MOVE THE WORLD FORWARD MITSUBISHI HEAVY INDUSTRIES GROUP

# Contributing to Decarbonization with Nuclear Technology

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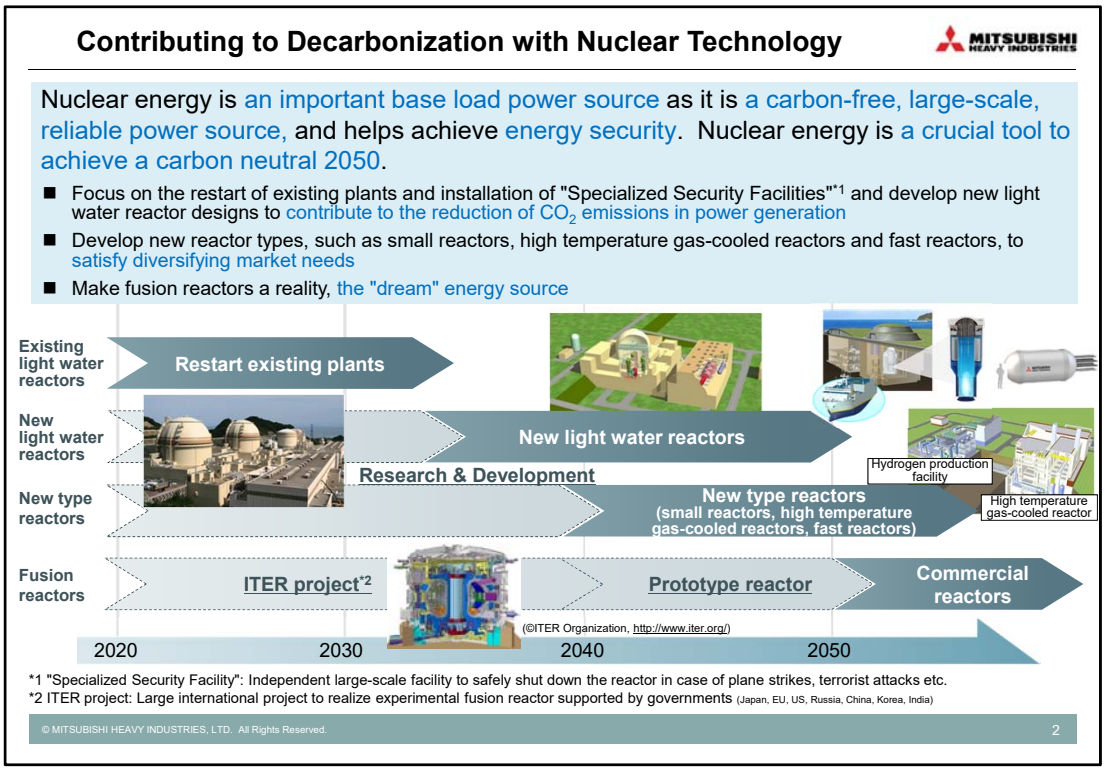
Executive Vice President
Head of Nuclear Energy Systems

My name is Akihiko Kato, head of Nuclear Energy Systems.

I would like to explain to you MHI's contribution to decarbonization with nuclear energy.




Nuclear energy is a carbon-free, large-scale and reliable power source that also serves an important energy security role from the perspective of base load power. Therefore, we believe it is essential that nuclear energy utilization is maintained and expanded in the future, in order to achieve carbon-neutrality by 2050. With this understanding, I will explain our nuclear energy business and our current initiatives on Page 2 of this slide.

First, in the coming years, MHI will focus on the restart of existing plants and installation of “Specialized Security Facilities”.
In parallel, we will work on the development of a new light water reactor design, aiming for commercial use by the mid-2030s.
We will contribute to a significant reduction in CO2 emissions in the power generation sector by maintaining a certain level of carbon-free nuclear energy. In addition, we will develop new-type reactors, such as small modular reactors, high temperature gas-cooled reactors and fast reactors, in order to satisfy diversifying needs.
Furthermore, from a long-term perspective, we will work to make fusion reactors a reality, which is considered the “dream” energy source.

