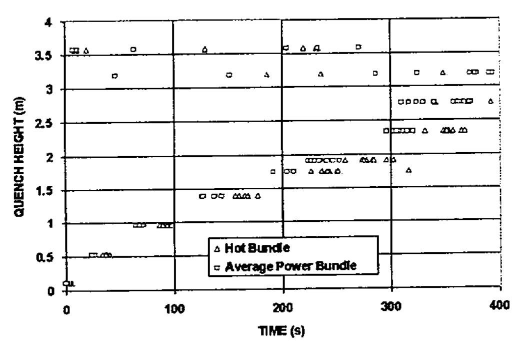


Dominion *End of Transient Justification* FRAMATOME ANP

- *Slab Core Test Facility (SCTF) CORE-III Test S3-15*

Bundle #	1	2	3	4	5	6	7	8
Power Ratio	1.36	1.20	1.10	1.00	0.91	0.86	0.81	0.76

SCTF CORE-III Test S3-15



➤ BEACH Benchmark of SCTF Test S3-15

FIGURE G-72. HOT CHANNEL QUENCH FRONT
SCTF TEST 3-15.

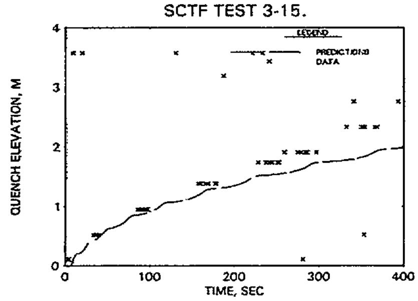
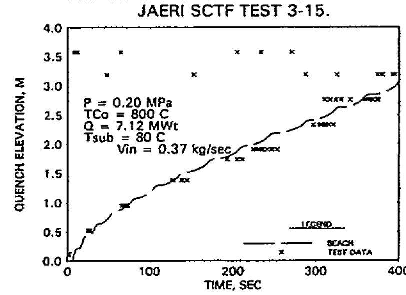


FIGURE G-73. AVERAGE CHANNEL QUENCH FRONT
JAERI SCTF TEST 3-15.



➤ BEACH Benchmark of SCTF Test S3-15

FIGURE G-70. HOT CHANNEL CLAD TEMPERATURE
JAERI SCTF TEST S3-15.

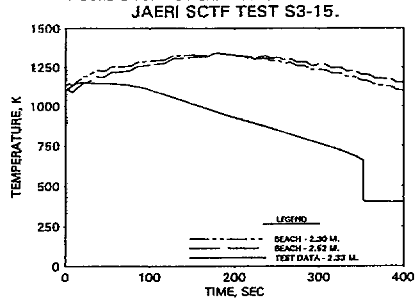
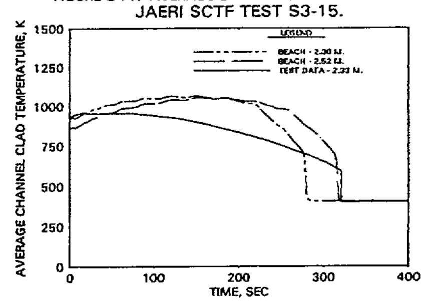
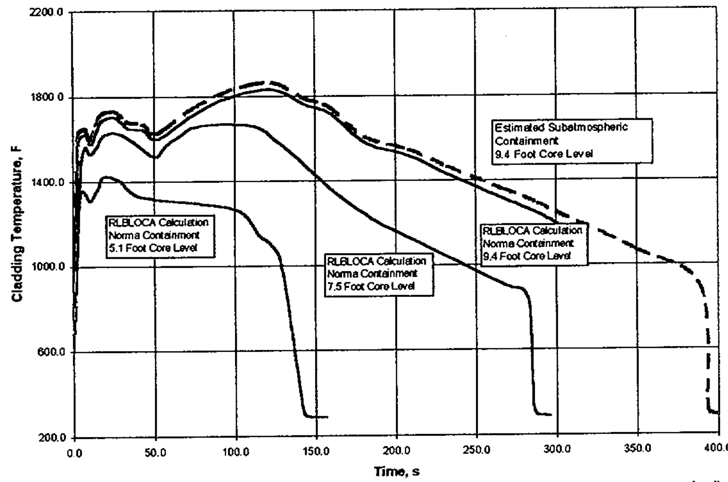


FIGURE G-71. AVERAGE CHANNEL CLAD TEMPERATURE
JAERI SCTF TEST S3-15.



