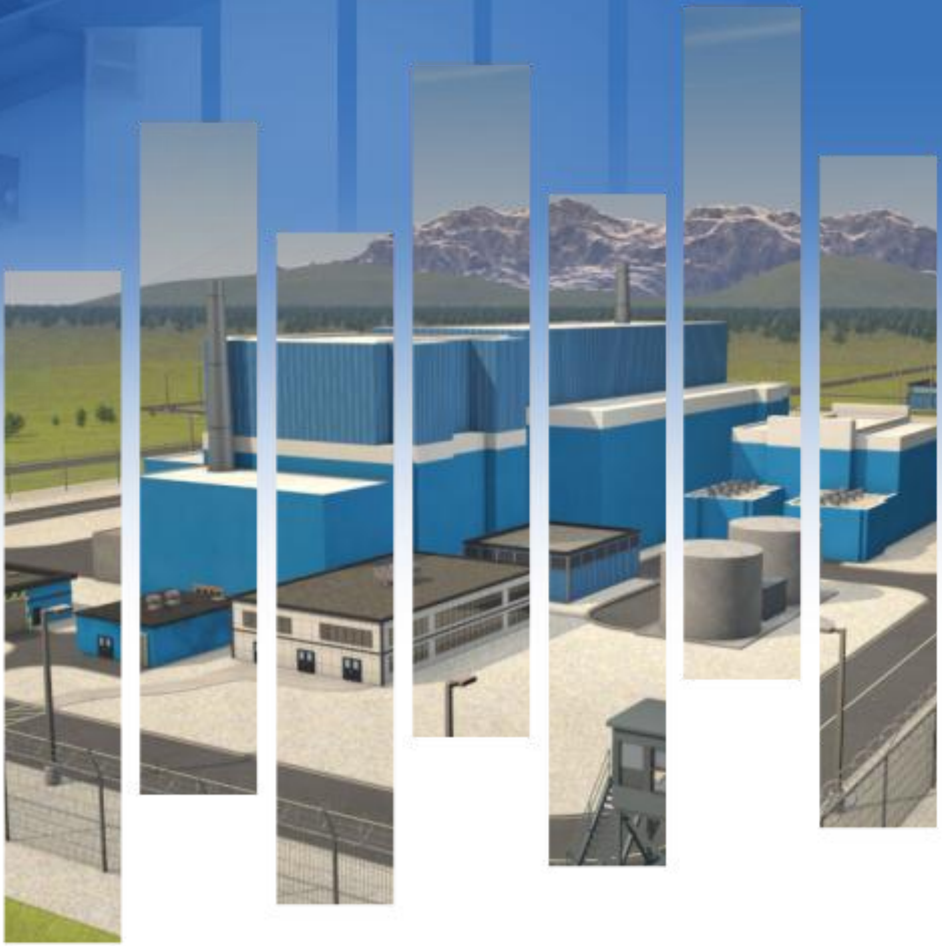

Boiling Water Reactor (BWR) Technology ABWR/ESBWR

June 28, 2013

Isidro de la Fuente
Vice President, Sales
Nuclear Plant Projects

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GE Hitachi Nuclear Alliance – Wilmington

- In alliance with Hitachi – the only U.S. controlled OEM today
- HQ Wilmington, NC (1650 acres)
- ~6000+ employees worldwide (GEH/HGNE)
- BWR pioneer – 2 in India, 35 in the USA, 30 in Japan … 94 globally
- Continuous investments in technology over past 50 years

50 years of commitment

- First GE BWR – 1957
- BWRs Gen 1-6 get built – 60's-80's
- First ABWR operational – 1996
- ABWR certified in USA – 1997
- GNF JV formation – 2000
- ESBWR DCD submission – 2005
- GEH Alliance formation – 2007
- Laser Enrichment Test loop – 2009

..advanced generational technology solutions

- ABWR – Gen III
- ESBWR – Gen III+
- PRISM – Gen IV

..backed by experience, expertise & innovation

- Nuclear, Turbine islands, balance of plant
- Life extension
- Power uprates
- Performance services
- Outages, Inspections
- Spent fuel storage

..expanding competencies and build upon adjacencies

- BWR, mixed oxide fuel
- Candu fuel & handling
- Fuel engineering svcs
- Laser enrichment
- Advanced Recycling
- Nuclear isotopes

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94 BWRs in Asia, Europe, and Americas

GEH and HGNE have been continuously constructing nuclear plants for over 50 years

Recent experience and project status

Kashiwazaki-Kariwa 6/7 ABWR

COD 1996/1997

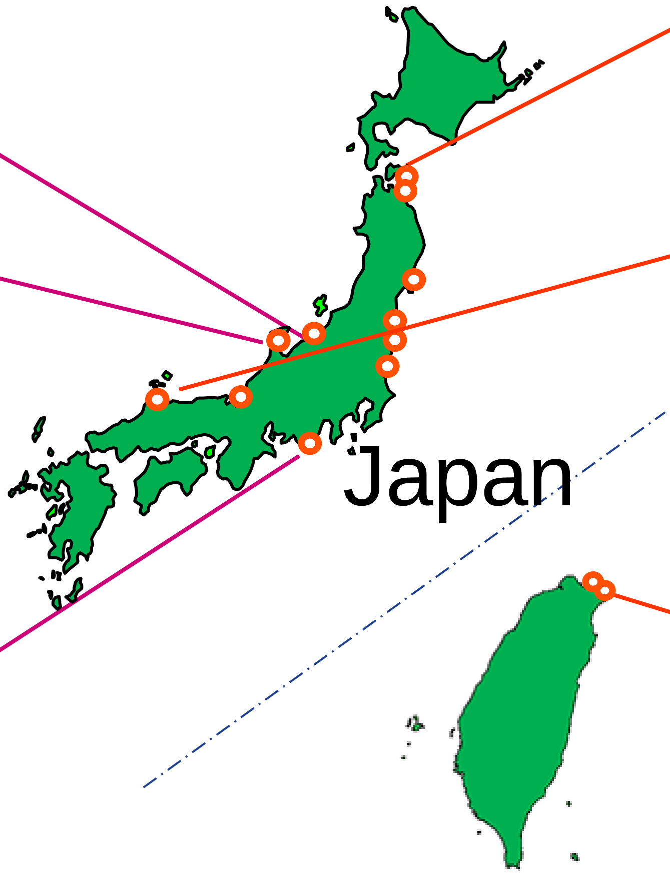
Shika-2 ABWR

COD 2006

Hamaoka-5 ABWR

COD 2005

Plants Completed	**4 Units**
Under Construction	**4 Units**



Ohma ABWR

Under Construction
COD (suspended)

Shimane-3 ABWR

Under Construction
COD (suspended)

Lungmen-1/2 ABWR

Under Construction
COD 2013 (estimated)

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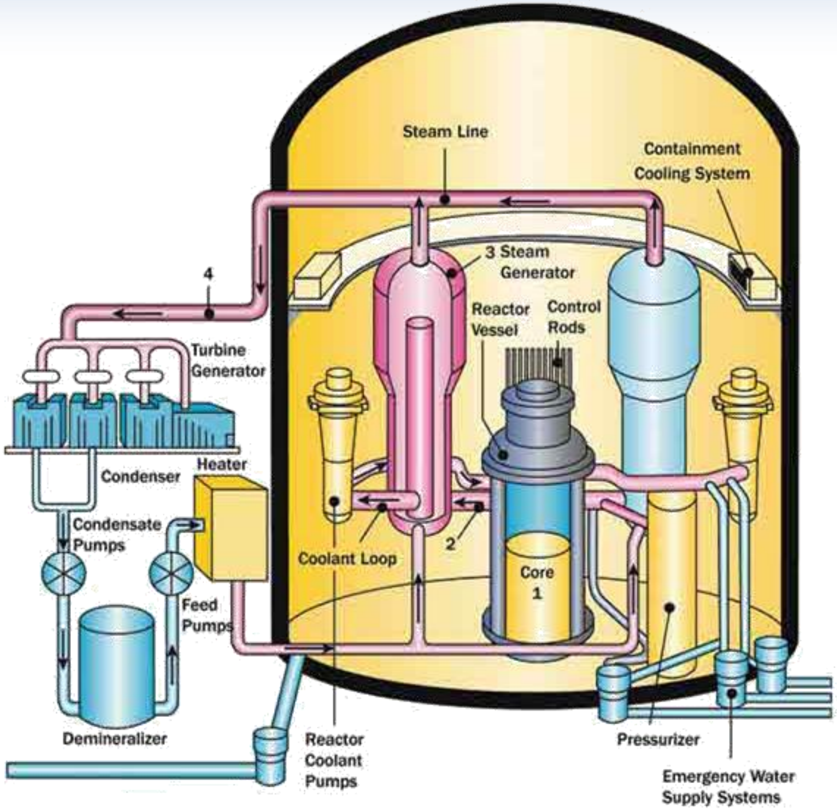
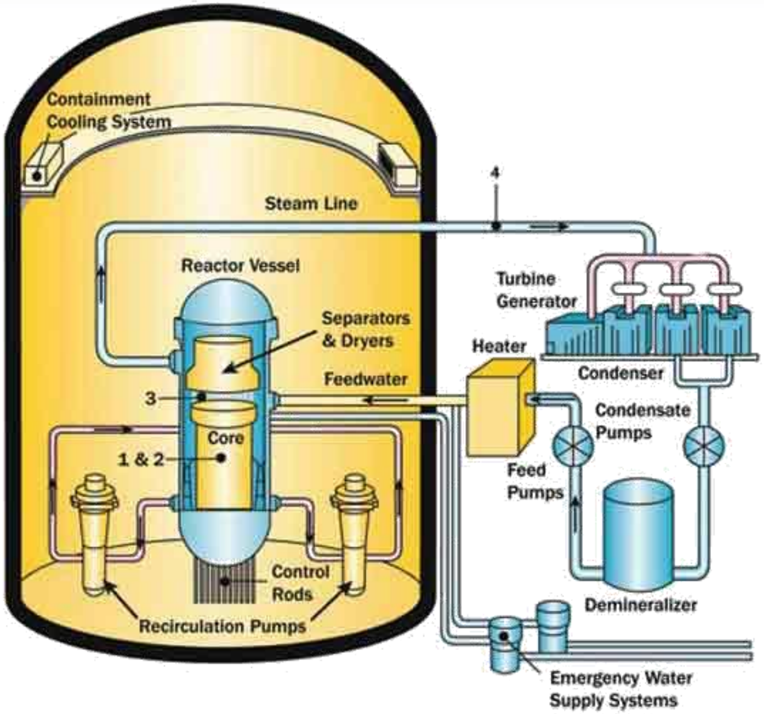
PWRs and BWRs – the basics



Typical Pressurized Water Reactor



Typical Boiling Water Reactor

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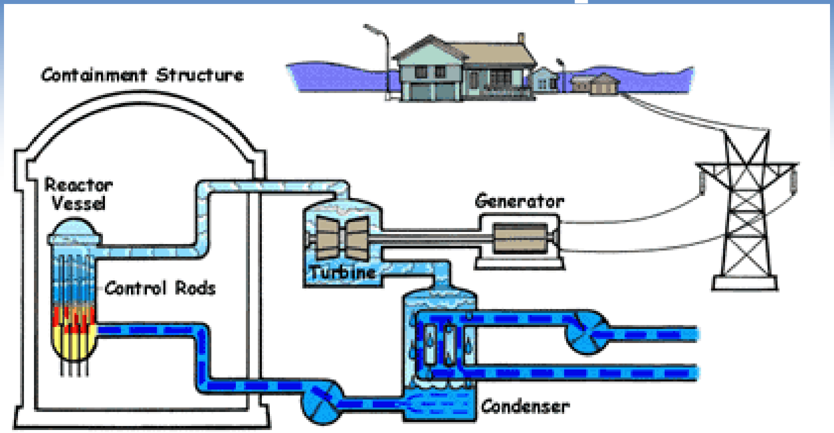
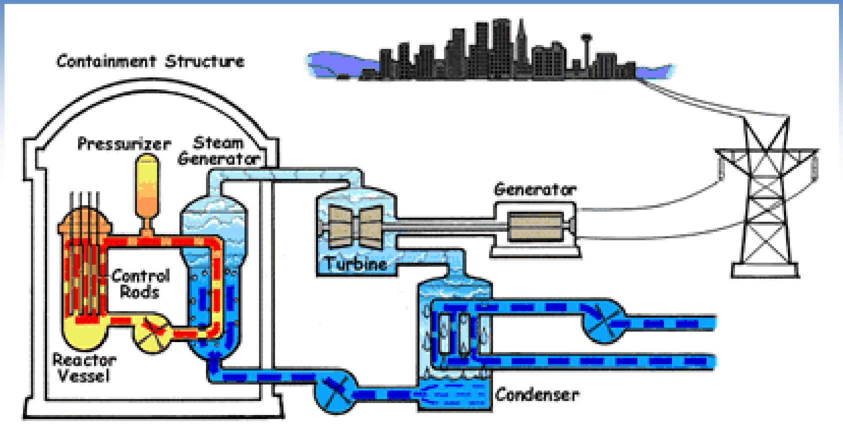
Basic Principles of Steam





