Westinghouse Holistic Approach to the Nuclear Fuel Cycle

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Our Place In Nuclear Energy History

Exploration
1937-1956

Development
1951- present

Implementation
1957- present

Renaissance
2008 and Beyond

We are the leaders of a new global generation of clean nuclear energy technology!
Westinghouse in the Nuclear Industry

• Pioneered and engineered nuclear technology
• Supports all aspects of nuclear power: design, licensing, operations and plant maintenance
  – 60% of LWR’s in the United States are of Westinghouse design
  – 50% of the world’s LWR fleet are of Westinghouse design
• Provides over 50% of the nuclear fuel in the US, as well as a significant share of the world market
• Comprehensive understanding of technical, financial and regulatory aspects in every stage of the fuel cycle
Focused on operating plant success through reliable operation, maximized power output and better (shorter, more predictable) outages

A single-source fuel provider for PWR, BWR, VVER, AGR and Magnox reactors worldwide

Specializing in the technology of new nuclear power plants and component manufacturing

Instrumentation and control solutions to enhance the reliability of nuclear plant control and safety systems

All product lines will continue to team with Toshiba
The Westinghouse AP1000® Plant

Passive Safety Systems
Lessons learned from operating fleet applied to Gen III+ designs

- Safe Shutdown Condition within the first 72 hours of Station Blackout, without the need for AC or DC power or operator action
- With some operator action after 3 days, passive plants continue to maintain reactor core cooling and Spent Fuel Pool cooling indefinitely

Provides superior coping capabilities as well as significantly reduced risk for core damage

AP1000® Plant Construction is underway
- In China, four AP1000® plants are under construction at the Sanmen and Haiyang Sites
- Plans to build many more in the coming years and decades
- Sanmen Unit 1 expected to come online in late 2013 timeframe
- Combined operating licenses for nuclear build at Vogtle and VC Summer plants
- 14 AP1000® reactors announced in the U.S.

Current Status of the AP1000® Unit under construction at the Sanmen site in China Summer 2012

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The Westinghouse SMR

Best opportunity for cost competitiveness
- Most power with the least material
- Fully modular design
- Plant modules are installed, not constructed
- Rail and truck transportable

Highest levels of safety with fewer accident scenarios
- 7 days of passive heat removal with onsite inventory, assuming complete loss of AC power
- 100% reliance on natural forces

225+ MWe capacity
- All the advancements of the AP1000® reactor
- An integral, standalone PWR
- Compact design, proven components

Speed to market
- Proven ability to design, license & deploy reactors
- Existing supply chain, technical skills & licensed technologies
- Eliminates supply chain bottlenecks
- Leveraging AP1000® plant experience and lessons learned
Westinghouse continues to advance products and services, both near- and long-term

- Innovative new service offerings to utilities (e.g., Underwater Laser-Based Welding)
- Advanced fuel development (AXIOM cladding; improved fuel materials; exploration of new fuel and cladding materials: e.g., Leader of one Accident-Tolerant Fuel project funded by DOE-NE)
- An Industry leader of the Consortium for the Advanced Simulation of LWRs (CASL) — next generation of multi-physics core analysis tools
- Continuous improvement of Spent fuel services

Our Innovation path is driven by the current and evolving needs of our customers
Current Fuel Cycle

• Once-through irradiation with fuel discharge
  – Used fuel cooled in pools and then moved to dry casks
  – Poor fuel resource utilization compared to other fuel cycle options, but optimum solution with cheap uranium resources
  – Ultimately would entail final disposal
  – Perceived threats from long-lived actinides

• Pu-recycle in MOX is also pursued
  • improvement in fuel resource utilization
  • requires additional infrastructure
  • partially addresses the long-lived actinides
Historical “Advanced” Fuel Cycle options

• Previous fuel cycle alternatives driven by the **forecasted diminution of U resources**
  – Fast spectrum reactor (EBR-II, LMFBR, FFTF, etc.)
  – Thermal Breeders Thorium-based reactors (MSBR, Shippingport Breeder) also pursued to a more limited extent

• Recent **emphasis on waste management issues** has resulted in the formulation of alternate closed fuel cycles
  – Actinides recovered and recycled to minimize long-lived components to be disposed
Closing the fuel cycle

• Fast Spectrum Reactors can bring increased sustainability and potential back end storage improvement
  – Dramatically expanded fuel resource utilization
  – Recycle actinides in discharged Used Nuclear Fuel (UNF)
    ➢ Worth another look?

• Issues/Concerns
  – Cost (Development, Capital, Policy, Licensing, . . .)
  – Commercial viability
  – Infrastructure risks (technical, programmatic, health)

• Notional Alternatives to Fast Reactors
  ➢ Do we need another paper reactor?
Westinghouse Ideal Final Result:

A fuel cycle that is *environmentally responsible* and *commercially viable*

- Encompasses the **entire** cycle
  - Front End, Reactors, Back End
- Addresses National and International Policy
- Acknowledges public concerns
- Recognizes commercial viability requirements

*Has sustained national direction and support and clear objectives*
Industry Needs National Direction

• Cannot be a “trickle down” issue solved only by vendors
• Policies must withstand multiple administrations
• International collaboration is fundamental
• U.S. government support is required for...
  – storage and processing demonstration projects, including final repository
  – University and lab support to develop needed transformational technologies and systems
  – Coherent, sustained effort that will be required to produce results
What must drive nuclear energy policy prioritization?

• Energy security
• Carbon footprint control, environmental concerns
• Operational Safety
• Overall Public Health
• Economics
• Proliferation Resistance
• Waste Disposal/Storage
• Sustainability
• Other?
The Conversation

- Led by the US DOE, aimed toward decisions, demonstrating results, **producing a plan of action** for commercialization
- Guided and supported by the nuclear industry – utilities and vendors
- Reflects accountability to the public as stakeholders and **the ultimate customer**

Westinghouse is eager to participate in this discussion with utilities, other vendors and the DOE
Thank you very much.

Questions?
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