Westinghouse

Westinghouse Electric Company
Nuclear Services
P.O. Box 355
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USA

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Attention: J. S. Wermiel, Chief
Reactor Systems Branch
Division of Systems Safety and Analysis

Direct tel: 412/374-5036
Direct fax: 412/374-4011
e-mail: galem1js@westinghouse.com

Our ref: LTR-NRC-03-68

November 19, 2003

Subject: Copy of Draft Slide Presentation Material for the Westinghouse Semi-Annual Fuel Performance Update Meeting of December 9-10, 2003, (Proprietary/Non-Proprietary)

Dear Mr. Wermiel:

Enclosed are representative draft slide presentations (Proprietary and Non-Proprietary) for the NRC/Westinghouse meeting regarding the Westinghouse Semi-Annual Fuel Performance Update Meeting to be held at the Westinghouse Nuclear Fuel facility in Columbia, South Carolina on December 9-10, 2003. These representative slides are provided for NRC review with respect to proprietary determination and posting of the meeting notice. A finalized set of slides for the meeting will be supplied under separate cover letter and affidavit to the NRC Document Control Desk

Also enclosed are:

1. One (1) copy of the Application for Withholding, AW-03-1740 with Proprietary Information Notice and Copyright Notice.

2. One (1) copy of Affidavit, AW-03-1740.

This submittal contains Westinghouse proprietary information of trade secrets, commercial or financial information which we consider privileged or confidential pursuant to 10 CFR 9.17(a)(4). Therefore, it is requested that the Westinghouse proprietary information attached hereto be handled on a confidential basis and be withheld from public disclosure.

This material is for your internal use only and may be used solely for the purpose for which it is submitted. It should not be otherwise used, disclosed, duplicated, or disseminated, in whole or in part, to any other person or organization outside the Office of Nuclear Reactor Regulation without the expressed prior written approval of Westinghouse.

Correspondence with respect to any Application for Withholding should reference AW-03-1740 and should be addressed to John S. Galembush, Acting Manager of Regulatory Compliance and Plant Licensing, Westinghouse Electric Company, P. O. Box 355, Pittsburgh, Pennsylvania 15230-0355.

Very truly yours,

John S. Galembush, Acting Manager
Regulatory Compliance and Plant Licensing

Copy to:
F. M. Akstulewicz, NRR
B. J. Benney, NRR
D. G. Holland, NRR
E. S. Peyton, NRR

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Attention: J. S. Wermiel, Chief
Reactor Systems Branch
Division of Systems Safety and Analysis

Our ref: AW-03-1740

November 19, 2003

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: Copy of Draft Slide Presentation Material for the Westinghouse Semi-Annual Fuel Performance Update Meeting of December 9-10, 2003, (Proprietary/Non-Proprietary)

Reference: Letter from John S. Galembush to J. S. Wermiel, LTR-NRC-03-68, dated November 19, 2003

Dear Mr. Wermiel:

The application for withholding is submitted by Westinghouse Electric Company LLC, a Delaware limited liability company ("Westinghouse"), pursuant to the provisions of paragraph (b)(1) of Section 2.790 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary material for which withholding is being requested is identified in the proprietary version of the subject report. In conformance with 10 CFR Section 2.790, Affidavit AW-03-1740 accompanies this application for withholding, setting forth the basis on which the identified proprietary information may be withheld from public disclosure.

Accordingly, it is respectfully requested that the subject information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.790 of the Commission's regulations.

Correspondence with respect to this application for withholding or the accompanying affidavit should reference AW-03-1740 and should be addressed to the undersigned.

Very truly yours,

John S. Galembush, Acting Manager
Regulatory Compliance and Plant Licensing

AW-03-1740

# AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared John S. Galembush, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC, a Delaware limited liability company ("Westinghouse") and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief.

John S. Galembush, Acting Manager
Regulatory Compliance and Plant Licensing

Sworn to and subscribed
before me this 19th day
of November, 2003.

