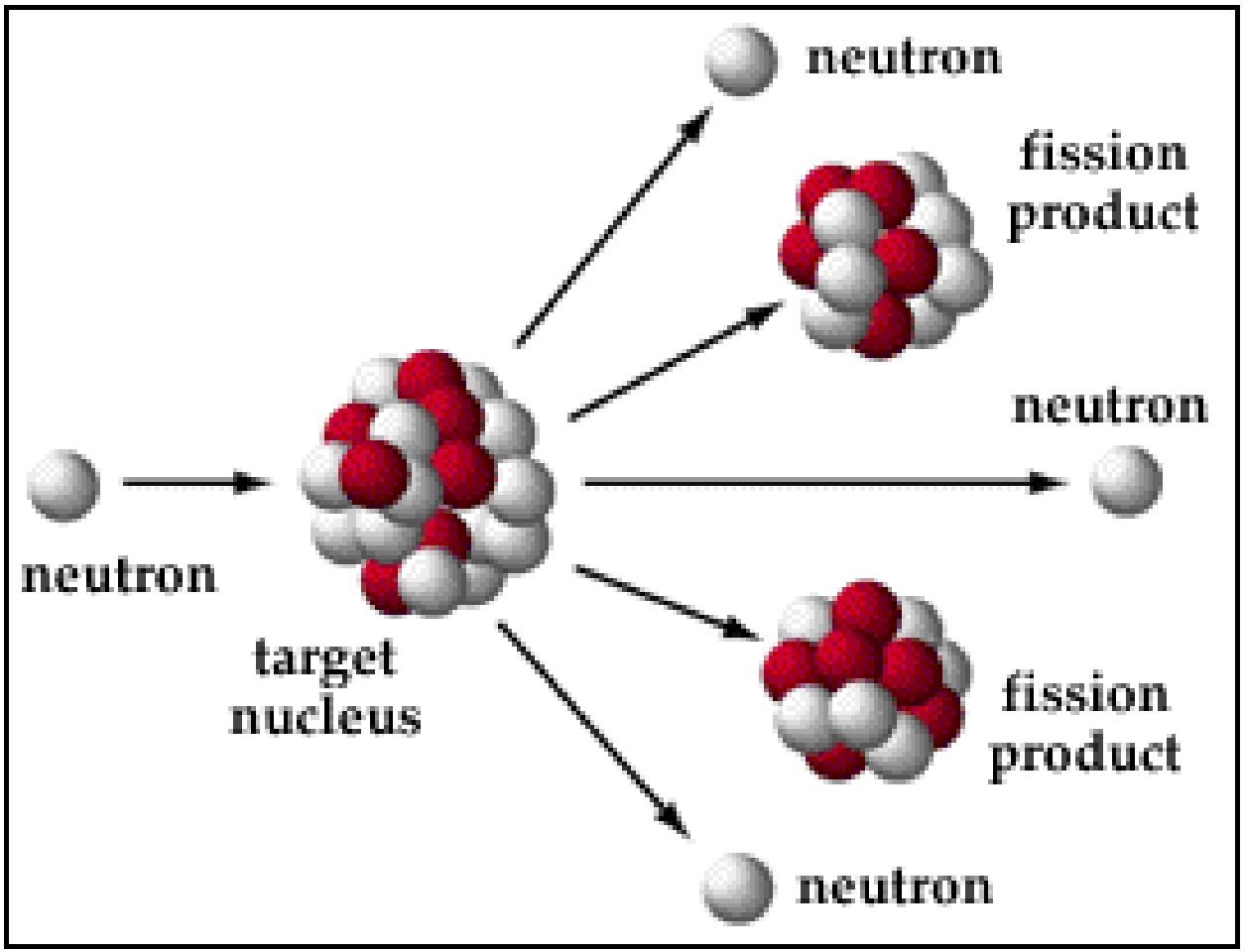
Parliamentary Friends of Nuclear Industries

