Small is Beautiful
The New Nuclear

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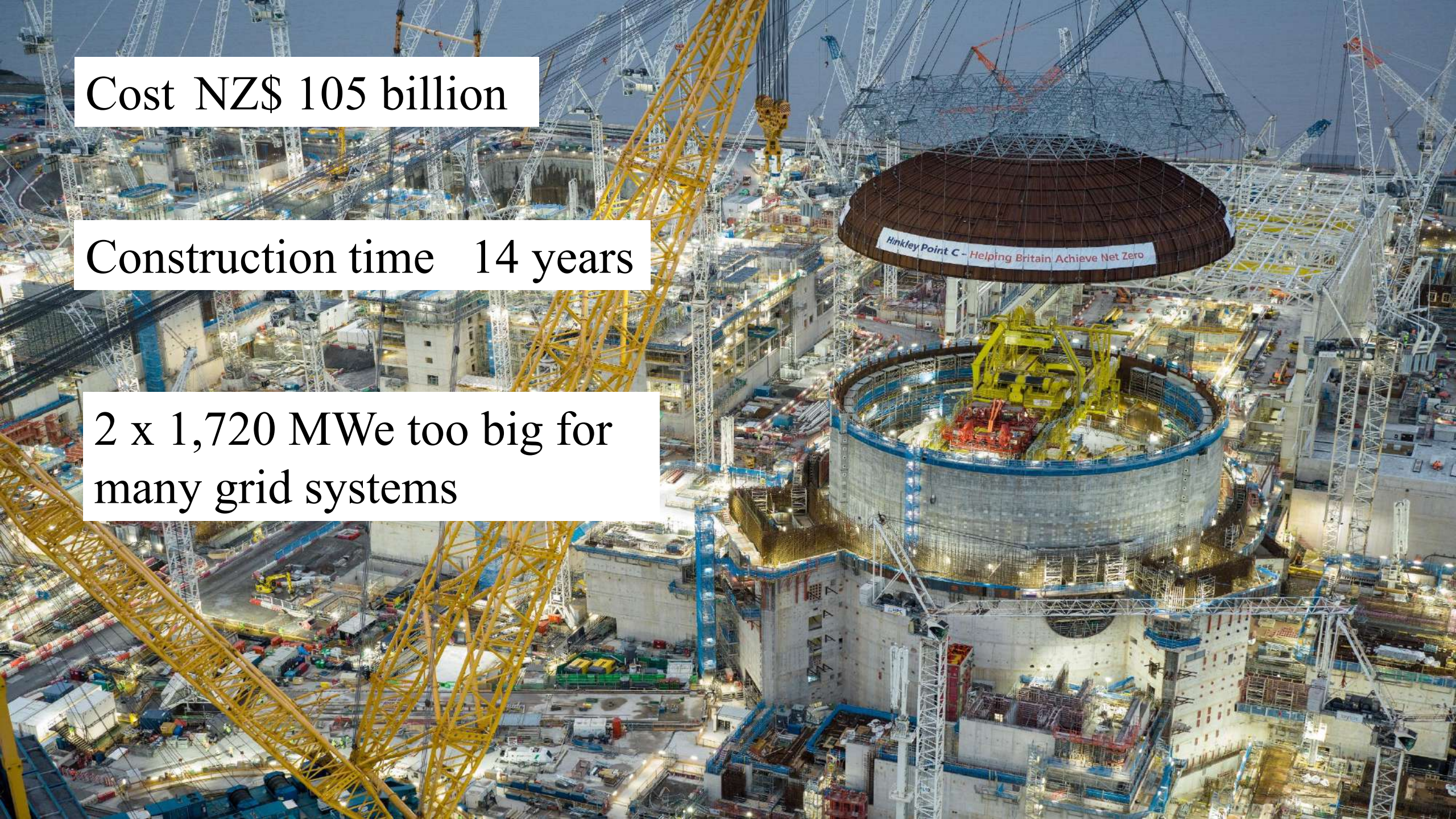
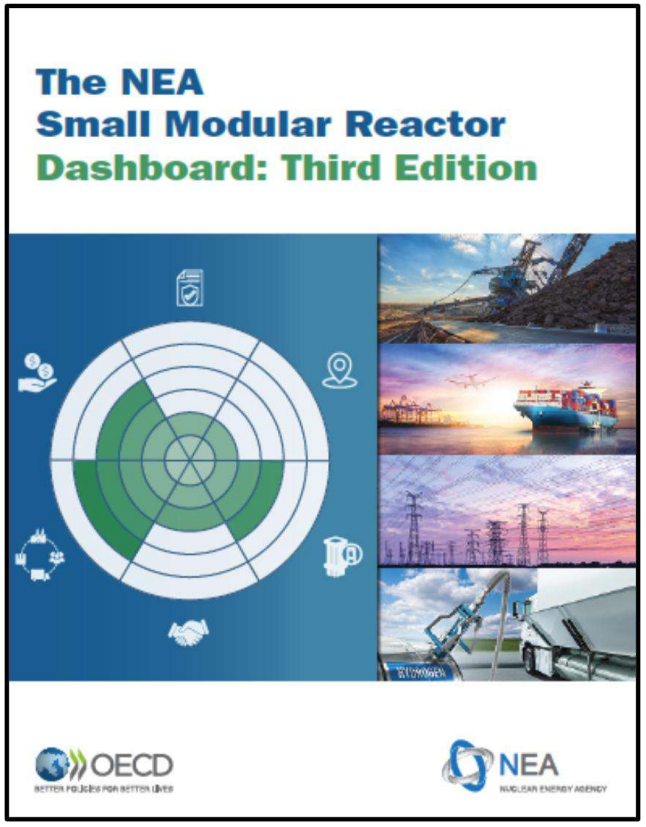
May 2026



Cost NZ$ 105 billion

Construction time 14 years

2 x 1,720 MWe too big for many grid systems



Third Edition July 2025

Small Modular Reactors (SMRs)

- Reactors with a power output < 300 MWe (IAEA), more usually < 200 MWe
- Factory built reactor module

