国立研究開発法人

日本原子力研究開発機構

Japan Atomic Energy Agency

ビジョン ～目指す将来像～
Vision (Future Image)

「ニュークリア × リニューアブル」で拓く新しい未来

Exploration of a New Future with the Synergy of Nuclear and Renewable

原子力（ニュークリア）と再生可能（リニューアブル）エネルギーが二元論を乗り越え、融合することで実現する新しい持続可能（サステナブル）な未来社会を目指します。

We aim for a new ‘sustainable future society’ achieved by integrating nuclear and renewable energies, overcoming dichotomy.

Message from President KOGUCHI

I would like to express my sincere gratitude for your understanding and support of the research and development (R&D) activities of the Japan Atomic Energy Agency (JAEA).

We are witnessing substantial changes in the global as well as domestic circumstances surrounding nuclear energy. In Japan, the GX (Green Transformation) initiative announced by Prime Minister Kishida last fall is being materialized toward its realization, in which the maximum utilization of nuclear energy is advocated.

JAEA is an organization that is tasked with implementing Japan's nuclear policy as a national research institute. Based on this shift of the major national policy, we set forth a new vision "Explore a New Future with the Synergy of Nuclear and Renewable" in this April to clarify the overall directions of our specific activities.

The vision demonstrates our commitment to realize a decarbonized society by fully utilizing strengths and complementing weaknesses of each energy source, nuclear and renewables. Specifically, we aim to provide carbon-free energy sources (hydrogen, heat, and electricity) through the development of advanced reactors such as high-temperature gas-cooled reactors and fast reactors and to provide a stable and seamless electricity supply in harmonization with renewable energy. Furthermore, we would like to conduct research to make nuclear energy itself more sustainable through the reductions of volume and radiotoxicity of high-level radioactive waste as well as its recycling. This is an indispensable technological development for Japan to lead the world in realizing a decarbonized society, and I believe it is a worthwhile theme for JAEA to address with its maximum efforts.

As efforts toward a decarbonized society have begun simultaneously in many developed countries including Japan, mutual coordination and collaboration are becoming more important than ever before. In particular, cooperation with countries that share the same social value, such as the United States, the United Kingdom, France, and Canada is essential for accelerating R&D in the future. We are currently implementing a number of international collaboration in the field of advanced reactors, and we would like to further expand the scope of the collaboration.

The support and trust from society is a prerequisite for the implementation of nuclear technology in society. In addition to ensuring the safety of facilities and technology, it is necessary to fulfill accountability to the public and to be responsive to the opinions of society.
We hope to live up to this trust not only through R&D, but also through the appropriate maintenance management of our facilities and the contribution to the steady advancement of the decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Station, and by reaffirming the importance of this commitment with all management and employees, we will continue to be an organization that contributes to society.

I wish to express my deep appreciation for your continued understanding and support.

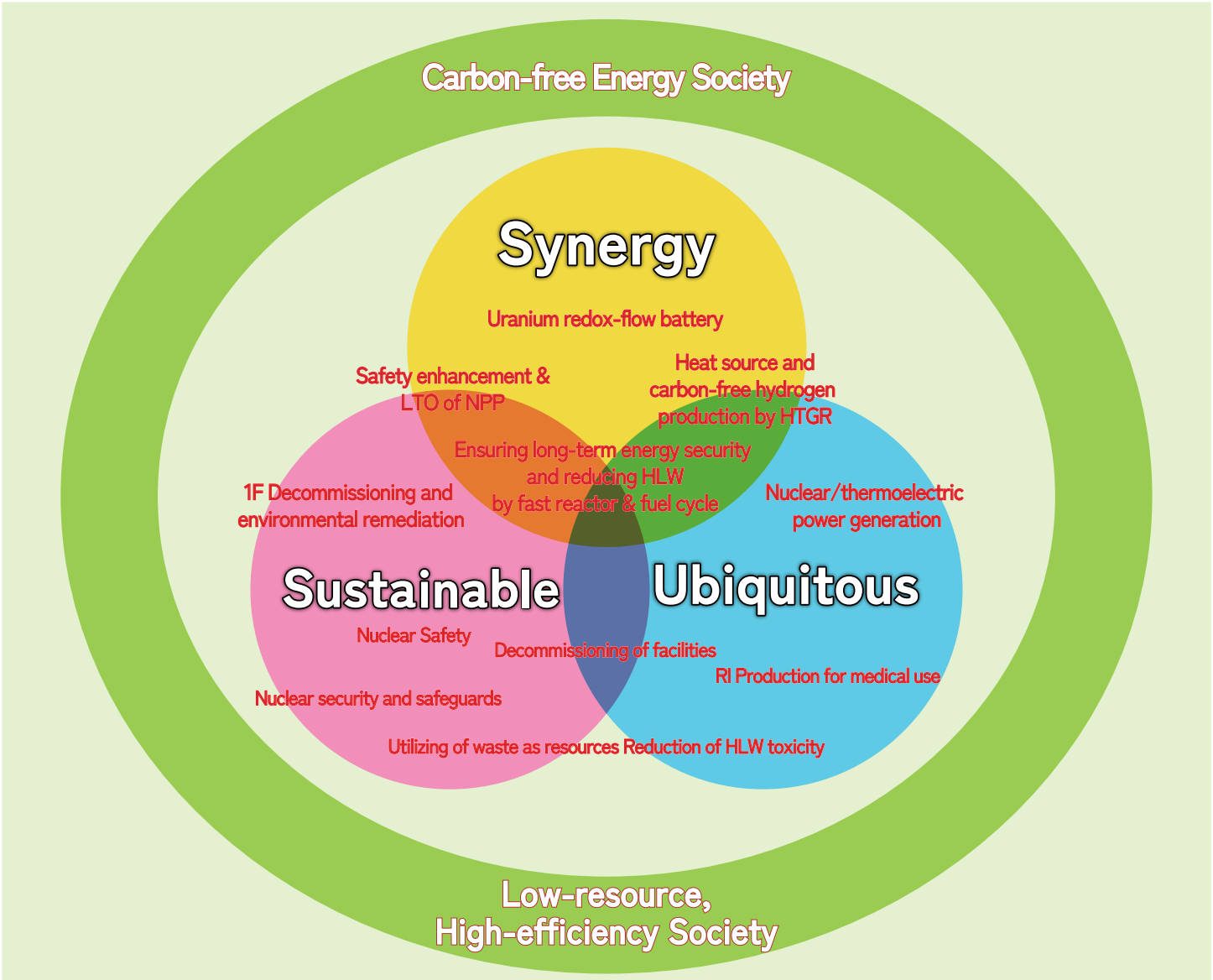
April, 2023
KOGUCHI Masanori
President

未来へげんき
To the Future / JAEA

The Way Forward for JAEA

Achieving JAEA's vision
Exploration of a New Future with the Synergy of Nuclear and Renewable

Pursuing Nuclear-Renewable **Synergy**	Making Nuclear Energy **Sustainable**	Making Nuclear Technology **Ubiquitous**



Contribution to the Welfare and Prosperity of Human Society through Nuclear Science and Technology

Organizational Chart

https://www.jaea.go.jp/english/about/organization.pdf

President
Executive Vice President
Executive Director

Chief Science and Technology Officer

Auditor

Headquarters

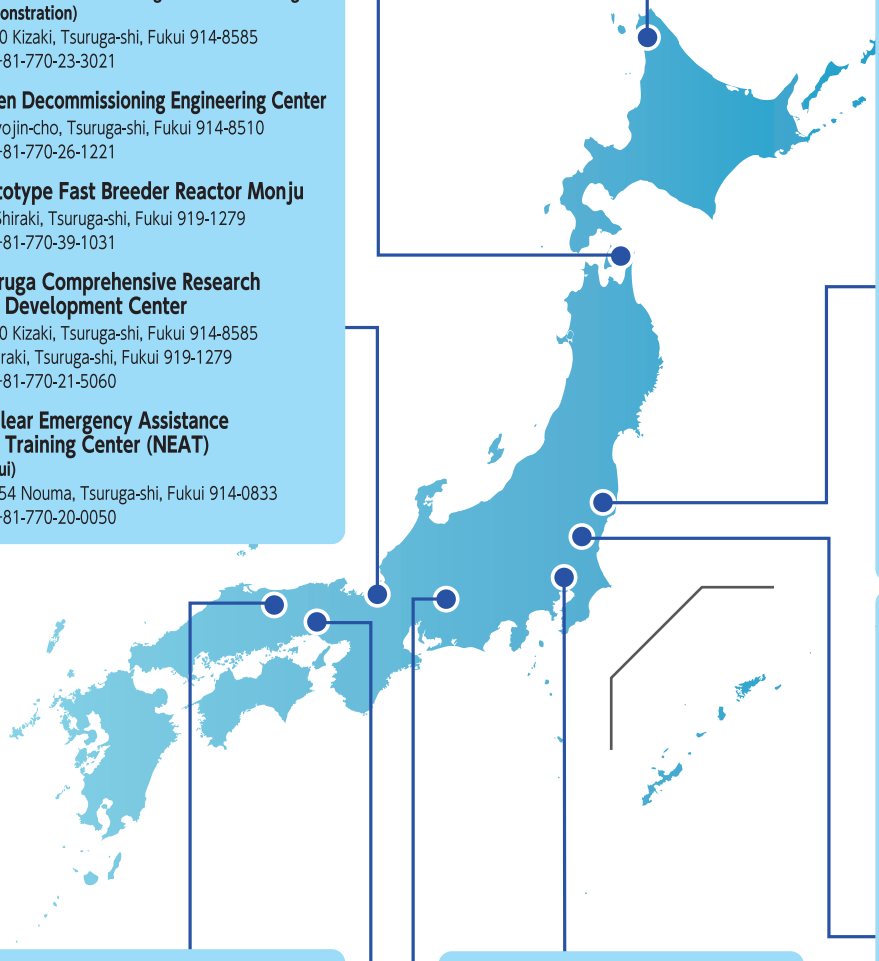
- Decommissioning and Radioactive Waste Management Head Office
- Safety and Nuclear Security Administration Head Office
- Policy Planning and Administration Department
- Overseas Business Strategy Department
- Research and Development Promotion Department
- General Affairs Department
- Human Resources and Development Department
- Financial Affairs Department
- Contract Department
- International Affairs Department
- Office of Auditor
- Nuclear Safety Audit Section
- Nuclear Energy Research and Development Domain
- Science and Technology Promotion Domain
- Decommissioning and Waste Management Domain
- Construction Department
- Center for Computational Science & e-Systems
- Nuclear Human Resource Development Center
- Integrated Support Center for Nuclear Nonproliferation and Nuclear Security
- New Research Reactor Promotion Office
- Tsuruga Head Office

Research and Development Sector

- Fukushima Research and Engineering Institute
- Sector of Nuclear Safety Research and Emergency Preparedness
- Nuclear Science Research Institute
- J-PARC Center
- Oarai Research and Development Institute
- Nuclear Fuel Cycle Engineering Laboratories
- Ningyo-toge Environmental Engineering Center
- Tono Geoscience Center
- Horonobe Underground Research Center
- Aomori Research and Development Center
- Sector of Tsuruga Decommissioning Demonstration

R&D Institutes and Centers

https://www.jaea.go.jp/english/about/locationmap.html



Horonobe Underground Research Center
432-2 Hokushin, Horonobe-cho, Teshio-gun,
Hokkaido 098-3224
Tel:+81-1632-5-2022

Aomori Research and Development Center
400 Kitasekine, Sekine, Mutsu-shi, Aomori 035-0022
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Tsuruga Head Office
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65-20 Kizaki, Tsuruga-shi, Fukui 914-8585
Tel:+81-770-23-3021

Fugen Decommissioning Engineering Center
3 Myojin-cho, Tsuruga-shi, Fukui 914-8510
Tel:+81-770-26-1221

Prototype Fast Breeder Reactor Monju
2-1 Shiraki, Tsuruga-shi, Fukui 919-1279
Tel:+81-770-39-1031

Tsuruga Comprehensive Research and Development Center
65-20 Kizaki, Tsuruga-shi, Fukui 914-8585
1 Shiraki, Tsuruga-shi, Fukui 919-1279
Tel:+81-770-21-5060

Nuclear Emergency Assistance and Training Center (NEAT)
(Fukui)
6-2, 54 Nouma, Tsuruga-shi, Fukui 914-0833
Tel:+81-770-20-0050

Iwaki Office
8F Taira Central Building, 7-1 O-machi, Taira,
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Collaborative Laboratories for Advanced Decommissioning Science (CLADS)
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45-169 Sukakeba, Kaibama,
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Nuclear Fuel Cycle Engineering Laboratories (NCL)
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Tomata-gun, Okayama 708-0698
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Harima SR Radioisotope Laboratory
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2024.4

Fukushima Daiichi Nuclear Power Station Decommissioning and Environmental Restoration of Fukushima

https://fukushima.jaea.go.jp/en/

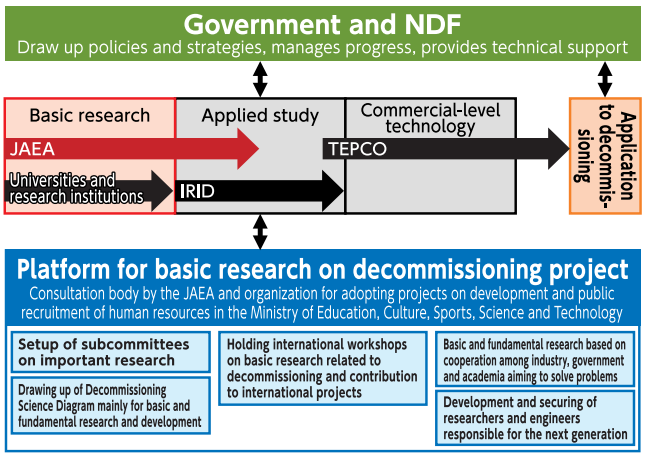
Efforts to research and development for decommissioning of Fukushima Daiichi Nuclear Power Station (FDNPS) of Tokyo Electric Power Company Holdings Inc.(TEPCO) and environmental restoration of Fukushima.

