Japanese Contribution to Climate and Energy Security

Mitsuru UESAKA
Japan Atomic Energy Commission (JAEC)

Tohru SUZUKI
Tokyo City University

Ayako TAKEUCHI
Mitsubishi Heavy Industries, Ltd.

INSC Workshop, September 16, 2026

Contents

Opening Remarks (M. Uesaka)

- Japan Atomic Energy Commission (JAEC)
- Nuclear Applications for Health

Contribution of Japanese Nuclear Society to Climate and Energy Security (T. Suzuki)

- Current status of NPPs in Japan
- Contribution to Climate-Change Mitigation
- Energy Security in Japan
- Development of Advanced Reactors

Opening Remarks

Mitsuru UESAKA

Japan Atomic Energy Commission (JAEC)

Japan Atomic Energy Commission (JAEC)

(as of July 2026)

Commissioners



Chairperson
Dr. UESAKA, Mitsuru



Commissioner
Mr. NAOI, Yosuke



Commissioner
Dr. YOSHIHASHI, Sachiko

Decisions, Statements

White Paper on Nuclear Energy 2025, June 2026
https://www.aec.go.jp/en/kettei/hakusho/

Basic Policy for Nuclear Energy, February 2023
https://www.aec.go.jp/en/kettei/kihon/

Plutonium Utilization in Japan, October 2017
https://www.aec.go.jp/kettei/kettei/20171003_e.pdf

JAEC website

https://www.aec.go.jp/en/

White Paper on Nuclear Energy 2025

Special Report: Outlook for the Nuclear Fuel Cycle toward the Next Generation

Ch1. Lessons Learned from the TEPCO Fukushima Daiichi Nuclear Power Plant Accident and Efforts toward Reconstruction and Revitalization
Ch2. Nuclear Energy Utilization
Ch3. Global Trends and International Collaboration
Ch4. Peaceful Use of Nuclear Energy, Non-proliferation, and Nuclear Security
Ch5. Rebuilding Public Trust in Nuclear Energy
Ch6. Decommissioning and Radioactive Wastes Management
Ch7. Advances in Application of Radiation and Radioisotope Technologies
Ch8. Innovation in Nuclear Energy Utilization
Ch9. Human Resource Development and Strengthening of Supply Chain

The white-Paper booklet will be distributed after the presentation.

JAEC's Basic Policy for Nuclear Energy (Key Points)

Revised in 2023

1. "Basic Policy for Nuclear Energy" and Background of Revision

- A 'compass' to show long-term directions for the government nuclear policy and to define Basic Objectives and Important Initiatives.
- The former "Basic Policy for Nuclear Energy" was decided in July 2017, and it was approved to respect by the Government of Japan.
- It was decided to revise approximately every five years considering rapidly changing environment, and the JAEC started the revision in Nov. 2021. Having accumulated discussion with and hearing from experts, the new Basic Policy was approved in Feb. 2023.

2. Basic Idea

- Effective utilization of nuclear energy is important for Japan from the viewpoint of seeking for every possible option to secure energy supply and to realize carbon neutral society.
- On the other hand, nuclear energy can cause serious disasters when it is used in wrong ways.

⇒ It is important to utilize nuclear technology wisely, recognizing its 'pluses' and 'minuses' and paying full attention to safety.

3. Changes in Environment Surrounding Nuclear Energy

- Uncertainty over stable energy supply / Increased geopolitical risk
- Development and construction of innovative nuclear reactors worldwide / Extension of operating periods of existing nuclear power plants
- Expanded movement toward carbon neutrality
- Reaffirmation of ensuring the safety of nuclear facilities against terrorism and military threats

4. Important Initiatives

- To break away from the "safety myth" and promote the stable use of nuclear energy under the principle of ensuring safety as a major prerequisite. The government and the industry should play their respective roles, while carefully communicating with the public, without turning a blind eye to the issues related to radioactive waste treatment and disposal, as well as new issues that may emerge as a result of the development and construction of innovative reactors, in addition to improving the environment for smooth project implementation.
- The Government and the industry should work together to maintain and strengthen supply-chains and human resource development, which are fundamental for nuclear applications, not only in nuclear energy applications but also in non-energy applications.

