FRAMATOME ANP

Fuel Performance Meeting - NRC and Framatome ANP

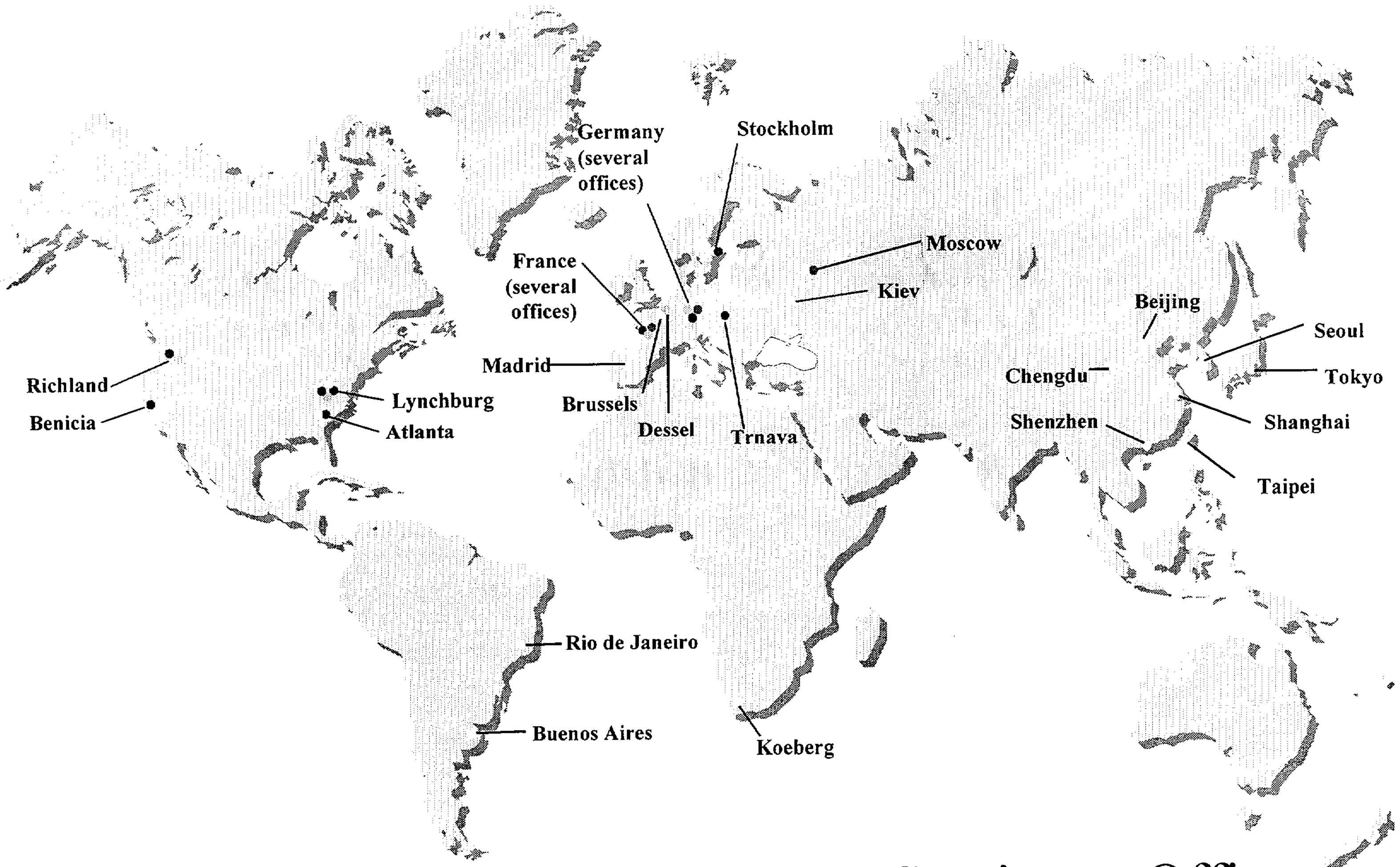
April 9 and 10, 2002

FRAMATOME ANP

FUEL PERFORMANCE MEETING - APRIL 9 and 10
NRC and FRAMATOME ANP
AGENDA

- Introduction and Purpose
- Description of Framatome ANP (Organization, Facilities, and Services
- Description of Current Fuel Designs and Key Features
    - PWR
    - BWR
- Recent Fuel Performance Experience
- Corrosion Experience Update
- Lead Test Assemblies
- Description of Recent Post-Irradiation Examinations
- Emerging Issues
- Plans for Future Topical Reports

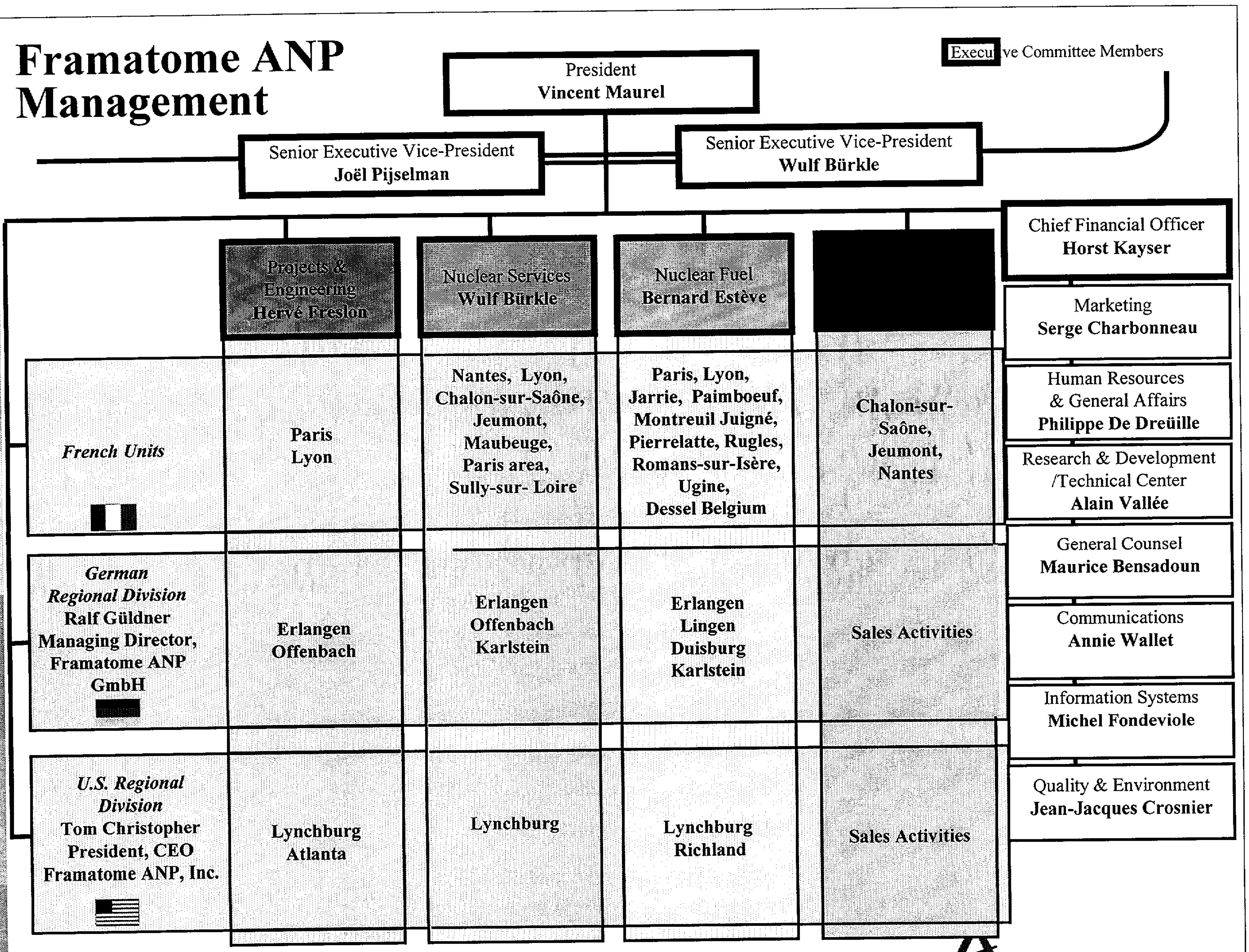
Framatome ANP: 13,000 Employees Worldwide



- Engineering
- Manufacturing
- Services
- Offices

FRAMATOME ANP

Framatome ANP Management



Execu ve Committee Members

President
Vincent Maurel

Senior Executive Vice-President
Joël Pijselman

Senior Executive Vice-President
Wulf Bürkle

	Projects & Engineering Hervé Freslon	Nuclear Services **Wulf Bürkle**	Nuclear Fuel **Bernard Estève**	[redacted]
French Units 🇫🇷	**Paris Lyon**	**Nantes, Lyon, Chalon-sur-Saône, Jeumont, Maubeuge, Paris area, Sully-sur- Loire**	**Paris, Lyon, Jarrie, Paimboeuf, Montreuil Juigné, Pierrelatte, Rugles, Romans-sur-Isère, Ugine, Dessel Belgium**	**Chalon-sur-Saône, Jeumont, Nantes**
German Regional Division **Ralf Güldner Managing Director, Framatome ANP GmbH** 🇩🇪	**Erlangen Offenbach**	**Erlangen Offenbach Karlstein**	**Erlangen Lingen Duisburg Karlstein**	**Sales Activities**
U.S. Regional Division **Tom Christopher President, CEO Framatome ANP, Inc.** 🇺🇸	**Lynchburg Atlanta**	**Lynchburg**	**Lynchburg Richland**	**Sales Activities**

Chief Financial Officer
Horst Kayser

Marketing
Serge Charbonneau

Human Resources & General Affairs
Philippe De Dreüille

Research & Development /Technical Center
Alain Vallée

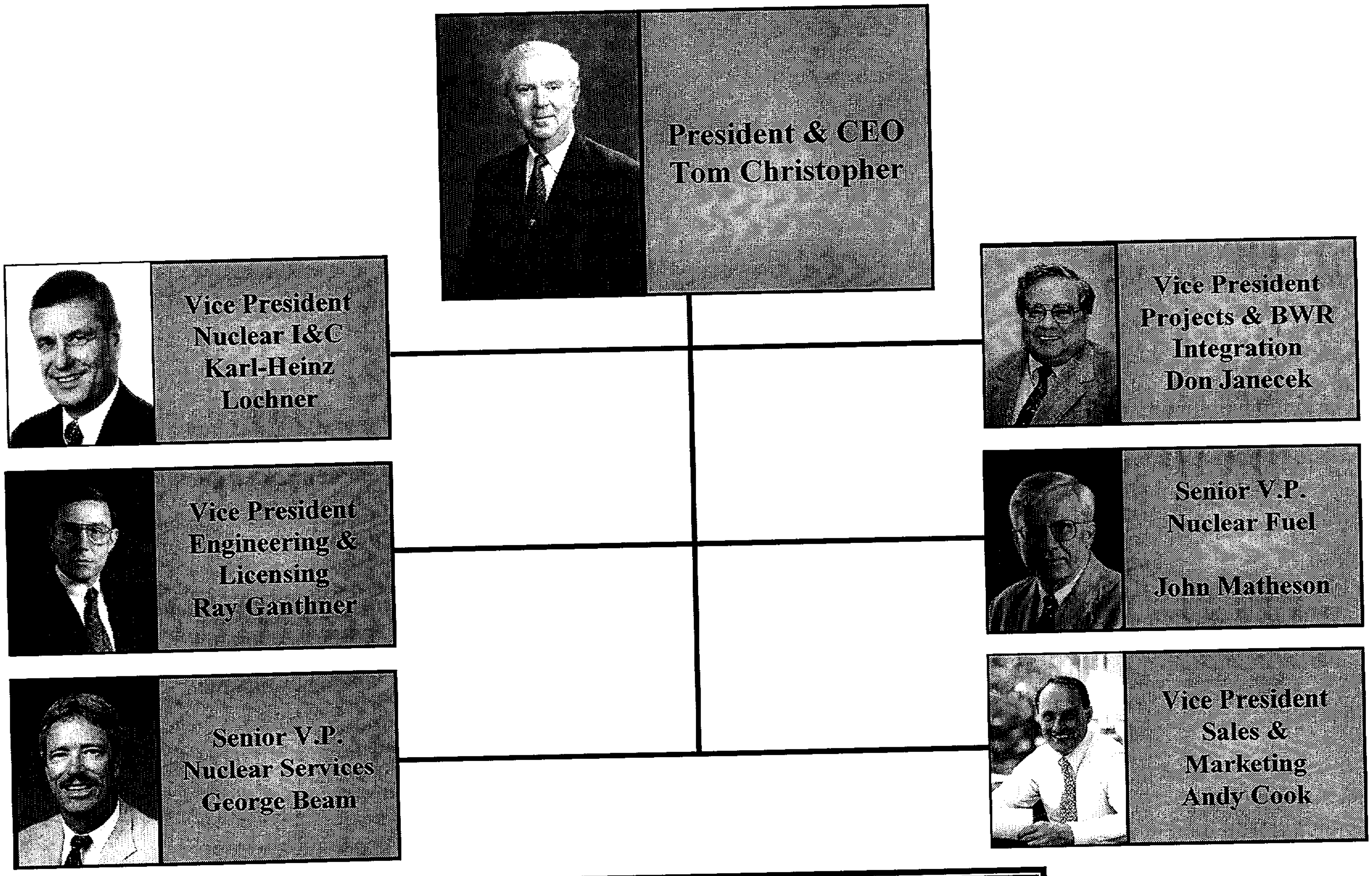
General Counsel
Maurice Bensadoun

Communications
Annie Wallet

Information Systems
Michel Fondeviole

Quality & Environment
Jean-Jacques Crosnier

U.S. Organization



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Tom Christopher

Vice President
Nuclear I&C
Karl-Heinz Lochner

Vice President
Engineering & Licensing
Ray Ganthner

Senior V.P.
Nuclear Services
George Beam

Vice President
Projects & BWR Integration
Don Janecek

Senior V.P.
Nuclear Fuel

John Matheson

Vice President
Sales & Marketing
Andy Cook

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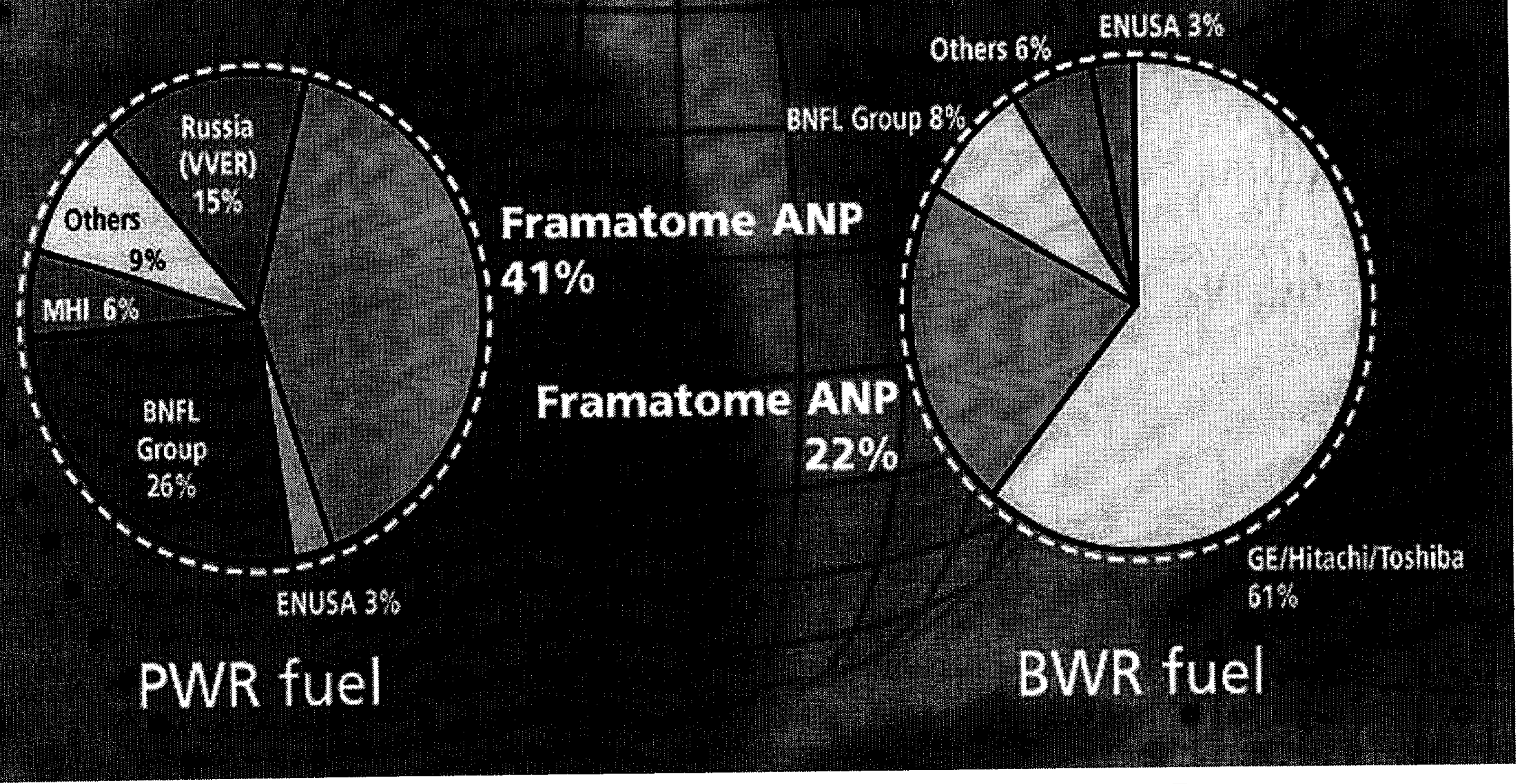
Nuclear Fuel : Optimizing the cycle

From the manufacture of zirconium alloy to the delivery of fuel assemblies, **Framatome ANP** is the world leader in fuel for nuclear power reactors and research reactors.



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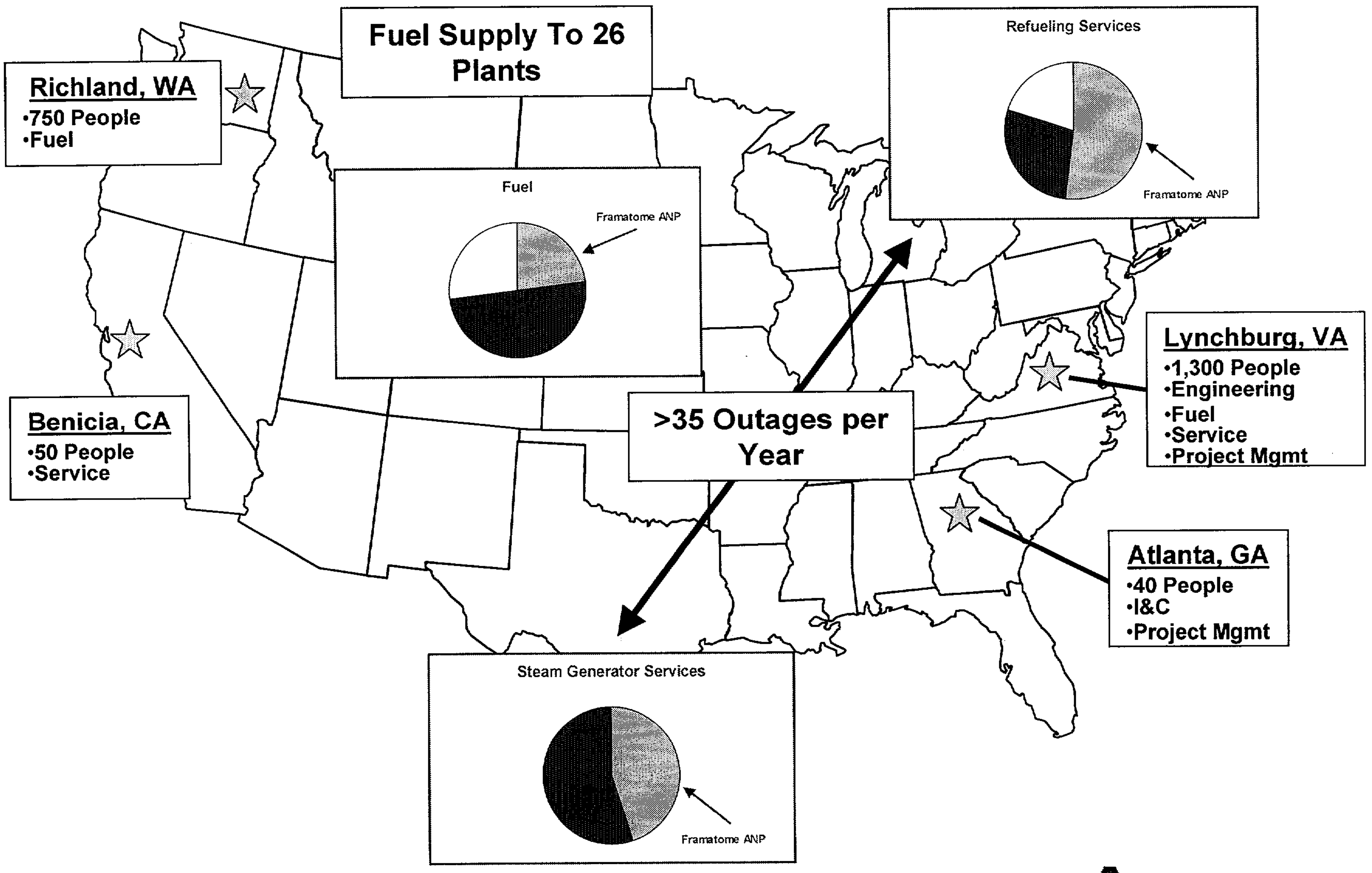
Framatome ANP in the U.S.