Notary Public

Notarial Seal
Lorraine M. Piplica, Notary Public
Monroeville Boro, Allegheny County
My Commission Expires Dec. 14, 2003
Member, Pennsylvania Association of Notaries

(1) I am Acting Manager, Regulatory Compliance and Plant Licensing, in Nuclear Services, of the Westinghouse Electric Company LLC, a Delaware limited liability company ("Westinghouse") and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rulemaking proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Electric Company.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by the Westinghouse Electric Company in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked "Copy of Draft Slide Presentation Material for the Westinghouse Semi-Annual Fuel Performance Update Meeting of December 9-10, 2003, (Proprietary/Non-Proprietary)," for submittal to the Commission, being transmitted by Westinghouse Electric Company (W) letter (LTR-NRC-03-68) and Application for Withholding Proprietary Information from Public Disclosure, John S. Galembush, Westinghouse, Acting Manager Regulatory Compliance and Plant Licensing to the attention of J. S. Wermiel, Chief, Reactor Systems Branch. Division of Systems Safety and Analysis. The proprietary information as submitted by Westinghouse Electric Company is to provide draft slides for NRC review with respect to proprietary determination and meeting posting in preparation for the Fuel Performance meeting on December 9-10, 2003.

This information is part of that which will enable Westinghouse to:

(a) Provide the Commission with fuel performance updates regarding the Westinghouse fleet of fuel designs and to report on future fuel development efforts.

(b) Assist customers in improving their overall fuel performance (zero defects).

Further this information has substantial commercial value as follows:

(a) This information contains detailed test data, design and methodologies used in fuel development.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended for developing the enclosed improved core thermal performance methodology.

Further the deponent sayeth not.

**Proprietary Information Notice**

Transmitted herewith are proprietary and non-proprietary versions of documents furnished to the NRC. In order to conform to the requirements of 10 CFR 2.790 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.790(b)(1).

## Copyright Notice

# Westinghouse Semi-Annual Fuel Performance Update Meeting (Slide Presentation of December 9-10, 2003)

# Westinghouse Semi-Annual Fuel Performance Update Meeting December 8-10, 2003 Columbia, SC

## Agenda

| | | |
|---|---|---|
| **Monday Dec 8 1300-1600** | Plant Tour of the COLA Facility (Security check-in, Welcome Brief and Tour) | |
| **Tuesday Dec 9 0800-1700** | Update meeting | |
| 0730 | Check-in and coffee, juice and pastries available | |
| 0800 - 0815 | Introductions and welcome | |
| 0815 - 1015 | Fuel Performance Update (PWR/BWR) | Proprietary |
| | General Fuel Performance Update (W/CE) - Issues | |
| 1015 - 1030 | Break | |
| 1030 - 1100 | Grid Crush Strength of Irradiated grids | Proprietary |
| 1100 - 1140 | Materials Update (Advanced Alloy Development) | Proprietary |
| 1140 - 1230 | NRC Discussions with W/customers | |
| 1230 - 1300 | Lunch | |
| 1300 - 1330 | High BU LTA Programs and Other Testing (Halden, Cabri, NFIR, HFIR, Vogtle, etc.) | Proprietary |
| 1330 - 1430 | Fuel Development Program Update (NGF) | Proprietary |
| 1430 - 1445 | Break | |
| 1445 - 1530 | 15x15 FCEP (Grid Correlation Applicability) | Proprietary |
| 1530 - 1700 | BWR Update | Proprietary |
| **Wednesday Dec 10 0800-1300** | Update meeting (cont.) | |
| 0730 | Coffee, juice and pastries available | |
| 0800 - 0920 | Code / Method Integration Update | Proprietary |
| | Fuel Rod Performance Code Integration | Proprietary |
| | RAVE | Proprietary |
| | VIPRE | Proprietary |
| | Nuclear Integration | Proprietary |
| 0930 - 0945 | CHF Update | Proprietary |
| 0945 - 1000 | Break | |
| 1000 - 1045 | Licensing Update | Proprietary |
| | Topical Reviews | Proprietary |
| | Alternate Source Pelleting | Proprietary |
| | Exemptions and LTA Programs | Proprietary |
| | Status of Optimized ZIRLO™ | Proprietary |
| 1045 - 1145 | Westinghouse / NRC Round-table Discussion | |
| 1145 - 1200 | Wrap-up | |
| 1200 | | Lunch |


