MOVE THE WORLD FORWARD

MITSUBISHI HEAVY INDUSTRIES GROUP

NUCLEAR ENERGY SYSTEMS

Nuclear Energy Systems

MITSUBISHI HEAVY INDUSTRIES, LTD.

www.mhi.com

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MITSUBISHI HEAVY INDUSTRIES

NUCLEAR ENERGY SYSTEMS DIVISION

As one of the world's finest comprehensive plant manufacturers, MHI offers ideal solutions in the field of nuclear power generation and is able to provide a full range of services from plant development through manufacture, operation and maintenance. Based on advanced monozukuri (manufacturing) skills cultivated through more than 50 years of experience with a variety of pressurized water reactor (PWR) plants and major plant equipment, the company is developing the most advanced technology in the world both domestically and overseas. In addition, MHI is proactively working on spent fuel reprocessing and other fields related to the nuclear fuel cycle. The company is contributing to the provision of a stable power supply, the improved reliability of nuclear power, the effective use of energy resources and the realization of a low-carbon society.

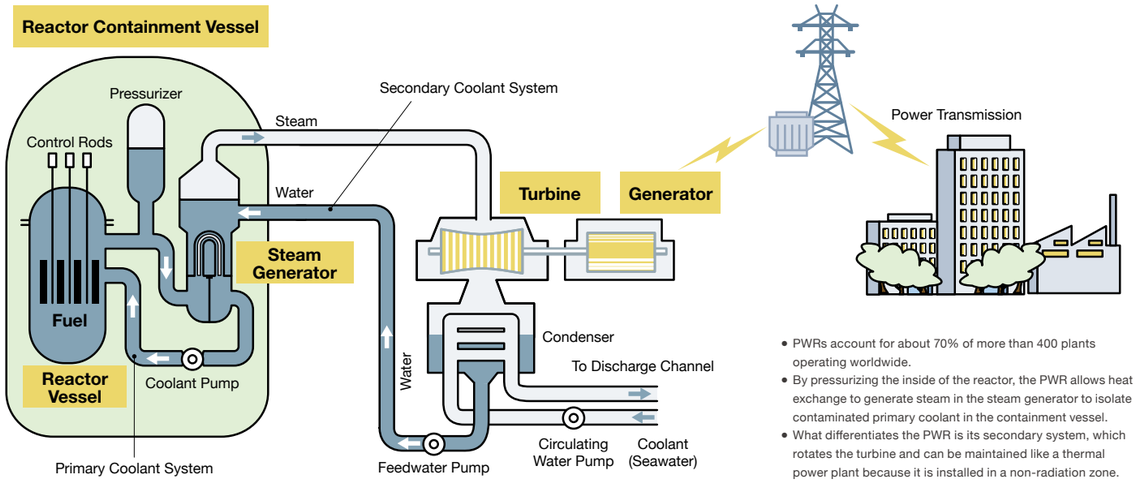
LIGHT WATER REACTORS (DOMESTIC AND GLOBAL) / NUCLEAR FUEL CYCLE & ADVANCED SOLUTIONS

PWR PLANTS

The PWR reactors constitute the largest majority of nuclear power plants in the world and uses ordinary water as the moderator and coolant. There are 24 PWR nuclear power plants constructed in Japan, of which all but the first few plants were designed, manufactured, and constructed by MHI as the main contractor. Development is also underway for new light water reactors, i.e., next-generation PWRs. For emerging countries and remote islands where large-scale power transmission infrastructure is not available, MHI develops small PWRs which have potential as a source of regionally distributed power.