Dominion *End of Transient Justification* FRAMATOME ANP

➢ RLBLOCA Results for 3-Loop Plants



Dominion *End of Transient Justification* FRAMATOME ANP

➢ Conclusion

- Ending Transient at 400 sec Justified
  - After Calculated Peak Cladding Temperature
  - Average Core Temperature Below Oxidation Potential (<1,200 F)
  - Average Core Quench Height Near 9 Foot Level
  - Hot Assembly Quench Height Should Also be Near 9 Feet with Low Cladding Temperatures
  - Experiments Show Core Quench Before 400 sec
  - Realistic Calculations Show Core Near Quench at 400 sec

Dominion | *North Anna-Specific LOCA Licensing Needs* | FRAMATOME ANP

North Anna Plant-Specific Items/EM Departures

X	Core Peaking for LOCA Evaluation	Bert Dunn
X	Energy Deposition	Bert Dunn
X	Average Core Energy Representation	Bert Dunn
X	Minimum Containment Backpressure	John Biller
X	REFLOD3B Carryout Rate Fraction	C. K. Nithianandan
X	End of Transient Justification	C. K. Nithianandan
X	Oxide Calculations	Gordon Wissinger
	SBLOCA Noding	

April 16, 2002 - 53

Dominion | *Oxide Calculations* | FRAMATOME ANP

- *Current RSG EM Oxide Calculation*
  - Amount of Metal-Water Reaction at Any Elevation in Core is Determined by Ratio of Adjusted Power Times Metal-Water Reaction at That Elevation in Hot Channel
    - Calculation Based on REFLOD3B Quench Front Prediction
    - Adjusted Power is Power in Excess of Minimum Power for Which Any Oxidation Increase Occurs
    - 1,000 F Clad Temperature Metal-Water Cutoff
  - Integration Over Core Then Gives Core-Wide Oxidation Increase or Amount of Hydrogen Generation
    - Based on Assumed Core Radial Power Distribution
    - Ten Subdivisions with Average Radial Power per Division

April 16, 2002 - 54

Dominion

Oxide Calculations

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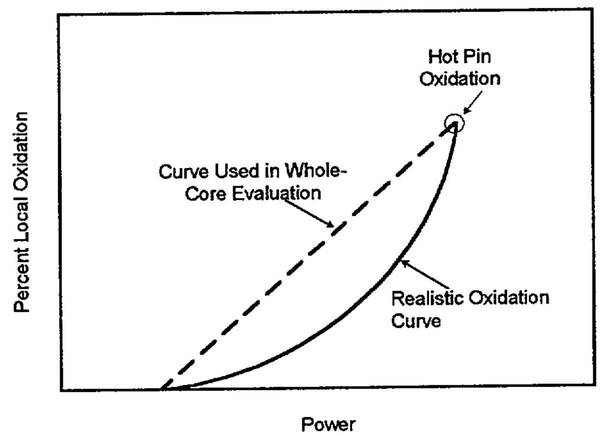
- *RSG Axially Dependent Local Oxidation*



April 16, 2002 - 55

Dominion

Oxide Calculations

FRAMATOME ANP

- *Method Change*
  - Transient is Finished at 400 sec
    - Use Oxides at 400 sec
    - Conservative Based on Highly Conservative Cladding Temperature Response
  - Change Oxide Calculation to Mimic NRC-Approved OTSG Whole-Core Metal-Water Calculation Technique
    - LOCA Simulation Uses 3 Heat Structures
    - Extrapolation of Hot Pin to Whole-Core Excessively Conservative
    - Close to Exceeding 1% Criterion

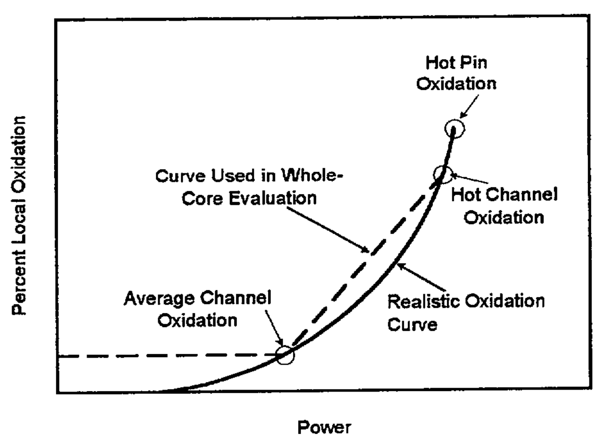
April 16, 2002 - 56

Dominion | *Oxide Calculations* | FRAMATOME ANP

- *Change Oxide Calculation to Mimic NRC-Approved OTSG Whole-Core Metal-Water Calculation Technique*
  - Use Oxidation Increase from Three (3) Heat Structure Simulation with Typical Core Power Map
    - Hot Pin, Hot Bundle, and Average Core
  - Hot Channel and Average Core Local Oxidation Increases are Used to Determine Oxidation Increase for Assemblies in Which Radial Power Factor Lies Between Them
  - Assemblies with Radial Power Factors Below Average Core Value Use Average Core Oxidation Increases
  - Integration of These Channels Over Entire Core Results in Core-Wide Oxidation Increase or Amount of Hydrogen Generation

