Japan's Nuclear Energy Policy

Ministry of Economy, Trade and Industry

September 2019

METI
Ministry of Economy, Trade and Industry

Position of Nuclear in Japan's Strategic Energy Plan

Towards 2030 : Achievement of Optimal Energy-Mix Target

Nuclear is Important Baseload Power Source

- Safety is First Priority. Only when approved by NRA's strict review, NPPs restart.
- With principle of minimizing nuclear dependence, achieving 20-22% nuclear by 2030.

	2010	2013	2017	2030
Nuclear	25%	1%	3%	22-20%
Renewable	9%	11%	16%	22-24%
Thermal	65%	88%	81%	56%

Towards 2050 : Challenge for Energy Transition

Nuclear is One Option for Energy De-carbonization

- Safety is First Priority. Minimizing dependence on nuclear while trying to expand Renewable.
- Great progress in human resources, technology and infrastructure
- Pursuit of safe, economically efficient and mobile reactors, Development of Back End tech

Pursue every possible energy source

Nuclear Power Plants in Japan

As of 9th, September, 2019

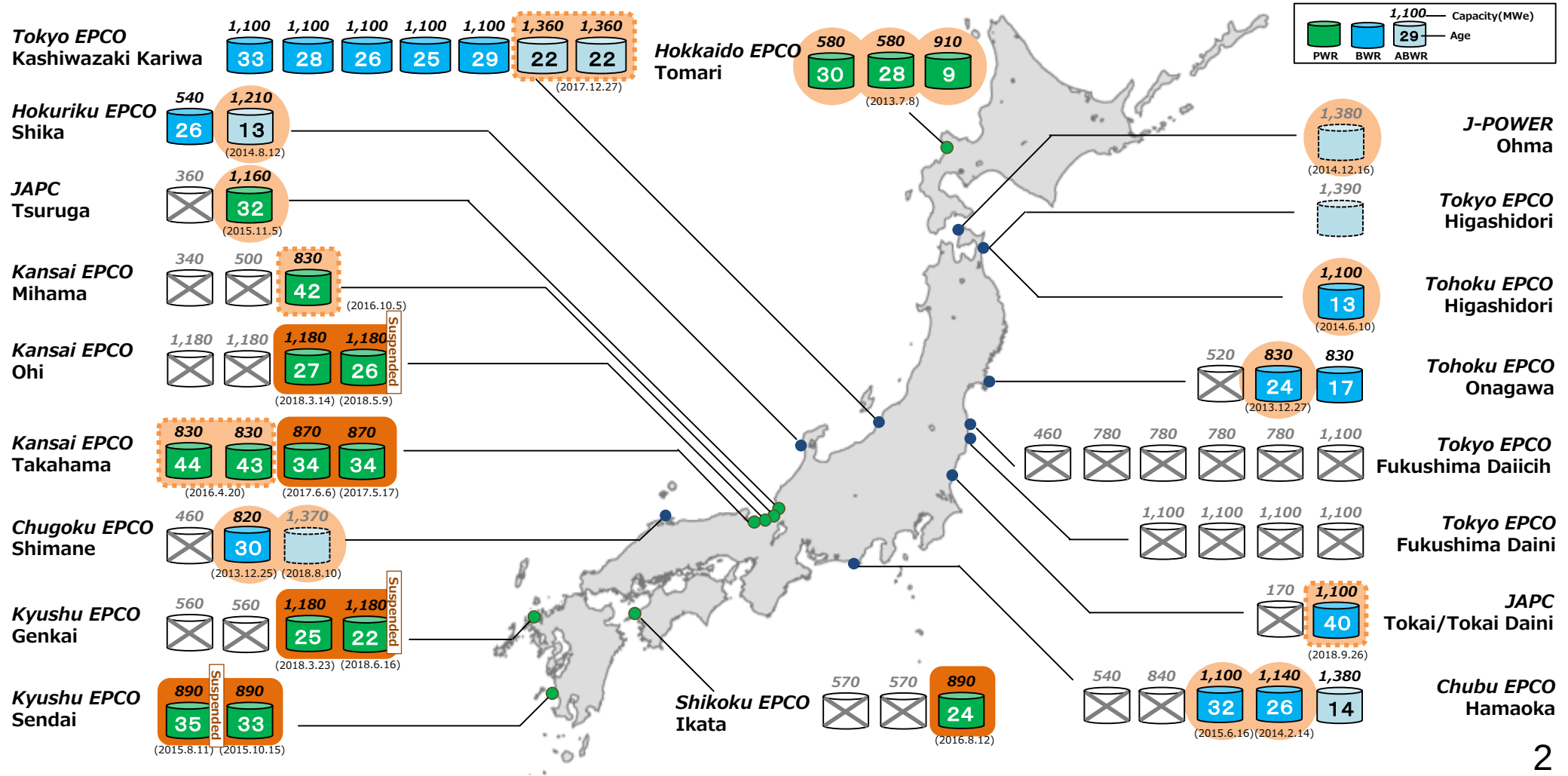
Restarted
9 reactors
In Operation : 6 reactors
Suspended : 3 reactors
(Date of Restart)