Nuclear 101

Thanks to 20th Century Fox



Fission Reaction

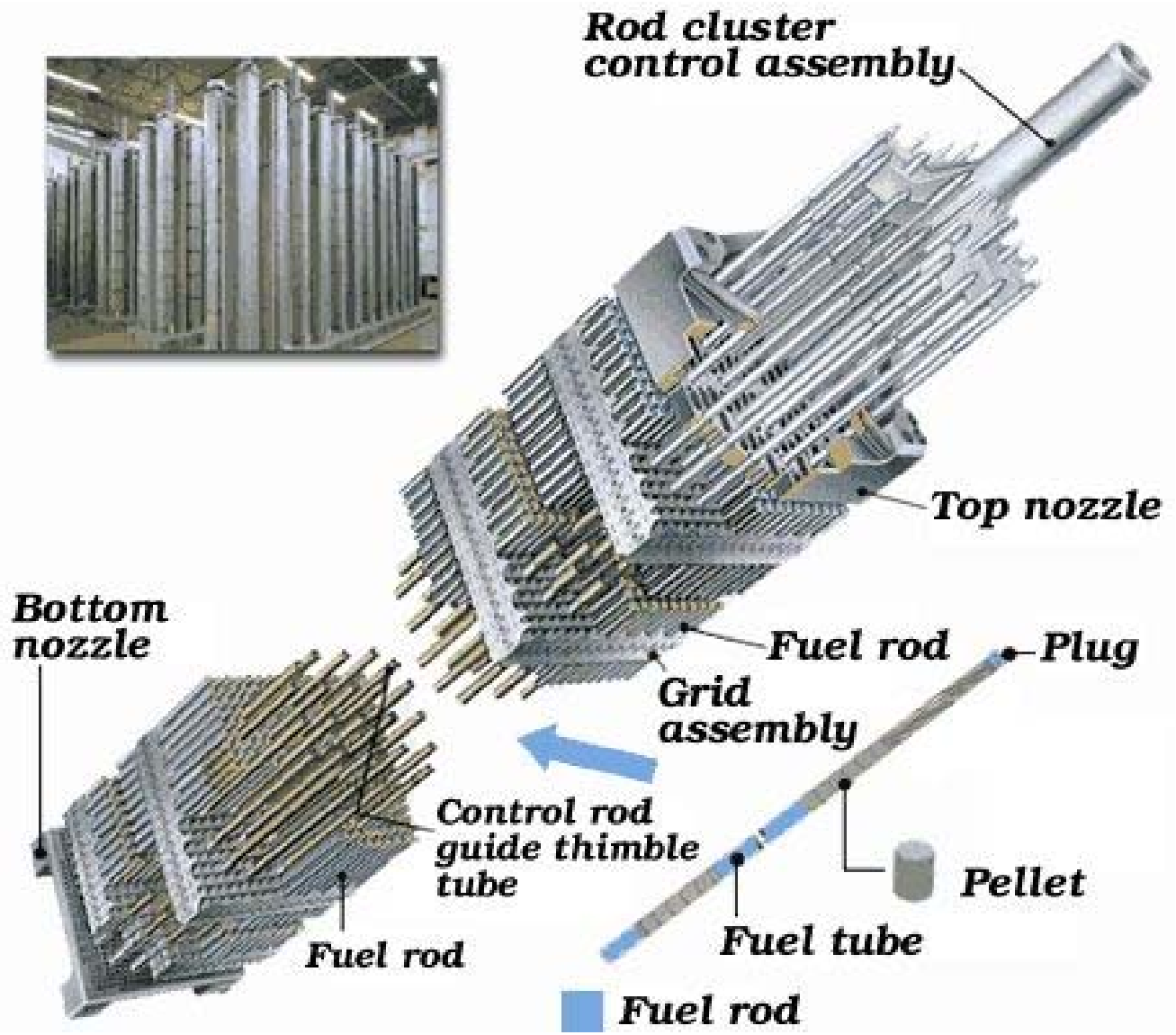
U-235 is the only naturally occurring fissile material (0.71% of uranium ore, rest is U-238)

- Neutron absorbed
- Excited compound nucleus formed, then decays and fission products ejected = *Energy*
- 2 or 3 neutrons emitted = *Chain reaction*
- Fission products decay with emission of neutrons = *Control*
- Increased probability of fission when neutrons slowed down = *Moderator*

