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Design & Manufacturing Complexities in SMR Technology

Regulatory Information Conference
March 14, 2012

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President & CEO
Generation mPower LLC

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Formal alliance between B&W Company and Bechtel Power Corporation
- Executed July 14, 2010
- Substantial commitment by B&W and Bechtel
- Platform for One-Stop Shop; Design/Licensing through Deployment

Develop and deploy, by 2020, an SMR that offers:
- ✓ Lower capital cost
- ✓ Schedule & cost certainty
- ✓ Competitive levelized cost of electricity (LCOE)

within the constraints of:
- Proven: GEN III+, established NRC regulation
- Safe: Robust margins, passive safety
- Practical: Standard fuel, construction and O&M
- Benign: below grade, small footprint, public acceptance

A "game changer" for the nuclear power plant industry

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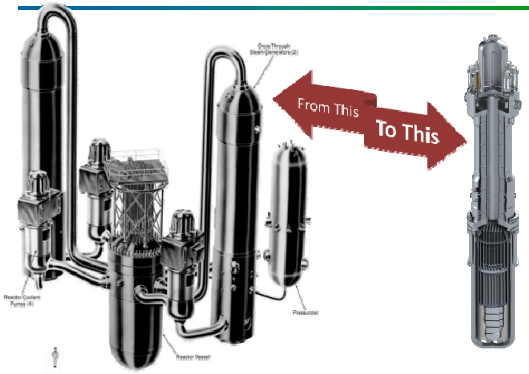
Major Complexity



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B&W mPower™ Reactor

Integral 530 MWt NSSS module
- Core, CRDMs, SG, Pressurizer, and Coolant Pumps
- No penetrations below top of core

Passively safe design philosophy
- Core remains covered during DBAs
- No active ECCS or safety-related AC power

4-Year fuel cycle with "standard" PWR fuel
- 69 fuel assemblies with <5% ^{235}U enrichment
- Burnable poisons, no chemical shim in coolant
- Full reactivity control using Control Rod Assemblies

1. Pressurizer
2. Once-Through Steam Generator
3. Feedwater Inlet / Steam Outlet
4. Reactor Coolant Pumps
5. Electro- Hydraulic CRDMs
6. Upper Internals
7. Reactor Core

Modular ALWR with best of Generation III+ features … low risk, low cost and passively safe

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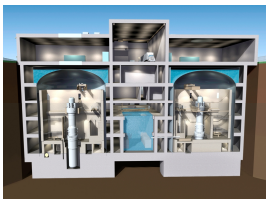
Nuclear Island Features

Nuclear Island fully underground
- Lower overall seismic response
- Greater protection from external threats

Passive safety systems
- Passive Cooling – AC power not required for safety functions
- 72-hour battery supply for monitoring/control
- No shared Safety Systems (Non-safety systems shared where possible)
- 14-day cooling

Enhanced spent fuel pool configuration
- 20-year storage capacity
- Underground, inside protected structure
- Large heat sink, 30+ days boil-off protection



Simple solution to plant safety and O&M functions

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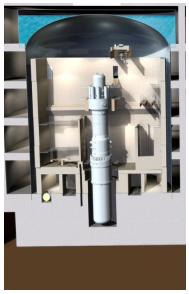
Key Challenges

Design and Licensing
- Risk-informing design and regulatory reviews
- "Right-sizing" staffing, source terms, EPZ, etc.
- Development testing – validation of design concepts

Manufacturing
- Optimization of capital investment and existing facilities to reach mass market adoption capacity
- N-qualified forging capability in North America – impacts long lead material procurement

Construction
- Below grade containment /shield building
- 36-month construction schedule



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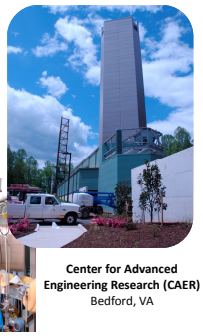
Development Testing Programs