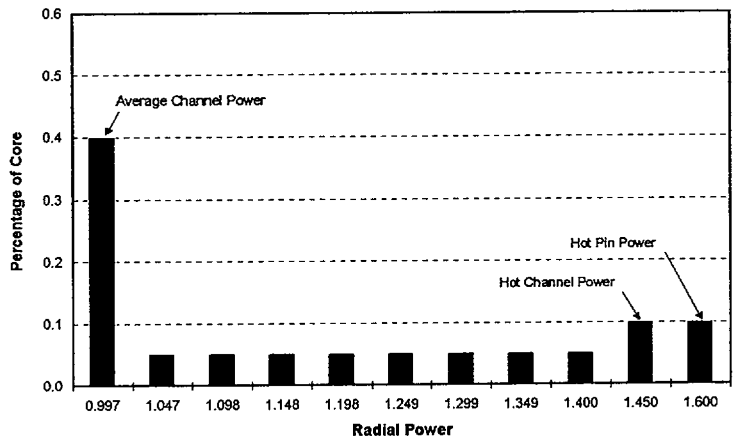
Dominion | *Oxide Calculations* | FRAMATOME ANP

- *RSG Axially Dependent Local Oxidation w/3 HS*



Dominion — Oxide Calculations — FRAMATOME ANP

- RSG Core Power Distribution w/3 HS



Dominion — Oxide Calculations — FRAMATOME ANP

- Conservatism in Method
  - Conservative Cladding Temperature Response
  - Oxidation in Base Run Computed Using Baker-Just Correlation
    - ~50% Conservative
  - Core Power Distribution
    - Reasonable and Representative
    - Pushed to Peak Powers Allowed by Plant Tech Specs
  - Power Ratio Determining Degree of Oxidation for Lower Power Zones is Conservative
    - 40% of Core at Average Core Power

Dominion | *North Anna-Specific LOCA Licensing Needs* | FRAMATOME ANP

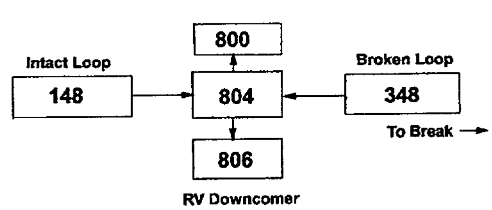
North Anna Plant-Specific Items/EM Departures

X	Core Peaking for LOCA Evaluation	Bert Dunn
X	Energy Deposition	Bert Dunn
X	Average Core Energy Representation	Bert Dunn
X	Minimum Containment Backpressure	John Biller
X	REFLOD3B Carryout Rate Fraction	C. K. Nithianandan
X	End of Transient Justification	C. K. Nithianandan
X	Oxide Calculations	Gordon Wissinger
X	SBLOCA Noding	C. K. Nithianandan

Dominion | *SBLOCA Noding* | FRAMATOME ANP

- *North Anna 3-Loop Plant—EM Model*
  - When Intact Loop Clears
    - Entrains Intact Loop ECC to Break
    - **Less Than Expected ECC Penetrates Downcomer**

RELAP5 SBLOCA Upper Downcomer Noding Arrangement - Base Model



EM Intact Loop Bias

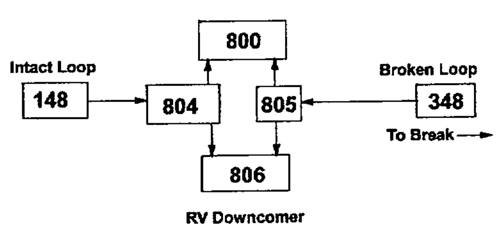
- 1-foot Bias to Promote Broken Loop Clearing—4-Loop Plant
- 2-foot+ Bias Required—3-Loop Plant
  - Bias Becoming Excessive
- UPTF Test 25
  - Test to Evaluate ECC Entrainment During Reflood
  - **Wallis CCFL-Type Correlation**—Calculate DC Liquid Level (NUREG/IA-0126, Figure 4.3-4)
    - **Applicable to Calculate DC Liquid Level During SBLOCA**
- UPTF Correlation Predicts Higher Downcomer Level Than RELAP5 for SBLOCA Cases

Dominion
SBLOCA Noding
FRAMATOME ANP

Upper Downcomer Geometry—Revised Model

- Hot Leg Penetrations Block This Region
- Intact Cold Leg Flow to Break
  - Must Go Up and Over or Down and Under Hot Leg Penetration