Enriched Uranium

^{235}U percentage	Neutrons/absorption event
0.71% (natural U)	1.33
1%	1.48
2%	1.73
3%	1.83
20%	2.04
30%	2.07
100%	2.08

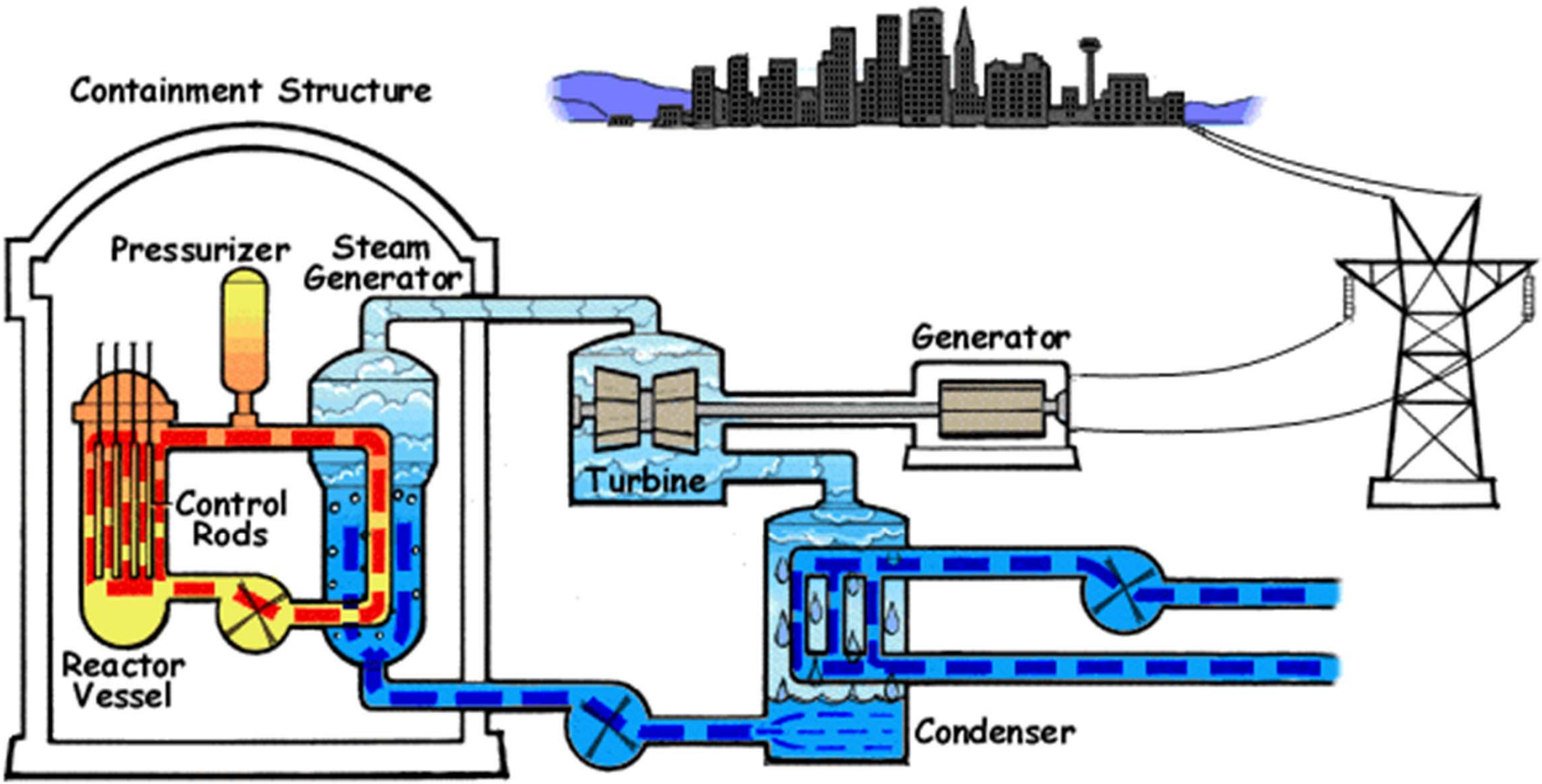
Power Reactor = 3%-5%, UO_2 ceramic oxide, Zirconium clad
Research Reactor = 19.75%, silicide, aluminium clad
Nuclear weapon > 90%