Fuel Supply To 26 Plants

Richland, WA
- 750 People
- Fuel

Benicia, CA
- 50 People
- Service

>35 Outages per Year

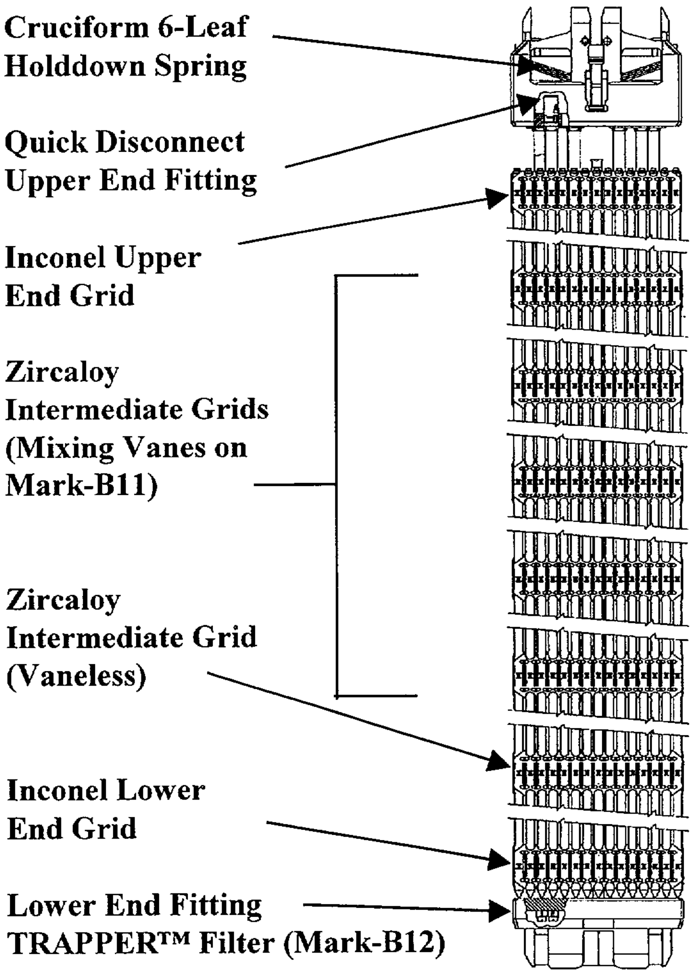
Lynchburg, VA
- 1,300 People
- Engineering
- Fuel
- Service
- Project Mgmt

Atlanta, GA
- 40 People
- I&C
- Project Mgmt

Description of Current U.S. Batch Fuel Designs and Key Features

FRAMATOME ANP

Advanced Mark-B Design Features



Mark-B10K/B12

TRAPPER™ debris filter lower end fitting
Heavy loaded fuel rod (0.430")
M5™ advanced alloy cladding & guide tubes
Cruciform 6-leaf holddown spring
Optional quick disconnect upper end fitting

Mark-B11

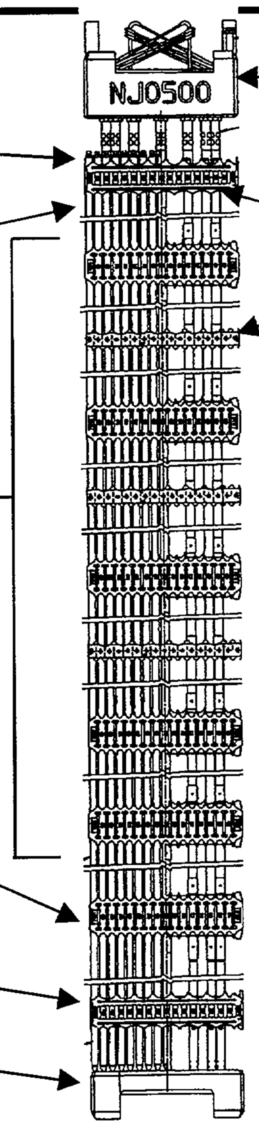
Plug-in-grid debris filter
Reduced diameter (0.416") fuel rod
M5™ advanced alloy cladding
High thermal margin flow mixing grids
Cruciform 6-leaf holddown spring
Quick disconnect upper end fitting

M5™ Design Features

Fuel Rods - Spring 2000
Guide Tubes - Fall 2001
Intermediate Grids - 2004

FRAMATOME ANP

Advanced Mark-BW Design Features



Top Nozzle
Inconel 718 Leaf Springs & Spring Screws
(Quick Disconnect optional)

Inconel Top End Grid

M5™ Structural Tubing

M5™ Fuel Rod Cladding

M5™ Mid-Span Mixing Grids (optional)

M5™ Mixing-Vane Intermediate Grids

M5™ Vaneless Intermediate Grid

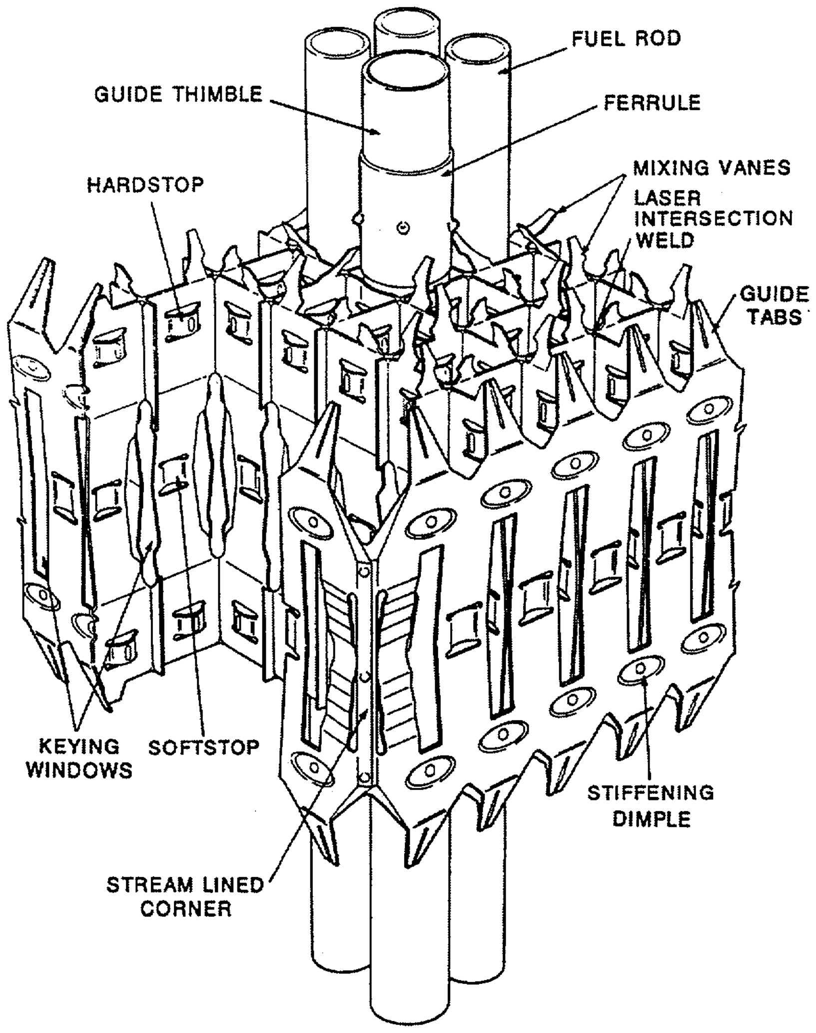
Inconel Bottom End Grid

TRAPPER™ Bottom Nozzle

M5™ Design Features

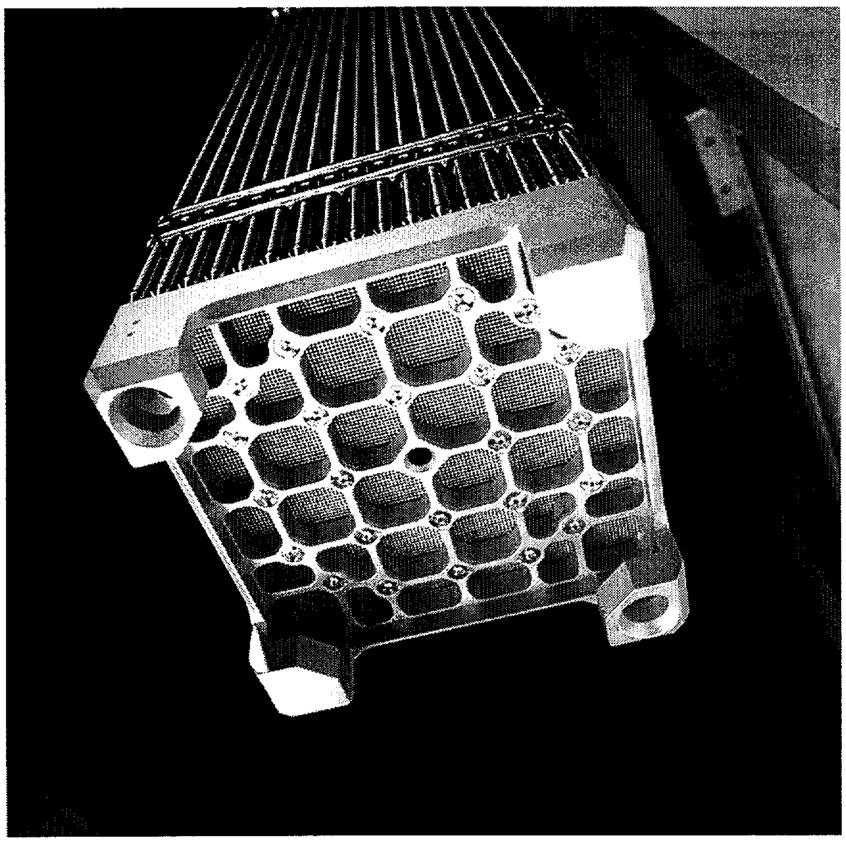
Fuel Rods - Fall 2001
Guide Tubes - Fall 2001
Intermediate Grids - Spring 2003
MSMGs - Spring 2003

Mark-BW (17x17) Spacer Grid Design



- High CHF performance
- Floating intermediate grids
- Keyed spacer grids

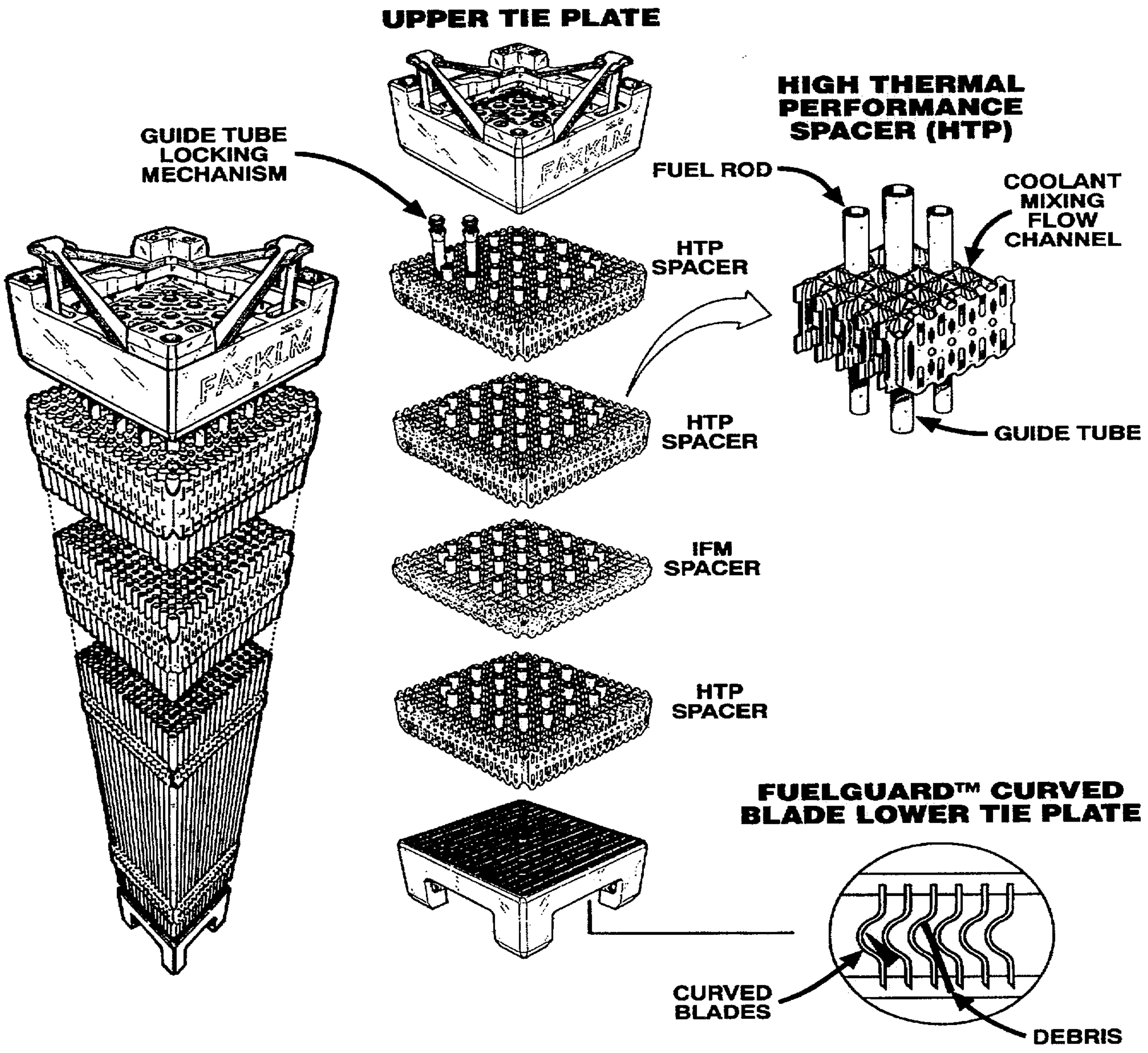
TRAPPER™ Bottom Nozzle



> Provides superior debris protection

- No debris failures since introduction for more than 2,000 fuel assemblies
- Pressure drop equivalent to traditional debris filters

HTP Type PWR Fuel Assembly



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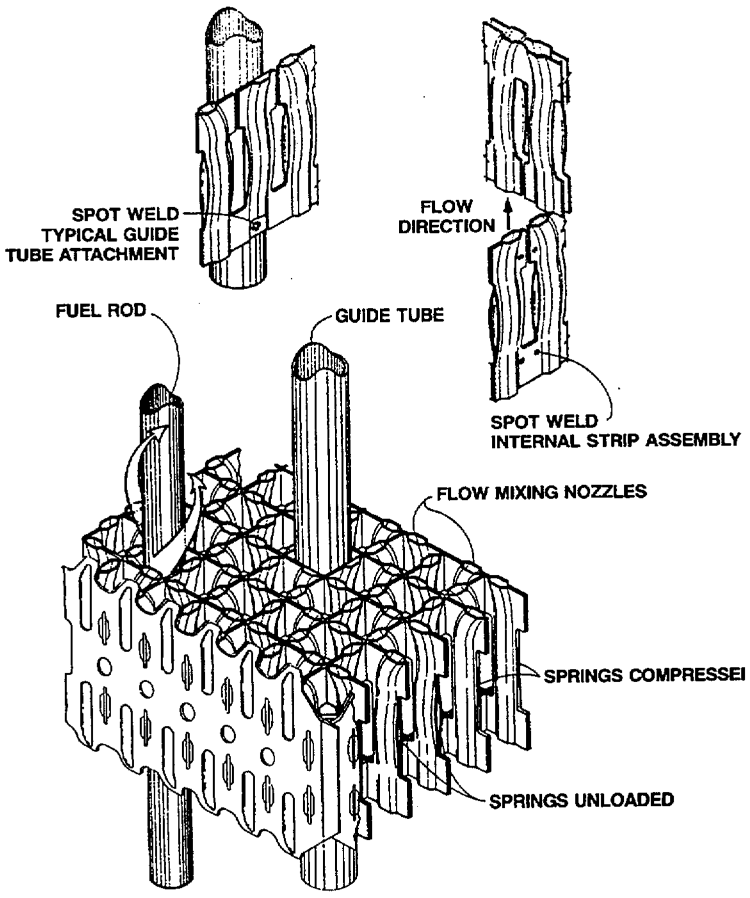
High Thermal Performance (HTP) Spacer

- All Zircaloy
- Channels for flow mixing
- Low flow resistance
- Optimum rod contacts
- Robust construction