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# Fuel Development Program Update

NRC/Westinghouse Meeting
Columbia, SC
December 9, 2003

## Margin Generation – New Fuel Design and Features

- Objective
  - Describe the commonality of approach of Westinghouse product development across the product lines and fuel arrays
- Overall Outline
  - Significant Focus
  - Common Approaches and Enabling Technologies
  - Global Sharing
  - Margin Enhancements
  - Advanced Alloy Development
  - Specifics on each product line program
  - Summary



## Significant Focus

Product Development for [ ]a,c

- Main objective has been to develop fuel designs with [ ]a,c

[ ]a,c

- These will complement our already introduced product upgrades
  - 14x14 Turbo CE
  - 14x14 422 VANTAGE + Westinghouse

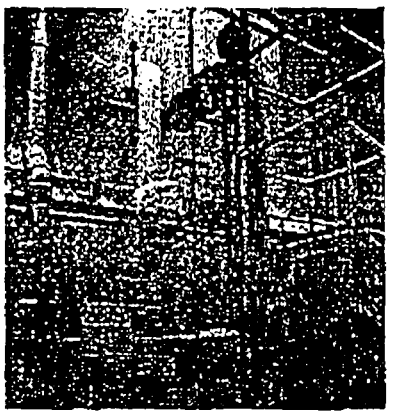
## Common Approach and Enabling Technologies

Process
- New Product Development Process

Analysis and Software
- Integrated solids modeling & analysis
- Computational Fluid Dynamics (CFD)
- Latest reload methods, e.g. PAD, BOB

Testing

[ ]a,c



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## Global Sharing

### Key Experts, Best Processes and Technologies

- Key experts utilized from all over the world
  - Columbia, Vasteras, Windsor, Monroeville, technical consultants, customers
- Best technologies from our worldwide experience
  - [ ]a,c
  - [ ]a,c
  - [ ]a,c
  - [ ]a,c
- Sharing of design approach, test results, and lessons learned across all product lines

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## Margin Enhancements

- Advanced Alloy Programs
  - [ ]a,c
- I-Spring Design [ ]a,c
  - [ ]a,c
- Improved Mixing Vane Designs
  - [ ]a,c
- Added IFMs
  - [ ]a,c

* [ ]a,c

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## Margin Enhancements

- Tube-in-Tube Design
  - [ ]a,c
- Westinghouse Integral Nozzle
  - [ ]a,c
- Fuel Rod Design Enhancements
  - [ ]a,c
- [ ]a,c

** [ ]a,c

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## Advanced Alloy Development Programs

- ZIRLO™
  - Excellent performance, low growth, low corrosion
  - Licensed to 62K; [ ]a,c
- Optimized ZIRLO™
  - Building on ZIRLO™'s extensive performance base
  - Improved corrosion margin [ ]a,c
- Alloy X
  - Improved corrosion margin target [ ]a,c
  - Maintaining optimum mechanical and microstructure characteristics

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## Advanced Alloy Development Status

- ZIRLO™
  - 100% utilization in Westinghouse NSSS plants
  - Currently being transitioned into the CE NSSS plants
- Optimized ZIRLO™
  - [ ]a,c
  - [ ]a,c
  - [ ]a,c
    - [ ]a,c
- Alloy X
  - [ ]a,c
  - [ ]a,c
  - [ ]a,c