Passed NRA Review
for the Permission for Changes in Reactor Installation
6 reactors
(Date of Approval)

Under NRA Review
12 reactors
(Date of Application)

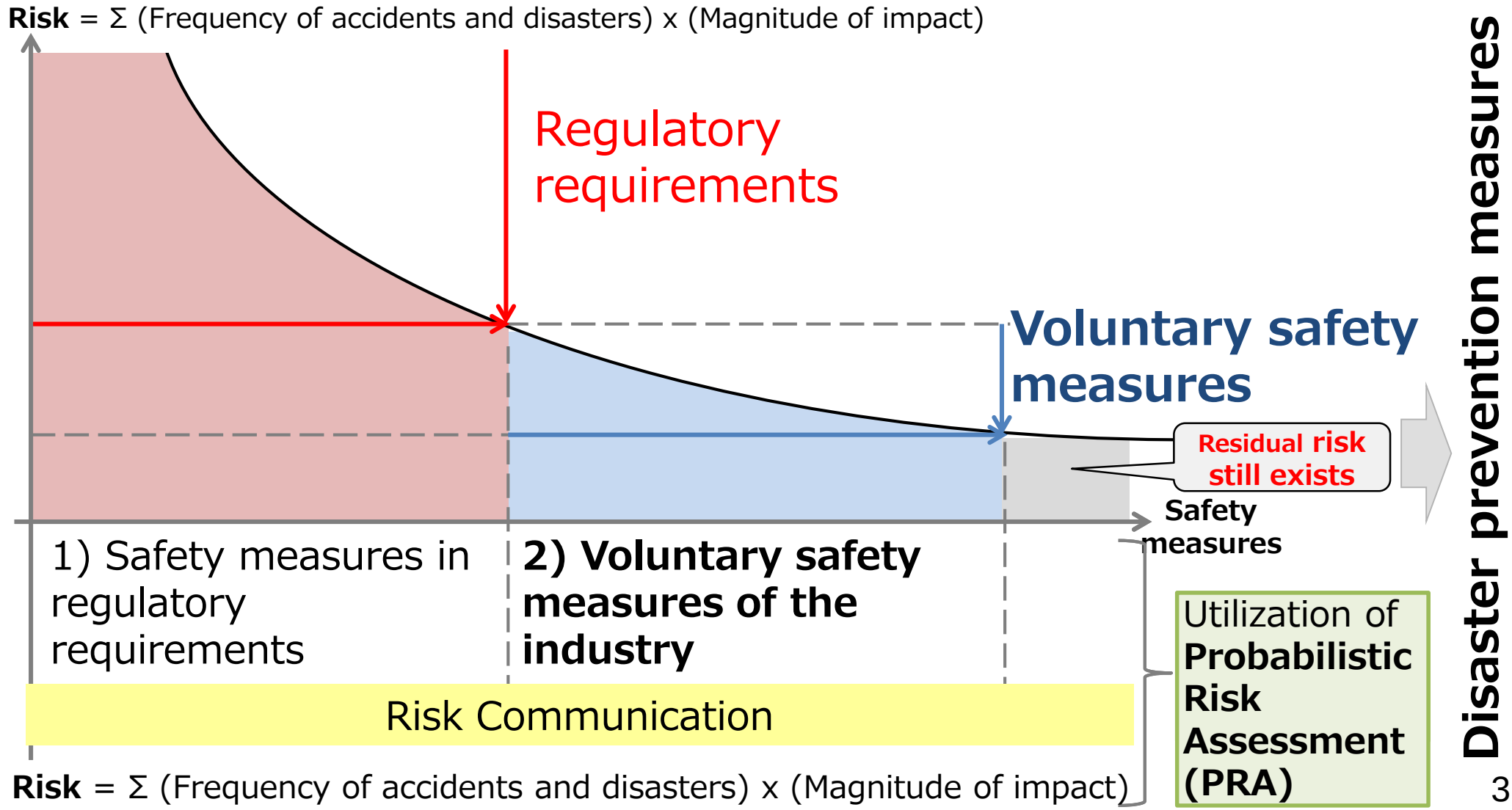
Not yet Applied
9 reactors

Decommission
24 reactors



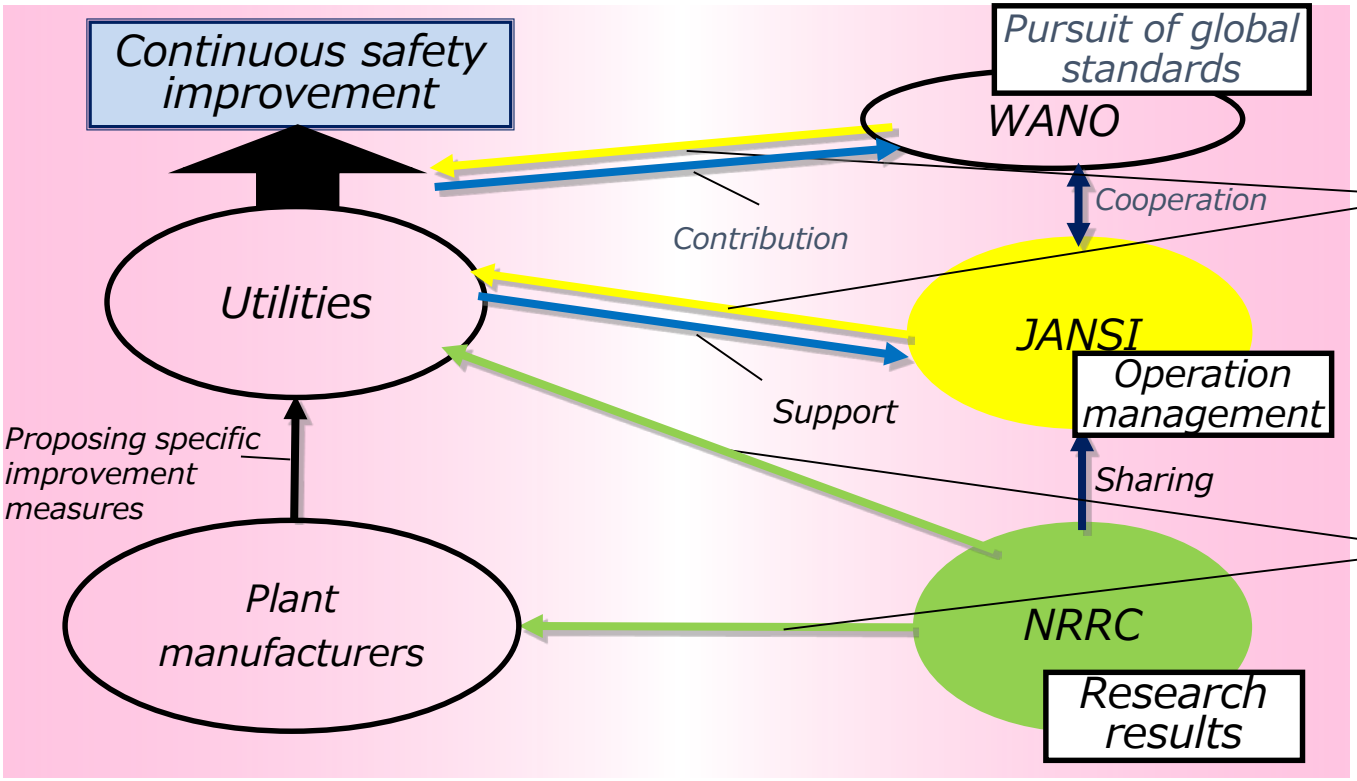
Basic Principle for Ensuring Nuclear Safety

- According to the belief that the risk in ensuring nuclear safety will never be zero, in addition to the 1) safety measures in the regulatory requirements, it is important that the **2) industry itself pursues safety measures voluntarily**.



Establishment of Organizations to Support Utilities in Improving Safety

- For improving nuclear safety, **functions to effectively support** the voluntary efforts of the utilities are necessary.
- On November 15, 2012, **Japan Nuclear Safety Institute (JANSI)** was established as a self-regulatory Organization that is independent from the utilities and drives nuclear safety strongly.
- On October 1, 2014, **Nuclear Risk Research Center (NRRC)** was established with the aim of developing methods for evaluating risks of external events such as earthquake or tsunami.