As introduced on this slide, from a long-term perspective of 2050 and beyond, MHI will steadily proceed with its business in order to realize decarbonization by effectively utilizing nuclear energy, a power source that does not emit CO2.

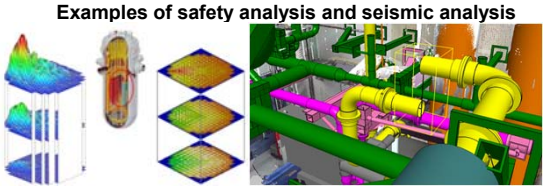
## Current Initiatives

**Restart and Maintain Existing Plants / Construct "Specialized Safety Facilities"**

- Support utility companies through analysis, evaluation and tests to meet the world's highest-level regulatory requirements
- Deliver upgrades to safety measures* and construct "Specialized Safety Facilities" to enable restart of PWRs and BWRs

* Reinforce safety facilities, increase power source reliability, and increase resilience to natural disasters, such as earthquakes and tsunamis

**Examples of safety analysis and seismic analysis**

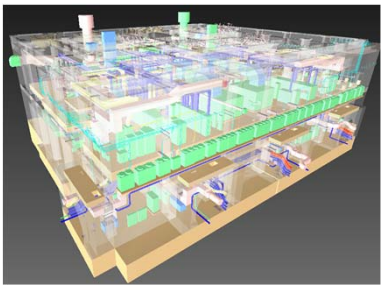


**Example of seismic test**

**Example of reliability increase of power source**


**Emergency gas turbine generator**

**Image of "Specialized Safety Facility"**






Now I would like to explain each of our nuclear businesses in more detail.

First, I will explain our current initiatives: the restarting of existing plants and the construction of “Specialized Safety Facilities”.

Coming out of the Fukushima accident, Japan’s regulatory safety requirements for nuclear power plants are now the highest in the world. In order to satisfy these requirements, we have been supporting our utility customers through safety analysis, seismic analysis and tests. In addition, we have strengthened the safe operation of nuclear power plants by increasing the reliability of the power source through means such as installing emergency gas turbine generators.

We have also carried out construction of additional safety measures to improve resilience to natural disasters such as earthquakes and tsunamis. As of today, we have achieved the restart of nine PWR plants which were all constructed by MHI. Moreover, we are currently constructing large-scale “Specialized Safety Facilities”, as shown on the right-hand side of this slide.

We will continue to help enable the swift restart of not only PWR plants but also BWR plants through the implementation of many safety measures and the construction of “Specialized Safety Facilities”.

## Current Initiatives

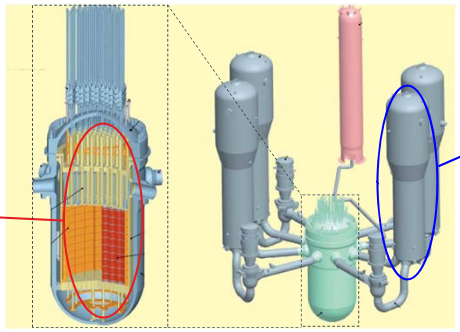
### Maintenance Services for Restarted Plants

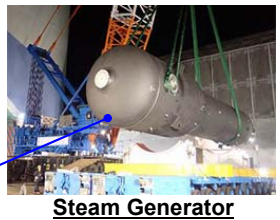
- Provide major maintenance work, such as SGR, CIR, CBR*1, aiming for plant life extension to 60 years
- Provide evaluation services to continuously improve safety and maintenance services using state-of-the-art technology

**Contribute to the safe and stable operation of nuclear power plants**

*1 SGR: Steam Generator Replacement, CIR: Core Internals Replacement, CBR: Control Board Replacement

