Nuclear Innovation

April 2019

Agency for Natural Resources and Energy

Nuclear Power Plants in Japan

As of 5th, Apr, 2019

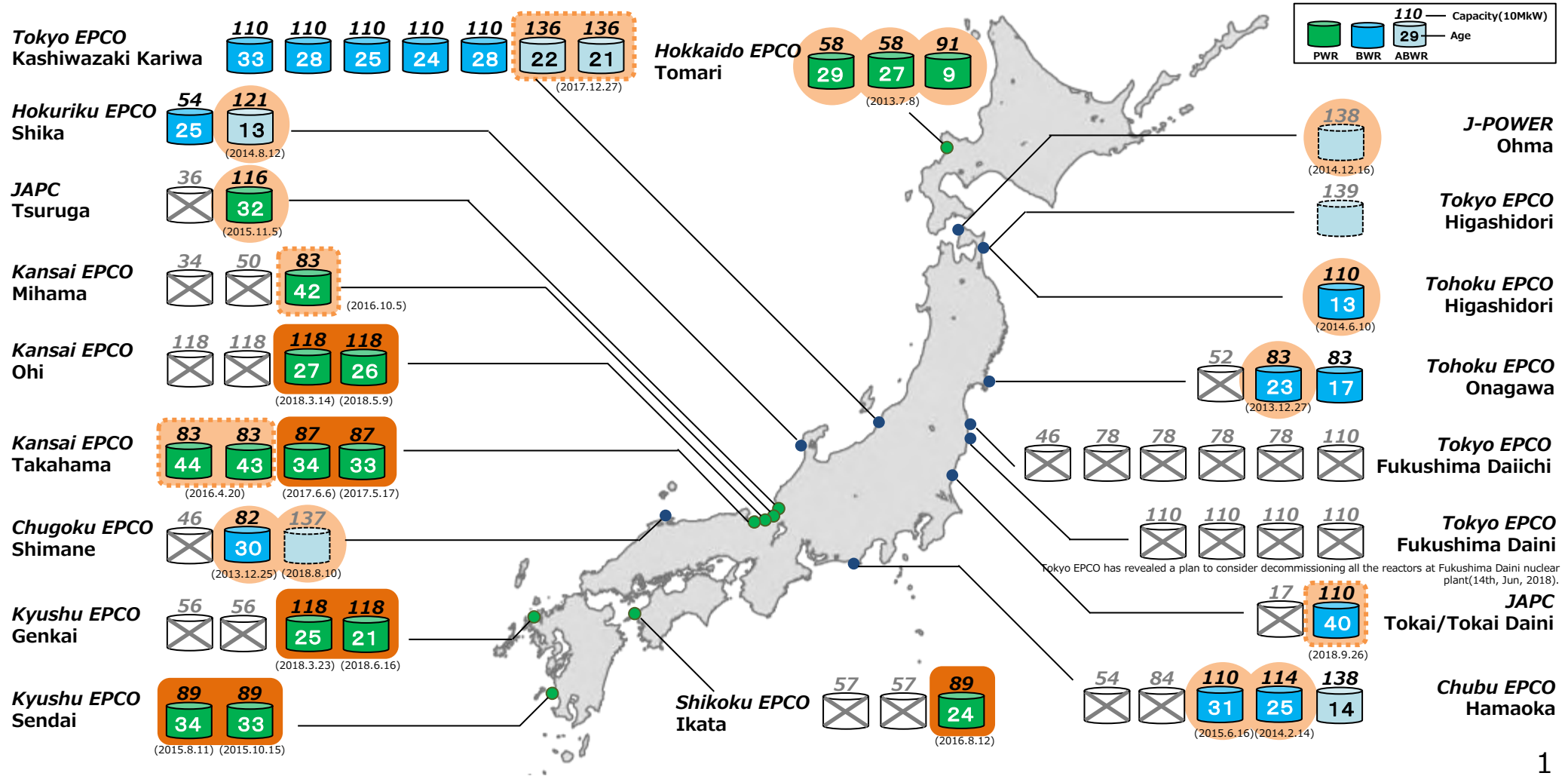
Restarted
9 reactors
In Operation : 9 reactors
Suspended : 0 reactors
(Date of Restart)

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

already decided/predicted to **Decommission**
24 reactors



5th Strategic Energy Plan (Cabinet Decision in July 2018)