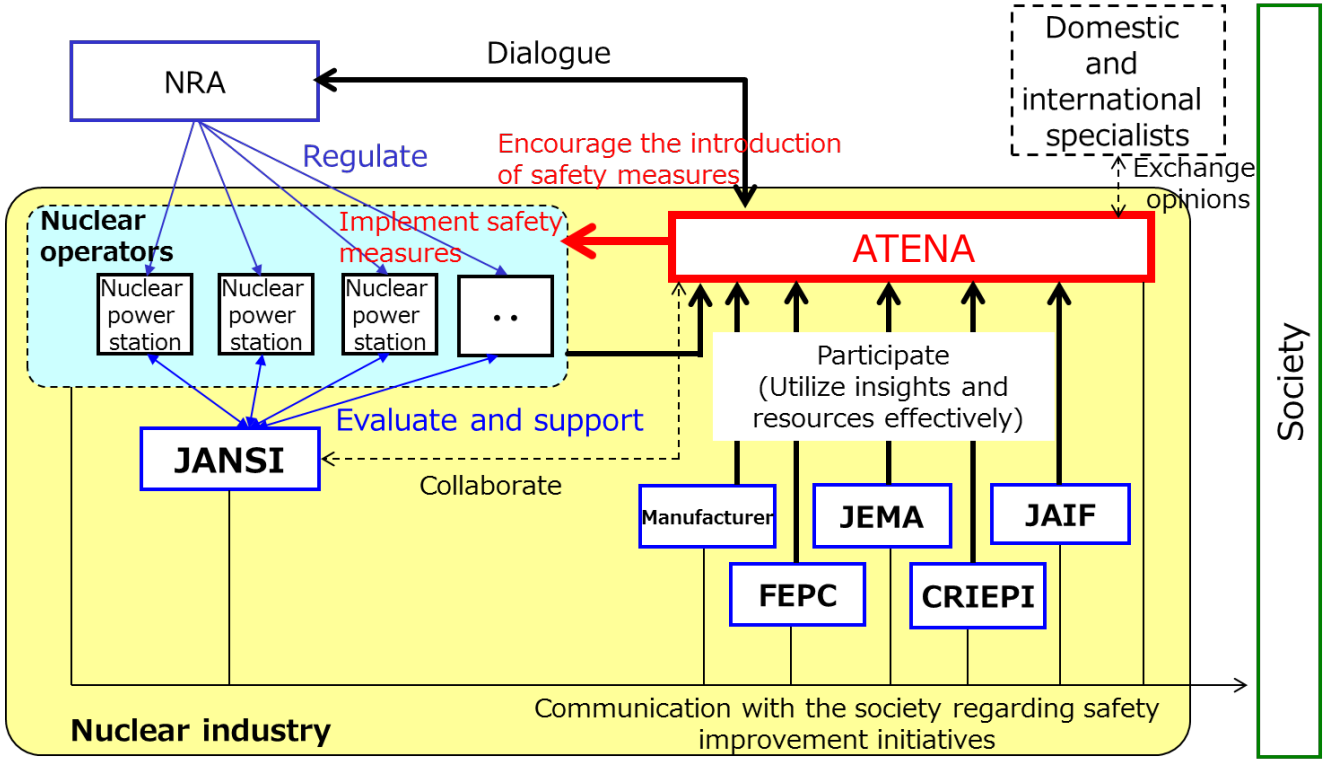
Peer review

Probabilistic Risk Assessment (PRA) approach

WANO: World Association of Nuclear Operators

Possible Relationship between Nuclear Stakeholders in Japan

- New Organization (**ATENA: Atomic Energy Association**) was established in July 2018.
- ATENA will help nuclear operators with their efforts to improve nuclear safety by
  - ・specifying challenges in nuclear power safety that the nuclear industry needs to address
  - ・coordinating the nuclear industry's activities to discuss solutions to challenges
  - ・having representative nuclear industry specialists join discussions on solutions to challenges
  - ・developing into a technical report about solutions for challenges and publish it
- **Nuclear operators, manufacturers, and other nuclear organizations** join the discussion.



Nuclear Fuel Cycle & Plutonium Management Policy

Excerpt from Strategic Energy Plan

Promotion of the nuclear fuel cycle

- The basic policy of Japan is to promote a nuclear fuel cycle that reprocesses spent fuels and effectively utilizes the plutonium etc. retrieved, from the viewpoint of effective utilization of resources and reduction of the volume and harmfulness of high-level radioactive waste.
- Specifically, GOJ will promote plutonium use in LWRs, and proceed with such measures as completion of the Rokkasho Reprocessing Plant, construction of a MOX fuel fabrication plant, and completion of the Mutsu interim storage facility on the underlying premise of ensuring safety.