Technologies:

- Light water reactors (coolant and moderator) Pressurised Water Reactors (PWR) and Boiling Water Reactors (BWR)
- Gen IV (Advanced Reactors)
  - High Temperature Gas Reactors (HTGR)

Small Modular Reactors (SMRs)

- Provide reliable, low emissions power particularly for small grid systems or where multiple units preferred. Floating barge-mounted versions for island nations and remote locations.
- High level of passive or inherent safety
- Reactor vessel can be installed below ground (external hazards/security)
- Compact, factory built, transportable module – reduced on-site construction time, less risk of delays
- Lower initial capital cost and modules can be added as demand increases
- One module shutdown for refuelling, remaining modules producing power
- Simpler to operate and maintain
- Load following, island mode and black start capabilities
- Multipurpose: electricity, process steam, desalination, district heating
- Compact site (BWRX-300 fenced area 2.6 hectares)

Boiling Water Reactor (BWR)

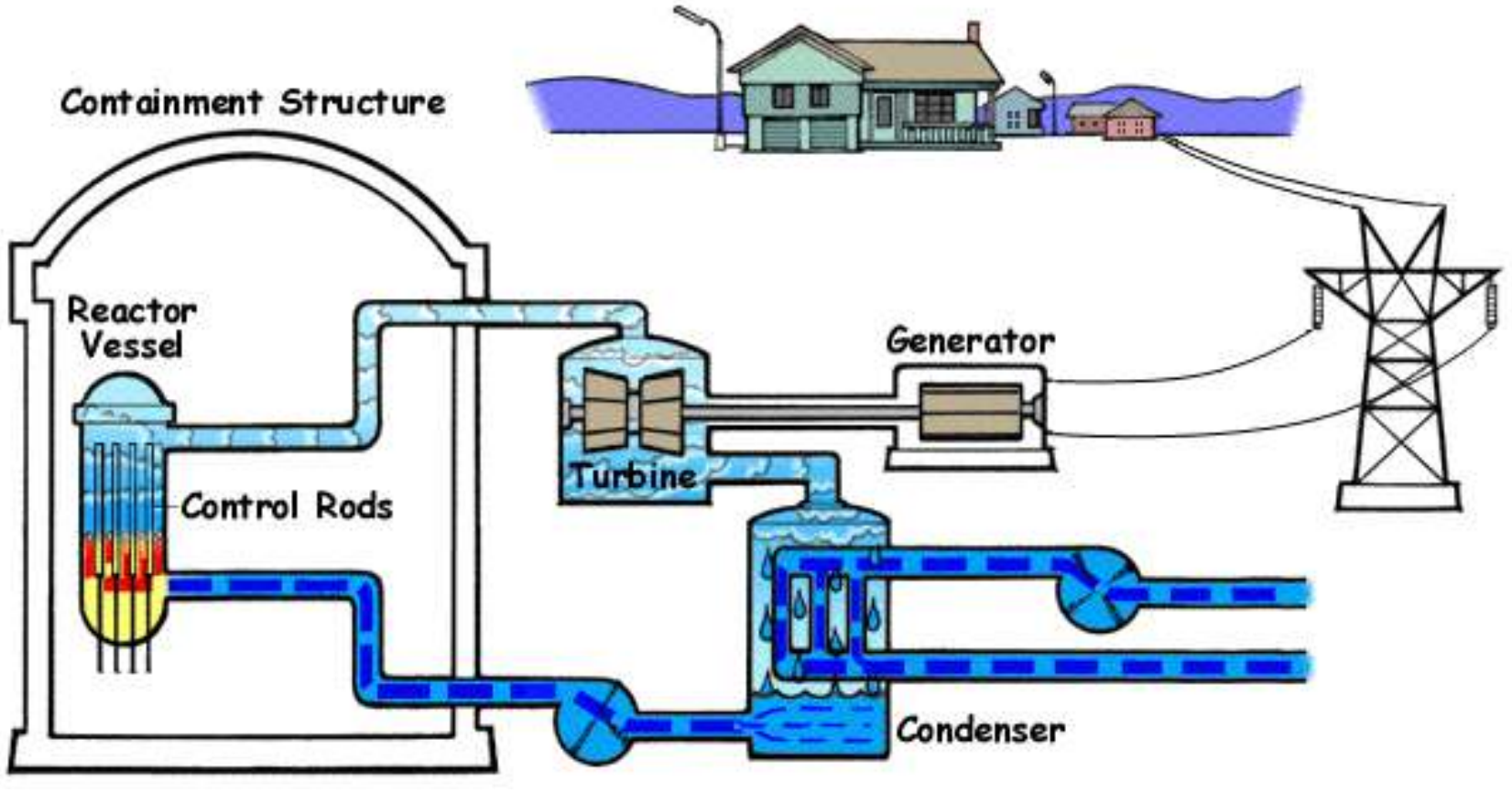
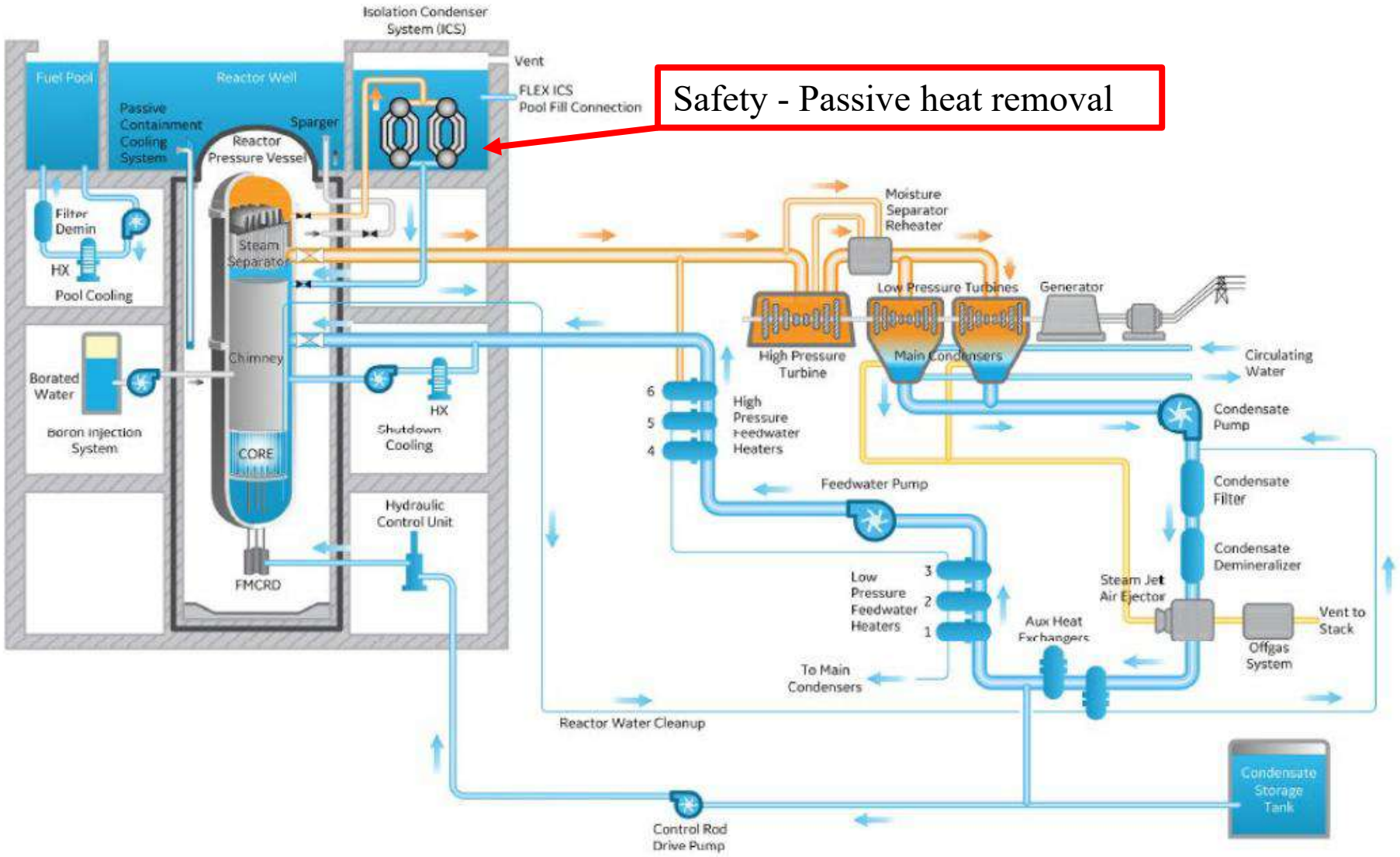