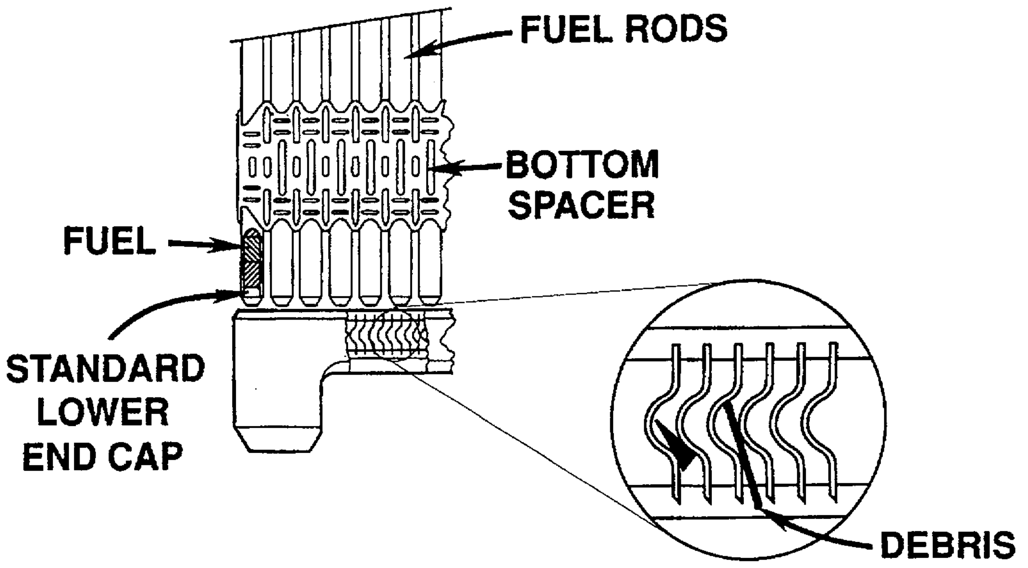


FRAMATOME ANP

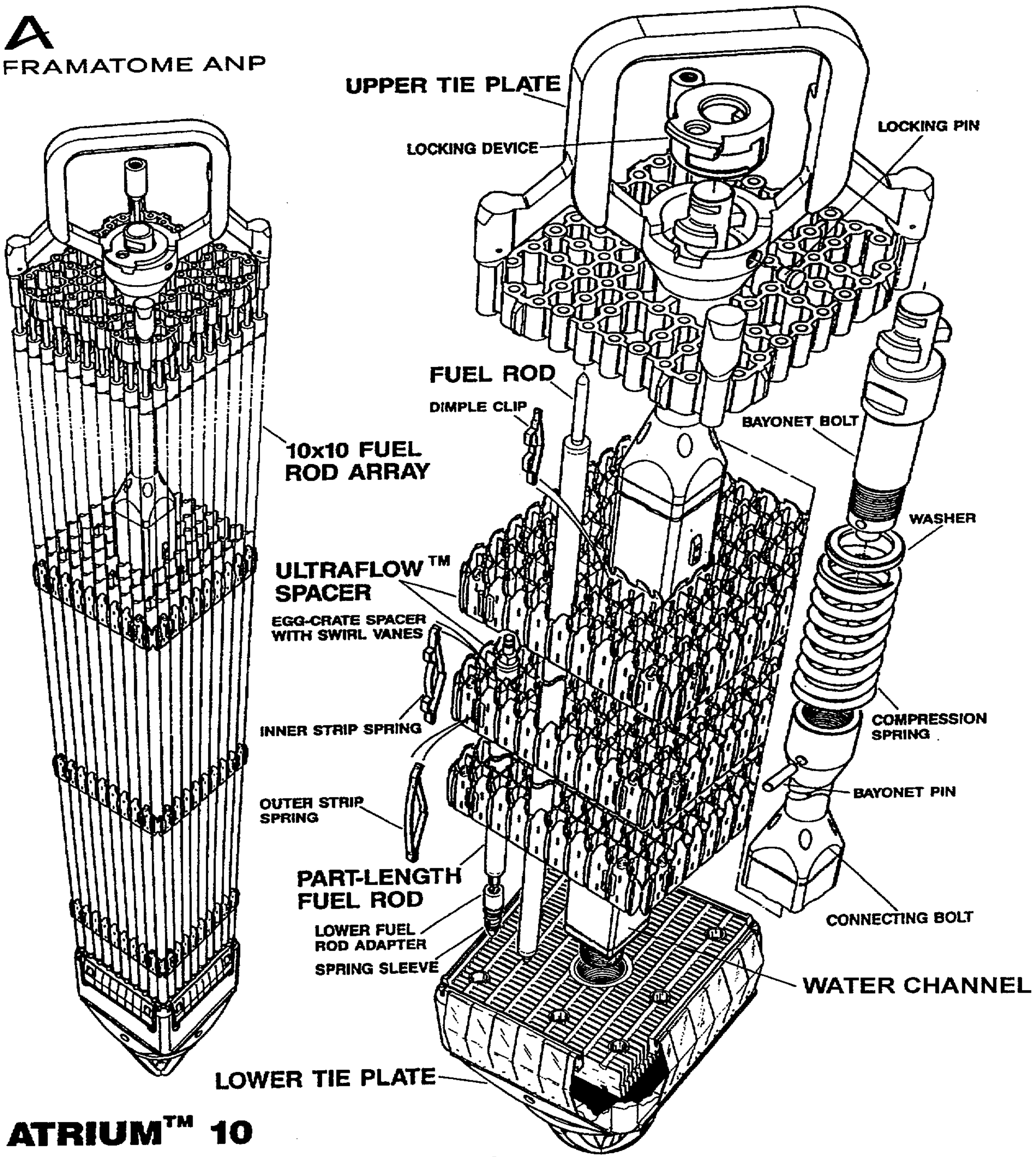
FUELGUARD™ Lower Tie Plate

> Debris protection

> Reduction of inlet turbulence



FRAMATOME ANP



ATRIUM™ 10

FUEL ASSEMBLY FOR BOILING WATER REACTORS

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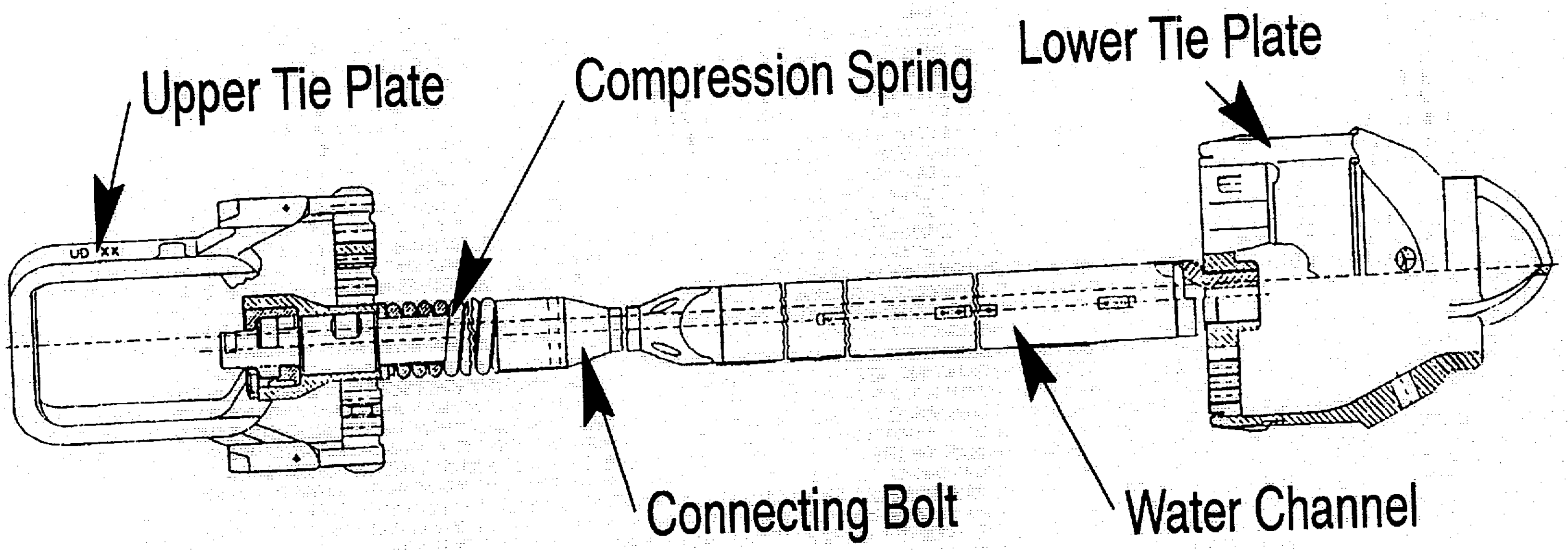
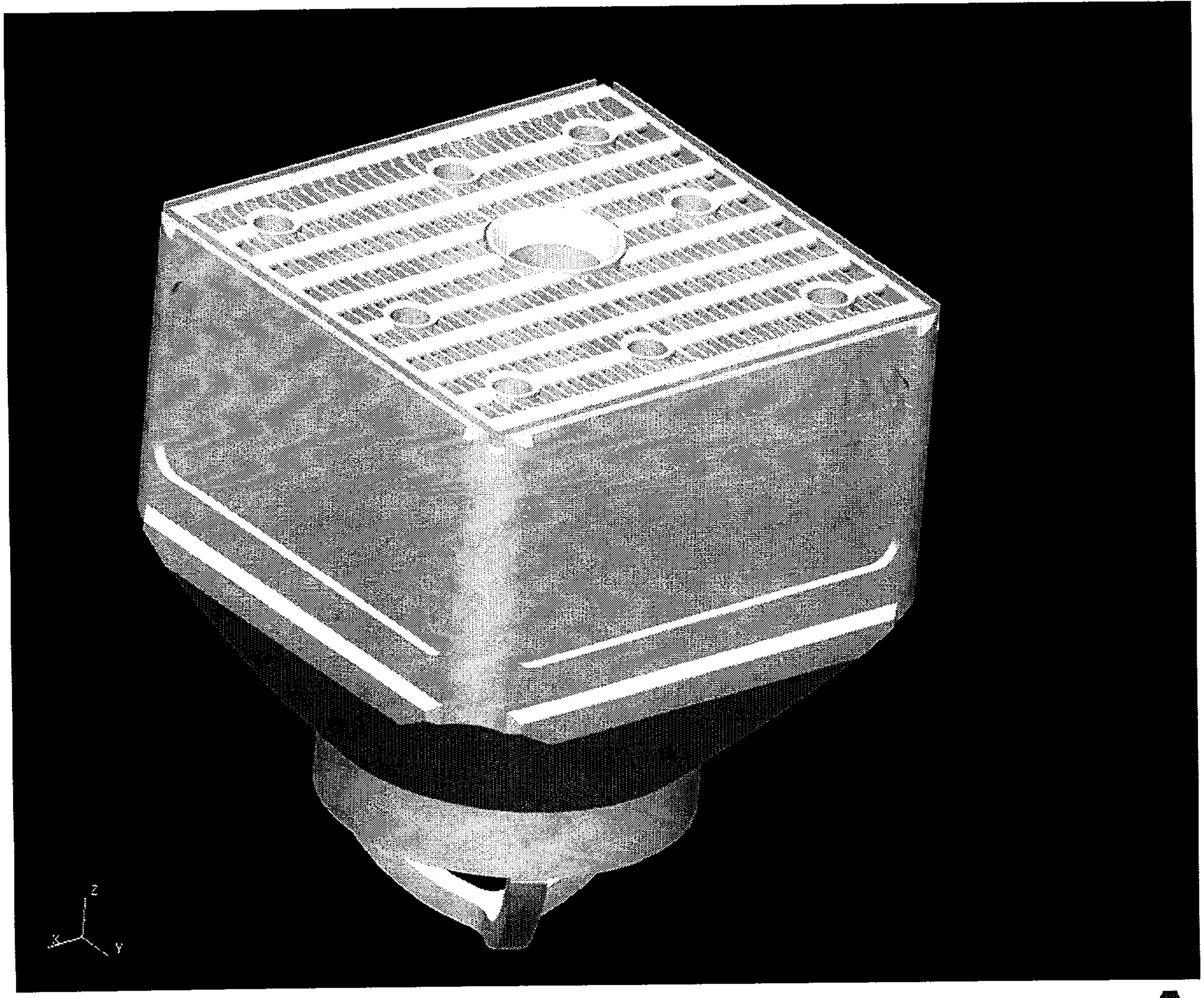
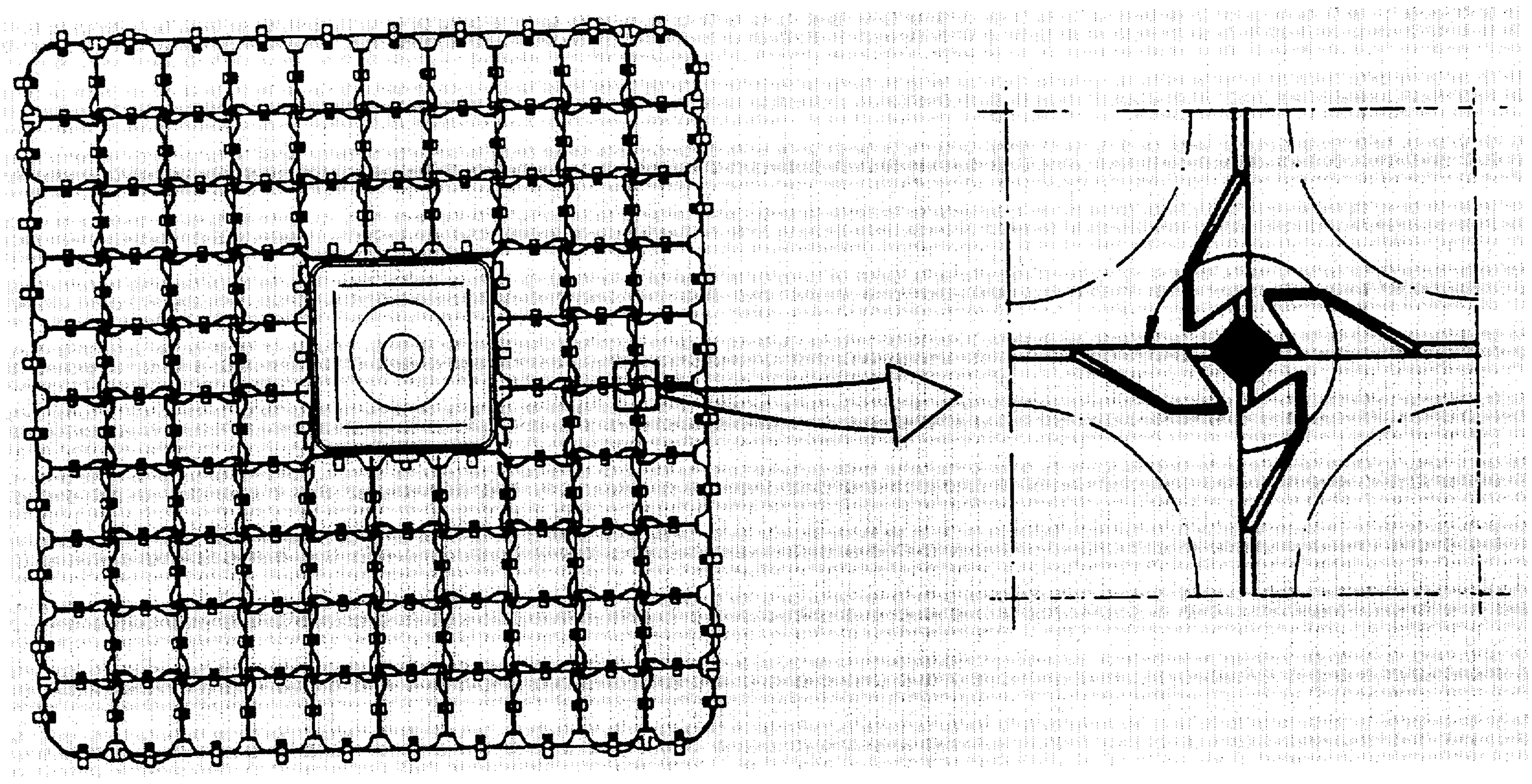
ATRIUM™-10 Fuel Assembly: Structural Internal Water Channel



