The Westinghouse AP1000® Plant: Providing a Proven and Affordable Power Supply for Bulgaria

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Outline

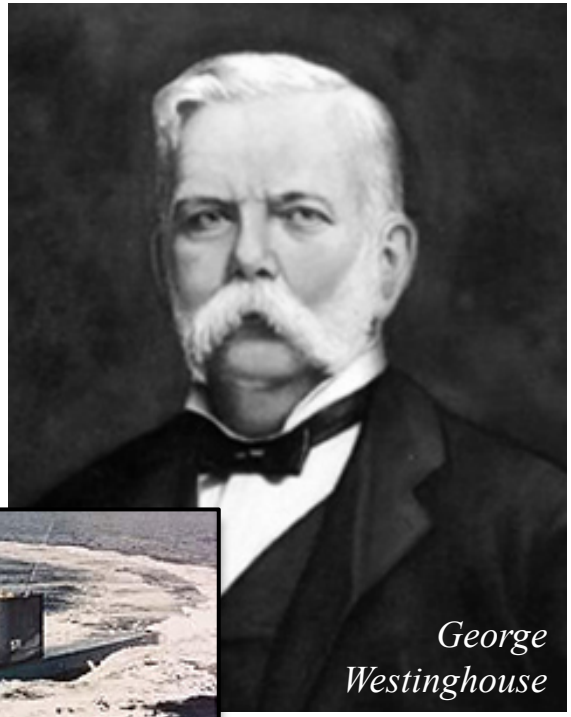
- Westinghouse Overview
- **AP1000®** Plant Features
  - Safe, Simple and Standardized
  - Operations & Maintenance (O&M)
  - Certainty, Opportunity
- **AP1000** Plant Construction Update
- United Kingdom and Bulgaria Project Updates

Westinghouse

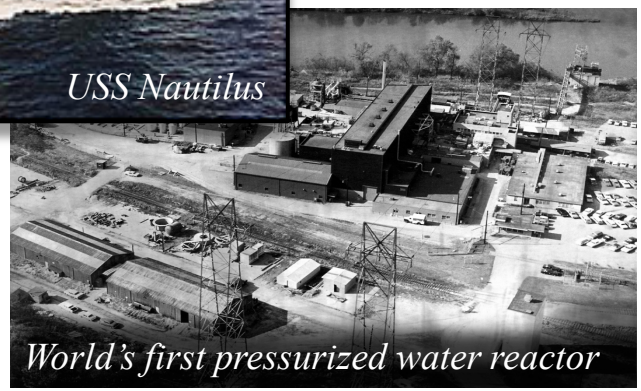
Westinghouse Electric Company

- Incorporated in 1886 by George Westinghouse
- Responsible for some of the world's most important achievements:
  - AC technology
  - 1st commercial radio broadcast
  - USS Nautilus
  - 1st camera on the moon
  - **Commercial nuclear power**

Vision: to be the customers' choice in supplying leading-edge nuclear technology to satisfy the world's growing demand for energy


George Westinghouse


USS Nautilus


World's first pressurized water reactor

Westinghouse

Broad Global Capabilities and Experience

Operating Plants Business

Delivers operating plant products and services, including global field services, instrumentation and control, welding and machining, and installation-related functions

New Plants & Major Projects

Delivers both new-plant projects and major projects for new and operating plants on a global basis

Decommissioning, Decontamination & Remediation

Deploys global technologies and forms local partnerships to carry out long-term projects

Nuclear Fuel & Manufacturing

Designs and delivers fuel for PWR, BWR, VVER and AGR reactors, and oversees manufacturing operations worldwide

Engineering Center of Excellence

Supports all product lines by driving common engineering capabilities and accelerating innovation

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Westinghouse technology is the basis for nearly 50 percent of nuclear power plants operating worldwide!

Westinghouse Locations

60+ sites worldwide!

*Westinghouse joint venture operations

Westinghouse in Europe

1962
first Pressurized Water Reactor (PWR) in Europe was built by Westinghouse

60%
of the nuclear power plants in the EU are based on Westinghouse technology

25
commercial reactors designed and supplied by Westinghouse across Europe

4,000
highly-skilled and trained people across Europe, plus an additional 1,500 contractors

- **54 out of the 58 French reactors** are based on Westinghouse licensed technology.
- **65 nuclear reactors in Europe** are currently fuelled by Westinghouse (PWR – including VVER, BWR, AGR and Magnox).
- We have operations in **10 European countries.**
- **Our AP1000® reactor is the safest, most efficient and reliable** design currently available in the worldwide marketplace.