Center | Fukushima | Tokai | Oarai

R&D for decommissioning of FDNPS

Based on the medium- and long-term road map established by the government toward decommissioning of FDNPS, the technological strategy plan established by the Nuclear Damage Compensation and Decommissioning Facilitation Corporation (NDF) and other policies, and needs of on-site from medium- and long-term perspectives, JAEA is steadily carrying out required research and development (R&D) activities. In addition, JAEA focuses on developing research infrastructures and securing and fostering human resources.
The results obtained from decommissioning of FDNPS are utilized in the decommissioning of JAEA's facilities, and the results are actively disseminated to contribute to improving the safety of nuclear facilities in Japan and abroad.

[Implementation system for decommissioning of FDNPS]



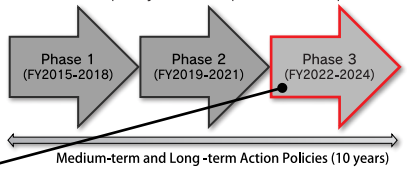
* IRID: International Research Institute for Nuclear Decommissioning

R&D for environmental restoration

In collaboration with Fukushima Prefecture and National Institute for Environmental Studies (NIES), JAEA promotes R&D in accordance with Medium-term and Long -term Action Policies of Fukushima Prefectural Centre for Environmental Creation (CEC), in order to implement the policy of Basic Guidelines for the Reconstruction and Revitalization of Fukushima.
JAEA carries out R&D and survey for restoration of environment contaminated by radioactive materials. JAEA conducts environmental dynamics study in the larger fields such as forests and rivers, and develops systems to visualize and predict radiation dose rate. Moreover, JAEA will actively offer technical expertise.

[Medium-term and Long-term Action Policies of CEC]

The applicable period is 10 years from FY2015 to FY2024. As the project of CEC is unprecedented, its policy is to be split into three phases.



Activities in Phase 3 (FY2022-2024):
Expansion of scientific knowledge, taking into account social conditions and the needs of the people of Fukushima
- Enriching and enhancing the finely tuned, continuous environmental radioactivity monitoring system
- Reduction of the lower detection limit of the measurement or simplification and speeding up of the measurement
- Sophisticating the dynamics assessment model for radioactive cesium in land and water areas

Efforts after the end of Phase 3 will be considered within the period of Phase 3, taking into account the progress of the initiatives up to Phase 3 and changes in the social situation.

Research and development organizations

Naraha Center for Remote Control Technology Development (NARREC)

R&D on remote technology, provision of occasions for verification testing, and preparedness of equipment for nuclear emergencies.

Cooperation

Collaborative Laboratories for Advanced Decommissioning Science (CLADS)

Center for R&D and human resources development cooperating with universities, research institutions toward decommissioning.

Sharing results

R&D on environmental dynamics, radiation monitoring, etc.

Cooperation

Okuma Analysis and Research Center

R&D of analytical techniques for radioactive waste, fuel debris, etc. and analysis of ALPS treated water as a third party.

(Administration building and Laboratory-1 are in operation, and Laboratory-2 is under preparation for construction.)

Cooperation

[TEPCO, IRID and NDF] [National and international universities, research institutions, etc.] [Fukushima Prefecture, Ministry of the Environment and F-REI]
[Cooperation with the R&D institutes of JAEA in the Ibaraki and other areas, and Utilize facilities that use nuclear fuel and/or radioactive materials.]

* F-REI: Fukushima Institute for Research, Education and Innovation

JAEA contributes to the decommissioning of TEPCO's FDNPS and environmental restoration of Fukushima.

R&D for decommissioning

CLADS

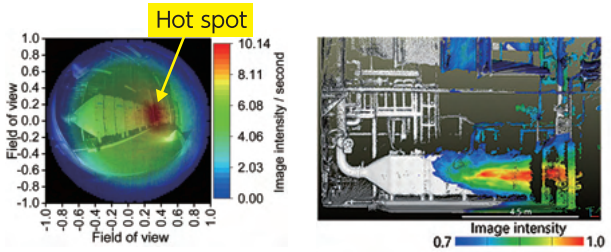
Elaboration of the assessment and evaluation of the situation in the reactor

3D chart showing an estimated condition inside the reactor

Through a variety of means, such as experiments and analysis, we estimate the condition inside the reactor.
The obtained results are summarized in debrisWiki for use by national or international decommissioning operators, researchers and engineers, and a 3D chart is created that visually shows an estimated condition inside the reactor that can be easily recognized.

Developing radiation measurement technology and 3D visualization system

Radionuclide visualization techniques are being developed to reduce radiation doses for workers on FDNPS and to help in the planning of decontamination programs.
Validation test of iRIS, radiation imaging system, was carried out at a work site in reactor building, successfully visualizing hot spots with high dose rates.



Visualized hot spots in the filter train of the emergency gas treatment room of Unit 2
Y. Sato and Y. Terasaka, Journal of Nuclear Science and Technology, in press (2023)

R&D for environmental restoration

CLADS

Dissemination of R&D achievements and development of analysis tools

CLADS publishes the findings of the environmental dynamics study, based on scientifically evidence, on the website in an easy-to-understand manner.

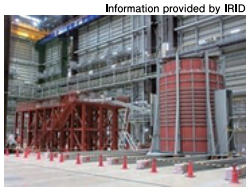
Fukushima Comprehensive Environment Information Site (FaCE!S)
-Radiation monitoring data and research findings-
https://fukushima.jaea.go.jp/ceis/en/index.html

Development of R&D infrastructures

NARREC

NARREC is used to decommissioning, conduct verification testing on remote equipments and devices (such as robots) for various fields, and provide work training.
Currently, full-scale mock-up test for detailed internal investigation of primary containment vessel (PCV) is being carried out by IRID in order to safely carry out a test extraction of the fuel debris.

Information provided by IRID



Full-scale mock-up testing facility for investigating the inside of PVC.

Development of technology for estimating radiation sources and doses, and simulating reduction of radiation exposure for improving the work environment of FDNPS.

Okuma Analysis and Research Center

The radioactive material analysis and research facilities has been developing to analyze and study the characteristics of the radioactive waste and fuel debris generated by FDNPS accident.
The facility administration building began operation in March 2018.
Laboratry-1 for analyzing radioactive materials was completed in 2022 and, in accordance with the Government's policy, third-party analysis of ALPS treated water prior to ocean discharge began at the end of March 2023.
Laboratry-2 for analysing fuel debris is under preparation for construction.

Establishment of radiation exposure dose assessment method based on lifestyle behavior patterns

Establishment of a method for assessing radiation exposure based on lifestyle behavior patterns, and the results were used as important information when discussing the lifting of evacuation orders of specific reconstruction areas.
Based on this evaluation method, a system has been developed to calculate exposure doses by entering the necessary information via an interactive screen, and to compare the calculated doses with general exposure doses. This system is available on municipal websites and installed in government offices as digital signage.

Simulator of External Exposure Dose (SEED)

Technical support for nuclear safety regulation and nuclear emergency

https://www.jaea.go.jp/04/anzen/en/index_e.html

The sector supports the safety regulation and emergency preparedness and response by investigating phenomena that menace nuclear safety and by studying risk-information utilization.

Center | Tokai (NSRI) | Hitachinaka

Safety research for contributing to nuclear safety regulation

The sector technically supports the nuclear regulatory body and the optimization of emergency preparedness and response, based on the lessons learned from the accident at the Fukushima-daiichi Nuclear Power Station of Tokyo Electric Power Company and trends around the utilization of nuclear power (such as carbon neutrality, energy security, restarting of and disaster prevention for light-water reactors, and the introduction of new inspection systems).
To meet needs for safety research on light-water reactors, the sector conducts research focusing on the measures for long-term operation, the utilization of risk information, the environmental safety associated with decommissioning of light-water reactors, and the optimization of emergency preparedness and response.

Measures for long-term operation

Improvement of methods for assessing structural integrity of reactor pressure vessels considering ageing degradations such as neutron irradiation embrittlement

Utilization of risk information

Improvement of methods for assessing the risk associated with events including external factors that would lead to severe accidents, and its utilization for decision making

Optimization of emergency preparedness and response

Utilization of plant information for emergency preparedness and response

Development of monitoring technology and maintenance of its system

Training and development of specialists

Environmental safety

Maintenance of methods for assessing the safety of waste disposal from reactors etc.

Major Fields of Study

Thermal-hydraulic Safety

Left: Researcher Ali Hamdani
Right: Researcher Shu Soma

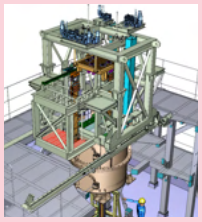
Containment Integral Measurement Apparatus (CIGMA)

Fuel Cycle Safety

Researcher Takuya Ono

Apparatus for Evaluating Clogging Effect of HEPA Filter on Confinement Capability Under Fire Accident (ACUA)

Criticality Safety

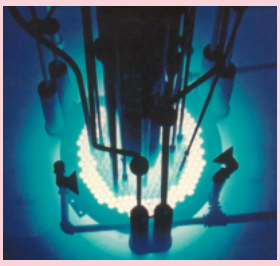


Static Experiment Critical Facility (STACY)
*Under modification

Safety of light-water reactor facilities

Safety of nuclear fuel cycle facilities

Fuel Safety

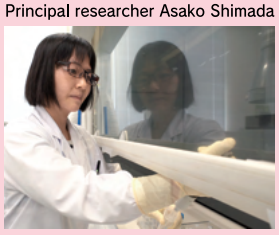


Nuclear Safety Research Reactor (NSRR)

Reactor Fuel Examination Facility (RFEF)

Environmental Safety

Principal researcher Asako Shimada



Analysis equipment in the safety research building

Safeguards

Clean Laboratory for Environmental Analysis and Research (CLEAR)

