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Westinghouse Small Modular Reactor Design and Application

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Canadian Nuclear Society
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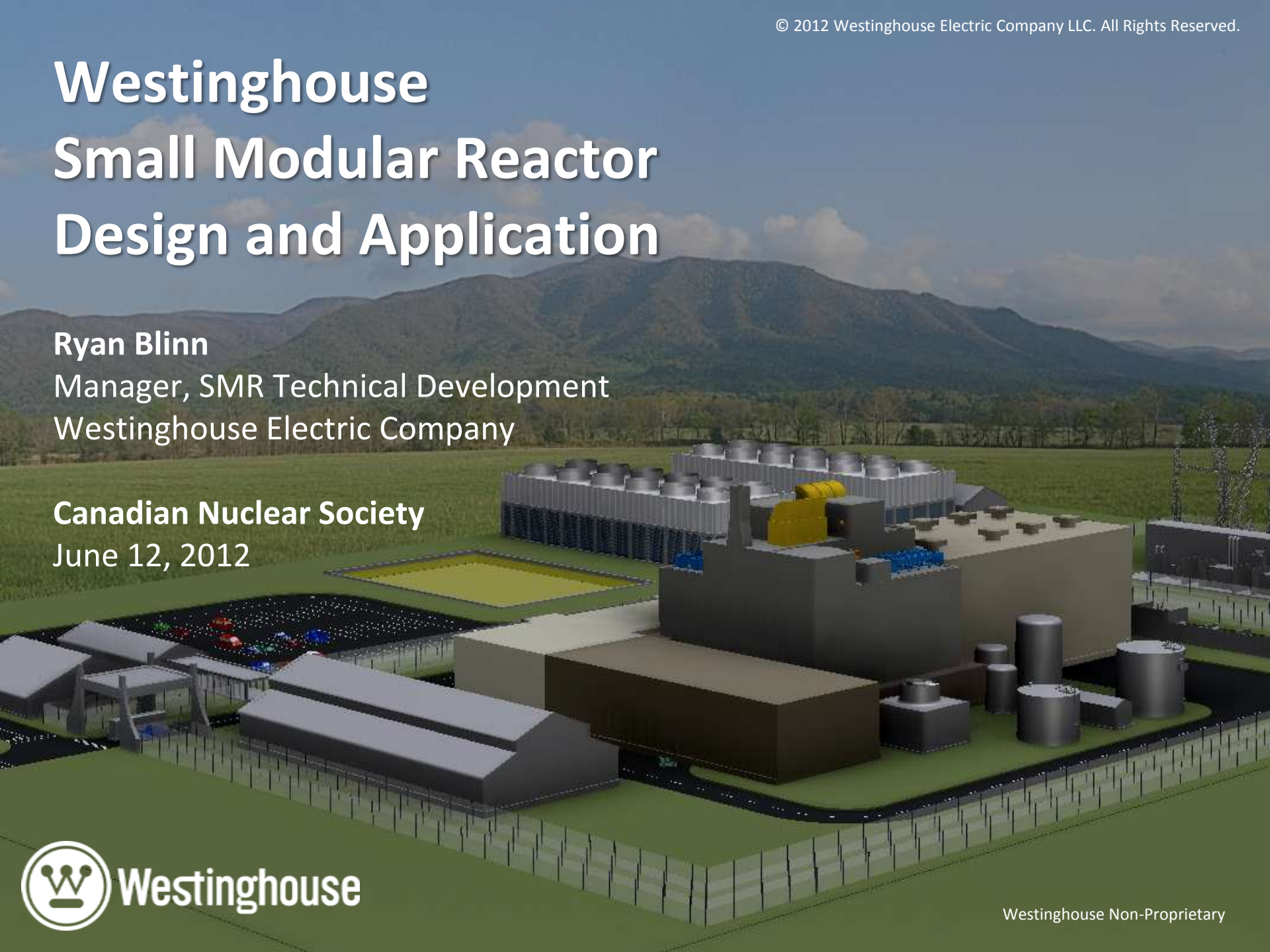