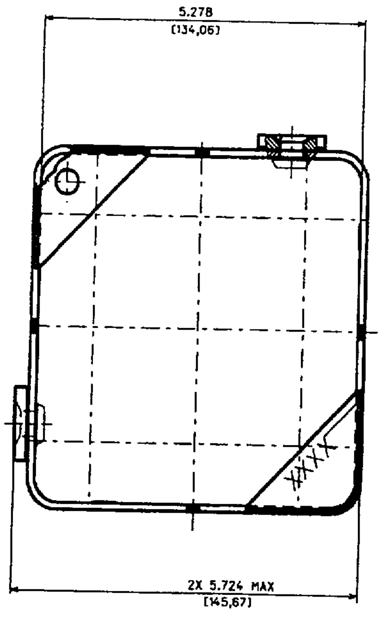
FUELGUARD™ Lower Tie Plate

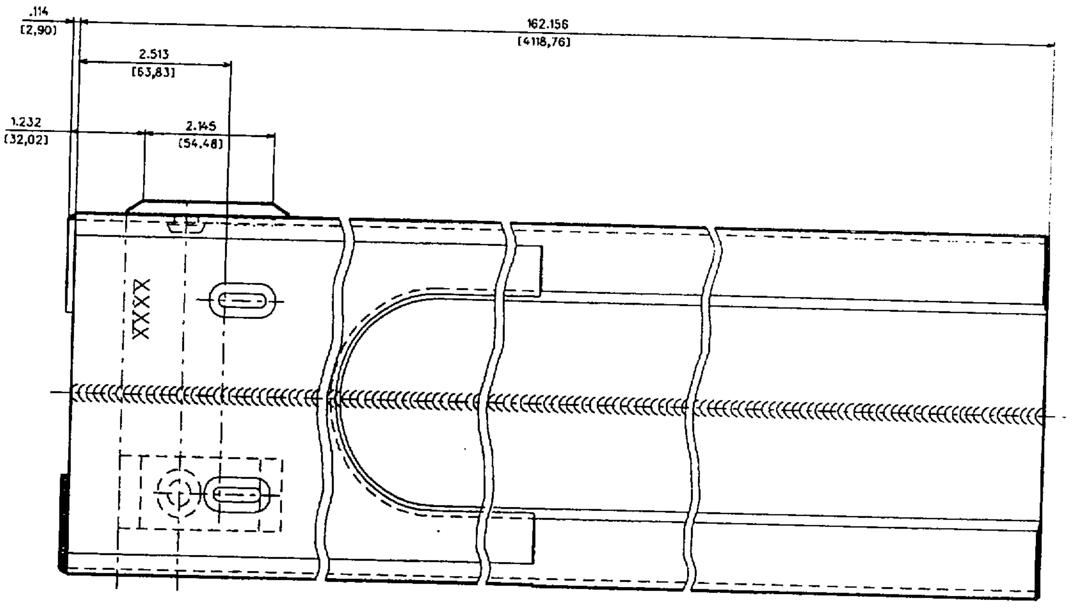


ATRIUM™-10 Fuel Assembly: Layout of ULTRAFLOW™ Spacer



ATRIUM^{TM}-10 Fuel Assembly: Advanced Fuel Channel

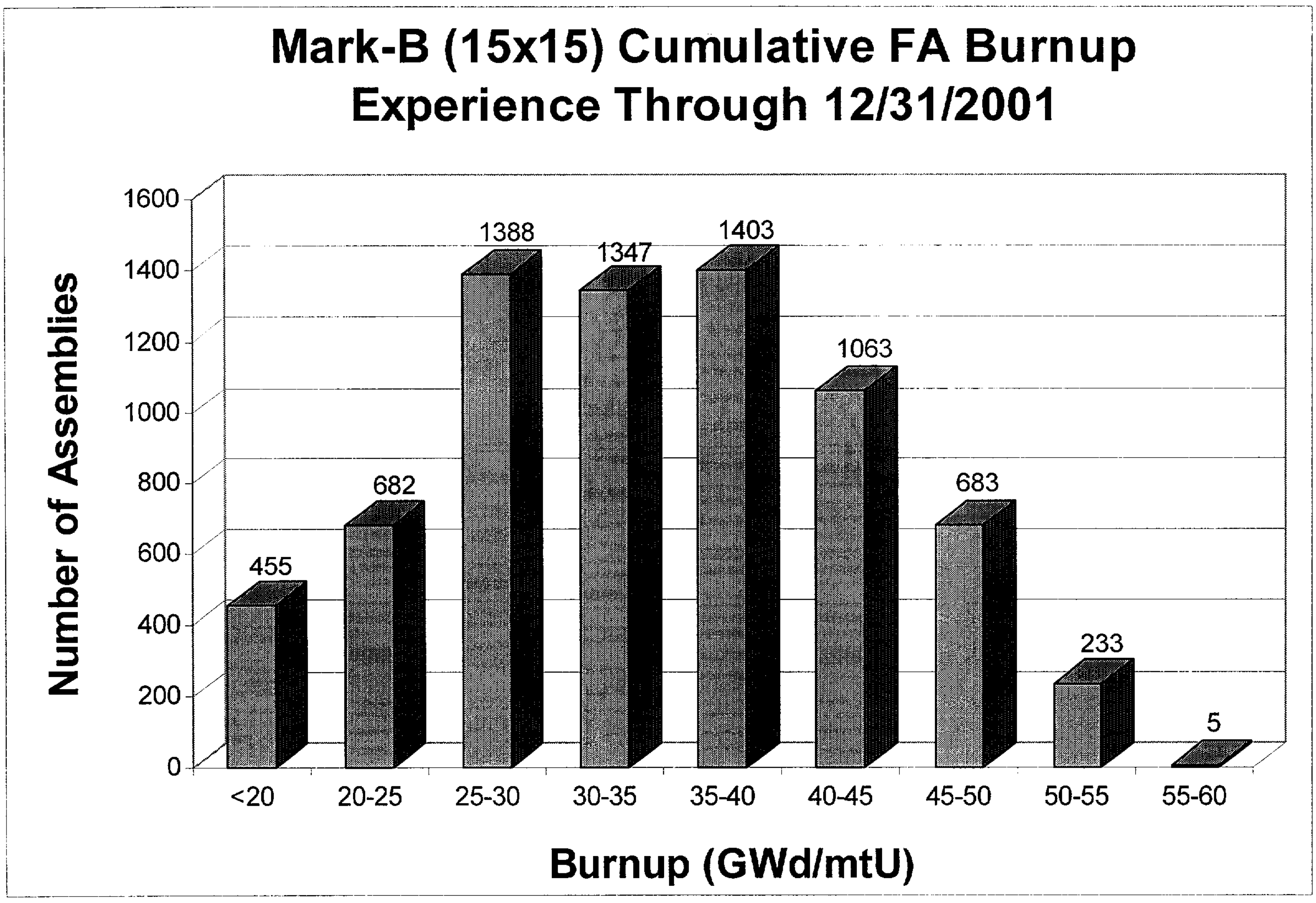




Recent U.S. Fuel Performance Experience

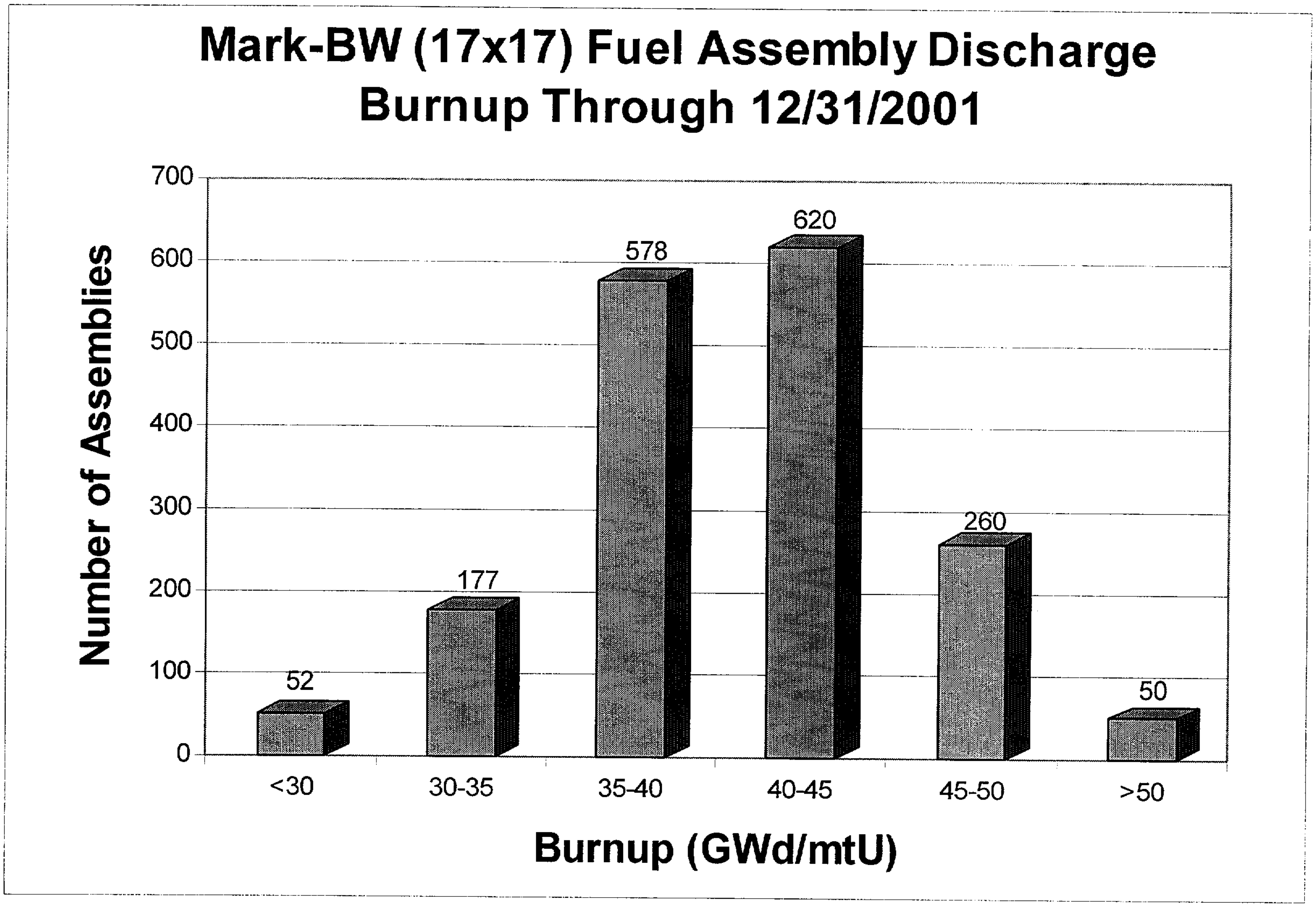
FRAMATOME ANP

Framatome ANP PWR Fuel Burnup Summary As Of 12/01



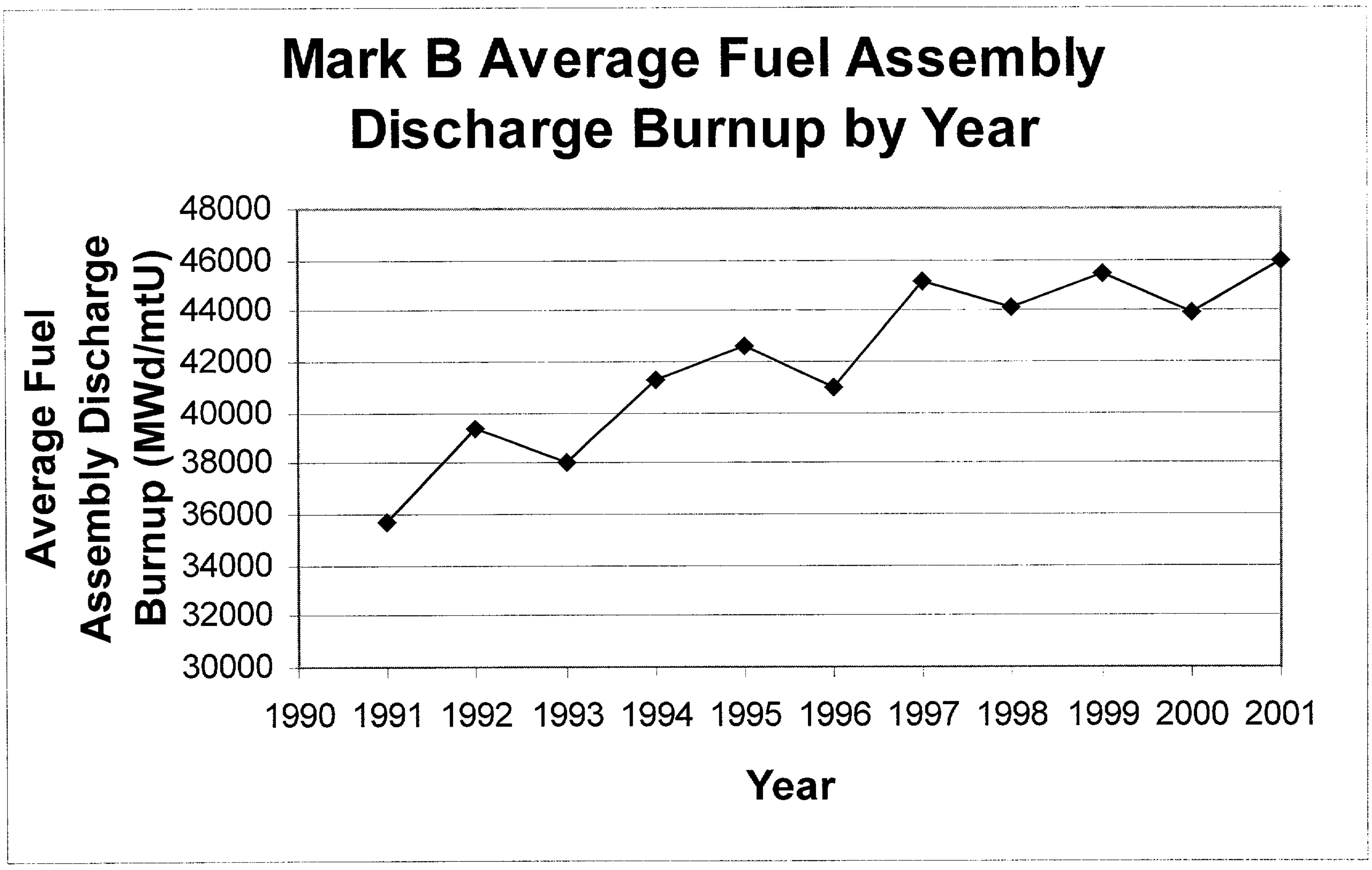
FRAMATOME ANP

Framatome ANP PWR Fuel Burnup Summary As Of 12/01



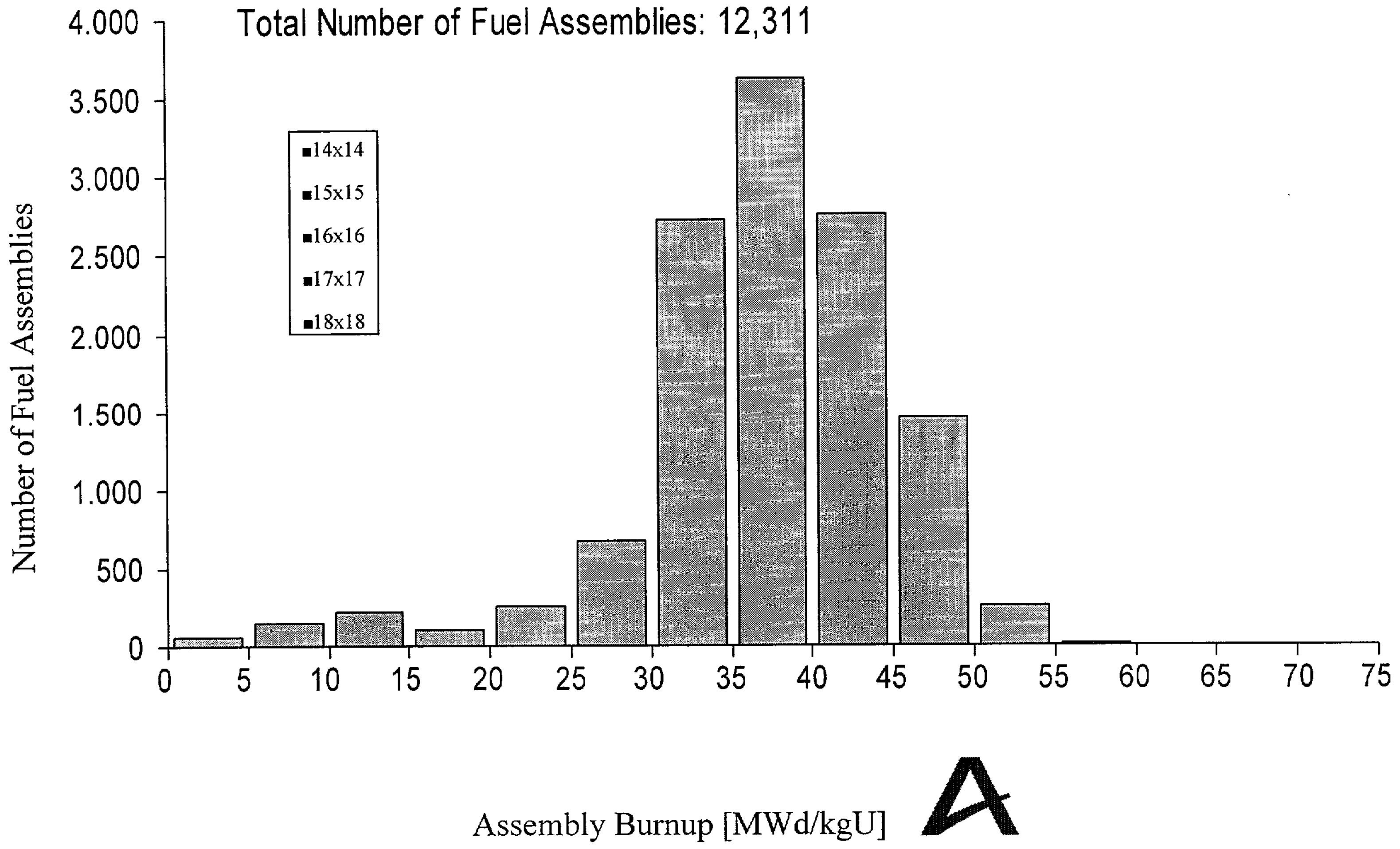
FRAMATOME ANP

Framatome ANP PWR Fuel Burnup Summary As Of 12/01



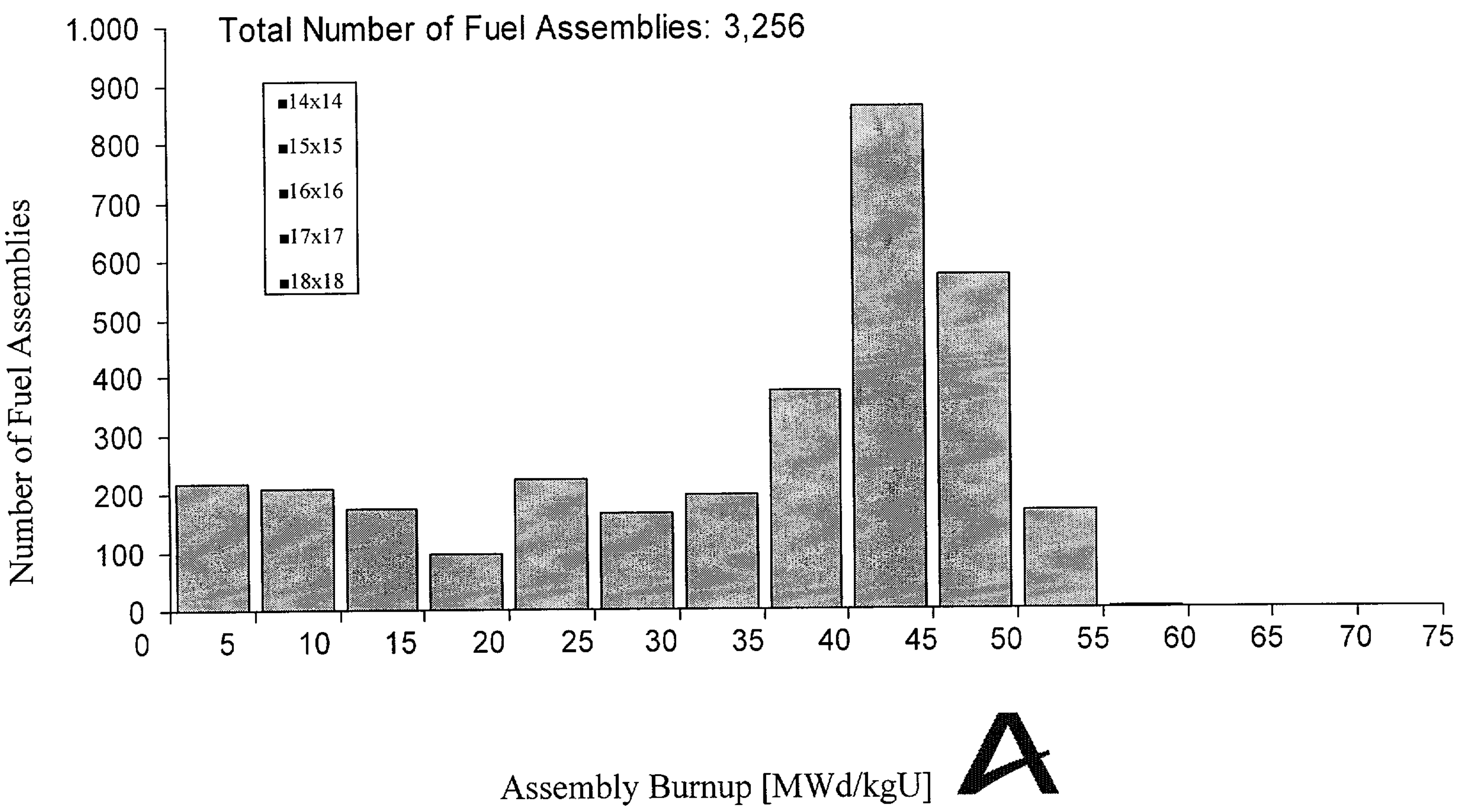
Mark B Average Fuel Assembly Discharge Burnup by Year

Burnup Distribution of Framatome ANP PWR Fuel (former SPC) (Status 8/2001)



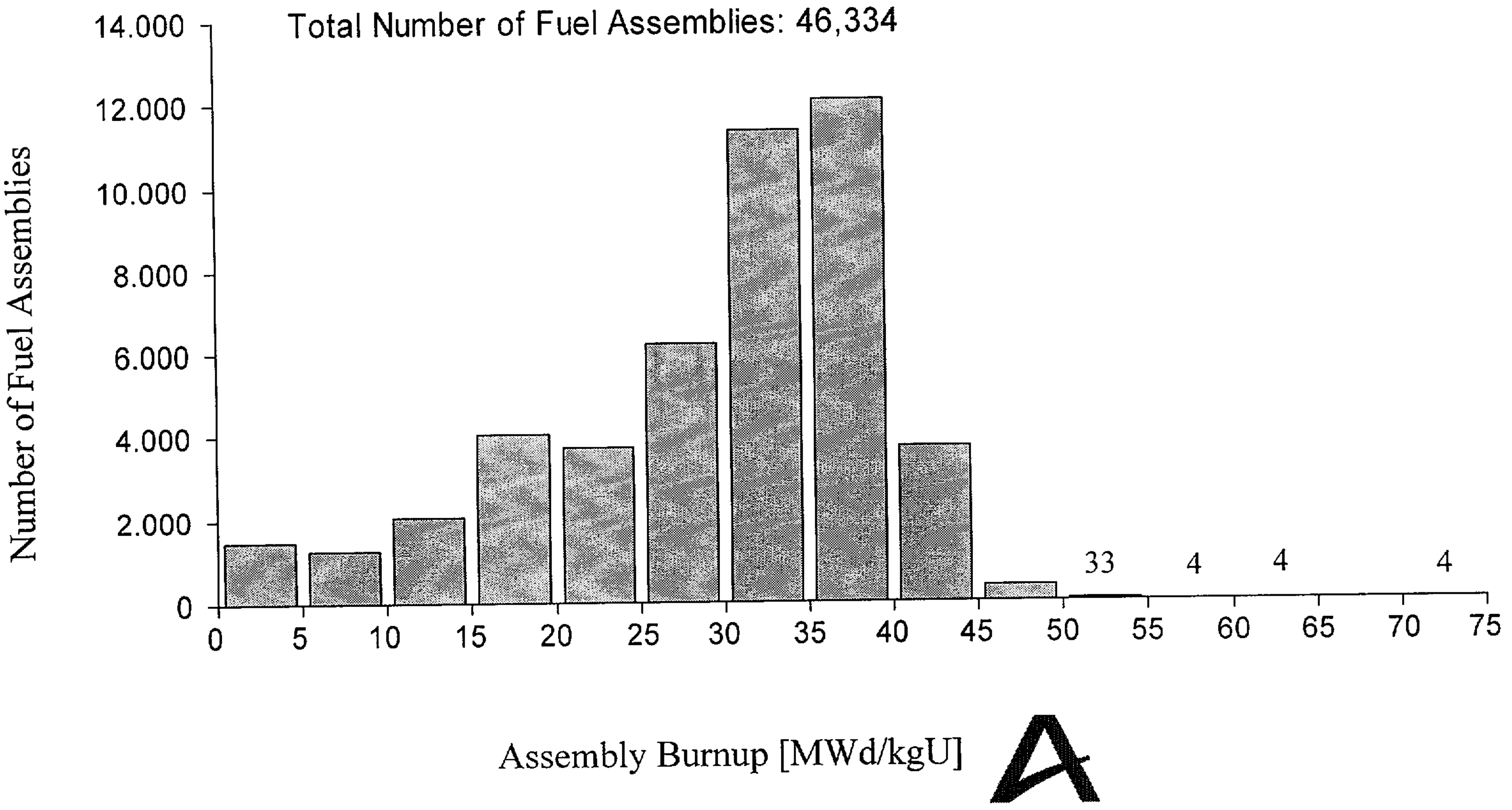
FRAMATOME ANP

Burnup Distribution of Framatome ANP PWR Fuel with HTP Spacers (Status 8/2001)



