BWRX-300: Innovative Deployable SMR

May 2022

GE Hitachi Nuclear Energy

BWRX-300 Small Modular Reactor

Rich history of nuclear innovation ready to support advanced reactor market

Proven success turning vision into commercial-scale reality, on time and on budget






OVER 80 YEARS OF NUCLEAR EXPERIENCE AND INNOVATION

1939	1955	1957	1962	1974	1986	1990	1996	2014	2017	2021
First GE involvement in nuclear physics	GE Atomic Division established	Vallecitos BWR AEC License #1	NPD achieves full power	25th BWR Peach Bottom 3	50th BWR River Bend	Laguna Verde 1	1st ABWR built on time on budget	ESBWR NRC License	BWRX-300 launched	BWRX-300 down selected by OPG

67 reactors licensed in 10 countries

Global presence

DEEP EXPERTISE AND BROAD CAPABILITIES

- BWR OEM
- Fuel Design and Manufacturing
- Reactor Internals Manufacturing
- Design Engineering
- Services
- Licensing
- Test Reactor Operation
- Hot Cell Capability
- Full-scale Reactor Vessel Training Facility
- Virtual Reality Training

GEH Facilities

Vallecitos Nuclear Center **Vallecitos, CA**

GEH Morris Operation **Morris, IL**

GEH SMR Technologies Canada **Toronto, ON**

GENUSA Fuel Factory **Salamanca, Spain**

GEH Office **Zurich, Switzerland**

Rinkai Works **Japan**

BWR Training Center **San Jose, CA**

GEH and GNF HQs **Wilmington, NC**

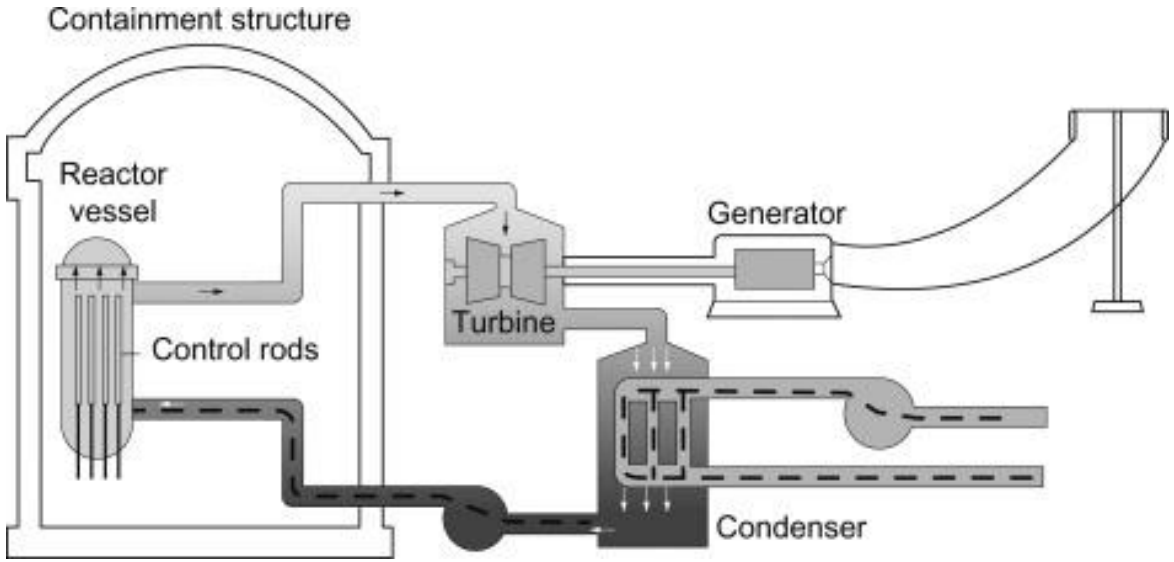
GEH & GENUSA Office **Madrid, Spain**

GEH Office **Stockholm, Sweden**

Hitachi Works **Japan**

GNF-J **Japan**

