未来へげんき
To the Future / JAEA

Japan Atomic Energy Agency

Support for Decommissioning of the Fukushima Daiichi Nuclear Power Station and Efforts Toward Environmental Restoration

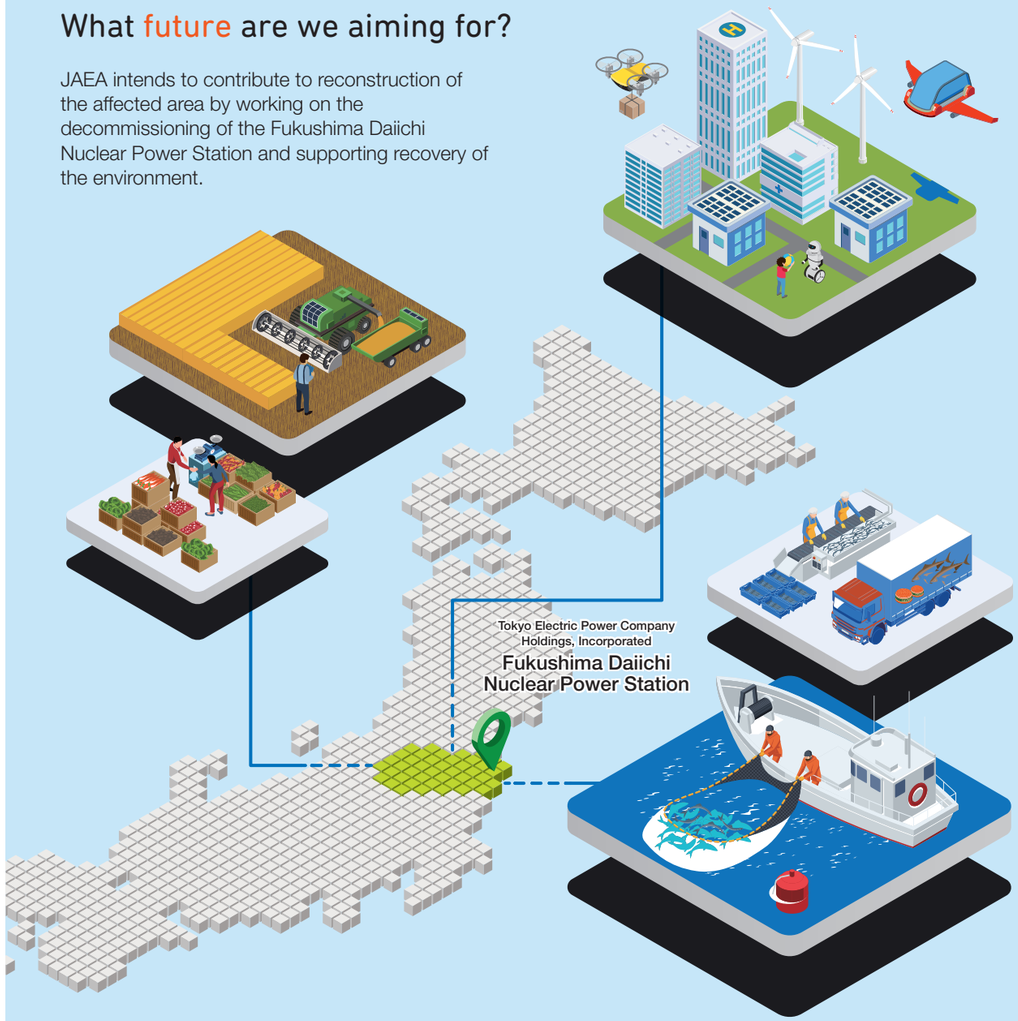
Sustainable

–Helping to reconstruct the affected area–

JAEA intend to contribute to decommissioning the Fukushima Daiichi Nuclear Power Station, and restoring the surrounding environment, through the achievements of our research and development.

What future are we aiming for?