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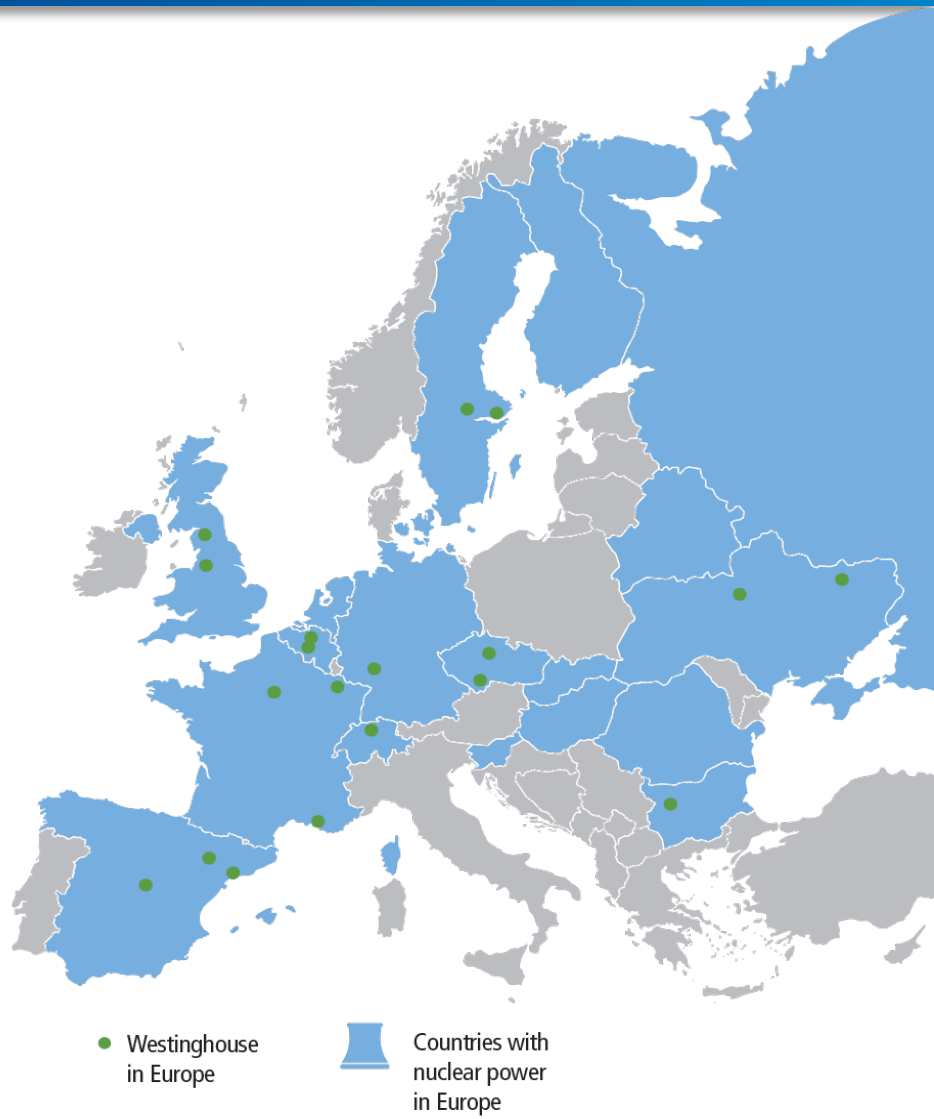

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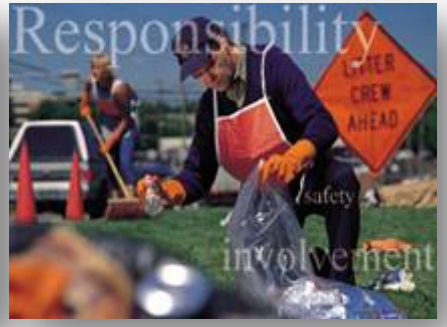
Solely Focused on Commercial Nuclear Technology

*Nearly **50 percent** of the nuclear power plants in operation worldwide are based on Westinghouse technology*



- Our newest design – the **AP1000** pressurized water reactor (PWR) – features innovative passive safety systems and proven technologies based on Westinghouse's 50+ years of experience

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AP1000 Plant: Safe, Simple and Standardized