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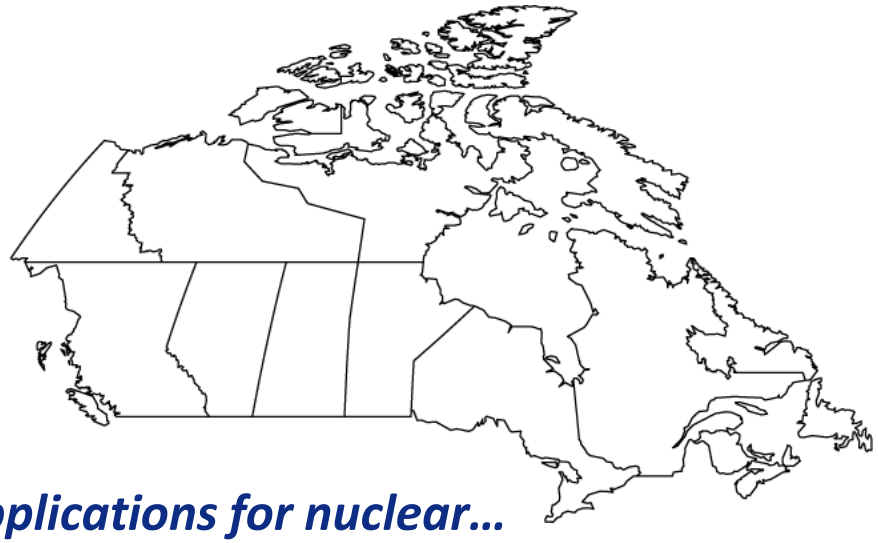
The Westinghouse Vision

Westinghouse will be the first to deploy a safe, economic SMR to meet the many needs of existing and new to nuclear customers

- **Working within constraints**
  - Land, grid, cooling water, financing, distributed service territory
- **Offering clean energy**
  - Offset owner costs for infrastructure development: land, cooling, T&D
  - Generation diversity
  - Operational flexibility
- **Providing project certainty**
  - Reduced licensing risk
  - Short-construction durations
  - Cost predictability and certainty



New applications for nuclear…

Aging Fossil Plants
District Heating
Remote Markets
Small Grid Markets
Desalination
Process Heat

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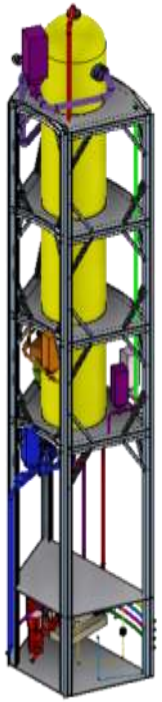
Westinghouse SMR Product Philosophy

Best opportunity for cost competitiveness

- Most power with the least amount of material
- Fully-modular design
- Plant modules that are installed, not constructed
- Rail & truck transportable

Speed to market

- Proven ability to design, license & deploy reactors
- Existing technical skills, licensed technologies & supply chain
- Designing to eliminate supply chain bottlenecks
- Leveraging **AP1000®** plant development and lessons learned



Westinghouse is leveraging its recent experience to achieve these goals with the SMR

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SMR Development & Licensing Collaboration

- **Westinghouse is partnered with the NexStart SMR Alliance to seek up to $452 million in U.S. Department of Energy funds targeted to aid the development of small modular reactors**

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Commercial Deployment in Canada

- **Market/Customer Base**
  - Ideal for the replacement of coal-fired generation baseload units
  - Applications in remote locations for electricity and process heat (e.g., oil sands)
- **Canadian Content**
  - Increased Westinghouse focus on Canadian market
    - Westinghouse Electric Canada, Inc. subsidiary formed earlier this year for Nuclear Services support and **AP1000** & SMR Business Development activities
  - $70+ million spent with Canadian suppliers over the past 5 years, increasing at ~10% annually – Buy Where We Build
- **Licensing the SMR in Canada**
  - Will build on licensing efforts of the **AP1000** with the CNSC
  - Commercial operation date for SMR in Canada – early 2020s