JAEA intends to contribute to reconstruction of the affected area by working on the decommissioning of the Fukushima Daiichi Nuclear Power Station and supporting recovery of the environment.



Key technologies for realization

1. Supporting decommissioning of the Fukushima Daiichi Nuclear Power Station
2. Supporting restoration of the environment

Sustainable

Supporting decommissioning of the Fukushima Daiichi Nuclear Power Station and the environment restoration

With regard to decommissioning the Fukushima Daiichi Nuclear Power Station, JAEA is working on research and development intended to move forward with technically difficult decommissioning processes, such as safe, reliable and prompt fuel debris retrieval. JAEA is also working on investigations and research and development that are intended to recover the environment, toward creation of an environment where the people can live safely with peace of mind.

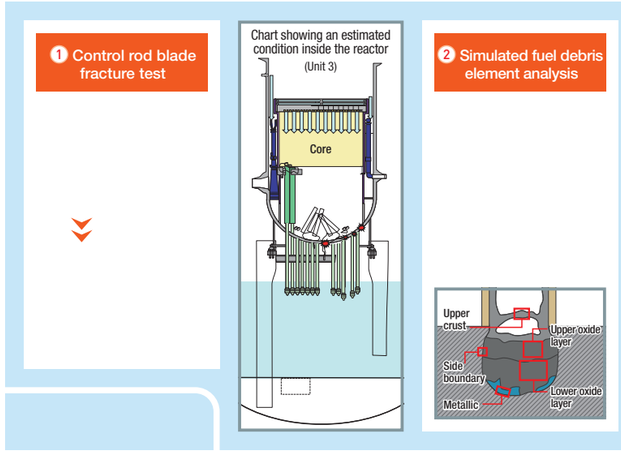
For details, scan the code

What are the JAEA's initiatives for the future?

1 Support decommissioning of the Fukushima Daiichi Nuclear Power Station

<Analysis of fuel debris>

For safe and reliable treatment and disposal of the fuel debris in the reactor, JAEA will analyze its properties. JAEA's laboratories are collaborating together on the analysis in cooperation.



◀ Radioactive Material Analysis and Research Facility Laboratory-2 (preparations being made for construction in Okuma-machi)
The laboratory analyzes high-dose radioactive materials such as fuel debris.

<Analysis of ALPS treated water as third-party>

In accordance with the Government's policy, JAEA is conducting an analysis from the standpoint of a third party independent from Tokyo Electric Power Company Holdings (third-party analysis), with the aim of ensuring highly objective and transparent measurement of radioactive materials contained in the ALPS treated water.

Flow of analysis

(1) Pretreatment — This treatment is to increase the purity of the nuclides to facilitate measurement.

(2) Measurement — Measurement is performed using an appropriate analyzer for each nuclide while considering the radiation emitted from the nuclide to be analyzed.

(3) Confirmation/ evaluation — JAEA will confirm and evaluate the validity of the analysis data output from the analyzers, report the results to the Government and issue official publications.

2 Supporting restoration of the environment

To contribute to lifting the restrictions imposed on the Evacuation Order Areas and revitalizing the agriculture, forestry, and fishery industries, JAEA is developing technologies for grasping the present state of distribution of radio-nuclides, and research on environmental dynamics and environmental analysis, in which the movements of radionuclides are examined and predicted.