Boiling Water Reactors (BWR) … the simplest way to make steam

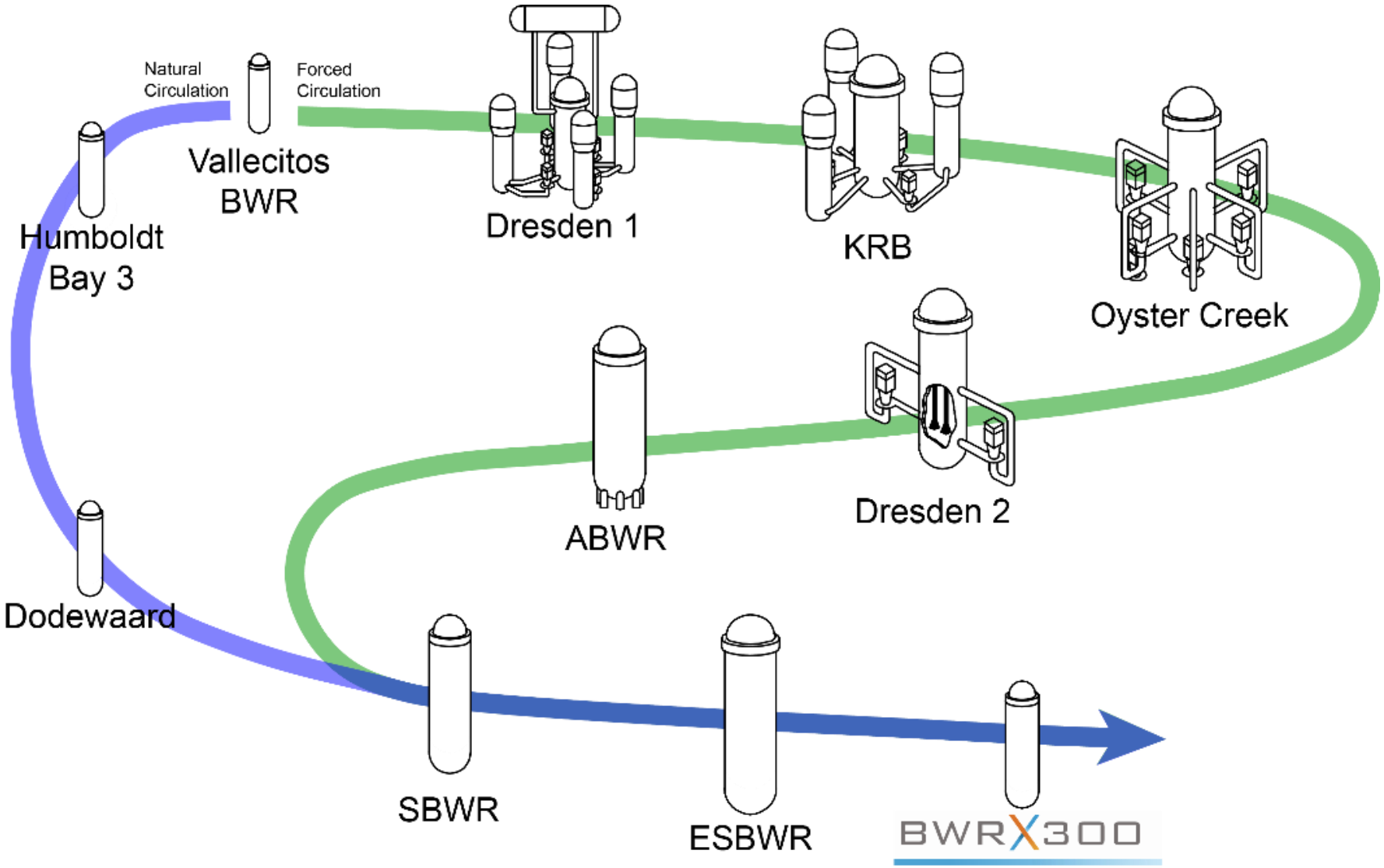


INHERENTLY SIMPLE REACTOR DESIGNS

- Direct cycle design with no secondary steam generator and pressurizer
- Traditional balance of plant for electricity generation
- Low enriched (3-5% U-235) oxide fuel in metal cladding

- Water coolant that also serves as “moderator” to slow down fast neutrons
- Coolant circulated through core with natural circulation (forced circulation in legacy designs)

Evolution of the BWR



BWRX-300 small modular reactor

- 10th generation Boiling Water Reactor
- World class safety
- Leverages U.S. NRC licensed ESBWR
- Design-to-cost approach
- Significant capital cost reduction per MW
- Capable of load following
- Ideal for electricity generation and industrial applications, including hydrogen production
- Constructability integrated into design
- Initiated licensing in the U.S. and Canada
- Operational as early as 2028

MOST
COMPETITIVE SMR

BWRX-300 Small Modular Reactor

300 MW Water Cooled SMR

Designed to Mitigate LOCA

Reduced Staff

$

Competitive LCOE

Darlington New Nuclear Project Unit 1

Breakthrough innovation – integral isolation valve

- Part of code boundary for vessel
- Minimizes inventory loss for large breaks
- Patented & NRC approved Licensing Topical Report
- Enables dramatic design simplification and elimination of unnecessary systems
- Leading to more than 50% reduction in construction materials per MW