Fuel for Pressurised Water Reactor (PWR)

4 m high, 215 mm x 215 mm
264 fuel tubes/fuel assembly

Pressurised Water Reactor (PWR)

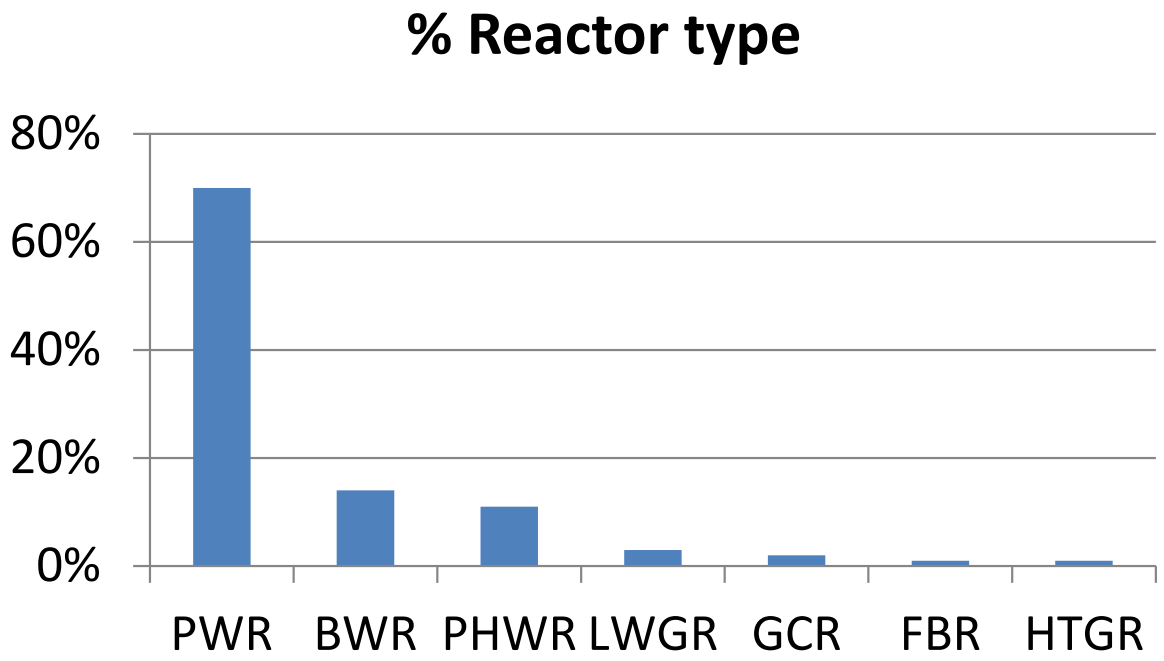


Primary circuit: 294°C inlet, 325°C outlet, 15 MPa
Secondary circuit 224°C inlet, 275°C outlet, 7 MPa