***AP1000** Plant Site at Sanmen, China*

- **Passive safety** replaces mechanical and electrical systems – harnesses natural forces like gravity, convection and condensation to achieve safe shutdown
- **Strong licensing pedigree** based on reviews in multiple countries; first Generation III+ reactor to receive design certification from the U.S. NRC
- **Simplified design and modular construction** provide a plant that is easier and less expensive to build, operate and maintain

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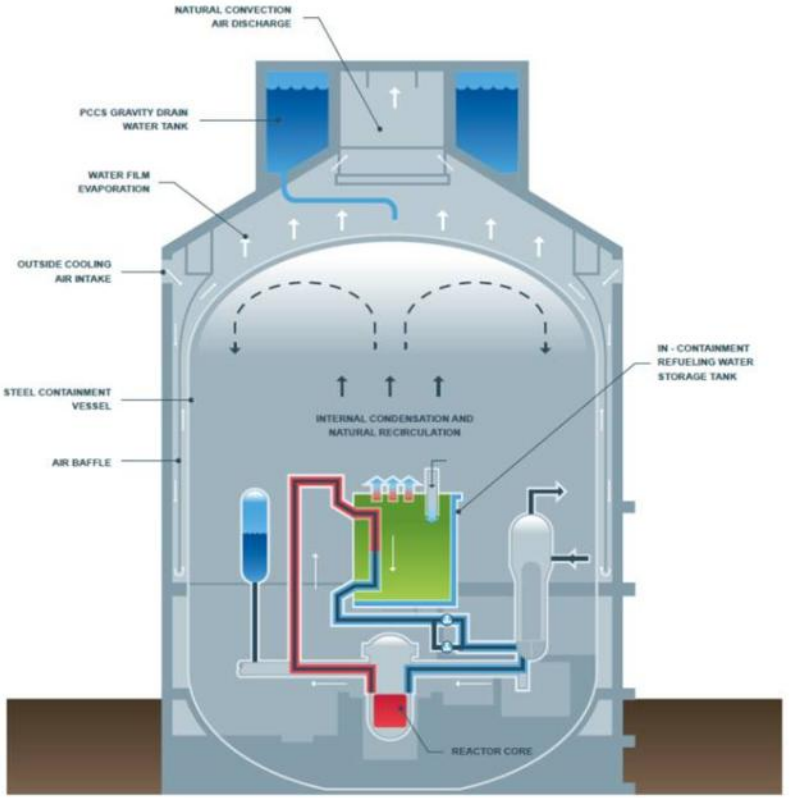
Major Safety Advancements of the **AP1000** Plant

Passive Safety-Related Systems

- Use “passive” processes only, no active pumps, diesels, ….
- One-time alignment of valves
- No support systems required after actuation
- Greatly reduced dependency on operator actions

Active Defense in Depth-Related Systems

- Reliably support normal operation
- Redundant equipment powered by onsite diesels
- Minimize challenges to passive safety systems
- Not necessary to mitigate design basis accidents



