



# WESTINGHOUSE ELECTRIC COMPANY

## Innovating and Delivering for the Future of Nuclear Power

Terry Rudek – Vice President  
Engineered Systems & Solutions

# WESTINGHOUSE HISTORY



- Founded by George Westinghouse in 1886

Westinghouse established

**59**

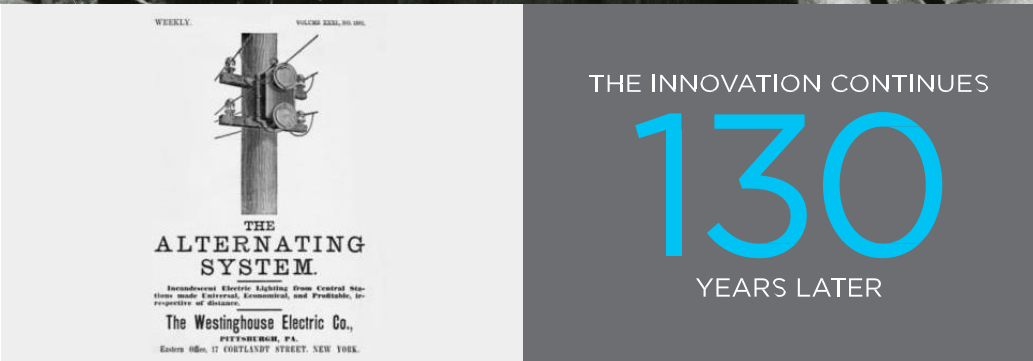
other companies

He received over

**360**

patents for his work

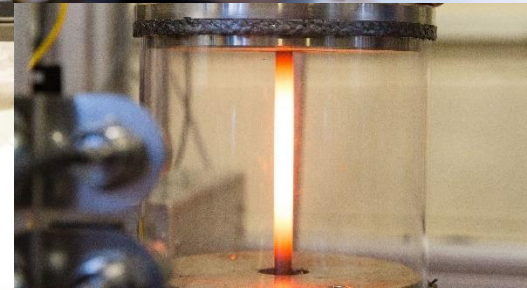
- Responsible for some of the world's greatest advances in energy technology
- World's first commercial pressurized water reactor (PWR) in 1957 in Shippingport, Pennsylvania, U.S.



# WESTINGHOUSE INNOVATION

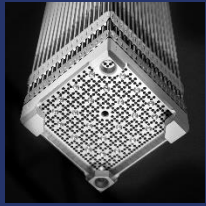
## Westinghouse continues to drive nuclear research & development:

- Focused on technology exploration and development to deliver value for our customers and enable Westinghouse growth
- A broad portfolio of commercially driven innovation projects
- Works across the global Westinghouse organization and with our industry partners to develop products and services for both future and existing clean energy markets





# COMPREHENSIVE PORTFOLIO OF PRODUCTS & SERVICES



Nuclear Fuel



Instrumentation and Control



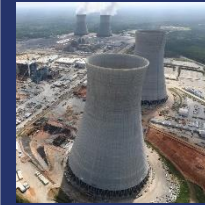
Staffing Services



Components and Manufacturing



Field Services and Plant Modifications



New Plants



Engineering Services



Decontamination & Decommissioning Solutions



Stone & Webster

# Multiple Paths for Nuclear Power's Future

## Commercial Nuclear Power Solutions Need to be Adaptable

- There is an increasing desire to look for smaller power plants as a solution
  - SMRs
  - Micro-Reactors
- Large new power plants like AP1000 still have place in meeting electricity demands

### AP1000® Plant



### eVinci™ Micro-Reactor



### Small Modular Reactor

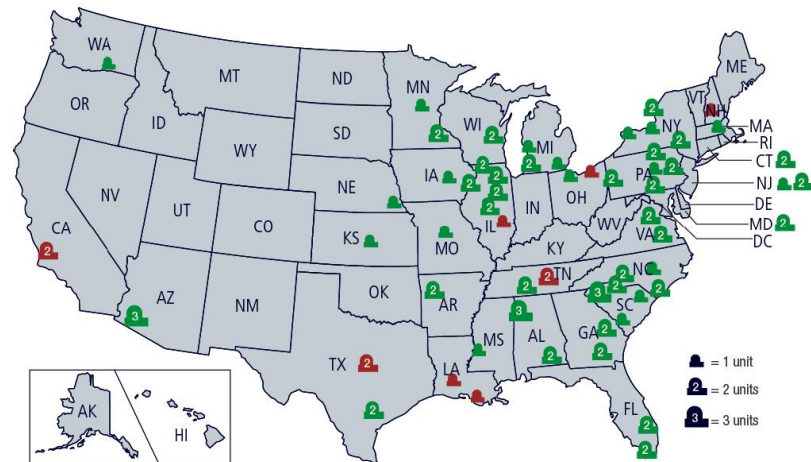


# Multiple Paths for Nuclear Power's Future

## Commercial Nuclear Power Solutions Need to be Adaptable

- Asset preservation through license renewal and long-term operations (LTO)
  - For example, in the US 87 of the 98 currently operating plants have been granted license renewals (40 to 60 years)
  - Subsequent License Renewal (SLR) applications have now been submitted (60 to 80 years)

### License Renewals Granted for Operating Nuclear Power Reactors



Licensed to Operate (98)

▲ Original License (11) ▲ License Renewal Granted (87)

Note: The NRC has issued a total of 91 license renewals; four of these units have permanently shut down. Data are as of September 2018. For the most recent information, go to the Dataset Index Web page at <https://www.nrc.gov/reading-rm/doc-collections/datasets/>.