1. Continue to reflect on the Fukushima Daiichi Accident and learn lessons.

2. Use nuclear energy for stable energy supply and carbon neutrality.

3. Proceed domestically and internationally based on global trends

4. Ensure peaceful use of nuclear energy, non-proliferation and nuclear security under international collaboration.

5. Rebuild public trust and confidence for using nuclear energy

6. Undertake decommissioning and radioactive waste management under the involvement of the government

7. Promote the utilization of radiation and radioisotopes

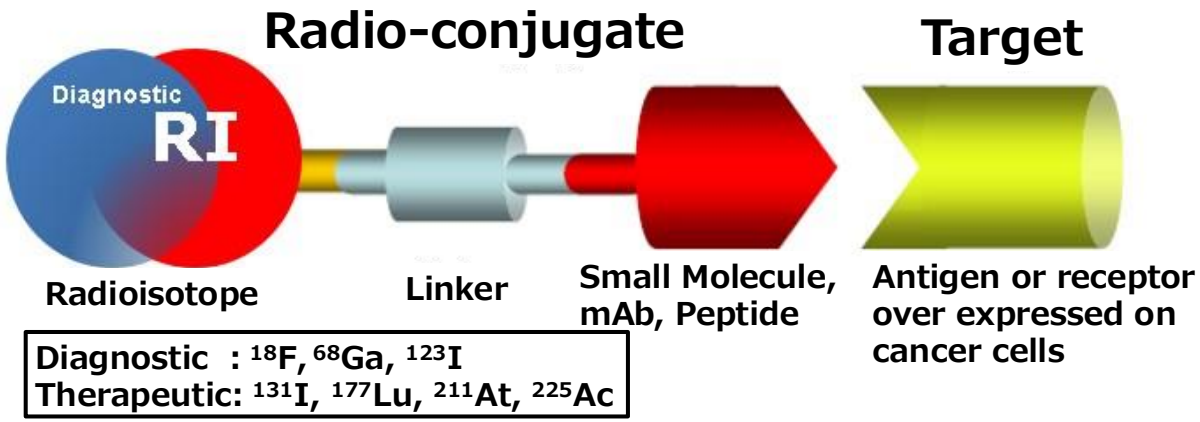
8. Facilitate innovations relevant to nuclear energy utilization

9. Strengthen human resource development

Nuclear Application for Health

International Trends

- Rapid global market growth
- New pioneering therapies with advancements of alpha-emitting radionuclides (Ac-225 & At-211)



Efforts in Japan

- The Advisory Committee, established under the Japan Atomic Energy Commission, is currently discussing key issues, including:
  - ✓ Support measures for new radiopharmaceuticals and RI raw materials
  - ✓ Regulatory optimization
  - ✓ Human resource development

The Japan Atomic Energy Commission (representing the government) is working to promote the use of medical radioisotopes, and a side event is scheduled for this afternoon.