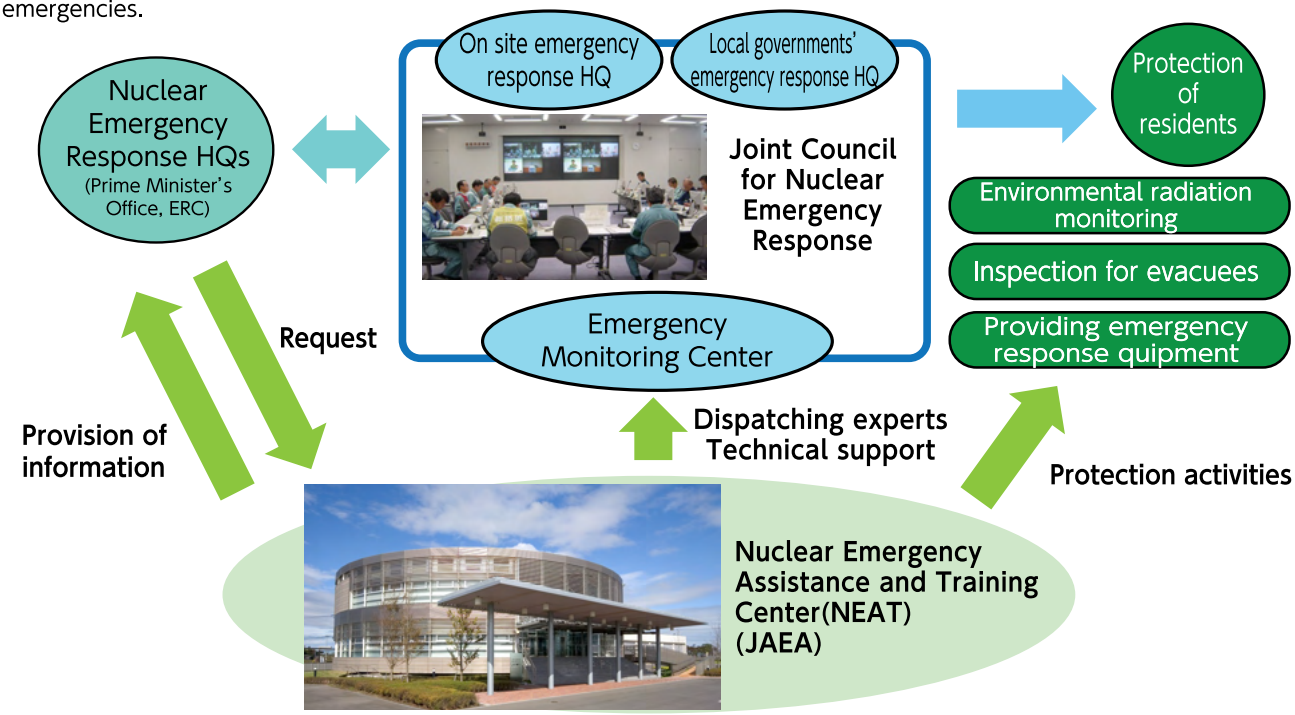
Nuclear emergency assistance and training

JAEA supports activities on nuclear emergency preparedness and response with human resources, information and technology.

https://www.jaea.go.jp/04/shien/en/

Activities in Emergencies

JAEA provides technical support for national and local governments' nuclear emergency response activities as one of the designated public institutions based on law.
The Nuclear Emergency Assistance and Training Center (NEAT) is the base of technical support for response to nuclear emergencies.




HQ function for emergency support


Dispatch of experts for monitoring



Monitoring using a manned helicopter
Operation inside the helicopter

Activities in Normal Times

JAEA supports nuclear emergency drills of national and local governments and personnel training related to nuclear emergency response.
JAEA also conducts investigation and research to give support in strengthening the nuclear emergency response system, and provides assistance for nuclear emergencies and enhancing emergency preparedness of other countries.


Dispatch of inspection personnel to evacuation and exit inspection drills


Remote lecture on nuclear emergency preparedness and response


Measurement experiment using radiation portal monitor for vehicles

Creating Innovation through Nuclear Science and Technology

https://snsr.jaea.go.jp/en/index.html

JAEA devotes itself to produce scientific knowledge and technologies supported by the basic nuclear science, and to foster human resources having abilities to produce them.

Center | Tokai (NSRI) | Harima

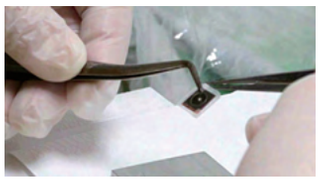
Promoting basic nuclear science and engineering research and advanced nuclear science research

We lead the latest scientific technology that supports development of nuclear energy and radiation applications.

In the basic nuclear science and engineering research, JAEA is devoting itself to research activities related to nuclear reactor, improvement of its fuel and material performances, radionuclide behaviors and radiation properties in order to reinforce the technology platform in nuclear science. In addition, considering the public needs, JAEA contributes to solving issues in the nuclear energy utilization such as reduction in volume and toxicity of high-level radioactive waste and safety improvements of nuclear reactors, by using the developed technologies.

In the advanced nuclear energy science research, JAEA is promoting world-leading, advanced research in actinides science and nuclear materials science, playing a key role as a core institution around the world. JAEA aims to acquire new knowledge beyond existing frameworks by discovering new principles and phenomena, and creating new materials.

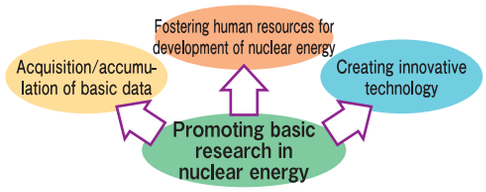
Furthermore, by making full use of JAEA's infrastructure facilities, JAEA is commited to the development of researchers and engineers with sophisticated problem-solving capabilities at our R&D sites.



Creating a target of einsteinium, element 99

Basic nuclear science and engineering

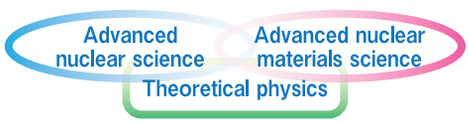
JAEA is devoting basic R&D for creating innovative technologies of the nuclear energy utilization, with fostering nuclear scientists and engineers who support a base of the nuclear energy.



- Nuclear data and reactor engineering
- Nuclear fuel and material science
- Chemistry, environmental and radiological science

Advanced nuclear energy science research

JAEA is conducting world-leading research in advanced nuclear and materials sciences, which bring strong impacts on the groundbreaking science and technology for nuclear energy science.



- Heavy element science
- Basic science on actinide, etc.
  → Nuclear transmutation, MA nuclear data, etc.
- Energy-conversion material
- Environmentally resistant material science, etc.
  → Thermoelectric materials, multifunctional materials, etc.

Research for improving safety performance in nuclear energy utilization

JAEA is promoting fundamental R&D for improving the safety of light water reactors, and developing technologies for safer decommissioning.

JAEA is improving the safety and reliability of light water reactors, and contribute to technical basis for both the promotion and regulation. For these purposes JAEA is conducting basic research, such as development of codes and maintenance of database for reduction of accident risk, mitigation of accidents, and safer and steady decommissioning.

Basic nuclear science and engineering

- Nuclear engineering
- Thermal hydraulic engineering
- Fuels/materials engineering
- Nuclear chemistry

Safer and steady decommissioning

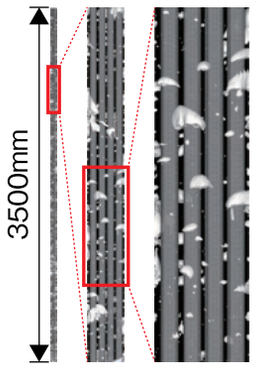
- Development of techniques for evaluating nuclide composition and radioactivity for decommissioning
- Development of technologies for analyzing long-term integrity of decommissioned facilities
- Development of radionuclide distribution measurement and quantitative analysis techniques

Reduction of accident risk

- Development of technologies relevant to the feasibility of candidate cladding materials for accident-resistant fuels
- Development of models for predicting the aging of nuclear facilities
- Advancement of analysis technology of core thermal hydraulics

Mitigation of accident

- Advancement of analysis techniques of core-melt progression in a severe accident
- Development of technology for analyzing radioactive material behavior

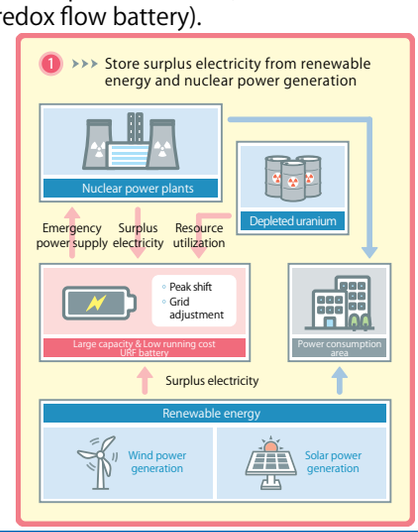


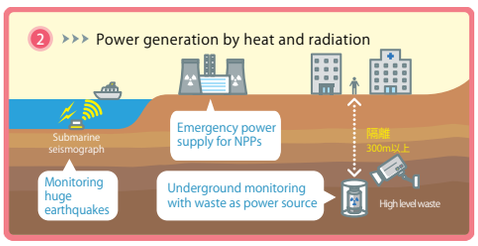
Example of results of a thermal hydraulics analysis (upward flow of 4-by-4 bundled inner bubbles)

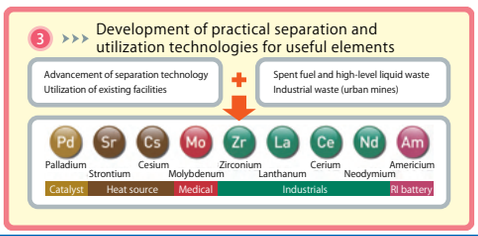
Technological Innovations to Change Radioactive Waste into Resources

We will create new value to realize Nuclear x Renewable.

In addition to technologies to separate useful elements from spent fuel, we are developing technologies to effectively utilize spent fuel as an energy source.
Furthermore, as part of our efforts to create synergy between nuclear and renewable energy, we are developing technology to utilize depleted uranium, which is stored in large quantities in Japan and overseas, as a storage battery (Uranium-based redox flow battery).



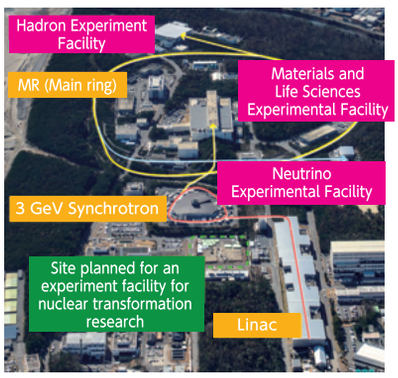




Promoting cutting-edge research by J-PARC

Supporting the development of science, technology and academia and promotion of industry as a global center of neutron science research.

The Japan Proton Accelerator Research Complex (J-PARC) is a multi-purpose research facility jointly operated by JAEA and the High Energy Accelerator Research Organization. By utilizing a variety of secondary particles, such as neutrons, muons and neutrinos, which are generated by the world-class proton accelerator, J-PARC is creating results for cutting-edge research from basic science to industrial applications together with users of the system. At the Materials and Life Science Experimental Facility, research utilizing the world's strongest pulsed neutrons is carried out, including academic studies related to various materials and studies related to development of industries (e.g., development of batteries).

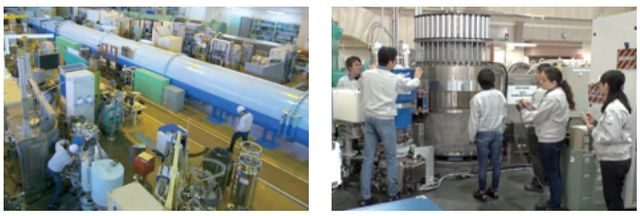


J-PARC (Tokai-mura, Ibaraki)

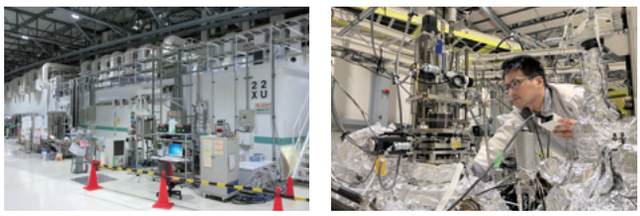
Neutron and synchrotron radiation applied research and development

By full use of JAEA owned neutron and synchrotron radiation applied advanced structural and functional analysis tools, we promote materials sciences research which contributes to nuclear science and utilization of nuclear energy.

JAEA develops and upgrades neutron and synchrotron radiation applied advanced analysis tools and create innovative results and seeds in a wide range of science and technology and academic fields. Moreover, JAEA provides new findings obtained by the advanced analysis tools for nuclear science and engineering research and advanced nuclear research, and then accelerates the promotion of the research in these areas.



Research reactor, JRR-3 beam hole (left),
and neutron beam experiment equipment (right)



SPring-8 BL22XU, a large synchrotron-radiation facility (left),
and synchrotron-radiation experiment equipment (right)

Development of Fast Reactor and High Temperature Gas-cooled Reactor (HTGR)

https://www.jaea.go.jp/04/sefard/

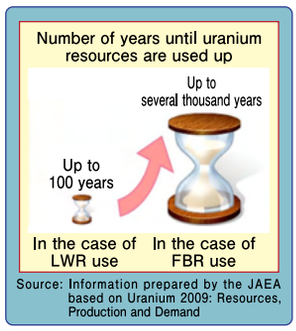
We are conducting research and development for realization of advanced reactor and fuel cycle system to enable stable energy supply with enhanced safety for the future.