3 E + S	⇒	Sophisticated 3 E + S
○ **S**afety		+ Safety innovation by technology/governance reform
○ **E**nergy security		+ Raise technical self-sufficiency rate and ensure diversity of choice
○ **E**nvironment		+ Work towards decarbonisation
○ **E**conomic efficiency		+ Enhance domestic industrial competitiveness

Towards 2030

~ To reduce emission of greenhouse gases by 26% ~
~ To achieve energy mix target ~

- **Currently halfway to the target**
- **Deliberate promotion**
- **Realistic initiatives**
- **Intensify and enhance measures**

< Primary measures >

○ Renewable energy
- ・Lay foundations to use as major power source
- ・Cost reduction, overcome system constraints, secure flexibility of thermal power

○ Nuclear power
- ・Lower dependency on nuclear power generation to the extent possible
- ・Restart of nuclear power plants and continuous improvement of safety

○ Fossil fuels
- ・Promote independent development of fossil fuels upstream, etc.
- ・Effective use of high-efficiency thermal power generation
- ・Enhance response to disaster risks, etc.

○ Energy efficiency
- ・Continued thorough energy efficiency
- ・Integrated implementation of regulation of Act on Rationalizing Energy Use and support measures

○ Promotion of hydrogen / power storage / distributed energy

Towards 2050

~ Toward reducing GHGs by 80% ~
~ Challenges towards energy transitions and decarbonisation ~

- **Possibility and uncertainty**
- **Ambitious multiple track scenario**
- **Pursue every option**

<Primary directions>

○ Renewable energy
- ・Aim to use as major power source, economically independent and decarbonised
- ・Start on hydrogen/power storage/digital technology development

○ Nuclear power
- ・One of the options for decarbonisation
- ・Pursuit of safe reactors, development of backend technologies

○ Fossil fuels
- ・Major power source during the transitional period. Enhance resource diplomacy
- ・Shift to gas, fadeout inefficient coal
- ・Start hydrogen development for decarbonisation

○ Heat & transportation, distributed energy
- ・Challenges for decarbonisation with hydrogen, power storage, etc.
- ・Distributed energy systems and regional development (Combination of next generation renewables / power storage, EV, micro grid, etc.)

Draw up strategic plan ⇒ All Japan's efforts (projects, international collaboration, financial dialogue, policy)

Position of Nuclear Energy in 5th Strategic Energy Plan

Towards 2030 : Achievement of Optimal Energy-Mix Target

- Based on the principle of 3E+S, towards steady realization of the 2030 energy mix

Nuclear power = Important base-load power source contributing to the stability of the energy supply-demand structure in the long term

- On the premise that safety comes before everything else, in case that the NRA confirms the conformity of nuclear power plants with the new regulatory requirements ,which are of the most stringent level in the world, the GOJ will follow the NRA's judgment and will proceed with the restart of nuclear power plants.
- Under the policy of reducing dependency on nuclear power as much as possible, we will aim towards realization of **the power source composition ratios in the 2030 energy mix**, which was formulated after assessing certain levels of nuclear power to be maintained, and steadily implement necessary measures.

Towards 2050 : Challenges of Energy Transition

- **Pursuing every option** "Ambitious multiple track scenario"
- Through "scientific review mechanism", flexibly revise and determine development goals and the relative importance

Nuclear power = Option for decarbonization that is at the practical stage

- Having experienced TEPCO's Fukushima Daiichi Nuclear Power Plant disaster, Japan will give the highest priority to safety and will lower reliance on nuclear power as much as possible while attempting to expand economically self-sustaining and decarbonized renewable energy.
- To recover public trust, the GOJ will immediately begin strengthening human resources, technology, and the industry's foundations and go forward with the **pursuit of reactors that are safe, economical, and mobile while developing technology that aims to resolve backend problems.**

Various Issues

Nuclear non-proliferation

- Demand for safety, non-proliferation and strengthening nuclear security
- Active contribution to emerging countries where nuclear demand is increasing

Demand for improved safety

- Pursuing further safety expansion worldwide, such as strengthening regulatory standards for natural disasters such as earthquakes and tsunamis, and pursuing passive safety

Radioactive waste management

- Volume reduction / hazard reduction for long-term risk reduction related to high level radioactive waste

Multi-purpose use of energy

- Not only power generation, but various nuclear power applications such as hydrogen production and heat utilization

