April 11, 1995

LICENSEE: Duke Power Company

FACILITY: Oconee Nuclear Station, Units 1, 2, and 3

See Rpt.

SUBJECT: SUMMARY OF JANUARY 31, 1995, MEETING WITH DUKE POWER COMPANY AND B&W FUELS COMPANY CONCERNING MARK B11 FUEL ASSEMBLY PROGRAM

On January 31, 1995, NRC staff members met with representatives of Duke Power Company (DPC) and B&W Fuels Company (BWFC) to discuss the development program and implementation plan and schedule for the B&W Mark B11 fuel assembly. Meeting attendees are listed in Enclosure 1. The agenda for the meeting is included as Enclosure 2. Copies of non-proprietary handouts are included as Enclosure 3.

Presentations by the DPC and BWFC representatives provided an overview of the Mark B11 design activities, which was initiated as a joint fuel assembly design study in May 1993. The BWFC representatives provided a technical description of the design of the new fuel assemblies and the associated accident analyses needed to support the new fuel. Implementation and test schedules were presented for both the Lead Test Assembly (LTA) installation and full batch implementation at Oconee. The use of the 10 CFR 50.59 process for the LTA implementation and the licensing submittals needed for full batch implementation were described. In closing, DPC representatives stated that they desired a follow-up meeting with the NRC to discuss the scope of a Topical Report on non-LOCA transient analyses. It was tentatively agreed to plan for such a meeting in the June 1995 time-frame.

/s/

Leonard A. Wiens, Senior Project Manager
Project Directorate II-2
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

Enclosures:
1. Meeting Attendees
2. Meeting Agenda
3. Non-proprietary Handouts

cc w/enclosures:
See next page

DISTRIBUTION
Docket File
PUBLIC
PD22 Reading File
W. Russell/F. Miraglia, O-12 G18
R. Zimmerman, O-12 G18
S. Varga
J. Zwolinski
F. Orr, O-8 E23
OGC, O-15 B18
E. Jordan, T-4 D18
ACRS (4), TWF
G. Tracy, EDO, O-17 G21
R. Crlenjak, RII
E. Merschoff, RII
L. Phillips, O-8 E23
E. Kendrick, O-8 E23
L. Kopp, O-8 E23

Memo 4

DFO1

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	LA:PD22:DRPE	E	PM:PD22:DRPE	E	D:PD22:DRPE	N						
NAME	LBERRY		LWIENS:cw		HBERKOW							
DATE	4/10/95		4/11/95		4/ /95		/ /95		/ /95		/ /95	

DOCUMENT NAME: G:\OCONEE\MTGSUM.B11

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 11, 1995

LICENSEE: Duke Power Company

FACILITY: Oconee Nuclear Station, Units 1, 2, and 3

SUBJECT: SUMMARY OF JANUARY 31, 1995, MEETING WITH DUKE POWER COMPANY AND B&W FUELS COMPANY CONCERNING MARK B11 FUEL ASSEMBLY PROGRAM

On January 31, 1995, NRC staff members met with representatives of Duke Power Company (DPC) and B&W Fuels Company (BWFC) to discuss the development program and implementation plan and schedule for the B&W Mark B11 fuel assembly. Meeting attendees are listed in Enclosure 1. The agenda for the meeting is included as Enclosure 2. Copies of non-proprietary handouts are included as Enclosure 3.

Presentations by the DPC and BWFC representatives provided an overview of the Mark B11 design activities, which was initiated as a joint fuel assembly design study in May 1993. The BWFC representatives provided a technical description of the design of the new fuel assemblies and the associated accident analyses needed to support the new fuel. Implementation and test schedules were presented for both the Lead Test Assembly (LTA) installation and full batch implementation at Oconee. The use of the 10 CFR 50.59 process for the LTA implementation and the licensing submittals needed for full batch implementation were described. In closing, DPC representatives stated that they desired a follow-up meeting with the NRC to discuss the scope of a Topical Report on non-LOCA transient analyses. It was tentatively agreed to plan for such a meeting in the June 1995 time-frame.

Leonard A. Wiens, Senior Project Manager
Project Directorate II-2
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

Enclosures:
1. Meeting Attendees
2. Meeting Agenda
3. Non-proprietary Handouts

cc w/enclosures:
See next page

cc:

A. V. Carr, Esquire
Duke Power Company
422 South Church Street
Charlotte, North Carolina 28242-0001

J. Michael McGarry, III, Esquire
Winston and Strawn
1400 L Street, NW.
Washington, DC 20005

Mr. Robert B. Borsum
Babcock & Wilcox
Nuclear Power Division
Suite 525
1700 Rockville Pike
Rockville, Maryland 20852

Manager, LIS
NUS Corporation
2650 McCormick Drive, 3rd Floor
Clearwater, Florida 34619-1035

Senior Resident Inspector
U. S. Nuclear Regulatory Commission
Route 2, Box 610
Seneca, South Carolina 29678

Regional Administrator, Region II
U. S. Nuclear Regulatory Commission
101 Marietta Street, NW. Suite 2900
Atlanta, Georgia 30323

Max Batavia, Chief
Bureau of Radiological Health
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

County Supervisor of Oconee County
Walhalla, South Carolina 29621

Mr. Ed Burchfield
Compliance
Duke Power Company
Oconee Nuclear Site
P. O. Box 1439
Seneca, South Carolina 29679

Ms. Karen E. Long
Assistant Attorney General
North Carolina Department of
Justice
P. O. Box 629
Raleigh, North Carolina 27602

Mr. G. A. Copp
Licensing - EC050
Duke Power Company
526 South Church Street
Charlotte, North Carolina 28242-0001

Dayne H. Brown, Director
Division of Radiation Protection
North Carolina Department of
Environment, Health and
Natural Resources
P. O. Box 27687
Raleigh, North Carolina 27611-7687

Mr. J. W. Hampton
Vice President, Oconee Site
Duke Power Company
P. O. Box 1439
Seneca, South Carolina 27679