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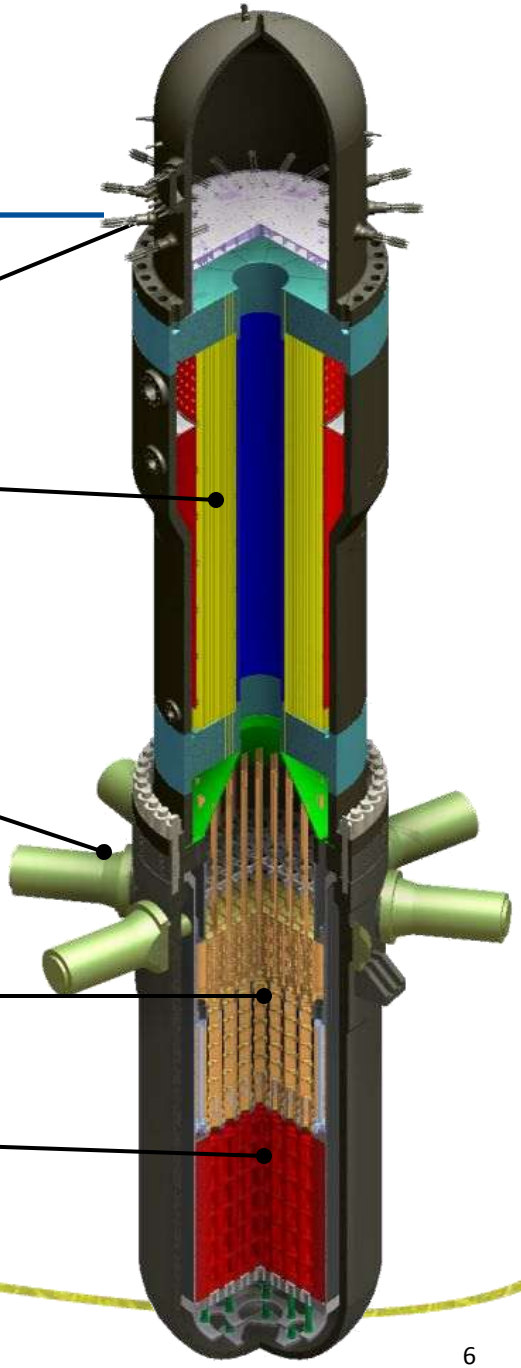
The Westinghouse SMR

- An integral PWR
- Innovative packaging of proven components
- The highest levels of safety with fewer accident scenarios
- Industry-proven system designs
- Compact reactor coolant system and containment
- An engineered solution for today's clean energy challenges

The Most Economic SMR Design



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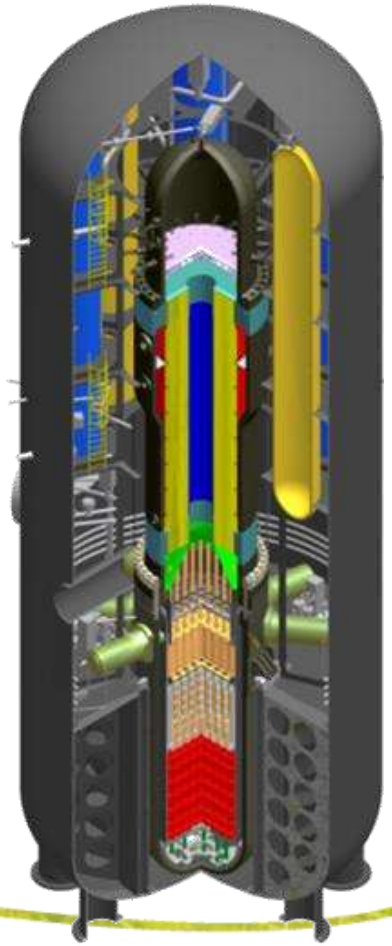
Westinghouse SMR Plant Design

- Single > 225 MWe reactor (standalone plant design)
- Fuel – Modification of standard Westinghouse product (17x17 RFA)
- Forced flow with 8 reactor coolant pumps
- Internal CRDMs
- Compact/high pressure containment vessel below grade
- Recirculating straight tube steam generator with steam drum location outside of the containment vessel
- 24-month cycle length
- Spent fuel pool below grade
- Load follow capability
- Total site area: 15 acres



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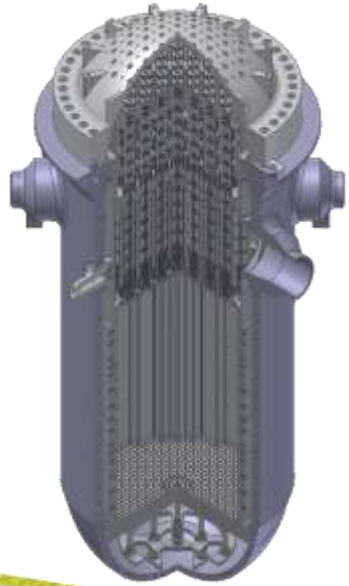
Existing Designs used in the SMR

- **Fuel Assemblies**
  - Based on existing Westinghouse design with decades of proven performance
- **Internal CRDMs**
  - Three-coil magnetic jack-based **AP1000** design with high-temperature modifications
- **Reactor Vessel Internals**
  - Referencing detailed designs from **AP1000** with addition of patented intermediate ring from previous small reactor programs



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Leveraging Passive Safety in our Design

