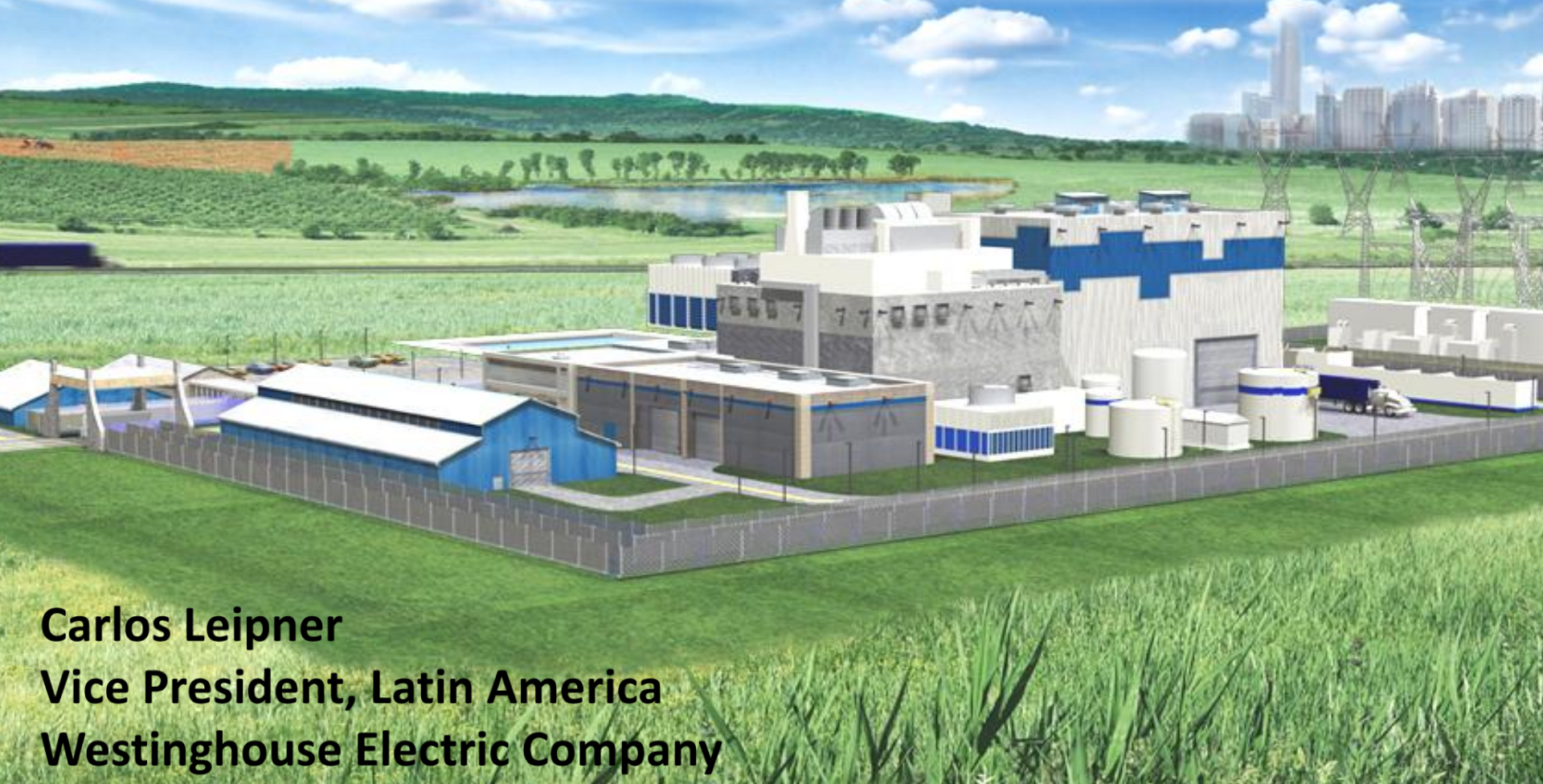


# Nuclear Power

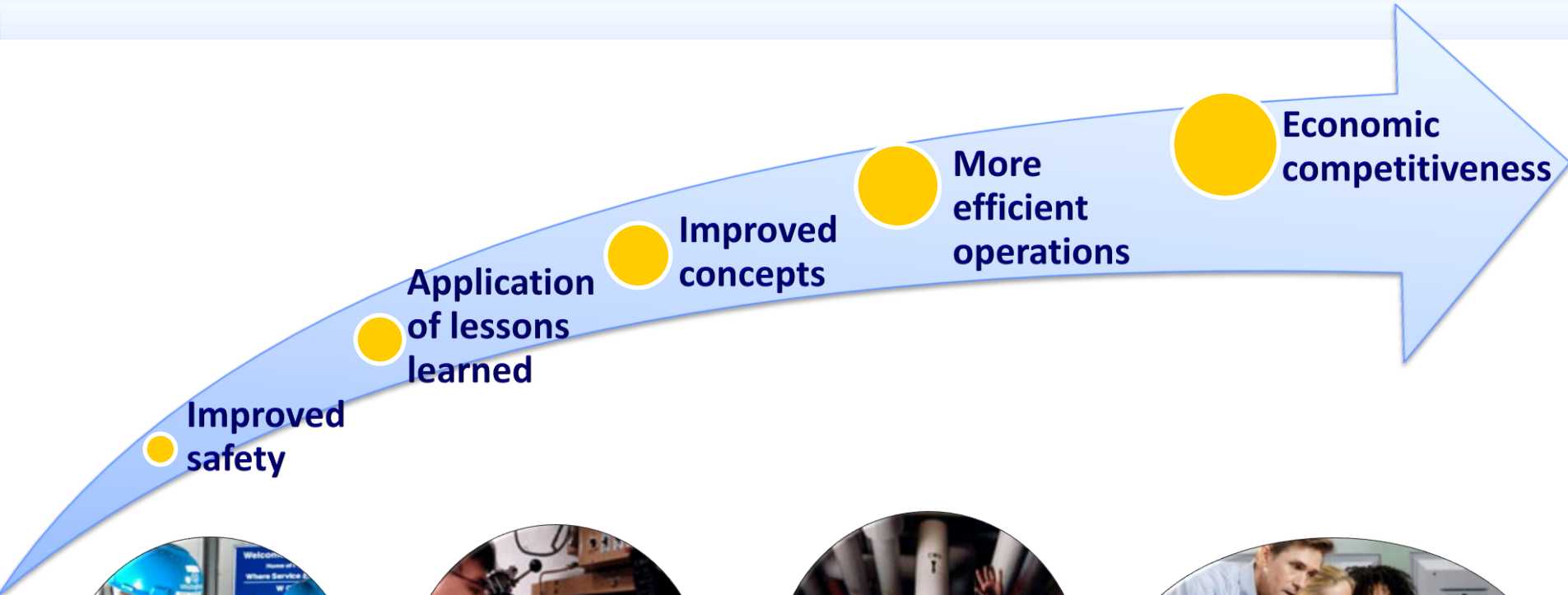
## A Journey of Continuous Improvement



**Carlos Leipner**  
**Vice President, Latin America**  
**Westinghouse Electric Company**



# Continuous Improvement



# Westinghouse R&T Priorities

- **Highest Priority: Serve the Existing Fleet**
  - Improve Performance
  - Extend Total Plant Life and Safety
  - Extend Reliability and Efficiency
- **Realize New Build Opportunities**
  - Improve delivery
  - Apply lessons learned from operating fleet
- **Strengthen Nuclear as Environmental Choice for Energy**
- **Advance Next Generation of Nuclear**
- **Leverage Nuclear beyond Electric Utility**



Technologies developed for today's operating plants should be leveraged for use in developing new plant designs