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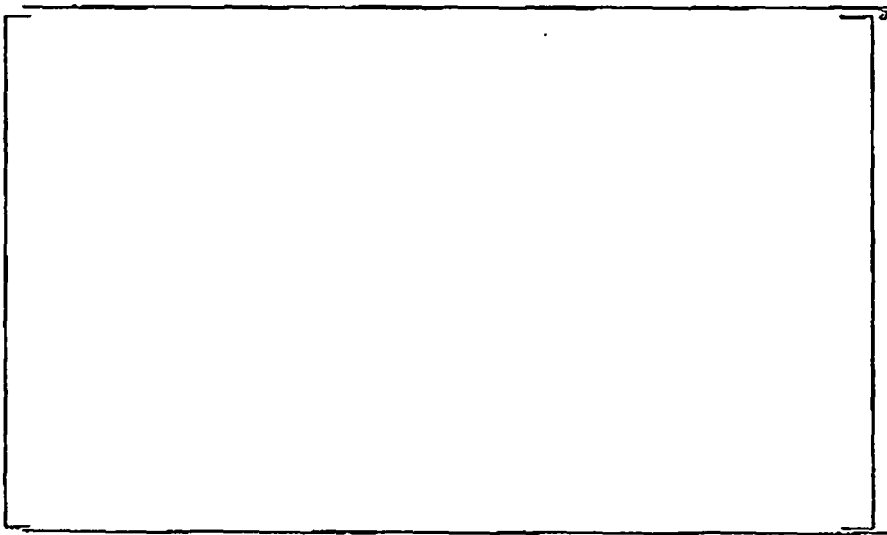
## ZIRLO™ Microstructure