Center | Oarai | Tsuruga

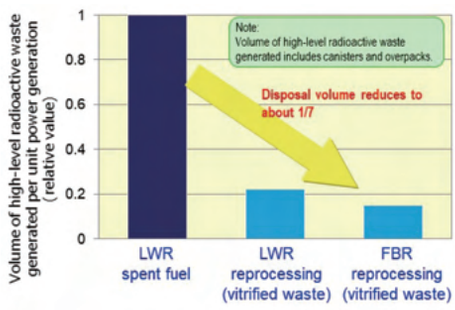
Significance of R&D on fast reactor cycle system

While a typical nuclear power plant (light-water reactor) uses a small portion of uranium (combustible uranium of 0.7%) as fuel to generate electric power, a fast-breeder reactor transforms the remaining part of uranium (incombustible uranium of 99.3%) into plutonium so that it can use plutonium as fuel. If a fast-breeder reactor is used to use the uranium resource, the amount of resources is ten times more than that for light-water reactors, which enables uranium to be used as energy for more than a few centuries.

Used fuel generated at nuclear power plants include substances called minor actinoids (MA), which emit radiations for an extended period of time. You can remove these substances from used fuel and control them not to transfer into radioactive waste by transforming them into materials that easily burn in fast reactors or confining them inside the cycle (for example, by directly burning them); this also can reduce the environmental burden.



Source: Information prepared by the JAEA based on Uranium 2009: Resources, Production and Demand



Reduction of volume of high-level radioactive waste generated

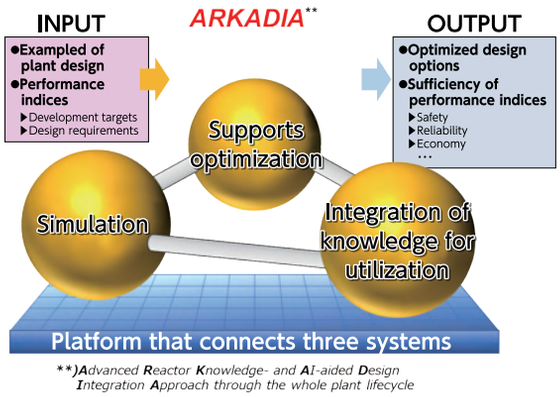
Development of technology base toward commercialization of fast reactor cycle

JAEA is pushing ahead with activities aimed for maintenance and development of the research and development infrastructure that can apply to contribution to nuclear innovation and diversified nuclear concepts.

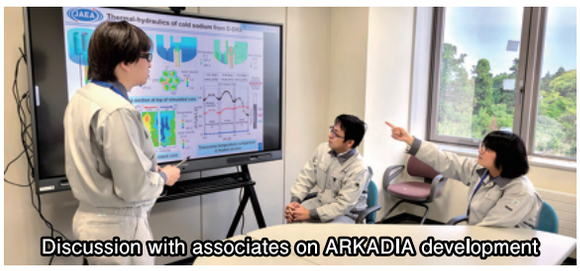
- With the objective of shortening the design period and innovating the development processes, we are carrying out activities for building three systems (a system developed from the simulation technologies that we have been developing; a system that integrates knowledge about the research and development, design, operation, and maintenance of fast reactors; and a system that supports design optimization) on a user-friendly platform to provide these systems as ARKADIA.
- To actualize a fast reactor that features compatibility between safety and cost effectiveness, we are conducting research and development toward sophisticating the requirements and standards for design and construction of fast reactors.

  * By incorporating the evaluation formula that more precisely forecasts material characteristics into the standards of the Japan Society of Mechanical Engineers, we made it possible to achieve design for an in-service period of 60 years.

- In developing a fuel cycle, we are conducting research and development to support high-burnup, high performance fuel and materials, reduction of radioactive waste, MA cycles for lowering harmfulness, etc.



**)*Advanced Reactor Knowledge- and AI-aided Design Integration Approach through the whole plant lifecycle*

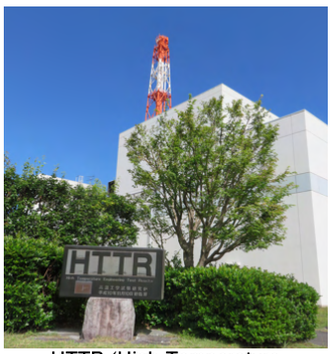

Discussion with associates on ARKADIA development


Creep testing on fast-reactor materials

R&D on High-Temperature Gas-cooled Reactor (HTGR) and heat utilization technology

Through the development of HTGR and hydrogen production technologies, JAEA contribute to practical use of highly-safe HTGR, a trump card for global warming prevention.

Inherent safety characteristics of HTGR, which stems from consisting key elements: coated fuel particles with excellent heat resistance and radioactive material confinement properties, a highly heat-resistant and large heat capacity graphite moderator, and chemically inert helium gas coolant, make it possible to practically eliminate severe accidents which are postulated in LWRs. HTGR is a next-generation nuclear energy systems that is expected to contribute to reducing environmental burdens through a wider spectrum of heat utilization.



HTTR (High Temperature Engineering Test Reactor)

R&D on HTGR system

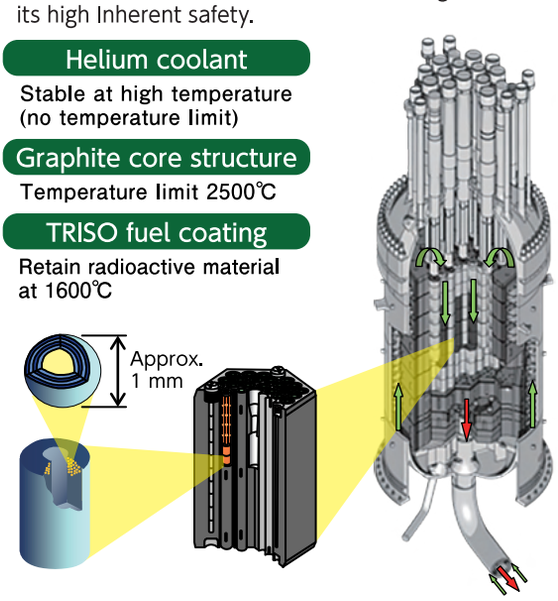
Superior safety

● It is possible to design a high-temperature gas-cooled reactor that does not cause core melting because of its high Inherent safety.

Helium coolant
Stable at high temperature (no temperature limit)

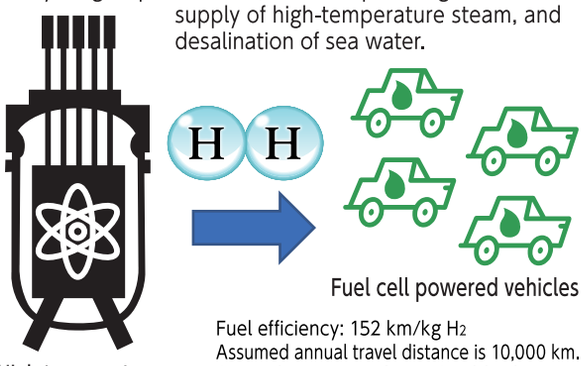
Graphite core structure
Temperature limit 2500℃

TRISO fuel coating
Retain radioactive material at 1600℃



Flexible heat utilization

● High-temperature gas-cooled reactors can supply high-temperature heat higher than 900℃, which can be used for a wide range of applications, such as hydrogen production, electric power generation, supply of high-temperature steam, and desalination of sea water.



High temperature gas-cooled reactor

Fuel cell powered vehicles

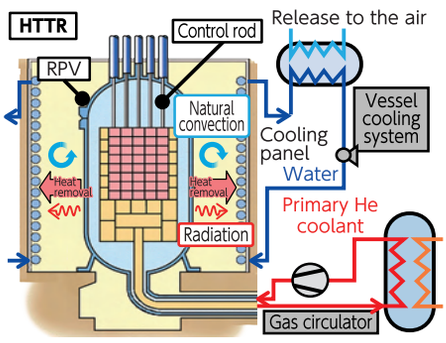
Fuel efficiency: 152 km/kg H_2
Assumed annual travel distance is 10,000 km.
Annual amount of required hydrogen: approx. 730 m^3/unit

A high-temperature gas-cooled reactor* (with a thermal output of 250 MW) can produce hydrogen for 300,000 fuel cell powered vehicles per year.

* Based on the assumption that the efficiency of hydrogen production based on water splitting is 50% and the availability is 80%.

HTGR hydrogen production systems with high level of safety can contribute to the hydrogen society and reduce greenhouse gas emissions by utilizing heat.

Safety test using HTTR

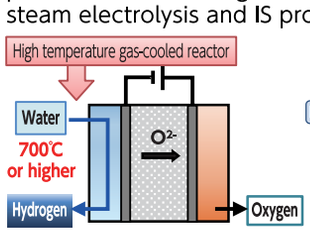


- Reactor power:100% (30MW)
- Tripping all gas circulators to reduce primary coolant flow rate to zero.
  → **No core cooling!**
- No scram operation of reactor. (No control rods insertion)
  → **No core reactivity control!**

● It was confirmed that the reactor power decreased to about zero automatically and reached to stable state without activating the reactor shutdown and forced cooling systems (March 2024).

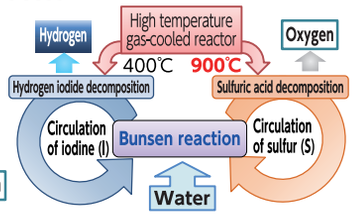
Carbon-free hydrogen production technologies

JAEA is reviewing the feasibility of carbon-free hydrogen production technologies such as the high temperature steam electrolysis and IS process.



High temperature water steam electrolysis

High temperature steam electrolysis uses ceramic solid electrolytes to electrolyze steam. Highly efficient hydrogen production can be achieved by using high-temperature heat.



IS process

IS process decomposes water with heat of 900℃ using chemical reactions of iodine (I) and sulfur (S).

Establishment of decommissioning technology for nuclear facilities and disposal technology for high-level radioactive wast

This sector works on the technological development of decommissioning and radioactive waste management.

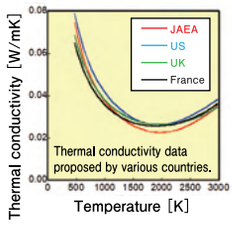
Center | Tokai (NCL) | Horonobe | Tono | Ningyo-toge | Aomori

Technological development related to nuclear fuel cycle

Nuclear Fuel Cycle Engineering Laboratories (NCL) engages in various technological developments toward realization of nuclear fuel cycle.

[Technological development for MOX fuel]

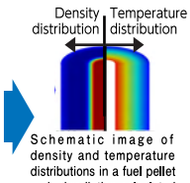
In the Plutonium Fuel Development Center (PFDC), thermo-chemical properties of MOX fuel have been measured and evaluated to apply improving the MOX fuel production technology and simulation accuracy of fuel behavior under irradiation. The measurement results, internationally acknowledged as highly reliable data, contribute to the establishment of property database in international institutions as well as international standardization of the property data of nuclear materials.



Thermo-chemical properties measured at PFDC are adopted for six out of seven types of physical property data recommended by international institutions.
- Thermal conductivity
- Melting temperature
- Thermal expansion
- Oxygen potential
- Lattice parameter
- Mechanical properties

The data are used in fuel behavior simulation, fuel design and etc. at international laboratories.

Thermo-chemical property measurement and establishment of database



Schematic image of density and temperature distributions in a fuel pellet under irradiation calculated by simulation program

Example of fuel behavior simulation

[Basic studies on the development of advanced nuclear fuel cycle technologies]

Nuclear Backend Technology Center aims reduction of HLLW (High Level Liquid waste) radiotoxicity and improvement of proliferation resistance relating to nuclear fuel cycle, through the studies of dissolution behavior of MOX fuel, co-extraction technology of uranium and plutonium, and MA (Minor Actinides) recovery from HLLW using spent nuclear fuel.

Experiments in a hot cell

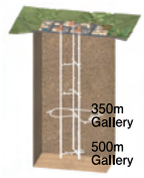
Analysis in a glovebox

[Establishment of safe treatment technology of nuclear wastes in facilities]

Nuclear Backend Technology Center promotes a new collaborative research project named as STRAD (Systematic Treatments of Radioactive liquid wastes for Decommissioning). Tentative target is investigation of new treatment approaches on various organic liquid wastes.

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

Steadily promoting fundamental R&D required for achieving disposal and enhancing reliability of long-term safety of geological disposal technologies.



【Horonobe】In situ experiment carried out at 350 m Gallery of Horonobe URL

[Underground research laboratory project]

The Horonobe Underground Research Center in Horonobe Town, northern Hokkaido has now been tackling the following key R&D challenges by developing and utilizing the Horonobe URL: (1) Study on near-field system performance in geological environment, (2) Demonstration of repository design options, and (3) Understanding of buffering behavior of sedimentary rocks to natural perturbations. In addition, the extension of the Horonobe URL at 350 m depth and down to 500 m depth is currently underway. At the research facility in Mizunami City, Gifu Prefecture, meanwhile, backfilling of the underground facility and removal of surface facility were completed by January 16, 2022 and environmental monitoring of groundwater is currently underway.