BWR

Direct Cycle (Single Cycle)

RPV Pressure ~70 Bar (1020 psig)

RPV Temperature 288 ºC (550 ºF)

Steam Generated in RPV (with Separator & Dryer)

Bulk Boiling Allowed in RPV

Pure Water H_2O

PWR

Indirect Cycle (Dual Cycle)

RPV Pressure ~155 Bar (2240 psig)

RPV Temperature 326 ºC (619 ºF)

Steam Generated in Steam Generator (via Second Loop)

No Bulk Boiling in RPV

Water + Boric Acid

BWR Has Lower RPV Pressure and Simplified Steam Cycle

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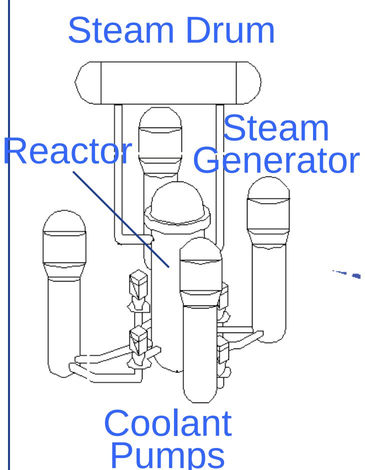
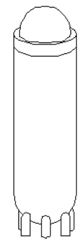
Reactor Evolutions

BWR Evolution Summary



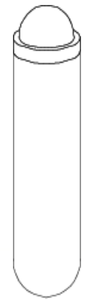
1960

ABWR



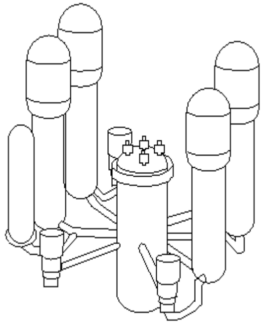
1996

ESBWR



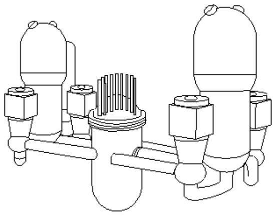
2008-2009

PWR Evolution Summary



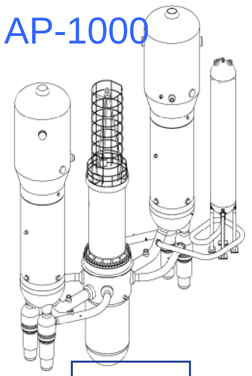
1960

System 80+



1997

AP-1000



2005

BWR Simplification = Fewer Major Components

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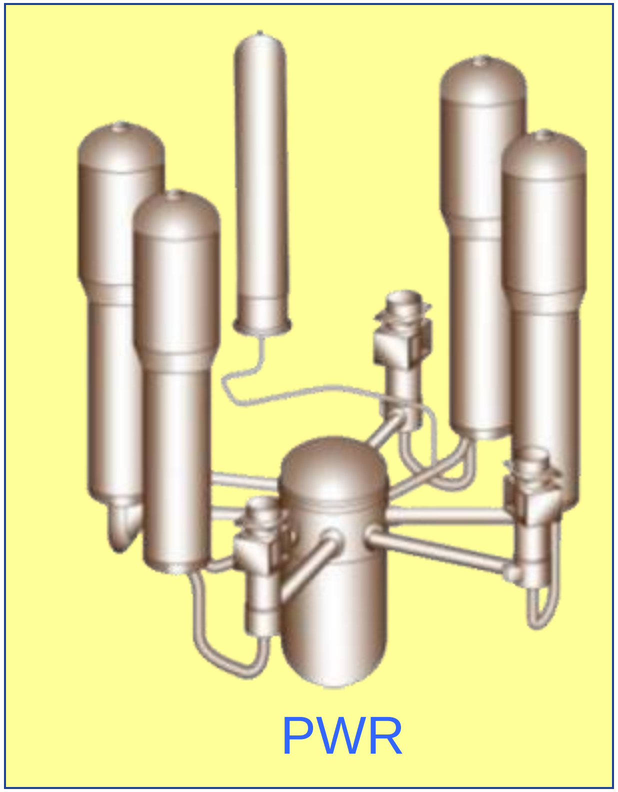
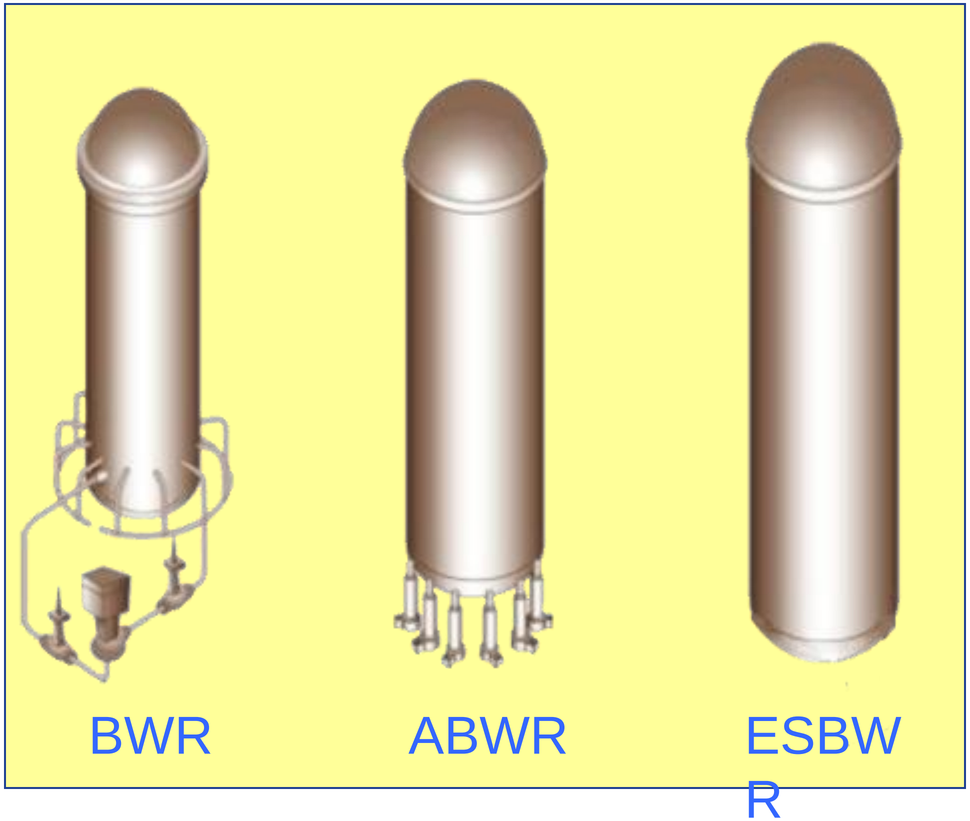
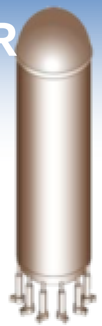
Simplification of design



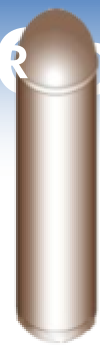


Major Nuclear Steam System Components

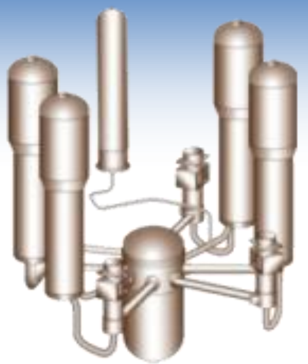
ABWR



ESBWR



PWR



BWR

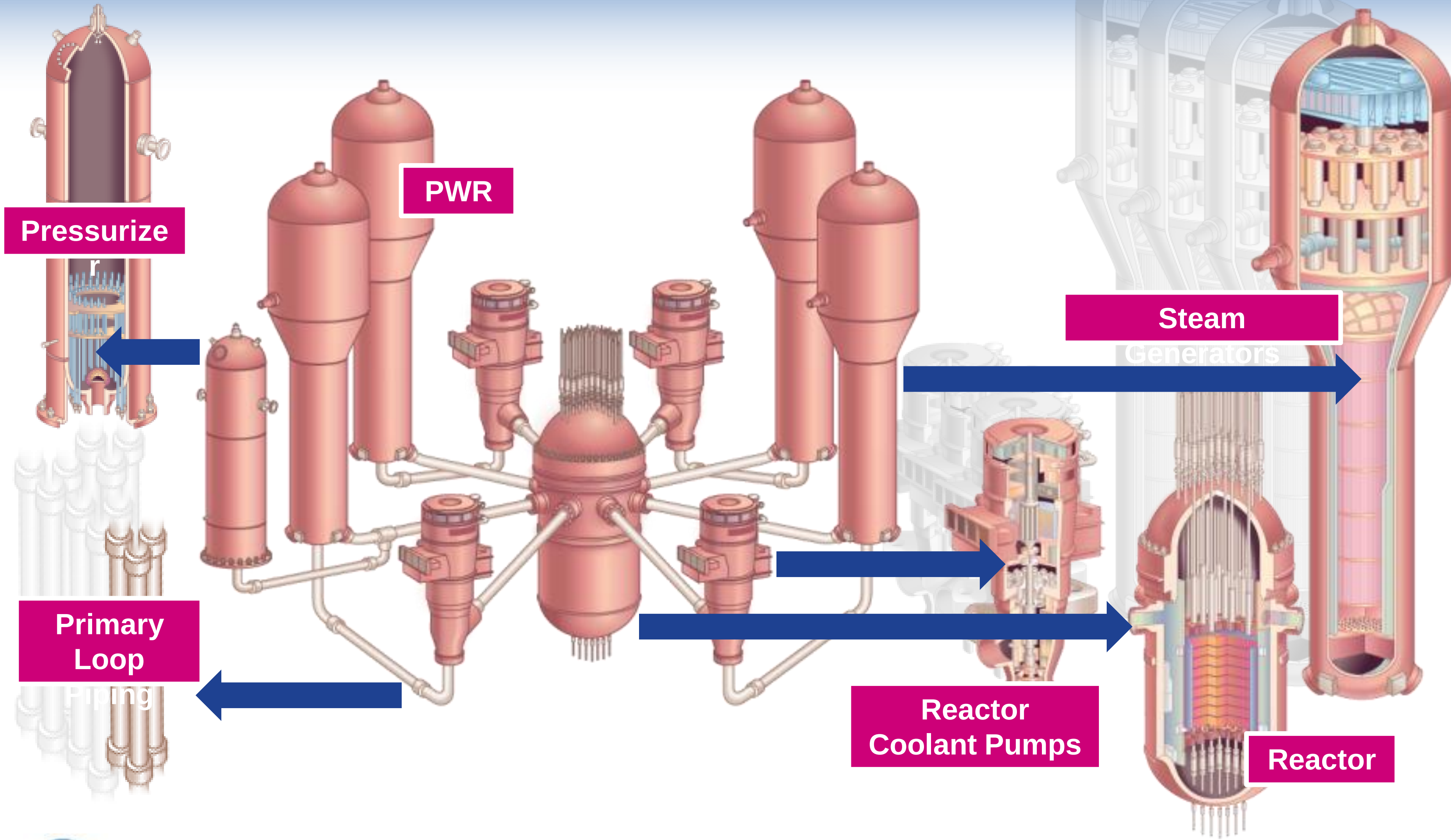
RPV (with Dryer & Separator)
No Steam Generator
No Pressurizer
RPV mounted pumps (ABWR)
Natural Circulation (ESBWR)
Bottom Entry Control Rod Drives
No piping (ABWR/ESBWR)