# Broad Technology Strategic Focus Areas

## LWR Sustainability

- *Fleet support*
- *Life beyond 60-years*

## Advanced Core Monitoring & Diagnostics

## Next Generation Instrumentation & Control (I&C)

- *Safety systems*
- *Performance optimization*
- *Grid compatibility*

## Advanced Reactors

- *Light Water*
- *Fast spectrum*
- *High Temperature Gas*

## Advanced Materials

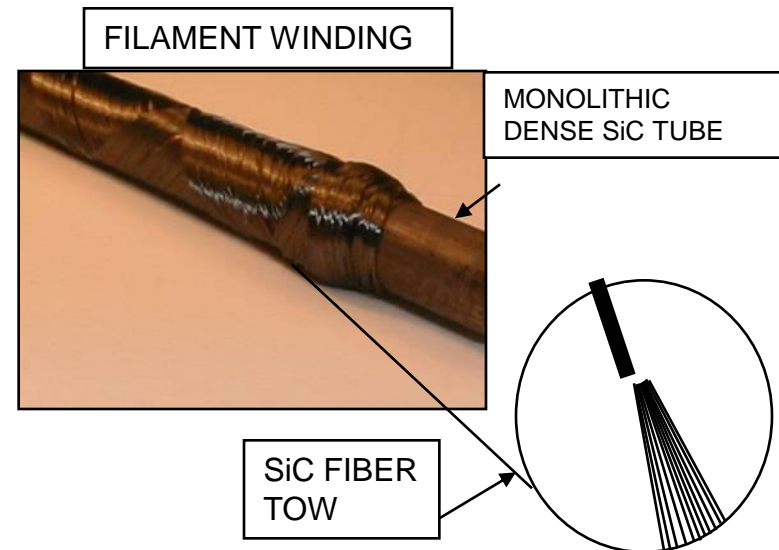
- *Underlies ALL areas*

## Fuel Cycle Back End

- *Light Water*
- *Fast spectrum*
- *High Temperature Gas*

# Advanced Fuel Program – SiCar Cladding

- Enrichment savings due to lower cross-section
- Uprate capability
- Insensitive to dry-out or DNB
  - $>1900^{\circ}\text{C}$  operational capability
- Immunity to debris fretting failure
- Simplification of safety systems – reduced capital and O&M costs



# Today's Industry of Tomorrow

**Sanmen Site Progress:  
Time Lapse View  
2009 to 2013**



# Westinghouse Small Modular Reactor



# Market Drivers for Nuclear & SMRs

The energy industry demands *versatility*

## The Westinghouse SMR delivers:

- A replacement for aging fossil fuel plants
- A solution for the needs of small utilities
- A solution for remote and grid limited applications
- A design with the ability to load follow and adjust to varying grid load swings
- An economic solution for the industry
- A balanced energy portfolio