Image: NRC

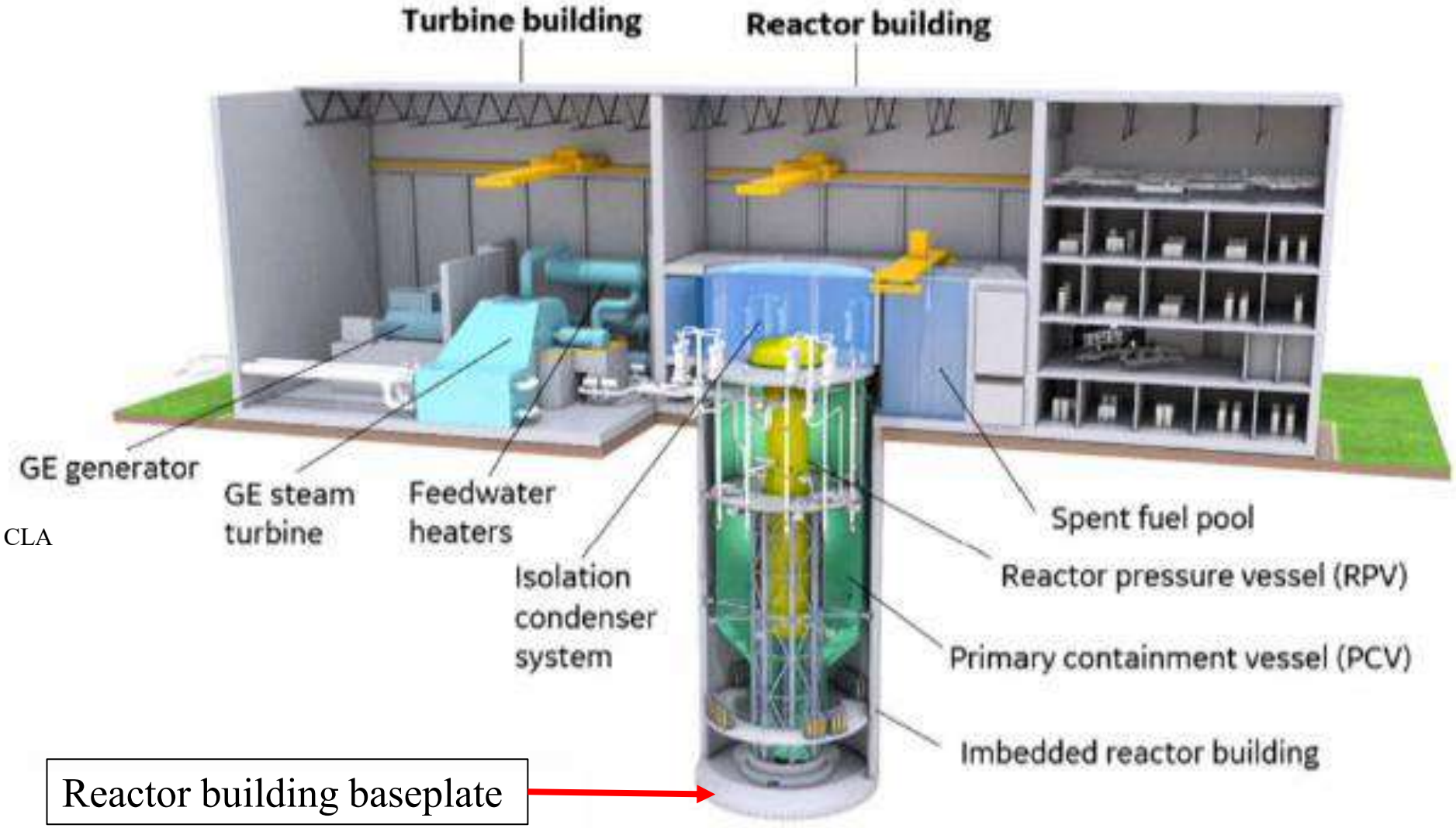
Operating pressure 7.2 MPa, core inlet/outlet 270/288°C