PWR

RPV
2 -4 Steam Generators
1 Pressurizer
Rx Coolant pumps outside of RPV

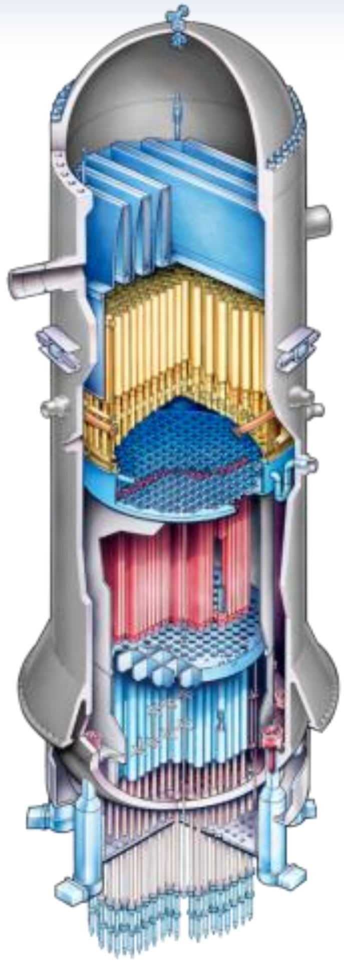
Top Entry Control Rod Clusters
Interconnecting piping

Consider the complexity of the PWR



Compare PWR to ABWR

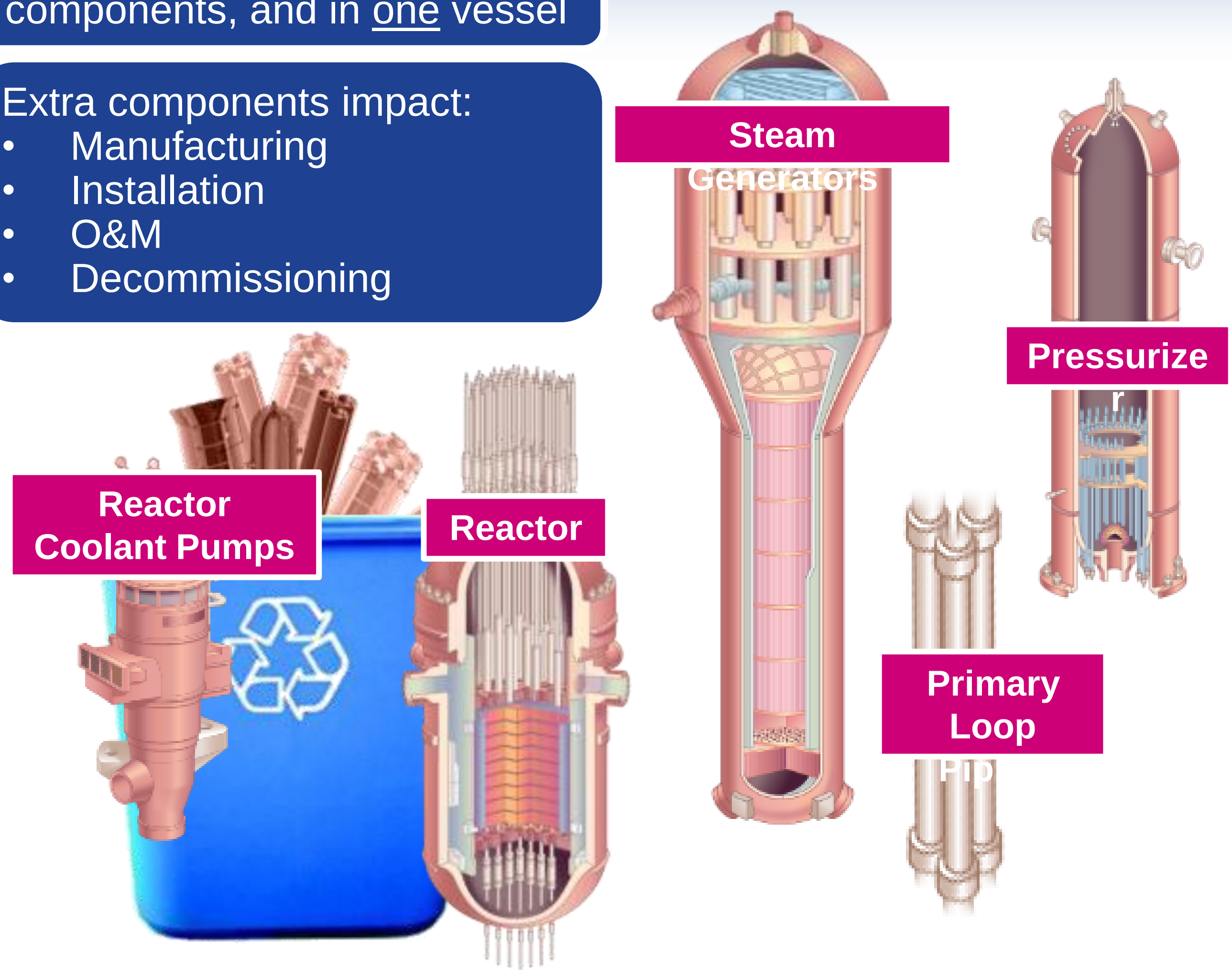
ABWR



Only the <u>necessary</u> components, and in <u>one</u> vessel

Extra components impact:

- Manufacturing
- Installation
- O&M
- Decommissioning



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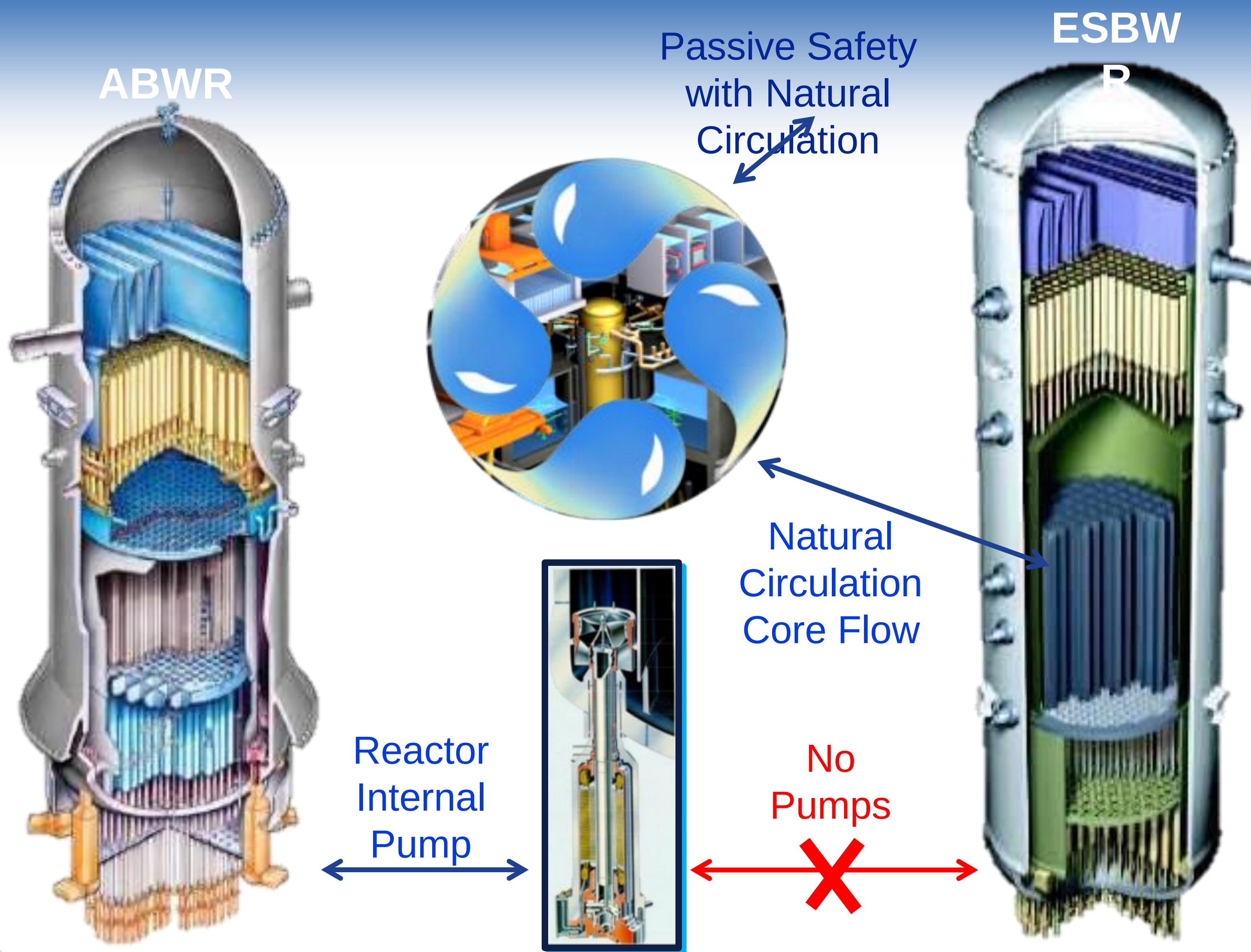
Continued Evolution and Investment in BWRs



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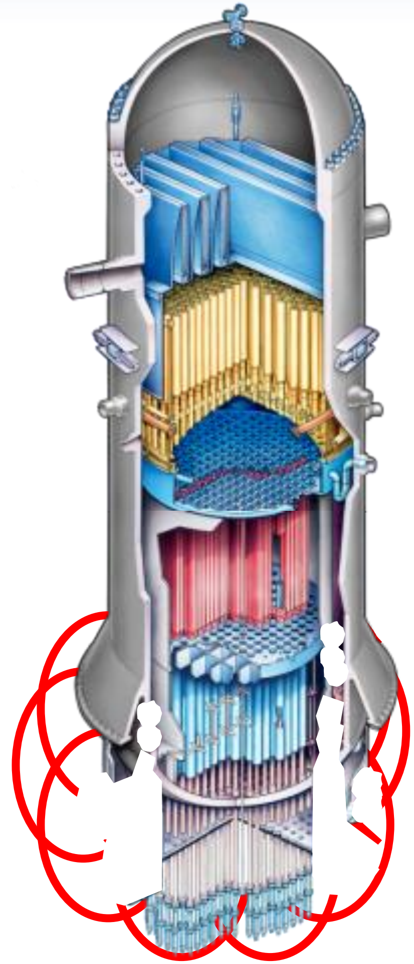
Evolution to ESBWR

ESBWR

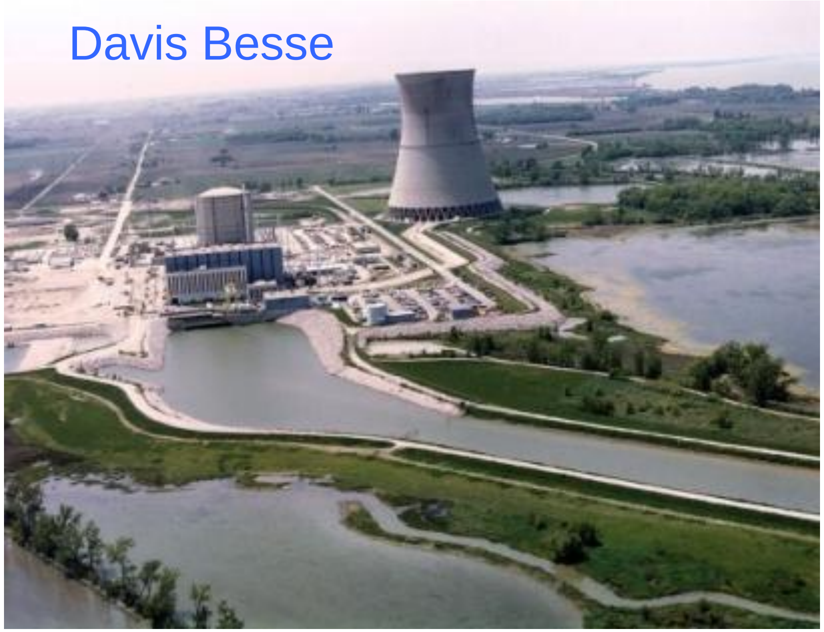
chimney

ABWR

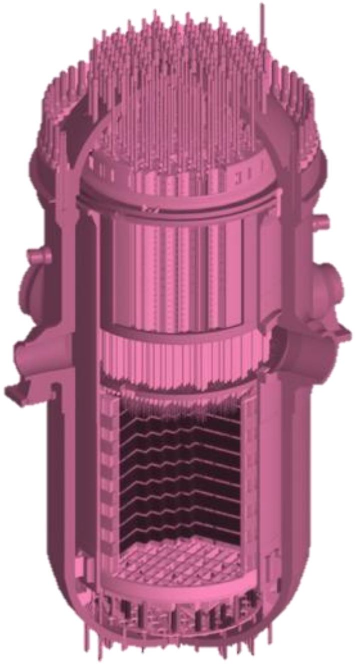


No large pipe penetrations

Consider the PWR …*Vessel Head Is*



Reactor



Vessel Head

- Boric acid erosion… from boron used for power control
- This was a significant safety issue
- Davis Besse shut down 2002-2004 with a total cost of $600MM+