1 Hokkaido Electric Power Co., Inc., Tomari Power Station
2 Next-Generation PWR
3 Small PWR

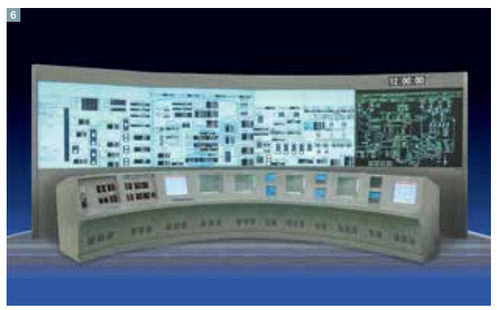
Mechanism and Features of the PWR Plant

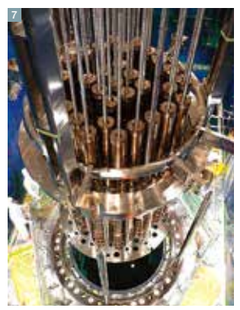


- PWRs account for about 70% of more than 400 plants operating worldwide.
- By pressurizing the inside of the reactor, the PWR allows heat exchange to generate steam in the steam generator to isolate contaminated primary coolant in the containment vessel.
- What differentiates the PWR is its secondary system, which rotates the turbine and can be maintained like a thermal power plant because it is installed in a non-radiation zone.

Reliable Plant Components

At PWR plants, high reliability is essential for such main components as the reactor vessel, steam generator, reactor coolant pump, steam turbine, and main control board. MHI has a solid track record in this regard by implementing strict quality control at its large-component factories in Kobe, Futami and Takasago. As a result, MHI has compiled outstanding references in Japan and overseas and has become Japan's leading exporter of PWR plant components.



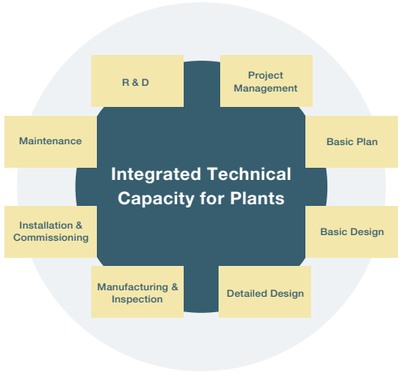


4 Reactor Vessel
5 Steam Generator
6 Main Control Board
7 Reactor Internals
8 Reactor Vessel Closure Head
9 Steam Turbine
10 Reactor Coolant Pump

Integrated Technical Capacity Supporting Safety and Reliability

MHI capitalizes on its integrated technical capacity in all the processes for the PWR plant, from design and manufacturing to construction, maintenance and operational support, in order to ensure safe and reliable operation.

Key Technologies Supporting Our Nuclear Energy Systems



Manufacture

State-of-the-art equipment and machining technologies are employed to manufacture components which require high precision. For example, we use electron beam welding systems that do not use filler material; and a large-scale, high-precision milling machine known as the Super Miller, which facilitates precision machining of a huge reactor vessel weighing about 400 tons while holding it in a standing position to avoid material deformation.

Super Miller - Large-scale, Precision Machine Tool for Reactor Vessel Machining

Construction

MHI is promoting a modular construction method using heavy-duty cranes. This method, by which the upper dome of the reactor containment vessel (weighing about 600 tons) is entirely installed, enables safe and efficient work onsite.

Construction at Hokkaido Electric Power's Tomari Power Station Unit 3

Maintenance Technology

MHI owns various technologies for maintenance, including statutory periodical inspections, repair and replacement of main components (e.g., the steam generator, reactor internals) of aging plants to ensure component integrity. Through extensive use of mechatronics technologies, we also realize remotely operated inspection devices and repair robots to improve inspection accuracy and shorten processes.

Replacement of Integrated Reactor Internals

Water Jet Peening

Maintenance Training

MHI emphasizes the development of human resources through detailed simulation training using full-scale mockup facilities at the Maintenance Training Center in its own factory. By improving accuracy and workability, we seek to increase safety for operators, reduce their occupational exposure to radiation, and enhance plant safety.

Ultrasonic Testing Equipment for Reactor Vessel (A-UT machine)

Operational Support

MHI has been developing various types of full-scale simulators for operator training. Also, an online monitoring system provides advanced core management and operational support.

