



UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

May 2, 1997

MEMORANDUM TO: David B. Matthews, Chief
Generic Issues and Environmental
Projects Branch
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

FROM: Claudia M. Craig, Senior Project Manager *Claudia M. Craig*
Generic Issues and Environmental
Projects Branch
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF MEETING WITH WESTINGHOUSE TO DISCUSS MECHANICAL
MODEL ASSOCIATED WITH THE INCOMPLETE ROD CLUSTER CONTROL
ASSEMBLIES (RCCA) INSERTION ISSUE

The subject meeting was held at the Nuclear Regulatory Commission (NRC) offices in Rockville, Maryland on April 17, 1997, between representatives of Westinghouse and the NRC staff. The meeting was held for Westinghouse to discuss in detail the additional work performed with the mechanical model developed for the incomplete RCCA insertion issue. Attachment 1 is a list of meeting participants. Most of the meeting was closed to the public due to the proprietary nature of the information being discussed with regard to the mechanical model. By letter dated April 22, 1997, Westinghouse provided both proprietary and non-proprietary versions of the material presented at the meeting. Attachment 2 is a copy of the non-proprietary version of the presentation material.

Westinghouse provided the results of the sensitivity studies, the drag methodology, the predictive methodology, the data related to testing performed with ZIRLO tubes, and the proposed fuel assembly design changes. Based on the work it has performed, Westinghouse has concluded that no restrictions are needed for burnup, the mechanical model is sufficient to predict span drag, and the methodology is sufficient to determine the potential for incomplete RCCA insertions.

A member of the Westinghouse Owners Group (WOG) presented the WOG position on the issue. The presentation material was the same as that presented at the WOG/NRR Senior Management Meeting on April 16, 1997. The WOG representative's presentation material is provided in Attachment 3. The WOG representative outlined the short, intermediate, and long term actions to address the issue. Additionally, the representative informed the staff of the new working group within the WOG that will deal with fuel issues. In the past the WOG has not been involved in fuel issues due to the fact that different vendors provide fuel to the WOG members. But, recent issues have arisen which may be conducive to WOG activities. The representative outlined potential areas where the newly formed working group may be involved. *1/1 DF03*

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The staff stated that the validity of the Westinghouse and WOG approach relies entirely on the accuracy of the mechanical model. The staff wants to ensure the mechanical model can predict susceptibility and requested Westinghouse run the model using South Texas data to determine whether the model fits the rod insertion problems at South Texas. Additionally, the staff requested the mechanical model be submitted to the staff such that a detailed review can be performed. An additional meeting between the WOG, Westinghouse, and the staff after the work on the mechanical model is completed will be needed to discuss plans for future actions.

Project No. 700

Attachments: As stated

cc w/atts: See next page

D. Matthews

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May 2, 1997

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Project No. 700

Attachments: As stated

cc w/atts: See next page

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WESTINGHOUSE / NRC MEETING
MECHANICAL MODEL UPDATE FOR THE INCOMPLETE RCCA INSERTION ISSUE

APRIL 17, 1997

MEETING PARTICIPANTS

<u>NAME</u>	<u>ORGANIZATION</u>
Claudia Craig	NRC/NRR/PGE
John Galembush	Westinghouse Nuclear Safety
Elwyn Roberts	Westinghouse CNFD
Jim Sparrow	Westinghouse CNFD
Vinny Esposito	Westinghouse CNFD
Howard Menke	Westinghouse CNFD
Vance VanderBurg	WOG/AEP
Muffet Chatterton	NRC/NRR/SRXB
H.F. Conrad	NRC/NRR/DE/EMCB
H.L. Ornstein	NRC/AEOD
J. Rajan	NRC/NRR/EMEB
Harold H. Scott	NRC/RES/DST

Incomplete RCCA Insertion

Program Status

NRC Meeting

April 17, 1997

NRC Meeting Incomplete Rod Insertion 4/17/97

Sensitivity Studies



SPARROW

Drag Methodology



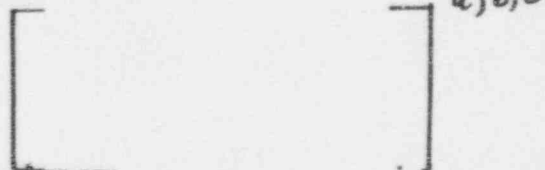
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Predictive Methodology