Mobility

- Adaptation to an environment in which the expansion and introduction of renewable energy is progressing
- Dispersion-type power source

Economic efficiency

- Pursuing further economic efficiency by cutting costs through new technology and shortening construction periods

Research and technology development

<Technology development for further improvement of safety, reliability and efficiency of LWR >

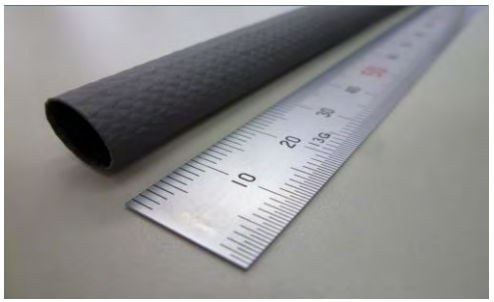
※Safety improvement technology development budget ： 3.02 billion yen （FY2019）

（Practical examples）

○ Development of a new fuel component that is not easily damaged and generates less hydrogen

○ Development of system to process hydrogen generated at the time of accident

○ Development of a core catcher that catches molten fuel at the time of an accident and prevents erosion of concrete



<Promotion of innovation based on diverse social demands >

※Fast reactor development budget ： 4.15 billion yen （FY2019）

⇒ Formulated a "strategic road map" in December last year

※Innovation Technology Development Budget ： 650 million yen （FY2019）

R&D for geological disposal in METI

Scale

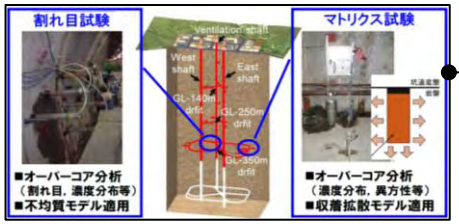
Literture survey | Preliminary investigation | Detailed investigation (first half) | Detailed investigation (latter half) | Construction・operation | Backfilling and sealing

Near-field (approx. 100m)

Hundreds m scale

Several km scale

Dozens km sale



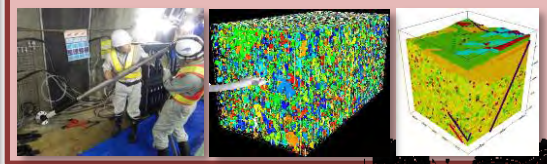
R&D for confirmation the safety assessment methods around near filed

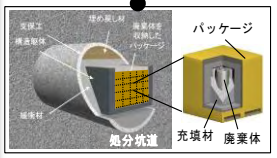
Advancement R&D for assessment method of reversibility & retrievability

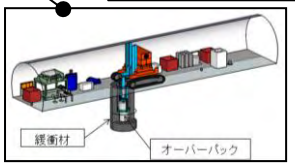
R&D for Confirming the sealing system of facility

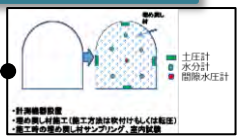
R&D for Confirmation the safety assessment methods of TRU wastes

Advancement R&D for assessments of groundwater flow at the deep underground environments

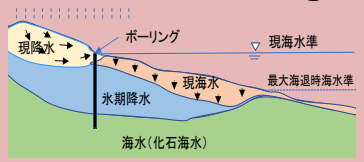




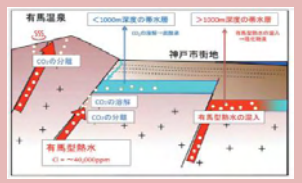




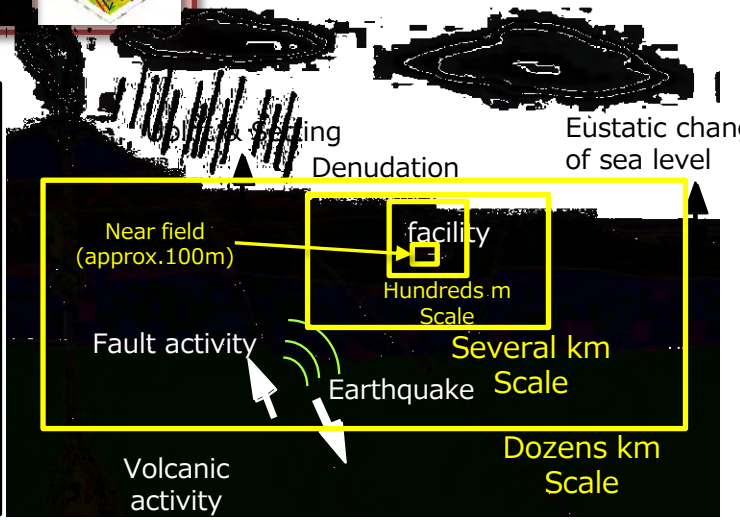
Advancement R&D for geological disposal system around the coastal region