Source: US NRC

November 2022 World Power Reactors

Source: WNA Reactor database



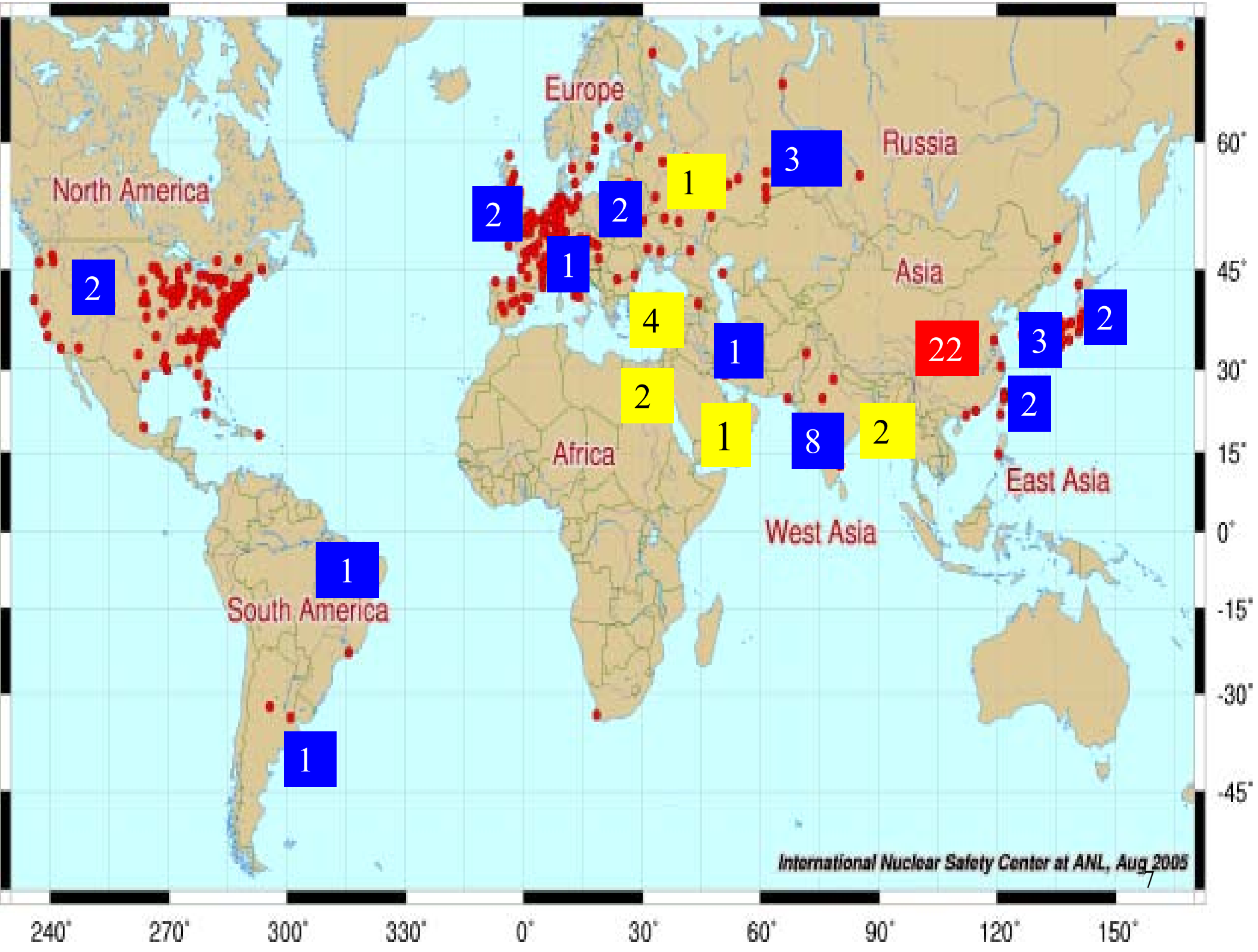
Reactors under Construction

PWR	51
BWR	2
PHWR	3
FBR	4
Total	**60**

PWR	Pressurised Water Reactor	307
BWR	Boiling Water Reactor	61
PHWR	Pressurised Heavy Water Reactor	47
LWGR	Light Water Graphite Reactor	11
GCR	Gas Cooled Reactor	8
FBR	Fast Breeder Reactor	2
HTGR	High Temperature gas Reactor	1
	Total Number of operable reactors	**437**

Require enriched uranium

Use natural uranium


Europe
Russia
North America
Asia
Africa
West Asia
East Asia
South America
2
2
2
1
1
3
4
1
2
1
8
2
22
3
2
2
1
1
60°
45°
30°
15°
0°
-15°
-30°
-45°
240°
270°
300°
330°
0°
30°
60°
90°
120°
150°
International Nuclear Safety Center at ANL, Aug 2005

United Arab Emirates – 4 x APR-1400

2008	Policy on the development of peaceful nuclear energy
2009	Contract awarded to South Korea (Kepco)
2012	Construction of first unit commenced, completed 2018
2020	Unit 1 operating
2021	Unit 2 operating
2022	Unit 3 operating

