Enclosure 2 Nuclear Island System Slides(Redacted)

babcock & wilcox nuclear energy, inc., a Babcock & Wilcox company

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Market Content And Systems Design Update (Redacted Version)

April 26, 2012

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mPower[™] Reactor Nuclear Island (NI) Systems

- Overview of NI Systems Safety Strategy
- Reactor Coolant System (RCS)
- Auxiliary Condenser System (CNX)
- Reactor Coolant Inventory and Purification System (RCI)
- Emergency Core Cooling System (ECC)
- NI Systems Responses to Transients/Design Basis Accidents (DBA)
- Summary



NI Systems Function Summary



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3



Overall NI Systems Safety Strategy

- RCS design minimizes both the probability and impact of design basis accidents
- Non-safety systems maintain RCS with safe operating envelope as first line of defense (defense in depth)
- A simple, passive safety system protects the reactor core in the event of a DBA

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 Simple, passive features protect the lower vessel and containment in the event of a severe accident



NI Systems Safety Strategy

Strategy	Design
RCS minimizes the probability and impact of design basis accidents	 Large integral NSSS Small penetrations – [•
Promote defense in depth	
Rely upon simple, passive safety features and capabilities	•
Provide protection from severe	•
accidents	
-	[CCI per Affidavit 4(a)-(d)]



Robust Defense-in-Depth Strategy

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Major Enhancements to NI Systems



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7



Major Enhancements to NI Systems(cont.)





RCS Features Minimize Design Basis Accident Probability and Consequences

- Large reactor coolant inventory
- Small RCS penetrations [



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Benefits of [

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

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



Reactor Coolant System (RCS) Functions and Key Features



Safety-Related RCS Functions

- Maintain reactor coolant pressure boundary integrity
- Transfer sufficient decay heat from the core via natural circulation
- Provide overpressure protection
- Vent non-condensable gases following severe accidents



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NonSafety-Related RCS Functions

Maintain forced circulation of reactor coolant

• Maintain a steam-water interface in pressurizer

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Reactor Coolant System Process Flow Diagram

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16

ASME Section III Subsection NB (Class 1) & Seismic Category I

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21







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- Pressurizer Safety Valves
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- LTOPs
 - Designed to ASME III ND-7000





Venting Non-Condensables Following Severe Accidents

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Venting Non-Condensables Following Severe Accidents





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Forced Circulation of Reactor Coolant

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mPower Forced Circulation of Reactor Coolant

- Reactor Coolant Pumps
 - 8 RCPs located around pressurizer
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- Pressurizer Heaters
 - [CCI per Affidavit 4(a)-(d)]
 - Proportional control

Proportional control

Pressurizer Spray

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34



Auxiliary Condenser System (CNX)


CNX Safety-Related Functions

Containment Isolation

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CNX Defense-In-Depth Related Functions





CNX Process Flow Diagram

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CNX Containment Isolation Valves

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CNX – Operation

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Reactor Coolant Inventory and Purification System (RCI)



RCI Safety Function

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- HPDHR
- [•
 - ► [CCI per Affidavit 4(a)-(d)]
 - High pressure decay heat removal

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RCI Defense in Depth Functions (cont.)

- LP RHR
- **Boron Injection** ۲

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44



RCI Nonsafety Functions



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RCI Process Flow Diagram





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RCI Defense in Depth Functions Boron Injection

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RCI Nonsafety Functions

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RCI Nonsafety Functions

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Emergency Core Cooling System (ECC)



Simplified Approach to Safety

- Reduced number of safety-related components
- Reduced quantity of high-pressure safety-related piping susceptible to pipe breaks
- Limited number of active valves required to perform safety functions (also simplifies control system)
- Simplified safety analysis



ECC Safety Functions

1) RCS Automatic Depressurization	3) Emergency Decay Heat Removal
2) Passive Core Cooling Injection	4) Long-Term Core Cooling

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1) RCS Automatic Depressurization

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1) RCS Automatic Depressurization (cont.)

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2) Passive Core Cooling Injection

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2) Passive Core Cooling Injection (cont.)

- Intermediate Pressurized Injection Tanks (IPITs)
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- Refueling Water Storage Tank [CCl per Affidavit 4(a)-(d)]





3) Emergency Decay Heat Removal

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3) Emergency Decay Heat Removal (cont.)

- The safety-related decay heat removal function is performed

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4) Long-Term Core Cooling

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Reactor Cavity Long-Term Recirculation

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NI Systems Responses to Transients/Accidents

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NI Systems Responses to Transients/Accidents

- Loss of heat sink
 - Loss of feedwater
 - Station blackout
- Loss of coolant
 - Break of a makeup or letdown line (low break)
 - Break of a vent line (high break)
- Backup shutdown capability


Loss of Feedwater -I

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Loss of Feedwater – [

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Loss of Feedwater – [

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Station Blackout – [

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Station Blackout – [

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Leak/Very Small Break – [

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Low Break - Isolate





High Break – [

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Backup Core Shutdown Capability

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Summary

Plant safety is enhanced by:

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