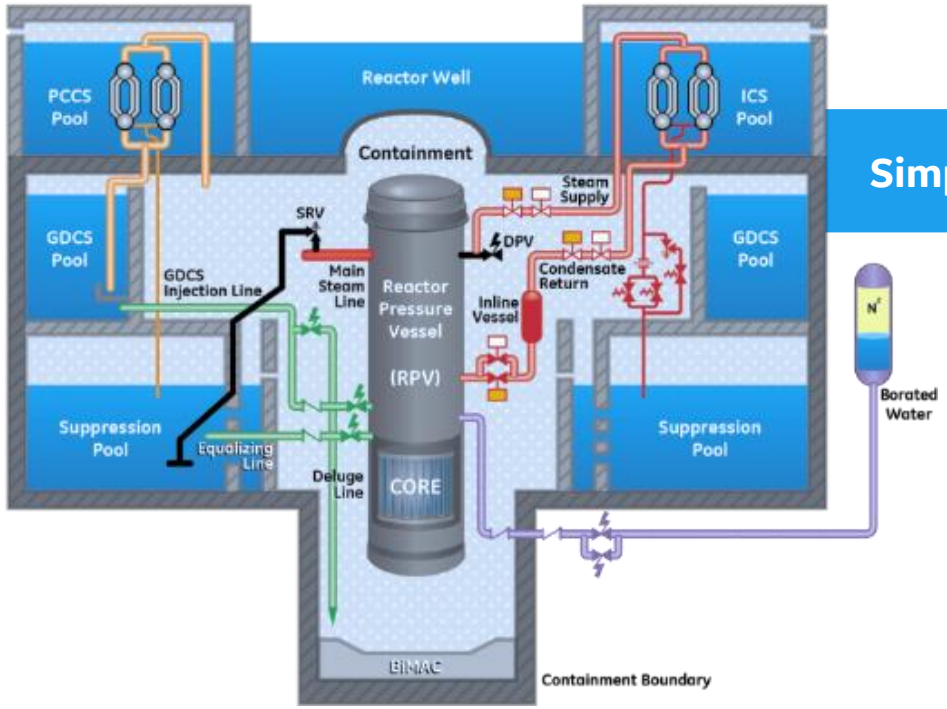
BWRX300

GROUNDBREAKING BWRX-300 SMALL MODULAR REACTOR ACHIEVES LICENSING MILESTONE

BWRX-300 Small Modular Reactor

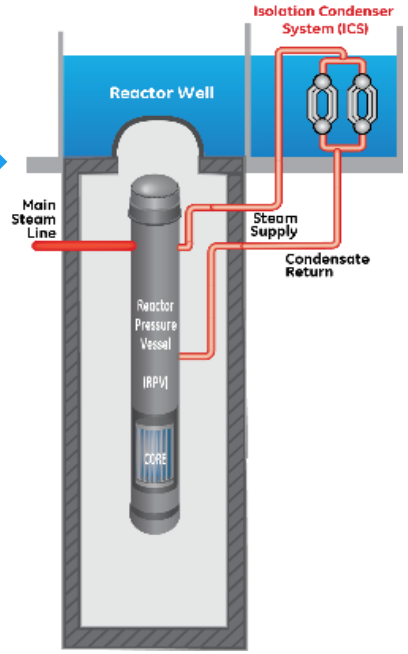
Simplifying proven technologies

ESBWR



Simplification

BWRX300



Systems/components eliminated:

- Suppression Pool
- GDCS Pool
- Safety Relieve Valves & Spargers
- Depressurization Valves
- BiMac (core catcher)

Systems/components simplified:

- Passive Containment Cooling (PCCS)
- Containment (use of SC)
- Boron injection
- Security (built into design)
- Turbine
- Generator (air cooled)