Full-scale Simulator for Operator Training

Rich Experience in Plant Construction

Utility Company	Plant Name	Commercial Operation	Output (MWe)
The Kansai Electric Power Co., Inc.	Mihama-1	1970	340
	Mihama-2	1972	500
	Mihama-3	1976	826
	Takahama-1	1974	826
	Takahama-2	1975	826
	Takahama-3	1985	870
	Takahama-4	1985	870
	Ohi-1	1979	1,175
	Ohi-2	1979	1,175
	Ohi-3	1991	1,180
	Ohi-4	1993	1,180
Shikoku Electric Power Co., Inc.	Ikata-1	1977	566
	Ikata-2	1982	566
	Ikata-3	1994	890
Kyushu Electric Power Co., Inc.	Genkai-1	1975	559
	Genkai-2	1981	559
	Genkai-3	1994	1,180
	Genkai-4	1997	1,180
	Sendai-1	1984	890
	Sendai-2	1985	890
Hokkaido Electric Power Co., Inc.	Tomari-1	1989	579
	Tomari-2	1991	579
	Tomari-3	2009	912
The Japan Atomic Power Company	Tsuruga-2	1987	1,160

24 units, 20,278 MWe

ADVANCED REACTOR PLANT

DEVELOPMENT OF THE FAST BREEDER REACTOR (FBR)

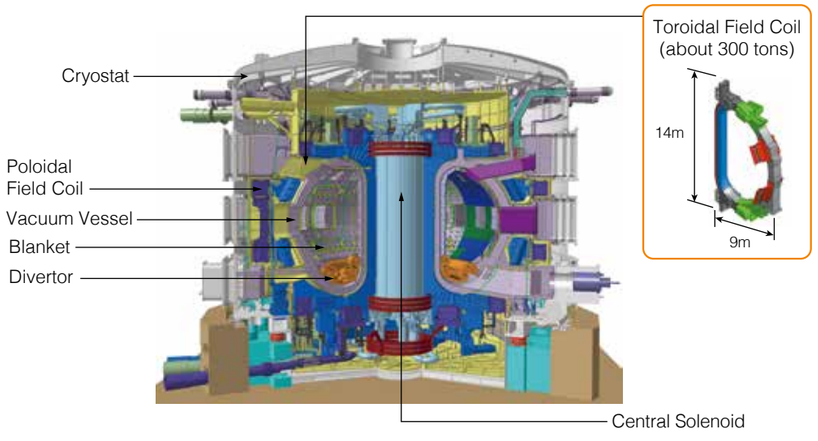
The FBR is a reactor that generates electricity while producing more nuclear fuel than it consumes. It is expected to contribute to improving Japan's energy self-sufficiency by dramatically increasing the efficiency with which uranium resources are used. MHI has been selected to play a key role in the realization of demonstration/commercial reactors as Japan's leading developer of FBRs. In 2007, we established Mitsubishi FBR Systems, Inc., a company that focuses on conceptual design and other activities related to FBR development.

1 Prototype Reactor "Monju" (Electrical Output: 280 MWe)
(Courtesy of The Japan Atomic Energy Agency)
2 Experimental Reactor "Joyo" (Reactor Output: 140 MWt)
(Courtesy of The Japan Atomic Energy Agency)
3 Fast Reactor

FUSION REACTOR AS A FUTURE SOURCE OF ENERGY

Power generation systems based on fusion reactors are expected to serve as next-generation energy sources in terms of resource and environmental preservation. Planning of the International Thermonuclear Experimental Reactor (ITER*) is progressing, and among the components and equipment supplied by Japan, the superconducting toroidal field (TF) coils, large welded precision structures, are key components of the ITER. We are committed to the development and manufacture of the challenging TF coils by using our expertise and facilities for manufacturing large structures.