MEETING ATTENDEES

MARK B11 FUEL ASSEMBLY DEVELOPMENT

January 31, 1995

NAME	ORGANIZATION
LEN WIENS	NRC/NRR/ORPE
LARRY PHILLIPS	NRC/NRR/DSSA/SRXB
Edward Kendrick	NRC/NRR/DSSA/SRXB
FRANK ORR	NRC/NRR/DSSA/SRXB
Steve Perrero	Duke Power/ONS/Nuclear Eng
KEN CANADY	DUKE POWER/NUCLEAR ENGR
Gregg Swindlehurst	Duke Power/Nuc. Eng.
Dennis Gottuso	B&W Fuel Co.
Robert St. Clair	Duke Power/Nuclear Engineering
Tom Wampler	B+W Fuel Co/Project Managment
M.E. Aldrich	B&W Fuel Company
Frank McPhatter	B&W Fuel Company/Licensing
John Klingenfus	B&W Nuclear Technologies/LOCA Methods
Ron Gribble	Duke Power Co/Nuclear Engineering
Ed Burchfield	Duke Power/ONS/Reg. Compliance
LARRY Kopp	NRC/NRR/DSSA/SRXB

Agenda

Duke / BWFC Presentation to NRC
Mk-B11 Development Program

Background	(J.E. Burchfield, 15 mins.)
Development Program	
Design Description	(D.A. Gottuso, 30 mins.)
LOCA Analysis	(J.A. Klingenfus, 15 mins.)
Safety Analysis	(G.B. Swindlehurst, 15 mins.)
Testing	(M.E. Aldrich, 15 mins.)
Irradiation Program	(R.M. Gribble, 15 mins.)
O1C17 Mk-B11 LTA Analysis	(R.M. Gribble, 15 mins.)
Summary	(K.S. Canady, 10 mins.)

Enclosure 2

Background

J. Ed Burchfield
Duke Power
ONS Regulatory Compliance

Meeting Objectives

- Provide an Overview of Mark B11 Design Activities
- Describe 50.59 Process for Implementing 4 Lead Test Assemblies (LTAs) beginning with Oconee 1 Cycle 17
- Outline Licensing Submittals Necessary to Support Full Batch Implementation of Mark B11 Design Beginning with Oconee 3 Cycle 19

Fuel Rod Optimization Design Study

- Duke Power and BWFC Initiated a Joint Fuel Assembly Design Study in May of 1993
- Design Study Objectives
  - Fuel Cycle Cost Reduction
  - No Reduction In Thermal Margin
  - Ensure Design Would Meet Mechanical Design Limits
  - Ensure Design Would Satisfy Current Burnup Limits

Design Study Assumptions

- ONS Cycle Length of 470 EFPD
- Feed Batch Size of 56 Assemblies
- Range of Fuel Rod Diameters Form 0.410 to 0.430 Inches Considered
- Maximum Fuel Pin Burnup Limit of 60,000 MWD/mtU

Overview of Analyses

- Scoping Calculations Indicated That Fuel Utilization Is Optimized By Maximizing the Uranium Loading of the Assemblies
- Based on Scoping Calculations, Each Fuel Rod Design Incorporated the Following Characteristics:
  - Thinner Cladding
  - Smaller Fuel-to-Cladding Gap
  - Increased Stack Height
  - Increased Theoretical Density

Overview of Analyses (continued)

- Core Physics Calculations Were Performed for a Range of Rod Diameters
- Thermal Hydraulic Calculations Were Completed for Each Design to Evaluate Thermal Margin. Impact of Mixing Vane Grids Was Incorporated.
- Fuel Mechanical Calculations Were Performed to Evaluate:
  - Internal Pin Pressure
  - Creep Collapse

Conclusions of Study

- For a Given Fuel Rod OD, Fuel Utilization is Optimized By Maximizing the Uranium Loading of the Fuel Assembly.
- Fuel Utilization Continues to Improve As Fuel Rod OD is Decreased
- Thermal Margin Decreases as Fuel Rod OD Decreases
- Fuel Assembly/Pin Burnup Increases as Fuel Rod OD Decreases
- Pin Peaking Increases as Fuel Rod OD Decreases

Conclusions of Study (continued)

- **Fuel Rod OD of 0.416 Inches Is Optimum for ONS Cores**
- **Mixing Vane Grids Offsets Slight Increase in Pin Peaking/Decrease in Thermal Margin Associated With the Fuel Rod OD Reduction**
- **Fuel Rod Burnup Limits/Mechanical Limits Are Met For 0.416 OD Fuel Rod**
- **Duke Power and BWFC Performed Independent Calculations to Confirm 0.416 OD Design. Agreement Between These Calculations Was Excellent**