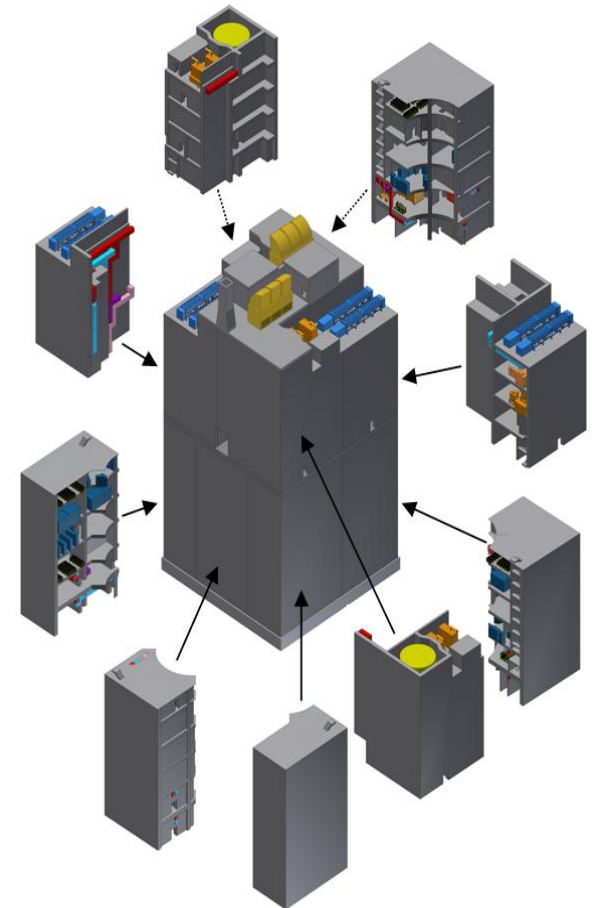




# Design Philosophy

- **Enhanced safety and security**
  - Based on tested & licensed passive safety systems
  - Reactor & safety systems below ground
- **Best opportunity for cost competitiveness**
  - Most power with the least amount of material
  - Entirely modular design
  - Rail, truck and barge transportable
- **Speed to market**
  - Proven ability to design, license and deploy reactors
  - Existing technical skills, licensed technologies and fuel supply
  - Designing to eliminate supply chain bottlenecks