Generations of Nuclear Energy

Generation I

Early Prototypes

- Shippingport
- Dresden
- Magnox

Generation II

Commercial Power

- PWRs
- BWRs
- CANDU

Generation III

Advanced LWRs

- CANDU 6
- System 80+
- AP600

Generation III+

Evolutionary Designs

- ABWR
- ACR1000
- AP1000
- APWR
- EPR
- ESBWR

Generation IV

Revolutionary Designs

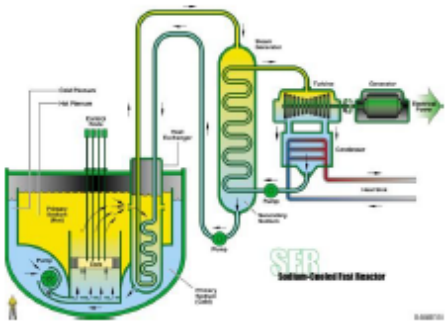
- Safe
- Sustainable
- Economical
- Proliferation Resistant and Physically Secure

1950 1960 1970 1980 1990 2000 2010 2020 2030

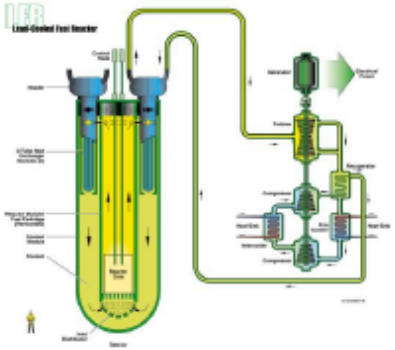
Gen I | Gen II | Gen III | Gen III+ | Gen IV