Mk-B11 Design Description

Dennis A. Gottuso
Mk-B Product Engineering Mgr.
B&W Fuel Company

DUKE POWER

B&W FUEL COMPANY

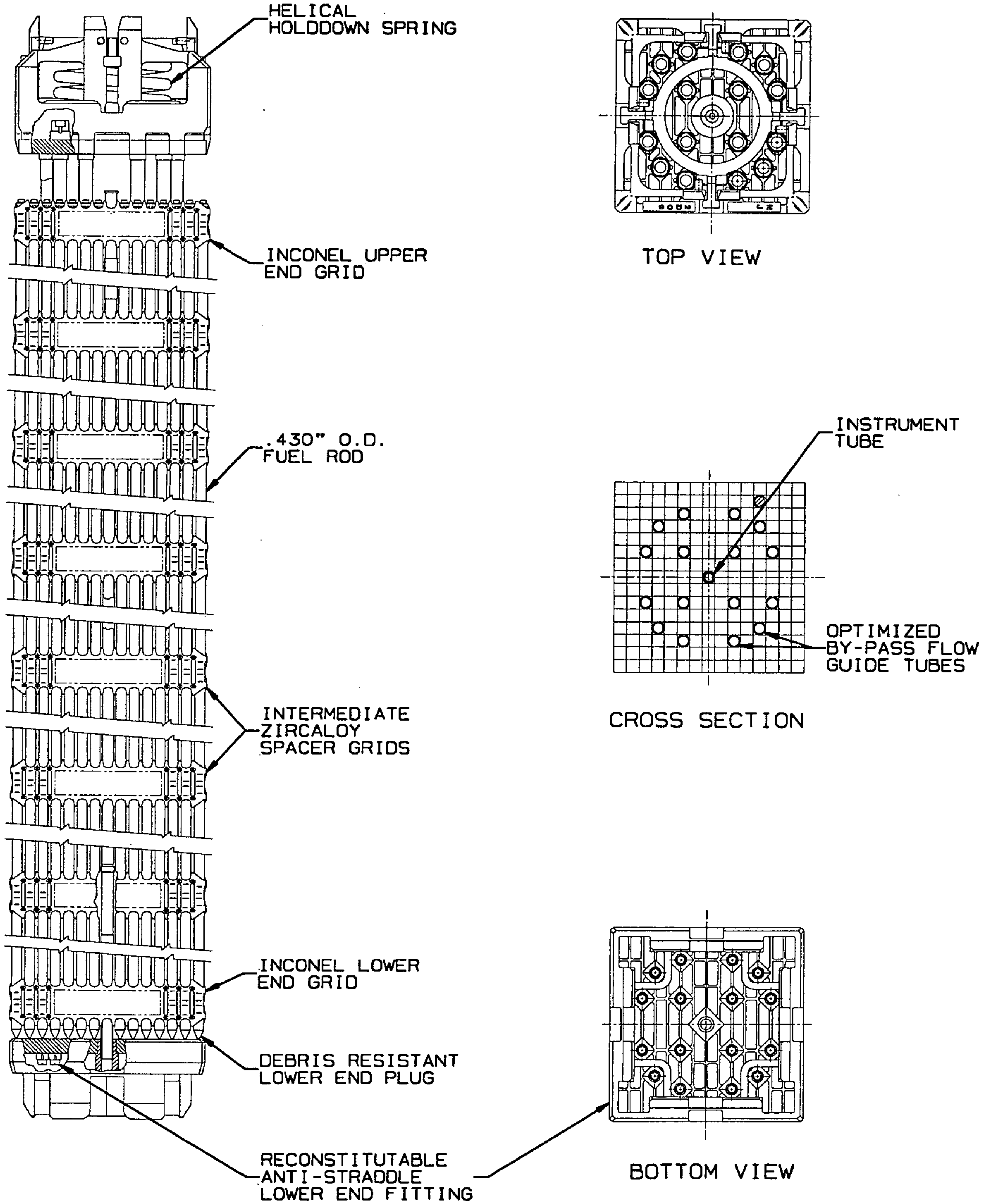
DUKE POWER

B&W FUEL COMPANY

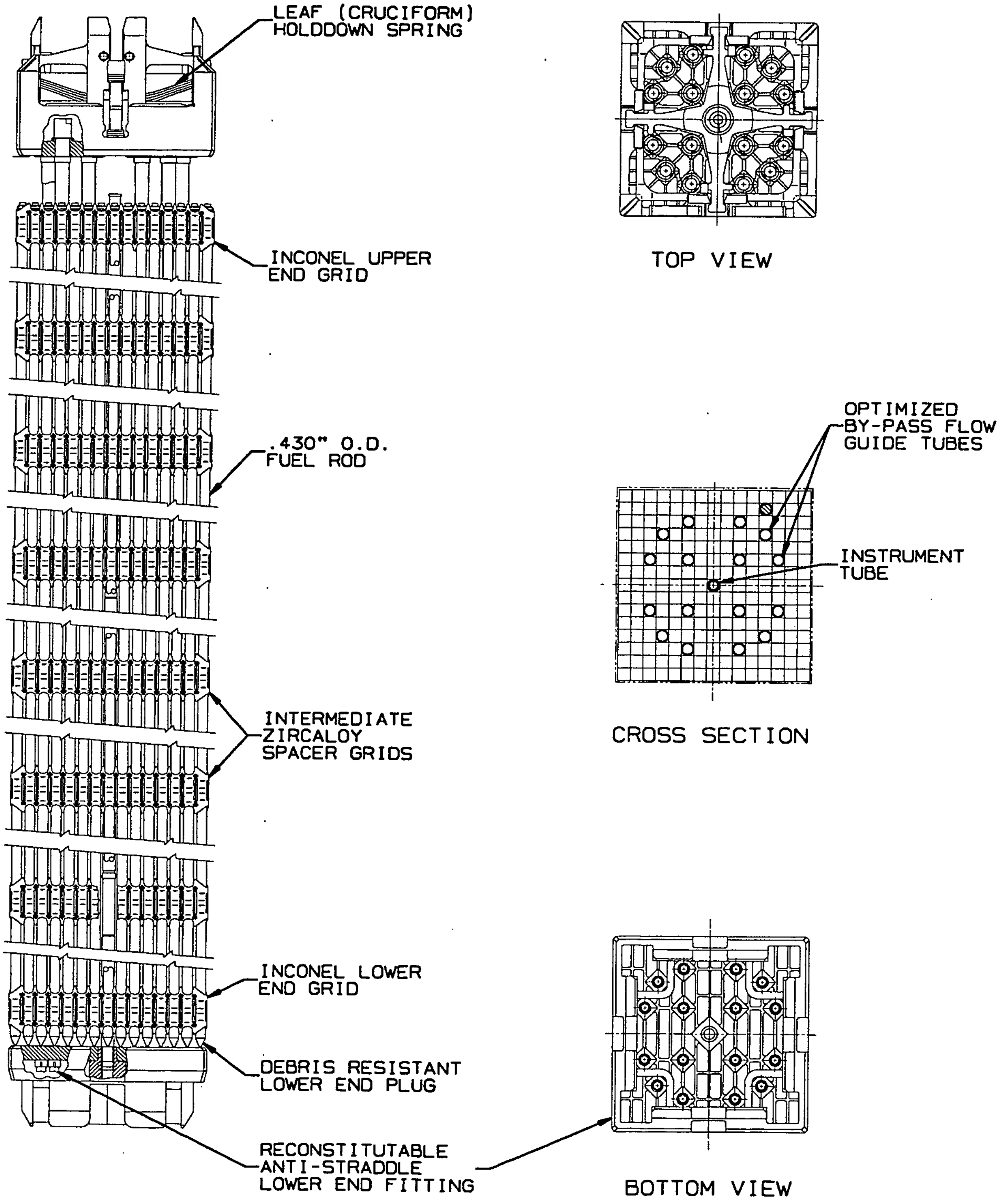
Mark-B Products

- Mark-B9 fuel assembly
  - 0.430" O.D. B9 fuel rod
  - Helical hold down spring
- Mark-B10 fuel assembly
  - 0.430" O.D. B9 fuel rod
  - Cruciform hold down spring
- Mark-B10T fuel assembly
  - 0.430" O.D. B10 fuel rod
  - Cruciform hold down sprin
  - Increased uranium loading