- **7 Days of Passive Heat Removal with Onsite Inventory**
  - Capability to add additional water inventory for indefinite cooling
- **100% reliance on natural forces**
  - Evaporation, condensation, gravity

www.westinghousenuclear.com/smr

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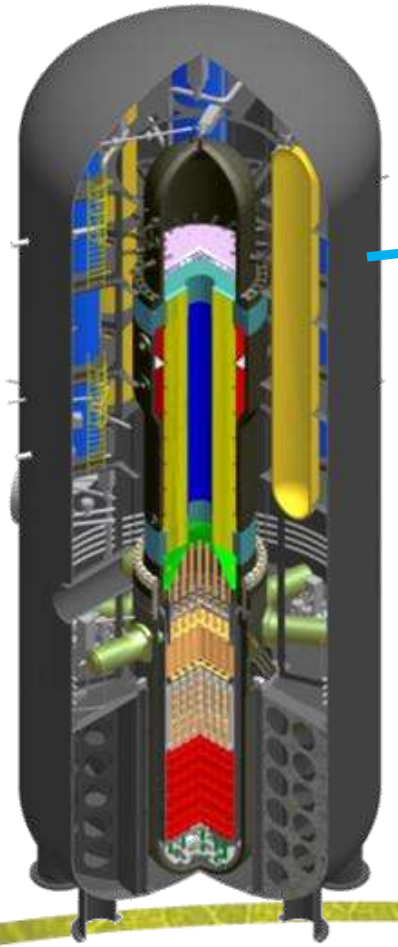
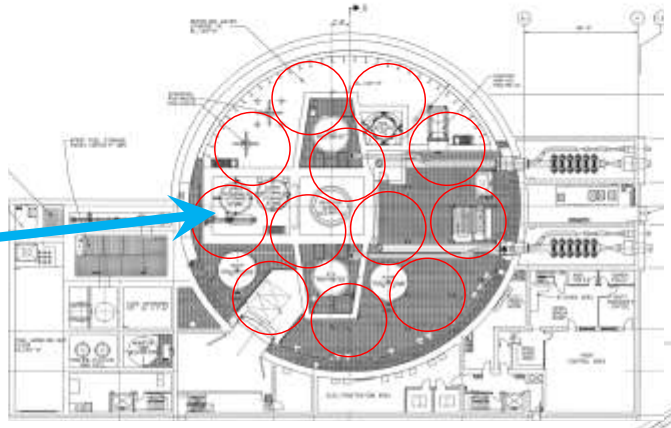
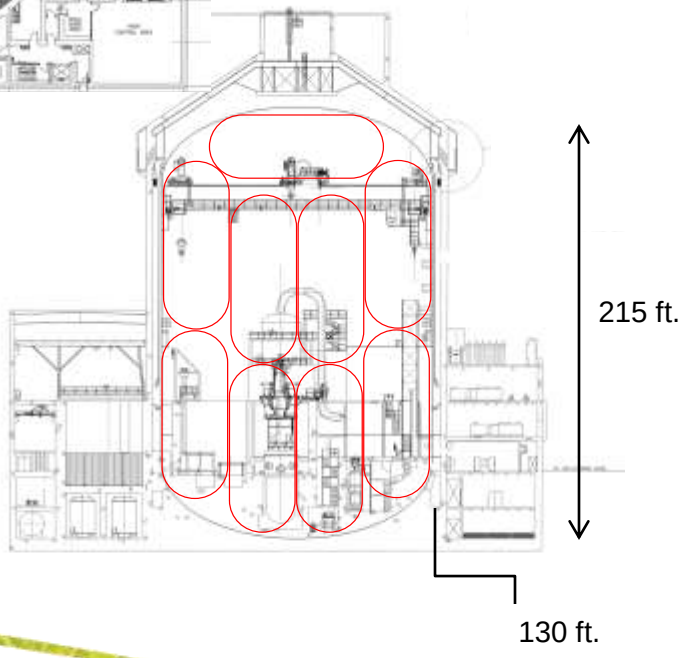
Driving Down Plant Costs