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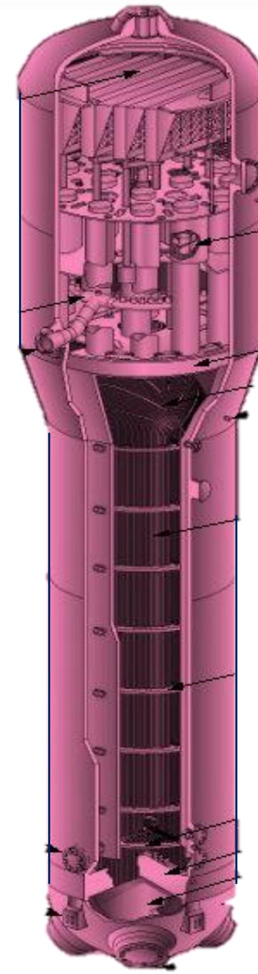
Consider the PWR …*Steam Generator Rep*

Steam Generators



Steam Generator Replacement (SGR)

- Tube leaks due to corrosion and mechanical wear…alloy 600
- $250 - $300 MM to replace
- 3+ month outages with additional dose of 0.8-2.5 Sv (80-250 rem)
- Access holes created in containment
- Significant rad waste components
- May be necessary more than once in reactor lifetime

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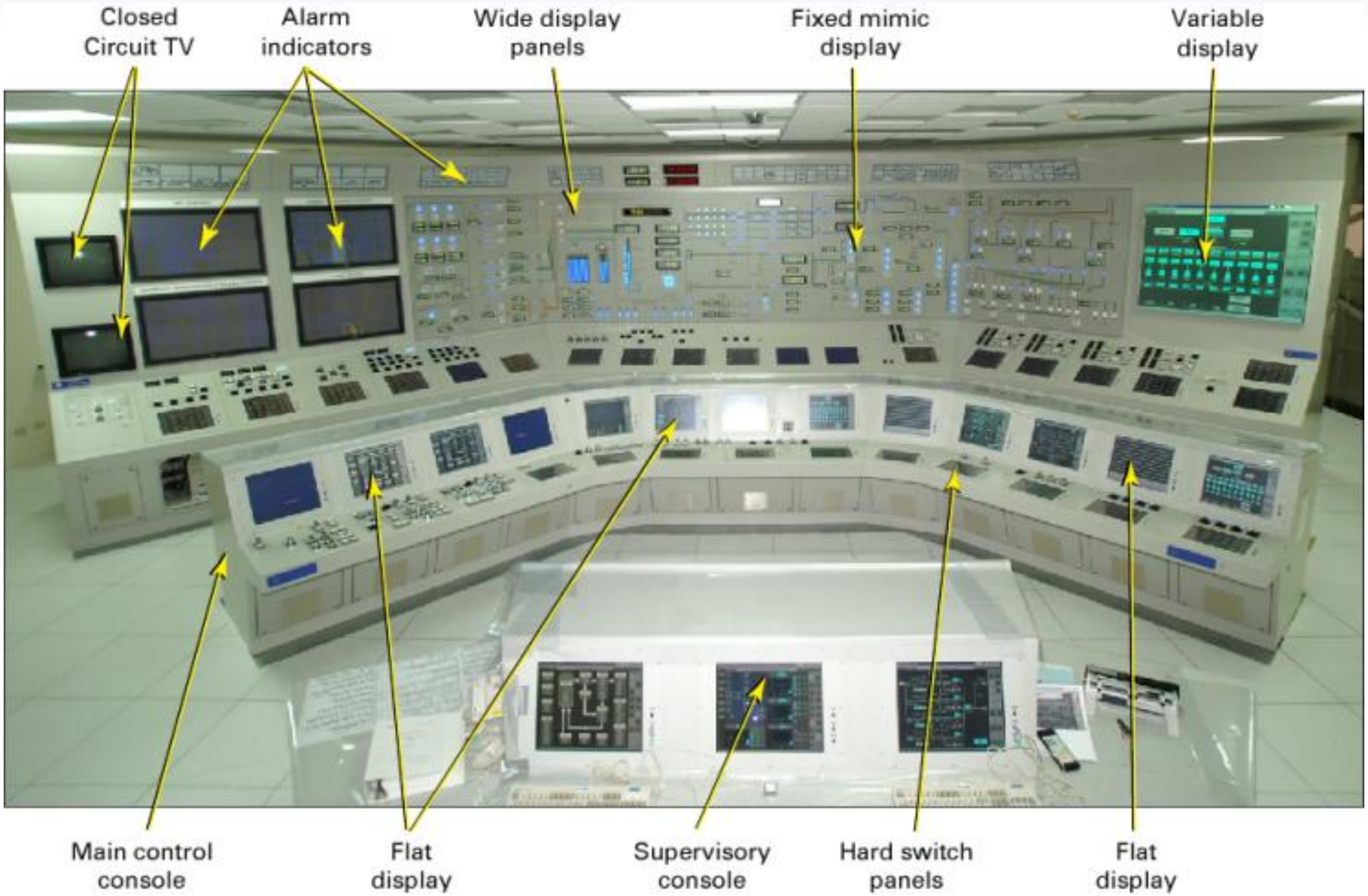
ABWR Control Room



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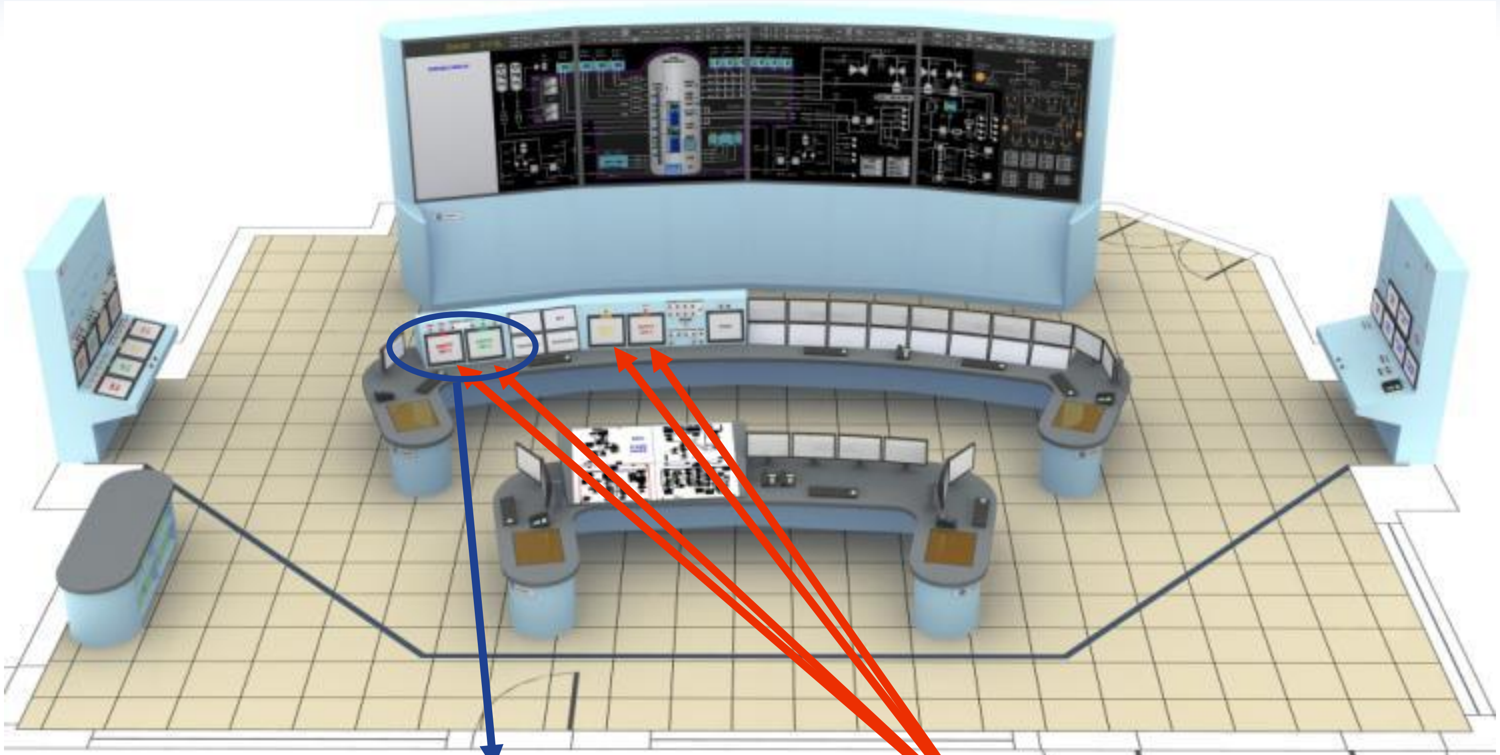
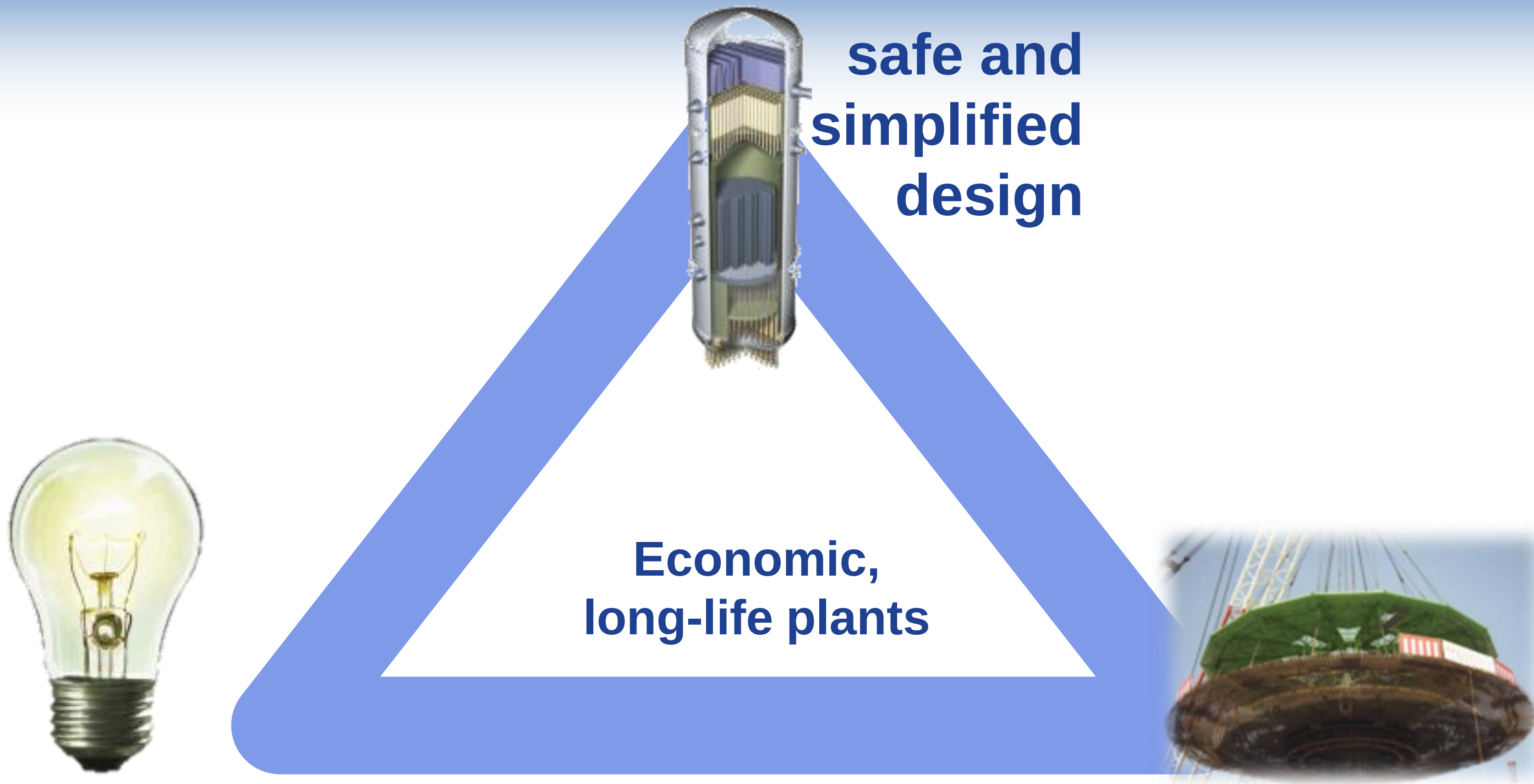
ESBWR Control Room