[ ]a,b,c



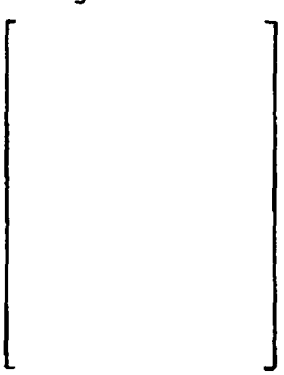
BNFL Slide 11 Westinghouse

## I-Spring

Selected as the [ ]a,c rod support system

- [ ]a,c
- Proven in the 14 CE Turbo Design

[ ]a,c



BNFL Slide 12 Westinghouse

## I-Spring VIPER Results Show Significant Benefit

[ ]a,b,c

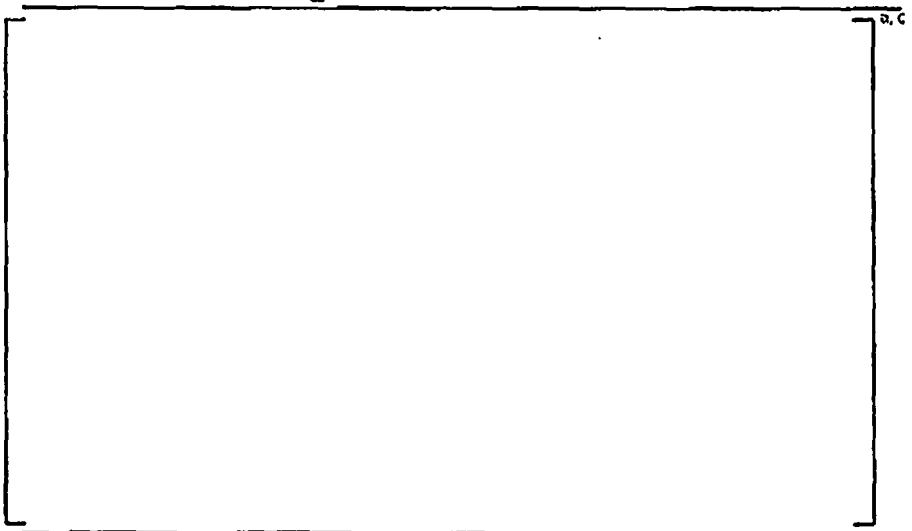


## Mixing Vane Designs

Optimized to Match Assembly Requirements

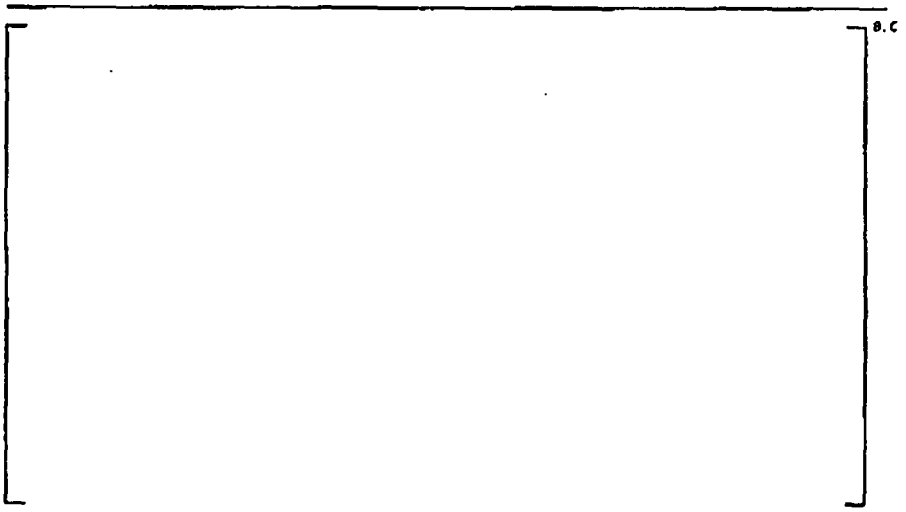
- Common Approach
  - [ ]a,c
  - [ ]a,c

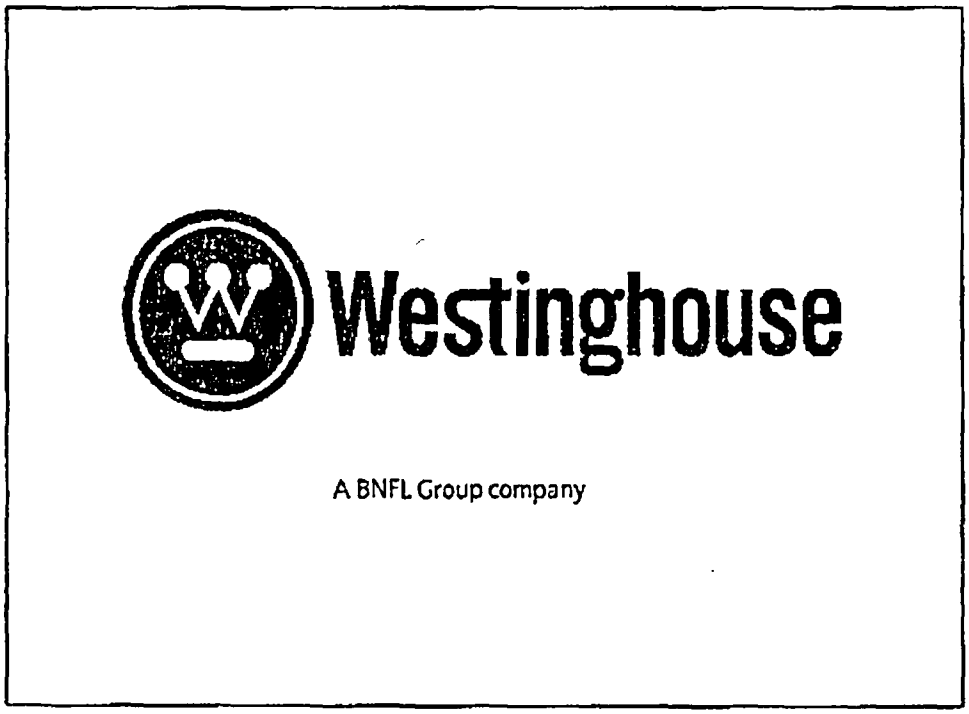
## Tube-in-Tube Design





## Integral Nozzle Adds Robustness

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*Reactivity Insertion Accident*