GE Hitachi BWRX-300 SMR
870 MW thermal, 300 MWeG



Source: OPG CLA

GE Hitachi BWRX-300

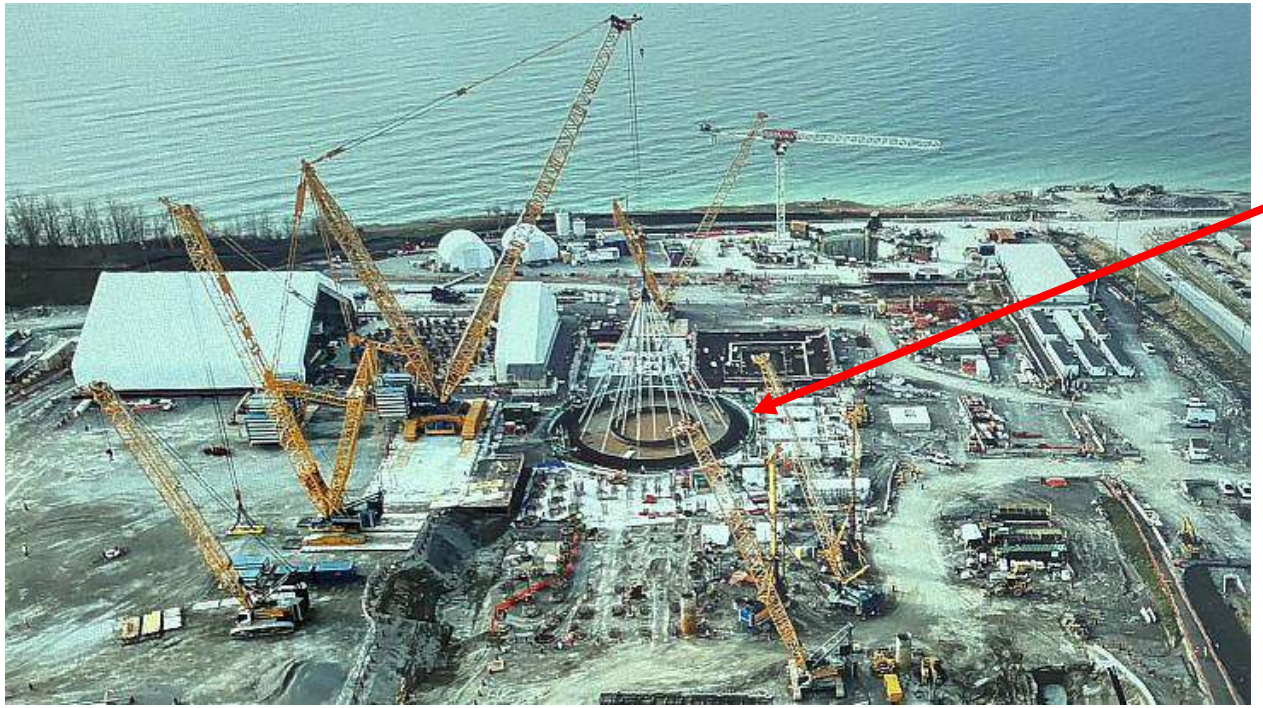


Source: OPG CLA

870 MWt, 300 MWe (Gross) Boiling Water Reactor (BWR)

GE Hitachi BWRX-300 – First Deployment

Dec 2021 selected by Ontario Power Generation (OPG) for Darlington site. Existing nuclear site with four operating CANDU reactors
March 2022 contract placed for site preparation
31 Oct 2022 - Construction licence application lodged by OPG to CNSC.
July 2023 – announced another three to be built on the same site
4 April 2025 – CNSC (Canadian nuclear regulator) issues construction licence
2 April 2026 – RHP 1 lifted – OPG can place the foundations of the reactor building and commence civil construction and internal reactor building system and components. (Next RHP 2 = installation of the reactor vessel)
March 2026 – OPG applied for an operating licence (scheduled operating 2030).



1 May 2026 Baseplate Installed. 37m dia.

Rolls-Royce UK SMR (PWR)

UK SMR
Power Station Basic Design

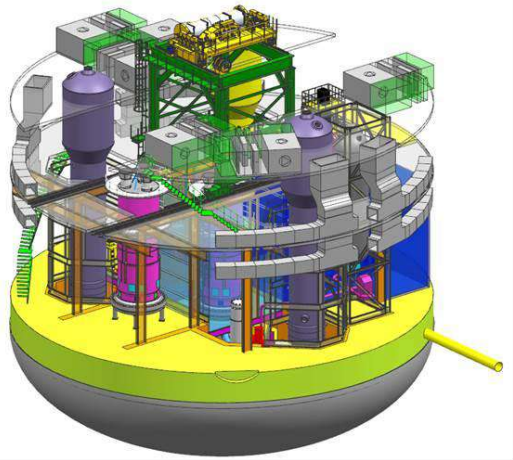
- ✓RR SMR is a **modular build power station,** not a nuclear reactor
- ✓**c.470MWe** output
- ✓**60-year plant lifetime**
- ✓**>90% availability factor**
- ✓**Enhanced Gen III+ levels of safety and security**