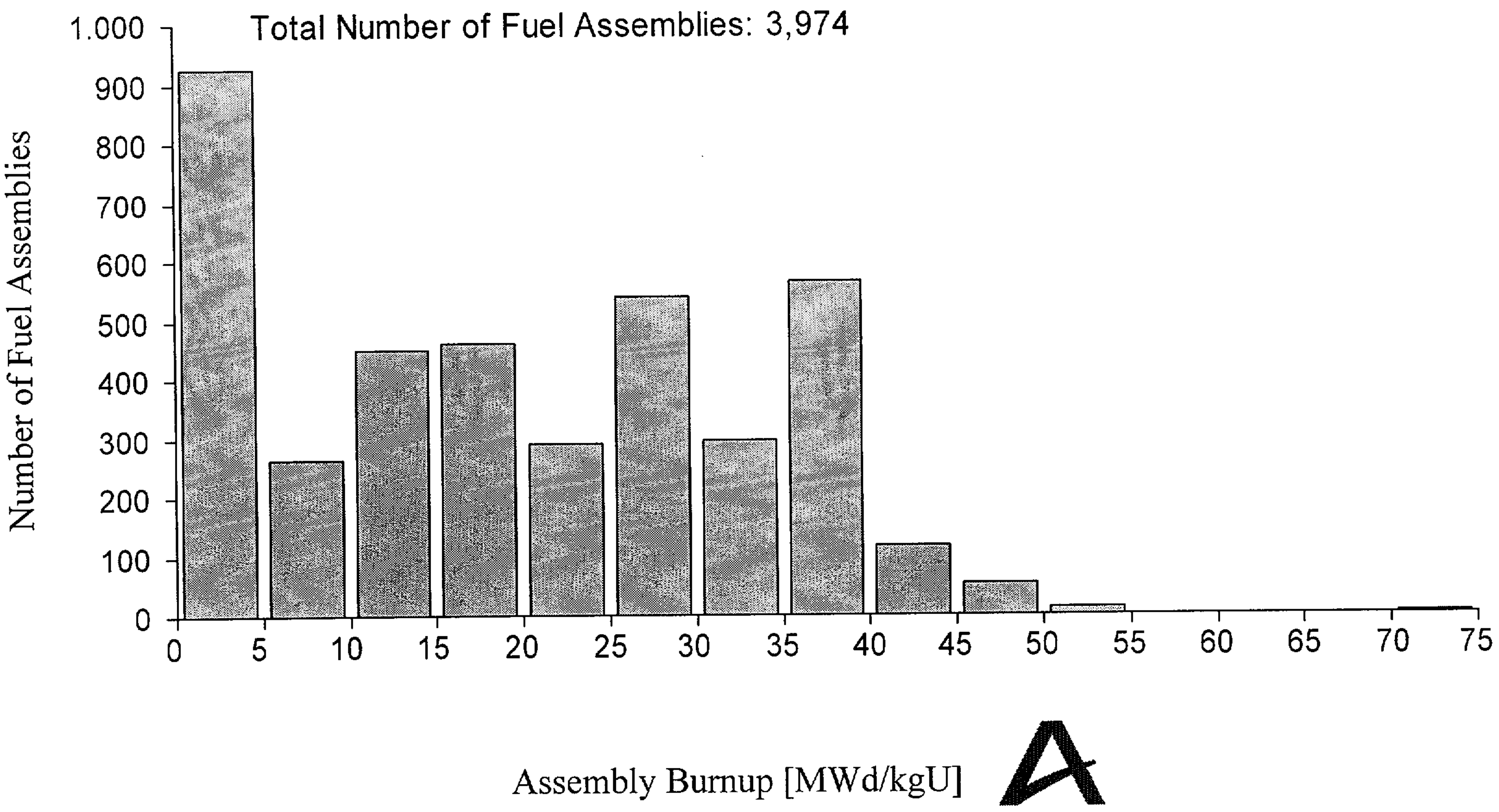
FRAMATOME ANP

Burnup Distribution of Framatome ANP BWR Fuel (Status 8/2001) (U.S. & German)



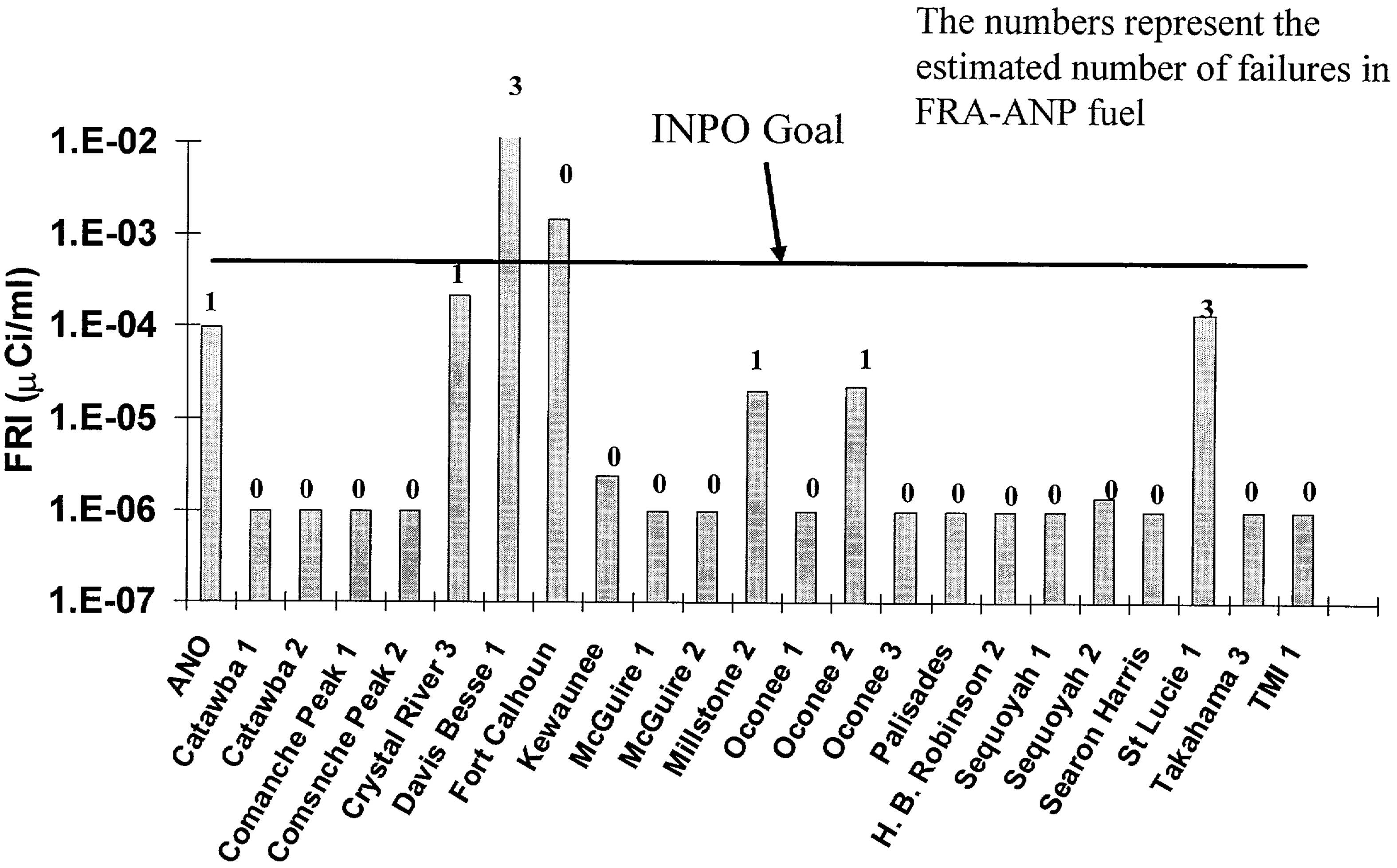
FRAMATOME ANP

Burnup Distribution of Framatome ANP BWR ATRIUM^{TM}-10 Fuel (Status 8/2001) (U.S. & German)



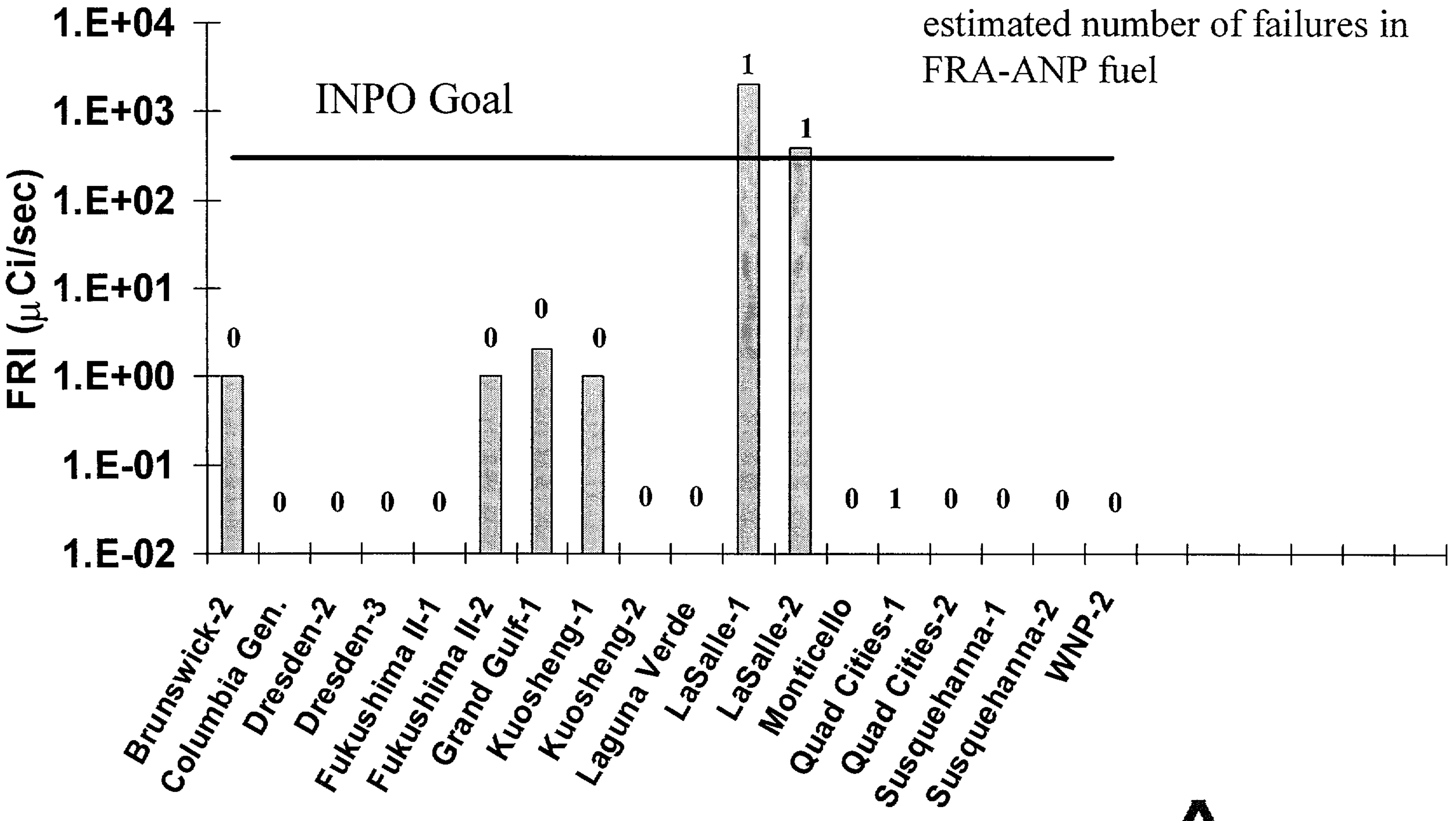
FRAMATOME ANP

Framatome ANP PWR Fuel Performance Status As Of 3/02



The numbers represent the estimated number of failures in FRA-ANP fuel

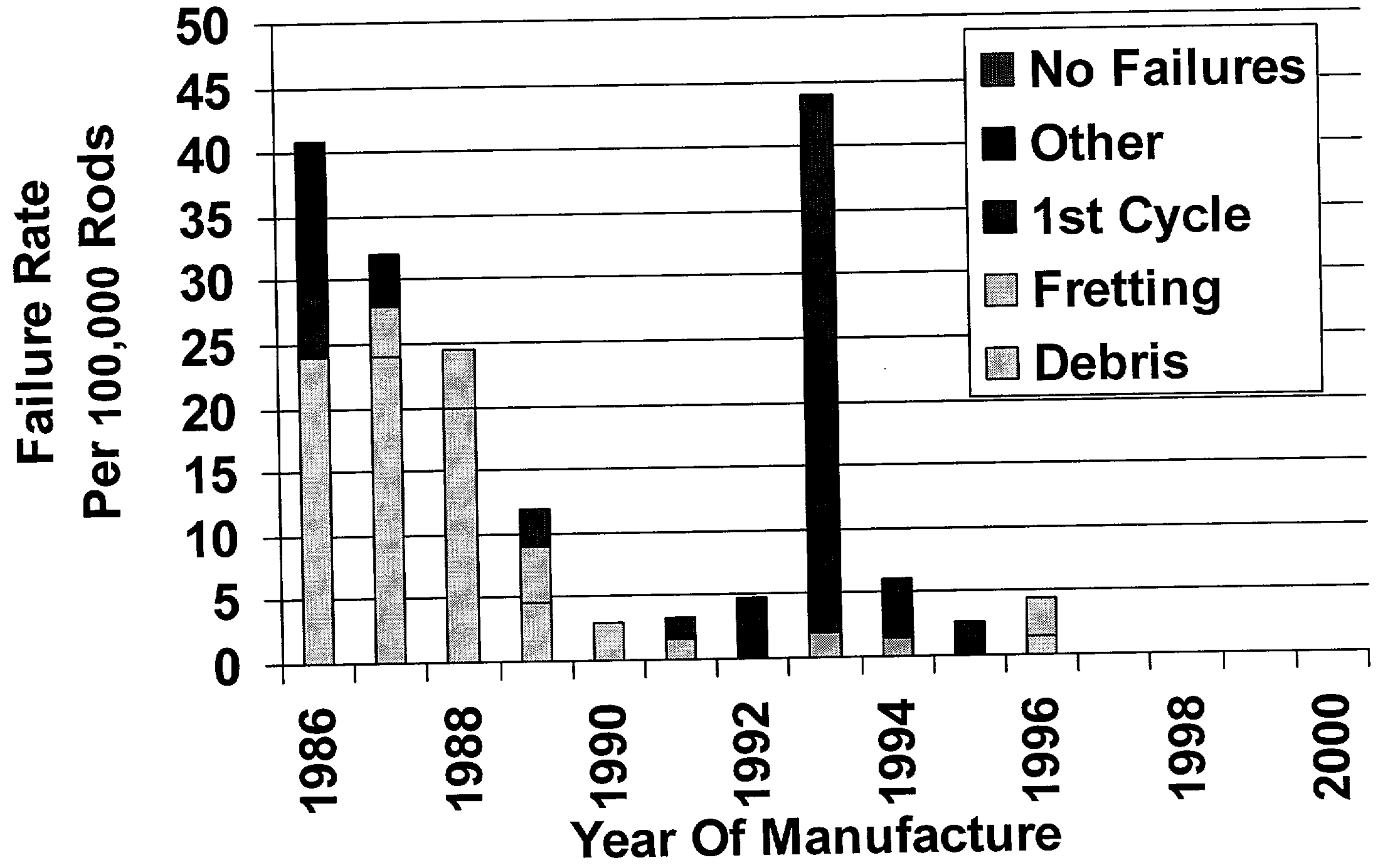
Framatome ANP BWR Fuel Performance Status As Of 3/02