All Critical Station Blackout Response Features FAIL SAFE

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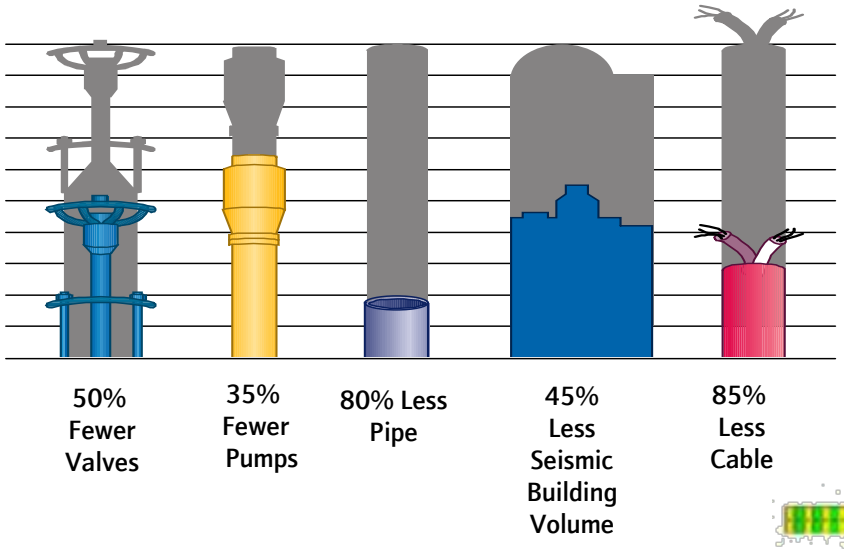
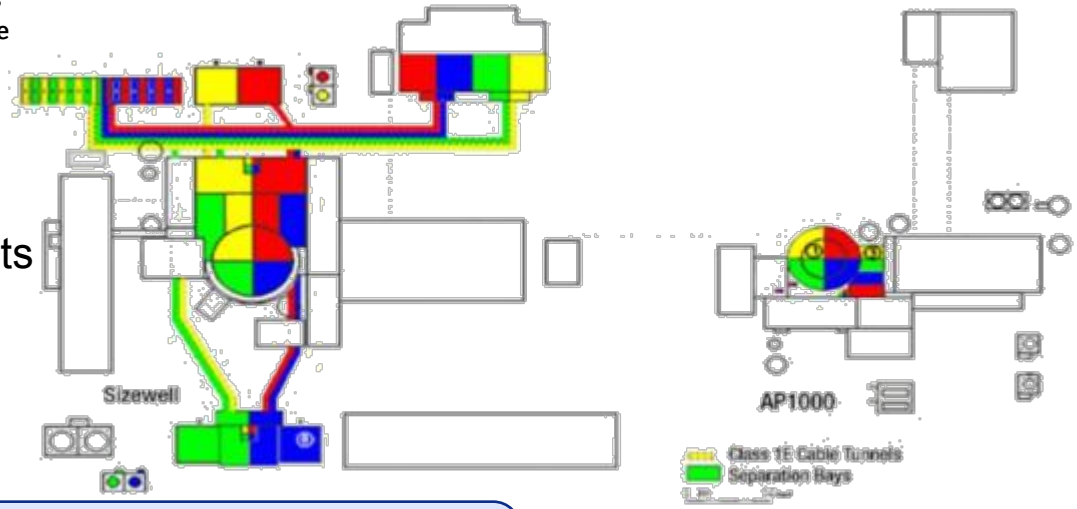
Simplification of Design



- Reduces seismic category 1 buildings
- 80% less concrete and rebar
- Safety rated equipment within nuclear island

- Eliminates components, reduces cost
- Reduces construction, O&M, D&D costs
- Localizes supply chain (greater percentage of non-safety related components)



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	Concrete, m^3	Rebar, metric tons
Active plant:	400,000	60,000
AP1000 plant:	<100,000	<12,000

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AP1000 Plant Offers Improved and More Efficient Operations

- Lower staffing requirements
- Lower annual O&M costs than benchmark LWRs
- Minimized waste generation
- Lower spare parts inventory requirements
- Projected long-term high availability factor
- Shorter outage periods
- Most equipment and commodities are non-nuclear safety class
- Excellent leak-free plant rate for Westinghouse-supplied fuel

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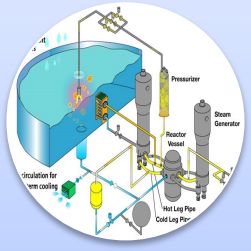
AP1000 Plant Sets the Standard in Design and Construction

Standard Design

lessons learned from initial units transferred to future units



Passive design

smaller footprint and less plant & equipment

Modular Design

improves QC and shortens construction schedule

Horizontal supply chain

reduces costs and eliminates shortages of key components

Experience from building **eight plants simultaneously** in China and the U.S. will provide valuable insights as additional plants are built across the world.