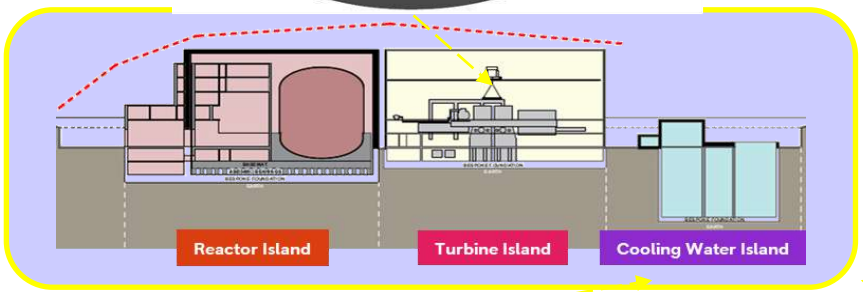
April 2022 – commenced UK Nuclear Regulator (ONR) GDA process, now in final step 3

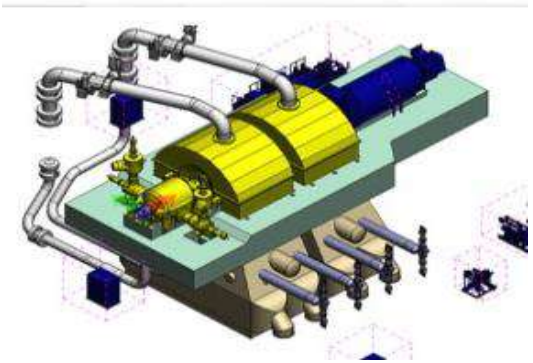
June 2025 – selected by UK Gov as preferred technology for UK's first SMR project.

Nov 2025 – Wylfa selected as site for three RR SMRs

April 2026 – RR signed contract with GB Energy-Nuclear to allow work to start immediately on delivery of 3 RR SMRs at Wylfa.







Reactor Systems

- A robust and licensable design incorporating:
  - A 3-loop PWR
  - 3 reactor coolant pumps (one in each loop)
  - 3 vertical **u-tube** steam generators
  - Steam pressurised using a **pressuriser**
- Nuclear fuel is industry standard 17x17 assembly **UO_2 enriched up to 4.95%**,
- **Boron free design** to enable a **low environmental impact and eliminate handling hazards.**

Cooling Water Island

- Indirect cooling system utilises modular cooling towers to remove heat from the turbine island

Turbine Island

- Comprises a commercially available turbine and generator set

Floating Nuclear Power Plant
Akademik Lomonosov at Pevek

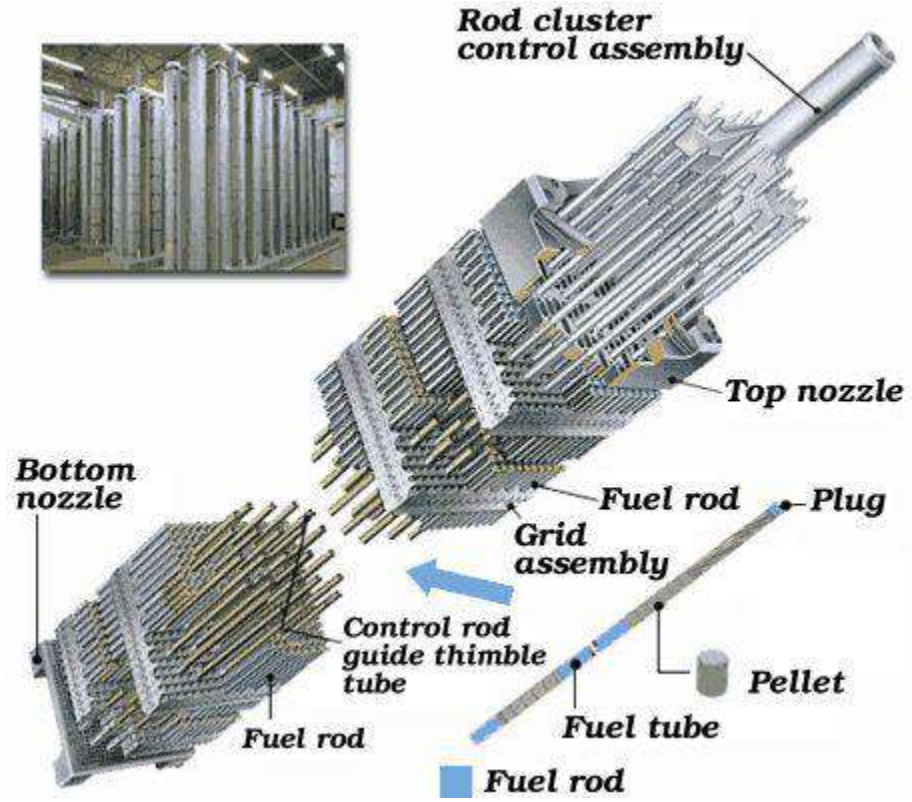
Image: TVEL

Two 35 MWe pressurised water reactors (PWR) on a 140m long, 21,000 tonnes displacement non-self propelled barge

December 2019 – deployed at Pevek, most northern city in Russia. Supplying electricity and heat to remote artic community and local gold, silver and copper mines. First refuelling 2023/2024.

Next floating nuclear power plants based on 2 x RITM-200 reactors (103 MWe) used in latest icebreakers. Four barges under construction in China for the Cape Naglounyn project to supply mining developments in the Baimskaya ore zone (copper and gold), Russian artic. Requires 300 MWe electrical supply – four x 103 MWe plants to be installed (one on standby/refuelling)
First barge delivered to St Petersburg April 2026 for installation of reactors.