RELAP5 SBLOCA Upper Downcomer
Noding Arrangement - Revised Model

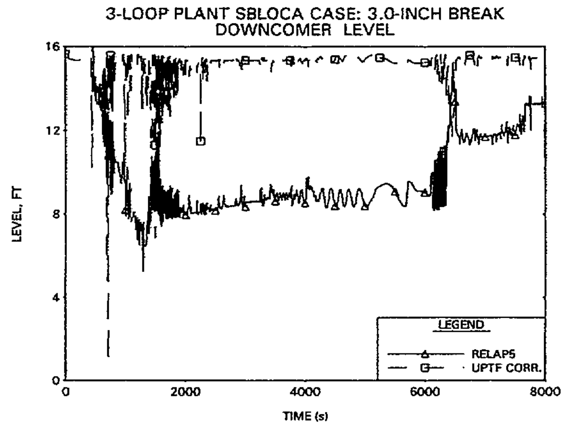


Dominion

SBLOCA Noding

FRAMATOME ANP

- *North Anna—Downcomer Level Comparison*



April 16, 2002 - 65

Dominion

SBLOCA Noding

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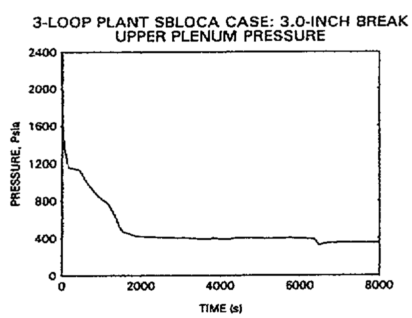
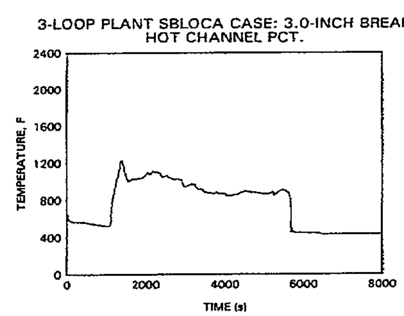
- *North Anna 3-Inch Break Case*





April 16, 2002 - 66

Dominion

SBLOCA Noding

FRAMATOME ANP

- *Conclusion*
  - Plant Noding Change Necessitated by Nature of North Anna Plants
  - DC Liquid Level Conservatively Calculated (Based on UPTF Correlation)
  - **Change Consistent with Appendix-K Requirements**

Dominion

Concluding LOCA Remarks

FRAMATOME ANP

LOCA Licensing Needs

J. S. Holm – Framatome ANP

Dominion

LOCA Licensing Needs

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- *BEACH Topical Report*
  - Initial Reflood Temperature
  - Reflood Rate

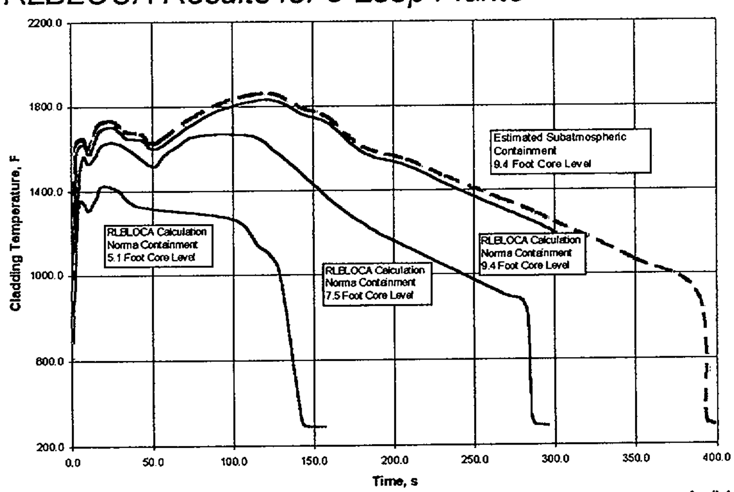
- *North Anna Plant-Specific Items/EM Departures*
  - Core Peaking for LOCA Evaluation
  - Energy Deposition
  - Average Core Energy Representation
  - Minimum Containment Backpressure
  - REFLOD3B Carryout Rate Fraction
  - End of Transient Justification
  - Oxide Calculations
  - SBLOCA Noding

Dominion

LOCA Licensing Needs

FRAMATOME ANP

- *RLBLOCA Results for 3-Loop Plants*



Dominion

Concluding Comments
Integrated Review Schedule

FRAMATOME ANP

Integrated Transition Program Review Schedule

G. L. Darden - Dominion

Dominion

Integrated
Review Schedule

FRAMATOME ANP

- *Key Milestones—License Amendment Request for North Anna Transition Including Approval of North Anna-Only LOCA Changes*
  - Dominion Submits LAR—**Completed 3/28/02**
  - SER BAW-10164P, Revision 4—Fuel Temperature Uncertainty—**Completed 4/9/02**
  - SER BAW-10199, Addendum 2—MSMG CHF Correlation—**Completed 3/27/02**
  - Target Date for First RAI—**6/15/02 ???**