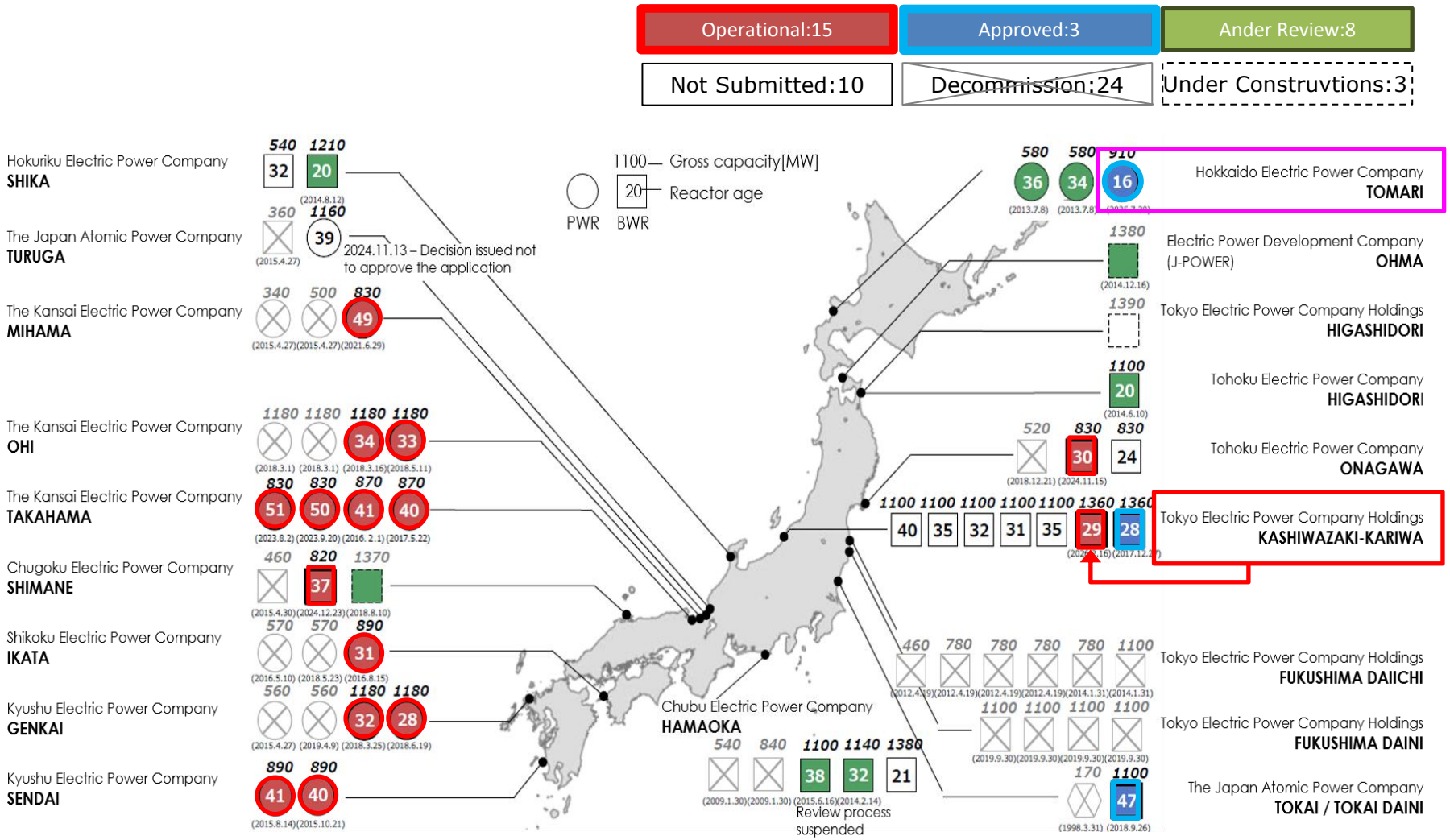
Contribution of Japanese Nuclear Society to Climate and Energy Security

