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PROJ 776

July 16, 2009

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: Non-Proprietary Slides for B&W *mPower*™ Modular Reactor Approach to Reactivity.

REFERENCE: B&W Transmittal letter dated July 6, 2009.

The B&W Nuclear Power Generation Group met with the NRC staff on July 7th 2009 in a closed meeting to discuss the reactivity control approach for the B&W *mPower*™ Reactor. During that meeting, and in the referenced letter, B&W committed to providing a redacted, non-proprietary version of the presentation.

The attached sets of slides are provided as non-proprietary and releasable to the public without restriction.

Questions concerning this submittal may be directed to Jeff Halfinger at (434) 522-5941.
(Email: jahalfinger@babcock.com).

Jeff A. Halfinger

JAH/jlr

cc: Thomas J. Kenyon, NRC, TWFN-6 C34
William D. Reckley, NRC, TWFN-6 C34

4G01

NRO

Add: TJ Kenyon
WD Reckley 2 ERIDS

B&W mPower™
a progressive energy solution

Redacted Version

B&W
nuclear power generation

Modular Reactor Approach to Reactivity Control

July 7, 2009 NRC Pre-Application Review

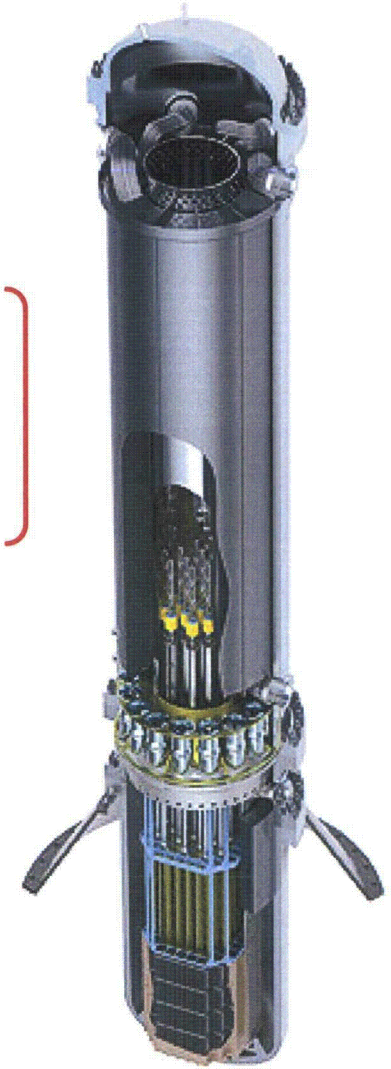
Redacted material marked with square brackets and noted by
[CCI per Affidavit 4(a)-(d)**]**

Presentation Outline

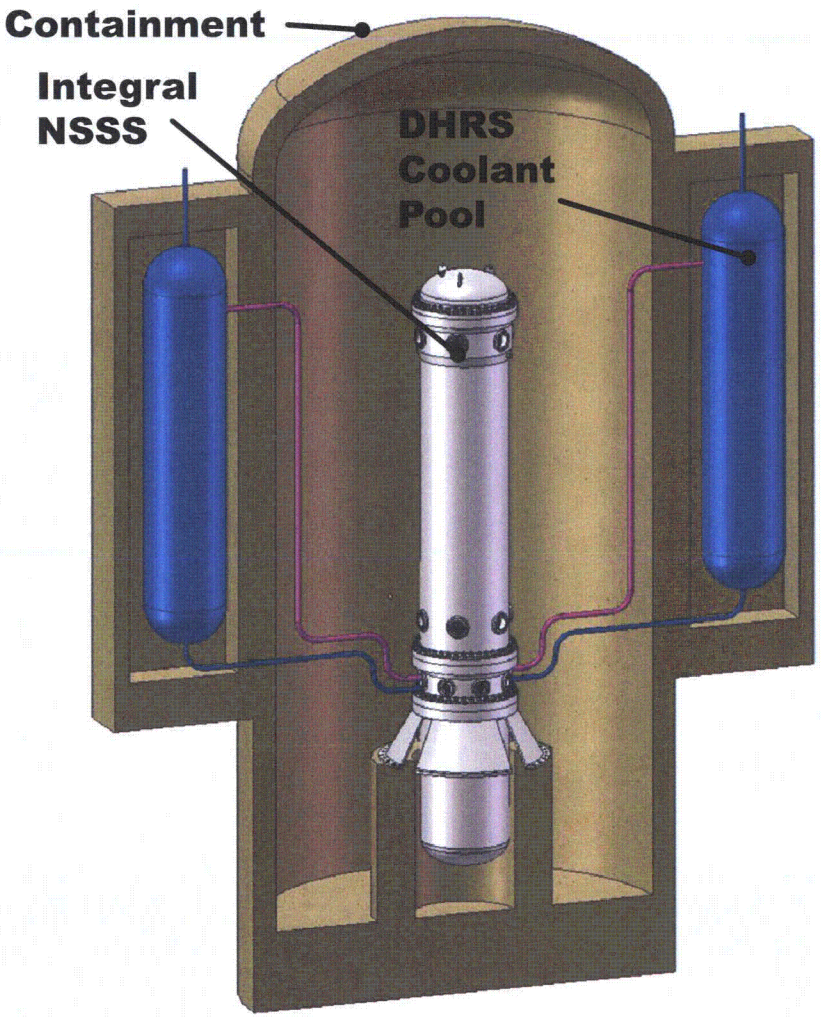
- Introduction
- B&W *mPower* safety design features