Dominion

Integrated Review Schedule

FRAMATOME ANP

- *Key Milestones—License Amendment Request for North Anna Transition Including Approval of North Anna-Only LOCA Changes, Continued*
  - SER BAW-10166, Revision 4, Appendices H and I—BEACH
    - **7/1/02**
  - Dominion Issues LOCA Supplement to LAR—**August 2002**
  - Target Date SER on VEP-FRD-42, Revision 2—**8/31/02**
  - Target Date Last RAI—**10/31/02**
  - NRC Draft SER for LAR—**12/15/02**
  - Target Date to Issue SER—**1/31/03**
  - Delivery First Framatome ANP Reload Batch—**January 2003**

April 16, 2002 - 73

Dominion

Summary
Questions, Action Items, ...

FRAMATOME ANP

Summary
Questions
Action Items

G. L. Darden - Dominion

April 16, 2002 - 74

FRAMATOME ANP

TO:	James F. Mallay	20553A-8 (1/2002)
FROM	John R. Biller	CUSTOMER OR FILE:
SUBJ.	BEACH Topical Report Revision—BAW-10166, Revision 5 NRC Verbal Request for Information	DATE: April 3, 2002

Reference: Framatome ANP Letter, J. F. Mallay, to Document Control Desk, NRC, "Request for Review of Appendices H and I to BAW-10166," NRC:01:050, December 10, 2001.

On March 27, 2002, Messrs. Biller, Dunn, Klingenfus, Mallay and Nithian of Framatome ANP, Mr. Frank Orr of the NRC, and Mr. Len Ward, an NRC contractor, participated in a telephone call regarding the referenced submittal. During the call, Len Ward requested explanatory and reference materials relative to Framatome ANP's BEACH submittal. A partial response to Mr. Ward's requests follows.

Enlarged copies of figures I-15 and I-17 were requested; they are attached hereto. These two figures are actual copies of the original digitized test benchmarks, rather than just enlargements of the Appendix I figures. For ease of reference, these figures are labeled with the same Appendix I figure numbers. The third and fourth figures attached hereto are two different versions of Figure I-24. One with and one without shading within the envelope. The data points beneath the envelope should be visible in either figure.

Regarding the question on vapor temperature, void fraction, and droplet diameter, your attention is directed to the NRC-approved version of the BEACH topical Report—BAW-10166P-A, Revision 4, February 1996. Please note the materials responding to Question 14, page 5-43 and Figures 14-1 through 14-18 on pages 5-107 through 5-115. Chapter 5 of the report contains, in chronological order, all BEACH licensing materials or references thereto.

Relative to the quench front prediction for FLECHT Test 8037, Framatome ANP agrees that the benchmark of this test indicates an excessively quick decrease in cladding temperature. However, this test appears to be outside the norm in this regard. In the BEACH topical report, Question 1, the subjects of quench time and metal-water reaction were discussed; please refer to pages 5-291 through 5-302. Also note the Revision 4 SER and TER on pages 5-340 and 5-341, and 5-354 and 5-355, respectively, where the effects of the earlier higher temperatures and the cladding gap are credited as trading off against the slightly earlier BEACH quench prediction.