Advancement R&D for understanding the long-term stability of geological environments



- Methodologies for understanding the geological environment
- Methodologies for safety assessment
- Methodologies for safety assessment & engineering design
- Methodologies for engineering design



※In addition, “R&D for Confirming the safety assessment of direct disposal & alternative method” and “R&D for low-level radioactive wastes disposal” are underway.

R&D budget (METI,2019) : 4.02 billion yen
R&D budget (NUMO,2019) : 1.9 billion yen

Development of human resources

Human resource development is implemented in the framework of the “Nuclear Human Resource Development Network” in which makers, electric power companies, universities, and so on, participate.

In the future, we will collaborate with US and international organizations.

Nuclear Human Resource Development Network

Universities, research institutes, etc.
(the gross number of participants: 5925)

Budget for fiscal year 2019 : 210 million yen

① Advancement and internationalization of nuclear power related education

② Conducted radiation training, etc. at a nuclear facility-owned organization

(Practical examples)

・Fukushima University
: Human resources development to continuously support decommissioning

・Tohoku University
: Education on radioactive waste treatment and disposal

・Osaka Prefecture University
: Human resource development using large-scale radiation facilities

Industry etc.
(the gross number of participants: 677)

Budget for fiscal year 2019 : 100 million yen

① Training for maintenance and transmission of skills

② Developing human resources capable of risk communication etc.

(Practical examples)

・Aomori Gennen Technology Center
: Safety management training and internship

・Wakasa wan Energy Research Center
: Improvement training for decommissioning technology