>50% building volume reduction/MW
>50% less concrete/MW

Utilizing proven technology

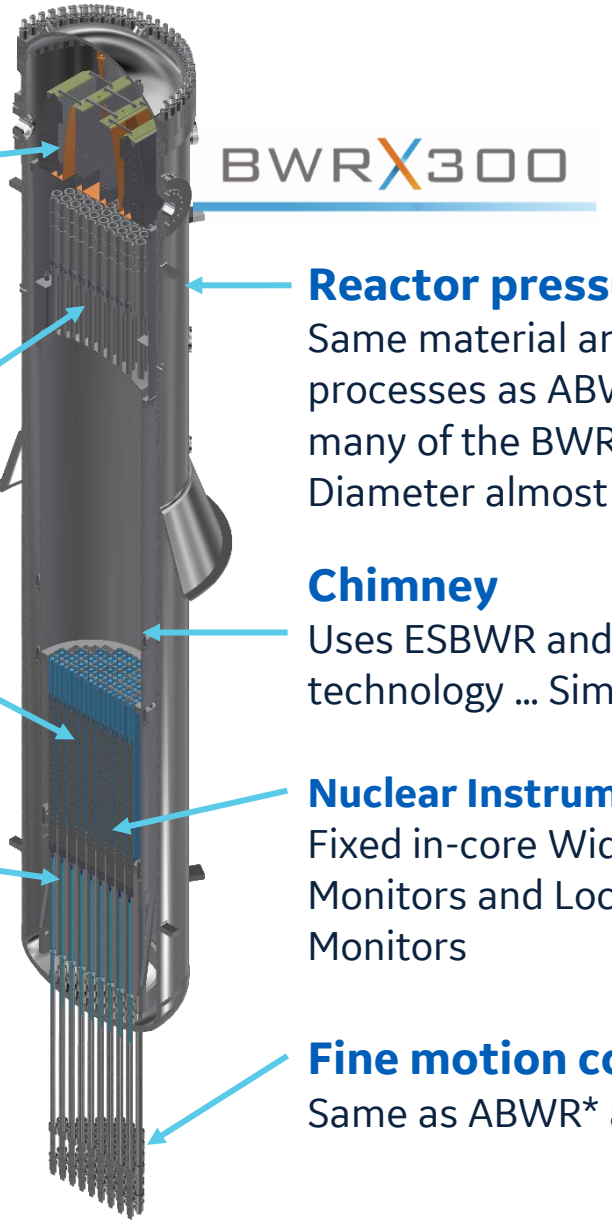
PROVEN COMPONENTS, PRIOR TESTING, AND OPERATIONAL HISTORY GREATLY ACCELERATE DEPLOYMENT

Dryer
Same features as ABWR* and ESBWR ...
Same as upgrades for existing fleet ...
Size nearly identical to KKM**

Steam separators
Same as ABWR* and ESBWR ...
Similar to the BWR fleet

GNF2 fuel
>19,000 bundles delivered ...
Utilized by ~70% of BWR fleet

Control rod blades
Same as ABWR* ...
Longer than ESBWR ...
Almost identical to latest design for BWR fleet



Reactor pressure vessel
Same material and fabrication processes as ABWR*, ESBWR and many of the BWR fleet ...
Diameter almost identical to KKM**

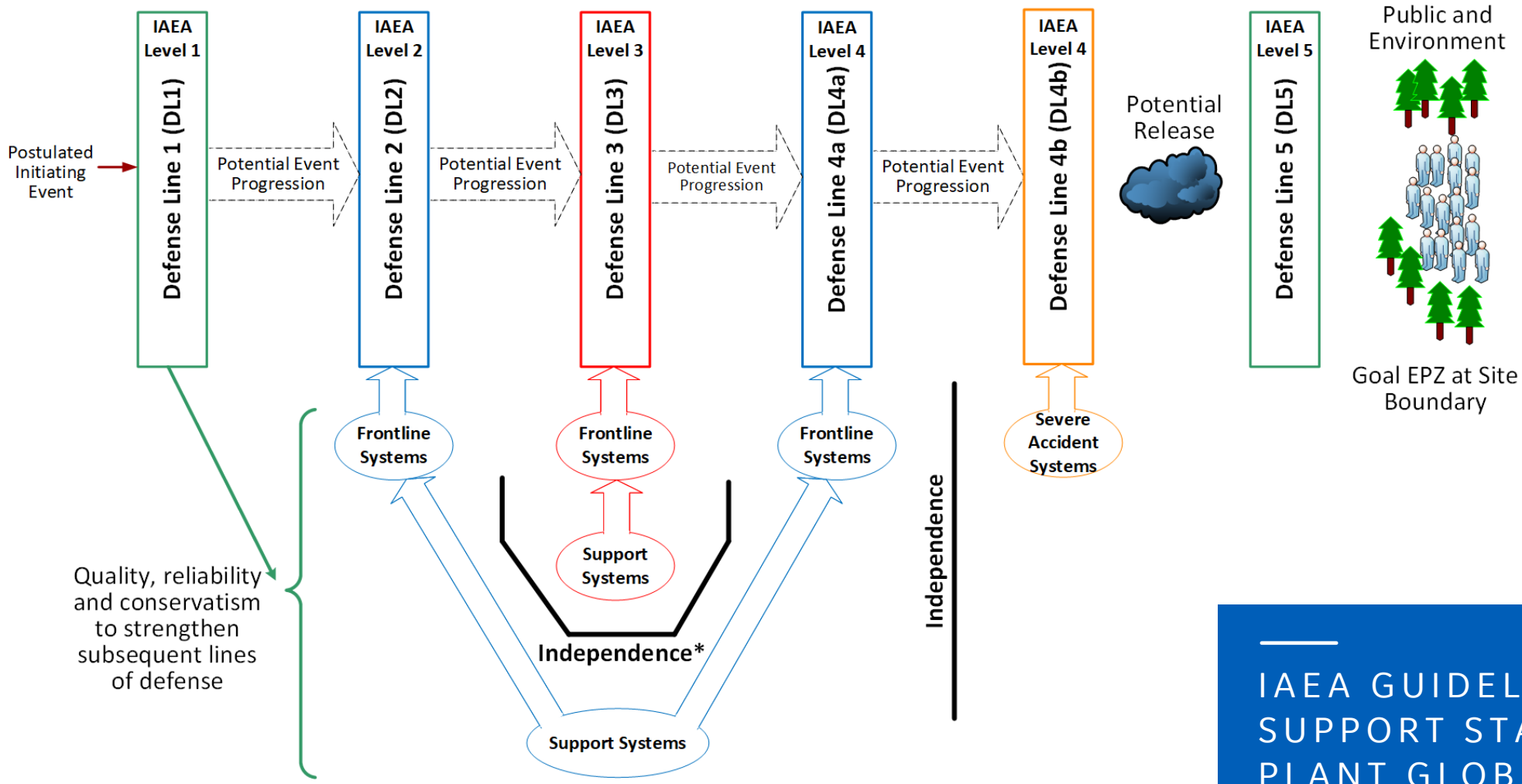
Chimney
Uses ESBWR and Dodewaard*** technology ... Simplified