FIGURE 1-24. TEMPERATURE RISE VRS. FLOODING RATE TO ROD PEAK POWER RATIO

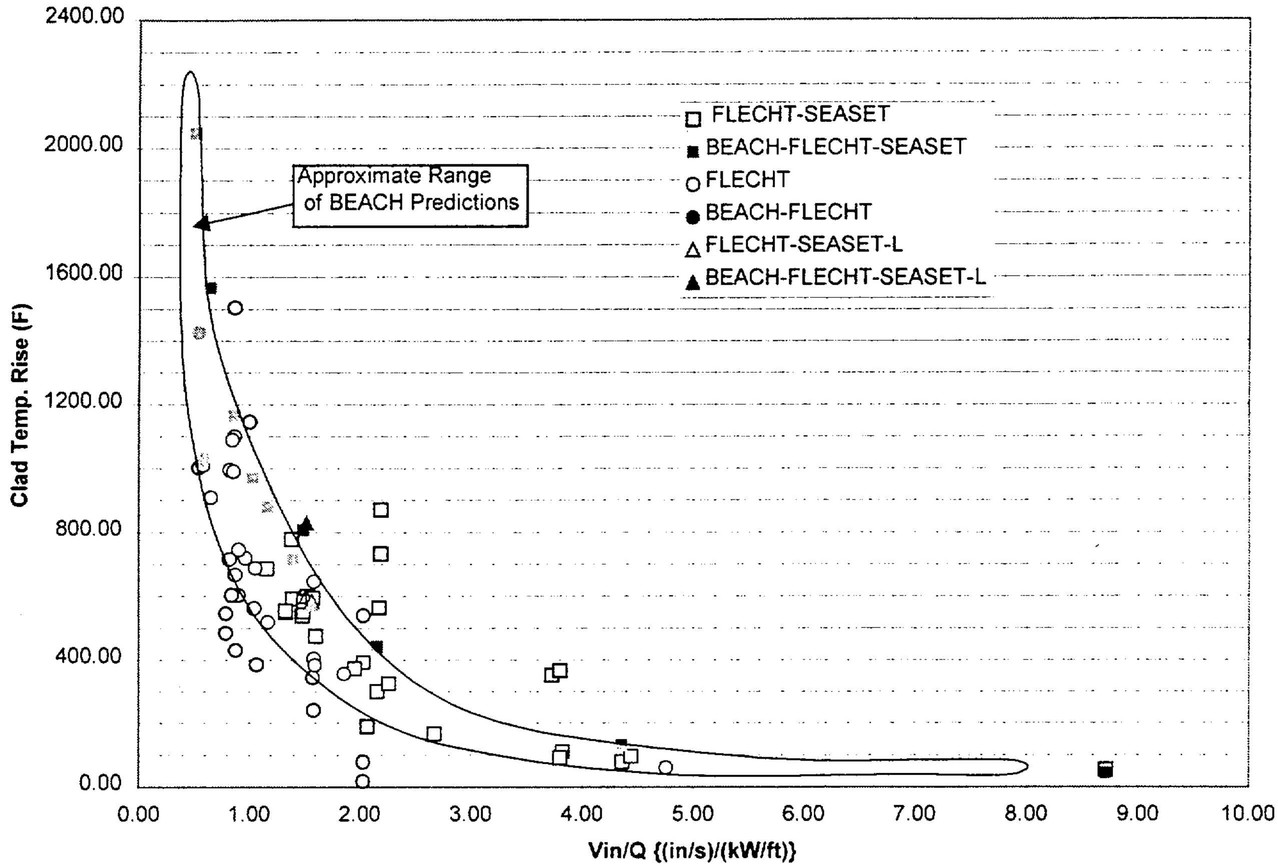


FIGURE 1-24. TEMPERATURE RISE VRS. FLOODING RATE TO ROD PEAK POWER RATIO