Tohru SUZUKI

Tokyo City University

Current Status of NPPs in Japan

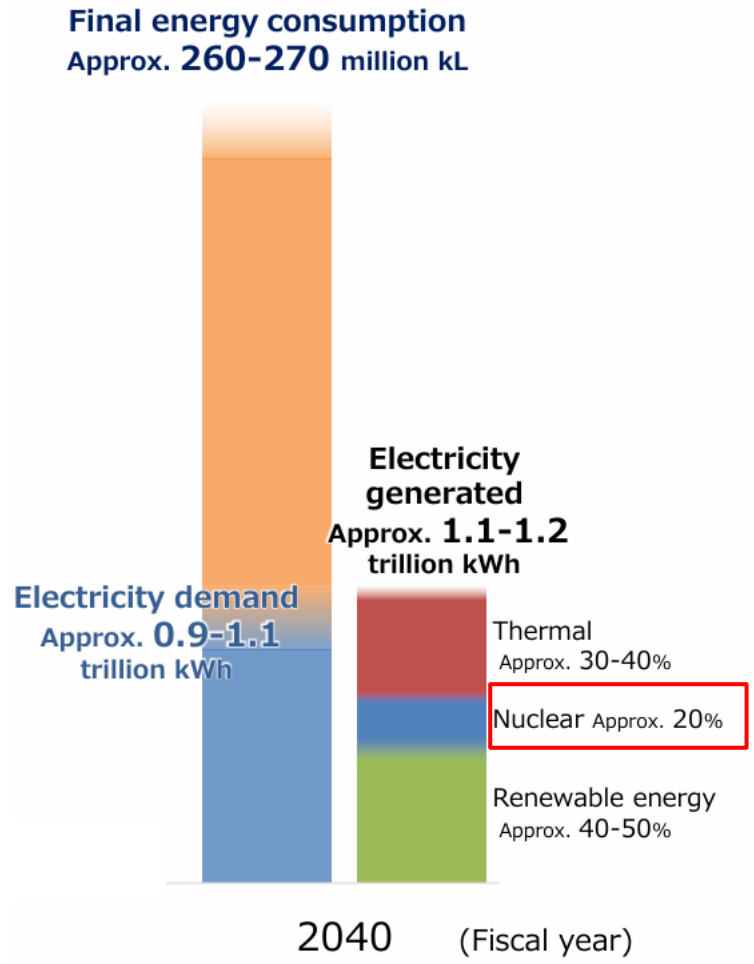
- 15 reactors have been restarted, and 3 have been granted safety assessment approval by the NRA. (Sep. 2026)
- In July 2025, Tomari - 3 received regulatory approval for facility modifications required to meet the post-Fukushima safety requirements.
- In February 2026, Kashiwazaki-Kariwa Unit 6 resumed operation.



Source: Cabinet Office, based on Ministry of Economy, Trade and Industry (METI), Trends and recent developments in nuclear energy policy, Material 1, 48th Nuclear Energy Subcommittee (2026)