Traditional Fuel for Power Reactors



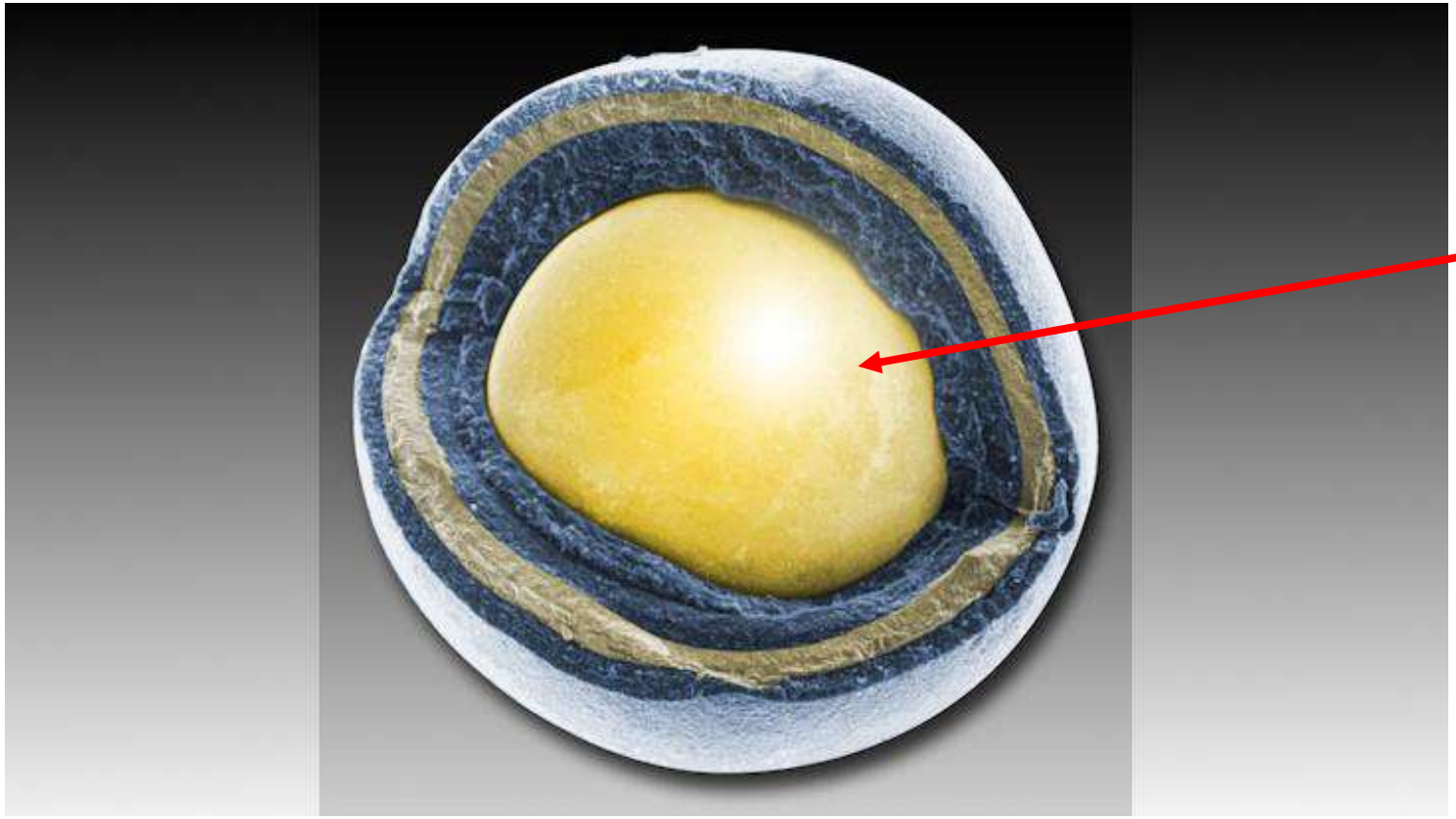
PWR Fuel assembly
4m high,
215mm x 215 mm wide

Fuel Assembly or Bundle

CANDU Fuel bundle for Canadian Pressurised Heavy Water Reactor (PHWR)
495 mm long, 102 mm diameter

Canteach.candu.org image library

Tri-Structural Isotropic Fuel (TRISO)

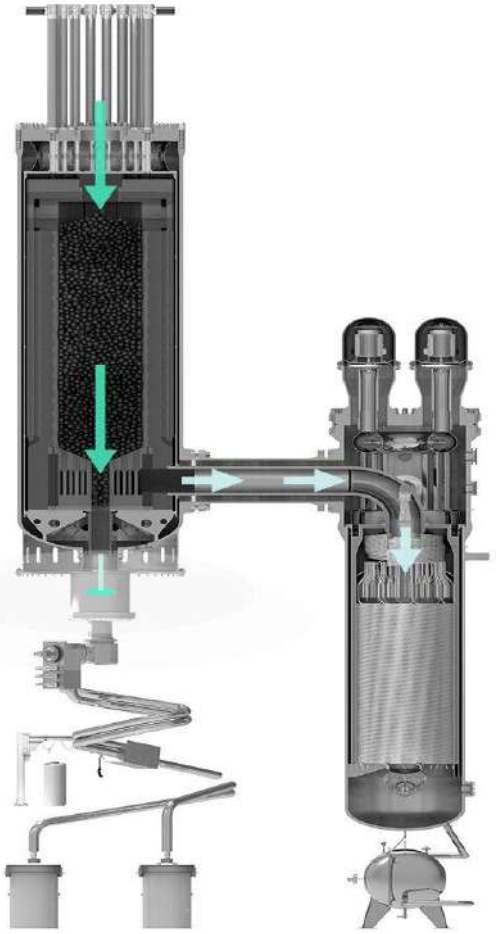


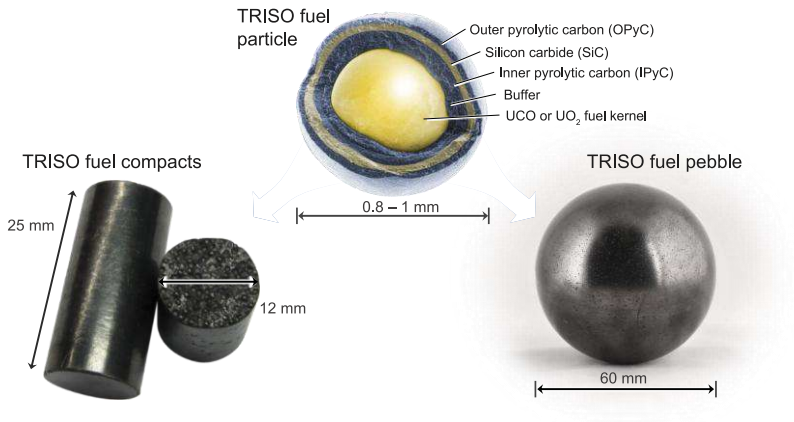
Uranium fuel kernel the size of the tip of a ballpoint pen