**Examples of major maintenance works**





**Steam Generator Replacement (SGR)**

**Core Internals Replacement (CIR)**

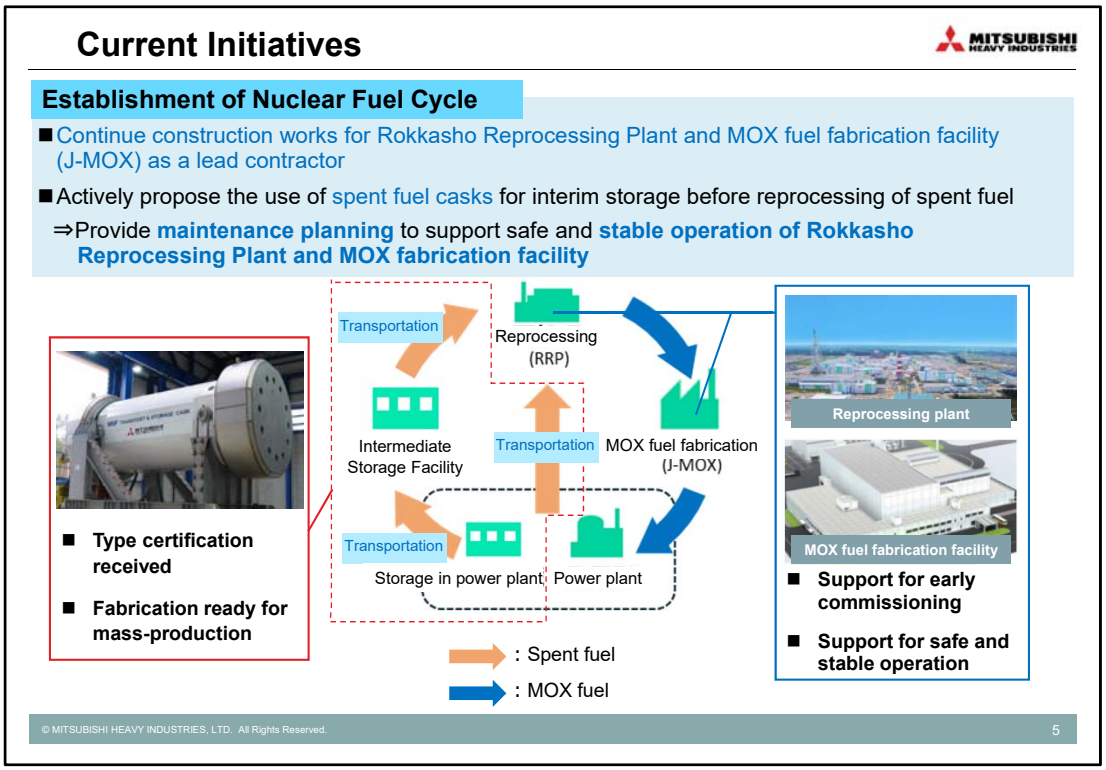
**Control Board Replacement (CBR)**
the latest digital control system technology




The safe and stable operation of restarted nuclear power plants is of the utmost importance.

After restart of the plants, we will provide major maintenance works, aiming for plant life extension to 60 years. This slide shows some examples of major maintenance work we envision. We will support the replacement of major components such as Core Internals and Steam Generators. Additionally, Control Board Replacements will enable the modernization and incorporation of the latest digital control system technologies.

Additionally, MHI provides evaluation services that are essential to continuously improve safety and maintenance services using state-of-the-art technology. Through these measures, MHI will support utility companies and contribute to the safe and stable operation of these plants.




The establishment of a nuclear fuel cycle is also important for the ongoing and continuous use of nuclear power.

Please refer to the illustration on Page 5. The fuel cycle represents the flow in which spent fuel used at a power plant is transported to a reprocessing plant for reprocessing, followed by MOX fuel fabrication, and finally MOX fuel is supplied to the power plant again. The fuel cycle is essential for effective and efficient utilization of nuclear fuel resources.

In order to establish this cycle as quickly as possible, MHI is working on construction at Rokkasho Reprocessing Plant and MOX fuel fabrication facility (J-MOX) as a lead contractor. In addition, MHI has already received certification for spent fuel casks, which is a means for interim storage before reprocessing of the spent fuel, and has completed preparation for mass-production of these casks. We will move forward with engineering and manufacturing of the casks based on the plans of the utility companies.

In this way, we will support utilities through maintenance planning by providing safe and stable operation of Rokkasho Reprocessing Plant after its commissioning.