Dedicated, Divisional Video Display Units (DVUs)

Confidence for investors and regulators



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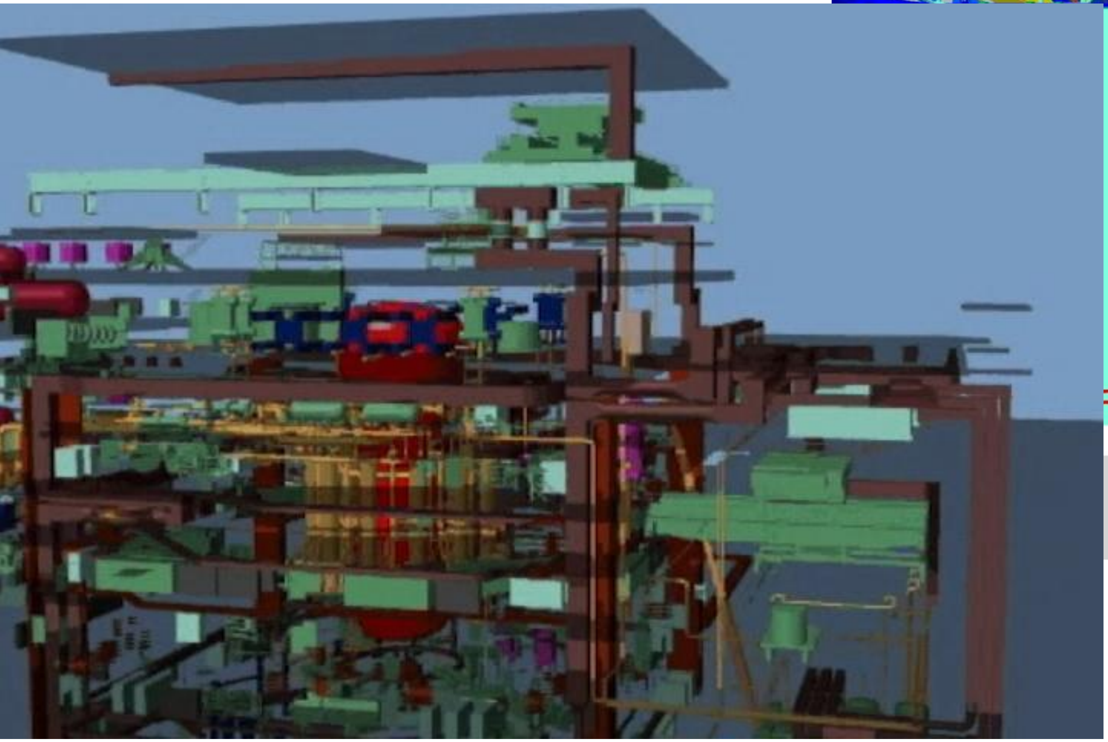
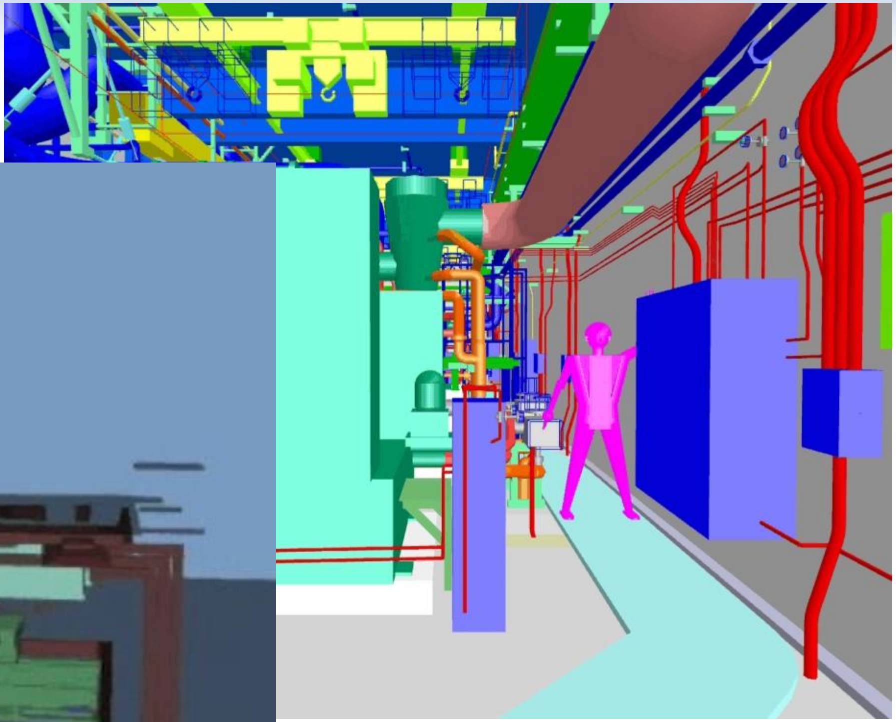
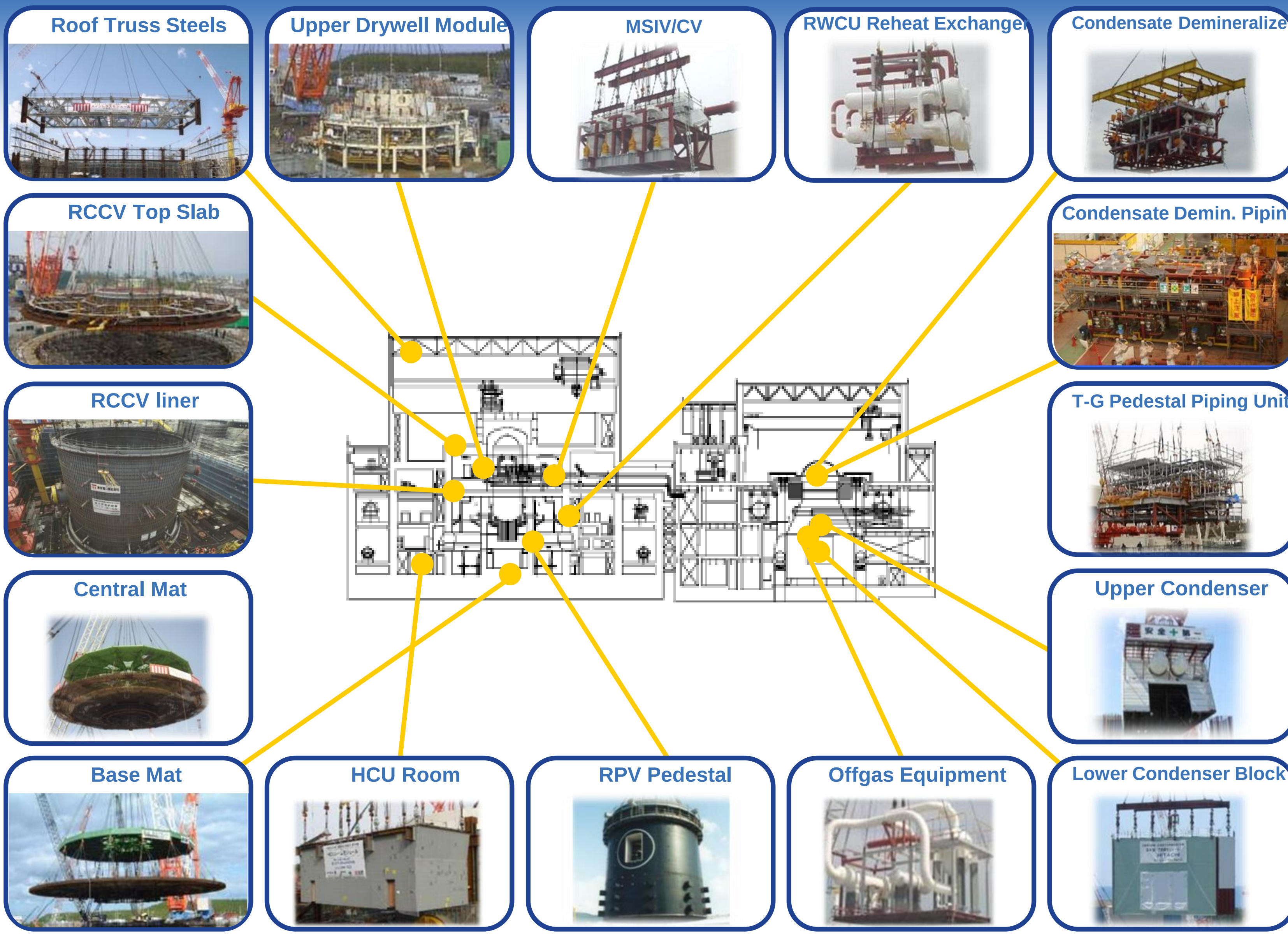
Detailed engineering before on-site work