Contribution to Climate-Change Mitigation

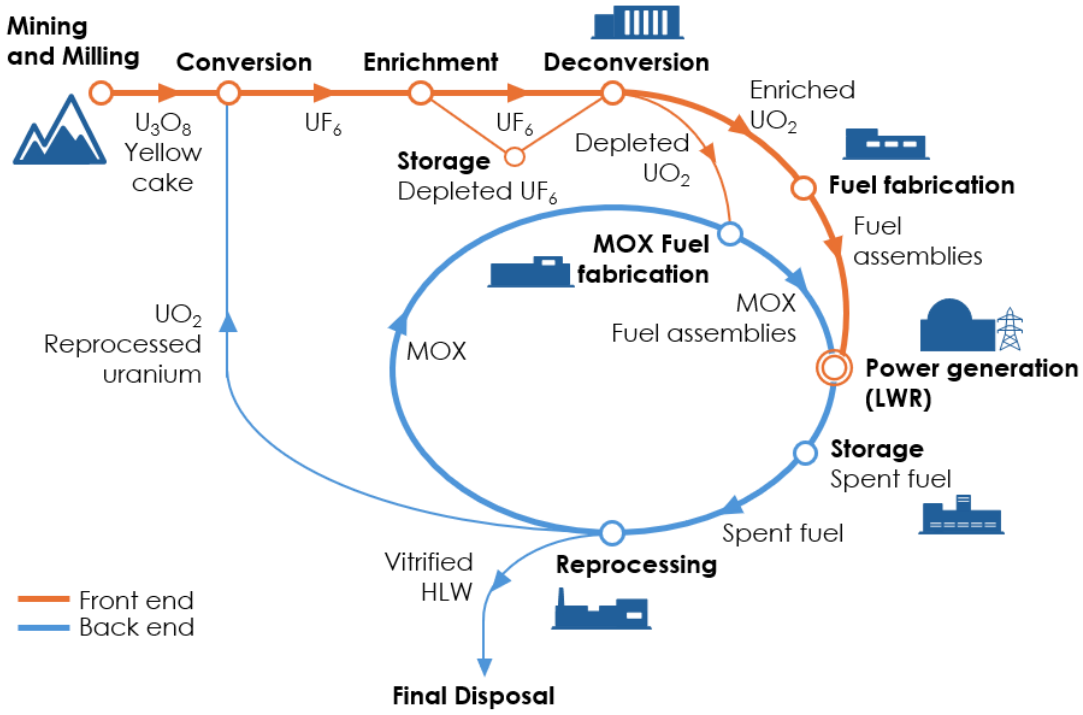
- As an ambitious goal that is consistent with the global 1.5°C target and on a linear path toward achieving net zero by 2050, Japan aims to **reduce greenhouse gas emissions** by 60% in FY2035 and by 73% in FY2040.
- The **7th Strategic Energy Plan**, issued in February 2025, presented a policy to replace existing nuclear reactors with next-generation advanced reactors in order to promote the use of nuclear power as a decarbonized energy source.
- In the energy supply and demand outlook, the electricity mix for fiscal year 2040 is expected to include nuclear power with a share of approx. 20%.



The energy supply and demand outlook

Energy Security in Japan

- Japan's energy self-sufficiency rate was approximately 16.4% in FY2024 (April 2024–March 2025), almost the lowest among the G7 countries, highlighting its vulnerabilities in terms of energy security.
- With limited domestic energy resources, Japan positions nuclear power as an important source of energy that contributes to energy security, and Japan promotes a closed **nuclear fuel cycle** as a basic policy.
- Under the Atomic Energy Basic Act, Japan limits the use of nuclear energy to peaceful purposes. All nuclear material in Japan is subject to stringent IAEA safeguards, and the IAEA has been drawing conclusion that such material remains in peaceful activities.



Overview of nuclear fuel cycle (LWR fuel cycle)

Source: Cabinet Office

Energy Security in Japan

Nuclear Fuel Cycle (*See White Paper*)

- The government and private sector will work together to maintain technologies for uranium enrichment and fuel fabrication, and to ensure a sustainable fuel supply system.
- Activities are underway toward the completion of Japan Nuclear Fuel Ltd.'s **Rokkasho Reprocessing Plant** (scheduled for FY2026) and MOX Fuel Fabrication Plant (scheduled for FY2027).
- Electric utilities aim to expand the use of MOX fuel in at least 12 commercial reactors by FY2030, subject to obtaining the understanding of local communities.



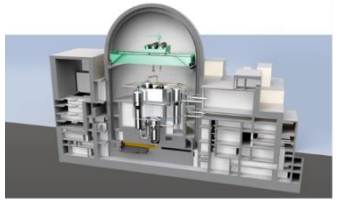
Overview of the Rokkasho Reprocessing Plant

Source: Japan Nuclear Fuel Ltd.(JNFL), Our business-Reprocessing, JNFL website(2026)

Development of Advanced Reactors

- On July 31, 2026, the **Ministerial Council on Nuclear Power** revised *the Direction and Action Guidelines for Future Nuclear Energy Policy* in light of the 7th Strategic Energy Plan and the evolving environment surrounding nuclear energy.
- The guidelines estimate that **replacement of existing nuclear power plants** will be required to provide approximately 2.2-5.5 GW of generating capacity by the 2040s, and a cumulative 12.7-16.0 GW by the 2050s, including the capacity expected to be replaced during the 2040s.
- **METI** published the **Roadmap** for Developing Innovative Reactors in April 2026.