【Tono】A dating equipment at TGR (Pelletron Accelerator mass spectrometer, JAEA-AMS-TONO-5MV)

[Study on long-term stability of the geological environment]

The Toki Geochronology Research Laboratory (TGR) is developing investigation technologies and evaluation methods to characterize seismic and fault activities, volcanic and hydrothermal activities, uplift and denudation, and climate and sea-level changes, and their effects on the geological environment, along with the development of geological and groundwater dating methods.

[Study on design and safety assessment of geological disposal system]

Research facilities at Nuclear Fuel Cycle Engineering Laboratories (NCL) in Tokai Village, Ibaraki Prefecture are developing technologies necessary for design and safety assessment of geological disposal system. This is being achieved by the acquisition of experimental data on the behavior of engineered barrier system and migration properties of radionuclides, and utilization of results obtained from URLs. Furthermore, R&D on alternative disposal options including direct disposal of spent fuels are being conducted.

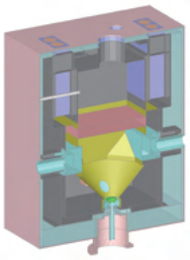
【Tokai (NCL)】Laboratory experiments using radionuclides at QUALITY (Quantitative Assessment Radionuclide Migration Experimental Facility)

Reprocessing technology development and decommissioning

JAEA will proceed with the decommissioning of Japan's first reprocessing plant while prioritizing safety, and contribute to the establishment of systematized decommissioning technology.

[High-level liquid waste vitrification technology]

JAEA steadily progresses vitrification of high-level liquid waste, and works on technological development pertaining to advancement of vitrification technology. In order to efficiently remove platinum-group elements that hinder stable operation, the melter is planned to be upgraded to a new type melter in which the bottom shape is changed from the current quadrangular pyramid to a cone.

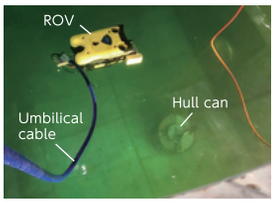


New melter

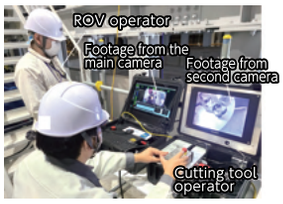
Glass pouring from drain nozzle in operation test of new melter

[High-level solid waste removal technology]

The chopped pieces of cladding tube of spent fuel are placed in hull cans and stored underwater (in a pool).
To remotely take out hull cans from underwater, JAEA is working on the development of devices such as underwater robots (ROV:Remote Operated Vehicle) while utilizing overseas knowledge and findings.



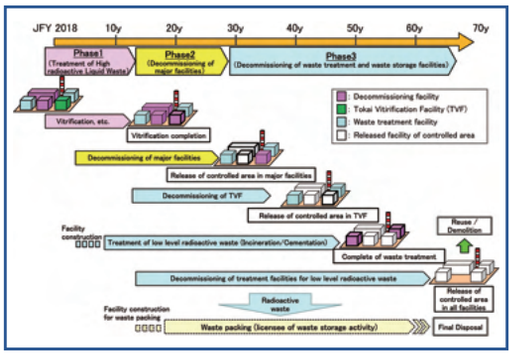
Underwater robot



view of underwater robot operation

[Decommissioning Tokai reprocessing facility]

The Tokai Reprocessing Plant (TRP) has shifted to the decommissioning stage. Decommissioning of TRP is essential and extremely important in establishing a nuclear fuel cycle, and is a long-term large-scale project that spans multiple generations. JAEA will tackle diverse challenges in the decommissioning by mustering domestic and overseas wisdom to develop technologies pertaining to decontamination and dismantling of facilities and equipment, remote control, treatment of radioactive waste, and measurement and analysis, and thereby contribute to the establishment of systematized decommissioning technology.



Outline of decommissioning schedule

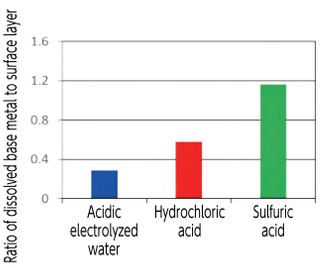
Decommissioning of related nuclear facilities and R&D

JAEA is committed to the safe and rational decommissioning of nuclear facilities, and dissemination of the outcome of technological development inside and outside Japan.

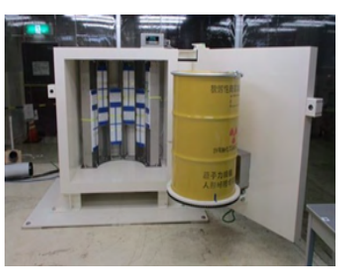
The Ningyo-toge Environmental Engineering Center intends to reduce the amount of uranium-contaminated radioactive waste as much as possible through decommissioning of uranium enrichment facilities. JAEA is developing technologies for removing more efficiently uranium adhering to the surface of radioactive wastes*1 and measuring the trace amount of uranium in "cleared materials"*2 after removing uranium.

*1: Decontamination using functional water (acidic electrolyzed water) can remove uranium up to 99.9%.
*2: Cleared material is the material decontaminated to the insignificant radioactivity levels of uranium and/or other radioactive elements, enabling its reuse as resources or disposal as general industrial wastes upon approval from the regulatory authorities in Japan.

The Aomori Research and Development Center 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 the development of relevant analysis technologies.

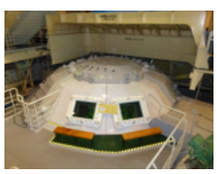


Comparison of dissolved base metal in wet decontamination



Measurement device for clearance

Accelerator mass spectrometer



Exhibition of reactor dismantled from nuclear ship (Mutsu Science Museum)

Decommissioning of Fugen and Monju

https://www.jaea.go.jp/04/haishisochi/

We will work on the “First” (unprecedented things) in decommissioning in Tsuruga, Fukui Prefecture with top priority placed on safety.

Center | Tsuruga

Toward future nuclear power led by decommissioning

First Challenge for Decommissioning

Diversity of fuels and pioneering of technology for using plutonium

Fugen, a prototype advanced thermal reactor

First nuclear reactor constructed based on Japanese technology

First decommissioning of a large water reactor in Japan

Incorporating developed and demonstrated technologies and experiences into decommissioning of other nuclear reactors

Baton to The Next

Energy security and reduction of environmental loads

Monju, a prototype fast-breeder reactor

First power plant in Japan that used sodium

Toward the **first** decommissioning of it

Incorporating findings and experience into future sodium reactors

To make the decommissioning of Fugen and Monju the “Beginning” to create new values, we will lead the technologies and findings obtained through the decommissioning to the future of nuclear power.

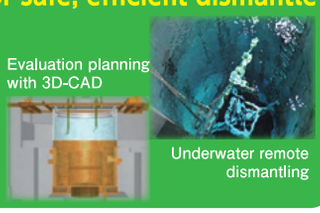
ふげん＆もんじゅ 心をひとつに 廃止措置

Decommissioning Fugen

FY	2007 [Completion]	2018	2030	2039 2040
Phase	Heavy Water and Other system Decontamination Phase	Reactor Periphery Facilities Dismantling Phase	Reactor Dismantling Phase	Building Demolition Phase
Main Activities	Transportation of Spent fuel			
	Dismantling of Reactor cooling system, Measurement control system,etc.			
		Dismantling of Nuclear fuel handling/Storage facilities, heavy water system, etc.		
		Developing automated remote equipment for dismantling reactor	Dismantling reactor core	Release of controlled areas
				Building demolition

Developing technology for safe, efficient dismantle

To more safely and efficiently disassemble nuclear reactors with a high dose due to long-term operation, we are developing dismantling techniques for reducing radiation-exposed workers through cutting technology based on lasers and remote/automated operation.



Toward Recycling resources based on Clearance system

For timber waste from decommissioning, the health impacts can be ignored. Toward a recycling-oriented society and reducing environmental loads, we are working on recycling based on the governmental clearance system.

✓ **Demonstrating safe, rational decommissioning technology and indicating a clear and robust path after nuclear power plants are closed.**

Toward a future where we can use nuclear power with security

Decommissioning Monju

FY	2018 [Completion]	2023	2032 2047
Phase	Fuel unloading (Phase 1)	Preparation for dismantling (Phase 2)	Dismantling Ⅰ ～ Dismantling Ⅱ (Phase 3) (Phase 4)
Main Activities	Fuel unloading		
		Preparations for dismantling sodium-cooling equipment	Dismantling and removal of sodium-cooling equipment
		Dismantling and removal of power generation facilities such as water/steam systems	
	Assessment of the radiation distribution		Dismantling and removal of buildings
	Processing and disposing of solid radioactive waste		

Experience and actual achievements in equipment operation in the sodium environment

We successfully removed all fuel assemblies from the nuclear reactors by October 2022. Through this activity, we obtained valuable findings on, for example, operation of equipment and response to troubles under sodium environment.

Through dismantling of sodium-containing equipment

We will review various methods for dismantling sodium-containing equipment safely and efficiently, and also develop technologies that would be necessary going forward.
The results obtained from these activities will provide knowledge and experience that can be utilized in designing reactors that use sodium in the future.

✓ **Accumulating know-how that leads to next-generation reactors**

✓ **Summarizing information on "what should be considered" while pushing ahead with decommissioning**

Toward future (next-generation) sodium reactors

Efforts for Sustainable Utilization of Nuclear Science and Technology

https://www.jaea.go.jp/04/be

JAEA will steadily implement measures to address back-end issues to realize sustainable nuclear science and technology that is trusted and accepted by society.

In order to make the use of nuclear energy sustainable with trust from society, it is essential to support the advancement of nuclear science and engineering and to perform safe, efficient, and rational dismantling of nuclear facilities that have ended their mission and processing and disposal of radioactive waste. To this end, the JAEA is planning and pushing ahead with comprehensive management of back-end issues and promoting disposal project of low-level radioactive waste from research facilities, etc.

Planning and promotion of comprehensive management of back-end issues

JAEA will draw up and push ahead with comprehensive plans for decommissioning nuclear facilities owned by the JAEA and for processing of radioactive waste.

We summarized the long-term prospects and policy for back-end measures by the entire JAEA as a "Back-end Road Map*." As a more specific plan, we formulated the Medium-/Long-term Management Plan of JAEA Facilities to be continually used that integrally pushes ahead with (1) selection and consolidation of facilities, (2) measures to maintain the safety of facilities, and (3) management of back-end issues.

* https://www.jaea.go.jp/about_JAEA/backend_roadmap/

Back-end Roadmap (policy for 70 years)

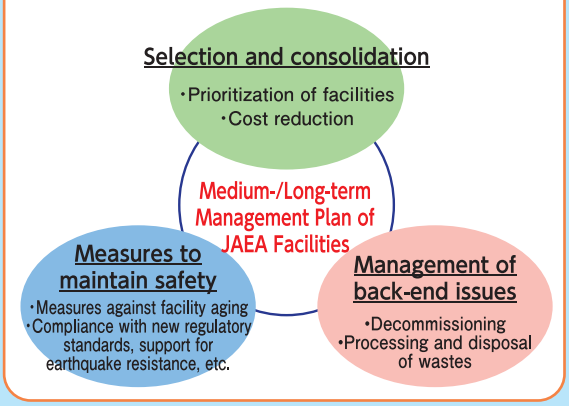
The 1st period (-2028, about 10 years)
Implement back-end measures while giving priority to ensuring safety of facilities. Specified in the Medium-/Long-term Management Plan of JAEA Facilities.

The 2nd period (2029-2049, for about 20 years)
Transition toward full-scale decommissioning through the implementation of the disposal of radioactive waste and the establishment of waste processing facilities.

The 3rd period (2050-, for about 40 years)
Implement full-scale back-end measures toward completion.

Medium-/Long-term Management Plan of JAEA (specific plan covering the period until fiscal 2035)

Trinity Plan of all JAEA's facilities



Selection and consolidation of facilities

[Policy of selection and consolidation]
▶As a nation, the facilities essential for maintaining the minimum R&D functions should be continued to use as much as possible, considering below:
・Consolidation of testing functions as much as possible
・Decommissioning of facilities that are difficult to continuously use from the viewpoint of safety measures, etc.

Selection of JAEA's facilities
●Facilities continued to be used 45 facilities
●Facilities to be decommissioned 45 facilities
<As of April 2023>
Facilities to be decommissioned are to be systematically decommissioned in order.