MENKE

ZIRLO Data



ROBERTS

FA Design Changes

Near Term

Longer Term

ESPOSITO

Sensitivity Studies

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Bow Sensitivity - Hold Down Force

Span 6

abc

Bow Sensitivity - Creep

Span 6

abc

Bow Sensitivity - Fixity

Span 6

abc

Bow Sensitivity - Temperature

Span 6



Growth Sensitivity - Hold Down Force



Growth Sensitivity - Creep

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Oxide Thickness Sensitivity - Temperature



CONCLUSIONS FROM SENSITIVITY STUDIES

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Thimble & RCC Bow without Interference



Thimble & RCC Bow with Interference



Calculations

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Guide Thimble Dashpot (Span 1)

Measured vs. Predicted Drag

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Upper Guide Thimble

Measured vs. Predicted Drag

abc

South Texas Guide Thimble Dashpot

Measured vs. Predicted Drag

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South Texas Guide Thimble Dashpot

Measured vs. Predicted Drag

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South Texas Upper Guide Thimble

Measured vs. Predicted Drag

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Wolf Creek H50 Individual Span Drag

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Wolf Creek H50 Total Drag

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Repeatability of Drag Data

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Drag Work vs. Insertion Distance

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Measured Drag Work for RCCAs

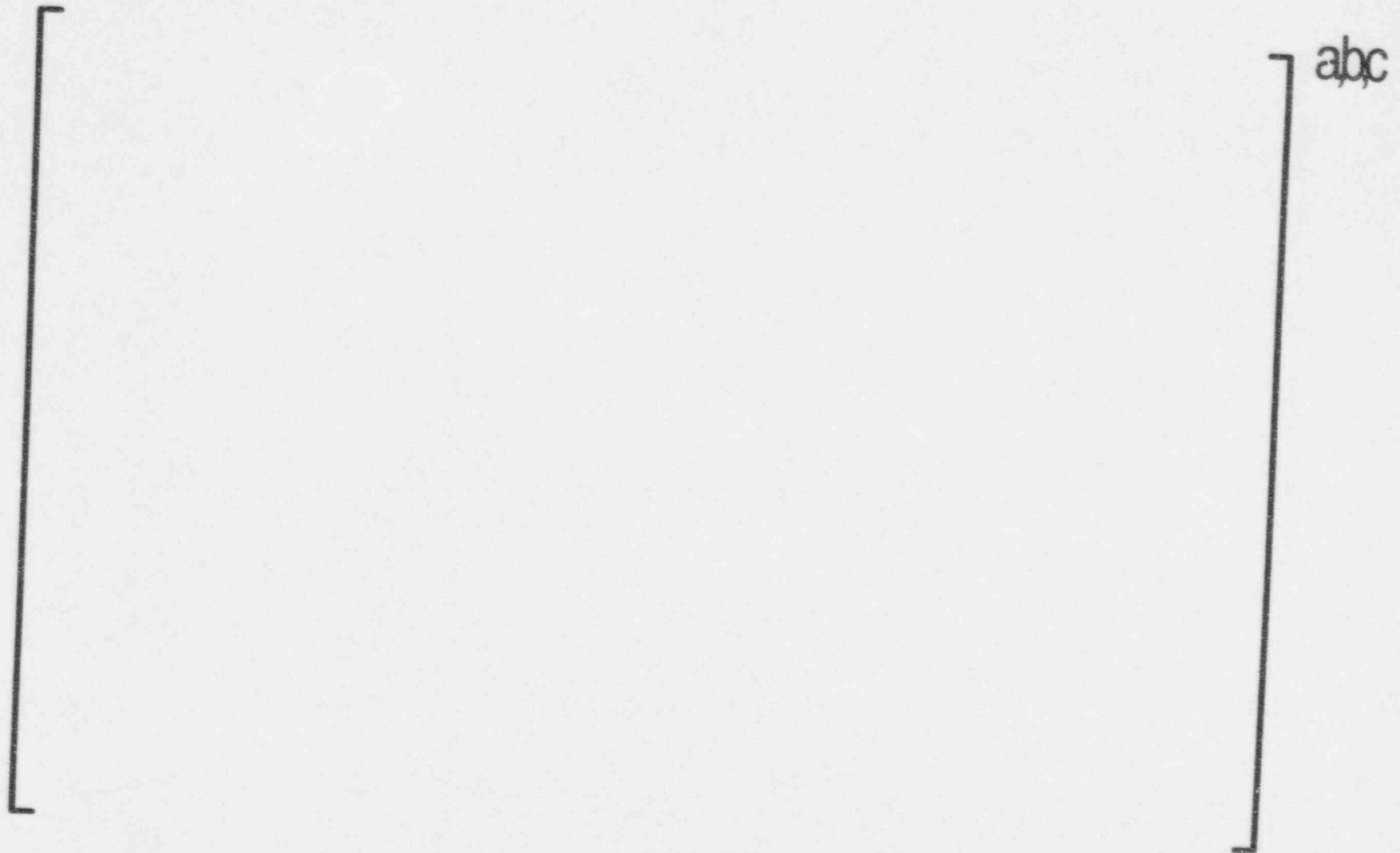
Plant Names

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Measured Drag Work for RCCAs

Fuel Types



Measured Drag-Work Vs Fluence

Selected Assemblies

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Predicted Drag-Work vs. Fluence

Selected Assemblies

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Measured vs. Predicted Drag-Work

Selected Assemblies



Comparison of Measured and Predicted Drag-Work

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South Texas Measured Drag-Work for RCCAs