## Future Nuclear Technology Initiatives

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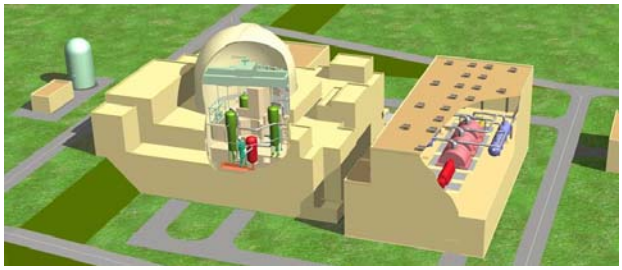
### New Model of Light Water Reactor (World's Safest Reactor)

- We believe nuclear power will be a crucial tool in achieving both carbon neutrality and energy security
- Drive forward R&D of world's safest reactors using evolutionary technologies with high economical efficiency (aiming for commercial operation in mid 2030's)



- Reinforce safety based on experiences from Fukushima accident
- Introduce new safety concepts leveraging latest technical capabilities and evolutionary technologies
  ⇒ Example: no resident evacuation required

⇨ **World's Safest Reactor**

- Maintain and utilize Japan's domestic nuclear supply chain

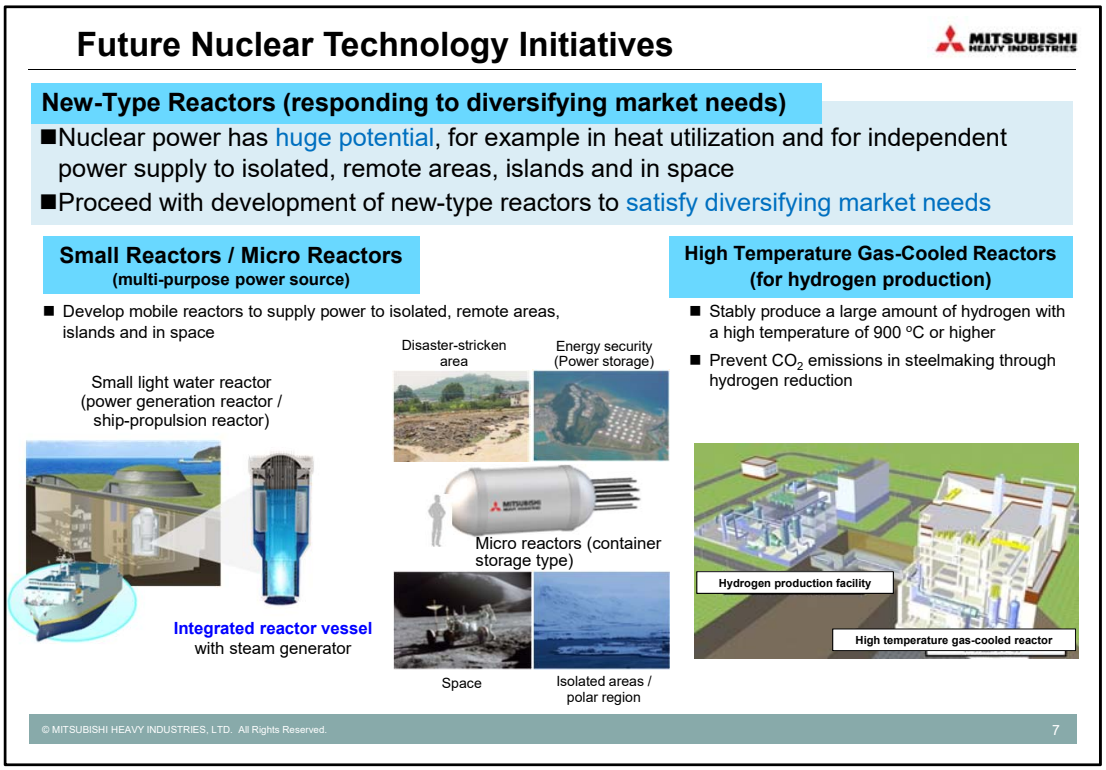



From Page 6 of this presentation, I will introduce our initiatives in future nuclear technologies.