[CCI per Affidavit 4(a)-(d)]

- Reactivity control approach
- Regulatory requirements for reactivity control
  - General Design Criteria 26, 27, and 29
  - Anticipated Transients Without Scram (ATWS)
- Summary



Key B&W *mPower* Safety Design Features

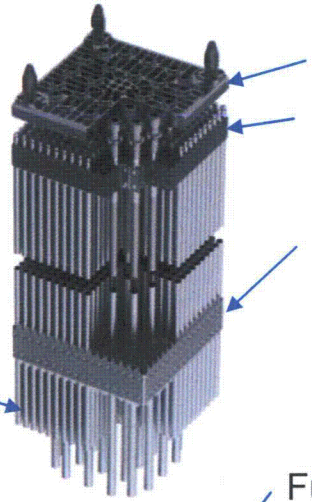


- Traditional PWR fuel assemblies operated at lower power density
- Integral nuclear steam supply system (NSSS)
- Natural circulation decay heat removal system (DHRS)
- Containment with passive heat absorption

[ ]

[CCI per Affidavit 4(a)-(d)]

Traditional PWR Fuel Assembly



Top nozzle

Top spacer grid

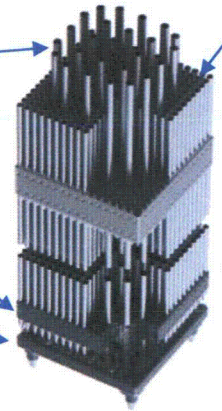
Intermediate spacer grid

17 x 17 fuel rod array

Control rod guide thimble

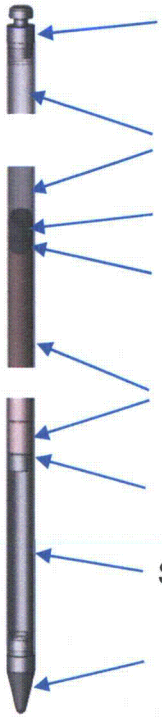
Bottom spacer grid

Bottom nozzle



Fuel rod

- **Lower power density**
- **Corrosion resistant Zircaloy**
- **Large plenum volume**