**The most economic SMR**

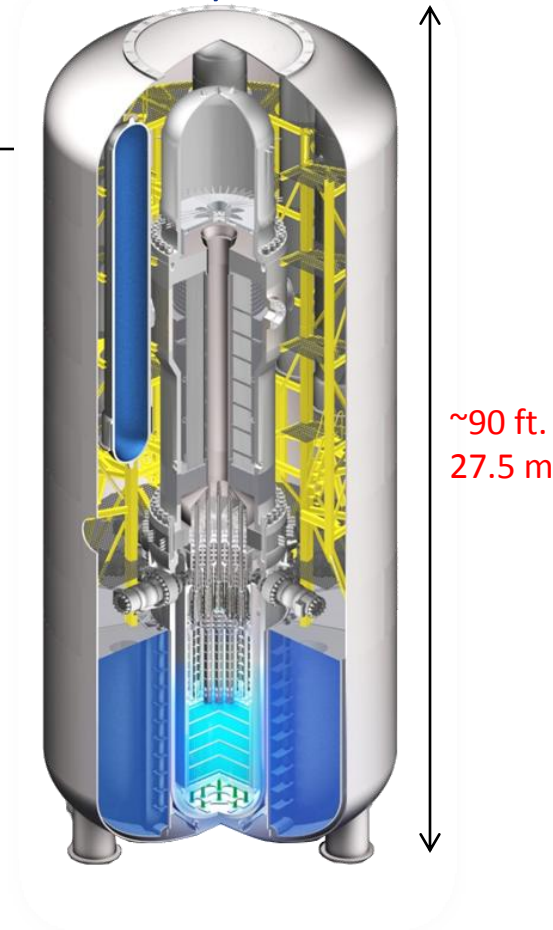


Sub-modules forming  
the NSSS island

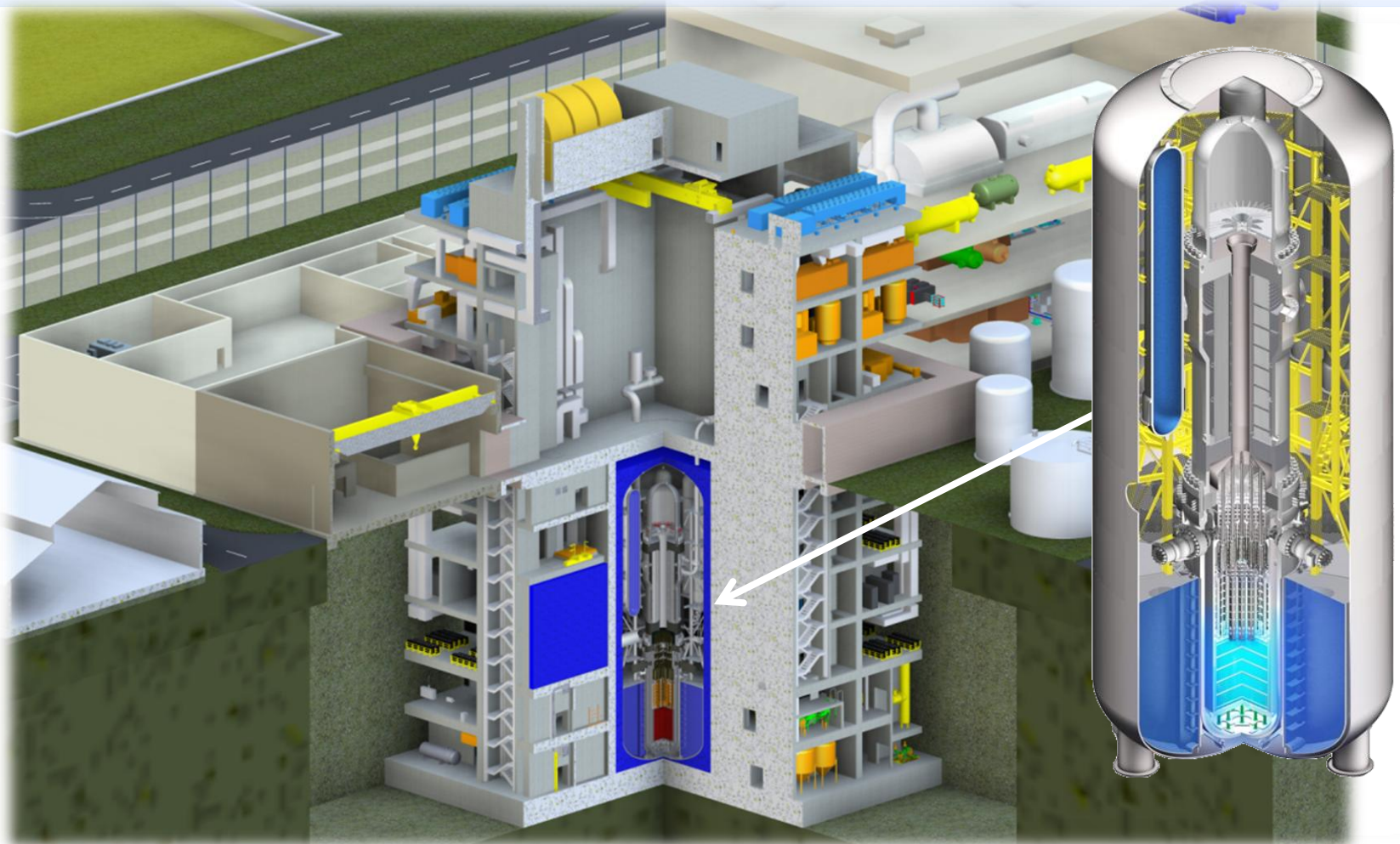
# Westinghouse Plant Design

- Single reactor site (standalone)
- Fuel – Modification of standard Westinghouse product (17x17 RFA)
- Forced flow with 8 reactor coolant pumps
- Internal control rod drive mechanisms
- Compact/high pressure containment vessel below grade
- Recirculating straight tube steam generator with steam drum location outside containment vessel
- Nuclear Island is 110'x110' (34 m x 34 m)
- Embedment is 110' deep (34 m)
- 24-month cycle length
- Load follow capability
- Total site area: ~15 acres (~6 hectares)
- Instrumentation and Control:  
Ovation<sup>®</sup>-based Digital Control System