U.S. NRC  
United States Nuclear Regulatory Commission  
Protecting People and the Environment  
Data as of September 2018

Source – US NRC Website



# AP1000<sup>®</sup> Plant

## Completed Westinghouse AP1000<sup>®</sup> Reactors

In early 2019, Westinghouse completed four AP1000 nuclear power plants at the Sanmen and Haiyang, China sites.

Each site has two AP1000 units, all of which safely and successfully achieved commercial operation.



# AP1000<sup>®</sup> Plant

## New Plants

**The Westinghouse AP1000<sup>®</sup> plant, a Generation III+ two-loop pressurized water reactor (PWR), is considered the most advanced commercially available plant, offering an industry-leading design featuring passive safety systems.**

Westinghouse provides the development, licensing, detailed engineering, project management, component manufacturing and startup support for new nuclear power plants.



Westinghouse currently has two AP1000<sup>®</sup> units progressing through construction at the Alvin W. Vogtle Electric Generating Plant near Waynesboro, Georgia, U.S.

Vogtle Site, Georgia, U.S.  
Image courtesy of Southern Nuclear

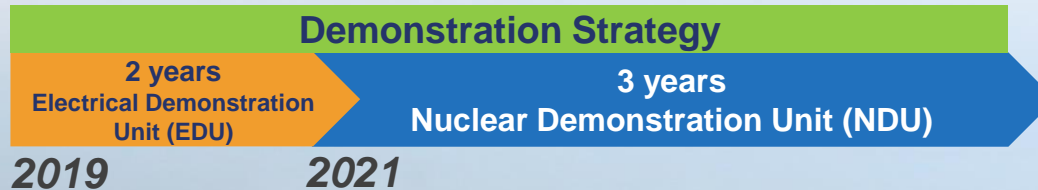




# Westinghouse eVinci™ Micro Reactor

## Product attributes:

- Combined heat & power: 0.2-5 MWe, up to 600°C
- Transportable energy generator
- Fully factory built, fueled and assembled
- Up to 10-year life
- < 1 month onsite installation
- Inherent safety
- High proliferation resistance
- Physics-based with no operator action or mechanical actuations
- Autonomous load-follow capability
- Heat pipe technology
- Solid monolithic core block
- Minimal moving parts
- Greenfield decommissioning



# LWR-SMR

- Westinghouse, EDF, & CEA signed a Framework Agreement for SMR Collaboration at IAEA General Conference
  - Agreement signed by each party's chief executive
  - Aligns support from French and US Governments
- Additional French partners, TechnicAtome & Naval Group, are supporting the collaboration



 <p><b>Extensive Nuclear New Build Delivery Experience</b></p> 	 <p><b>Established Innovators</b></p> 	 <p><b>Proven Licensed Technologies</b></p> 	 <p><b>Lessons Learned from Recent New Build Experience</b></p> 	 <p><b>Integrated Plant Operations Expertise</b></p> 	 <p><b>Licensing Excellence</b></p> 
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Drives Delivery Certainty and Integration for Long-Term Operational Success



# Long-Term Operations and License Extension

Years of Operation



<b>License Extension</b>		APPLICATION		APPLICATION				
			PSR	PSR	PSR	PSR	PSR	
<b>Plant Asset Management</b>	RCP	SG	MRP-227	RCP				
		RVH	I&C NS SYSTEM	I&C SAFETY SYSTEMS				
		TURBINES	CAPSULES	TURBINES				
		GENERATORS		GENERATORS				
		FEEDWATER HTRS		FEEDWATER HTRS				
	INSPECTIONS							
	MONITORING							
<b>Workforce Optimization &amp; Management</b>	WORKFORCE OPTIONS – CO-SOURCE, DIGITIZATION, PROCESS INNOVATION, SMART SYS							
	TRAINING							
<b>Performance Improvement</b>	UPDATES	UPGRADES – SHUTDOWN SEAL, FMS, SIMPLIFIED RVH, UPFLOW CONVERSION						
	EFFICIENCY IMPROVEMENTS – SIGMA SEAL, RISK -INFORMED OPERATIONS, SUBCRITICAL STARTUP TESTING							



# New Nuclear Horizons

- ***INAC's theme "New Nuclear Horizons: Fueling our Future" is very appropriate for Brazil at this time***
  - **Angra 1 has 35 years of operation and planning to extend its operating license to 2044**
  - **Angra 3 completion is a Brazilian government priority**
  - **Brazil is seriously considering a long term energy plan that will add new nuclear power plants**

# Thank You