Nuclear Instrumentation:
Fixed in-core Wide Range Neutron Monitors and Local Power Range Monitors

Fine motion control rod drives
Same as ABWR* and ESBWR

* ABWR fleet has combined 22+ years of operating experience | ** Kernkraftwerk Mühleberg (KKM): 355 MWe BWR/4, 1972 ~ 2019 | *** Dodewaard: 58MWe natural circulation BWR, 1969 ~ 1997

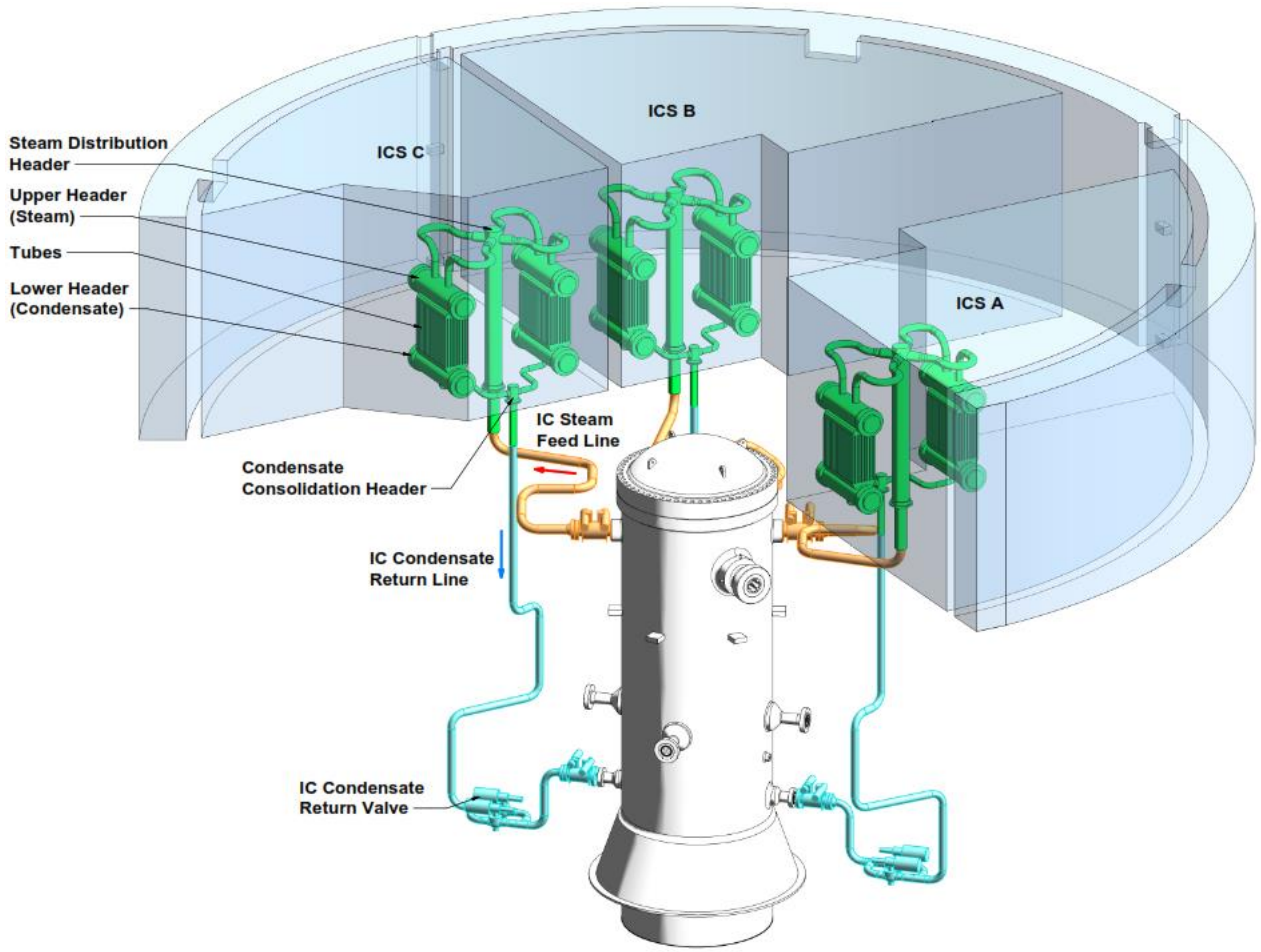
Defense in depth … safety by intelligent design