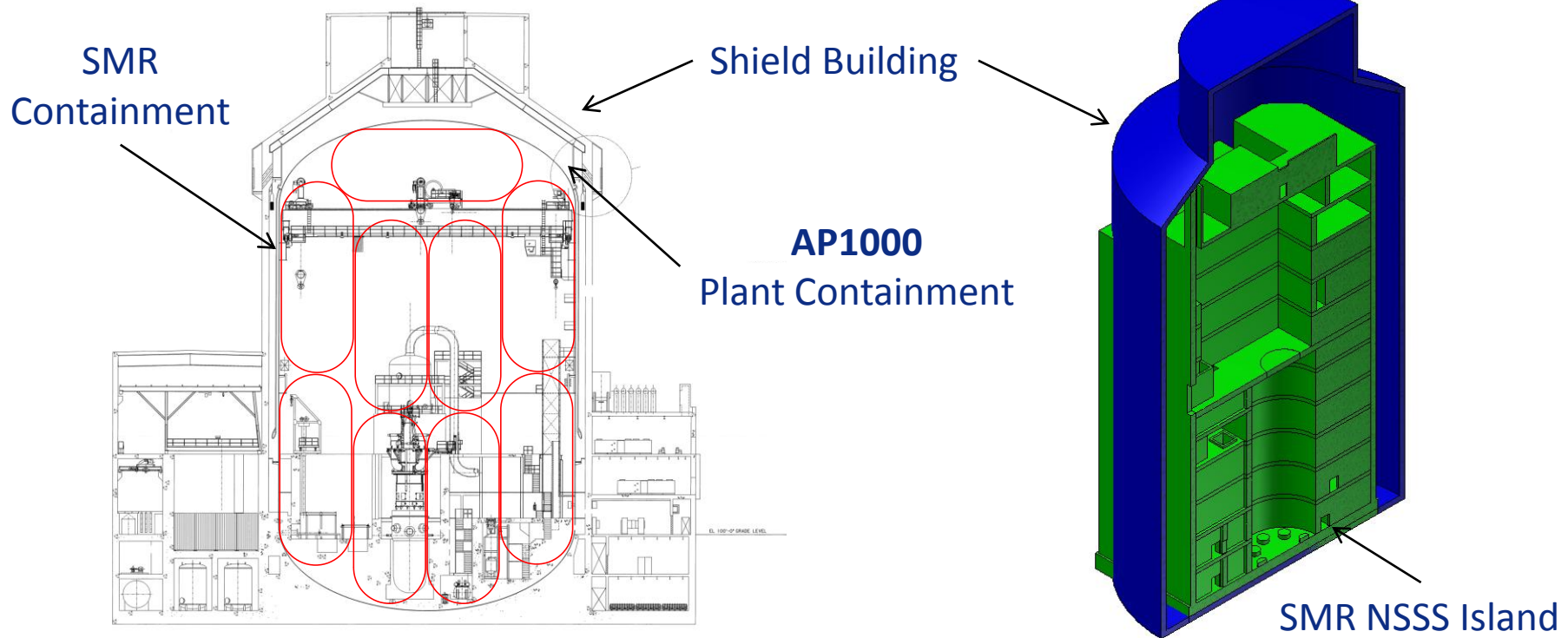
32 ft. (9.75 m)