Plutonium Management

- The Japanese government remains committed to the policy of not possessing plutonium without specific purposes on the premise of peaceful use of plutonium and work to reduce of the size of plutonium stockpile, thereby contributing to nuclear non-proliferation and steadily proceeding with such efforts while gaining international understanding.
- In order to achieve this policy effectively, the government will appropriately manage and utilize plutonium through further promotion of plutonium use in LWRs and the Government's involvement based on the framework of the Spent Nuclear Fuel Reprocessing Implementation Act newly introduced in 2016 while paying due consideration to an appropriate balance between the separation and utilization of plutonium.

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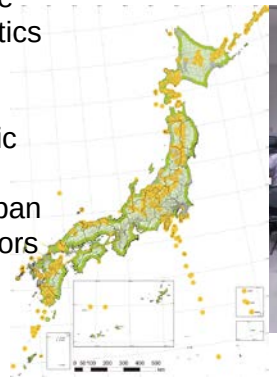
Realization of final disposal of high-level radioactive waste

- **Dialogue activities continue throughout Japan**, triggered by the publication of the "Nationwide Map of Scientific Features for Geological Disposal" in July 2017, toward realization of final disposal of high-level radioactive waste.
- In addition, **the government took the lead** in carrying out **proactive international cooperation with major nuclear power user countries that face the common challenge**.

Dialogue activities throughout Japan

- Public meetings have been held throughout Japan since last May. Since last fall, detailed **dialogue activities are being carried out mainly in "green coastal area"** (area where a possibility that favorable characteristics can be confirmed is relatively high on the map).
- **The social effect and activities to ensure safety** are also explained in detail, according to the **interest of participants**.

The map showing the scientific characteristics related to deep geological disposal based on the specific standards.
This map divides Japan into areas of four colors



Public meeting

Cooperation with nuclear power user countries

- **Sharing experiences and knowledge on dialogue activities in each of the nuclear power user countries**, promoting research cooperation and personnel exchange in participating countries
- **First international round-table conference is scheduled to be held on 14th October in Paris**.

Joint press conference of "G20 ministerial meeting in Karuizawa" (June 2019)

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Current Challenges

Step-by-step approach toward site selection for geological disposal

- The publication of the map is **the first step on a long way toward completion of geological disposal.**
- With expecting that multiple municipalities will undertake the site investigations, **we will continue to promote public dialogues to ensure deeper public understanding of this issue**.

Publication of Nationwide Map of Scientific Features

Deepen national and regional comprehension

Nationwide public meetings using the map

Listening to public voices

- **Prioritized activities focusing on "green (coastal area)"**
- Supporting regional deliberation
- Promotion of R&D
- International cooperation & contribution

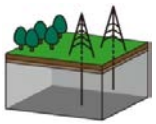
Application or Offer by Govt.

With the aim that multiple municipalities will accept site investigations

Site investigations

Conducted by NUMO based on regional comprehension

Literature survey



Preliminary investigation (borehole survey, etc.)

Detailed investigation (construction & studies in underground facilities)

Selection of final disposal site

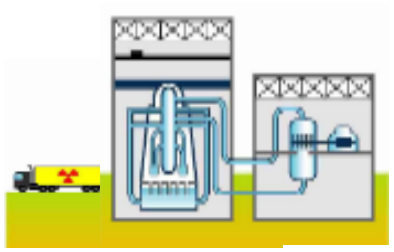
The process of general decommissioning

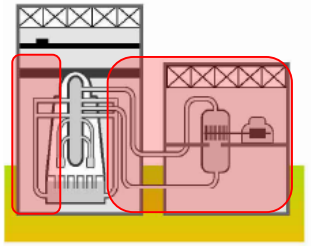
- The decommissioning process is mainly divided into four phases and each utility has formulated a plan to complete decommissioning in about 30 years.
- **<u>The second and third phase, during which large amounts of dismantled equipment and low-level waste is generated</u>**, are particularly important processes.

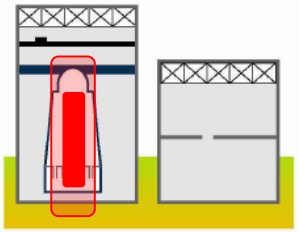
Approval of the decommissioning plan

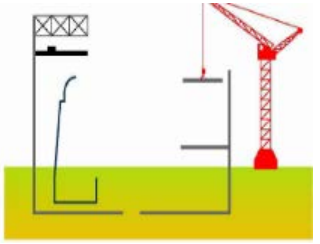
About 30 years

About 7 years	About 12 years	About 7 years	About 4 years
First phase (Dismantle preparation)	**Second phase (Peripheral equipment)**	**Third phase (Dismantling of nuclear reactor area)**	Fourth phase (Dismantling of building)