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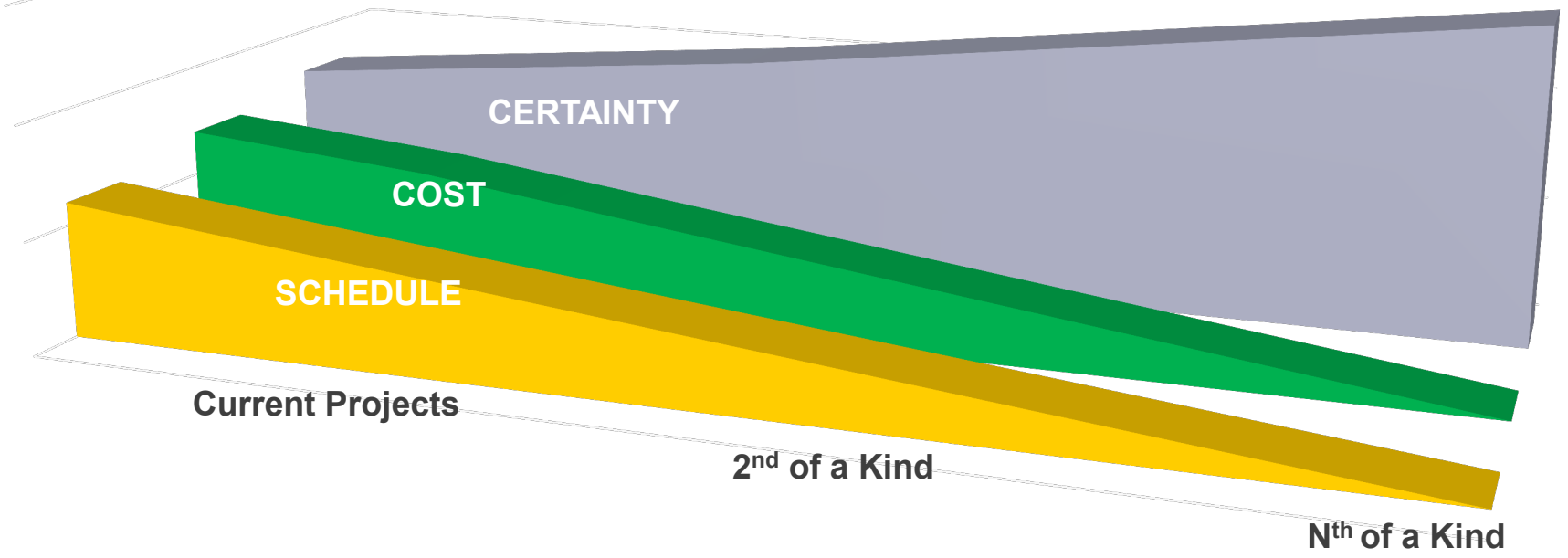
Westinghouse **AP1000** PWR

Continuous Improvement in Project and Product Delivery

AP1000 Plant Optimization Continuum



Achieving reduced schedule and cost, increased certainty through:

- Lessons Learned
- Optimization Concepts
- Best Practices
- Technical Advances

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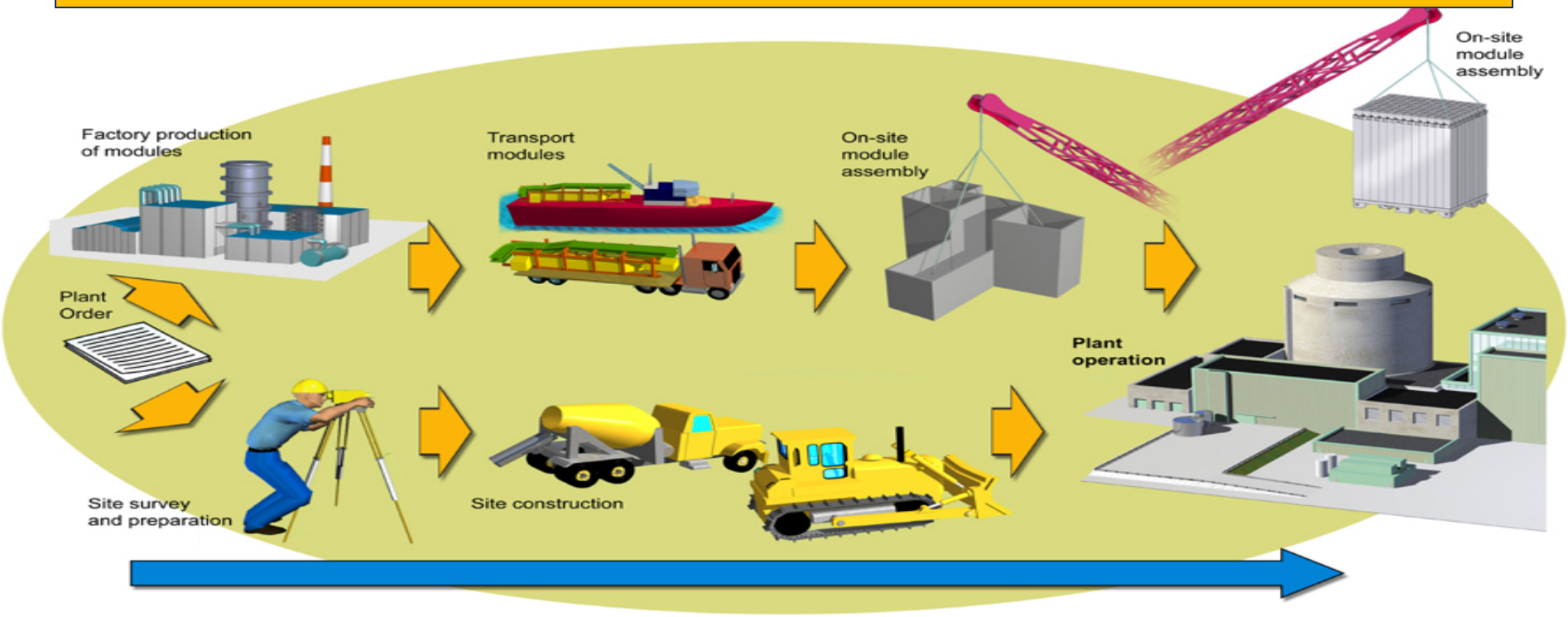
AP1000 Plant: Designed for Greater Certainty