Measures to maintain safety of facilities

●Complying with new regulatory standards and supporting earthquake resistance
●Measures against facility aging
→ Specification for each facility

Management of back-end issues

●Decommissioning plan (including consolidation of nuclear fuel materials)
●Establishment plan for waste processing facilities, etc.
→ Specification for each facility
●Plan for production of waste packages
●Risk reduction measures for Tokai Reprocessing Plant

Example of a nuclear facility being decommissioned

JRTF: JAERI Reprocessing Test Facility being decommissioned
(Nuclear Science Research Institute: former JAERI)

- Interior spaces of a glovebox before and after the dismantling and removal -

R&D for pushing ahead with back-end management

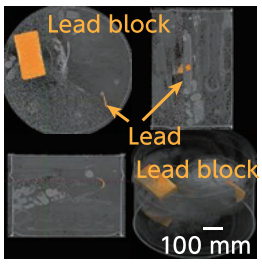
JAEA is developing technology toward reducing costs based on speed enhancement, automation, and a shift to remote operation and establishing a technique for evaluating radioactivity from radioactive waste.

Technological development associated with management of back-end issues

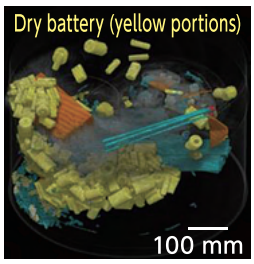
Non-destructive analysis based on high-energy X-ray CT

A large amount of stored radioactive waste containers will be checked whether or not they contain harmful materials (lead or mercury (dry batteries)) without opening. This substantially reduces the work of segregating harmful materials from waste.

Examples of harmful materials identified



Identifying lead based on differences in density



Identification of a dry battery (mercury) based on the characteristics of three-dimensional geometries

- ▶ Reducing measurement costs by developing a detector
- ▶ We are pushing ahead with research and development on, for example, speed enhancement of evaluation software.

Establishing methods for evaluating radioactivity

Characterization of radioactive waste

Measurement of gamma rays based on a high-purity Ge detector

Analysis of ^{3}H and ^{14}C based on a combustion method

Sample dissolution based on a microwave digestion

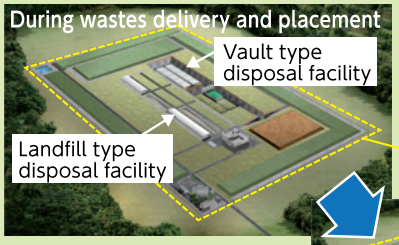
Analysis of ^{90}Sr using strontium adsorption resin

JAEA evaluates radioactivity of waste by taking advantage of a variety of pretreatment and analysis technologies.

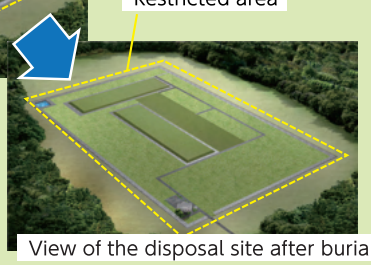
Promotion of disposal project of low-level radioactive waste generated from research, industrial and medical facilities

For sustainable nuclear power research and radiation usage, JAEA is working toward disposal of low-level radioactive waste from research and medical activities (from research facilities, etc.).

Radioactive Waste Disposal Center is conducting technical study for the basic design of near surface disposal facilities.
In addition, with the goal of setting up such facilities, we are disseminating information that can be easily understood by everyone about the safety of the near surface disposal with understanding of and assistance from academic parties concerned and waste generators.

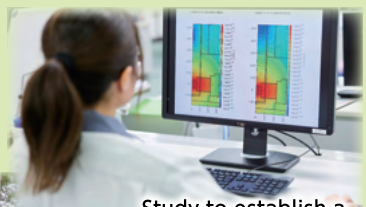


Near surface disposal facility (image)



View of the disposal site after burial

JAEA will continue to restrict access to the site and monitor it until the radioactivity concentration is low enough that control is no longer required.
This period is assumed to be approximately 300 years.



Study to establish a method for evaluating radioactivity of wastes

Study to establish groundwater monitoring technology

Introduction video of the waste disposal project

2024.4

Safety, Nuclear Security, and Safeguards

https://www.jaea.go.jp/about_JAEA/

JAEA is working on R&D while prioritizing “nuclear safety” and “proper management of nuclear materials”.

JAEA must be trusted by society through ensuring safety and proper management of nuclear materials since JAEA works on R&D using radioactive materials (radioisotope, nuclear materials). To this end, JAEA is working on R&D while prioritizing **3S**: **S**afety, nuclear **S**ecurity and **S**afeguards. Specifically, in addition to ensuring radiation safety, emergency response and response to nuclear security risks, JAEA strives to ensure the transparency in the peaceful use of nuclear materials by accepting the safeguards by the International Atomic Energy Agency (IAEA).

Safety

Ensuring radiation safety

To control worker's exposure, radiation doses in the air and surface contaminations are measured in controlled areas. Furthermore, to control public's exposure, environmental radiation, radioactive materials included in soil, vegetables, and marine products around the are monitored around the facilities. Their activities are made efforts to ensure radiation safety.

Measuring radiation using a monitoring car

Responding to emergencies

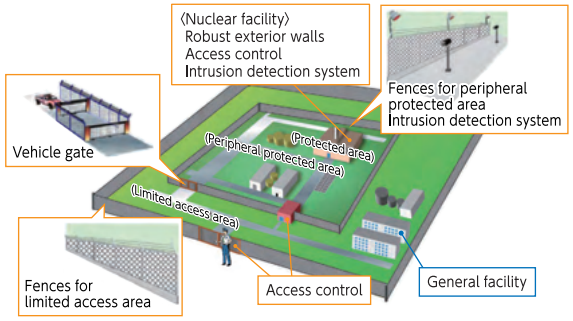
To perform quick notification and communication in case of an accident and/or trouble, periodically trainings are planned to our staff members to improve the capability for crisis management of each member. To consider damage to nuclear facilities associated with the occurrence of a large earthquake, a variety of safety measures are also carried out at each facility. In addition, to prevent personal injury during work, safety activities are kept by anticipate risks. By continuing the above activities, the safety of the organization is constantly maintained and improved.

Training prepared for outdoor contamination

Nuclear Security

Nuclear security

The unauthorized removal of nuclear materials and/or radioactive materials and the sabotage against nuclear facilities by terrorism or other malicious activities could have a significant impact on society.
In order to mitigate the nuclear security risks, JAEA is continuously promoting a nuclear security culture and maintaining actual physical protection measures.



Examples of protective measures

Safeguards

Ensure transparency in the peaceful use of nuclear materials

Nuclear materials can be diverted to nuclear weapon. For this reason, it is necessary to gain the understanding of society that nuclear materials are used only for peaceful purpose.
As part of this effort, the Government of Japan has concluded IAEA Safeguard Agreement based on the Non-Proliferation Treaty (NPT), JAEA accepts safeguards verification periodically by IAEA and Japanese government, and is also working on technological development to improve the efficiency.

Safeguards Activties by IAEA

2024.4

Nuclear Non-proliferation and Nuclear Security

https://www.jaea.go.jp/04/iscn/org/intro_en.html

Further strengthening nuclear non-proliferation and nuclear security

Toward a world without nuclear weapons and nuclear terrorism, the Integrated Support Center for Nuclear Proliferation and Nuclear Security (ISCN) Is developing technologies; studying policies; support capacity building and the international verification system for the Comprehensive Nuclear-Test-Ban Treaty (CTBT); etc. in the fields of nuclear nonproliferation and nuclear security

Technological development

JAEA is developing fundamental technologies which will contribute to improve safeguards and nuclear proliferation resistance for future nuclear cycle facilities, etc., as well as technologies required to enhance the nuclear security including measurement and detection of nuclear materials and nuclear forensics. Aiming to develop technologies that can be used in the nuclear non-proliferation and nuclear security fields in various countries and international organization, such as IAEA, JAEA is conducting research activities in collaboration with research institutions in Japan as well as the U.S. and European countries based on domestic and international challenges and needs.

Capacity building support

With the objective of supporting capacity building on nuclear non-proliferation and nuclear security in Asian region, JAEA develop needs-oriented training curricula and improving nuclear facilities, and providing training, seminars, and workshops as well as raising awareness of the importance of ensuring nuclear non-proliferation and nuclear security.

Contribution to the CTBT international verification regime

JAEA is contributing to the international nuclear non-proliferation effort by operating international monitoring system facilities for radionuclides and a national data center for analyzing and evaluating monitoring data established based on the Protocol of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) and developing associated verification technologies.

Political research

In light of the international trends about nuclear non-proliferation and nuclear security, JAEA is conducting political research based on technical findings from our experiences. While making a database of collected information, we survey and analyze domestic and international topics and trends about nuclear non-proliferation and nuclear security. And JAEA provide the research results related ministries and the other stakeholders.

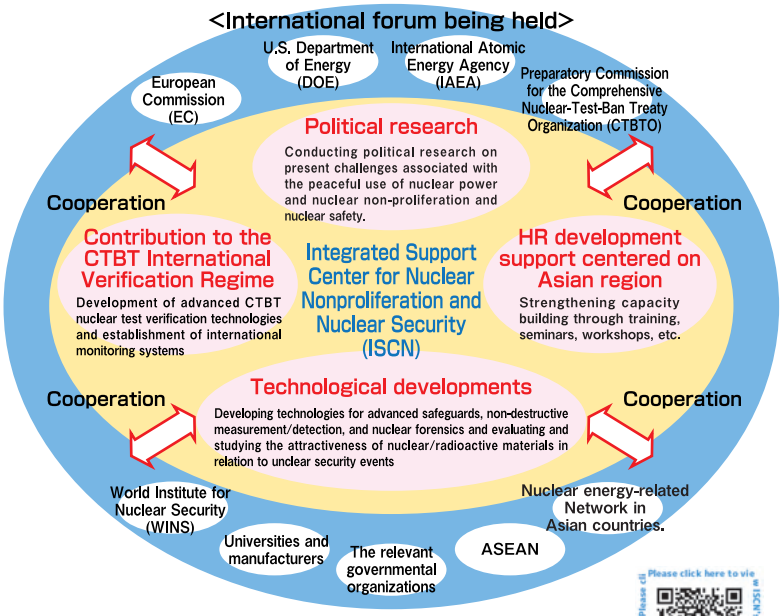
Efforts to increase awareness

With the object of increasing awareness of the importance and enhancement of nuclear non-proliferation and nuclear security and the activities of ISCN, JAEA deliver the monthly ISCN newsletter, reports and share our accomplishments at academic conferences, and organize the international forum. JAEA also provide the information (e.g. the report of nuclear non-proliferation trend, the nuclear non-proliferation pocket book) on the website of JAEA.

Analysis of nuclear nuclides at an international monitoring system facilities for the CTBT

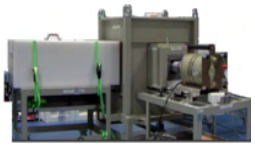
Nuclear forensics analysis using a thermal ionization mass spectrometer

Holding international Forum



Practical exercises on physical protection at the PP exercise field

Safeguards training using the virtual reality system



Delayed gamma-ray analysis instrument, tested at the JRC Ispra (Italy)

2024.4

Securing Public Trust

https://www.jaea.go.jp/index.html

JAEA works to promote mutual understanding with the public through dissemination of the results of its R&D to diverse stakeholders, public consultations, public relations, and dialog activities.

Interaction with diverse stakeholders

JAEA actively disseminates information to diverse stakeholders by staying in tune with society's needs through public hearings, public relations, and dialog activities.

By actively providing and disclosing information relating to JAEA's R&D findings, accidents, incidents, etc., JAEA ensures transparency of its operations. In addition, by taking into consideration the viewpoints of returning these R&D findings to society and communicating risks with society, through deferential public consultations, PR, and dialog, JAEA is able to deepen mutual understanding with the public and local communities, which will lead to securing trust.
Furthermore, by paying heed to diverse stakeholder and public view points, JAEA reflects advice from third-parties in order to contribute to these activities more effectively.

Public hearings, public relations, dialog activities, etc.

JAEA effectively conducts understanding promotion activities such as opening its facilities to the public, holding facility tours and briefing session, and having a booth at external exhibitions. Also, JAEA actively provides support to science education by holding science cafés and experiment classes as outreach activities, interactive communication activities utilizing its potential as a R&D institution.