IAEA GUIDELINES SUPPORT STANDARD PLANT GLOBALLY

Isolation Condenser System (ICS)

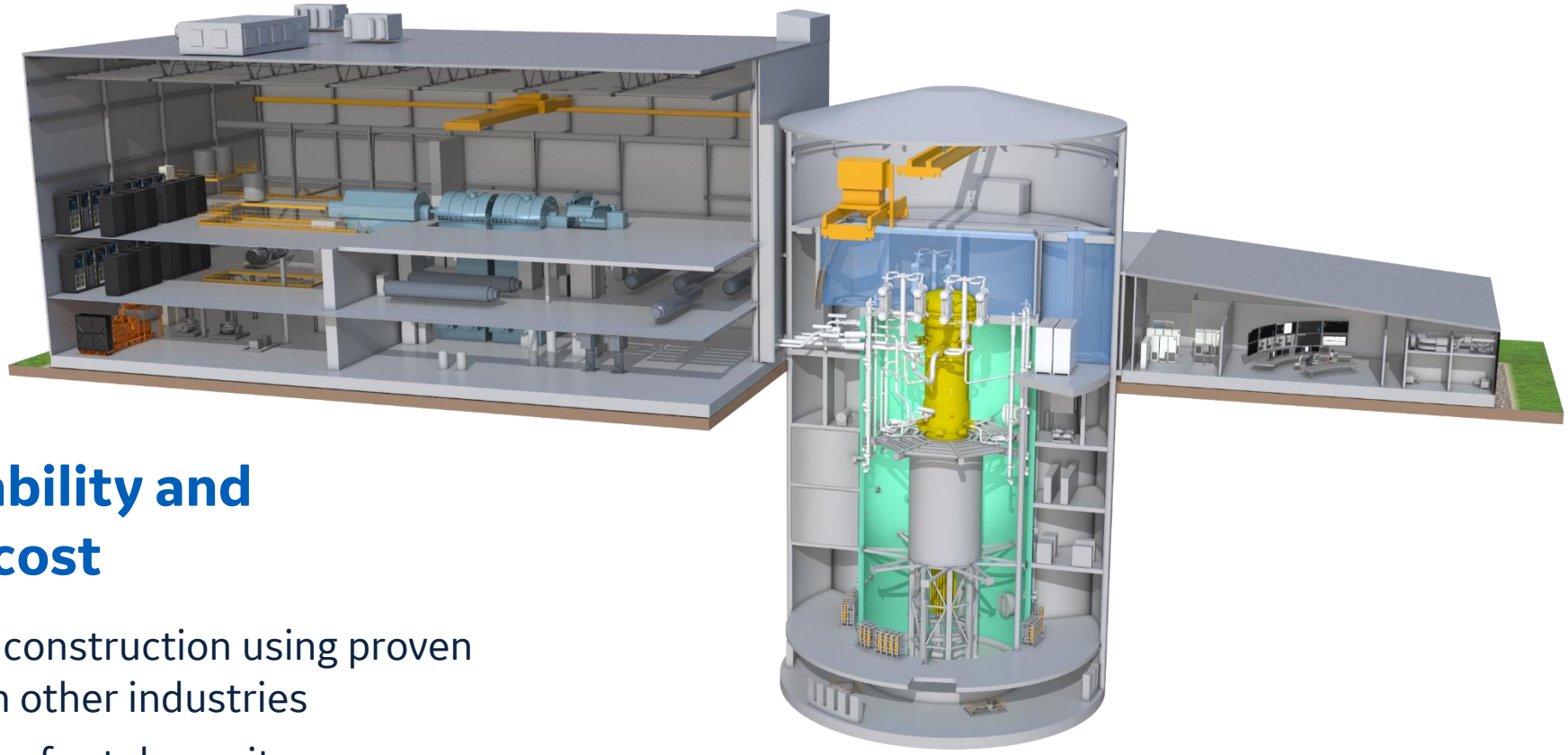
- IAEA TECDOC-626 Cat C Passive safety system
  - Operates without power or external cooling
  - Condensate return line opens on signal or loss of power
  - Steam generated in reactor and condensation in elevated heat exchanger drives flow
- Defense-in-Depth approach through both redundancy and diversity
  - 3 x 100% trains
  - Mechanically diverse valves
  - Instrumentation and controls are fail-safe, with multiple redundant and diverse I&C platforms
  - 7 days minimum of cooling during design basis accidents without operator action required