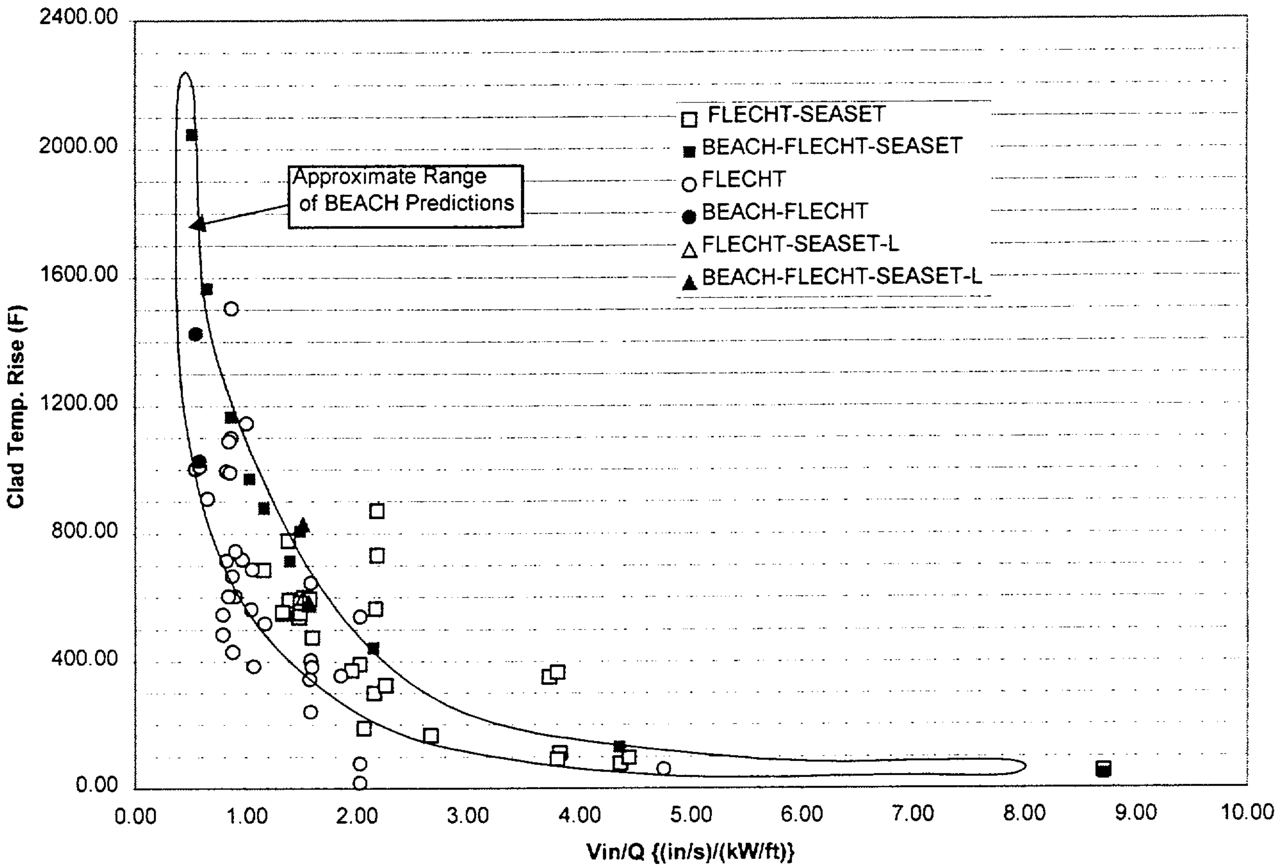


FIGURE I-15 _FLECHT 3215B (15x15) BENCHMARK f3215v25.in 32-5014735-00
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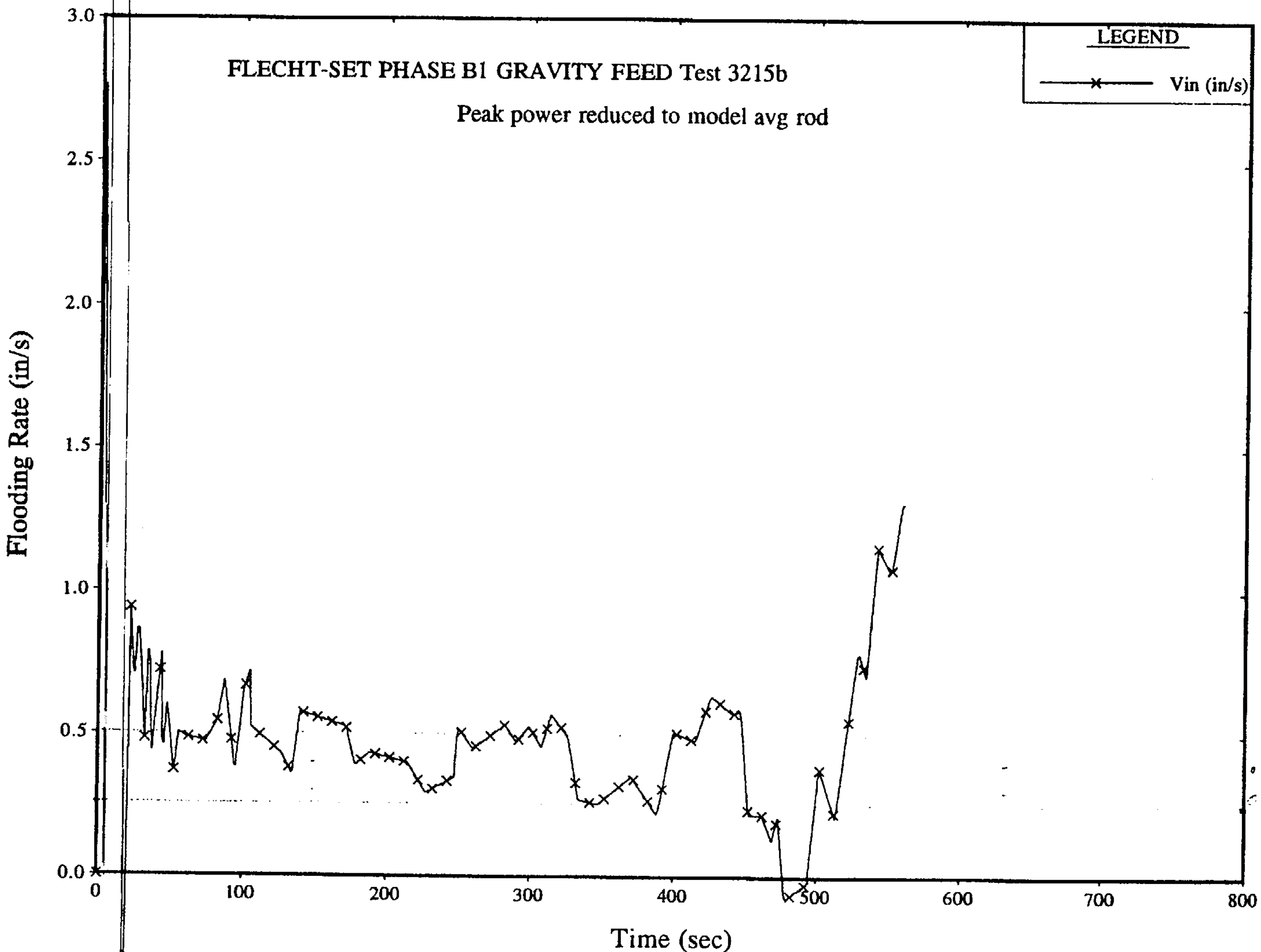