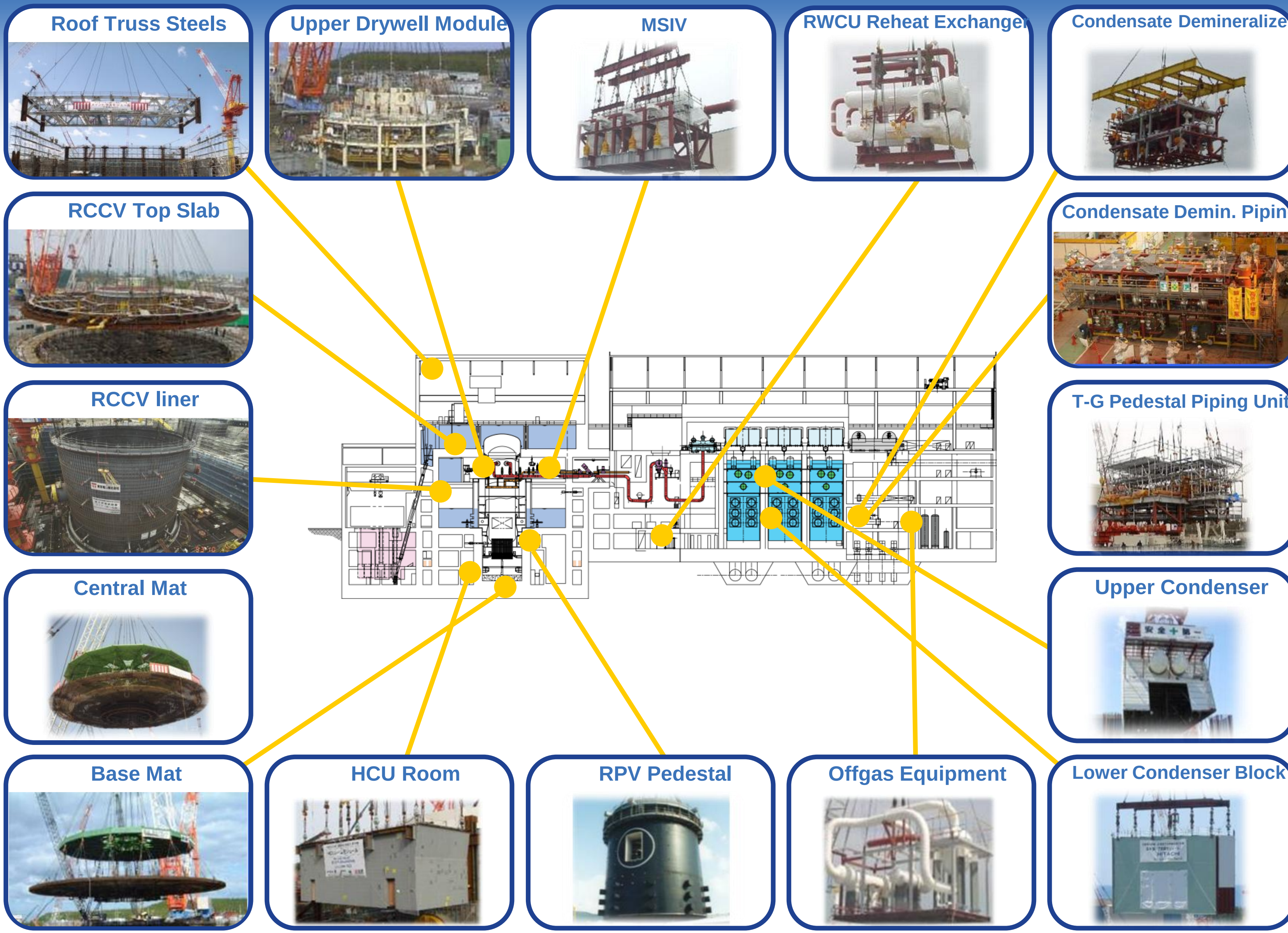




ABWR modularization – proven in Japan



ESBWR modularization – based on ABWR



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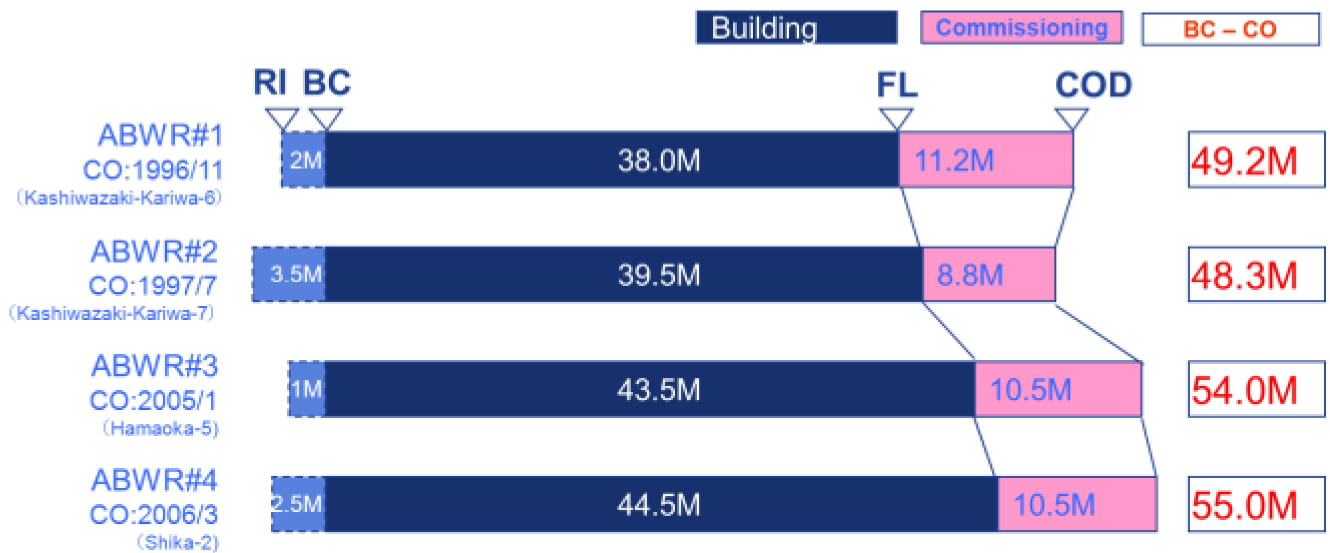
Predictability

1st of a Kind Advanced technology plant built on a 38-month construction schedule

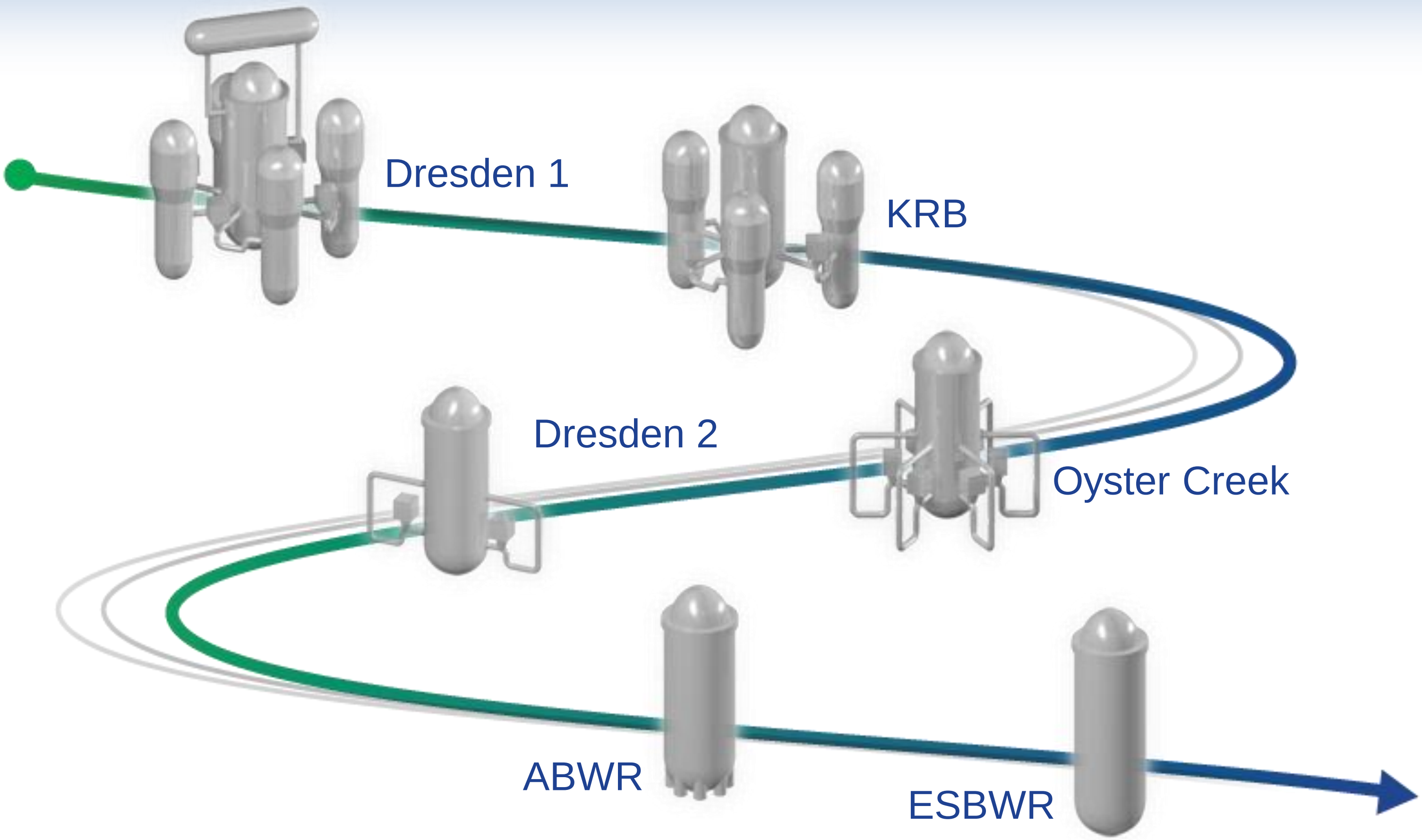
Kashiwazaki-Kariwa 6/7 ABWRs

Efficient, repeatable model:

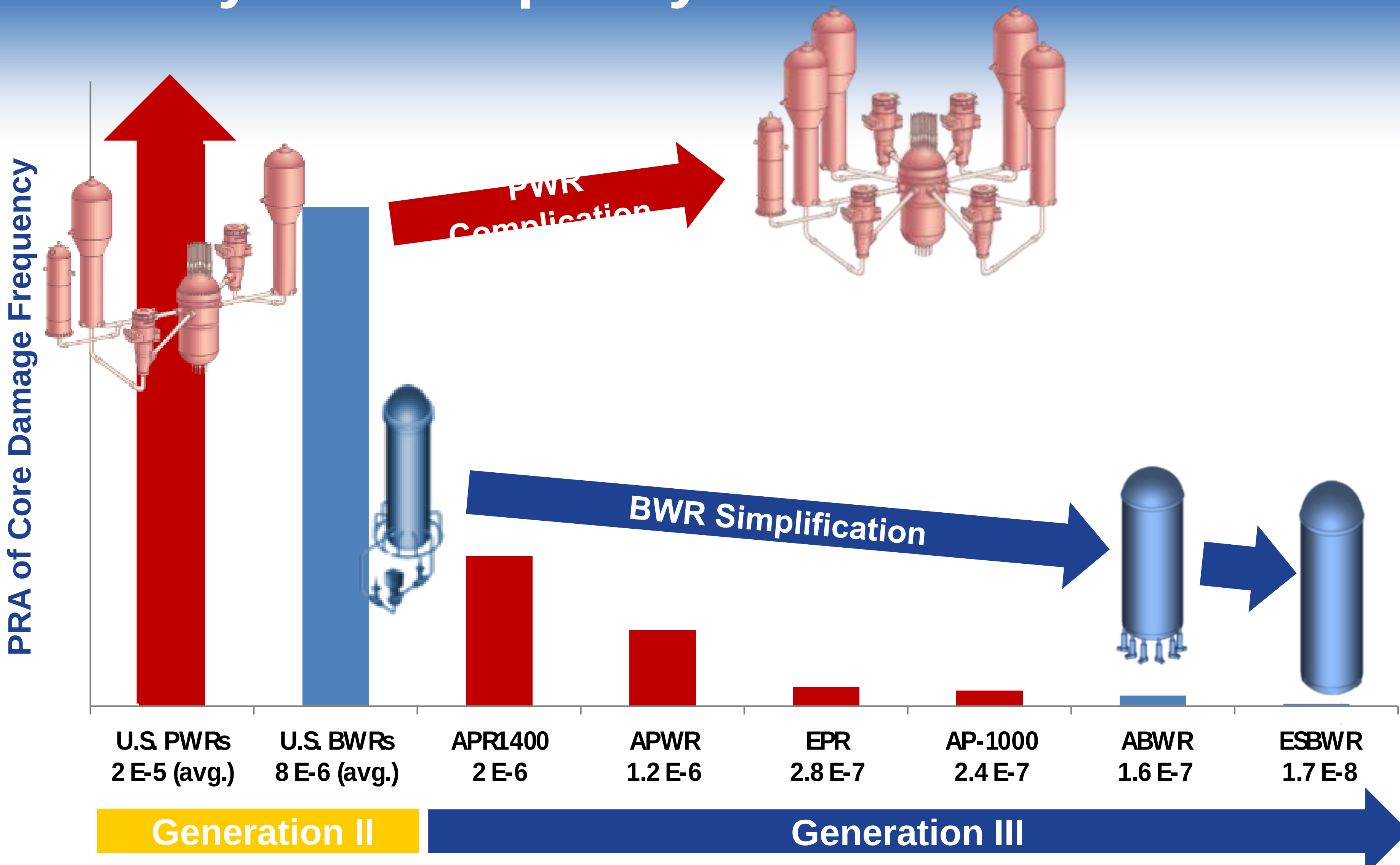


RI : Rock Inspection   BC : Start of Basemat Construction   FL : Fuel Loading   CO : Commercial Operation

Simplicity



Safety and simplicity



Note: PRA of CDF is represented in at-Power internal events (per year)

Note: NSSS diagrams are for visualization purposes only

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Fuel performance imperative to plant performance

Record runs for light water reactors

Plant Name	Type	Days of Continuous Operation	Date ended
LaSalle 1	BWR - GE	739	Feb-06
Susquehanna 2	BWR - GE	722	Apr-09
LaSalle 2	BWR - GE	711	Feb-07
Peach Bottom-3	BWR - GE	707.7	Sep-05
Brunswick 1	BWR - GE	707.2	Mar-02
Peach Bottom-3	BWR - GE	706	Sep-07
Three Mile Island 1	PWR - B&W	705	Oct-09
Calvert Cliff 2	PWR - CE	692.2	Feb-09
Three Mile Island 1	PWR - B&W	689	Oct-05
LaSalle 1	BWR - GE	687	Feb-08
Three Mile Island 1	PWR - B&W	680	Oct-03
Indian Point 3	PWR - W	678	Mar-09
Susquehanna 2	BWR - GE	677	Feb-05
Browns Ferry 3	BWR - GE	669.4	Mar-02
Three Mile Island 1	PWR - B&W	668	Sep-99
Monticello	BWR - GE	627	Dec-07
Three Mile Island 1	PWR - B&W	616	1997
Indian Point 2	PWR - W	616	Dec-05
Davis-Besse	PWR - B&W	593	Jan-02
Millstone 3	PWR - W	585	Feb-01

- GE BWRs represent 10 out of the top 20 longest running reactors
- The top six are GE BWRs
- GE BWRs represented 5 independent utilities