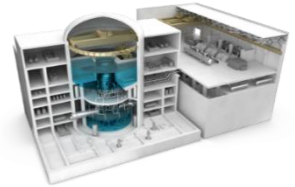
Advanced LWR



SRZ-1200, MHI



HI-ABWR, Hitachi-GE Vernova

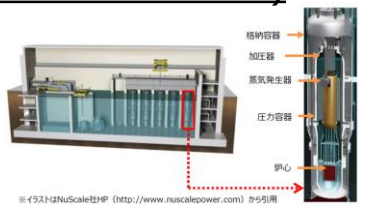


iBR, Toshiba

SMR (Small Moduler Reactor)



BWRX-300, GVH



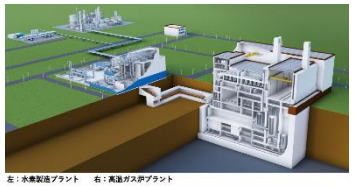
NuScale Power Module, NuScale

Fast Reactor



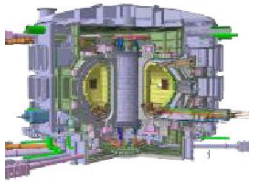
Demonstration FR, MHI

HTGR



HTGR, MHI

Fusion Reactor



ITER

1) Development of Advanced LWR

● Plant features

- ➢ New safety measures and advanced technologies to be incorporated from the design stage
- ➢ Strengthened functions for preventing accidents and mitigating their consequences
- ➢ Achievement of highest-level safety

● Current status of development in Japan

- ➢ **MHI** is developing a standard plant design of **SRZ-1200** with Japanese PWR Utilities.
  - Basic design is almost completed
  - Various experiments and tests for licensing are progressing smoothly
- ➢ Japanese PWR Utilities started discussions with Japanese NRA in Dec. 2024, aiming at enhancing foreseeability of regulations regarding their applicability to new plant design features.



2) Development of SMR (Small Module Reactor)

● Plant features

- ➢ Small LWR with an output of 300MW or less
- ➢ Core cooling by natural circulation (without cooling pump or external power)

● Current status of development in Japan

- ➢ In US and Canada, development of SMR is underway aiming the operation start before 2030 in order to supply power to data centers.
  - The CNSC has approved OPG to begin construction of the first **BWRX-300** in the **Darlington** site.
- ➢ Japan supports participation of Japanese companies in overseas projects and R&D.
  - **Hitachi-GE** is participating in the joint development of the **BWRX-300** and plans to utilize Japan's domestic supply chain to **provide key equipment** such as reactor internal structures.



(*Source*: Hitachi GE Vernova Nuclear Energy)



(*Source*: Ontario Power Generation website)

3) Development of Fast Reactor

● Plant features

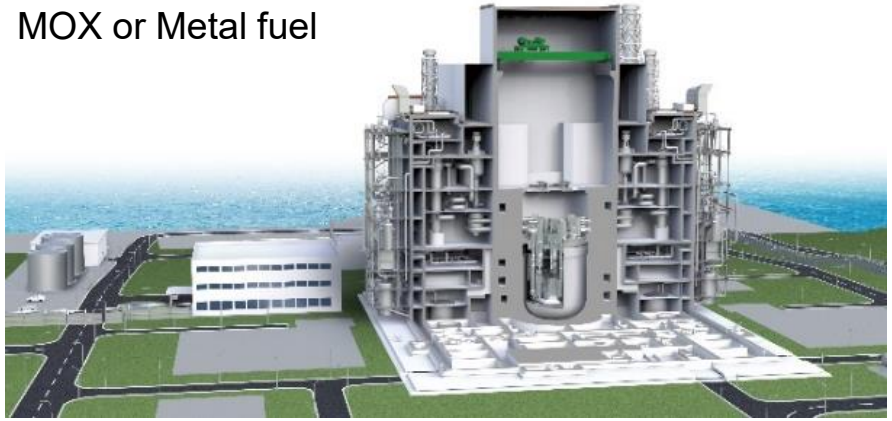
- ➢ Sodium coolant for efficient plutonium combustion
- ➢ Improvement of effectiveness for Nuclear Fuel Cycle by reducing waste volume and toxicity