# SMR Plant Layout



# How Small is Small?



**25 Westinghouse SMR containment vessels fit in a single AP1000 plant containment vessel**

**Westinghouse SMR NSSS island fits in the AP1000 plant shield building**

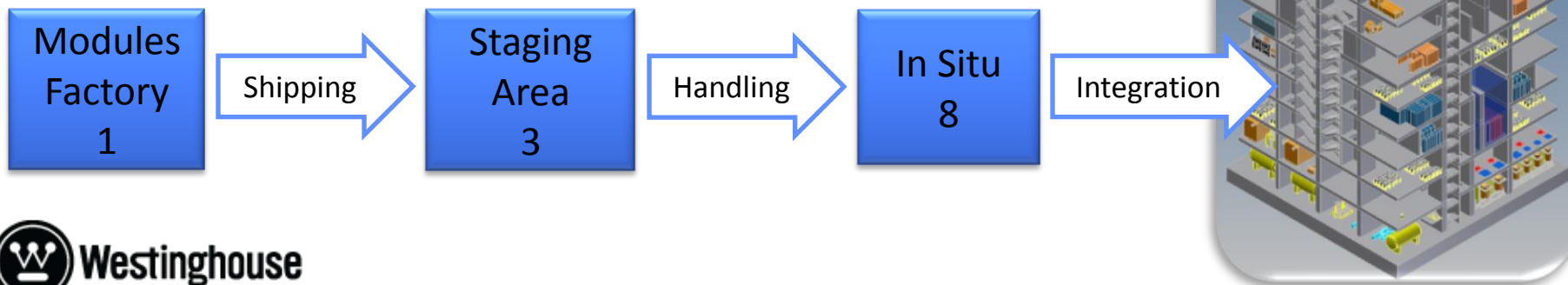
# SMR Safety

- **>7 Days of passive heat removal in Ultimate Heat Sink (UHS)**
  - Capability to add additional inventory to UHS tanks for indefinite cooling
- **100% reliance on natural forces**
  - Evaporation, condensation, gravity
- **No AC electric power required for plant safety for >7 Days**



# Modular Construction

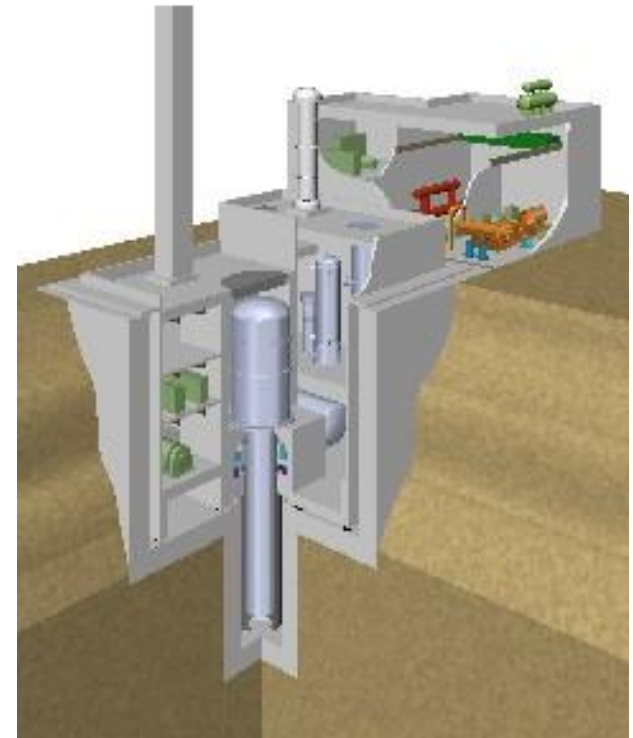
- Traditional large scale reactor economies of scale can be countered through application of modular construction techniques
- SMR maximizes modular design in all aspects of plant
- Modular design drives work normally completed at the construction site to the factory where quality is better controlled, overall cost are reduced and schedule certainty increased
- Modules are designed for road and rail transport to site and scalable to other forms of transport
- SMR uses the **AP1000** plant licensed modular wall and joint design



# 4S Sodium Fast Reactor

**TOSHIBA**  
Leading Innovation >>>

- Na-cooled fast reactor with passive safety systems
- 30 MWth/10 MWe (50 MWe also being developed)
- 510 °C outlet temperature
- 30 year lifetime core
- Innovative components:
  - EM pumps with no moving parts
  - Double-wall steam generators
- Low maintenance requirement
- High inherent security
- Ideal for remote areas of small power demand (e.g., Alaska, mining sites, etc.) and some process heat applications



# Summary

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- Nuclear Energy must be an essential part of our clean energy future
- Westinghouse has a long heritage of innovation in nuclear energy and continues today with our products, services, and advanced reactor portfolio
- Our AP1000 design is the world leader in new plant orders
- We will continue to actively promote the benefits of nuclear energy to the world community



# The Renaissance Continues...



From State-of-the-Art AP1000 . . .



...with the Westinghouse SMR



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