Greater Project Certainty and Shorter Schedule

Modular construction means more work done in parallel



Shorter schedule – Increased safety – Improved quality

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Regulatory Certainty

- EUR confirms **AP1000** plant can be **successfully deployed** in Europe (May 2007)
- **AP1000** plant amended design **unanimously approved** by NRC (December 2011)
- UK interim Design **Acceptance Confirmation** (December 2011)
- Combined construction and operating licenses (COL) approved for Vogtle 3&4 site (**February 2012)** and V.C. Summer 2&3 site (**March 2012)**
- Undergone/undergoing **licensing review** in the Americas (Canada and U.S.), Europe (United Kingdom) and Asia (China)


The United States Nuclear Regulatory Commission certifies the amended

AP1000 Standard Design

as set forth in Appendix D of 10 CFR Part 52

Dated the 30th day of December, 2011

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AP1000 Plant Global Project Delivery

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

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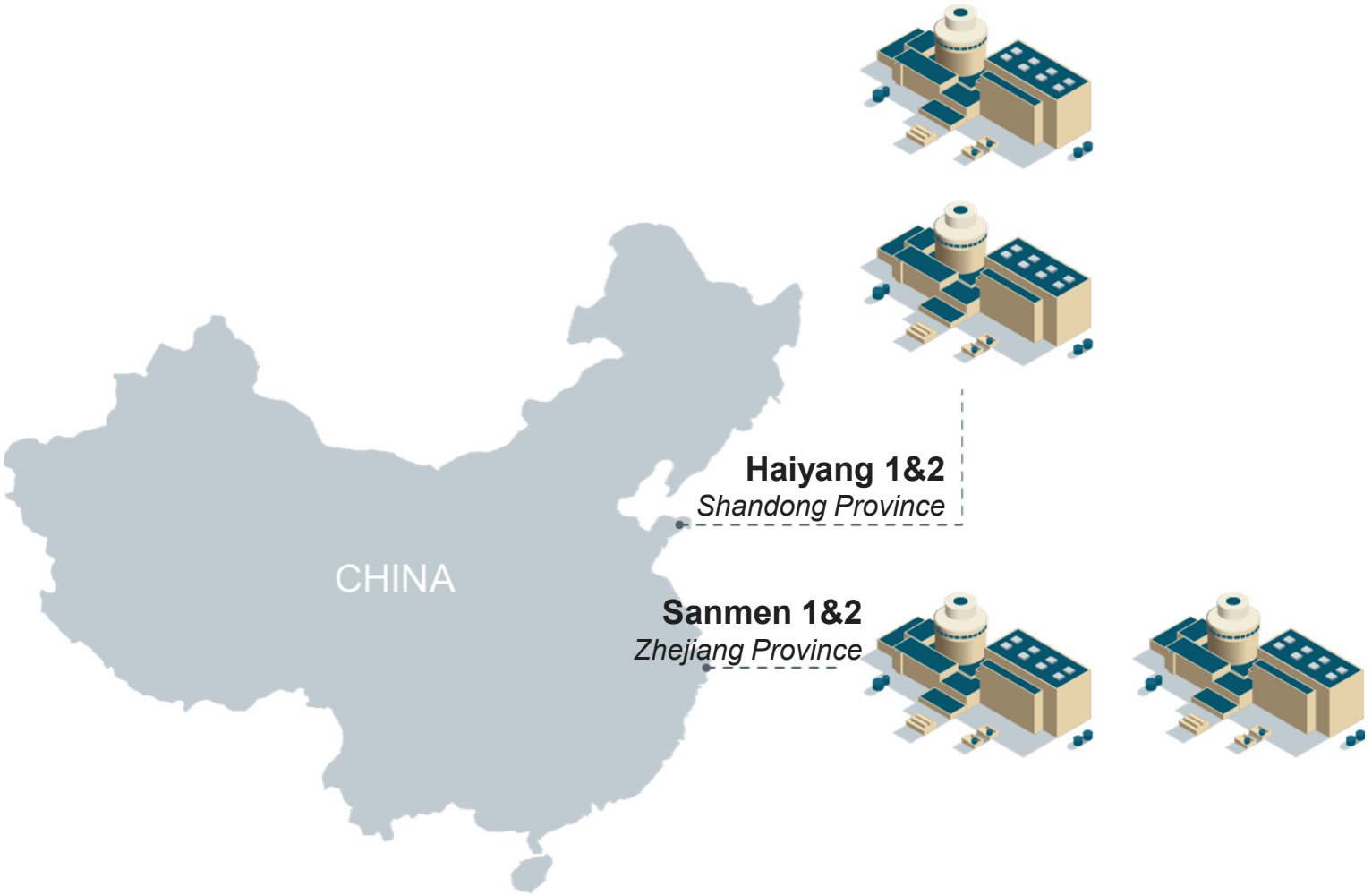
China **AP1000** Plant Projects