● Current status of development in Japan

- ➢ A project of **Demonstration Fast Reactor** development utilizing GX Transition Finance began in 2023.
- ➢ Knowledge gained from domestic reactors (**Joyo**/ **Monju**) and Japan-France joint development will be incorporated, as well as lessons learned from the Fukushima Daiichi Nuclear Power Plant accident and international safety design standards to enhance safety.

Main features of Demonstration Fast Reactor

Electric output: 600MW class
Sodium-cooled Tank Reactor
MOX or Metal fuel



Enhancing Safety
High Technology Maturity
Expansion to Diverse Outputs

4) Development of HTGR (High Temperature Gas-Cooled Reactor)

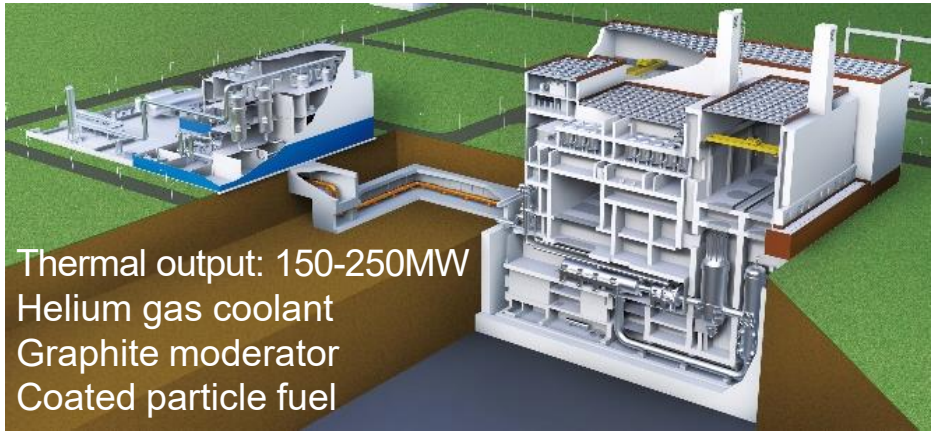
● Plant features

- ➢ Hydrogen production by utilizing high-temperature in addition to electricity generation
- ➢ Helium coolant due to its chemical stability
- ➢ Natural cold shutdown even if the cooling function is lost, due to graphite moderator

● Current status of development in Japan

- ➢ A **project of demonstration reactor development** utilizing GX Transition Finance began in 2023.
- ➢ Aiming to **hydrogen production tests** using research reactor **HTTR**※, an application for modification permission was submitted to NRA in Mar. 2025.
- ➢ Based on the technology and knowledge gained from HTTR, **demonstration of HTGR** aims to scale up and realize stable hydrogen production through high-temperature heat supply.

Main features of HTGR



- Inherent safety prevents core meltdown in case of accident
- Scaling up and increasing output based on HTTR technologies
- Stable large-scale H2 production by high temperature (900°C)

*HTTR: High Temperature engineering Test Reactor (https://www.jaea.go.jp/04/o-arai/nhc/en/faq/httr.html)

5) Development of Fusion Reactor

● Plant features

- ➢ Power generation using thermal energy obtained from nuclear fusion reactions

● Current status of development in Japan

- ➢ US startups have announced their efforts aiming to commercialized fusion energy around 2030.
- ➢ The International Experimental Reactor **ITER** Project and the Domestic Research Reactor **JT-60SA** Project are being promoted.
- ➢ The global movement and venture activities for fusion development are growing.
- ➢ **MHI** will contribute to fusion development by actively participating in the ITER project and the response to prototype reactors.