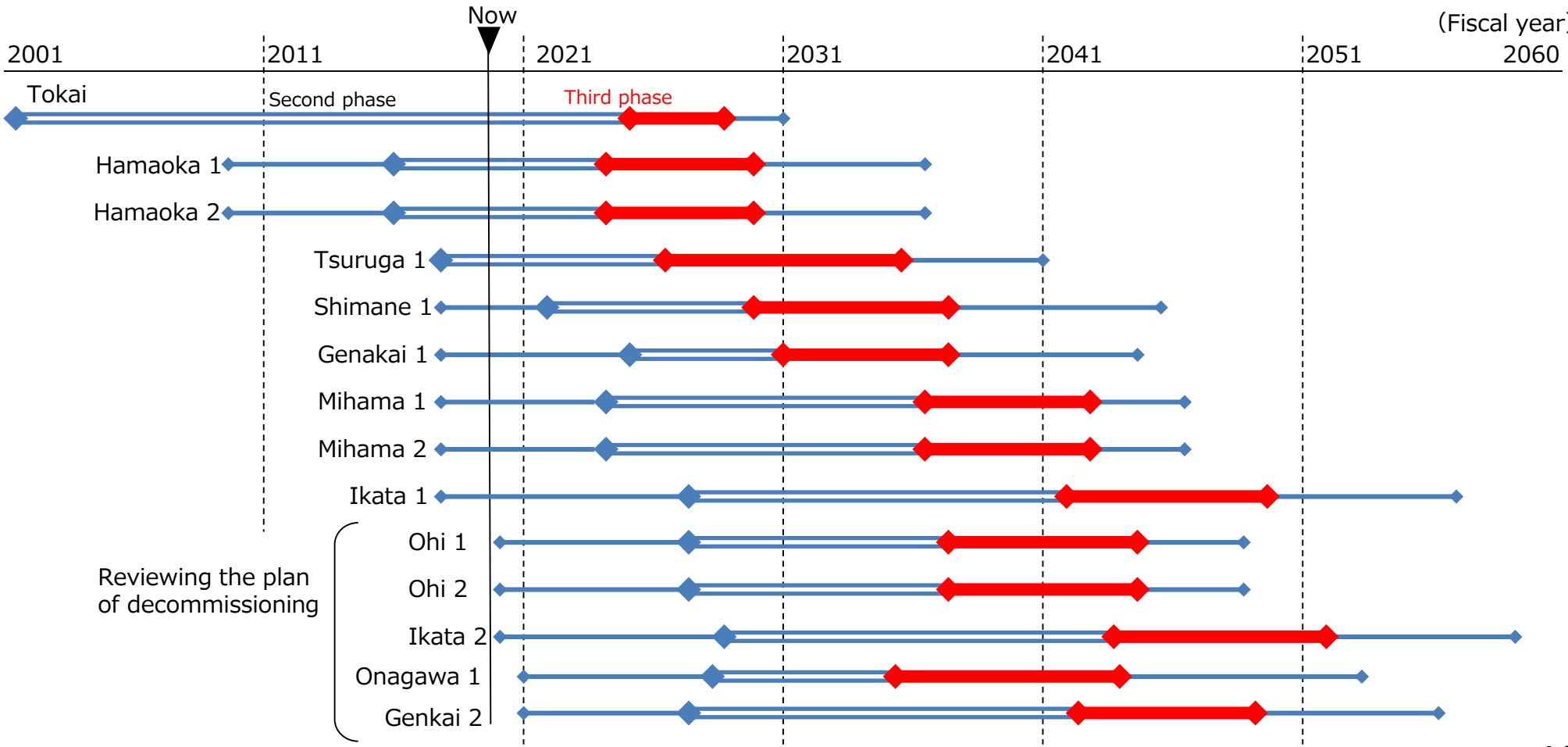


Land use newly as an industrial site

Removal fuel Investigation of pollution Decontamination	Dismantling of peripheral equipment	Dismantling of Nuclear reactor	Dismantling of building
	↓	↓	
	L3 waste etc.	**L2・L1 waste etc.**	

Decommissioning schedule of each nuclear power plant

- Now there are 4 plants in the second phase of dismantling peripheral equipment.
- **Full-scale dismantling will be reached in the mid 2020s** as plants enter the third phase of dismantling the reactor.



Fukushima daini 1～4 are planning the plan of decommissioning (not applying).