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China **AP1000** Plant Progress: Sanmen

Unit 1 View – December 2014

Unit 2 View – October 2014

Unit 1 CB20 Set – January 2014

Unit 1 Main Control Room – January 2014

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China **AP1000** Plant Progress: Haiyang

Units 1 and 2 View – October 2014

Unit 2 Reactor Vessel Lift – September 2014

Unit 1 Conical Roof Set – December 2013

Unit 1 CB20 Set – March 2014

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Progress of China Projects: Summary

- Major equipment delivered and installed at Sanmen Unit 1 and Haiyang Unit 1 includes:
  - Reactor Vessel
  - Steam Generators
  - Reactor Vessel Internals
  - Polar Crane
  - Integrated Head Package
- Shield Building Conical Roof and Passive Containment Cooling Water Tank set at Sanmen Unit 1 and Haiyang Unit 1
- Digital I&C turnover to Startup staff in progress
- Steam Generator Secondary Hydrostatic Test completed at Sanmen Unit 1
- Sanmen and Haiyang operators completed China NNSA reactor operator license exams
- Technology transfer well advanced

Sanmen Unit 1 – January 2015

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Haiyang Unit 1 – December 2014

Photo © Shandong Nuclear Power Company, Ltd. All rights reserved.

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Sanmen Site Progress: Time Lapse View *2009 to 2015*

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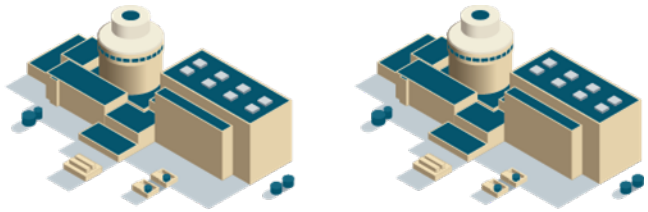
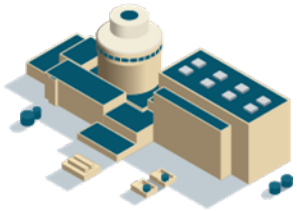
Photos © Sanmen Nuclear Power Company Ltd.

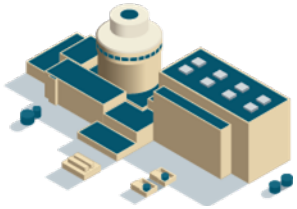
U.S. **AP1000** Plant Projects



V.C. Summer 2&3
Jenkinsville, South Carolina



Vogtle 3&4
Waynesboro, Georgia



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U.S. **AP1000** Plant Progress: Vogtle Site

Unit 3 Nuclear Island – February 2015

Unit 3 CA01 Module Assembly – December 2014

Unit 3 Turbine Island – July 2014

Unit 3 CV Lower Ring – October 2014

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U.S. **AP1000** Plant Progress: V.C. Summer Site

Unit 2 Steam Generator Delivery – January 2015

Unit 2 CA05 Module Set – December 2014

Unit 2 CA20 Lift – May 2014

Unit 2 CV Lower Ring Lift – June 2014

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Progress of U.S. Projects: Summary

- Nuclear Island basemat concrete pours completed for V.C. Summer Units 2&3; Vogtle Units 3&4
- Containment Vessel Bottom Head (CVBH) set in nuclear island for Vogtle Units 3&4; V.C. Summer Units 2&3
- CV first ring set for V.C. Summer Unit 2 and Vogtle Unit 3; fabrication of additional rings continues at both sites
- Component and module fabrication proceeding; major modules CA20 and CA05 set at Vogtle Unit 3 and V.C. Summer Unit 2
- Reactor Vessels delivered for initial units at each site; additional equipment and component deliveries continue to proceed

Vogtle Site View – January 2015

Photo © Georgia Power Company. All rights reserved.