Establishing a Technology for Decommissioning Nuclear Facilities

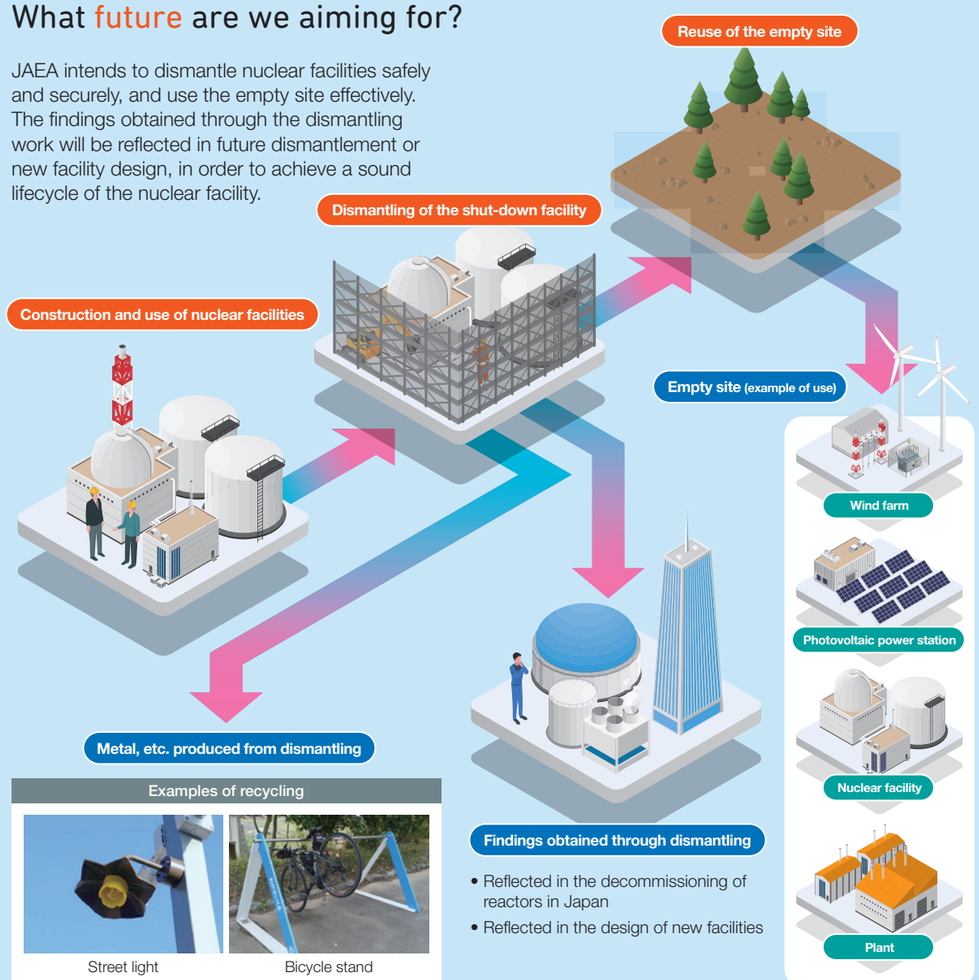
Sustainable Ubiquitous

–Turning the lifecycle of nuclear facilities–

As with architecture and social infrastructure, nuclear facilities also need sound lifecycle management.

What future are we aiming for?

JAEA intends to dismantle nuclear facilities safely and securely, and use the empty site effectively. The findings obtained through the dismantling work will be reflected in future dismantlement or new facility design, in order to achieve a sound lifecycle of the nuclear facility.



Examples of recycling

Street light

Bicycle stand

Findings obtained through dismantling

- Reflected in the decommissioning of reactors in Japan
- Reflected in the design of new facilities

Key technologies for realization

Consolidating the findings on decommissioning technologies through the decommissioning of the JAEA's facilities

Sustainable — Achieving a sound lifecycle for nuclear facilities

Ubiquitous — Recycling metals produced from decommissioning, and utilizing the recycled metals in general industrial fields

To make the use of nuclear energy sustainable, JAEA is moving forward with activities such as the decommissioning of nuclear facilities that have completed their mission, and the treatment and disposal of radioactive waste, in a safe, efficient, and rational manner. JAEA is also working on helping to realize a recycling-oriented society by promoting the reuse of matters such as clearance metal generated, for example, through the dismantling of facilities.

For details, scan the code

What are the JAEA's initiatives for the future?