The numbers represent the estimated number of failures in FRA-ANP fuel

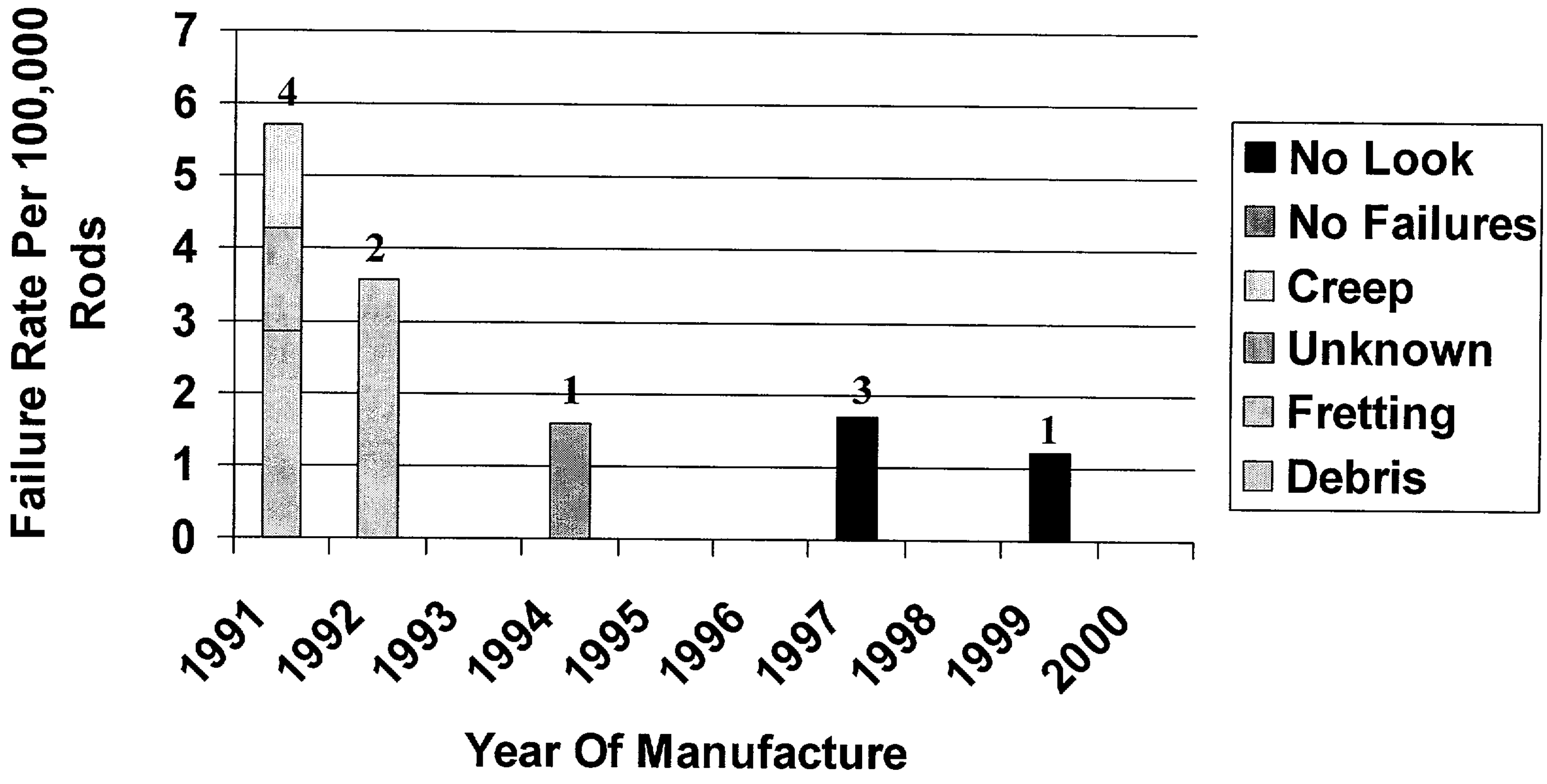
FRAMATOME ANP

Failure Rate for Mark-B (15x15) Fuel By Year Of Manufacture



FRAMATOME ANP

Failure Rate for Mark-BW (17x17) Fuel By Year Of Manufacture



Numbers above the bars represent the number of failures

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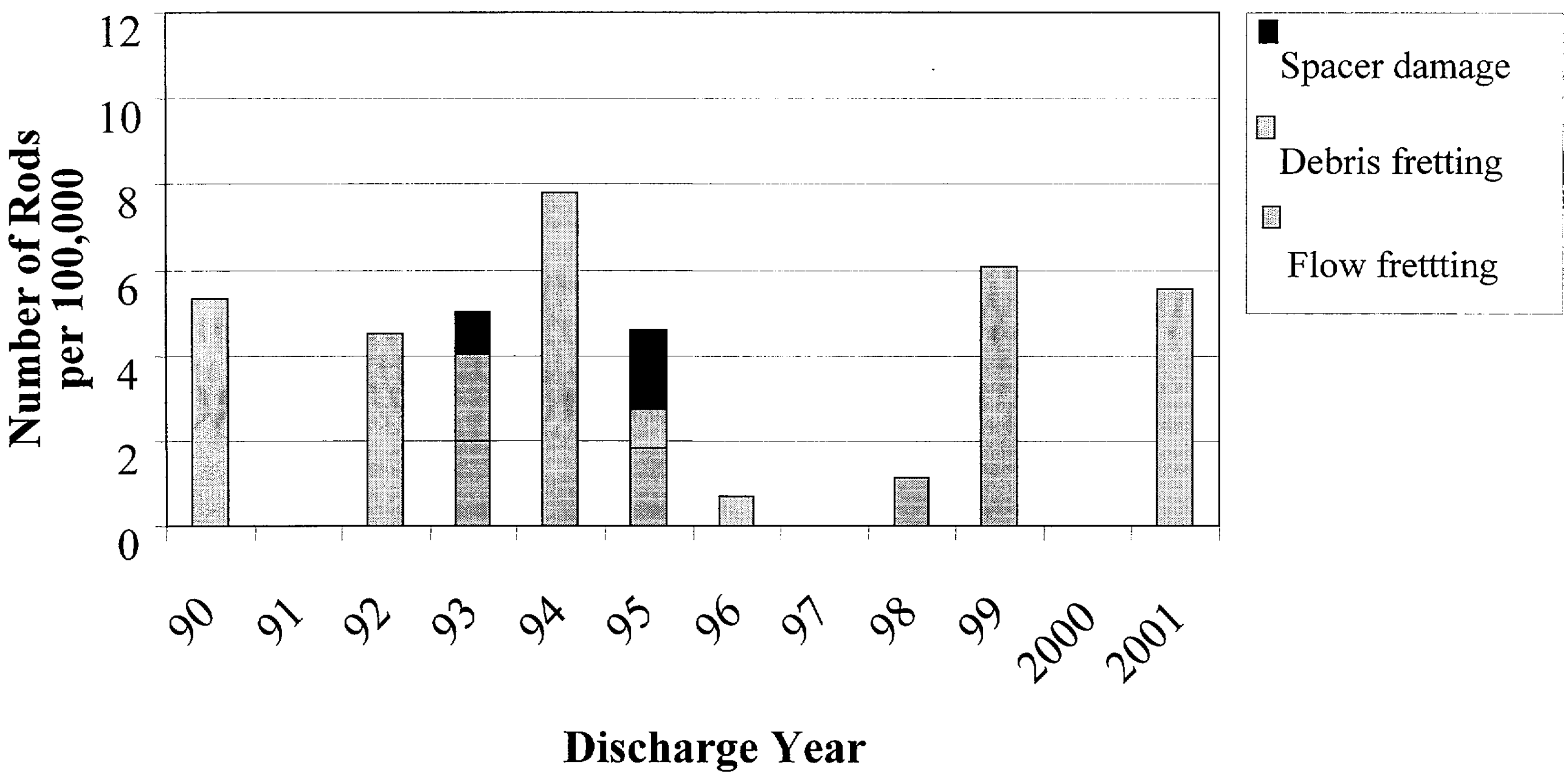
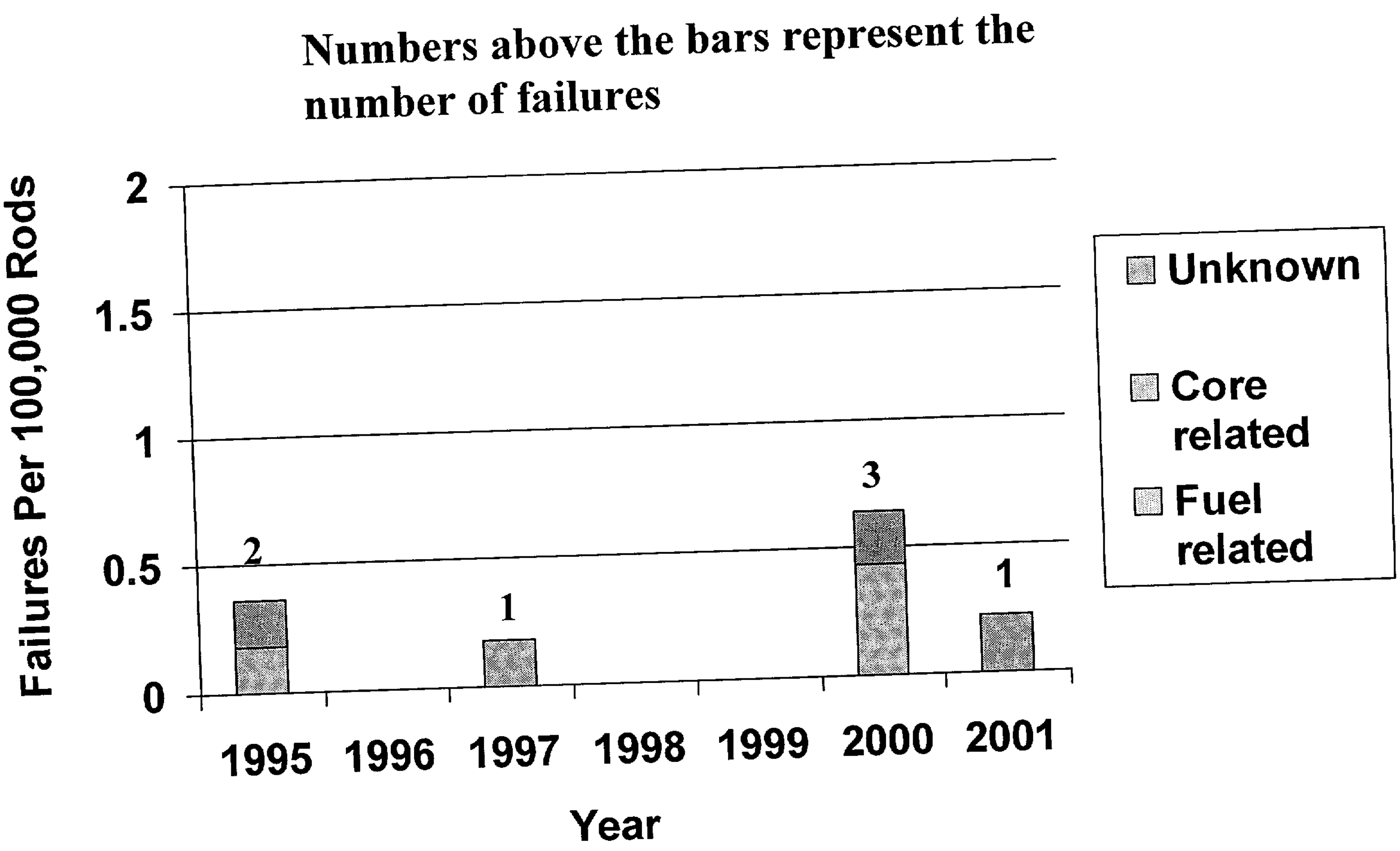
Failure Rate for former SPC PWR Fuel (bi-metallic spacers, no HTP failures)



Failure Rate for BWR Fuel


Numbers above the bars represent the number of failures

Current PWR Fuel Performance Summary

- ANO-1, Crystal River-3, Oconee-2
  - Currently Termed “Weak Indications”
- Davis-Besse
  - 2nd Cycle Discharged B10 Fuel Assembly
    - Interior rod, possible manufacturing defect, not fretting or debris
  - 3rd Cycle Discharged B10 Fuel Assembly
    - Edge rod, confirmed grid fretting
- Millstone-2, St. Lucie-1
  - Low-power assemblies
  - Experience shows fretting near baffle seam
  - Fuel assemblies do not have HTP spacers

Current BWR Fuel Performance Summary

> Quad Cities

- Confirmed during outage; cause unknown
- Clad cracking observed, but <u>NO</u> large split of the fuel rod [Fe-enhanced liner]

> LaSalle-1, LaSalle-2

- 1st-cycle assemblies
- No root cause as cycles are still operating
- Design does not have FUELGUARD™ LTP [Fe-enhanced liner]

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Improvement actions

- For PWR fretting-related failures at Millstone-2, St. Lucie-1
  - Batches of HTP introduced when failures recognized
- For PWR fretting-related failures at Davis-Besse, ANO-1
  - Formed the Fuel Integrity Quality Improvement Team (FIQIT II) to investigate spacer grid fretting failures
    - Review manufacturing and design changes
    - Review production data and processes
    - Recommend future work
  - Evaluating integration of HTP grid
- PCI failure at Kuosheng in previous cycle
  - Modified ramp rate procedures for deconditioned fuel

Cladding Corrosion Experience

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Corrosion Performance Data Sets

- PWR
  - Zry 4 (CEZUS) - transitioned to M5
    - Europe & US
  - Optimized Zry 4 (Duisburg & Sandvik) - planned transition to M5
    - US
- BWR
  - Zircaloy 2 Low temperature process (LTP)
    - Fully annealed (RXA)
      - Europe
    - Cold Worked Stress Relieved (CWSR)
      - US

M5 Cladding (Zr 1.0 Nb) Provides Outstanding Corrosion Performance

> Low corrosion rate, oxidation kinetic exhibits no acceleration at high burnup.

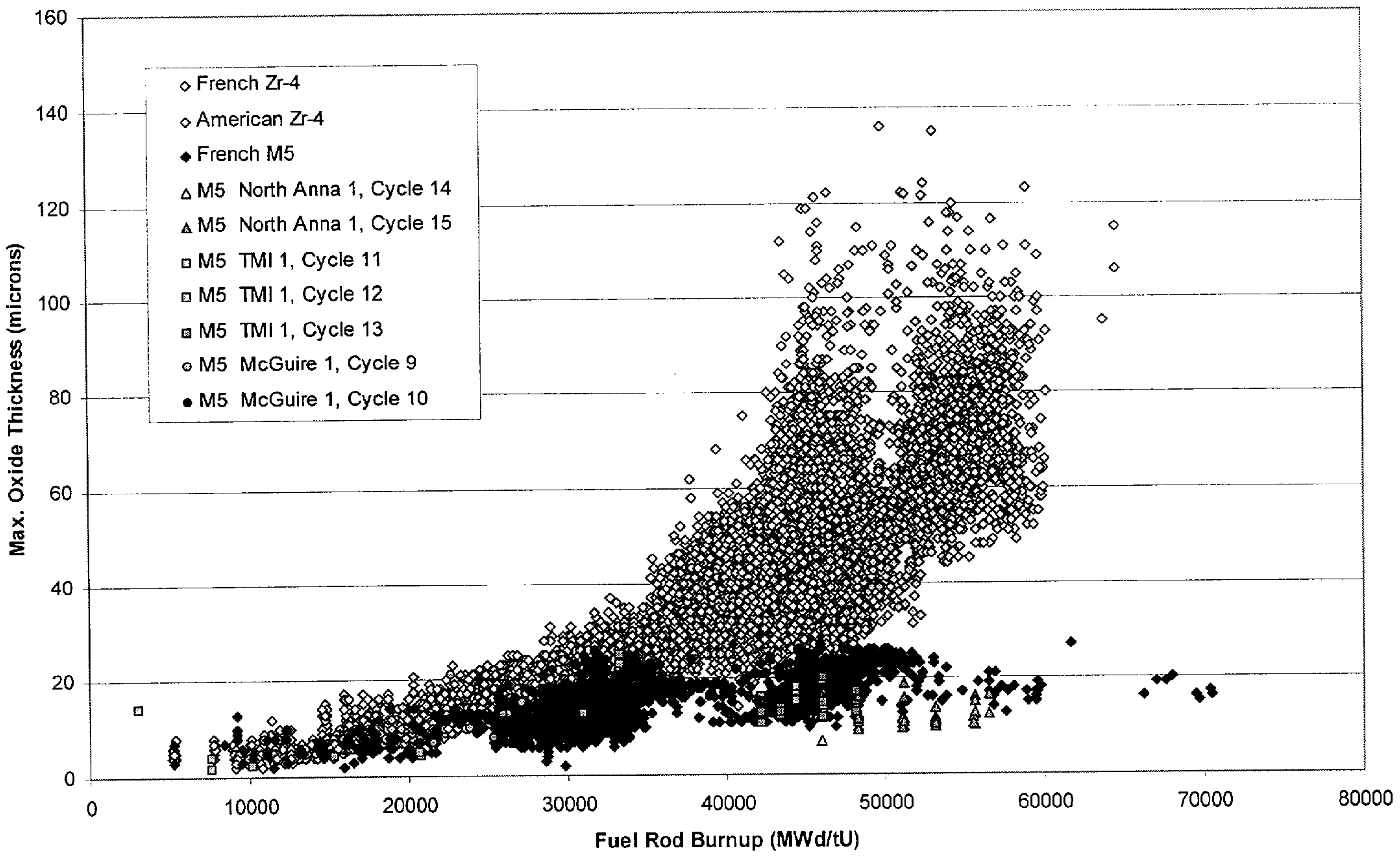
> Hydrogen pickup fraction of M5 cladding is low, limiting overall hydrogen pickup.

> M5 geometric behavior is equal to or improved over Zircaloy-4.

> M5 has a low sensitivity to reactor duty factors.

Worldwide M5™ Fuel Rod Oxide Experience

- U.S. and worldwide M5™ experience is consistent
- M5™ oxide continues to be very low for burnups of 70 GWd/mtU



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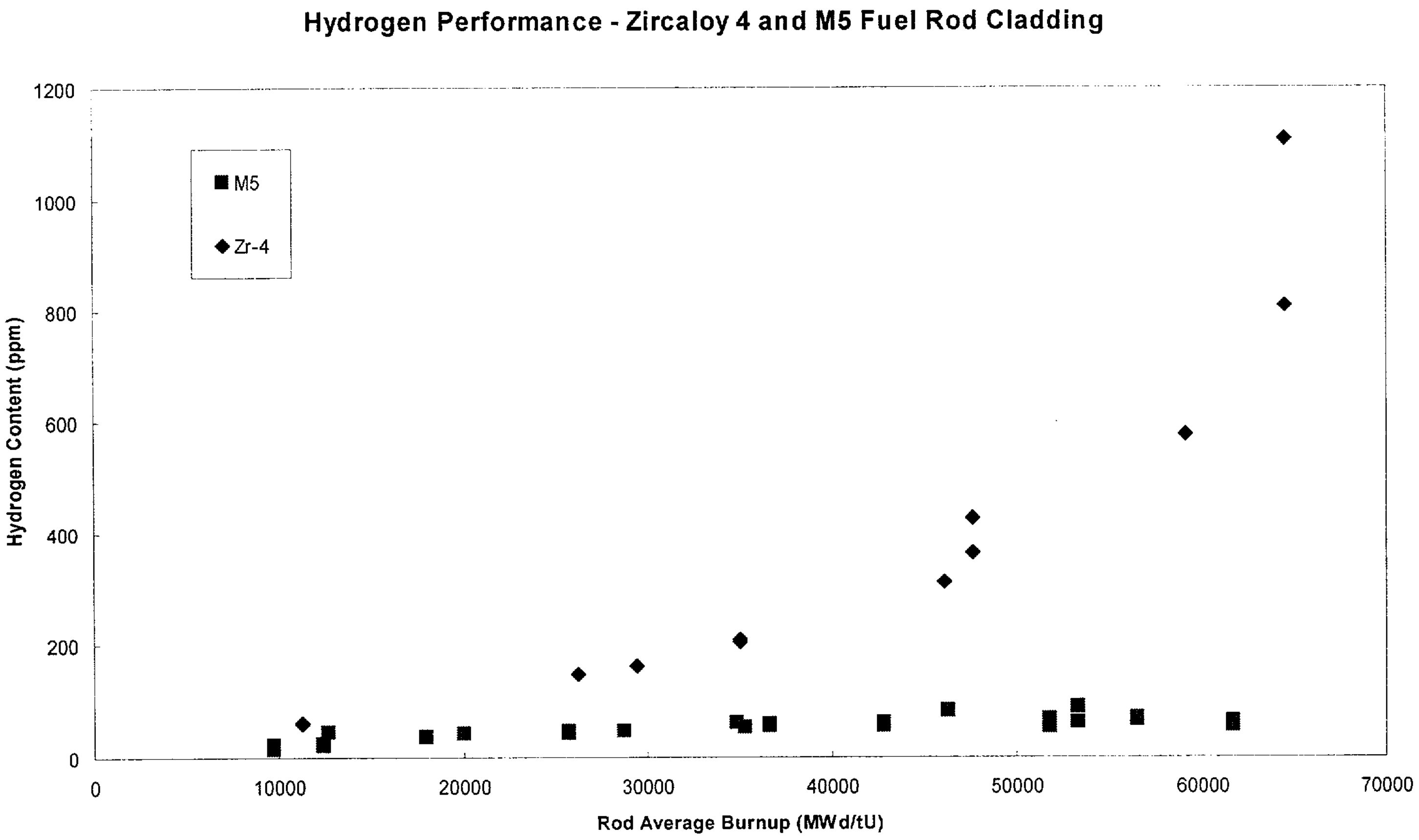
PWR Hydrogen Performance Of M5™

- M5™ continues to show much lower hydrogen pickup than Zr-4



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FRA-ANP Optimized Zircaloy-4

> Optimized Zircaloy-4 PWR cladding is low-tin high-iron and chromium Zry-4 that is optimized through special processing with respect to corrosion, growth, and mechanical properties

> Optimized Zircaloy-4 cladding differs from low-Sn Zircaloy-4 cladding and shows better corrosion performance than other low-tin Zircaloy-4 cladding

FRA-ANP Optimized Zircaloy-4

- Composition

Sn %	1.2-1.4
Fe %	0.20-0.24
Cr %	0.09-0.13
Si ppm	80-120

- Annealing parameter ΣA_i = (15-60) E-18 hrs.
- Fabrication
  - Forge Quench Forge process
  - Defined beta quench time and temperature
  - Texture control
  - High CW final pass

Corrosion of Optimized Zircaloy-4 Cladding in PWR Reactors

BWR Zircaloy 2 - LTP Cladding

- LTP: Low Temperature Process
  Material with an optimized annealing parameter;
  results in optimal size of Second Phase Particles:
    - reduction of coarse precipitates reduces nodular corrosion
    - avoiding extremely fine precipitates delays accelerated corrosion at high burnup
- LTP tubing (with Liner): optimum PCI resistance due to liner

