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Fuel/Core Design and Analysis Update (Redacted Version)

June 22, 2011

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AGENDA

- Introduction
- Design Optimization and Revised Plant Layout
- B&W mPower^{TM} Reactor Fuel Mechanical Design Update
- B&W mPower Reactor Physics Design and Analysis Update
- Conclusions

Note: Bracketed information in this presentation slide package has been determined to be proprietary, confidential commercial information(CCI) as per the affidavit provided to the NRC with the transmittal letter.

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DESIGN OPTIMIZATION OVERVIEW

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Other Impacts of Design Optimization

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Site Layout and General Arrangement Review

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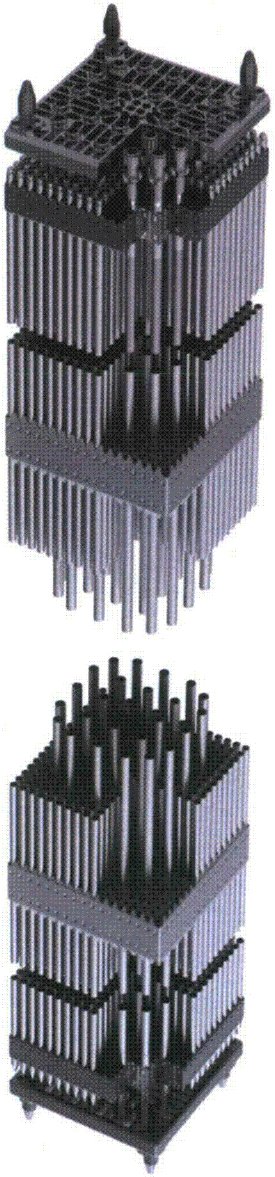

B&W mPower™ Fuel Mechanical Design Update

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General Fuel Mechanical Design Objectives

- Ensure that fuel rods, burnable poison rods, fuel assemblies and in-core control components are designed to -
  - Maintain coolable geometry and control component insertability under all anticipated operational occurrences (AOOs) and postulated accidents (PAs)
    - Designs shall account for the effects of temperature, pressure, irradiation, fission products, static and dynamic loads, and changes in the chemical characteristics of the constituent materials
  - Provide a means for their structural integrity and safe handling during transport, storage, installation, and refueling operations

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General Fuel Mechanical Design Objectives (cont.)

- Ensure that the fuel system is designed to -
  - Maintain structural integrity and as-designed fuel geometry under all AOOs and PAs
  - Be compatible under the effects of irradiation, and chemical and physical processes
  - Minimize any potential obstruction to coolant flow

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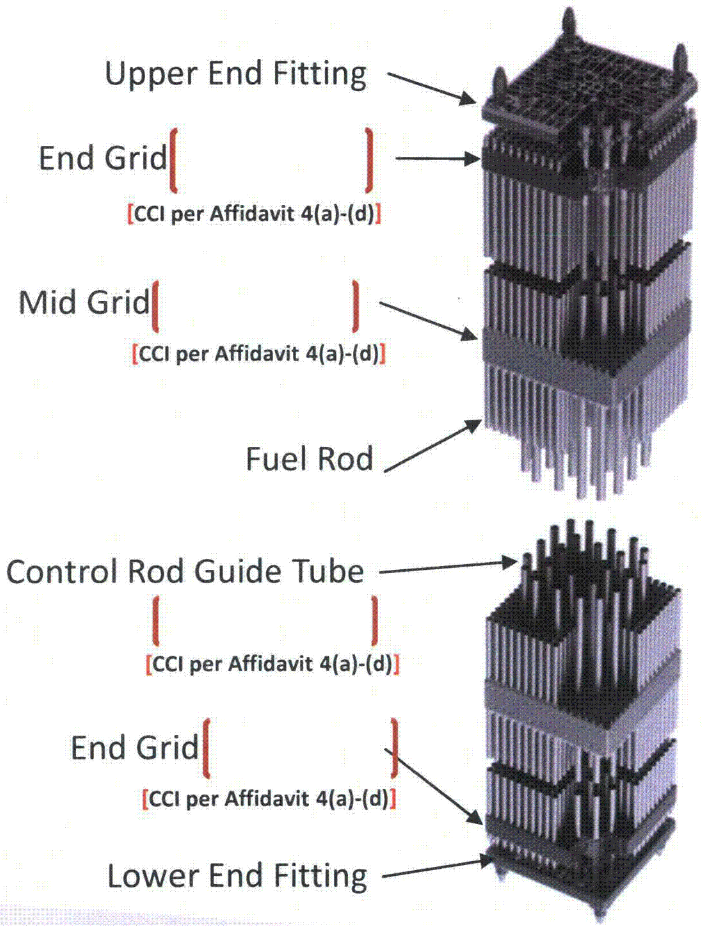
Fuel Assembly Design