Component Tests
- Reactor Coolant Pump
- CRDM
- Fuel Mechanical Testing
- CRDM/Fuel Integrated Test
- Fuel Critical Heat Flux
- Emergency High Pressure Condenser

Integrated Systems Test (IST)
- Heat Transfer Phenomena
- Steam Generator Performance
- LOCA Response
- Pressurizer Performance
- Reactor Control



Center for Advanced Engineering Research (CAER)
Bedford, VA

Greater than $100M Investment in Component Testing Program and IST Facility

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North American Fabrication Capability

Currently operating "N" stamp and fuel fabrication/manufacturing facilities for nuclear components:
- Heavy component fabrication – up to 1000 tons
  - Mt Vernon, Indiana
  - Barberton, Ohio
  - Cambridge, Ontario
- Control rod drive fabrication
  - Euclid, Ohio
- Fuel fabrication
  - Lynchburg, Virginia

Robust existing Approved Supplier List (ASL):
- Extensive experience with qualified vendors
- Regularly audited for compliance with relevant codes/standards
- Ongoing interface regarding required capacity & supply

B&W's fabrication facilities are unique in the North American nuclear industry

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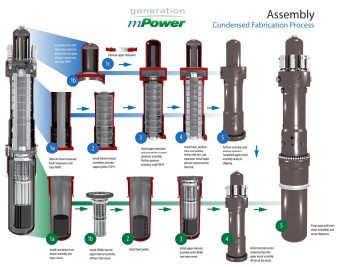
Process Development / Planning

GmP is positioned for unprecedented coordination between:
- sub-tier component suppliers
- fabrication plants
- field construction

Maximizing the benefits of modularity



Outstanding execution of SMR modularity will be the technology "advantage" that leverages the U.S. nuclear industry into a leading role internationally

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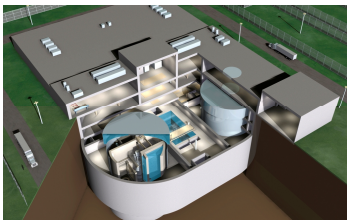
Nuclear Island Construction



Key Features:

- Advanced Simulation software
- Prefab, preassembly, modularization & off-site fab
- Advanced Construction Techniques
- Automation tools
- Tightly integrated team
  - Construction, Engineering, Licensing, Procurement, Contracts, Project Controls, Management

Integrated civil design and construction planning reduce quantities and schedule

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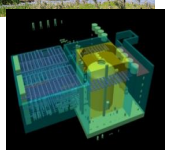
Modular Manufacturing & Construction Approach

Essential Attributes:

- Early implementation of modularity in the design process
  - Goal of 70% modular design and construction
- Ongoing integration of "area" and "component" modules, tightly integrated team
- Strong attention to tight tolerances, multiple interfaces, integration of vendors, and pre-planning
- Repeatability of processes using automation and re-usable tooling/equipment
- Maximizing component density and modular installation while ensuring optimal serviceability
- Robust fab-facility qualification of modules and low impact transportation to minimize field testing requirements



Maximizing modular attributes is the key to minimized field construction and lower SMR prices

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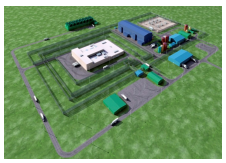
Summary

Develop and deploy commercially viable SMR by 2020

Design, Construction, and Operating Certainty

- GEN III+, existing NRC regulation
- Passive safety, robust margins
- Standard fuel, standard operations
- Comprehensive testing and verification program
- Proven manufacturing and construction capability
- Constructability / Modularity, 70% factory assembly



Business Benefits

- Three-year construction schedule, accelerated returns
- Incremental "buildout" matches retirements, load growth, local infrastructure
- Protection from natural gas price volatility and coal-related environmental issues
- Lower total cost, improved financing, less balance sheet stress
- Competitive LCOE

Basis for GmP and B&W mPower™ Reactor "Value Proposition"

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