Image: X-Energy

- Centre fuel kernel 0.5mm (500 µm) dia
- Porous carbon buffer 95 µm + inner pyrolytic carbon 40 µm
- Silicon carbide barrier coating 35 µm + outer pyrolytic carbon 40 µm
- **Particle diameter 900 µm**

X-Energy (USA)





Images_ X- Energy

- 80 MWe High Temperature Gas Reactor (HTGR), configure in 4-pack 320 MWe
- Outlet temperature 750°C, helium cooled, 6 MPa
- Produces process steam at 565°C, 16.5 MPa
- TRISO ~15% HALEU fuel, 200,000 pebbles
- Undergoing licensing by NRC and review by CNSC
- Oct 2020 US DOE Advanced Reactor Demonstration Program (ARDP) award USD 80 million

Aug 2022- agreement with DOW chemicals for supply of power and process heat to US Seadrift plant, South Texas.
March 2025 – construction permit application to NRC, approval expected by end 2026.
May 2026 – Environmental Assessment (EA) approved.

Amazon – 5GW of X-Energy by 2039

Micro Modular Reactors (MMR)

- Increasing interest in very small reactors, typically < 10 MWe power capacity known as Micro Modular Reactors or simply microreactors
- Provide reliable, low emissions power, independent of the weather.
- Suitable for many deployments including off-grid remote locations, microgrids, mining operations, critical infrastructure, strategic military installations, data centres and disaster recovery
- Multipurpose – electricity + heat + desalination, scalable
- Load following capabilities, work with renewable energies in a microgrid
- Factory built, very compact, transport in shipping containers, can redeploy on another site
- Quick, on-site installation – months/weeks instead of years

- Over 1,000 islanded electricity systems and microgrids across Australia serving a population of 450,000 (Australian Energy Council 2015)

In Canada, Governments of Ontario, New Brunswick, Saskatchewan and Alberta February 2023 Strategic Plan for deployment of MMR designed primarily to replace the use of diesel in remote communities and mines.

Demonstration of Microreactor Experiments (DOME)

The Experimental Breeder Reactor II (EBR II) operated on the INL site 1964-1994. Although the reactor has been decommissioned, the large concrete and steel containment dome has been retained – 24m diameter, 30.5m high.

Containment now repurposed as the DOME test bed.

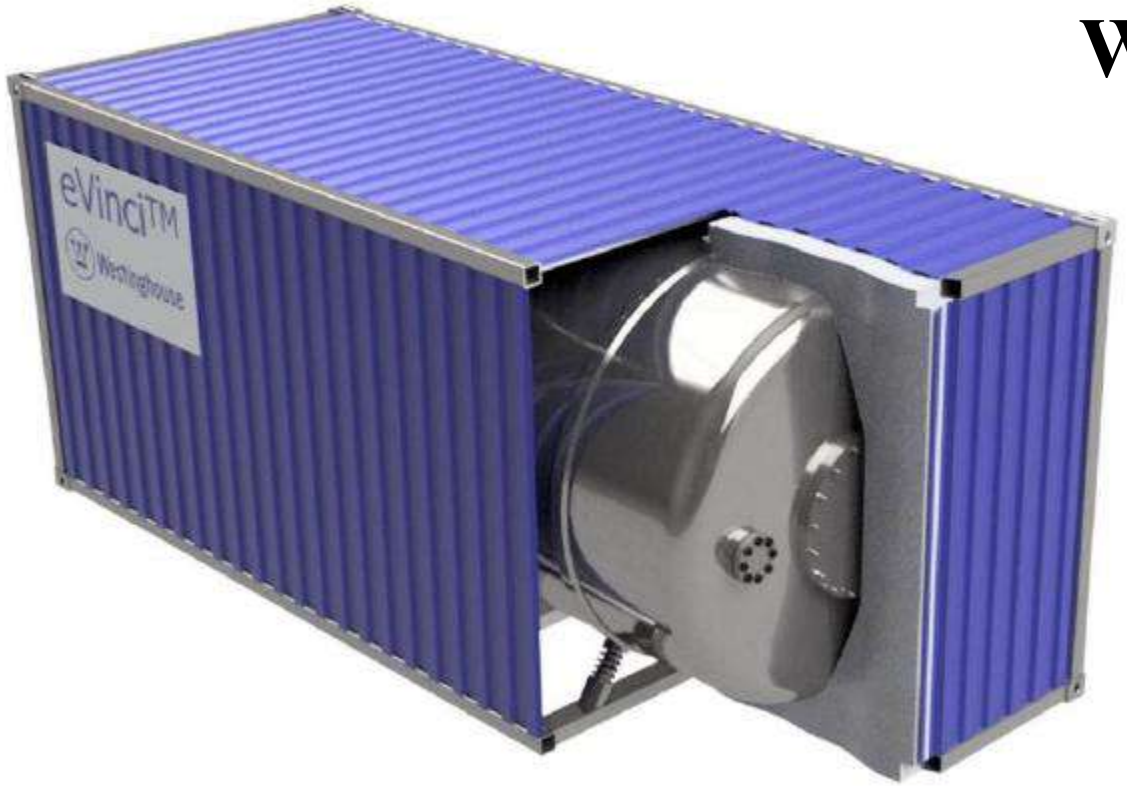
DOME will hold a shipping container sized microreactor. Up to 20 MWt. Up to 20% enrichment.

Radiant MMR first in DOME April 2026.