Multi-layered passive cooling system achieving world class safety

BWRX-300 Small Modular Reactor

Optimized for cost and ease of construction



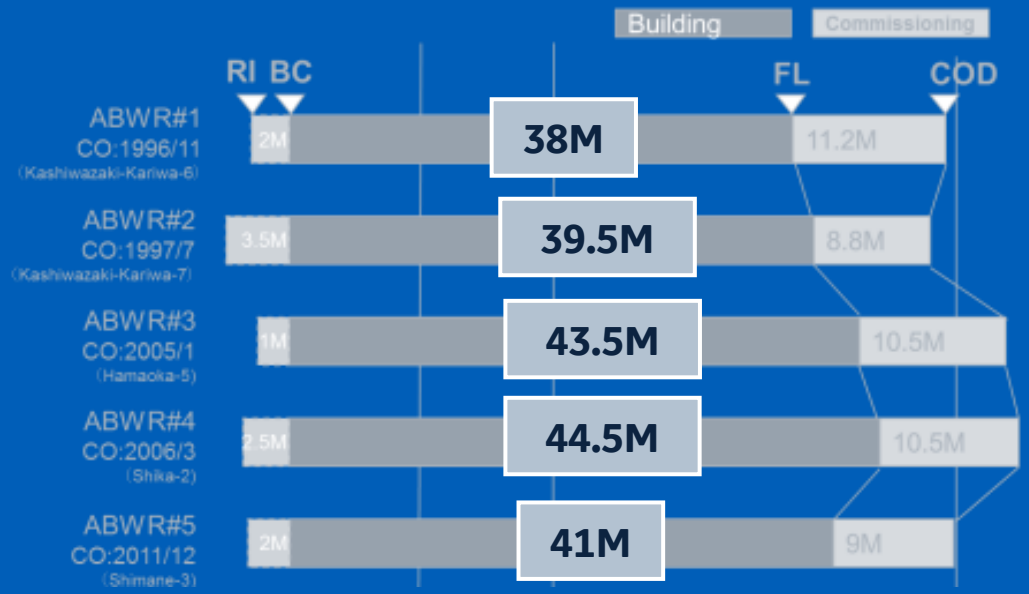
Constructability and Design-to-cost

- Underground construction using proven methods from other industries
- Maximum use of catalogue items
- “Off the shelf” turbine/generator