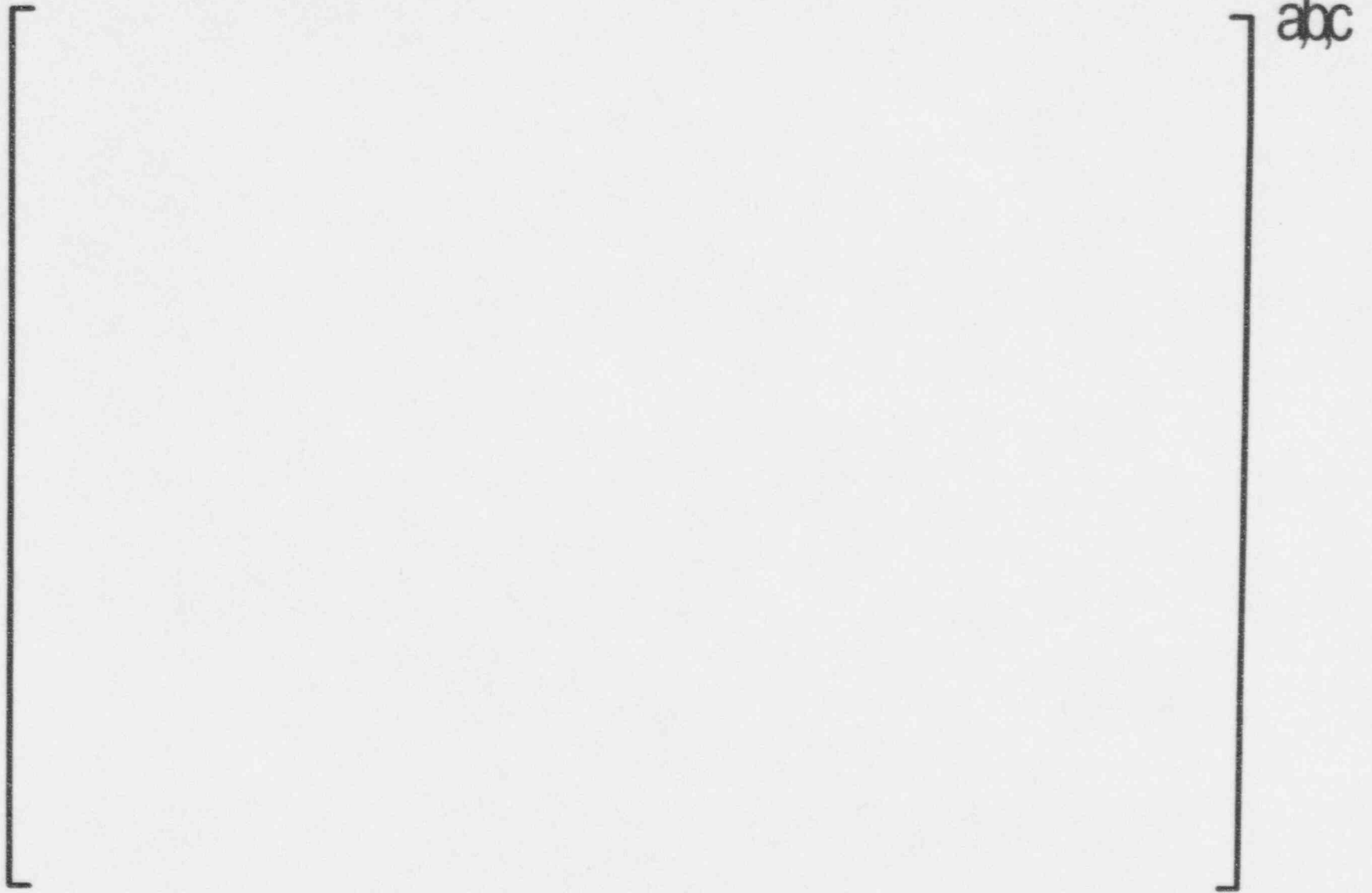


South Texas Measured Drag-Work vs. Fluence

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South Texas Predicted Drag-Work vs. Fluence



South Texas Measured vs. Predicted Drag-Work

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ZIRLO STRUCTURES

- F/A Mechanical Design--key properties

MECHANICAL PROPERTIES

-Strength

-Creep

CORROSION

GROWTH

ZIRLO STRUCTURES

Thimble Yield Stress



ZIRLO STRUCTURES

Cladding Creep



ZIRLO STRUCTURES

RXA Thermal Creep



ZIRLO STRUCTURES

Cladding Corrosion



ZIRLO STRUCTURES

Autoclave Corrosion



ZIRLO STRUCTURES

ZIRLO Growth

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ZIRLO STRUCTURES

ZIRLO Rod Growth



ZIRLO STRUCTURES

Growth from Corrosion



ZIRLO STRUCTURES

ZIRLO Assembly Growth



ZIRLO STRUCTURES

Summary: ZIRLO Growth

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ZIRLO STRUCTURES

POST IRRADIATION PLANS



ZIRLO STRUCTURES

Summary

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[illegible]

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NRC 96-01 Drag Data

(Upper Guide Thimble Drag vs. Fluence)

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NRC 96-01 Drag Data

(Total Drag vs. Fluence)

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Special W Fuel Assembly Features

- **ZIRLO**

- **Basic material property differences between ZIRLO and Zirc-4 are significant relative to RCCAs**

- Growth rate vs burnup
- Fuel rod growth vs burnup

- [•
• Oxide data] ^{a,b,c}

- **Comparison of Wolf Creek 50H FA with and w/o ZIRLO**

- [•
•] ^{a,b,c}

Special W Fuel Assembly Features (continued)

- ZIRLO skeletons are significantly less susceptible than Zirc-4 skeletons due to material properties such as creep, corrosion, etc.
- Additional high burnup data will be available from demos
- ZIRLO skeletons require no burnup restrictions given current burnup license limit

Special W Fuel Assembly Features

- IFMs
 - IFM FAs are less susceptible than non-IFM FAs
 - Reduced drag in upper guide tube region due to increased stiffness
 - Reduced compressive loads due to increased ΔP from IFM grids

Special W Fuel Assembly Features

IFM Conclusions

- No reported incomplete insertion for IFMs
- Drag tests with IFM do not exceed F-Spec
- Mechanical model predicts lower thimble tube bow for IFM FA than Wolf Creek H50