GENERATION IV REACTOR CONCEPTS

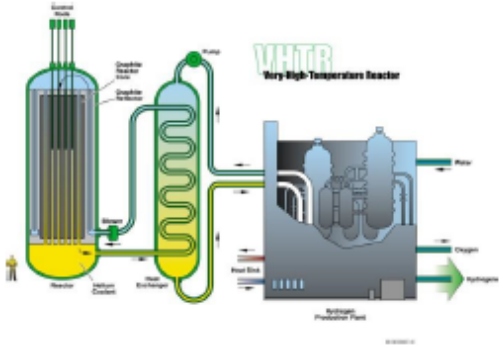
GEN IV International Forum



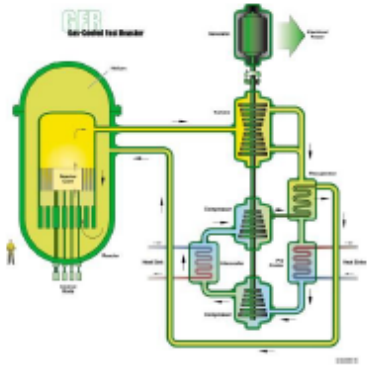
Sodium Fast Reactor



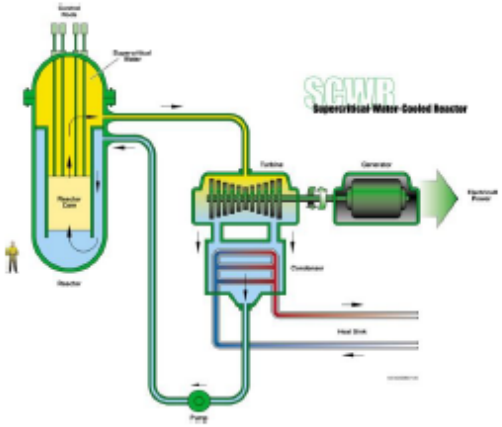
Lead Fast Reactor



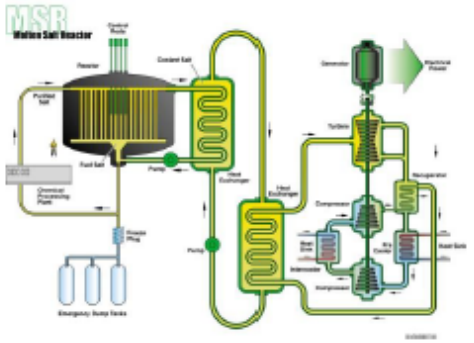
Very High Temperature Reactor



Gas-Cooled Fast Reactor



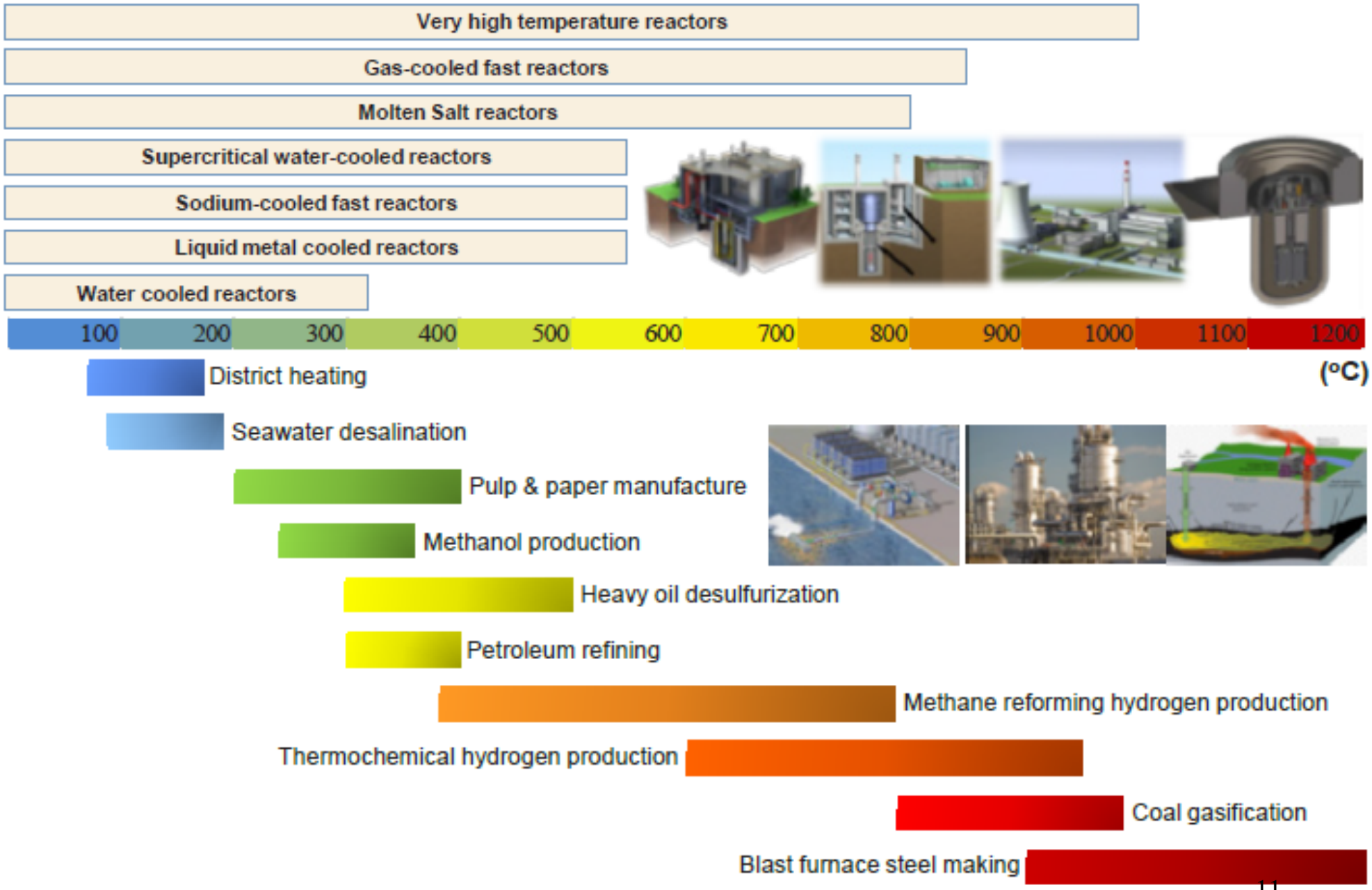
Super Critical Water Cooled Reactor



Molten Salt Cooled Reactor