Westinghouse Non-Proprietary Class 3

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# Application of Fuel Criteria Evaluation Process (FCEP) to the 15x15 Upgrade Fuel Design - WCAP-12488-A

NRC/Westinghouse Meeting
Columbia, SC
December 9, 2003

## DNB Correlation Applicability using FCEP

Westinghouse FCEP Section 6.0 specifies the guidelines relevant to determining Correlation Applicability for either grid design modifications or a new grid design:

"An existing DNB correlation will be valid and will meet the above design basis* without reservation provided the new fuel assembly geometry is [ ]$^{a,c}$." (of the licensed database for the DNB correlation of interest).

"If the new geometry is [ ]$^{a,c}$ of the test data, Westinghouse will evaluate the geometry [ ]$^{a,c}$."

* DNB design basis is that the probability of the limiting fuel rod not being in DNB be greater than 95 percent at a 95 percent confidence level.



## DNB Correlation Applicability using FCEP

(Cont.):

"If additional test data are used, [ ]$^{a,c}$. The new data will then be [ ]$^{a,c}$.

"If the new data [ ]$^{a,c}$ it may be treated explicitly as a [ ]$^{a,c}$ may be developed. If this step is necessary, it would involve NRC review."

Thus, there are three approaches that can be used: [ ]$^{a,c}$. If none of these approaches yield acceptable results, then a submittal to the NRC is required.

## DNB Correlation Applicability using FCEP

As specified in the TER of FCEP:

"An existing NRC approved DNB correlation is considered to be valid by Westinghouse for application to a new design when the new fuel assembly geometry is similar to or bracketed by the fuel assembly geometric parameters and correlation parameters of the critical heat flux (CHF) test data used to develop the approved DNB correlation."

BNFL Slide 5 Westinghouse

## DNB Correlation Applicability using FCEP

The relevant geometric parameters are:

a, b, c

[ ]

BNFL Slide 6 Westinghouse

## DNB Correlation Applicability using FCEP

The relevant correlation parameters are:

a, b, c

[ ]

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## Application of FCEP to RFA Fuel

15x15 Design Evolution

- In the 1970's, Westinghouse performed a large number of CHF tests on rod bundles prototypical of the 15x15 (0.422 in OD rod) and 17x17 (0.374 in OD rod) Inconel "R-grid" mixing vane grid types. The WRB-1 CHF correlation was developed based on the results from these tests
- Westinghouse continued to develop new fuel products, including the Optimized Fuel Assembly (OFA) designs, which were "scaled" or extrapolated from the R-grid designs
- The 14x14 and 17x17 OFA designs were DNB tested and the results showed that WRB-1 accurately predicted CHF for OFA fuel designs

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## Application of FCEP to RFA Fuel

15x15 Design Evolution

- Based on the scaling method and the similarity of the 15x15 OFA design with the R-grid geometry, the WRB-1 correlation was extended to cover 15x15 OFA fuel without DNB tests. This extension was accepted by the NRC
- Similarly, when the 15x15 V5H product was first developed, it was again compared with the R-grid geometry and it was determined that the WRB-1 correlation could also be extended to cover the design again without DNB tests



## Application of FCEP to RFA Fuel

15x15 Design Evolution

- In the process of getting a license amendment submittal approved for a licensee, the NRC staff insisted that Westinghouse perform DNB water tests on the 15x15 VANTAGE + fuel product (geometrically equivalent to the 15x15 V5H design with IFMs)
- As a result, Westinghouse proceeded to perform a DNB test on the 15x15 VANTAGE + product with IFMs to confirm that the WRB-1 correlation would be applicable to this design (refer to the table below)

