Westinghouse Nuclear Technology: Energizing the World

Alice Cunha da Silva

August 2018
SIEN
Rio de Janeiro, Brazil
Brookfield

- Approximately $250 billion under management globally
- 70,000 operating employees
- 700 investment professionals
- Over 30 countries
- 115 years investing in real assets

Brookfield Place, New York, NY

www.brookfield.com
Westinghouse Today: A Leading Position Across the Nuclear Value Chain

**New Projects Business**

**Development**
- New Plants Projects
- Nuclear Fuel
- Engineering Services
- Field Services & Modifications
- Components Manufacturing
- Instrumentation & Control (I&C)
- Decontamination, Decommissioning and Remediation (DDR)

**Global Products & Services**

**Description**
- Designs, develops, procures equipment for new plant projects
- Designs, manufactures, delivers PWR, BWR, AGR and VVER fuel globally
- Provides critical engineering design and analysis to enhance the safety, availability, and reliability of operating plants
- Delivers advanced products and services for complete outage support
- Manufactures specialized components for new and operating plants
- Engineers safety and non-safety, state-of-the-art instrumentation and control products and services
- Provides characterization, decontamination, segmentation, and production of waste treatment systems

**Adjacent Businesses**

- **Stone & Webster Non-Nuclear EPC and Plant Modifications**
  Provides engineering, procurement, construction for nuclear and non nuclear sites

- **Westinghouse Government Services**
  Provides engineering, site management and operations at US government nuclear sites

- **WECTEC Staffing Services**
AP1000 Plant Global Project Sites

- Six **AP1000** units under construction worldwide
  - Four units in China
  - Two in the United States

Photos © Georgia Power Company; South Carolina Electric & Gas Company; Sanmen Nuclear Power Company Ltd.; Shandong Nuclear Power Company Ltd. All rights reserved.
Sanmen Site Progress: Time Lapse View 2009 to 2018

Photos © Sanmen Nuclear Power Company Ltd.
Sanmen Unit 1 Nuclear Fuel Loading Complete

Sanmen 1 is comprised of 157 fuel assemblies with 264 fuel rods in each, totaling over 41,000 fuel rods overall. Regulatory reviews of the AP1000® unit took more than 700 person-years.

Operation of Sanmen 1 will avoid burning the equivalent of 16 million tons of coal in China during each 18-month operating cycle.

Each of the 157 fuel assemblies contain energy equivalent to burning more than 100,000 tons of coal.

The successful loading of the fuel assemblies into the reactor was the result of a total Westinghouse team effort, across the globe.

Sanmen 1 will be the first plant in the world to utilize passive safety technology while providing more than 100,000 homes with safe, reliable and clean energy.

Fuel load completed in four days.
Sanmen and Haiyang Updates

- **Sanmen 1**
  - Achieved initial criticality on June 21 and initial synchronization June 30

- **Haiyang 1**
  - Commenced initial fuel load on June 21 and next is initial criticality

- **Sanmen 2**
  - Commenced fuel load on July 5 and next is initial criticality

- **Haiyang 2**
  - Working towards initial fuel load

Aerial view of Sanmen site, courtesy of our customer SMNPC

Aerial view of Haiyang site, courtesy of our customer SDNPC
Westinghouse is Actively Present in all Nuclear Markets in Latin America

Argentina
- Atucha 1 inspection equipment
- Embalse Life Extension Program
- INVAP Engagement

Brazil
- Angra 1 OEM Services, I&C Modernization, Plant Life Extension Program
- Angra 2 Inspection Services
- INB Fuel Technology Transfer

Mexico
- Laguna Verde 1 and 2 Outage Support
- Steam Dryer Services
- SFPIIS, etc.
Energy Demand Per Capita

Source: World Bank 2013
Energy Demand Per Capita

Energy Use Per Capita

- Canada
- US
- France
- Germany
- Ireland
- UK
- Brazil
- China
- Bangladesh
- Eritrea

Source: World Bank 2013
What are the key challenges?

• Political stability
  – Needed for decisions to be made, Elections 2018

• Uncertainties in NPP program
  – Needed to be addressed to attract private investment

• Human Resources Development
  – Students need clarity of potential jobs

• Communication
  – Sector needs to improve
CNPE cria grupo para estudos de viabilidade da Usina Nuclear Angra 3

O Conselho Nacional de Política Energética (CNPE) instituiu um grupo de trabalho para realizar estudos e analisar a viabilidade da Usina Nuclear Angra 3. A Resolução foi publicada no Diário Oficial da União desta quarta-feira (18).

O grupo é formado pelos Ministérios de Minas e Energia, Fazenda e Planejamento, além do Gabinete de Segurança Institucional e Secretaria Especial do Programa de Parceria de Investimentos (PPI), vinculados à Presidência da República. Empresa de Pesquisa Energética, Eletrobras e Eletronuclear também participam do GT. O colegiado se reunirá a cada 15 dias e terá o prazo de 60 dias para concluir suas atividades, com possibilidade de prorrogação.
Economic Impact of Nuclear Power in the U.S.

- Sixty two nuclear plants comprising 99 reactors operate in the United States, representing over 100,000 megawatts (MW) of capacity and almost 800 million megawatt hours (MWh) of annual generation,
- Contributes approximately $60 billion annually to gross domestic product (GDP) ($103 billion annually in gross output).
- Accounts for about 475,000 full time jobs (direct and secondary).
- Helps keep electricity prices low – without nuclear generation, retail rates would be about 6% higher on average.
- Nuclear power is responsible for nearly $10 billion annually in additional federal tax revenues, and $2.2 billion in additional state tax revenues, because of the boost it gives to the economy.

Source: NEI
Technology Development

- Potential technology transfer to local markets
- Development of new suppliers – Security of Supply
- Manufacturing innovation
- Technical and Professional Development
Nuclear Energy and Air Pollution

- Nuclear prevents 573 million tons of carbon dioxide emissions, worth another $25 billion annually if valued at the federal government’s social cost of carbon estimate.

- Air pollution causes about 200,000 early deaths each year in the United States
  - Pollution from electricity generation still accounted for 52,000 premature deaths annually
  - Every dollar spent on air pollution improvements, we can get between a $4-$30 benefit in terms of reduced health impacts

Source: NEI
Accident Tolerant Fuel – The Future of Nuclear Fuel

EnCore™ Fuel
We're changing nuclear energy... again

Provides significantly increased safety margins in severe accident scenarios

The suite of EnCore Fuel products offers economic benefits of up to hundreds of millions of dollars

Accelerated delivery timeline

Superior design provides enhanced fuel cycle and plant economics

World's largest supplier of nuclear fuel with world-class partner network
A Reactor For A New Age

eVinci™ Micro Reactor
Ultimate Energy Solution for the Off-grid Customer

- Long-life nuclear battery eliminates fuel supply
- Affordable energy for remote communities and mines
- Enables Economic Development with abundant power
- Clean energy with low environmental impact
- Scalable power for complete energy needs
Summary

• Westinghouse continues to be a leader in the nuclear sector

• Westinghouse continues to be committed to the successful and safe reactor operations in Latin America
  – Capable of Supporting all Reactor Designs in the Region

• The AP1000 plant technology is the right size, it is passive, standardized and licensed

• Investing in innovation to drive future nuclear technologies

• Westinghouse Nuclear Technology and Engineering Development:
  – Driving to achieve the Nuclear Promise

Westinghouse: Partnering with our global Customers to provide safe, reliable, clean, competitive nuclear generation for years to come!
THANK YOU

Visit us at
http://www.WestinghouseNuclear.com