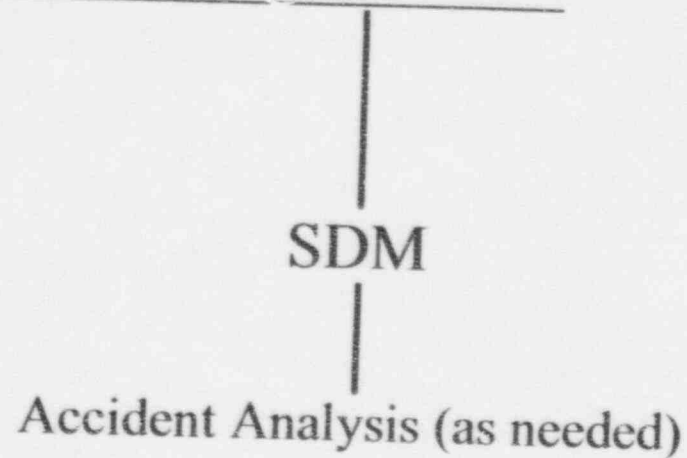
No Restrictions on IFMs up to Current Burnup Limit

Recommendation for Current Operating W Cores

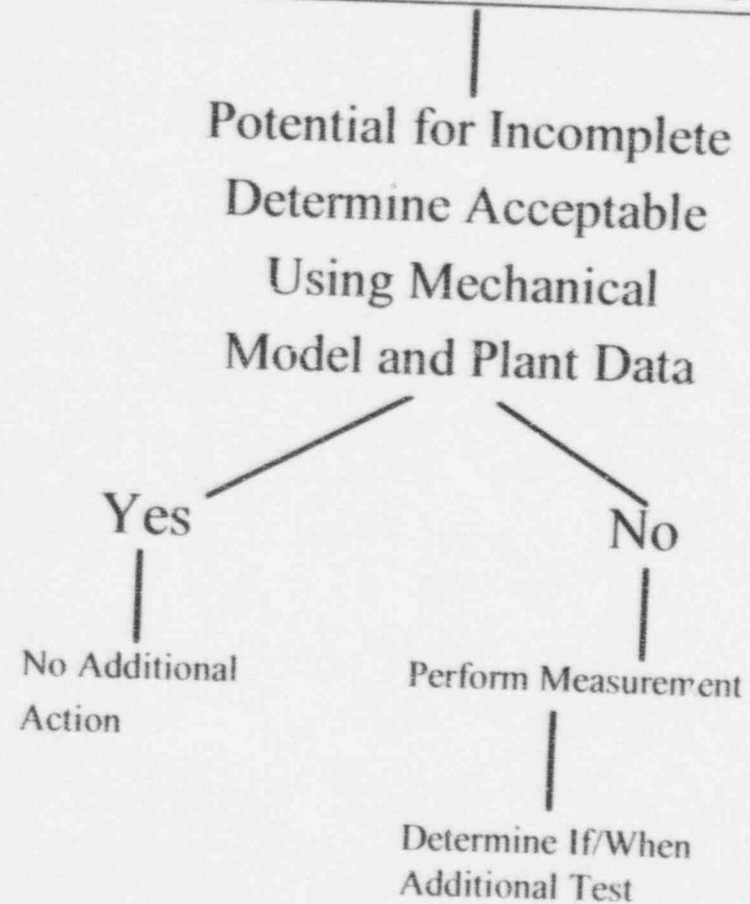
- **No restriction for IFM or ZIRLO skeleton FAs**
- **No restriction for low temperature plant or 2 cycle FAs**
- **Temperature > 615°F and 3 cycle FA (18 months)**
 - 12 Foot - 40,000 MWD/MWT
 - 14 Foot - 30,000 MWD/MWT
- **Temperature < 615°F**
 - 12 Foot - no restrictions
- **Process to assess acceptability should the above values be exceeded**

Process to Address Acceptability for Operating Plant above W Recommended Values

SAFETY EVALUATION



PREDICTIVE EVALUATION



Model Predictive Methodology

- Obtain necessary input of fuel assembly history

[•]^{a,b,c}

- If predicted burnup < EOC fluence by more than 2500 MWD/MTU
(Additional test required)

Fuel Assembly Near/Longer Term Actions to Enhance Margin to Incomplete Rod Insertion