SMR



AP1000





25 Westinghouse SMR Containment Vessels fit in a single *AP1000®* Containment Vessel

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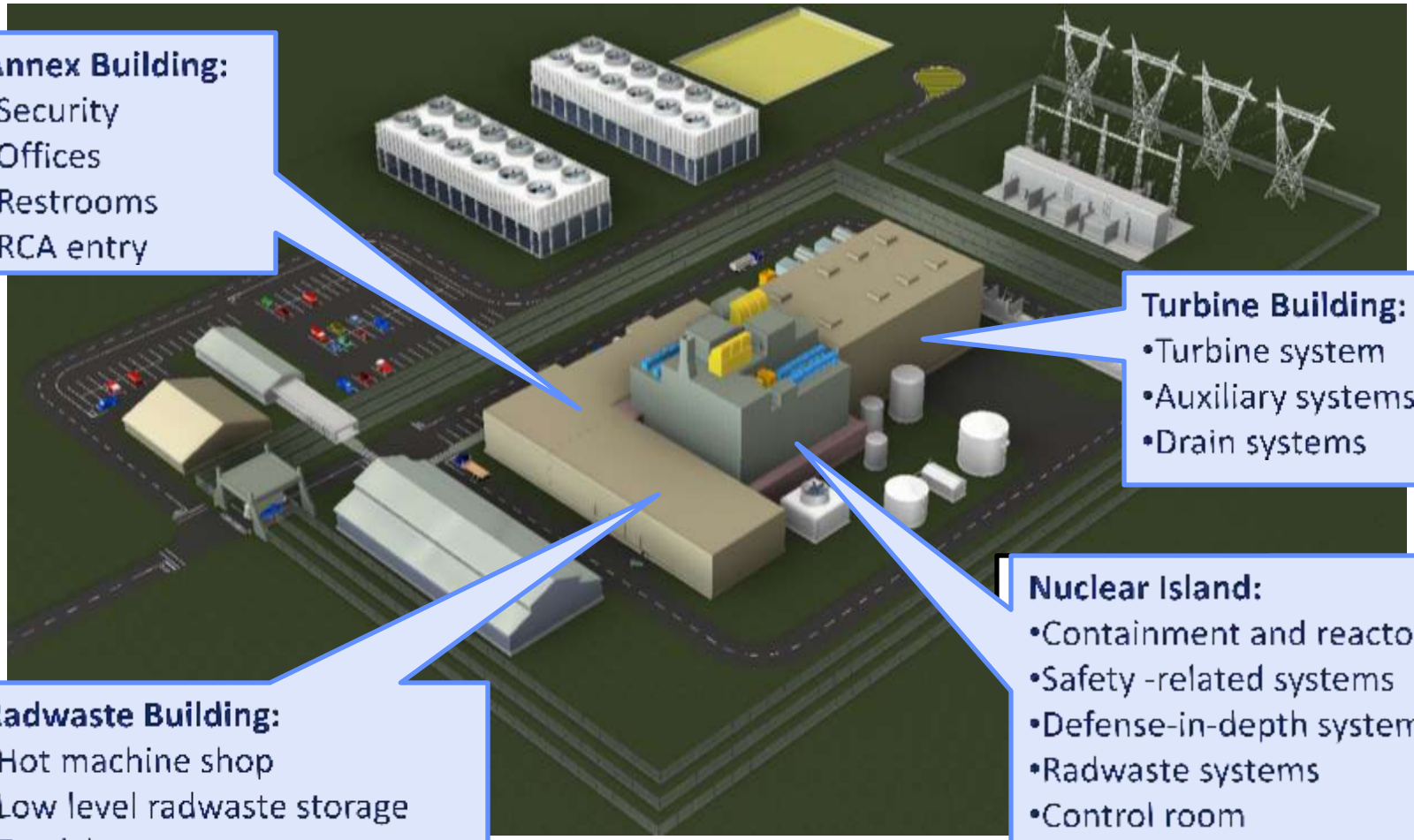
SMR Plant Layout

Site Requirement:
Less than 15 Acres



Annex Building:
- Security
- Offices
- Restrooms
- RCA entry

Turbine Building:
- Turbine system
- Auxiliary systems
- Drain systems

Nuclear Island:
- Containment and reactor
- Safety -related systems
- Defense-in-depth systems
- Radwaste systems
- Control room
- HVAC

Radwaste Building:
- Hot machine shop
- Low level radwaste storage
- Truck bay

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Westinghouse Project Certainty

- **Product Design**
  - Leveraging 50+ years of nuclear design & operating plant experience
  - Most power with the least amount of material
  - Simplified modular design with less on-site assembly
  - Shortened installation duration – 18-24 months
- **Licensing Experience**
  - 3 *certified* ALWR designs, licensed fuel designs
  - Regulatory requirements understood, multitude of licensed topical reports
  - Valued relationships with US NRC and CNSC
- **Project Implementation**
  - Continuous, successful reactor deployment experience
  - Established resources and organization for deployment

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Thank You!