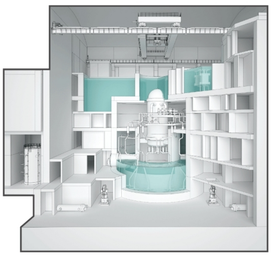
Innovative next-generation reactors

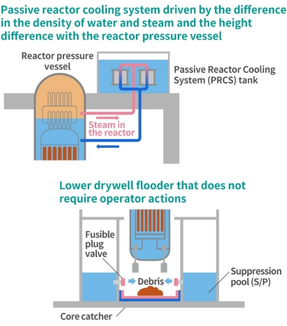
Innovative light-water reactor “HI-ABWR”(left),
Small modular reactor “BWRX-300”(right)

Nuclear power generation is becoming safer and more diverse. Innovative next-generation reactors are not only safer, but also expand the potential of nuclear energy by improving economic efficiency, reducing waste and addressing other environmental concerns.

Innovative Light-Water Reactor

Innovative light-water reactors are based on conventional reactors, but with improved safety. These reactor designs have enhanced functionality that limits or avoids the release of radioactive material in the unlikely event of an accident, making them more resilient to threats such as earthquakes and other natural disasters or acts of terrorism. In Japan, development is underway with the aim of launching operations in the late 2030s.





Small Modular Reactor

Small modular reactors (SMRs) are more compact than conventional reactors and offer exceptional safety. Many of their components can be factory-manufactured and assembled on-site, enabling faster construction. Their small footprint also offers greater flexibility in site selection, and potential application as a source of power for data centers and similar facilities are currently being explored. A number of countries have plans to build SMRs, and development is underway with target launch dates before 2030.

Fast Reactor

Fast reactors use sodium as a coolant for more efficient uranium and plutonium fission. They make effective use of limited resources by converting uranium 238, which is not readily fissile, into plutonium and using it as fuel. Fast reactors can also help reduce the amount and toxicity of radioactive waste. Development is underway in Japan with the aim of building a demonstration reactor in the 2040s.

High-Temperature Gas-Cooled Reactor

High-temperature gas-cooled reactors use helium gas as the coolant, and can extract heat at the extremely high temperature of 950 °C. In addition to power generation, this high-temperature heat could also be utilized for hydrogen production and as an energy source for chemical plants. Another feature of this reactor type is a design that uses graphite as a moderator to enable passive cold shutdown even if active cooling functions are lost. Extensive experiments based on this design are underway at a research facility in Ibaraki Prefecture.

Fusion

Fusion generates energy through the same process that powers the sun—by fusing light elements such as deuterium and tritium. The immense heat produced from this reaction is harnessed to generate electricity. Like other nuclear reactors, fusion energy does not emit carbon dioxide, but they also avoid producing high-level radioactive waste, making them a promising and environmentally friendly next-generation energy source. Japan is part of an international project aimed at finding practical application for nuclear fusion reactors, with the ITER demonstration reactor now under construction in France.

Related Links

- Innovative new lightwater reactor HI-ABWR
- BWRX-300 Small Modular Reactor
- Fusion and Research Accelerators

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