Direction of general decommissioning

【Knowledge, know-how】
①Cooperation with utilities

- It is important to accumulate and share knowledge and experience in order to safely and smoothly carry out decommissioning work, which will increase in the future.
- Properly utilizing the technology and know-how of overseas businesses.

Joint procurement and sharing of equipment
Public-private dialogue with foreign countries

【Clearance】
②Reuse of useful resources

- From the viewpoint of effective use of resources, it is important to promote the reuse of clearance objects, which will increase in the future.
- This includes gaining social understanding in order to establish the clearance system in society.

Further expansion of reuse destinations within the power industry (Building materials etc.)

【Regulation】
③Specific suggestion to regulator

- Can utility show the standard of reasonable process according to the risk level of each stage of dismantling.
- Can utility have dialogue with regulator and suggest about standard etc.

Study of standard of process
Dialogue with regulator

Points of Strategic Roadmap

- At the Ministerial Meeting for the Nuclear Energy Policy in December 2018, we decided "Strategic Roadmap" specifying the development work of fast reactor for approximately 10 years.

Significance of fast reactor development

・In the long term,
① Effective utilization of resources

・In the short term,
② Volume reduction and
③ Mitigation of harmfulness

of radioactive waste are important.

+

・It is necessary to pursue the function of plutonium management.

Schedule

Present state of uranium :
Identified resources are sufficient for over 135 years

・Commercial use
→ At some point in the latter half of the 21st century

・Start operation of the 1st fast reactor
→ For example, at an appropriate timing around the middle of the 21st century

・How to spend 10 years for the time being
First half: Support diversified technologies
→ Shorten and prioritize technologies after 5 years

Latter half: Develop prioritized technologies

Target technology

・Pursuing the possibility of various fast reactor technologies while maximizing the technology and personnel cultivated to date

Sodium-cooled fast reactor
- MOX fuel (France, Russia, etc.)
- Metal fuel (USA, etc.)

Molten salt fast reactor

Water-cooled fast reactor, etc.

Role sharing / Development system

・Manufacturers utilize knowledge and ingenuity to promote technological development on their own initiative

・Electric power companies as future users implement technology selection

・The government presents the direction of development and promotes active initiatives by private sector
① Financial support according to technology maturity
② Provide development base (JAEA)
③ Pursuit of safety considering the adaptation to regulation

Key Factors for Future Nuclear Innovation

①Sharing the direction of technology development, communication with stakeholders