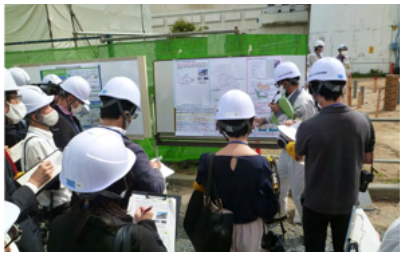
JAEA briefing session

Participating in a variety of events

Holding a science café

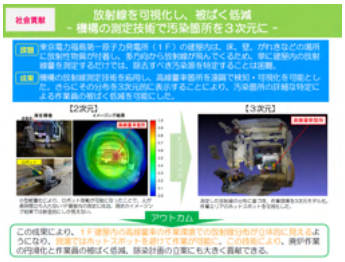
Dissemination of information to the public via media

Through press releases, JAEA endeavors to accurately and swiftly notify the public of its business activities in an easy-to-understand manner. JAEA also holds press reporter study meetings for the purpose of providing news media with knowledge and information on advanced science and fostering better understanding on JAEA's business.
In addition, as one of its efforts to disseminate its R&D results in an easy-to-understand manner, JAEA has opened a page on the JAEA website containing a simplified abstract version of press releases.



Briefing at on-site press gathering

Press reporter study meeting



Easy-to-understand research achievement

Internet-based Dissemination of R&D Results and Collection/Dissemination of Nuclear-related Information

Internet-based dissemination of results

Transmitting information via the Internet for widespread dissemination of results.

Official social media accounts list

https://www.jaea.go.jp/sns/

Actively releasing the latest information and R&D findings via SNS.

Information on events

https://www.jaea.go.jp/news/event/

Providing information on various events and facility tours held at JAEA centers.

Newsletter

https://www.jaea.go.jp/study_results/newsletter/

Introducing R&D findings by 'GENKI' in an easy-to-understand manner.

Brochure

https://www.jaea.go.jp/atomic_portal/brochure/

Brochure introducing activities performed by each department and R&D findings.

JAEA Channel

https://www.jaea.go.jp/atomic_portal/jaea_channel/

Visually introducing R&D findings with 'Project JAEA,' easy-to-understand videos.

Introduction of JAEA's R&D achievements in an easy-to-understand manner

https://www.jaea.go.jp/study_results/representative/

Introducing JAEA's R&D achievements in an easy-to-understand manner, especially on the latest R&D projects.

Dissemination of R&D results and transmission of information

As a library specialized in nuclear energy in Japan, the JAEA library collects and provides a broad spectrum of information about nuclear science and technology, such as books, journals and technical reports for the purpose of providing support in R&D activities in Japan.
In addition, JAEA is actively committed to the dissemination of R&D information through its activities as the national center for the IAEA INIS (International Nuclear Information System), and by collecting and providing information related to the accident at TEPCO's Fukushima Daiichi Nuclear Power Station through its Fukushima Nuclear Accident Archive (FNAA).

JAEA Library

Fukushima Nuclear Accident Archive (FNAA)

All inquiries should be directed to tenkai-ir@jaea.go.jp,
Research and Development Promotion Department

Promoting Use of Research Facilities and Collaboration with industry, Academia and Government

https://tenkai.jaea.go.jp/

JAEA operates facilities utilization systems for external utilization of JAEA's state-of-the-art large research facilities.

Promoting external utilization of research facilities

Through external utilization of facilities, JAEA makes broad contributions from basic studies for the advancement of science to creation of innovations in materials and medical care fields.

Positioning the research facilities and equipment owned by it as public property, the Japan Atomic Energy Agency makes its facilities and equipment through the facility provision system, etc. available for use by domestic and overseas users. We will also start to make the R&D equipment in Tokai area available to provide support services in cooperation with our facilities. This promotion of cutting-edge academic research is expected to promote the creation of new innovation such as development of functional materials and new pharmaceuticals.

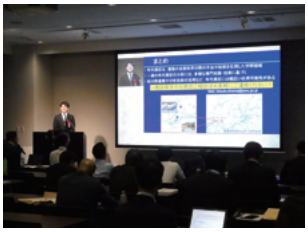
R&D equipment

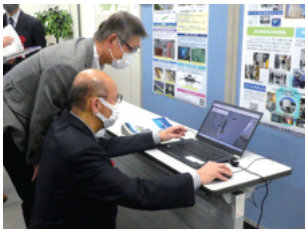
JAEA contributes to the creation of innovations by extensively returning R&D results to the public and society.

Promoting collaboration with industry, academia and government

JAEA is strategically working on the establishment of ideal R&D infrastructure including enhanced industry-academia-government collaboration, to maximize the effects of its R&D results and to contribute to the society, as well as to lead them to creation of innovations. Specifically, JAEA promotes collaboration with industry, academia and government such as joint research, technology transfer and technical co-operation for adding and creating new values.
JAEA also holds the JAEA Technology Salon for introducing its advanced technologies and discussing interests in their practical application and the possibility of commercialization, in a bid to drive R&D through the interdisciplinary research and to promote the utilization of R&D results.
In addition, JAEA R&D results, i.e. technical reports, journal articles and intellectual properties are accumulated in a database and provided through the JAEA website.

[JAEA Technology Salon]

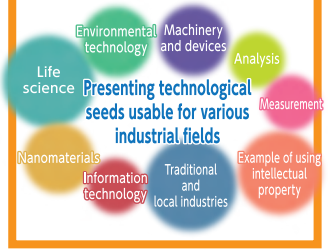




[JST New Technology Presentation Meetings]

[JAEA Technology Seeds]

JAEA publishes and disseminates information on its intellectual properties such as patents in easy-to-understand descriptions.



[Productization examples]

Automatic reduced pressure filtration system

FUKU Mask made of high-performance odor-eating Japanese paper

2024.4

Developing Nuclear Human Resources

https://nutec.jaea.go.jp/english/

We are working to develop human resources in the nuclear field, shaping people who will create the future.

Each sector of the Japan Atomic Energy Agency fosters nuclear human resources inside and outside of Japan according to its R&D field. Domestically, the Nuclear Human Resource Development Center (NuHRDeC) provides a variety of training courses ranging from basics to the level of national examination preparation, cooperates in university education, and carries out a wide range of human resource development activities in cooperation with related organizations in Japan. For foreign countries, NuHRDeC invites engineers and other professionals from Asian countries to Japan to give training and foster lecturers who will develop human resources in their home countries.

Human resources development concierge

We will answer promptly to inquiries and consultations from Japan and abroad regarding nuclear human resource development.

Domestic training

Fostering engineers for the safe use of nuclear energy

◆ **Regular courses** (21courses in 4 fields)
- Courses for nuclear energy engineers
- Courses for engineers handling radioactive materials and radiation
- Preparatory Courses for national examinations, etc.
  - Chief engineer of reactors
  - Chief engineer of nuclear fuel
  - Supervisor for radiation protection

◆ **Trainings upon request**
- Conduct based on requests from municipalities or related organizations

International training

Fostering lecturers who will give technical guidance in Asian countries

◆ **Lecturer fostering project (entrusted by the Ministry of Education, Culture, Sports, Science and Technology)**
Target countries: 11 countries in Asia
- Instructor Training Course and Advanced Instructor Training Course: fostering lecturers in Asian countries and helping increase the levels of lecturers
  - Reactor Engineering
  - Environmental Radioactivity Monitoring
  - Emergency Preparedness
- Follow-up Training Course: Dispatching specialists to Asian countries
- Nuclear technology seminar: Cultivating engineers and specialists

Japan Nuclear Human Resource Development Network

Conducting comprehensive human resource development activities by collaboration among industry, government, and academia

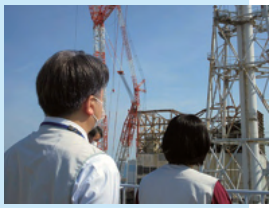
Japan Nuclear Human Resources Development Network - joint secretariat -

◆ Participation of **84 organizations in industry, government, and academia**

◆ Activities for globalizing domestic human resources
- Japan-IAEA Nuclear Energy Management School
- Support for participants in World Nuclear University
- Capacity Building Course for Young Nuclear Professionals

◆ Survey on the trends of students, etc.

◆ Nuclear facility visit for students



Cooperation with universities, colleges, etc.

Fostering students creating the future of nuclear energy

◆ **Dispatch of lecturers to cooperative courses**
- Dispatch of visiting faculty **approx. 60 people**

◆ **Delivery of remote lectures common to seven universities**[note 1]
- Distributed throughout the year and attended by **approx. 240 students**[note 1]

◆ **Operation and cooperation in student acceptance programs and practical training for university and graduate schools**
- **Approx. 500 students** accepted

Note 1: Tokyo Institute of Technology, Kanazawa University, University of Fukui, Okayama University, Ibaraki University, Osaka University, and Nagoya University

2024.4

Advanved Computer Science and Simulation Technology

https://ccse.jaea.go.jp/index_eng.html

To support the DX of nuclear R&D and contribute to the realization of Society 5.0, we are conducting R&D in computational science and data science

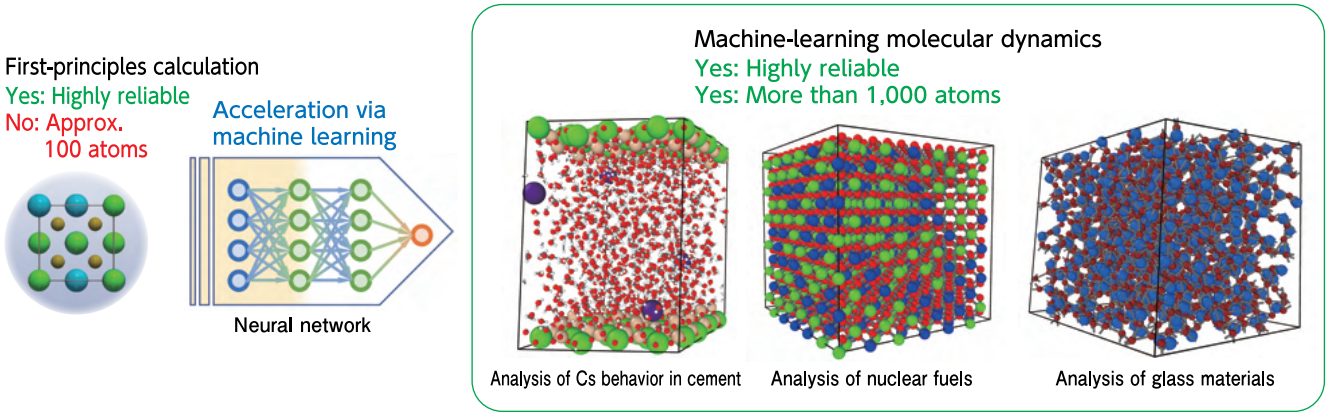
R&D on advanced computer science and simulation technology

Computational science and data science approaches using supercomputers are required to promote the digital transformation (DX) of nuclear R&D. In particular, to address the critical issues arising from the accident at the Fukushima-1 Plant (1F) of Tokyo Electric Power Company Holdings and to create new innovation, it is essential to develop a data assimilation technology, that combines real and virtual spaces, and machine learning, capable of extracting useful information from a large amount of data.

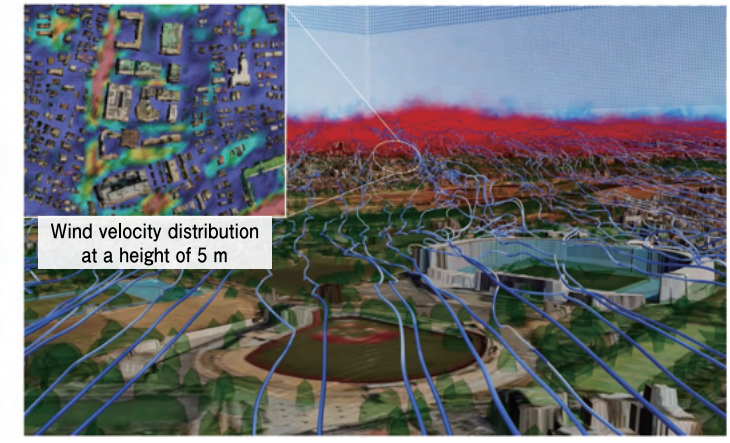
Towards the realization of Society 5.0, aiming to utilize systems that integrate real and virtual spaces, the Japan Atomic Energy Agency is conducting R&D on:

- Simulation technologies that provide highly accurate simulations using state-of-the-art supercomputers;
- Data assimilation technologies that create a digital twin by integrating simulation and observation data; and
- Visualization and machine learning technologies for large amounts of data obtained through simulations and observations.

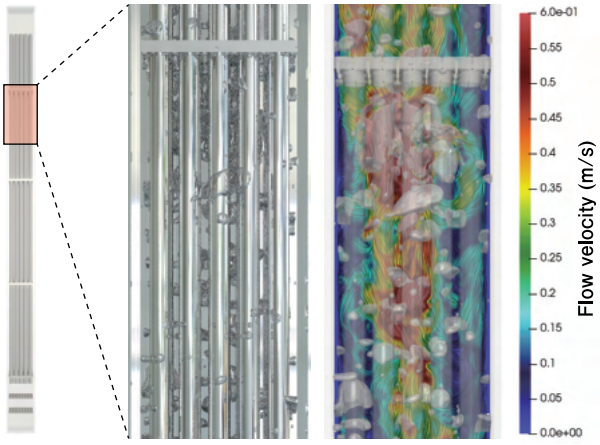
We are promoting public release of the software developed through these R&D, making it available to the academic and industrial communities.