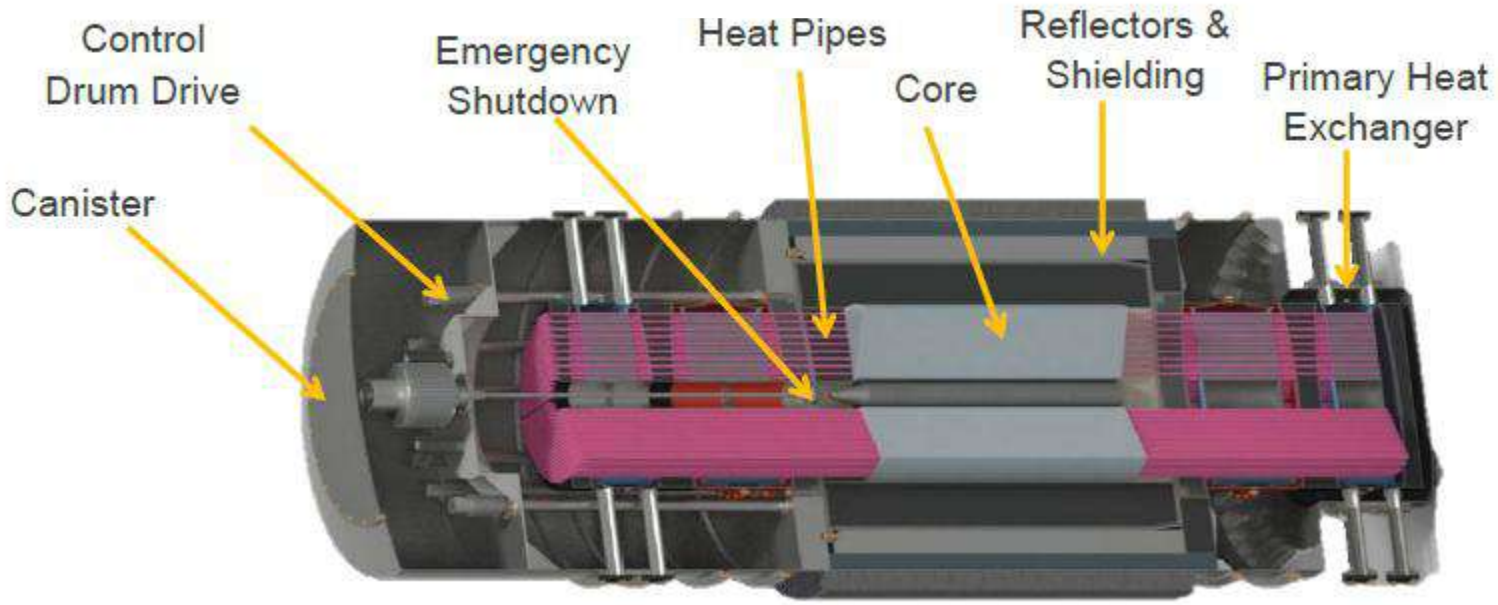
Radiant Industries Kaleidos 1.2 MWe HTGR

Company founded in 2019 by former Space X engineers. TRISO fuel, helium coolant, graphite moderator, Packed in single shipping container. Ship back for refuelling every 5 years. June 2024 US DOE approved safety design strategy for testing at INL's DOME facility, starting 2026. https://www.radiantnuclear.com/

Westinghouse eVinci Micro-Reactor 1MWe – 5MWe



Sodium filled heat pipes, no moving parts. Power conversion – Brayton cycle



BWX Technologies (USA) Microreactor

US Department of Defence Project Pele
Mobile, reliable, sustainable, resilient power source

Transportable microreactors can deliver clean, zero-carbon energy where and when it is needed in a variety of austere conditions (Image: BWXT)

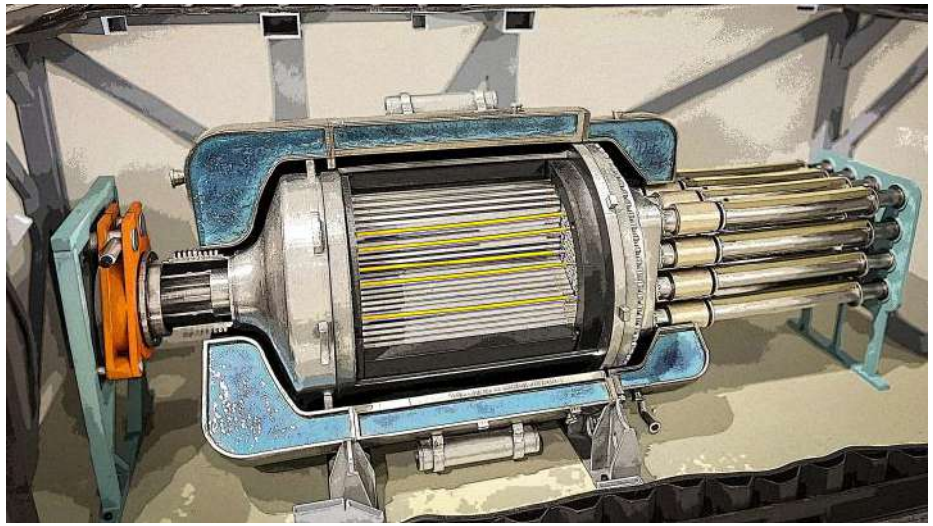


Image:BWXT

BWXT TRISO fuelled High Temperature Gas Reactor (HTGR) generates 1-5 MWe.
Transportable in 4 x 20-feet long ISO-compliant CONEX shipping containers. Operational within 72 hours of arriving on site.
June 2022 US DOD contract to BWXT to deliver prototype full scale microreactor. September 2024 site preparation at INL, testing 2026.

Summary

In addition to the advantages of all nuclear reactors in providing reliable, low emissions power, independent of the weather:

- SMRs and Microreactors are suitable for many deployments including small grids, off-grid remote locations, microgrids, mining operations, critical infrastructure, strategic military installations, data centres and disaster recovery.

- Microreactor power plants are factory assembled and tested, and the complete plant transported to site in shipping containers. Installation and re-deployment in days.