## Application of FCEP to RFA Fuel

15x15 Design Evolution

- Based on the DNB test performed for the 15x15 V5H/VANTAGE + fuel product with IFMs, Westinghouse submitted an FCEP Notification to the NRC to document the fact that the WRB-1 correlation was applicable to the design (refer to NSD-NRC-99-5828)
- Note: the 15x15 V5H/ VANTAGE + design still has the same original V5H LPD mid-grid configuration as the 17x17 V5H design incorporated (minor differences between array designs)
- To improve upon this 15x15 design, and incorporate those features proven for the 17x17 design, the plan is to implement the 15x15 RFA-2 design that has MV5H/MIFM grids and tube-in-a-tube guide thimble design (see illustration of the grid modifications on the next slide)



## Application of FCEP to RFA Fuel

a,b,c

## Application of FCEP to RFA Fuel

a, b, c

[ ]

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## Application of FCEP to RFA Fuel

15x15 Design Evolution

- Based on the assessment in the table on the preceding slide, it can be seen that the 15x15 RFA-2 design meets the geometric conditions for WRB-1
- Thus, WRB-1 is applicable to the 15x15 RFA-2 design
- [

]a,c

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# Application of Fuel Criteria Evaluation Process (FCEP) to the 15x15 Upgrade Fuel Design - WCAP-12488-A

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BNFL Slide 3 Westinghouse

## DNB Correlation Applicability using FCEP

(Cont.):

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BNFL Slide 4 Westinghouse

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BNFL Slide 5 Westinghouse

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a, b, c

[ ]

BNFL Slide 6 Westinghouse

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The relevant correlation parameters are:

a, b, c

[ ]

BNFL Slide 7 Westinghouse

## Application of FCEP to RFA Fuel

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BNFL Slide 8 Westinghouse

## Application of FCEP to RFA Fuel

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- Similarly, when the 15x15 V5H product was first developed, it was again compared with the R-grid geometry and it was determined that the WRB-1 correlation could also be extended to cover the design again without DNB tests



## Application of FCEP to RFA Fuel

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BNFL Slide 11 Westinghouse

## Application of FCEP to RFA Fuel

a, b, c

BNFL Slide 12 Westinghouse

## Application of FCEP to RFA Fuel

a, b, c

[

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## Application of FCEP to RFA Fuel

15x15 Design Evolution

- Based on the assessment in the table on the preceding slide, it can be seen that the 15x15 RFA-2 design meets the geometric conditions for WRB-1
- Thus, WRB-1 is applicable to the 15x15 RFA-2 design
- [

]a, c

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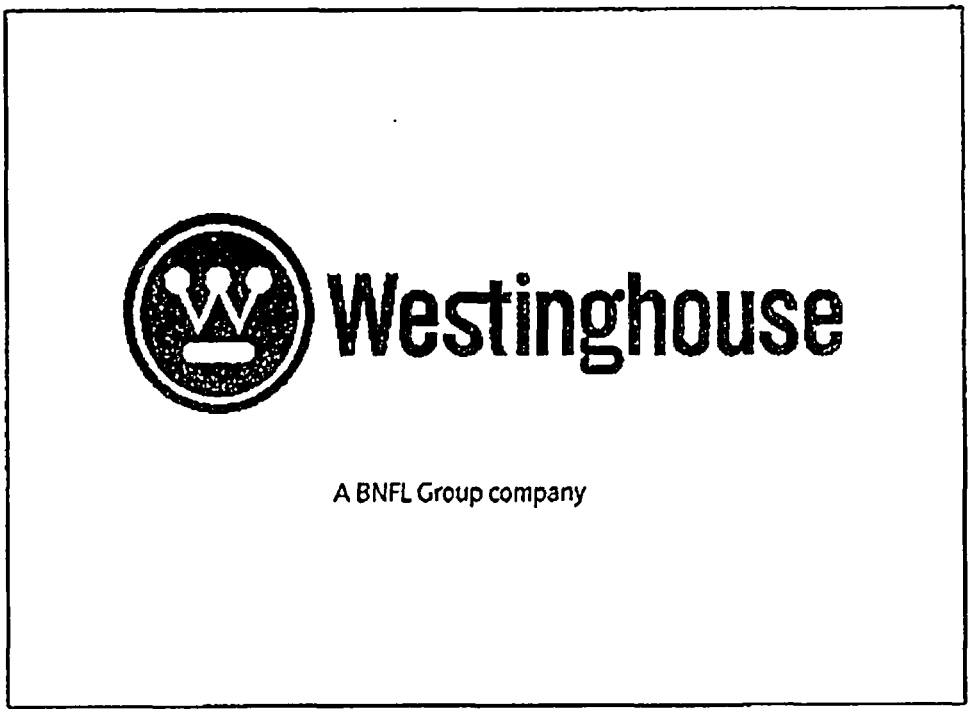
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# Results of Irradiated PWR Grid Impact Assessment