Consolidating the findings on decommissioning technologies through the decommissioning of the JAEA's facilities

<Fugen Decommissioning Engineering Center>

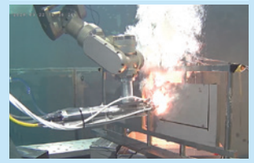
Ahead of power utilities, JAEA has pursued the decommissioning of a water-cooled reactor. Currently, JAEA is working on the development of technologies for remote and automated devices in order to conduct the dismantling and removal of reactor peripheral equipment, and the dismantling of the reactor itself.

2008–2017	2018–2029	2030–2038	2039–2040
Decontamination of heavy water ane other systems	Dismantling of reactor peripheral equipment	Dismantling of reactor	Demolition of reactor building

Dismantling and removal of large machineries around the reactor


Dismantling of the control-rod drive mechanism casing

Technological development related to the reactor dismantling method


Underwater laser cutting test

<Prototype Fast Breeder Reactor Monju>

JAEA is working on the decommissioning of a sodium-cooled fast reactor. Currently, JAEA is proceeding with activities such as the dismantling and removal of the electric power facilities with water and vapor systems, and the removal of the shields, etc. as a preparation for dismantling the sodium equipment.

2018–2022	2023–2031	2032–	–2047
Phase 1 Fuel unloading	Phase 2 Preparation for dismantling	Phase 3 Dismantling I	Phase 4 Dismantling II

Dismantling and removal of electric power facilities with water, vapor, and other systems


Current status of the dismantling of turbine generator

Achievement toward the transport of Monju sodium


Conclusion of a framework agreement on the processing in the United Kingdom (April 2023)

<Tokai Reprocessing Plant (TRP), Nuclear Fuel Cycle Engineering Laboratories>

JAEA is moving ahead with the decommissioning of the reprocessing facility. JAEA is working on the vitrification of high-level liquid waste, development of technology for treating low-level liquid waste, and decontamination toward the dismantling of the facility.

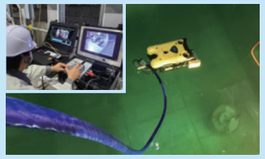
Approx. 70 years

Reduce the risk in TRP by conducting, Vitrification of high-level liquid waste, etc	Decommissioning of major facilities	Decommissioning of waste treatment and waste storage facilities
Vitrification of high-level liquid waste	Completion of vitrification	..... Decommissioning all facilities

Safety improvement of high-level liquid waste storage

Vitrification high-level liquid waste

Recovery and restrage of high-level solid waste



Cementation of low-level liquid waste

<Ningyo-toge Environmental Engineering Center Center>

JAEA is engaged in the decommissioning of uranium enrichment facilities that have completed their mission, the closure of mine facilities, and uranium waste engineering and environmental researches related to these activities.

<Aomori Research and Development Center>

JAEA promotes the decommissioning of nuclear facilities on nuclear powered ship Mutsu, assay of trace elements (iodine, carbon) in environmental samples using an accelerator mass spectrometer, and development of relevant analysis technologies.

Toward the Domestic Production of Medical Radioisotopes

What are medical radioisotopes?

JAEA is moving ahead with research and development with a view to domestically producing medical radioisotopes (hereinafter “medical RIs”), which are used for applications such as cancer treatment and diagnostic imaging.

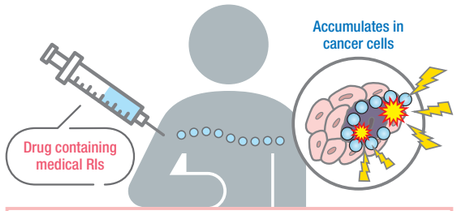
With the Experimental Fast Reactor Joyo

JAEA aims to produce actinium 225 which is expected to be effective for various cancers such as leukemia and melanoma.

R&D

Precisely killing only cancer cells with alpha rays emitted from medical RIs!

The method of killing cancer cells using radiation emitted from medical RIs administered in the body is called “internal therapy.” It is expected to be highly effective for cancer treatment.