MARK-B9 FUEL ASSEMBLY



MARK-B10 FUEL ASSEMBLY



Mark-B Products

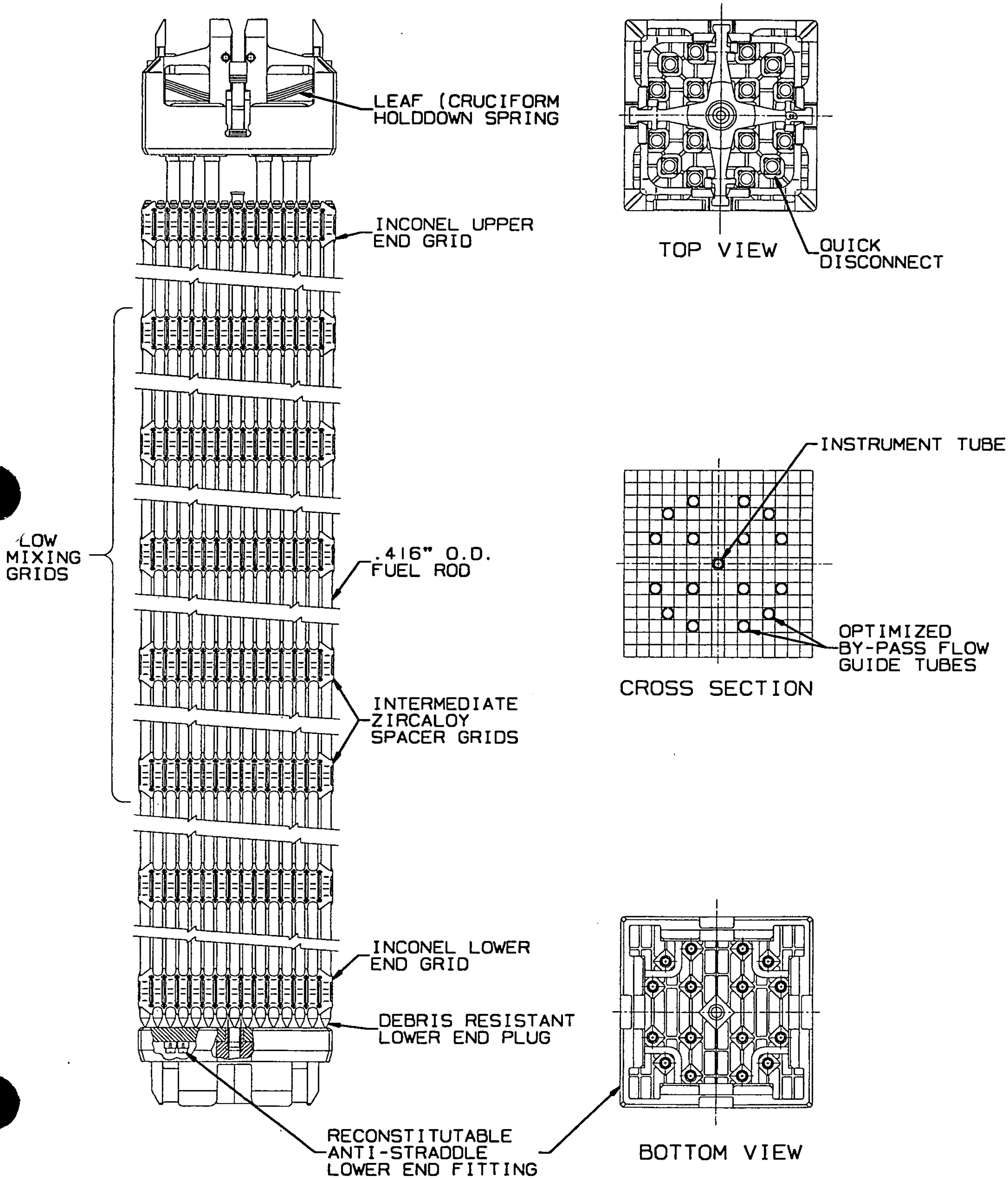
New Fuel Assembly Design Objectives

- Lower fuel costs
- Enhanced thermal-hydraulic performance
  - Increase in peaking margin
  - Increase in DNB margin
- Quick disconnect UEF

Mark-B Products

- Mark-B11 fuel assembly
  - 0.416" O.D. B11 fuel rod
  - Integral flow diverter spacer grid
  - Quick disconnect UEF
  - Cruciform hold down spring