Top end plug

Upper plenum

Clip

Top spacer

Fuel pellet column

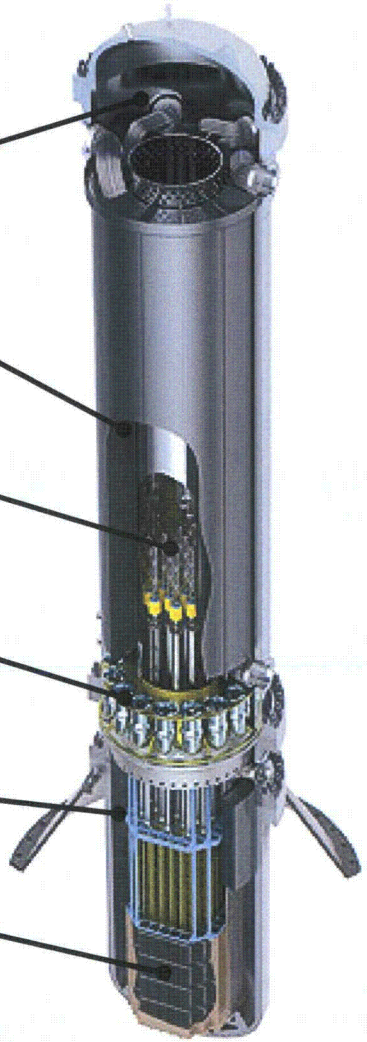
Bottom spacer

Standoff

Bottom end plug

Shortened and Simplified Conventional Fuel Assembly Design

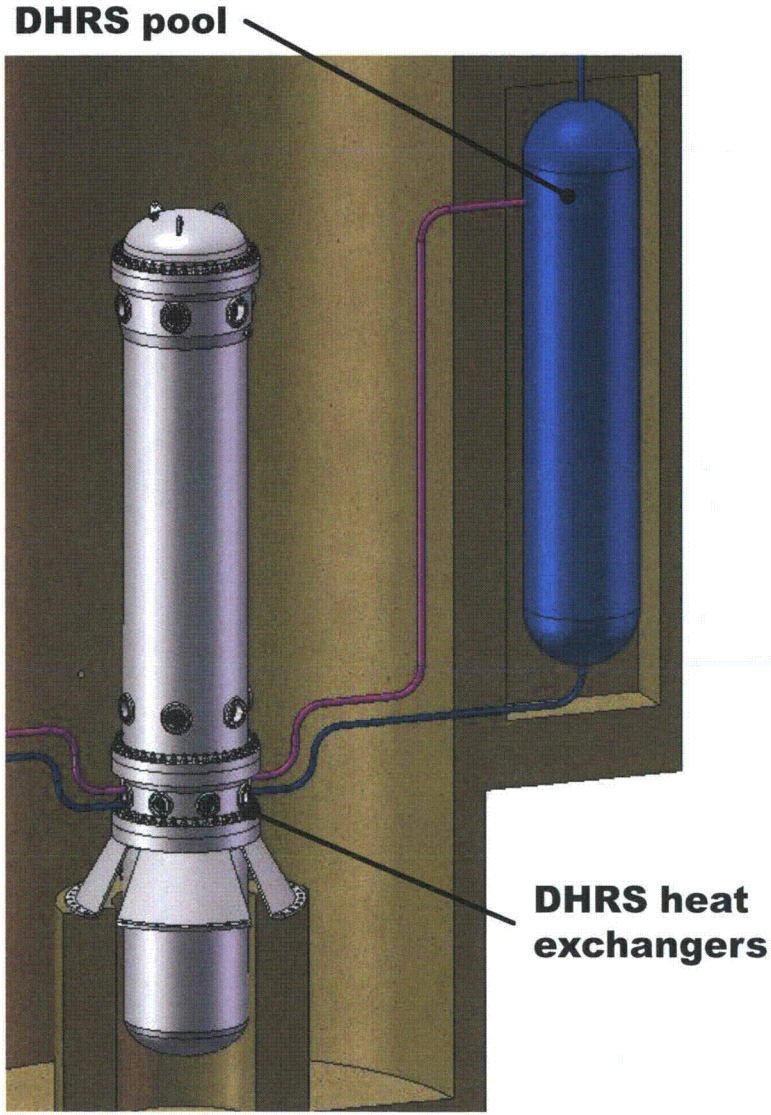
Integral Nuclear Steam Supply System



- Pressurizer and pressure relief at the high point of the vessel
- CRDMs inside vessel
- DHRS heat exchangers inside pressure vessel
- Large reactor coolant inventory
- RC penetrations at the top of the vessel and are small [ ] [CCI per Affidavit 4(a)-(d)]
- Core remains covered throughout design basis LOCA without coolant addition

