Global Westinghouse Spent Fuel Programs and Experience

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Outline

• Westinghouse Information and Update

• Global Decontamination, Decommissioning, Remediation and Waste Management overview

• Defueling Services

• Interim Spent Fuel Storage Facilities

• Conclusions
Westinghouse Group

- Around 10,000 employees globally
- Customer Focused Business Units:
  - Americas Operating Plant Services
  - EMEA Operating Plant Services
  - Asia Region
  - Plant Solutions
- More than 50 locations in 17 countries
- Headquartered in Cranberry Township, Pennsylvania, USA
- Acquisition by Brookfield Business Partners L.P. completed Aug 2018

- Westinghouse technology is the basis for nearly 50 percent of nuclear power plants operating worldwide!
- Operational Model: **Global Technology with Local Implementation**
Brookfield

- Manages over $265 billion of real assets focused on energy, real estate, infrastructure, renewable power, industrials and services
- Employs 700+ investment professionals
- Operates in 30 countries with 70,000 operating employees
- 115-year history of owning and operating real assets

Brookfield Place, New York, NY

www.brookfield.com
Focus on Westinghouse Customers

Operating Plant Services
- Sales & Marketing
- Delivery
- Field Services
- Regulatory Affairs

Plant Solutions
- New Plants
- Government Services
- Decontamination, Decommissioning, Remediation and Waste Management (DDR&WM)

Global Operations Services
- Nuclear Fuel
- Engineering Services
- Supply Chain
- I&C
- Components & Manufacturing
From Shutdown to Green Field

DDR&WM
- Global organization within Westinghouse focused specifically on back end of the nuclear cycle
- Holistic view of the back-end – part of the nuclear plant life cycle
- Includes all aspects from D&D planning to site clearance and remediation
- Today’s focus – Spent Fuel
From Shutdown to Green Field
Defueling Services

- Core loading & unloading
- **Spent fuel assemblies inspection and repair**
- Delivery/modifications of cranes and fuel handling machines
- **Pool-to-Pad spent fuel services**
- Spent fuel storage and transportation
- **Containers for failed fuel rods** ("Quiver" & SFR)
- ROV for Spent Fuel pool cleaning
- Spent Fuel pool cooling systems
- Training centers
Spent Fuel Management

- Westinghouse has extensive current expertise and capability in management of spent nuclear fuel
  - Spent fuel characterization, inspection, categorization, and repair
  - Damaged spent fuel management
  - Spent fuel management software
  - Spent fuel dry storage planning and implementation
  - Spent fuel dry cask loading services
  - Canister closure welding using state-of-the-art welding system
  - Dry storage facility and expansion, and plant crane mods

- Westinghouse has extensive historical experience in developing, licensing and delivering spent fuel storage systems and transportation packaging

- Westinghouse is uniquely qualified to develop state-of-the-art spent fuel management systems

Spent fuel management is a Westinghouse core competency
Containers for Transport and Storage of Damaged Fuel Rods

Purpose

• Storage of leaking fuel rods and fuel rod fragments leak-tight in a fuel pool
• Preparation for gas-tight transport to final storage
• Preparation for final storage

Benefits

• Safe storage of leaking rods in fuel pools at nuclear power plants
• No special treatment of leaking fuel rods in final storage needed

Quiver
Dryable cask with positions for leaking fuel rods and single magazines

Single Fuel Rod (SFR) Capsulation
Dryable single rod capsule stored in magazine

Management of Defective Fuel Rods
From Shutdown to **Green Field**
Spent Fuel Intermediate Storage Facilities

• **Dry storage:**
  – Independent Spent Fuel Storage Installations (ISFSI): design, engineering, construction supervision
  – **ATC** – Centralized Interim Storage for Spent Fuel (Spain): Detailed facility design, licensing support, safety analysis report, construction supervision

• **Wet storage:**
  – **CLAB** – Central intermediate storage facility for spent fuel (Oskarshamn SE): design, licensing support, safety analysis report, equipment supply, commissioning and installation supervision
ATC – Centralized Interim Storage for Spent Fuel

Requirements

• Dry spent fuel process:
  – Passive cooling
  – HVAC dynamic confinement
  – Non-intact spent-fuel management
  – Harsh environment (temp., radiation)

• Canister remote welding & inspection
  – ASME code requirements
  – Harsh environment (temp., radiation)

• Future spent fuel recovery (design lifetime 100 y, operating lifetime 60 y)

• Severe design basis earthquake (soil-structure interaction models)

Vault Design

• 1440 wells in 6 vaults
• Well: 1m ø, 15 m height, SS
• 2 canisters in each well
• 5-6 PWR / 15 BWR fuel bundles in each canister
Conclusions

Westinghouse provides:

• **Global** experience as fuel supplier
• **Advanced Technologies** to cope with specialized services (e.g. interim storage of damaged Spent Fuel)
• **Interim Spent Fuel storage facilities** experience for dry and wet solutions
• **Large presence in Europe** from fuel manufacturing to interim storage

Westinghouse is using our expertise to perform Spent Fuel management system design and licensing worldwide