Schematic View of ITER System



Main Specification of ITER

[Approximate Dimensions of System]
- Height x Width: 30 m x 30 m
- Total Weight: about 23,000 tons

[Plasma Specifications]
- Fusion Power Output: 500 MW (with no electricity generation)
- Plasma Current: 15 MA
- Plasma Duration: 400 sec or more

* ITER also means "road" in Latin.

(Source: National Institutes for Quantum and Radiological Science and Technology)

NUCLEAR FUEL CYCLE FACILITIES

In a nuclear fuel cycle, spent fuel is reprocessed for recycling. The establishment of a nuclear fuel cycle will lead to the effective use of uranium resources and to the improvement of Japan's energy security. MHI is working on the construction of the Rokkasho Reprocessing Plant, the key facility for Japan's nuclear fuel cycle, and the Rokkasho MOX Fuel Fabrication Plant, while providing related products, such as intermediate storage casks.

1 Cask
2 Rokkasho Reprocessing Plant, Japan Nuclear Fuel Limited
3 Spent Fuel Intermediate Storage Facility
4 Rokkasho MOX Fuel Fabrication Plant, Japan Nuclear Fuel Limited

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NUCLEAR FUEL

Mitsubishi Nuclear Fuel Co., Ltd. (MNF) is responsible for the development, design, manufacture and sale of nuclear fuel. In coordination with our plant core design, MNF supplies nuclear fuel that excels in economy and reliability. In 2009, we made a significant contribution to Japan's first use of MOX fuel in a thermal reactor, marking an important step toward the establishment of a nuclear fuel cycle.

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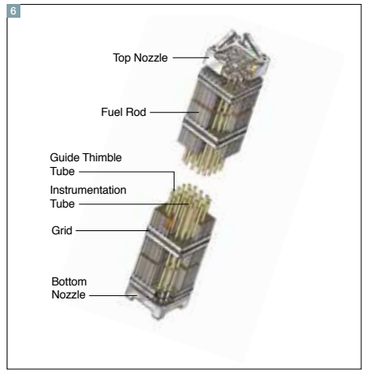

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5 Fuel Assemblies (UO_2 fuels)
6 Diagram of Fuel Assemblies
7 MOX Fuel Loading

WORKING FOR DECOMMISSIONING AT TEPCO'S FUKUSHIMA DAIICHI NUCLEAR POWER STATION

At the Fukushima Daiichi Nuclear Power Station, operated by Tokyo Electric Power Co. Inc. (TEPCO), the MHI Group is focusing on applying its comprehensive technological capabilities to improve the environmental conditions at the site. Specifically, the Group has developed robots that can readily move and operate in areas where people cannot enter, such as high-radiation areas. MHI is also participating in a national project intended to deal with contaminated water and problems caused by the accident and is undertaking technical development aimed at retrieving fuel debris.*

* Nuclear fuel that has solidified after melting inside one part of the reactor core structure.

8 MHI-MEISTeR
9 MHI-Super Giraffe
10 Contaminated Water Storage Tank
11 Method for Collecting Fuel Debris in Nuclear Plant Cleanup Work
12 Fuel Debris Removal Robot Arm

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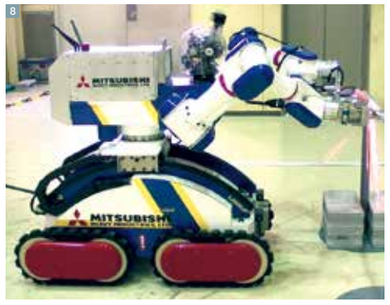

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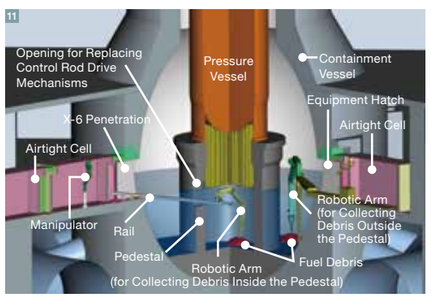

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