First of all, I would like to explain what we are doing in the development of a new model of light water reactor. MHI believes that nuclear energy will remain a necessary power source both now and into the future. This is why we are working on the research & development of a reactor type with the world's highest level of safety, using evolutionary technologies and achieving high economical efficiency, all while taking into account feedback received from discussions with utility companies. In response to the Fukushima accident, we not only reinforced safety measures for all types of hazards but also developed an entirely new safety concept by incorporating the latest knowledge and evolutionary technologies.

One example of this is being able to avoid the need for evacuation of residents near the plant in case of emergency. This innovative safety concept prevents radioactive materials from being released outside the power plant and so avoids the spread of radioactive materials beyond the plant and therefore the need to evacuate residents even in the unlikely event of an accident.

Considering the solid and existing nuclear supply chain in Japan that has been built up over many years, we will work to develop this new type of reactor with the world's highest level of safety, aiming for its commercialization in the mid-2030s.




Secondly, I would like to talk about new-type reactors coming in the future.

Nuclear power has huge potential, for example in heat utilization and for independent power supply to isolated, remote areas, islands and even in space. MHI will develop new-type reactors under the Japanese government's innovation program, in order to meet the diversifying needs of the market.

Please refer to the figures on Page 7 of this presentation. The left-hand side of this slide shows small modular reactors and micro reactors. These reactors can be used not only as a distributed power source for small grids but also as a means to supply power to disaster-stricken areas, remote areas, islands and outer space. MHI continues working on the development of such reactors.

The right-hand side of the slide shows a high temperature gas-cooled reactor. This reactor uses a heat source with a temperature of 900°C or higher, to stably produce a large amount of hydrogen. As an example, the produced hydrogen can then be used for hydrogen reduction in steelmaking, which will have positive effects for the decarbonization of industry. We will promote technological development in collaboration with the steel industry.

## Future Nuclear Technology Initiatives

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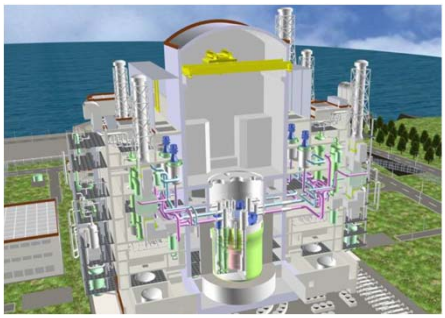
### Fast Reactors (Power generation reactors)

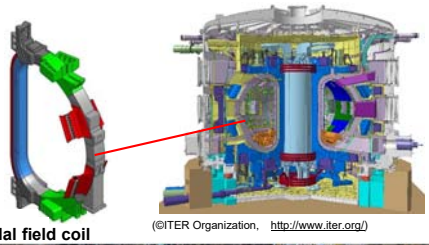
- Power generation using nuclear fission energy with fast neutrons
- Ability to effectively use nuclear fuel resources and to reduce volume of high level radioactive waste
- Development program in progress under international collaboration (Japan-France, Japan-US)



(Source: Technical development program on a fast reactor international cooperation, etc.)

### Fusion Reactors (ITER project)

- Fabrication of major components including toroidal field coil for the first time in the world
- Active involvement in development study for fusion reactor realization



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

Toroidal field coil





Please look at the images on Page 8 of this presentation.

In the left-hand column, you can see a fast reactor. Fast reactors differ from light water reactors in that they use nuclear fission energy from fast neutrons to generate electricity. For this reason, fast reactors can effectively and efficiently use nuclear fuel resources and reduce the volume of high-level radioactive waste. It is desirable to have multiple technical options in order to make effective use of nuclear power. MHI has been selected by the Japanese government as a core company for fast reactor development, and we are promoting development under the national budget, including international cooperation.

On the right side of the slide is an explanation of fusion reactors. We are currently involved in the ITER project, for which we are fabricating major components including toroidal field coil for the first time in the world. The photograph at the bottom of the slide was taken at the completion ceremony of the manufacturing of the toroidal field coil this January. We are proud that our technical capabilities are being leveraged for high-precision manufacturing for large components.
We plan to be actively involved in the journey to achieve realization of fusion reactors.

With this, I would like to end my explanation of the activities of MHI's nuclear business to help realize a carbon-neutral world.
With the pride of a leading company in the nuclear industry, we will steadily promote technological development and practical application toward decarbonization.

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