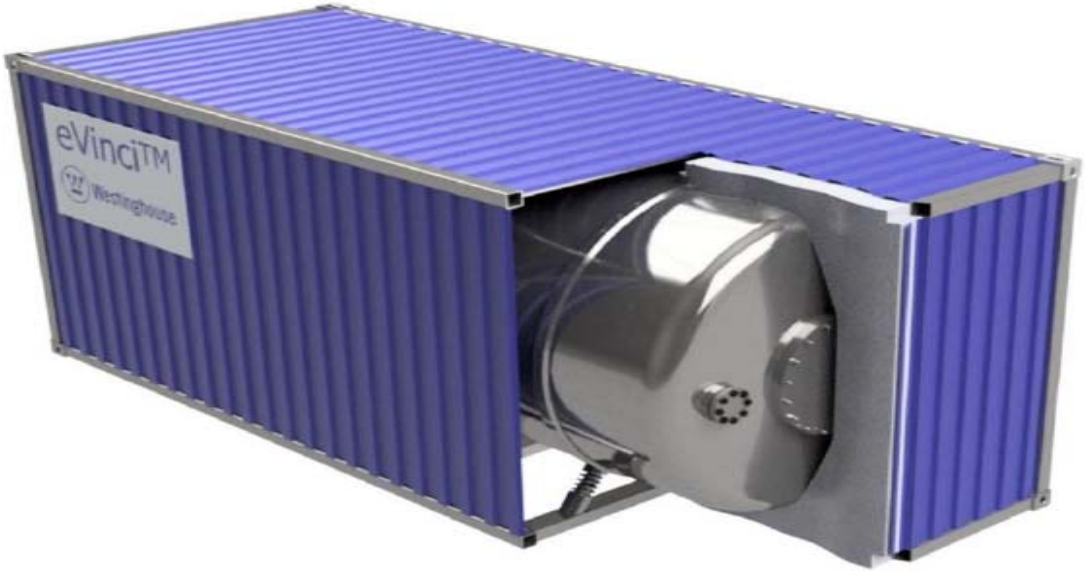
Australia is a member of GIF

Opportunities for Process Heat

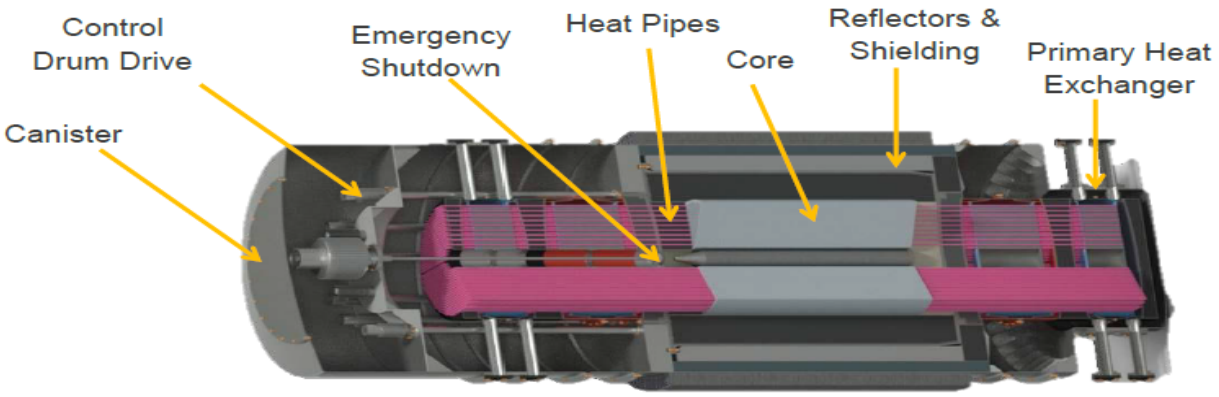


Source: 2016 IAEA SMR Book

Micro Reactor for Remote Sites, off grid applications



Westinghouse eVinci Micro-Reactor 5MWe



TRISO fuel, 10 years before refuelling.
Sodium heat pipes, no moving parts, no water.
Power conversion – Brayton air cycle.

Arrives on site in 3 shipping containers – 3 months from arrival to operating