- Effective, for which no treatment method has been established such as systemic cancers
- Limited damage to the surrounding normal tissues because of short radiation range
- Unnecessary hospitalization because of short treatment period

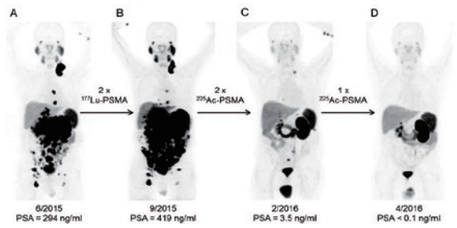
Eagerly anticipated for practical application in Japan and abroad!

Example of application overseas

The tumor in the late-stage metastatic prostate cancer has completely disappeared!

(all signs of cancer disappeared)

The administration of actinium-225 to a patient with cancer that had spread throughout the body resulted in the disappearance of the cancerous tumors.



Kratochwil,Giesel, JNM, July 7, 2016

Killing cancer cells with actinium 225 radiation

With Japan research reactor-3

JRR-3 aims to produce molybdenum-99/technetium-99m, which is used in diagnostic imaging (SPECT examinations).

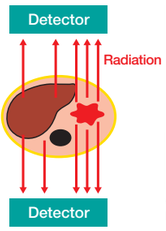
R&D

Diagnosing illness by administering a drug containing medical RIs!

Japan relies on imports for medical-grade radioisotopes used in diagnostic imaging. JAEA will effectively utilize the performance of JRR-3 and promote the development of irradiation manufacturing technology for social implementation.

- Capturing an organ’s functionality
  * CT and MRI scans are intended to capture abnormalities in an organ
- Sometimes, they can detect illnesses that are hard to find with other tests
- Very few side effects

Administering the drug in the body by injection, and conducting the test with the principle as shown in the figure below.



Website of the Nuclear Medicine, Center hospital of the National Center for Global Health and Medicine (https//www.hosp.ncgm.go.jp/s037/010/080/010/index.html)

Example of achievement

Early diagnosis with less impact on the body!

Bone scintigraphy is known as one of the most frequently conducted tests among nuclear medicine examinations.

Example of bone scintigraphy

[Advantages]

1. Functional diagnostic imaging that reflects changes in bone metabolism
2. Systemic search is easy (figure on the right)
3. Effective for judging the effect after treatment, and in follow-up

Website of the Nuclear Medicine, Center hospital of the National Center for Global Health and Medicine (https//www.hosp.ncgm.go.jp/s037/010/080/010/index.html)

Preparation of Neutron Supply Sources

Japan Research Reactor-3 [JRR-3]

The JRR-3 has applied properties of thermal neutron to RI production and semiconductor production as industrial use, meteorite analysis to make use of the property of distinguish elements, furthermore it has applied properties of cold neutron to elucidation of biological function with analysis of polymer structure. The reactor has provided high density source of thermal and cold neutron, which has used as a wide range of fields from fundamental research to industrial fields.

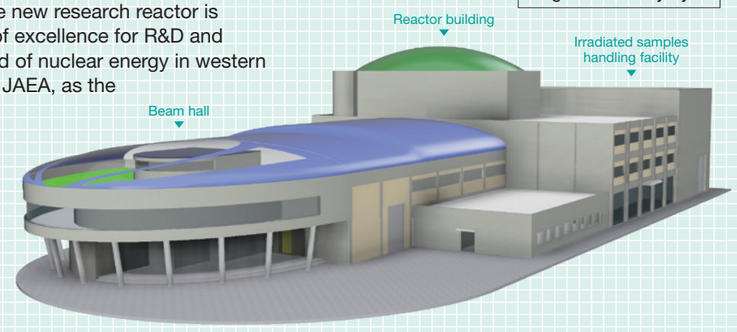
Japan Proton Accelerator Research Complex [J-PARC]

At the research complex, J-PARC is pursuing activities ranging from study of elementary particles and nuclei to research intended to elucidate mysteries surrounding of the origins of the universe. J-PARC has created a variety of secondary particle beams such as neutrons, muons, neutrinos and kaons from the world’s leading high-intensity proton beam accelerated almost to the speed of light, and various experiments are conducted there.