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Fuel Assembly Near/Longer Term Actions to Enhance Margin to Incomplete Rod Insertion



Conclusions

- No restrictions required for IFM and /or ZIRLO based on current burnup licensing limit
- A mechanical model has been revised to predict span drag
- A methodology was developed to predict incomplete insertion

**WESTINGHOUSE OWNERS GROUPS
WOG / NRC INFORMATION MEETING
APRIL 16, 1997**

II. WOG PRESENTATIONS

- Fuel Issues
 - Formation of WOG Fuel Working Group
 - Formation Meeting held March 7, 1997
 - Next Meeting scheduled for May 8, 1997
 - WOG Fuel Working Group Charter
 - Central focus for fuel issues
 - Provide coordination with NEI, EPRI, and other fuel vendors
 - Establish framework for WOG/Industry response to issues
 - Identify strategic fuel issues and action plan

9704041.PPT(3)

**WESTINGHOUSE OWNERS GROUPS
WOG / NRC INFORMATION MEETING
APRIL 16, 1997**

II. WOG PRESENTATIONS - continued

- Fuel Issues - continued
 - WOG Fuel Working Group Potential Activities
 - Bulletin 96-01, Incomplete RCCA Insertion
 - Development of industry standard for fuel designs
 - INPO SOER 96-02 (approach to issues/peer review)
 - Standard for handling fuel design changes
 - Review of Reload Safety Analysis Checklist process
 - Standard for fuel uprating
 - High burn-up fuel designs
 - OGE Pursuing Formation of a Fuel Issues Group within NEI

9704041.PPT(4)

**WESTINGHOUSE OWNERS GROUPS
WOG / NRC INFORMATION MEETING
APRIL 16, 1997**

II. WOG PRESENTATIONS - continued

- Fuel Issues - continued
 - Bulletin 96-01, Incomplete RCCA Insertion (IRI)
 - WOG Continues to Participate In & Monitor IRI Activities
 - Issue returned from Analysis Subcommittee to IRG
 - Preliminary plans underway to provide response/comments on proposed Supplement to Bulletin 96-01
 - May request comment period extension if limited to 30 days in order to compile comments from all WOG members

PTNRCM1.PPT(10)

**WESTINGHOUSE OWNERS GROUPS
WOG / NRC INFORMATION MEETING
APRIL 16, 1997**

II. WOG PRESENTATIONS - continued

- Fuel Issues - continued
 - Bulletin 96-01, Incomplete RCCA Insertion (IRI) - continued
 - Attending All Westinghouse/NRC meetings
 - January 10 initial discussions of issue management
 - February 19 detail discussion of W mechanical model
 - April 17 further discussion of W mechanical model
 - Currently evaluating alternatives as a means to reduce the need to perform mid-cycle tests

PTNRCM1.PPT(19)

**WESTINGHOUSE OWNERS GROUPS
WOG / NRC INFORMATION MEETING
APRIL 16, 1997**

II. WOG PRESENTATIONS - continued

- Fuel Issues - continued
 - Bulletin 96-01, Incomplete RCCA Insertion (IRI) - continued
 - Short Term: Manage Existing Cores with W Fuel
 - Use W model to determine susceptibility
 - Burnup less than NRC limit - No action required
 - Burnup greater than NRC limit and less than W model susceptibility limit - EOC testing
 - Burnup greater than the W model susceptibility limits - Avoid if possible (new cores); perform safety evaluation; testing as appropriate

PTWOLCM1.PPT(13)

**WESTINGHOUSE OWNERS GROUPS
WOG / NRC INFORMATION MEETING
APRIL 16, 1997**

II. WOG PRESENTATIONS - continued

- Fuel Issues - continued
 - Bulletin 96-01, Incomplete RCCA Insertion (IRI) - continued
 - Intermediate Term: Program to Further Confirm Model
 - Data from existing high burnup assemblies
 - Data from future high burnup assemblies
 - Long Term: Elimination of Problem
 - Use model to assess the effectiveness of new design features
 - Fuel Working Group to plan utilization of operating experience of fuel assemblies with new design features

PTWOLCM1.PPT(14)

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