Private-sector-led nuclear innovation

⑤communication with regulatory authority

②Financial support

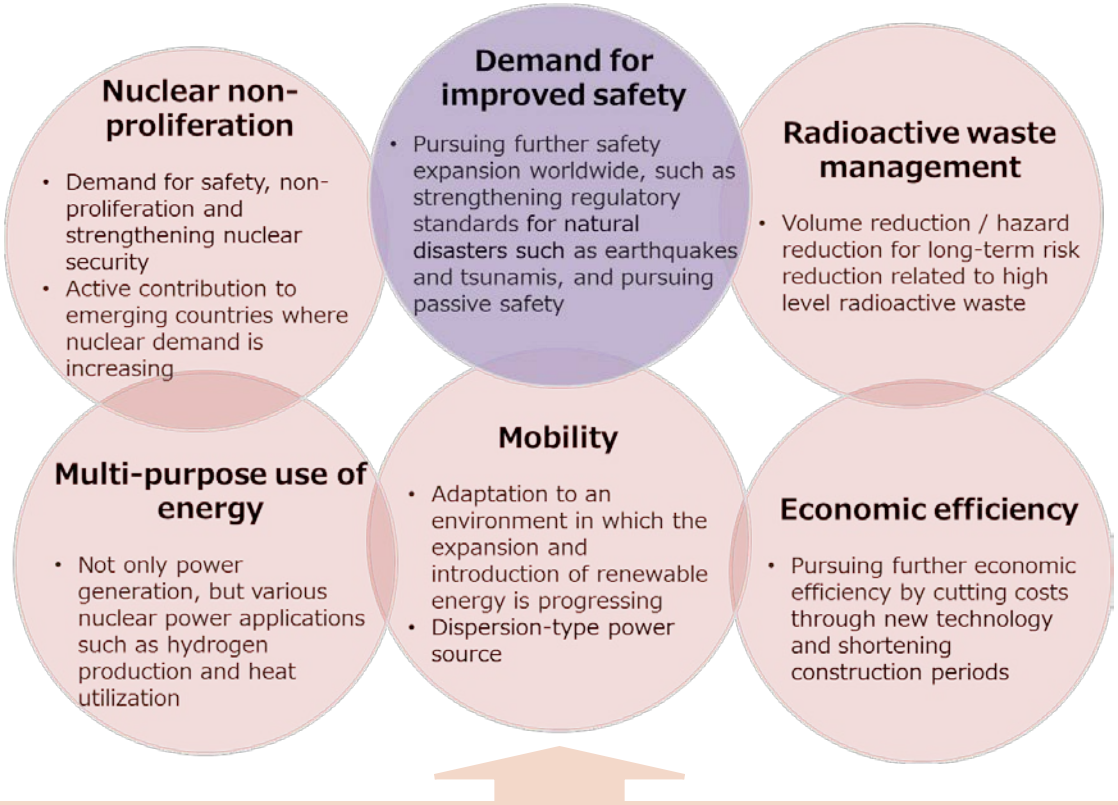
③ Provision of R&D Infrastructure

④Human Resource Development

①Sharing the direction of technology development, communication with Stakeholders

- In order to solve the issues that nuclear power is facing, not only relevant ministries and private sectors that are the main developers but also users' perspectives are indispensable.

<Issues that nuclear power is facing and perspectives to be incorporated >



○ Vendor (Development maker) ○ Power company ○ Financial institution,
○ Energy users (individuals / industries (electric power, hydrogen, heat related)), etc.

② R&D Support Programs

- **Programs on "R&D for improving safety of LWR", "R&D for fast reactor", and "R&D support on back-end of fuel cycle".**
  In addition, from this fiscal year of 2019, budgetary support **to promote technology innovation making use of ingenuity of private entities.**

<R&D for safety improvement of LWR>

■Budget: $27M (2019JPFY)

…Technology development to improve safety and reliability of LWRs, with enhancing lessons learned from the TEPCO Fukushima Daiichi Nuclear Power Plant accident.

<R&D for Fast Reactor>

■Budget : $38M (2019JPFY)

…R&D to enhance safety of fast reactors, with utilizing international cooperations.

<R&D support on Back-end of fuel cycle>

■Budget on geological disposal of high level radioactive waste: $35M (2019JPFY)

■Budget on vitrification for volume reduction of radioactive waste: $6M (2019JPFY)

…R&D to find solutions on nuclear spent fuel issues

<Promotion of technology innovation to meet diversified social demands>

■Budget: $6M (New item in 2019JPFY)

…Competitive budget, widely open to industries, on proposal of nuclear technology for solving social issues expected to be resolved. Conducting feasibility study (FS) on the proposals.

③Provision of R&D Infrastructure

<How to Provide R&D Infrastructure>

Promote various technological developments by private sectors

◆ **Utilizing the FY 2019 budget project for creating nuclear innovation**

→Pursuing the possibilities of various technologies in response to diversifying social issues. (Improvement of safety, coexistence with renewable energy, multipurpose use (hydrogen production), etc.)

Improving R&D in a private sector

Collaboration between companies

International Cooperation

etc.

- Implementation of effective and efficient R&D by mutual exploitation of the facilities among nuclear research institutions
- Building an R&D DB by multilateral cooperation

Promoting JAEA's mission

Mission of JAEA: Maintaining and Expanding Technical Foundation in Japan

Database of Scientific Expertise

- A DB of scientific expertise and intellectual properties will be compiled and offered to a private sector
- An overall quality of the DB will be improved with the international cooperation

Consolidation of Research Facilities

- A high-quality R&D foundation will be offered by consolidating research facilities which will support R&D in a private sector

Upgrading and Expanding

Common Technical Platform

- Evaluation and simulation tools for any types of reactors will be developed
- Safety and R&D (structural, material) standards will be defined

Technological Development for Improving Safety and Economy

- Development for fast reactors (e.g. natural-circulation cooling and countermeasures in case of an accident of the reactor core)

④Human Resource Development

<How to Develop Human Resources for Nuclear Innovation>

- The nuclear R&D infrastructure and the human resource development are weakened; “core networks” for international R&D and human resource development will be formed by combining the resources in Japan
- The core networks will offer an overseas deployment of young talented students and researchers and enhance the support systems for exploiting overseas research institutions

○Current Issues

- ✓ Suspension of research reactors and burden for decommissioning of facilities have weakened the nuclear R&D infrastructure and the human resource development; the resources are widely and thinly distributed
- ✓ Negative effects for nuclear innovation: the nuclear sector has few interactions with other research fields, and stakeholders don’t seamlessly work

○Ideas for How to Deal with the Issues

- ✓ Formation of “core networks” for international R&D and human resource development will be planned, carrying out a feasibility study
- ✓ Aiming at the formation of the self-subsistent core networks in the future