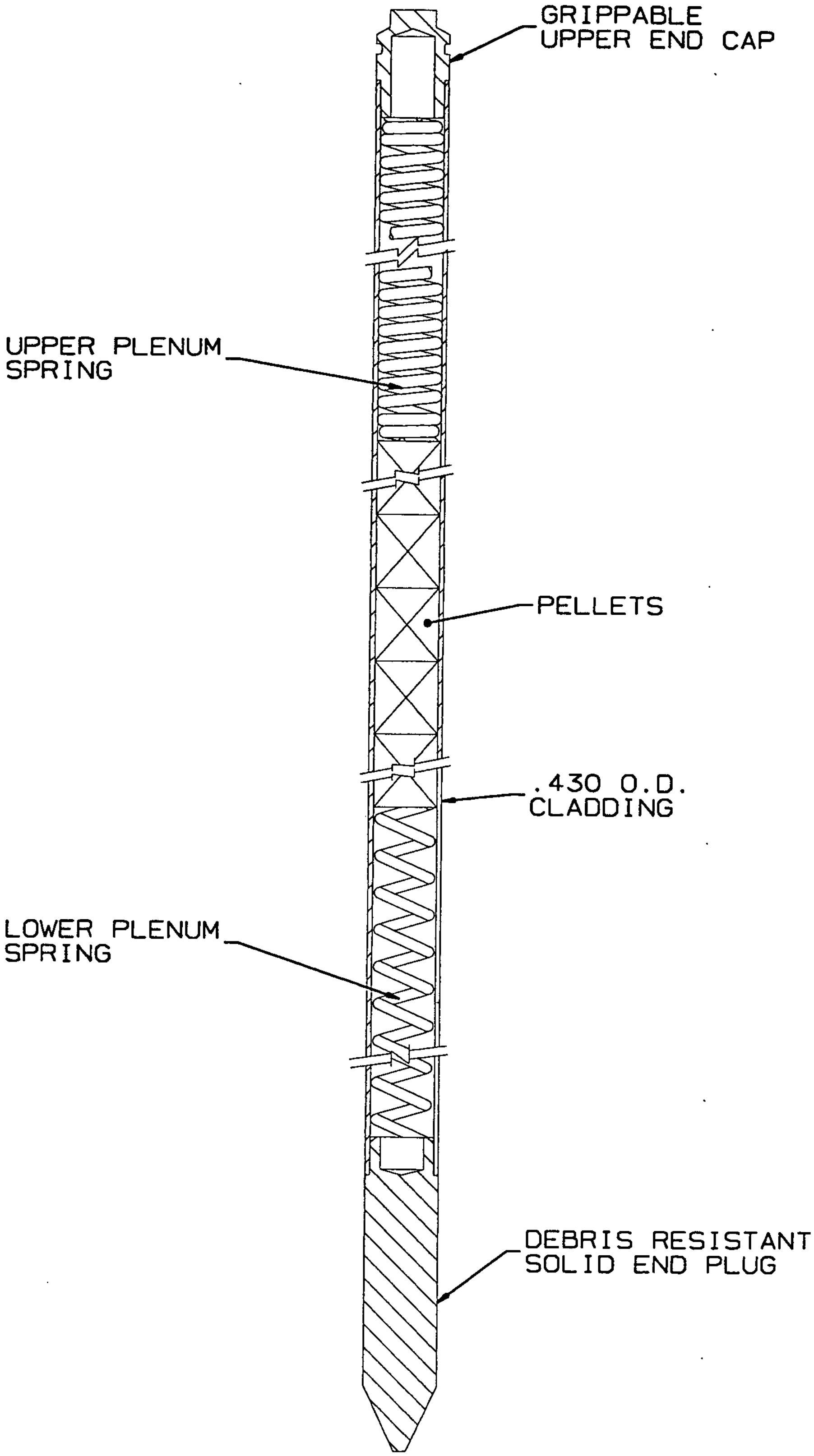
MARK-B11 FUEL ASSEMBLY



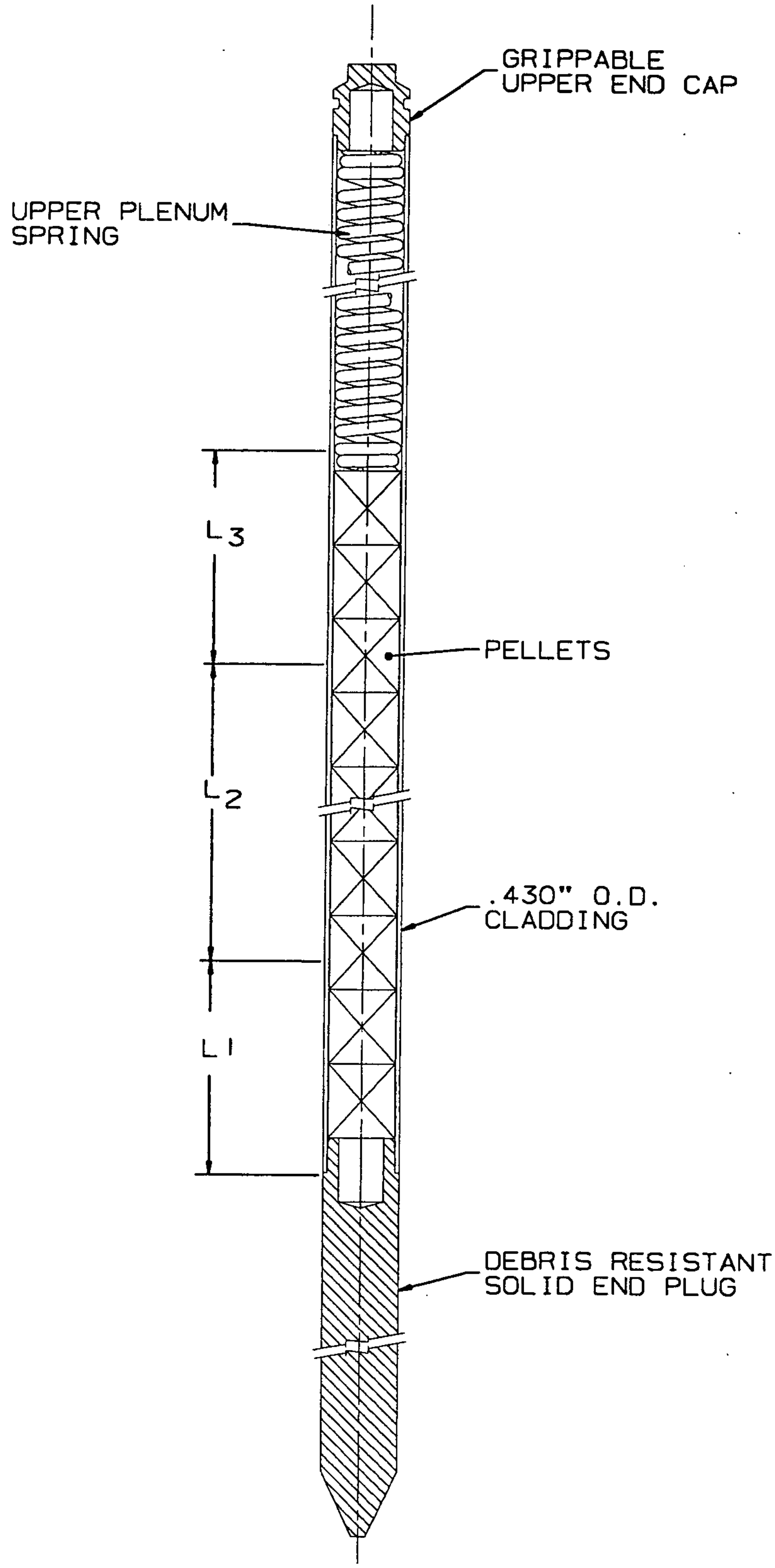
Mark-B Fuel Rod Comparsion

- B9 axial blanket fuel rod
  - Currently operating in Mark-B10 fuel assembly in Oconee 2, Cycle 15
- B10 axial blanket fuel rod
  - Integral to Mark-B10T fuel assembly
  - Planned for Oconee 3, Cycle 16 (July, 1995)
- B11 axial blanket fuel rod
  - Integral to Mark-B11 fuel assembly
  - Lead assemblies planned for Oconee 1, Cycle 17 (November, 1995)

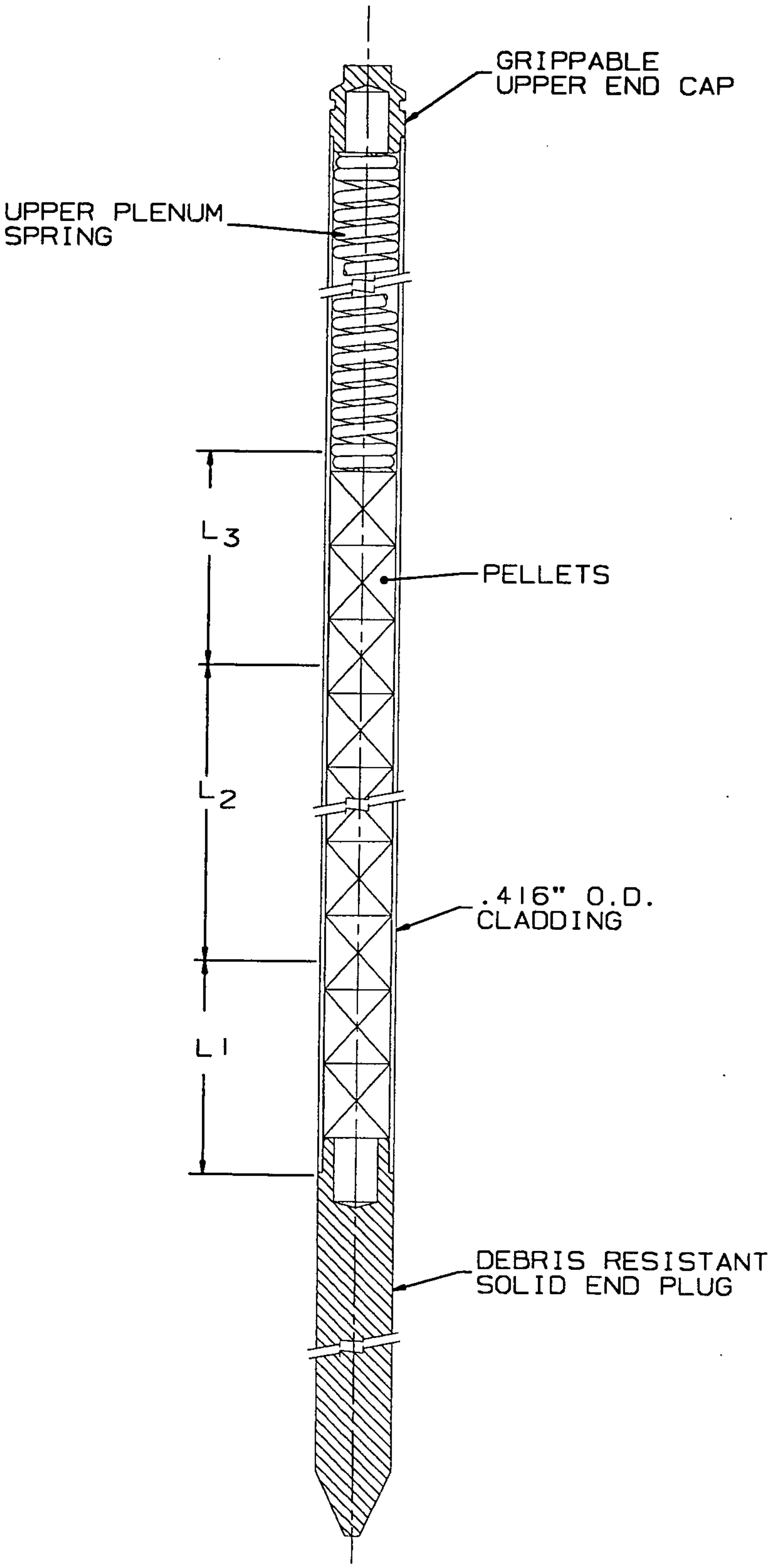
B-9 FUEL ROD


GRIPPABLE
UPPER END CAP
UPPER PLENUM
SPRING
PELLETS
.430 O.D.
CLADDING
LOWER PLENUM
SPRING
DEBRIS RESISTANT
SOLID END PLUG

B10 FUEL ROD


GRIPPABLE
UPPER END CAP
UPPER PLENUM
SPRING
L_3
PELLETS
L_2
.430" O.D.
CLADDING
L1
DEBRIS RESISTANT
SOLID END PLUG

B11 FUEL ROD


GRIPPABLE
UPPER END CAP
UPPER PLENUM
SPRING
L3
PELLETS
L2
.416" O.D.
CLADDING
L1
DEBRIS RESISTANT
SOLID END PLUG

DUKE POWER

B&W FUEL COMPANY

Comparison of Mk-B Fuel Rods

[b,c,d,e]

DUKE POWER

B&W FUEL COMPANY

Comparison of Mk-B Fuel Rods

[b,c,d,e]

Comparison of Mk-B Fuel Rods

[b,c,d,e]