No Large Break LOCA

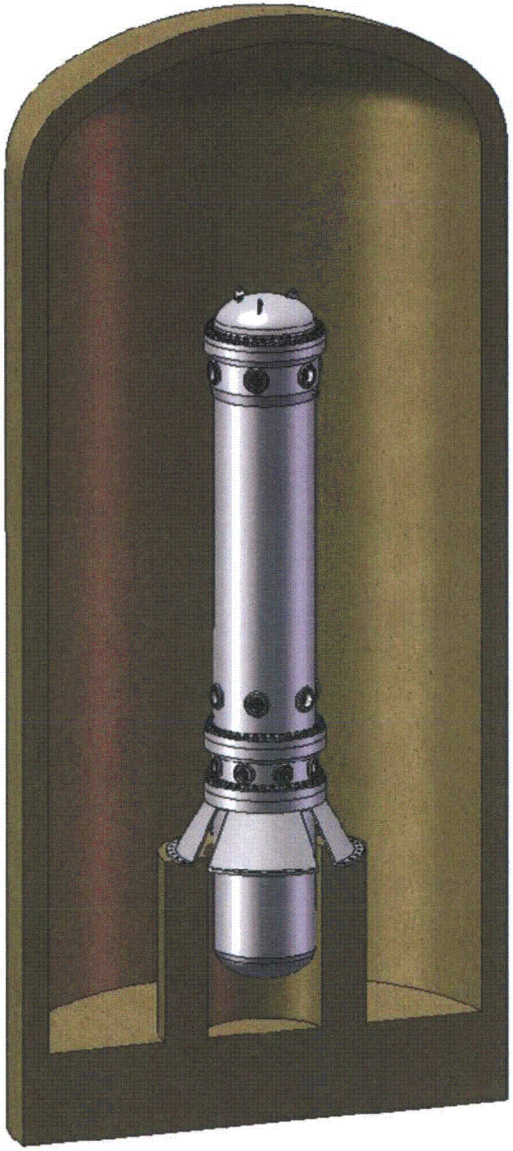
Natural Circulation DHRS



- Decay heat removal system (DHRS) serves as emergency core cooling system
- Multiple independent heat exchanger loops fed from stored water source(s)
- System is operable at all reactor pressures and temperatures
- Passive heat removal for more than 72 hours

Provides passive decay heat removal when steam generator is not available

Containment



- NSSS and all high energy pipe containing reactor coolant is located within containment
- Spent fuel stored inside containment
- Containment provides sufficient thermal storage to drop peak pressure after LOCA by >50% within 24 hours

Provides traditional defense in depth to minimize release of radioactive materials

[CCI per Affidavit 4(a)-(d)]

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[CCI per Affidavit 4(a)-(d)]

Reactivity Control Regulatory Requirements

- General Design Criteria
  - GDC 26 – Two independent reactivity control systems
  - GDC 27 – Capable of reliably controlling reactivity changes
  - GDC 29 – Highly reliable capability of performing safety function
- 10 CFR 50.62 reduction in risk from anticipated transients without scram (ATWS)

General Design Criterion 26

Two independent reactivity control systems of different design principles shall be provided. One of the systems shall use control rods, preferably including a positive means for inserting the rods, and shall be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as stuck rods, specified acceptable fuel design limits are not exceeded. The second reactivity control system shall be capable of reliably controlling the rate of reactivity changes resulting from planned, normal power changes (including xenon burnout) to assure acceptable fuel design limits are not exceeded. One of the systems shall be capable of holding the reactor core subcritical under cold conditions.

[CCI per Affidavit 4(a)-(d)]

General Design Criterion 27

The reactivity control systems shall be designed to have a combined capability, in conjunction with poison addition by the emergency core cooling system, of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained.

[CCI per Affidavit 4(a)-(d)]

General Design Criterion 29

The protection and reactivity control systems shall be designed to assure an extremely high probability of accomplishing their safety functions in the event of anticipated operational occurrences.

[CCI per Affidavit 4(a)-(d)]

10 CFR 50.62 - ATWS

- *(c)(1) PWRs must have independent, diverse, reliable equipment for auxiliary feedwater initiation and turbine trip upon indication of an ATWS*

[ ]

[Privileged information per Affidavit 6(b)]

10 CFR 50.62 - ATWS

- *(c)(2) pressurized water reactors manufactured by . . . Babcock and Wilcox must have a diverse, independent, reliable scram system ….*

[ ]

[CCI per Affidavit 4(a)-(d)]

Summary

[CCI per Affidavit 4(a)-(d)]

- Reactivity control system has diverse, independent, reliable scram systems and meets the requirements for ATWS
- B&W *mPower* design fully complies with General Design Criteria 26, 27, and 29
- Design assures the capability to cool the core under postulated accident conditions
- Design provides a highly reliable and passive approach to safety