New Research Reactor

JAEA plans to establish a new research reactor in the site of “Monju,” the Prototype Fast Breeder Reactor. The new research reactor is expected to play the role of the center of excellence for R&D and human resource development in the field of nuclear energy in western Japan and contributing to local society. JAEA, as the implementing body, conducts detailed design of the research reactor in collaboration with Kyoto University and the University of Fukui.

Image of the facility layout

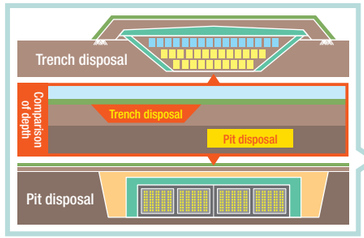


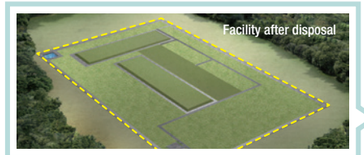
Establishment of Technology for Disposing of Radioactive Waste

Disposal of low-level radioactive waste

JAEA is engaged in disposal project of low-level radioactive waste from research and medical facilities.
Currently, we are working to establish a technical base focusing on designing for the safe disposal facility.

Basic policies for ensuring safety



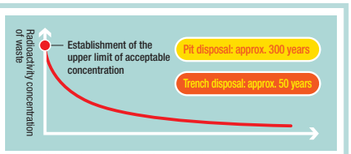


(1) Establishment of the upper limit of radioactivity concentration
We establish the upper limit of radioactivity concentration and do not accept wastes with radioactivity concentration that exceeds this limit.

(2) Control of the radioactive material migration
We construct a disposal facility with function to control the radioactive material migration.

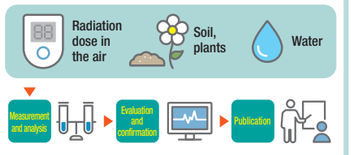
(3) Attenuation of radioactivity
We establish an entrance restriction into the disposal facility during the term until it becomes safe through the radioactivity attenuation even if the site is excavated.

(4) Long-term monitoring
We monitor the environment surrounding the disposal facility during the term of the entrance restriction and directly confirm the safety.



By establishing the upper limit of acceptable radioactivity concentration, the disposal facility becomes a safe condition after a fixed period of time because of the naturally attenuation of radioactivity.

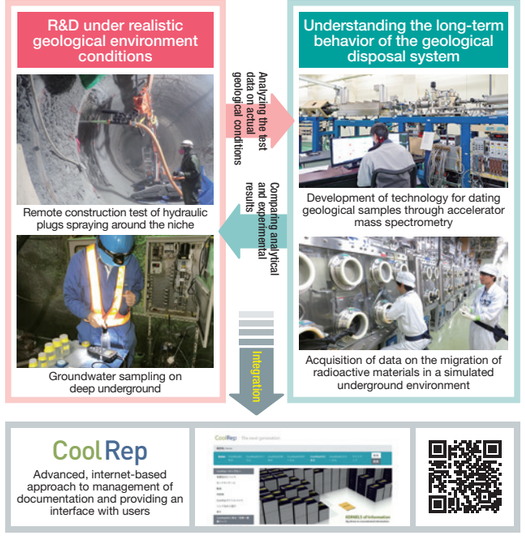
Examples of environmental monitoring



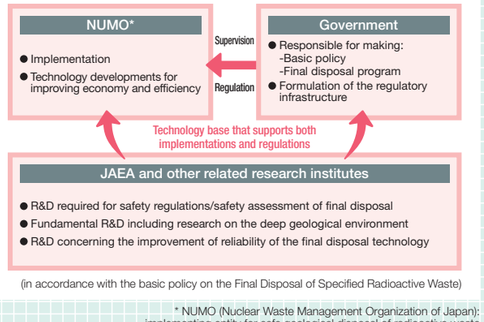
R&D on geological disposal of high-level radioactive waste

JAEA conducts investigation and prediction of the geological environment, as well as research and development necessary for the design and safety evaluation of the geological disposal system.