Corrosion of BWR Fuel Rods with LTP Clad (CWSR) (U.S.) (compared with 9x9)

[ ]

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Corrosion of BWR Fuel Rods with LTP Clad (RXA)

Lead Test Assembly Programs

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Current Programs

> Advanced Mark-BW/X1 – North Anna

■ Objectives

- Confirm operating performance of design features (MSMG's and Quick Disconnect Top Nozzle)
- Provide high/extended burnupp data on M5™

■ Scope/Status

- 4 LTAs successfully completed 3-18 month cycles of irradiation in North Anna 1 (57 GWd/mtU rod burnup)
- PIE completed January 2002
- Scheduled for re-insertion for a fourth cycle in North Anna 2
- PIE - Fall 2004
  - ~73 GWd/mtU fuel rod burnup
- Potential Hot Cell
  - 2003 (3 cycles)
  - 2005-2006 (4 cycles)

■ Batch Implementation – Spring 2003

Current Programs

> Alliance 12-foot – Sequoyah 2

- **Objectives**
  - Confirm operating performance of design features
  - Additional high burnup data on M5^{TM}
- **Scope/Status**
  - 4 LTAs complete 1 cycle of operation in April 2002
    - 20 GWd/mtU fuel assembly burnup
  - PIE 2005 (3 cycles) – Planned rod burnup of 60 GWd/mtu

Current Programs

> Mark-B11 LTA – Oconee 2

- **Objectives**
  - Confirm operating performance of design features
- **Scope/Status**
  - 4 LTAs - Completed 3 cycles of operation
    - 46 GWd/mtu FA burnup
    - Zircaloy material
  - Operated on baffle 2nd cycle to confirm FIV performance
  - PIE
    - Performed each cycle
    - Last PIE Completed April 2001
- **Mark-B11 batches in first cycle of operation at all Oconee plants**

Current Programs

> M5 High Burnup Fuel Rod – TMI-1

- **Objective**
  - Provide extended burnup data on M5™
- **Scope/Status**
  - 4 M5 fuel rods
    - Operated for 3 cycles - 48 Gwd/mtU rod burnup
    - Recaged into twice burned fuel assembly
  - Planned burnup of 69 GWd/mtU (4 cycles)
  - PIE – Fall 2003
  - Potential Hot Cell – 2004-2005 (Fourth Cycle)

Current Programs

> Mark-B10K M5 Structure – Davis-Besse

- **Objective**
  - Provide high/extended burnup data on design features
- **Scope/Status**
  - 4 fuel assemblies up to 52 GWd/mtu rod burnup
    - M5 fuel rods and guide tubes
    - Two uppermost intermediate grids with M5
  - PIE
    - Completed March 2002 (1 cycle) – 28 GWd/mtU rod burnup
    - 2004 (2 cycle)
    - Potential 2006 @ +62 Gwd/mtu

VGB Utility Group
BWR High Burnup Program

Plant	Design	Cladding material	No. of cycles	Rod burnup [MWd/kgU]	No. of (segments)	Main examination
KKP-1	9x9	LTP Fe liner	5	42.2	2 (6)	transient behavior
KKP-1	9x9	LTP Fe liner	8	69.3	2 (6)	transient behavior
KKP-1	10x10	LTP Fe liner	5	57.3	2 (6)	transient behavior shadow corrosion
GUN-B	10x10	LTP Zr liner	8	64.5-73.4	21	fission gas release, shadow correrosion
KKK	9x9	LTP Zr liner	8	67.3-69.9	2	fuel and cladding behavior

GUN-B High Burnup Program

> Objective:

- Burnup 70 MWd/kgU
- ATRIUM^{TM}-10A design

> Description:

- 4.95 % max. U235 enrichment
- Advanced pellets, cladding and spacer materials

> Scope:

- Begin irradiation, 1999: 8 FA
  2000: 4 FA (large grain fuel)
- Intermediate pool site examinations after 2, 4, 6 and 7 cycles
- Final pool site and hot cell examinations after 5 and 8 cycles

> Status:

- Intermediate exam performed at 26 GWD/tU

Description of Recent Post-Irradiation Examinations

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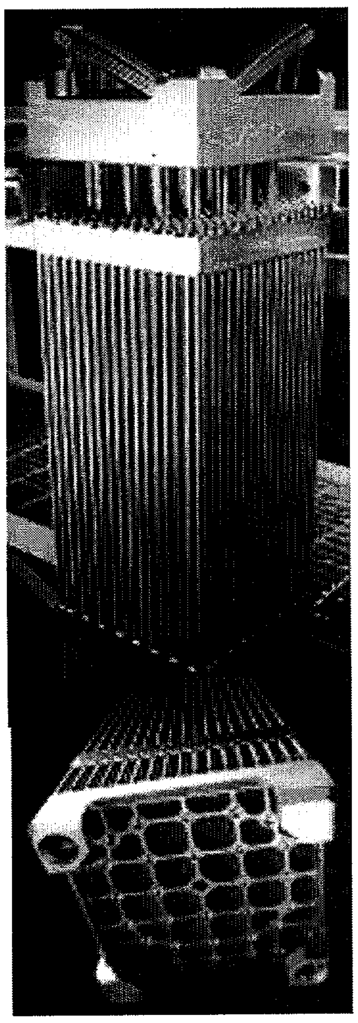
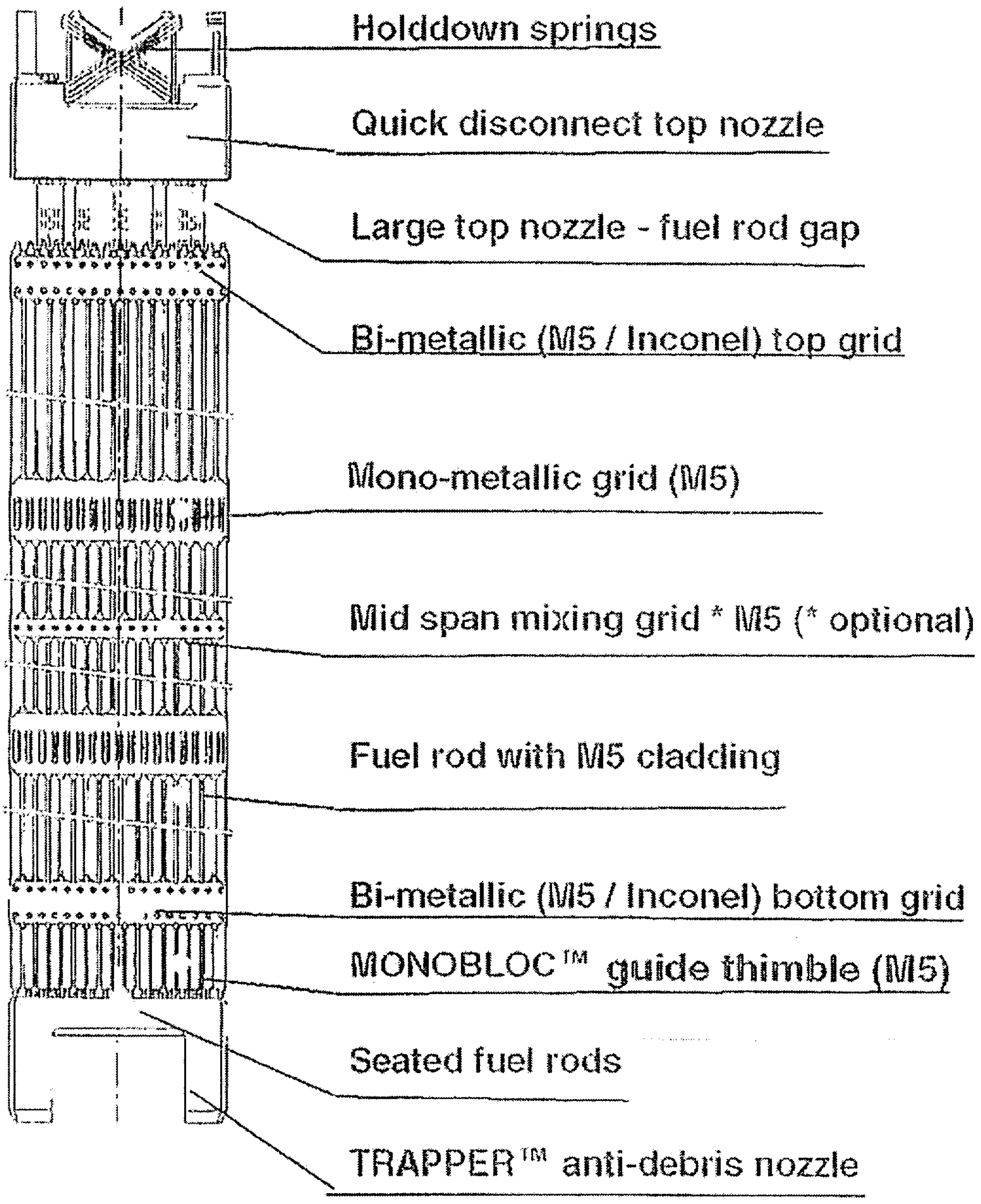
alliance™





Holddown springs

Quick disconnect top nozzle

Large top nozzle - fuel rod gap

Bi-metallic (M5 / Inconel) top grid

Mono-metallic grid (M5)

Mid span mixing grid * M5 (* optional)

Fuel rod with M5 cladding

Bi-metallic (M5 / Inconel) bottom grid

MONOBLOC™ guide thimble (M5)

Seated fuel rods

TRAPPER™ anti-debris nozzle

FRAMATOME ANP

PIE Objectives

- > Continue confirmation of advanced designs and materials
- > Purpose of the latest PIE data is to specifically support:
  - High burnups
  - M5™
  - Mark-B11 design
  - Advanced Mark-BW design
  - Alliance design

Post Irradiation Exams

> Recently Completed

- Oconee 2, Cycle 18 - B11 LTA
- TMI-1, Cycle 13 - M4/M5™ LTAs
- North Anna 1, Cycle 15 - Mark-BW/X1 LTAs
- Davis-Besse, Cycle 14 – Mark-B10K/B10K Structure Assemblies

> Upcoming

- Sequoyah 2, Cycle 11 – Alliance LTAs

M5^{TM} Fuel Rod Growth

- U.S and worldwide M5^{TM} fuel rod growth data are consistent

North Anna Advanced Mark-BW LTAs Continue To Show No Fuel Assembly Growth

Mark-B10 (15x15) Fuel Assembly Growth Experience

Fuel Assembly and Fuel Rod Growth Summary

> Fuel Rod Growth

- Zirc-4 fuel assembly and fuel rod growth supports existing models
- M5™ fuel rod growth supports existing M5™ model
  - U.S. data is consistent with worldwide data
  - Rod growth saturates above 40 GWd/mtU

> Fuel Assembly Growth

- Advanced Mark-BW M5™ fuel assembly growth is low
- Mark-B M5™ fuel assembly growth follows zirc-4 growth for low burnups as expected
  - M5™ fuel assembly growth should saturate above 40 GWd/mtU

> Fuel Assembly Growth Model

- UTL - 80% of zirc-4 at 62 GWd/mtU burnup
- LTL – No fuel assembly growth
- Alliance LTA data will be incorporated

PWR Fuel Assembly Growth

PWR Guide Bar Assembly Growth

Description of Recent Post-Irradiation Examinations

BWRs

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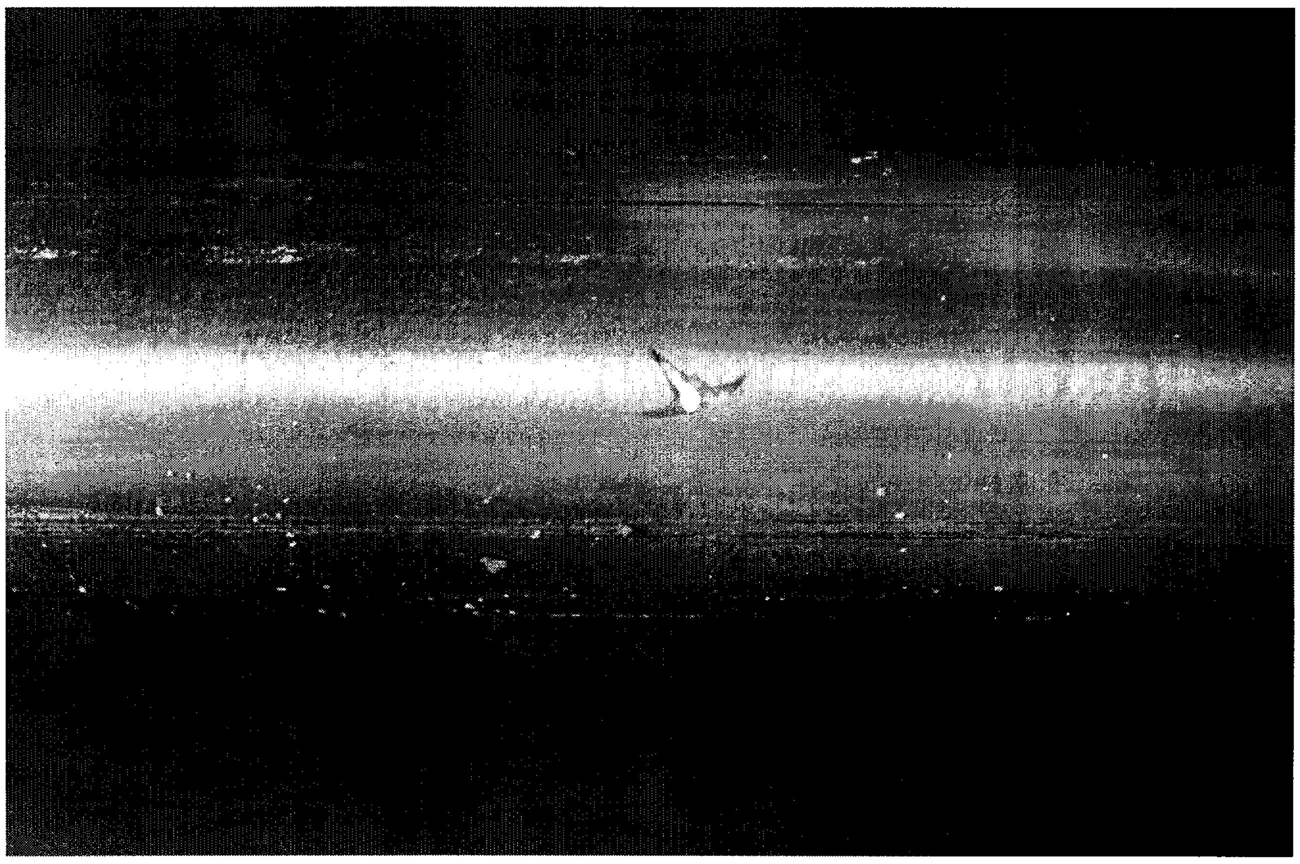
Recent US and Important German BWR Exams

Reactor	Main evaluation
TVO-1, Quad Cities	Failure of Fe-enhanced liner
Gundremmingen B	Oxide, growth, hot cell
Susquehanna	Oxide, growth, creepdown
Dresden	Oxide/CRUD

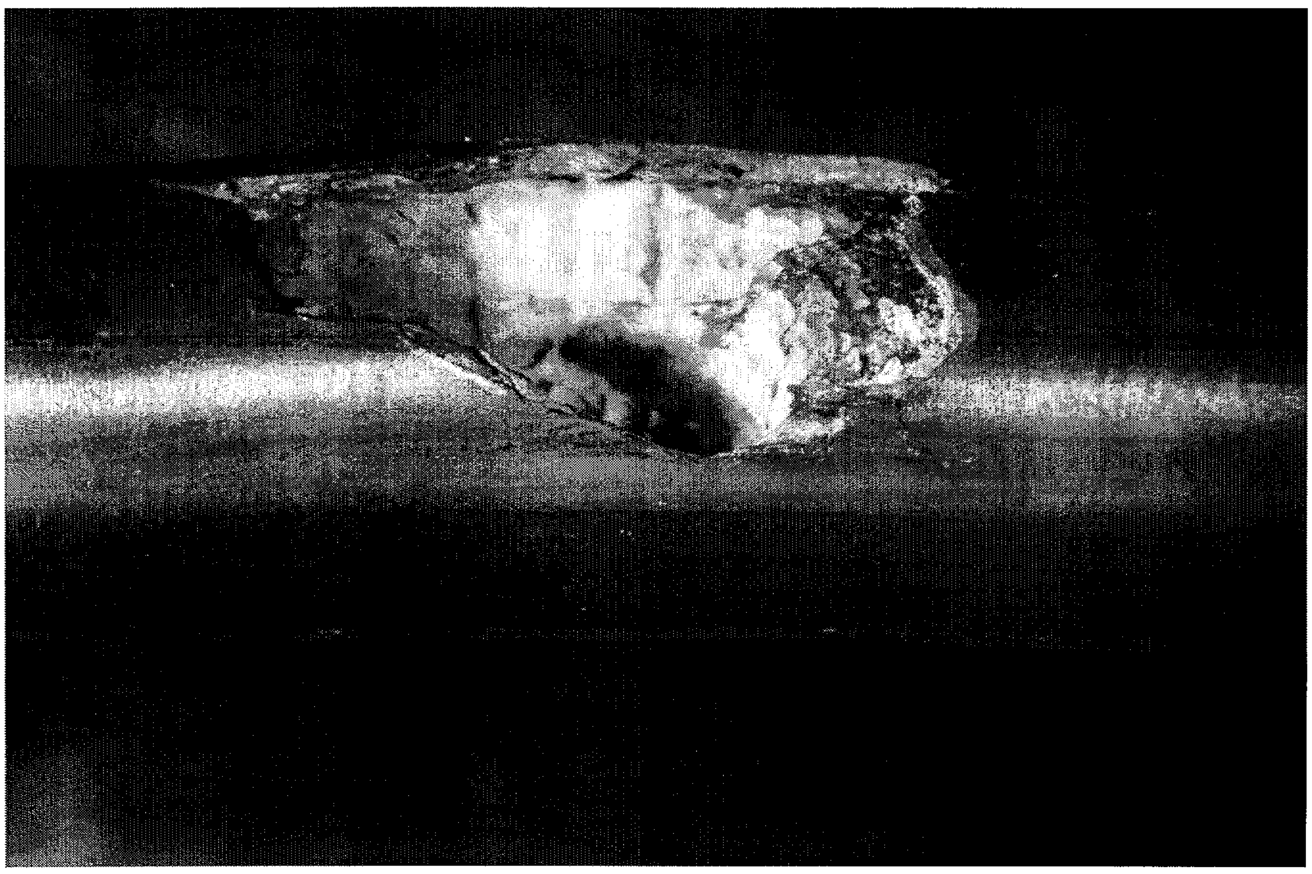
Post-Irradiation Examination of the First Defective Fuel Rod with Fe-enhanced Zr-Liner Cladding

Reactor	TVO
Fuel Assembly Type	ATRIUM^{TM}-10B
Irradiation Time	1 Cycle
Burnup	14 MWd/kgU
Operation with Defect	$\geq$9 Month