Comparison of Mk-B Fuel Rods

[b,c,d,e]

Fuel Assembly Comparison

[b,c,d,e]

Fuel Assembly Materials

[b,c,d,e]

B&W Fundamentals Maintained

[b,c,d,e]

John A. Klingenfus
BWNT

LOCA Analyses

DUKE POWER

B&W FUEL COMPANY

LOCA Analyses

- LOCA methods
- LOCA analyses
- LTA LOCA LHR limits

Mark-B11 LTA LOCA Limits

- Methods Topical Reports
  - RELAP5/MOD2-B&W -
    "BWNT LOCA" BAW10192, Rev 0
    - Submitted to NRC 2/94
    - All codes used have SERs
  - CRAFT2/THETA1-B -
    "B&Ws ECCS Evaluation Model"
    BAW10104, Rev 5
    - Approved

DUKE POWER

B&W FUEL COMPANY

Mark-B11 LTA LOCA Limits

[b,c,d,e]

Mark-B11 LTA LOCA Limits

[b,c,d,e]

DUKE POWER

B&W FUEL COMPANY

Mark-B11 LTA LOCA Limits

[b,c,d,e]

DUKE POWER

B&W FUEL COMPANY

Mark-B11 LTA LL Calculation

[b,c,d,e]

Mark-B11 LOCA Limits

[b,c,d,e]

Non-LOCA Safety Analysis To Support Implementation of Mk-B11 LTAs and Full Cores

- **O1C17 Reload with LTAs will be evaluated to ensure that the current licensing basis remains valid**
  - Key Safety Analysis Physics Parameters
  - Technical Specifications
  - Limits in the COLR
  - No problem expected
- **The Steady-State Thermal/Hydraulic Analysis to ensure acceptable DNBRs in the LTAs is also applicable to the Chapter 15 Transients**

Non-LOCA Safety Analysis To Support Implementation of Mk-B11 LTAs and Full Cores (continued)

- **Duke will be submitting a Topical Report on Non-LOCA Transient Analysis in the 3rd quarter of 1996 (DPC-NE-3005)**
  - Update FSAR Chapter 15 (20 years old)
  - Using approved RETRAN/VIPRE models (some model improvements)
  - Desire NRC input on the scope of the Topical Report
  - NRC approval will be needed to support O3C19 core design with Mk-B11 fuel (18 month NRC review period)

Mark-B11 Test Program

Mike Aldrich
B&W Fuel Company
Thermal & Performance Analysis

DUKE POWER

B&W FUEL COMPANY

Test Program Overview

[b,c,d,e]

Pressure Drop

[b,c,d,e]

Life and Wear

[b,c,d,e]

Flow Induced Vibration

[b,c,d,e]

Critical Heat Flux

[b,c,d,e]

DUKE POWER

B&W FUEL COMPANY

Laser Doppler Velocimeter

[b,c,d,e]

DUKE POWER

B&W FUEL COMPANY

Fuel Assembly Mechanical

[b,c,d,e]

Fuel Assembly Mechanical
(Continued)

[b,c,d,e]

DUKE POWER

B&W FUEL COMPANY

Current Testing Schedule

[b,c,d,e]

Mk-B11 LTA Irradiation Program

Lead Assembly Irradiation

Ron M. Gribble
Duke Power
Nuclear Engineering (G.O.)

Duke Progression to Mk-B11

Objectives:
- **Fuel Cycle Cost Reduction**
- **Equivalent Burnup**
- **No reduction in thermal margins**

Mark B10 **(Rod Burnup = 60,000 max.)**

↓

Mark B10T **(Rod Burnup = 60,000 max.)**
- Same O.D.
- Thinner clad
- Smaller gap
- Taller stack
- Maximized U-loading

↓

Mark B11 **(Rod Burnup = 60,000 max.)**
- Smaller O.D.
- Mixing vane grids
- Maximized U-loading

Mk-B11 LTA Irradiation Program

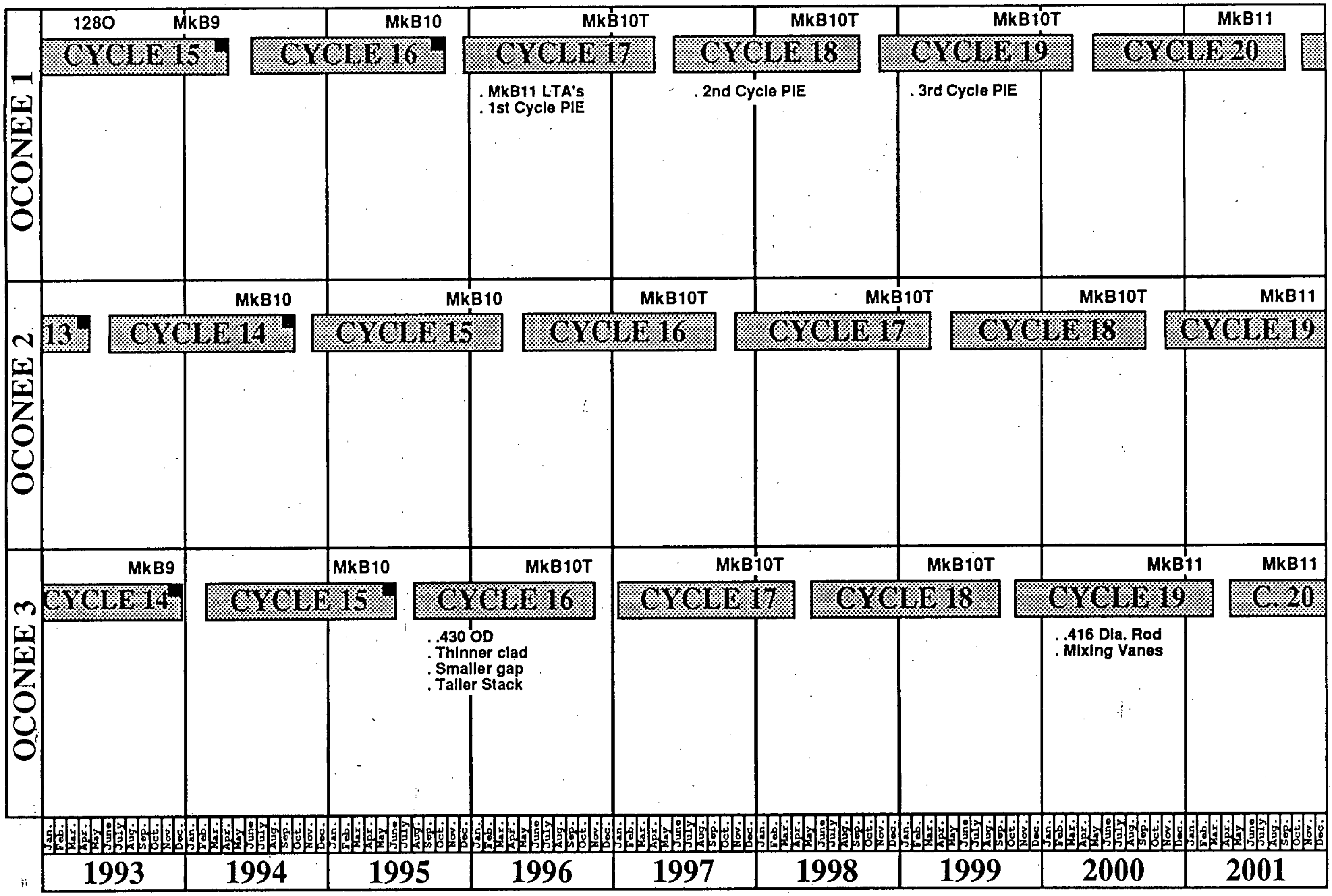
- **4 Lead Assemblies**
- **Non-limiting**
- **Approved methods**