・Ebara Byron Jackson
: Practical training using a reactor recirculation pump

Relevant ministries

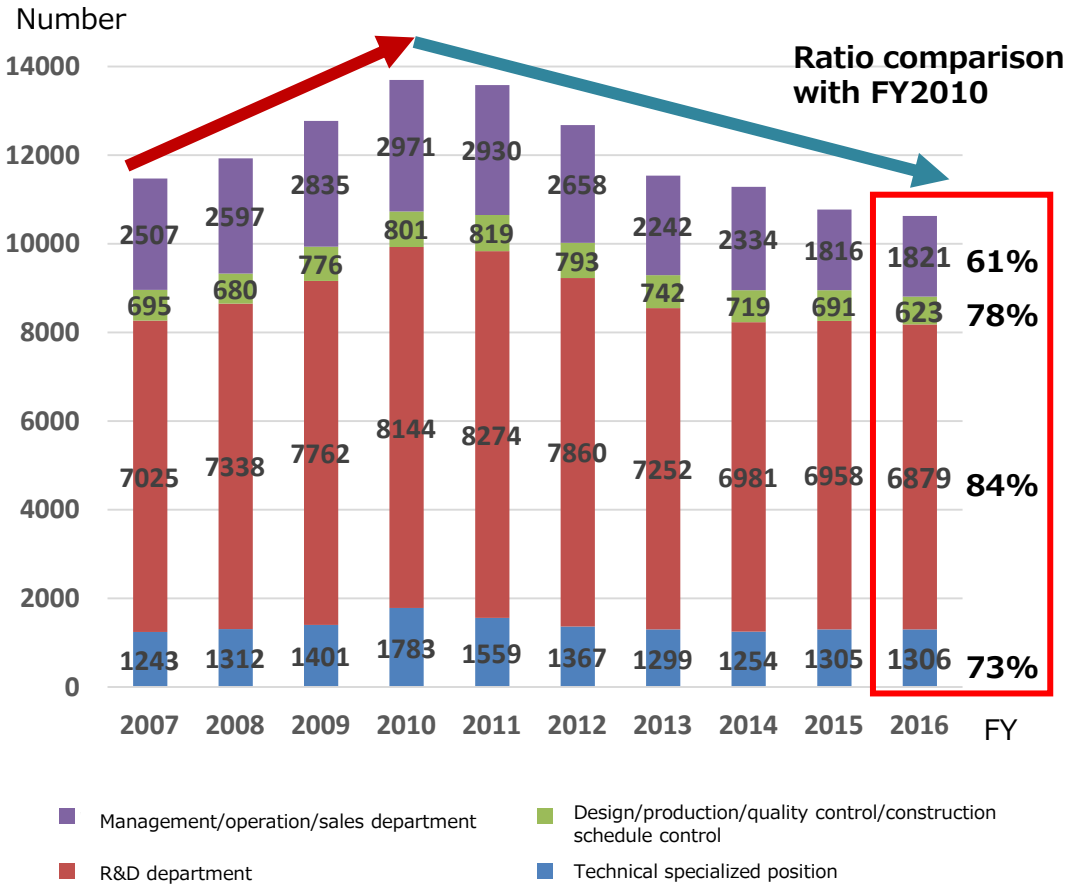
Local Governments

learned society

※ the gross number of participants and practical examples in FY2017

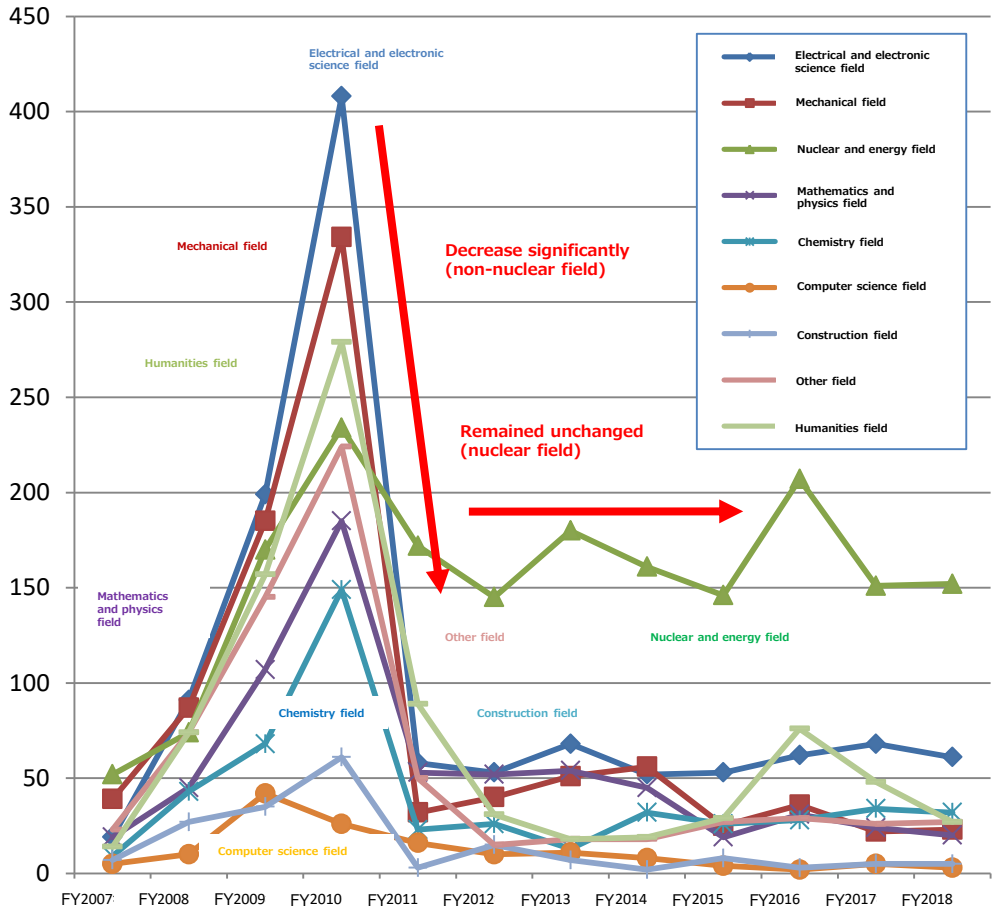
Current situation of nuclear human resources

<Number of nuclear workers in each sector over the last 10 years>



Ref. THE JAPAN ELECTRICAL MANUFACTURERS' ASSOCIATION

<JAIF number of participants of job fairs by major>



Ref. JAPAN ATOMIC INDUSTRIAL FORUM