Building on ABWR experience

Kashiwazaki-Kariwa 6/7 ABWRs

Efficient, repeatable model

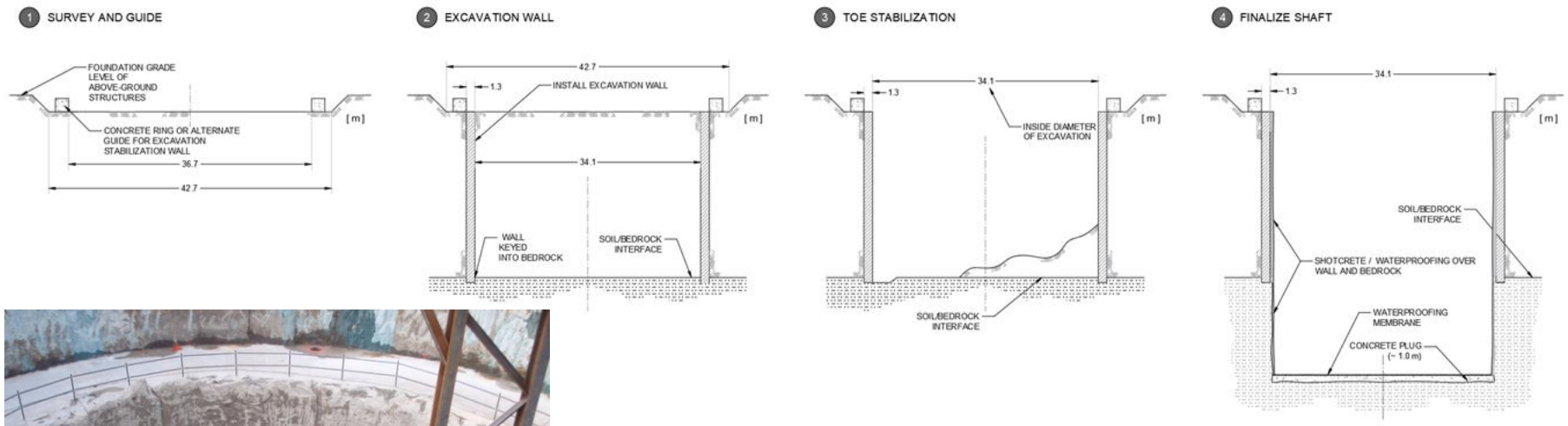


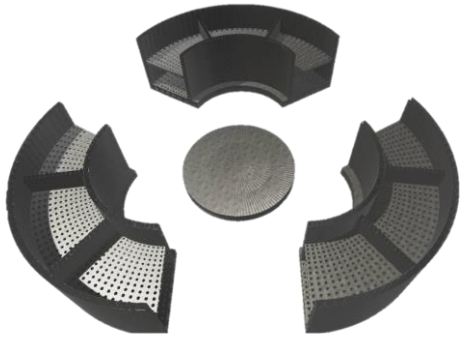
M - months

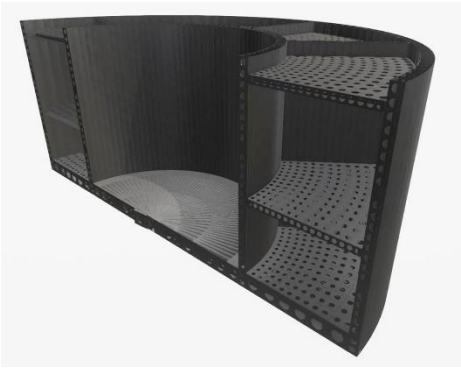
FIRST-OF-A-KIND GEN III PLANT BUILT ON 38-MONTH CONSTRUCTION SCHEDULE

Innovative construction

- A circular slurry shoring wall is installed in the softer upper soil
- Removal of the soil within the shoring wall
- Excavation is continued through the rock down to the bottom of the basemat
- Waterproofing is applied to the surface of the slurry wall and the rock face
- Build from the mud mat up with SteelBricks™ technology (Registered trademark of Modular Walling Systems)







ELIMINATES ONE MILLION CUBIC YARDS OF EXCAVATION AND ENGINEERED BACKFILL

BWRX-300 Codes and Standards – Top Level

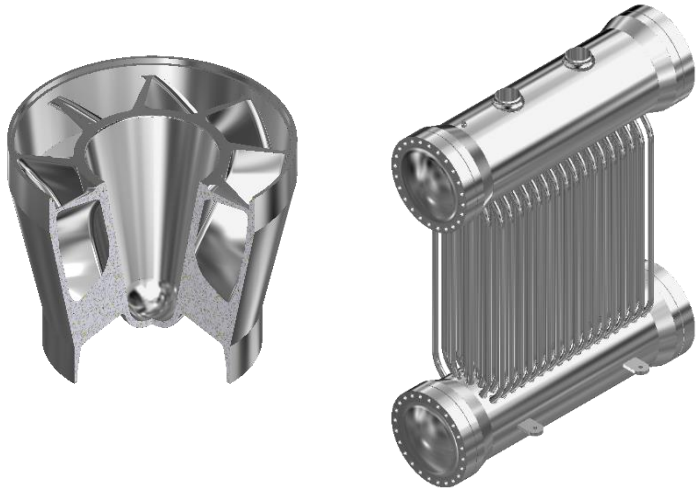
- Quality: ASME (American Society of Mechanical Engineers) NQA-1 endorsed to meet 10CFR50 App B…globally used for Safety Components
- Mechanical: ASME
- Electrical and Instrumentation & Control: IEC (International Electrotechnical Commission)
- Civil Structural: ASCE (American Society of Civil Engineers) and AISC (American Institute of Steel Construction)

Widely accepted codes and standards

Fabrication and Manufacturing Techniques

- Existing supply chain and techniques are fully capable for first deployments
- SteelBrick™ modules being demonstrated as part of the National Reactor Innovation Center's Advanced Construction Technology initiative
- Advanced manufacturing techniques will be introduced when technically ready. Examples:

Additive manufacturing



Electron beam welding