Exceptions:

LOCA EM

BWCMV applicability to LTAs

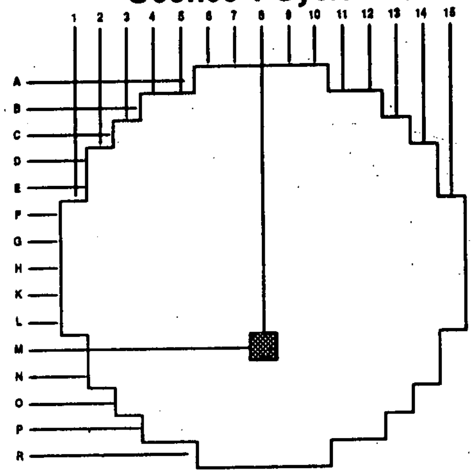
OCONEE Mk-B11 DESIGN SCHEDULE



LTA Irradiation Program Objective

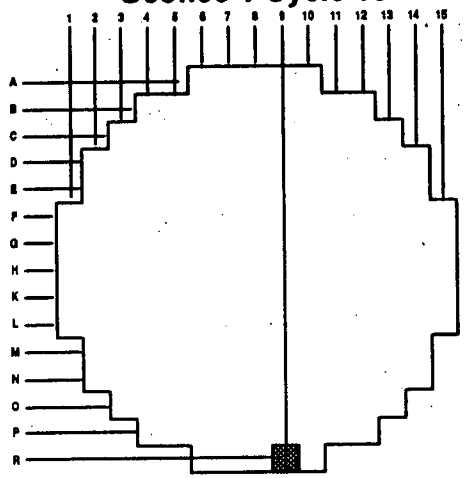
- **2 cycles of PIE prior to full batch**
- **Address standard concerns and emerging issues**
- **High, yet non-limiting 1st cycle exposure**
  - Demonstrate fuel rod integrity
  - Maximize grid relaxation
- **Residence in 2nd cycle at most susceptible baffle locations (with relaxed grids)**
- **Reinsert in center of core 3rd cycle to maximize burnup**

Oconee 1 Cycle 17



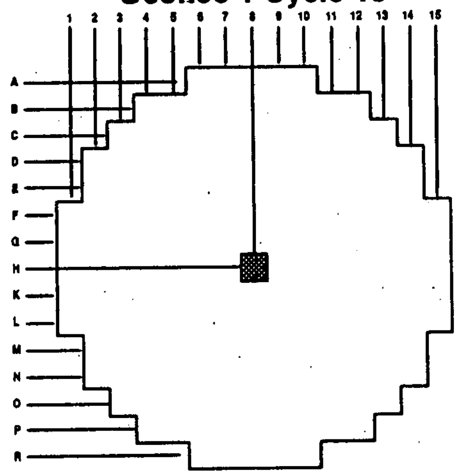
LTA Cycle Average Max. Pin = 1.35

Oconee 1 Cycle 18



LTA Cycle Average Max. Pin = 0.7

Oconee 1 Cycle 19



LTA Cycle Average Max. Pin = 0.95

Anticipated Mk-B11 LTA Post Irradiation Examination Scope

- FA Visual
- FA Growth
- FA Bow
- Shoulder Gap
- Fuel Rod Oxide
- Fuel Rod Diameter
- Fuel Rod Lifts & Visual
- Water Channel
- Grid Position

Analyses/Tests Completed Prior to LTA Loading

- Critical Heat Flux Testing
- Transition core hydraulic and DNBR analysis (BWC and BWCMV Correlations)
- Fuel assembly incremental pressure drop test (including subchannel form losses)
- Flow Induced Vibration Test (of Mk-B10 and B11)
- CRDL life and wear test
- Mk-B11 fuel rod mechanical analyses
- LOCA Analysis

Mk-B11 NRC Support Needed

Mk-B10T (O3C16 full batch)

- NRC TACO3 Audit of Duke completed and inspection report issued (March 31, 1995)
- CROV 9 approved (April 1, 1995)
- Technical Specification Submittal Approval (May , 1995)
- NRC Review of Oconee Enrichment Upgrade (Included with Tech. Spec. submittal)

Mk-B11 LTAs (O1C17)

- 50.59

Mk-B11 (O3C19)

- BWU (Mk-B11) Topical Approval (January, 1998)
- LOCA Topical Approval (January, 1998)
- Statistical Core Design Addendum Approval (April, 1998)
- Chapter 15 Approval (April, 1998)
- Mk-B11 Mechanical Topical Review (June, 1999)