V.C. Summer Site View – December 2014

Photo © South Carolina Electric & Gas Company. All rights reserved.

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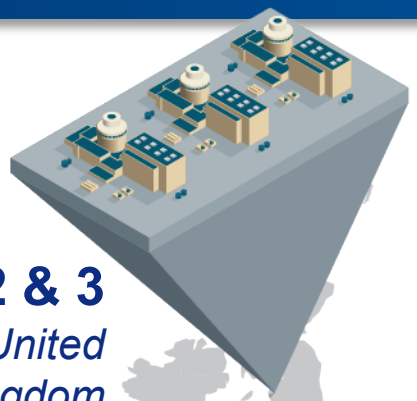
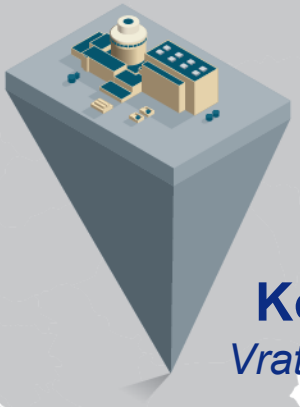


Moorside 1, 2 & 3
West Cumbria, United Kingdom



Kozloduy 7
Vratsa Province, Bulgaria

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Westinghouse **AP1000** PWR
Westinghouse New Build in the UK

- Toshiba and GDF SUEZ **complete** NuGeneration Ltd (NuGen) deal (30 June 2014).
- NuGen plans to build three **AP1000** reactors in West Cumbria (Moorside Project)
  - Delivering 3.4 GW of safe power at a competitive strike price, due to our modular design, fewer components and smaller footprint, enabling a shorter construction schedule.
  - First **AP1000** reactor targeted for operation in 2024 (each reactor will take approx. four years to build), due to our modular design, existing progress in Generic Design Assessment (GDA) and progress on site evaluation.

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Westinghouse **AP1000** PWR
Westinghouse New Build in the UK

- Providing nearly seven percent of UK's projected electricity requirements; delivering enough low-carbon electricity to power six million homes.
- Creating between 14,000 and 21,000 UK jobs (4,000 to 6,000 at peak construction) and reinvigorating the UK nuclear supply chain; creating sustainable, skilled manufacturing jobs.

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Westinghouse **AP1000** PWR
Westinghouse New Build in Bulgaria

- Kozloduy NPP and Westinghouse **sign** Kozloduy NPP - New Builds Shareholder Agreement (August 2014).
- Kozloduy NPP - New Builds, the project company established in 2012, plans to build one **AP1000** reactor at the Kozloduy site in northwest Bulgaria.
- Shareholder Agreement is substantive step in the project following a feasibility study under public tender to enter exclusive talks in December 2013:
  - **AP1000** reactor will baseload power that meets EU and Bulgarian requirements of energy security and diversification, competitive and low-carbon energy for the following 60 years.
  - At the height of construction, close to 3,500 local workers will be employed on site, with an additional 15,000 workers involved in the associated supply chain. Once the reactor is completed, its operation will require approximately 500 highly-skilled specialists.
  - **AP1000** PWR is designed to use local partners which meet the highest standards (western qualifications: ASME) and make Bulgarian industry more competitive domestically and internationally.

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Summary

- Westinghouse has a strong footprint on both sides of the Atlantic and is preparing for continued success in Europe with strong regional partners
- Positive support remains for new nuclear build
- The **AP1000** PWR:
  - features innovative passive safety systems
  - builds and improves upon established technology
  - saves money and time with a simplified plant design and an accelerated construction time period
- The **AP1000** reactor was developed to help reduce uncertainties for customers, and to provide a high degree of confidence that nuclear can be a good long-term investment
- Construction projects are progressing in China and the U.S.
- An **AP1000** reactor at Kozloduy will be an N^{th} of a kind that will benefit from continuous improvement in project and product delivery based on experience from building plants around the world (China, UK and the U.S.)

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The above illustration is an artist rendering of the **AP1000** PWR and may not depict actual design and layout.