R&D at JAEA



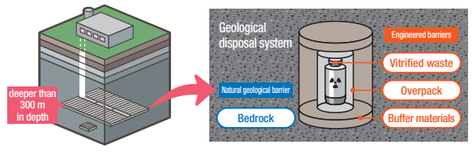
Organizational structure for geological disposal in Japan



(in accordance with the basic policy on the Final Disposal of Specified Radioactive Waste)

* NUMO (Nuclear Waste Management Organization of Japan): implementing entity for safe geological disposal of radioactive waste

Image of geological disposal



International Efforts and Contribution

International cooperation

Toward achieving a decarbonized society by making the most of nuclear science and technology, JAEA intends to actively engage in international cooperation and thereby contribute to address a wide range of issues concerned.

Fields of collaboration with other countries and recent major progress

Poland
High-temperature gas-cooled reactor, and material testing reactor
An R&D Cooperation Agreement with the National Centre for Nuclear Research (NCBJ) in Poland intended for cooperation on the basic design of a Polish high-temperature gas-cooled reactor was revised (November 2022).

European Commission (EC)
Nuclear non-proliferation/ nuclear security

United Kingdom
Decommissioning, radioactive waste management, and high-temperature gas-cooled reactor
Signed an extension of the technical co-operation agreement with the UK's National Nuclear Laboratory (NNL) in April 2023. Concluded the memorandum of co-operation in the field of high-temperature gas-cooled reactor technologies with NNL in September 2023.

Republic of Korea
Nuclear safety, environmental monitoring, radioactive waste management, neutron science, etc.
A technical cooperation agreement in the field of peaceful use of nuclear energy with the Korea Atomic Energy Research Institute (KAERI) was extended (July 2024).

The United States
R&D on next-generation reactor, R&D on nuclear fuel cycle and radioactive waste management, nuclear non-proliferation/ nuclear security, and nuclear science
Initiated cooperative R&D with Argonne National Laboratory to evaluate metal fuel for sodium-cooled fast reactors in January 2024.

Kazakhstan
High-temperature gas-cooled reactors fuels, test research reactors, and safety of fast reactors
An agreement on research cooperation for high-temperature gas-cooled reactor fuels with the Nuclear Physics of the Republic of Kazakhstan (INP) was extended (September 2024).

Emerging Nuclear Countries in Asia, the Middle East, etc.
Support for human resource development in nuclear safety and nuclear security

Switzerland
R&D on the disposal of high-level radioactive waste
An agreement in the field of radioactive waste management with the National Cooperative for the Disposal of Radioactive Waste (NAGRA) in Switzerland was extended (August 2023).

Australia
Neutron science

France
Fast reactor, nuclear safety, radiological protection, nuclear science, decommissioning, radioactive waste management, etc.
Promoted collaborative research on fast reactor development, radioactive waste management and nuclear science with the French Alternative Energies and Atomic Energy Commission (CEA).

International Atomic Energy Agency (IAEA)
Advanced reactor, nuclear safety, safeguards and nuclear security, decommissioning and radioactive waste management, etc.

Held side events at the 67th General Conference of IAEA and presented initiatives related to high-temperature gas-cooled reactors and human resource development in September 2023.

Concluded the practical arrangements on cooperation in the area of sampling and analysis at the Fukushima Daiichi NPS in November 2023.

Joined the first Nuclear Energy Summit, attended by heads of state and government, and presented as a panelist in March 2024.

Organisation for Economic Co-operation and Development/ Nuclear Energy Agency (OECD/NEA)
Advanced reactor, nuclear safety, nuclear science, decommissioning, radioactive waste management, and human resource development
Carried out the evaluation of advanced reactor performance through the reactor forced cooling loss test at 100% reactor power operation in the LOFC project using HTTR in March 2024.