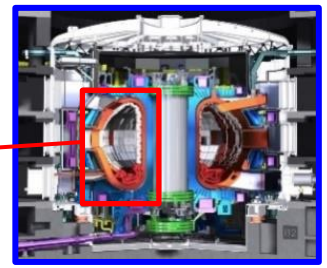
JT-60SA (Ibaraki, Japan)

【**Purpose**】
To support research for ITER & prototype reactors

ITER (France)

【**Purpose**】
Scientific/Technical Demonstrations of Fusion





©ITER Organization, http://www.iter.org/

【Toroidal Field(TF) Coil for ITER】
Long & large equipment required high-precision manufacturing
MHI is the world's first to ship 5 TF coils

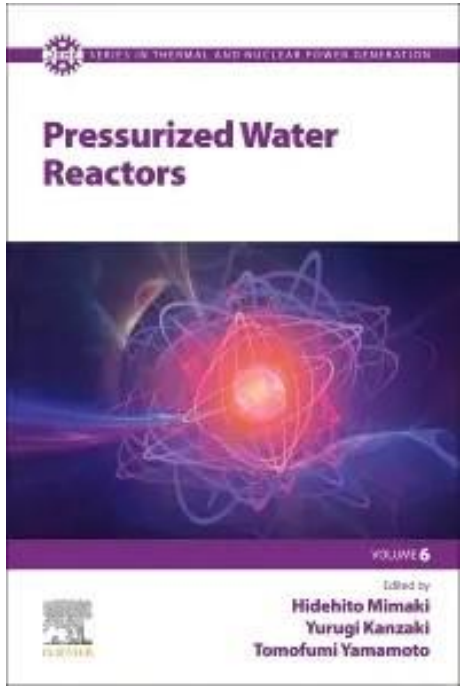
Prototype Reactor

【Purpose】
Stable power generation & economic demonstration

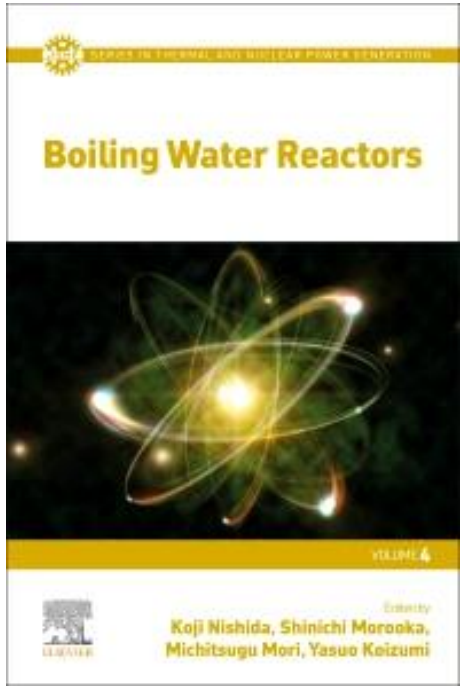
Practical use

JSME Series in Thermal and Nuclear Power Generation

- This series documents the development of thermal and nuclear power generation technologies in Japan up to the present day.
- The PWR and BWR volume outlines the evolution of these commercial reactors, from initial deployment to current state-of-the-art technologies.



Vol.6: Pressurized Water Reactors (PWR)
Editors: Mimaki, Kanzaki, Yamamoto
https://shop.elsevier.com/books/pressurized-water-reactors/kanzaki/978-0-12-823583-6



Vol.4: Boiling Water Reactors (BWR)
Editors: Nishida, Morooka, Mori, et al.
https://shop.elsevier.com/books/boiling-water-reactors/nishida/978-0-12-821361-2



Vol.1 : Fundamentals of Thermal and Nuclear Power Generation
Vol.2 : Advances in Power Boilers
Vol.3 : Sodium-cooled Fast Reactors
Vol.5 : High Temperature Gas-cooled Reactors