The Primary Defect has been Caused by Foreign Particle Fretting Below SG 4



Close Look at the Largest Secondary Failure - Open Hydride Blister



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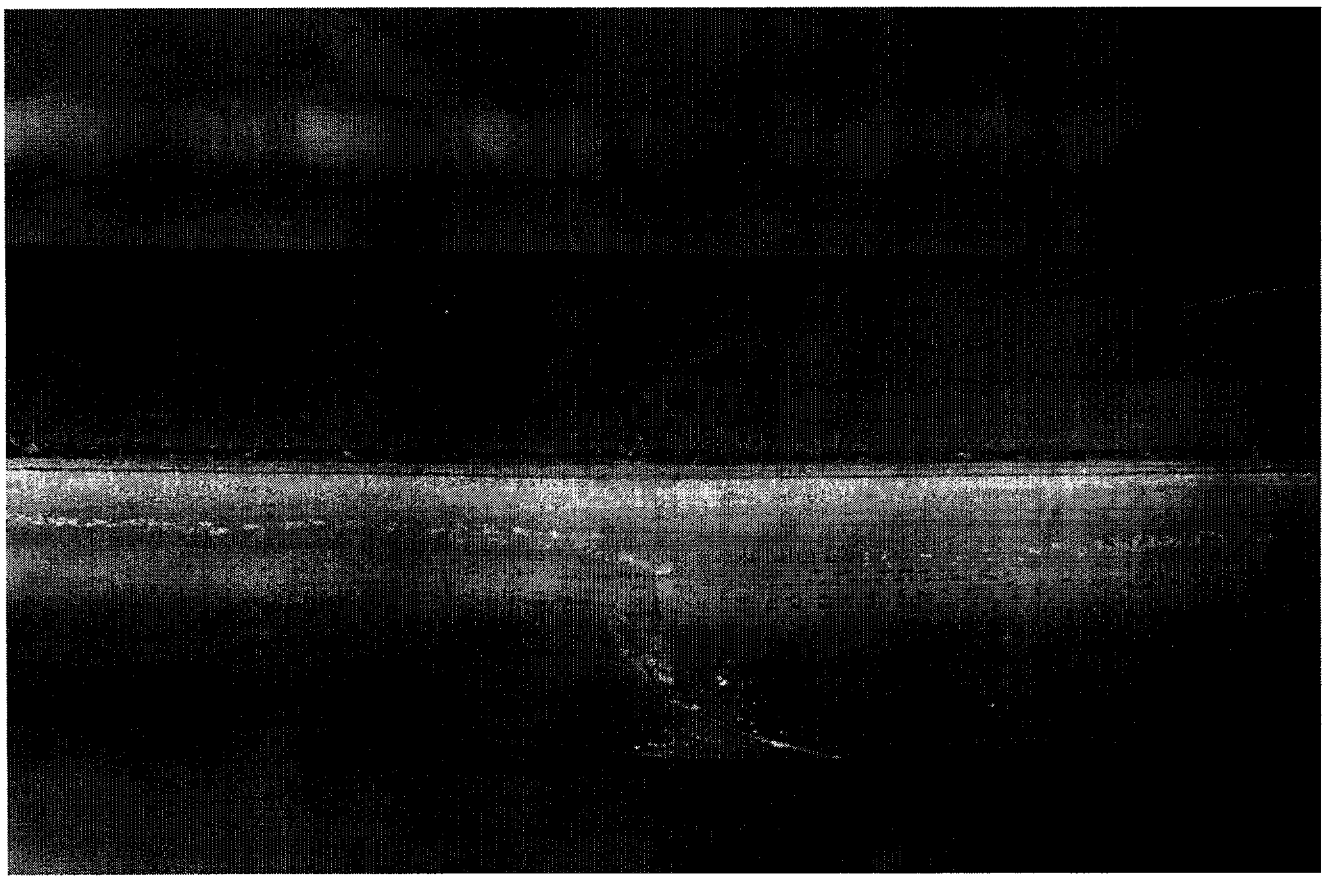
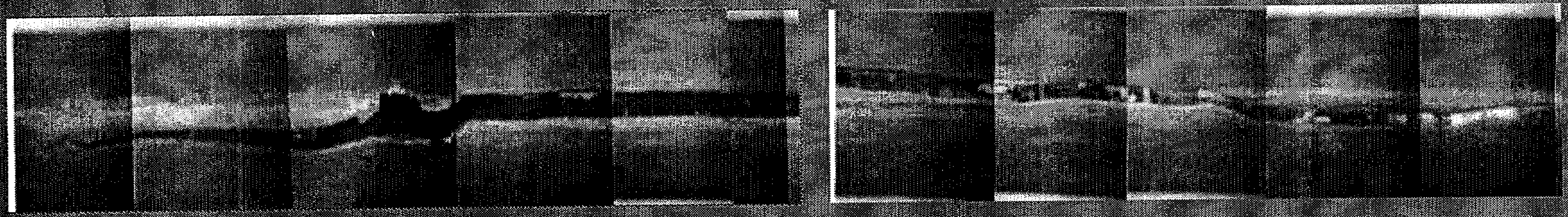
Cracks Starting at the Hydride Blister Stop Within a Few Millimeters



The Fe-enhanced Zirconium Liner Prevents Severe Secondary Degradation



Pure Zirconium Liner

Fe-enhanced Zirconium Liner

Defected Fe-enhanced Liner Clad Behaves the Same as Non-Liner Clad

> In spite of long-time operation in defect condition the activity release and fuel wash-out were relatively low

> Secondary defects were limited to local hydride blisters

> No signs of severe secondary degradation such as large cracks and long splits have been observed

> It is therefore concluded that the Fe-enhanced Liner effectively prevents the development of large axial splits

Dresden Crud/Oxide Measurement

- > 2 Assemblies, 3 cycles to 38 GWD/tU
  - One reference
  - One operated 3rd cycle in NMCA
- > Rods, 12 measured
  - Dual frequency corrosion thickness measurement
  - Crud scrapes
- > Preliminary results
  - Measurement system appears reliable
  - Total thickness increase seen under NMCA

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ATRIUM™ -10 Global Inspection Program

Reactor	FA Type	93	94	95	96	97	98	99	00	01	02	03	04
GUN–B	10A liner	1	2	3□	4◇	5◇	5◇	6◇	7□	8□H			
	10A non–liner					1v	2v	3v	4	5v	6□		
KKL	10B liner						1v	2v	3□	4□	5v	6□H	
TVO–1	10B non–liner				1v	2v	3▫	4□					
	10B liner							1v	2v	3v	4▫	5▫	6v
TVO–2	10B non–liner				1v	2v	3▫	4					
BRA	10B non–liner					1v	2	3v					
OKG–2	10B non–liner							1	2v	3	4	5	
OKG–3	10B non–liner					1	2	3v	4v		5v		
FMK–1	10B non–liner					1v	2	3	4				
FMK–3	10B liner							1	2v	3	4▫	5	6
RH–1	10B liner							1v	2▫	3	4▫	5	6
KKP–1	10B/10P liner					1v	2◇	3◇	4□	5□H			
GUN–C	10–8 liner		1◇	2◇	3□	4◇	5◇	6□					

v Visual Inspection ◇ Visual + Length ▫ Visual, Lenght, FR Oxide+Diam. (outer row)

□ Visual, Length, FR Oxide+Diam., WC Oxide+Dimensions H Hot Cell Examination

Preliminary Examination Schedule

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ATRIUM™ -10 Fuel Assemblies in GUN-B

> First time a BWR assembly reached 71 MWd/kgU with maximum rod burnup of 73.4 MWd/kgU.

> The fuel assemblies, fuel rods and channels showed good behavior.

> Fuel channels made of Zry-4 show a corrosion acceleration at high burnup.

> Detailed hot cell examination will be performed in addition to the final pool examination.

ATRIUM™ -10 Fuel Assembly Growth (German Region)

ATRIUM™ -10 Assembly Growth (U.S. Region Data) (Comparison with Fuel Channel Growth)

[

]

Description of Defects in the Fuel Rod with Fe-enhanced Zr-Liner

> Small primary defect caused by fretting of foreign particle at spacer grid 4

> One larger secondary defect, an open hydride blister about 100 mm above spacer grid 1

> Additional small hydride blisters were observed above spacer grids 3 and 6

ATRIUM™ -10 Rod Growth (CWSR Clad), (Compared with Other Arrays)

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Long Term PIE Goals

- Continued confirmation of existing and advanced designs
- Provide data to validate new designs to burnups above current levels
- Proactive response to provide information to support future robust fuel data needs
  - Selective assemblies for 3rd and 4th cycle burnups > 65 GWd/mtU
  - Selective reconstitution of M5™ fuel rods to reach rod burnups of 70-75 GWd/mtU

Emerging Issues

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Challenges to BWR Hardware Design

> Elimination of fuel failures
- Continue to identify root causes, make change as appropriate

> Increased Cycle Length
- Continue monitoring fuel behavior

> Coolant Chemistry
- Currently working with customers
  - Improved fuel corrosion and crud measurement
  - Balance ALARA, plant and fuel requirements

Challenges to BWR Core Design Management

> Plant Uprates in Combination with 2 Year Cycles

- Development of improved fuel performance analysis
  - Statistical approach
- Development of improved bundle CHF performance
  - Design improvements

Challenges to PWR Hardware Design

- > Elimination of fuel failures
  - ■ Continue to identify root causes, make change as appropriate
- > Resistance to Axial Offset Anomalies (AOA) & Distinctive Crud Pattern (DCP)
  - ■ Issue of crud – minimize boron concentration and power peaking
- > Reduction in fuel assembly distortion
  - ■ Design and core management issue
- > Increase fuel component dimensional stability
  - ■ Minimize growth of structural components [M5^{TM}]
- > Decrease fuel component corrosion and hydrogen pickup
  - ■ M5^{TM} material has low H pickup

Challenges to PWR Core Design Management

> Extended length cycles
> Power level uprates
> Increased discharge burnups
> Very low leakage fuel management

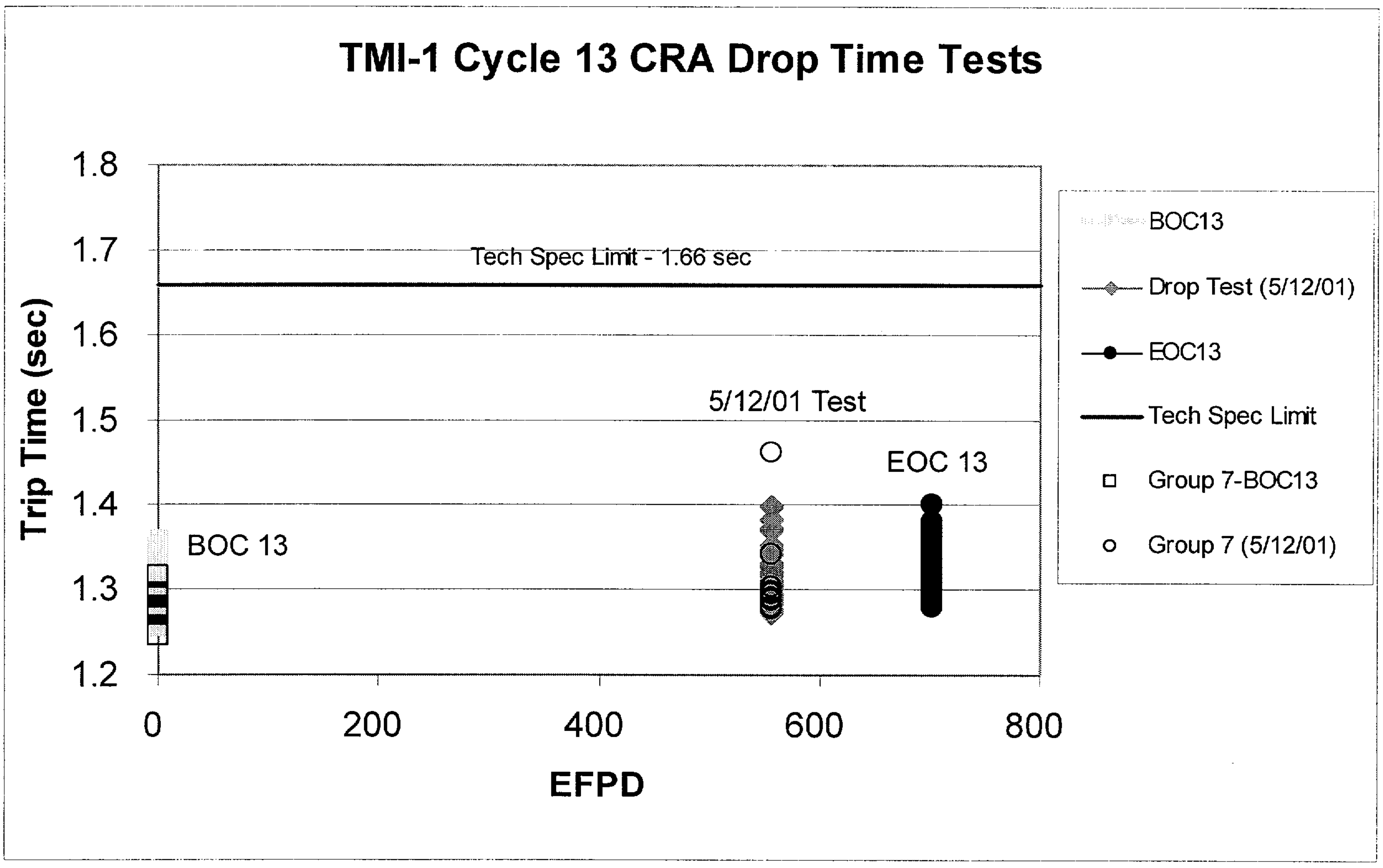
- Increased boron concentrations lead to crud, AOA issues
- High power, long residence time encourages assembly distortion
- Fresh-to-fresh interface increases likelihood of high power peaking, crud deposition, and boiling
- Fewer fresh assemblies leads to increased power peaking

Incomplete Rod Insertion Update

> TMI-1 cycle 13 operated successfully

- All control rods well within tech specs
- LER Supplement Report submitted to NRC by utility
- Corrective actions proved successful
  - Reduction in holddown loads by spring set
  - Cycle design improvements to remove same quadrant core shuffle
- New fuel design improvements for cycle 14 implemented
  - 6 leaf holddown spring
  - Lower growth M5 fuel rods and guide tubes

Incomplete Rod Insertion Update



TMI-1 Cycle 13 CRA Drop Time Tests

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Latest Mark-B Plant Outages Since July 200

- 24 month cycle plants
  - TMI-1 Cycle 13
  - Crystal River 3 Cycle 12
  - Davis-Besse Cycle 13
- 18 month cycle plants
  - ANO-1 Cycle 16
  - Oconee 1 Cycle 19
  - Oconee 2 Cycle 18
  - Oconee 3 Cycle 19
- All control rods met tech specs

Latest Mark-BW Plant Outages Since July 2000

- 18 month cycle plants with outages
  - Sequoyah 1 Cycle 11
  - Sequoyah 2 Cycle 10
  - McGuire 1 Cycle 14
  - McGuire 2 Cycle 13
  - Catawba 1 Cycle 12
- All control rods met tech specs

PWR METHODOLOGY VISION
B&W PLANTS

Methodology	**Topical Report**	**Schedule**
Neutronics	BAW-10180(A), NEMO Neutronics Code	Approved
Thermal-Hydraulic	BAW-10156(P)(A), LYNXT Core Transient Thermal-Hydraulic Code	Approved
DNB	BAW-10143(P)(A), DNB Correlations for Mark-B designs	Approved
DNB	BAW-X, DNBR Correlation for HTP Correlation in LYNXT	mid-2003
Statistical Core Design	BAW-10187(P)(A), Statistical Core Design Process	Approved
Non-LOCA	BAW-10193(P)(A), RELAP5/Mod2-B&W Safety Analyses	Approved
LOCA	BAW-10192(P)(A), Large and Small Break LOCA Evaluation Model	Approved
LOCA	BAW-X, Modifications to LOCA Methodology for HTP Spacer (if required)	mid-2003
Design	BAW-10179(P)(A), Safety Criteria and Methodology for Acceptable Cycle Reload Analyses	Approved
Design	BAW-10227(P)(A), M5 Cladding	Approved
Fuel Performance	BAW-10231(P) COPERNIC Fuel Performance Code	Under Review

PWR METHODOLOGY VISION

WESTINGHOUSE and COMBUSTION ENGINEERING PLANTS

Methodology	Topical Report	Schedule
Neutronics	EMF-96-029(P)(A) PWR Neutronics Methodology using SAV95	Approved
Thermal-Hydraulic	XN-NF-82-21(P)(A) , Thermal-Hydraulic and Mixed Core Analysis	Approved
DNB	EMF-92-153(P)(A), DNBR Correlation for HTP Spacer	Approved
DNB	BAW-X, DNBR Correlation for Mark-BW spacer in XCOBRA-IIIC	Nov-02
Setpoint	EMF-92-081(P)(A), Statistical Setpoint/Transient Methodology for Westinghouse Type Reactors	Approved
Setpoint	EMF-1961(P)(A), Statistical Setpoint/Transient Methodology for CE Type Reactors	Approved
Non-LOCA	EMF-2310(P)(A), Non-LOCA Methodology using S-RELAP5	Approved
Non-LOCA	BAW-X, Coupled Neutronics/System/TH Code	Future Submittal
LBLOCA - Realistic	EMF-2103(P), Realistic LBLOCA Methodology using S-RELAP5	Under Review
SBLOCA - Appendix K	EMF-2328(P)(A), SBLOCA Methodology using S-RELAP5	Approved
Design	EMF-92-116(P)(A), Generic Mechanical Design Criteria	Approved
Design	BAW-10227(P)(A), M5 Cladding	Approved
Design	BAW-X, M5 Cladding for RODEX2 and S-RELAP5 Methodologies	Oct-02
Design	BAW-10186(P), Extended burnup for M5 Cladding (62 GWd/MTU)	Under Review
Fuel Performance	BAW-10231 COPERNIC fuel performance code	Under Review

BWR METHODOLOGY VISION

Methodology	Topical Report	Schedule
Neutronics	EMF-2158(P)(A), CASMO4/MICROBURN-B2	Approved
Thermal-Hydraulic		
CHF	EMF-2209(P)(A), SPCB Correlation for ATRIUM-10	Approved
CHF	BAW-X, CHF Correlation for Advanced BWR Spacer Spacer	Future Submittal
Stability	EMF-CC-074(P)(A), STAIF Code for Stability Analysis	Approved
Safety Limit	XN-NF-80-19(P)(A) Vol 3, Safety Limit Methodology	Approved
Non-LOCA	BAW-X, S-RELAP5 for BWR Non-LOCA Transients	end of 2004
LOCA	EMF-2361(P)(A), EXEM BWR-2000 Evaluation Model	Approved
LOCA	BAW-X, S-RELAP5 for BWR LOCA	Future Submittal
Design	ANF-89-98(P)(A), Generic Mechanical Design Criteria for BWR Fuel Designs	Approved
Fuel Performance	BAW-X, RODEX4 and Statistical Design Methodology	Dec-02

TOPICAL REPORT SUBMITTALS

Methodology	Topical Report	Schedule
	B&W Methodology	
DNB	BAW-X, DNBR Correlation for HTP Correlation in LYNXT	mid-2003
LOCA	BAW-X, Modifications to LOCA Methodology for HTP Spacer (if required)	mid-2003
	W & CE Methodology	
Non-LOCA	EMF-2310 Revision 1, S-RELAP5 for PWR Non-LOCA modified Boron Dilution Methodology,	Apr-02
MOX	BAW-10238, MOX Fuel Design	Apr-02
MOX	BAW-10231(P) COPERNIC for MOX	Under Review
MOX	BAW-X, Modifications to LOCA Methodology for MOX	Future Submittal
Non-LOCA	BAW-X, Coupled Neutronics/System/TH Code	Future Submittal
DNB	BAW-X, DNBR Correlation for Mark-BW Spacer in XCOBRA-IIIC	Nov-02
LBLOCA - Realistic	EMF-2103(P), Realistic LBLOCA Methodology using S-RELAP5	Under Review
Design	BAW-X, M5 Cladding for RODEX2 and S-RELAP5 Methodologies	Oct-02
Design	BAW-10239, Advanced Mark-BW Design	Apr-02
Design	BAW-10186 Revision 1 Supplement 1, M5 Extended Burnup to 62 GWd/MTU	Under Review
Design	BAW-X, M5 Cladding for RODEX2 and S-RELAP5 Methodologies	Oct-02
Fuel Performance	BAW-10231(P) COPERNIC for UO2	Under Review
	BWR Methodology	
CHF	BAW-X, CHF Correlation for Advanced BWR Spacer	Future Submittal
Non-LOCA	BAW-X, S-RELAP5 for BWR Non-LOCA Transients	end of 2004
LOCA	BAW-X, S-RELAP5 for BWR LOCA	Future Submittal
Fuel Performance	BAW-X, RODEX4 and Statistical Design Methodology	Dec-02