Source: Platts News Flashes and Company Press Releases Updated 11/03/2009

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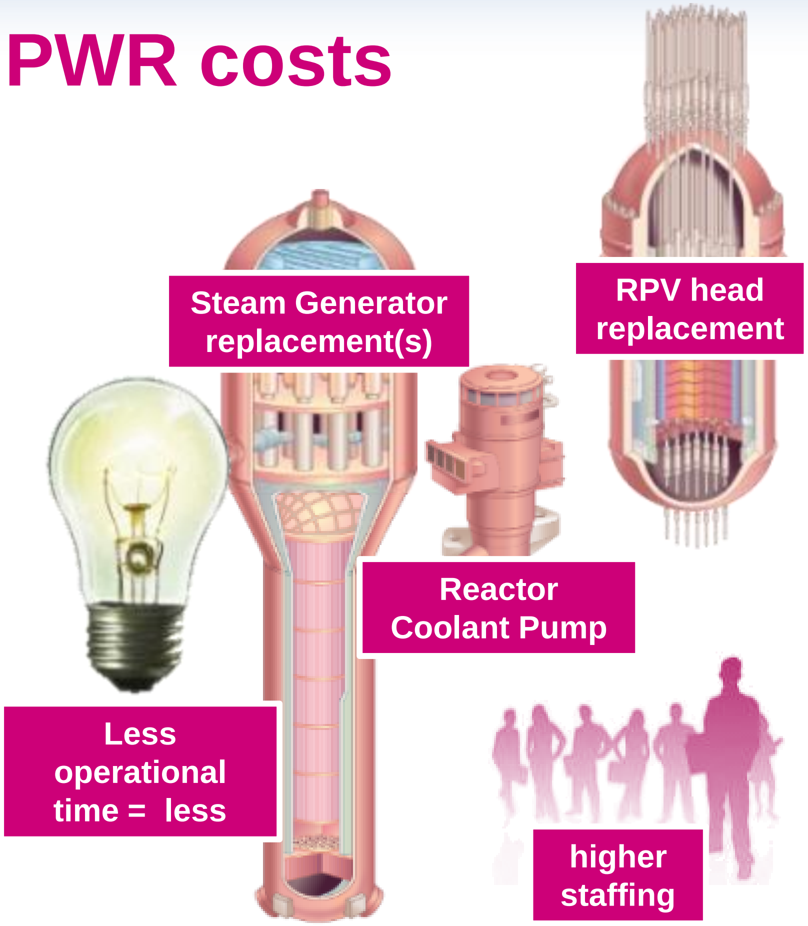
BWR Operational Cost Advantages

PWR costs



- No steam generator replacement(s)
  - **$250-300MM**, potential for up to $2.8B (Crystal River PWR)
- No vessel head replacement
  - ~**$32MM**, potential for up to $600MM (David Besse PWR)
- No Reactor Coolant pump to operate – 0.5% MWe output savings (ESBWR)
  - **$100MM** in lost revenue over 60 years
- ~50 less personnel per BWR unit
  - **>$400MM** over 60 years
- Six additional months of revenue on avg.
  - **$180MM** over 60 years
- ~8 fewer reloads over 60 years

BWR savings estimated to be more

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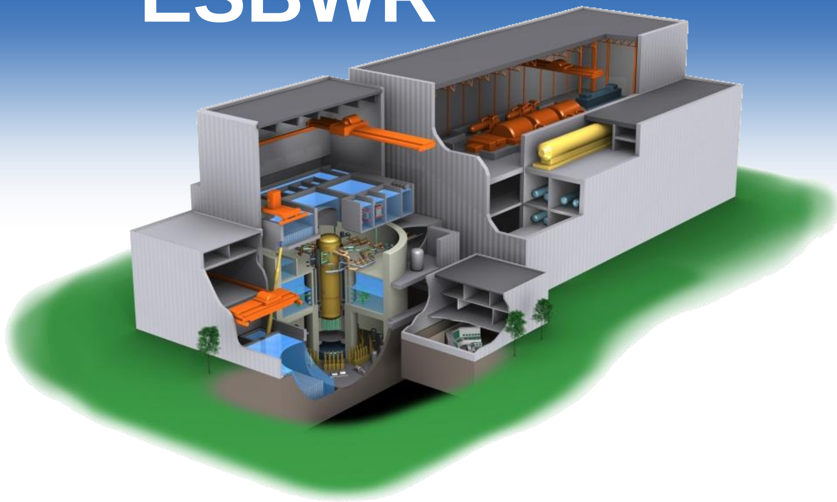
ABWR

- Best in-class CDF
- The only advanced technology in operation today
- Licensed in 3 countries
- 4 ABWRs in operation today
- 4 ABWRs under construction
- 1st of a kind plant built in 38 months with repeated success
- Less equipment, piping, etc. than similar sized PWRs

ESBWR



- Industry's lowest CDF
- Passive safety and natural circulation design
- Cooling for >7 days without AC power or human action
- Lowest projected operations & maintenance and staffing costs
- 25% fewer pumps, valves, and motors than active safety nuclear plants
- Completing NRC certification

Lowest core damage frequencies (industry standard for plant safety) of any Generation III or III+ reactors

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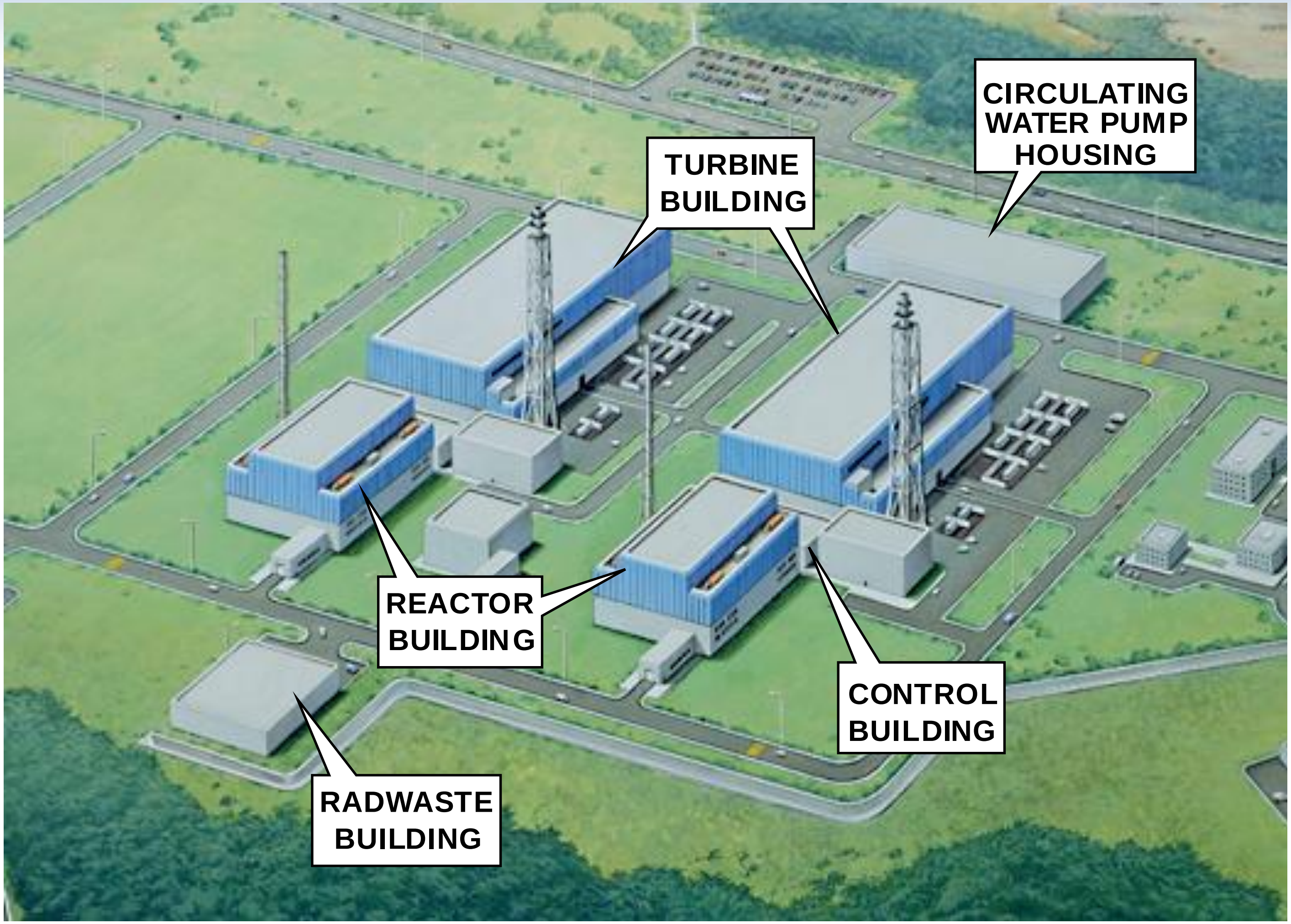
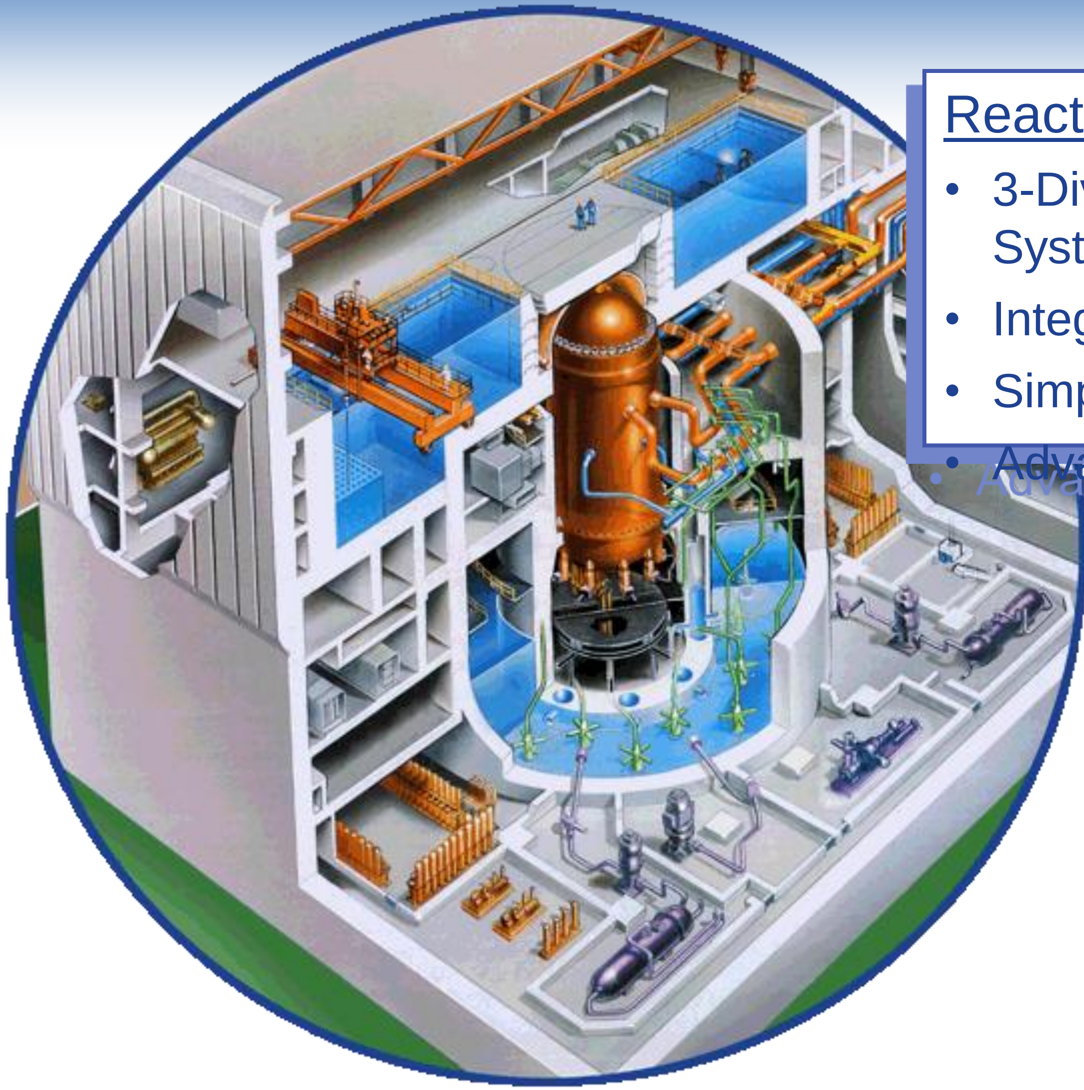
Typical Two Unit Site