The Generation IV International Forum (GIF)
Participated in R&D projects on Generation IV reactor systems

Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO)
Contributed to the international monitoring system to detect nuclear test explosions

International Science and Technology Center (ISTC)
Participated in cooperative R&D projects

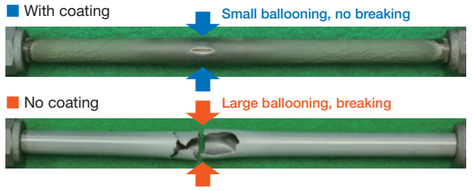
Introducing Our Initiatives 5

Research on Light-water Reactors

JAEA is pressing ahead with basic and fundamental research and development, which is intended to accelerate the development of ATF (accident tolerant fuel) elements that is less subject to severe accidents and would mitigate the impact of severe accidents. In addition, JAEA plays the role of coordinating the development in Japan to give a boost to development by manufacturers.

Appearance after LOCA (loss-of-coolant accident) simulation test

Mitsubishi Heavy Industries Technical Review Vol. 57 No. 4 (December 2020)



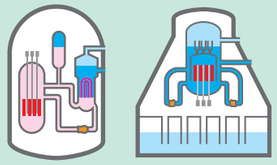
Safety Research

The integrity assessment of the reactor pressure vessel applying the probabilistic approach is expected to available quantitatively evaluating the safety margin in the existing evaluation method, and suporting more rational maintenance plans.

New calculation program

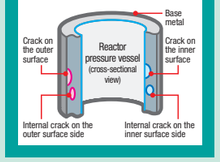
Capable of calculating the failure probability and failure frequency for all events that may cause failure of the pressure vessel

PASCAL5



- Changes in the pressure and the coolant the coolant water temperature in the reactor at startup and shutdown
- Pressurized thermal shock event
- Low-temperature overpressure event

Evaluating all assumed cracks



Introducing Our Initiatives 6

Fostering Human Resources for the Future of Nuclear Energy

For domestic human resource development, JAEA hold various training courses, cooperate in university education, and conduct human resource development activities in collaboration with related domestic organizations. For international human resource development, JAEA invite engineers and other professionals from Asian countries, and train them to become lecturers who will be responsible for human resource development in their home countries.

Practical training on dose measurement for engineers responsible for the safe use of nuclear energy

Introducing Our Initiatives 7

Strengthening Nuclear Non-proliferation and Nuclear Security

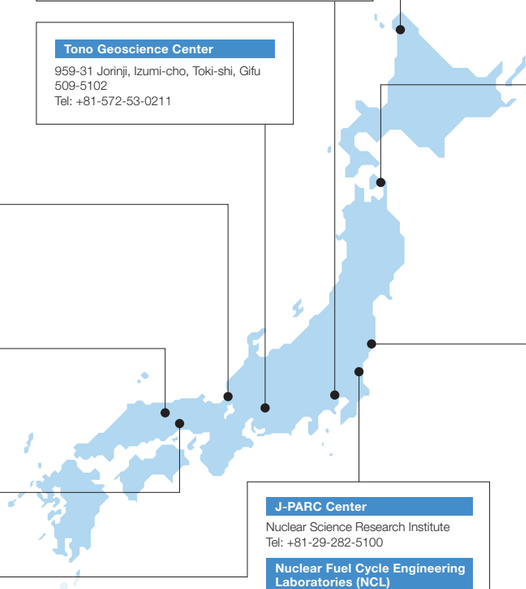
With the aim of realizing a world without nuclear weapons and nuclear terrorism, JAEA is working on activities in the field of nuclear non-proliferation and nuclear security, such as technological development, policy researches, support for human resource development, and support for the international verification regime of the Comprehensive Test Ban Treaty (CTBT).

Experience-based exercise on nuclear non-proliferation and nuclear security using a VR system

Location of R&D Sites

[as of November 2024]

- Number of staff: 3,090 people (end of fiscal 2023)
- Budget: 151.1 billion yen (fiscal 2023)



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