Fuel Assembly Attributes

- 17 x 17 Fuel Rod Array

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Shortened and Simplified Conventional Fuel Assembly Design

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Fuel Rod Design

Fuel Rod Attributes

- Low Power Density
- Large Plenum Volume (Low End of Life Pressure)

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Conventional Fuel Rod Design

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Upper End Fitting

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Simplified Upper End Fitting Design

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Robust, Low Pressure Drop End Grids

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Robust, Low Pressure Drop Mid Grids

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Guide Tube Assemblies

Double Tube Dashpot Design

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Lower End Fitting

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Simplified Lower End Fitting Design

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Lower End Fitting

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Simplified Lower End Fitting Design

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Reliable Joint Design

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Control Rod Assembly

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Reference Design Control Rod Configuration

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Mechanical Design Analysis Methodology

- Development And Validation of Design Analysis Methodology And Computer Codes
  - Fuel Rod Design Analyses
  - Fuel Assembly Design Analyses
- Fuel Rod Design Analysis Methodology And Codes

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Developing Suite of Design Analysis Codes

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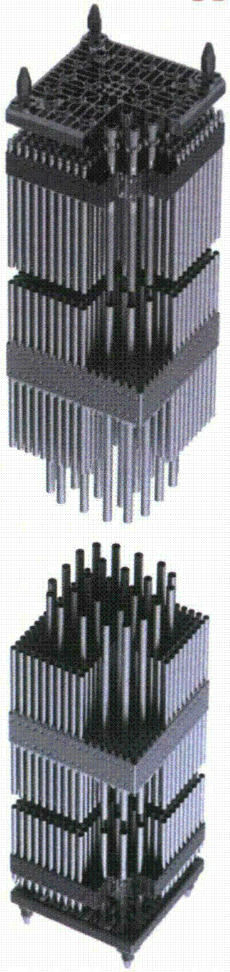
Mechanical And Hydraulic Tests



- **Extensive Mechanical And Hydraulic Testing Planned To Support Fuel Assembly Development And Qualify Design**

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Comprehensive Fuel System Testing Program

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Mechanical And Hydraulic Tests

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Extensive Component Mechanical Testing

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Mechanical And Hydraulic Tests

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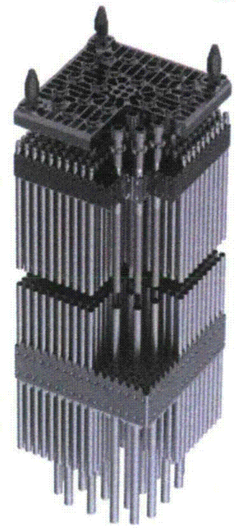
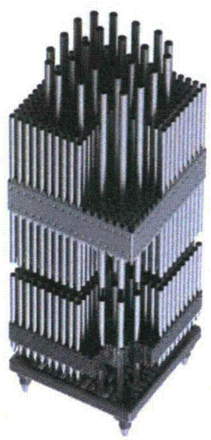
Mechanical And Hydraulic Tests





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Static and Dynamic Fuel Assembly Tests

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Mechanical And Hydraulic Tests