ABWR 3D Cutaway



<u>Reactor Building</u>

- 3-Division Safety Systems
- Integrated Containment
- Simple Geometry
- Advanced Modularization

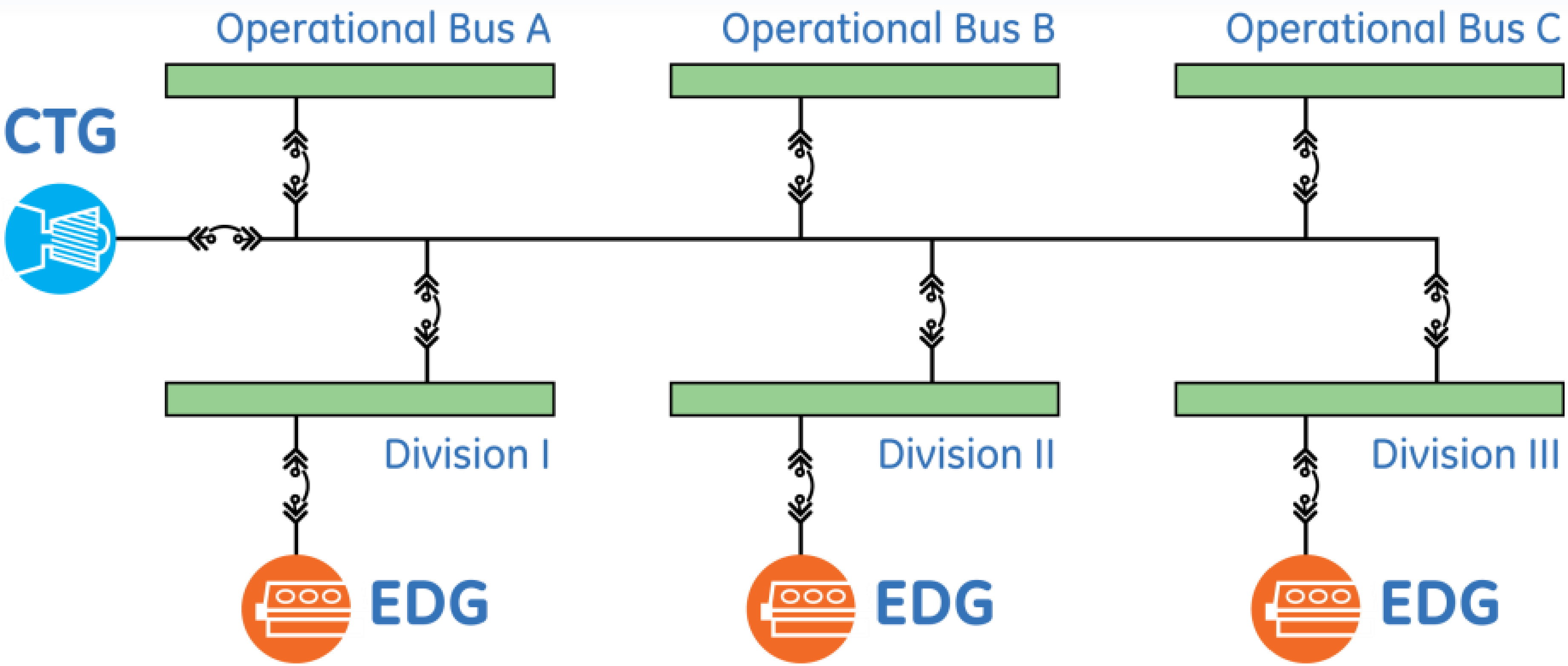
• Advanced Modularization

Photo.2 Fit up of Shell and Bottom Head

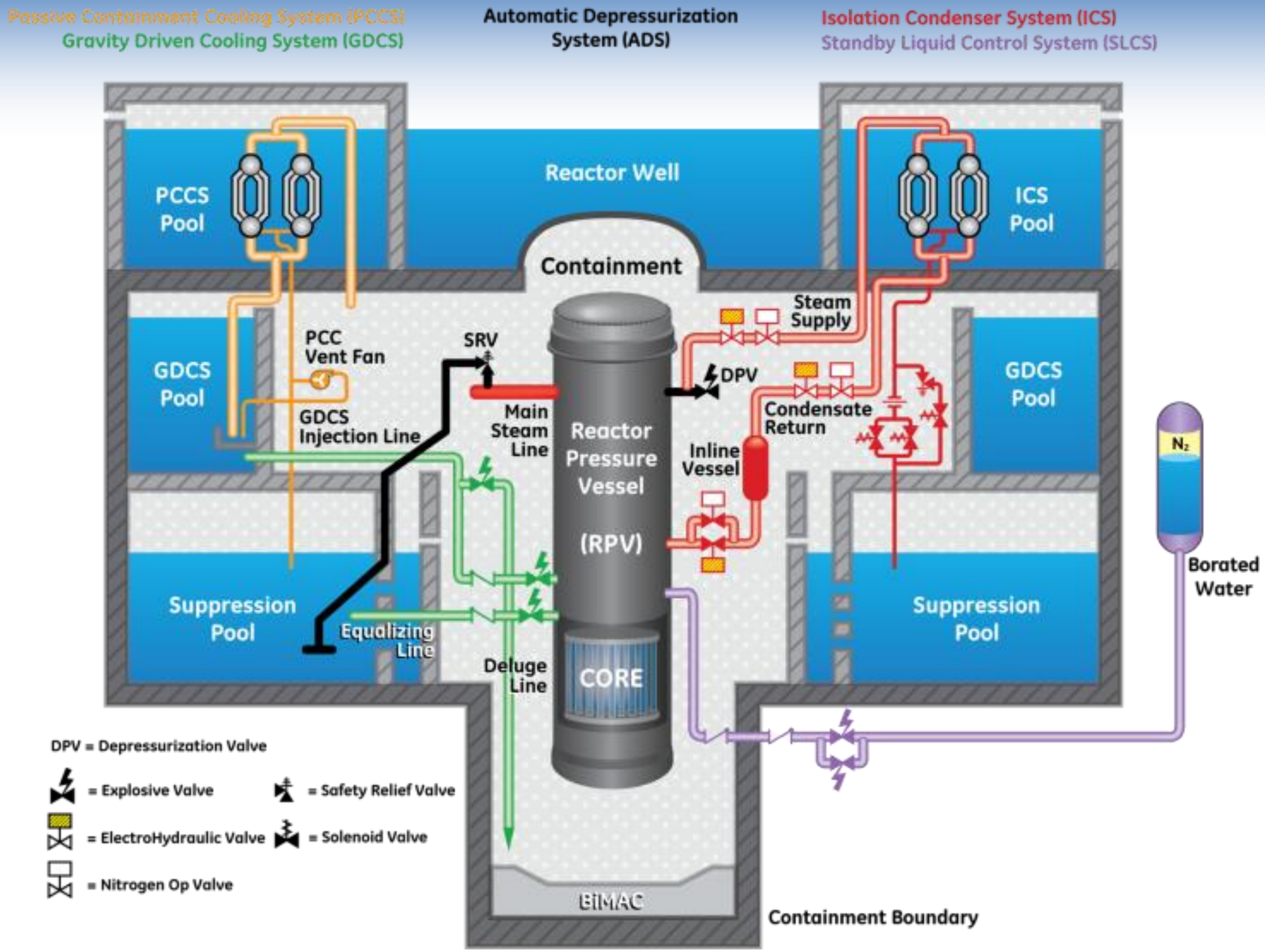
ABWR Reactor Recirculation System

- Forced circulation of coolant through core allows for higher heat transfer
- Adjustable speed pumps also control flowrate through core to change reactor power (voids)

ABWR Key Design Features – Onsite AC Power



ESBWR passive safety systems



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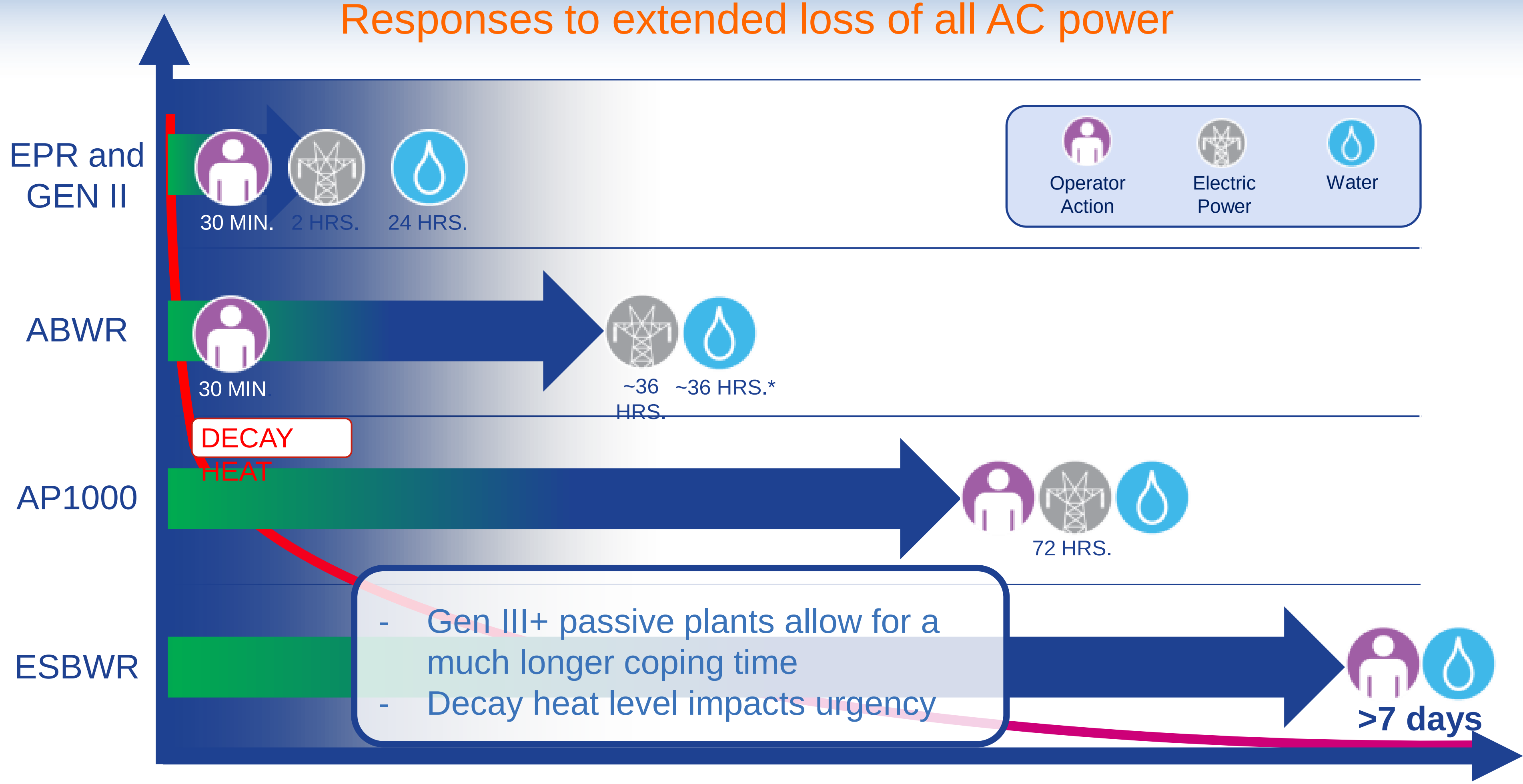
Isolation Condenser System

- Fully passive – only requires gravity to function and starts automatically (fails in-service if DC power is lost)
- 4 separate systems housed in reinforced concrete vaults
- Limits reactor pressure (no Safety Relief Valve lifts)
- Steam rises from reactor to the tubes in the condenser pool then gravity pulls the condensed water back into the reactor

Responses needed to maintain core cooling

Responses to extended loss of all AC power



*ABWR DCD credits water addition at 8 HRS.

References: AP1000: US DCD rev. 18 Section 8.5.2.1, EPR: US DCD Rev. 1 Section 8.4

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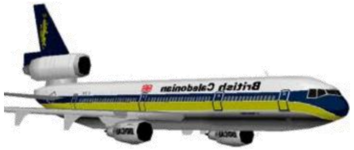
BWR Evolution is Natural



Dresden 1

Oyster Creek

Dresden 2

ABWR

ESBWR