RELAP5/MOD2 Version 25

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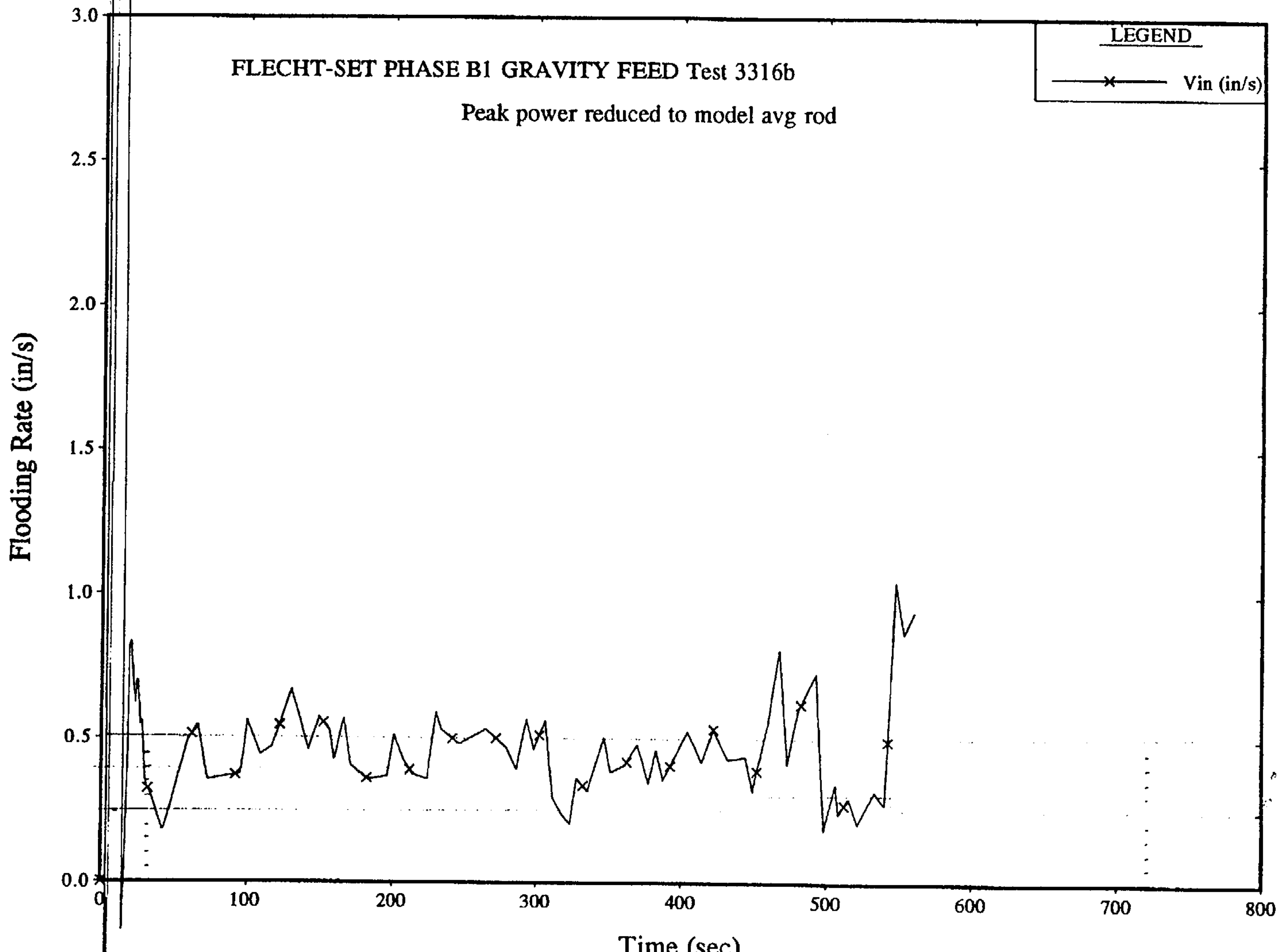
FIGURE I-17 _FLECHT 3316B (15x15) BENCHMARK f3316v25.in 32-5014735-00

P=var,TCO=1100,Q=0.84,TI=var TSUB=var,VIN=var



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