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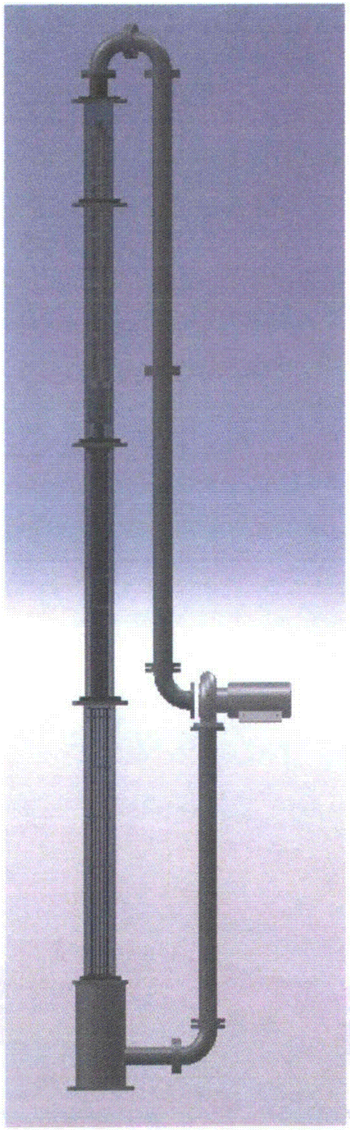
Mechanical And Hydraulic Tests



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Mechanical And Hydraulic Tests

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Prototype Fuel Assembly Fabrication

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Prototype Fuel Assembly Fabrication

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Prototype Fuel Assembly Fabrication

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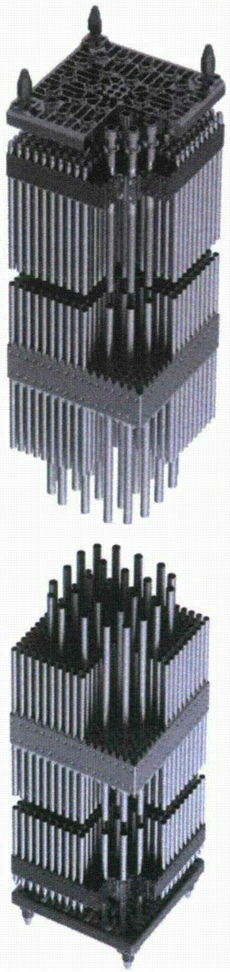
Mechanical Design Summary



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Unique, Simple Fuel Assembly Design

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B&W mPower™ Reactor Physics Design Update

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Primary Core Design Objectives

- **Load Enough Fuel Inventory To Ensure That**
  - The Core Excess Reactivity Is Sufficient To Operate At A Steady-State Power Level For 4 Years At A Capacity Factor > 95% Without Refueling

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- **Ensure Core Shutdown Margin (SDM) Of > 1% $\Delta k_{eff}/k_{eff}$ Under Cold Conditions At The Most Reactive Time In Core Life With The Highest Worth Rod Cluster Stuck Out**

Extended Core Life With Large Thermal Margins

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Fuel Design Characteristics

Conventional Fuel and Control Materials

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Core Design Developments

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Simplified Assembly Design Variations

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Control Cluster Configuration and Worths

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Core Axial Power Distribution

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Axial, Radial, and Nodal Peaking

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MCNPX Lattice Physics Benchmarks

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Lattice Benchmark k_∞ Preliminary Results

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MCNPX Lattice Reflector Benchmarks

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Lattice Benchmark Reflector Preliminary Results

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Lattice Benchmark Reflector Preliminary Results

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Core Thermal-Hydraulic Subchannel Analysis

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CHF Correlation Options in VIPRE

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- The Babcock & Wilcox BW-2 correlation is available in VIPRE, [but the B&W mPower reactor nominal pressure is outside its pressure range]
- Other correlations are for BWRs or non-applicable geometries

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Results with Available CHF Correlations

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B&W Nuclear Energy CHF Correlation

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Reactor Physics Design Status

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Conclusions

- Design optimization will maintain or improve core safety margins
- Future meetings with NRC staff to be scheduled to discuss
  - Modified comprehensive static core design detail
  - Preliminary transient analysis results
- MCNPX 2.7.0 release delay impacts schedule for Core Design Methods TR supplement

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