NRC/Westinghouse Meeting
Columbia, SC
December 9, 2003

## Results of Irradiated PWR Grid Impact Assessment

- Agenda
  - Overview and Purpose
  - Current Grid Testing Methodology
  - Applicability to Westinghouse Grid Designs
  - Summary



## Overview

- WCAP 13488-A, Addendum 1-A, Rev. 1:
  - Justifies BOL condition testing as bounding for irradiated grids
  - Applicable to all Westinghouse grids
- Westinghouse grids behave similarly:
  - Evaluation of grid deformation during impact loading
  - Grids designed at Columbia, Windsor, and Västerås
- Key aspects to grid crush:
  - Stiffness
  - Crush strength
  - Both form "Seismic Factor"
- Factors contributing to crush behavior:
  - Geometry
  - Hydrogen
  - Oxiding, or strap thinning

## Irradiated PWR Grid Impact Assessment

- Today's discussion - Grid impact analysis and test methods for Westinghouse grids:
  - Traditional Westinghouse (Columbia) designs
  - "CE" (Windsor) designs
  - "Sweden" (Västerås) designs
- Path for today's discussion:
  - Effects of irradiation on grid dynamic capability
    - Grid impact strength requirements
    - Interaction of grid stiffness and grid impact strength
  - Applicability of test results to irradiated grids
  - Integration of methods between designs



## Traditional Westinghouse (Columbia) Grids

- NRC Approval of WCAP-12488-A Addendum 1, Revision1 confirmed current testing method
- Basis:
  - [ ]a,c
  - [ ]a,c
- Grid acceptance criteria defined by column buckling
  - [ ]a,c
  - [ ]a,c
- Seismic Factor used to assess grid dynamic capability
  - [ ]a,c

## Parametric Tests Supporting WCAP-12488-A Add. 1-A, Rev.1

- Conclusion - Use of production grid test data:
  - Continues to be valid approach
  - Used in seismic/LOCA analysis
- Basis:

[ ] a, c

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## Examples of Crushed Grids, Basis of WCAP-12488-A, Add. 1-A, Rev.1

[ ] a, b, c

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## Grid Impact Strength Sensitivity to Hydrogen

- Hydrogen concentration has no effect on hot crush strength

a, b, c

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## Grid Impact Strength Sensitivity to Strap Thinning

- Oxide provides benefit to offset base material thinning from oxidation.

a, b, c

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## "CE" (Windsor) Grids

- Conclusion:
  - *Columbia testing applicable to column buckling aspects of wavy strip design*
  - Initial evaluations of plastic deformation aspects indicate:

[ ]a, b, c

- Basis:

[ ]a, b, c

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## "Sweden" (Västerås) Grids

- Conclusion:
  - Material behavior change, based on testing of simulated irradiated grids at Columbia, are applicable to Västerås grids

- Basis:

[ ]a, b, c

- Note: Currently, grids designed at Västerås not used in U.S. plants.

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## Summary and Conclusions

- WCAP 13488-A, Addendum 1-A, Rev. 1:
  - –Justifies BOL condition testing as bounding for irradiated grids
  - –Applicable to all Westinghouse grids
- Westinghouse grids behave similarly:
  - –Evaluation of grid deformation during impact loading
  - –Grids designed by Columbia, Windsor and Västerås



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