Material simulation technology using machine learning



A wind digital twin that integrates real-time wind analysis and obserbation



Gas-liquid two-phase flow analysis in a fuel bundle structure

2024.4

International Cooperation

https://www.jaea.go.jp/04/kokusaibu/eng/

We will effectively and efficiently promote R&D through intense cooperation with overseas research institutes and international organizations.

Global cooperation and contribution

We will aim to proactively promote international cooperation and make a wide variety of international contribution toward the realization of a net-zero society through nuclear energy.

While effectively implementing our R&D projects, we will aim to promote R&D cooperation for increasing the value of nuclear energy as well as to make international contributions for developing the infrastructure for using nuclear energy toward the realization of synergy of nuclear and renewable. In addition, to help advance nuclear science and technology around the world through our technology and experience, we will increase the dispatch of specialists to overseas and presentations at international conferences, and encourage the international use of our research facilities, and so on.

Bilateral and multilateral cooperation in R&D

Bilateral cooperation : advanced nuclear reactor technology and human resource development in nuclear security in cooperation with the US, fast reactor technology in cooperation with France, and high-temperature gas-cooled reactor technology in cooperation with the UK and Poland.

Multilateral cooperation : multilateral frameworks concerning R&D on advanced nuclear reactor technology (Generation IV International Forum), etc.

Japan-France workshop (organised by the Paris Office)

Symposium on US-Japan Nuclear Research Cooperation (organised by the Washington Office)

Partnership with the National Centre for Nuclear Research in the Republic of Poland

Partnership with the UK National Nuclear Laboratory

Invitation of researchers from overseas

Promotion of research networking and training activities by inviting researchers from overseas

International utilization of research facilities

Promotion of international utilization of the Japan Proton Accelerator Research Complex (J-PARC) and Horonobe Underground Research Center

Contribution to international organizations

Dispatch of specialists to the International Atomic Energy Agency (IAEA), Organisation for Economic Co-operation and Development/ Nuclear Energy Agency (OECD/NEA), and other organizations

Contribution to the IAEA

Overseas projects

Promotion of the decommissioning of our facilities using findings of overseas companies

Framework contract for sodium treatment from Monju reactor in the UK

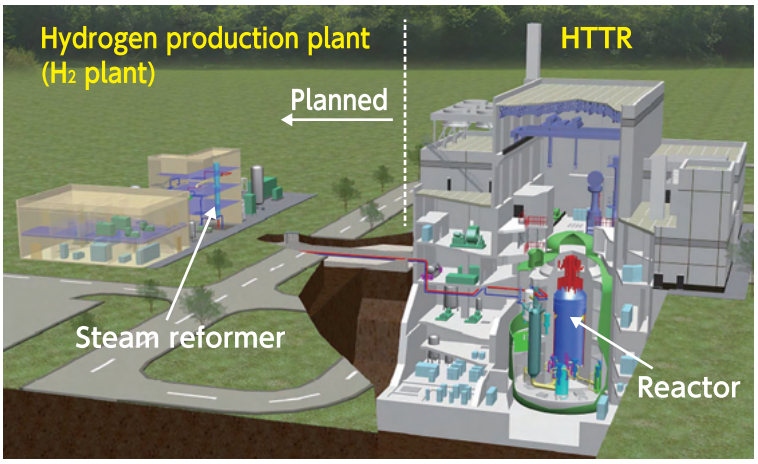
2024.4

High Temperature Gas-cooled Reactor (HTGR) Projects

https://www.jaea.go.jp/04/o-arai/nhc/en/index.html

JAEA has been conducting the following five projects aiming to reduce greenhouse gas emissions using heat from HTGR towards achieving carbon neutrality in 2050.
(1) Hydrogen production demonstration using HTGR (HTTR heat application test), (2) HTGR demonstration reactor, (3) UK HTGR demonstration reactor, (4) UK HTGR fuel, and (5) Poland HTGR research reactor

Hydrogen production demonstration using HTGR (HTTR heat application test)



- JAEA launched a hydrogen production demonstration project with a hydrogen production plant using steam reforming of natural gas using the heat from the HTTR (High Temperature Engineering Test Reactor) (Oarai Town, Ibaraki Prefecture) .
- JAEA will establish technologies for safe coupling between HTGR and hydrogen production plant and demonstrate hydrogen production technologies using the HTTR by 2030.
- JAEA also plan to connect a hydrogen production plant using a carbon-free hydrogen production method to the HTTR to demonstrate HTGR carbo-free hydrogen production technologies.

2022-		2028-
Safety design and safety analysis / licensing	HTTR modification / hydrogen production plant construction	Hydrogen production test
HTTR modification design/hydrogen production plant design		

HTGR demonstration reactor

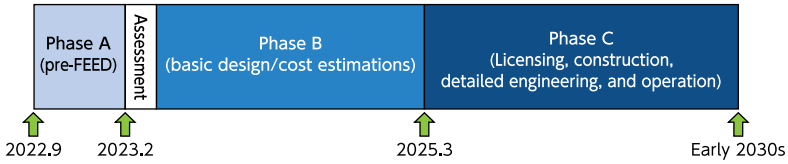
- Japanese Government adopted the "Basic Policy for GX Implementation" (in February 2023) to put forward development and construction of next-generation advanced reactors including HTGR that incorporate new safety mechanisms based on the premise of reactor safety.
- JAEA started research and development on HTGR in the 1960s and has established basic HTGR technologies through design, construction, and operation of the HTTR. The technologies and experience will be fully incorporated into the HTGR demonstration reactor in Japan in cooperation with a core company who is responsible for basic design, detailed design, manufacturing and construction of the demonstration reactor.

		2023	2024	2025	2026	2027	2028	2029	2030	2030s (2040)	2040s (2050)
Goal/ strategy	HTGR (demonstration reactor)	Basic design				Detail design		Manufacturing/ construction		Operation	
GX investment		Research & development, design, etc. of HTGR demonstration reactor			Development, construction, operation, etc. of demonstration reactors such as HTGR ➡ Investment of approx. 1 trillion yen over the next 10 years						
International strategy		Participation in overseas demonstration reactor projects and penetration to overseas markets through Japan-UK cooperation in HTGRs									

UK HTGR demonstration reactor

- Aiming for net-zero greenhouse gas emissions by 2050, the UK plans to introduce HTGR demonstration reactor in the early 2030s.
- The team involving the UK National Nuclear Laboratory (NNL) and JAEA was selected in July 2023 as one of two teams to implement Phase B of the UK HTGR demonstration reactor program, following Phase A.
- The UK also considers locating HTGRs in an industrial complex. The experiences and knowledges obtained thru demonstration of technologies and economic feasibility under the project will be incorporated to the HTGR demonstration reactor project in Japan.

▶ Phase A : Pre-FEED studies
▶ Phase B : Basic design and cost estimations
▶ Phase C : Licensing, construction, detailed engineering and operation

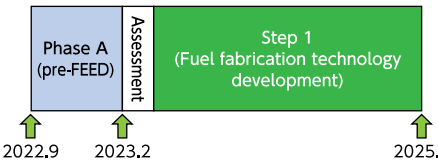


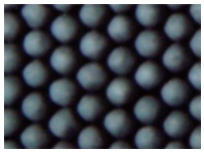
Meetings among the Japan Atomic Energy Agency, UK National Nuclear Laboratory, and Jacobs (July 2022)
From the left, Andy VP from Jacobs, President Koguchi from the JAEA, and CEO Paul from the NNL

UK HTGR fuel

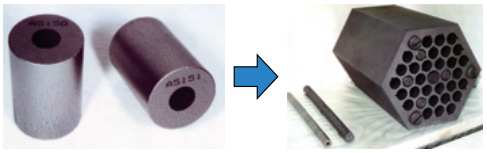
- The UK started a program to develop fuel for the HTGR demonstration reactor together with the demonstration reactor program.
- The team involving NNL and JAEA conducted pre-FEED studies of Phase A of the UK HTGR fuel program. In July 2023, NNL was selected as the executor to perform Step 1. JAEA will collaborate with NNL to develop fuel fabrication technology in the UK.
- We plan to establish commercial-scale HTGR TRISO fuel technologies in UK based on JAEA's design technologies and manufacturing technologies for world's highest quality fuel by Japanese private companies considering a procurement of Japan's HTGR demonstration reactor fuel from UK as an option.

▶ Phase A : Pre-FEED
▶ Step 1 : Fuel fabrication technology development





TRISO fuel
(coated fuel particles)



Fuel compact　　Fuel rod, fuel block

Poland HTGR research reactor

- Poland aims to reduce carbon dioxide emissions from the industrial sector using HTGRs replacing coal-fired boilers which use a large amount of coal.
- The "Action Plan for the Implementation of the Strategic Partnership between the Government of Japan and the Government of the Republic of Poland" (signed by the foreign minister of each country in May 2017) states the collaboration between the JAEA and Poland National Centre for Nuclear Research (NCBJ) aiming to start research and development of HTGR technologies. JAEA and NCBJ concluded an Implementing Arrangement for Cooperation in Research and Development in the Field of High temperature Gas-cooled Reactors in September 2019 in response to the Action Plans.
- Polish government started basic design for a HTGR research reactor to be constructed at NCBJ to establish HTGR steam supply technology. JAEA has been cooperating with domestic private companies corresponding to the request by NCBJ to undertake research activities about basic design since November 2022.

JAEA and NCBJ signed the implementing arrangement for cooperation in research and development in the field of HTGR (November 2022).
From the far side, Director Kurek from the NCBJ and President Koguchi from the JAEA

New Research Reactor to be Installed at the Monju Site

https://www.jaea.go.jp/04/nrr/en/

We will create innovation in R&D utilizing neutron beams

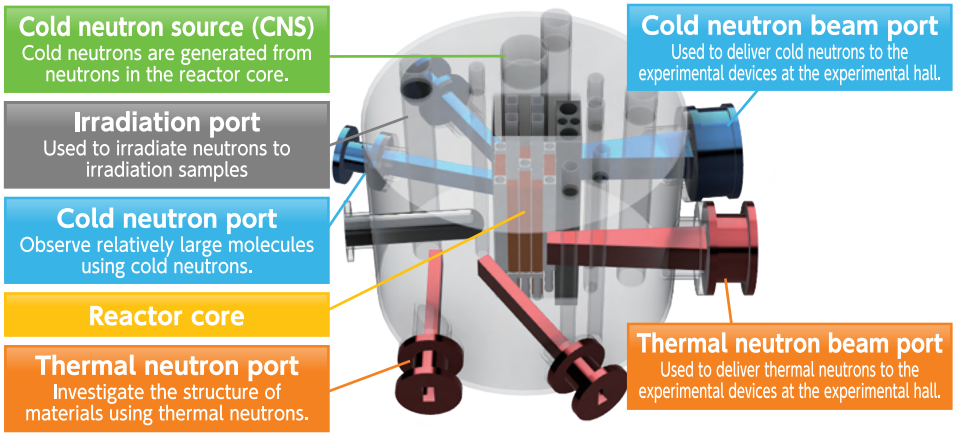
Background (and history) of the installation

In 2016, installation of a new research reactor in the Monju site was decided together with decommissioning decision of Monju, a prototype fast-breeder reactor. Since fiscal year 2020, JAEA, Kyoto University, and University of Fukui have investigated the conceptual design and operation of a new medium-power research reactor mainly for neutron-beam utilization, in order that the research reactor will become a center of excellence in western Japan area for nuclear research and development and nuclear human resources development referring various opinions from the stakeholders.
JAEA was designated in fiscal year 2022 by the Ministry of Education, Culture, Sports, Science and Technology as the implementing body for installing the new research reactor, and then, JAEA concluded a cooperation agreement with Kyoto University and University of Fukui in fiscal year 2023. We will continue designs and reviews of the new research reactor by ensuring safety as a top priority.

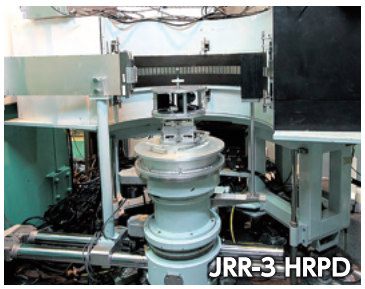
President Ueda of University of Fukui　President Koguchi
President Minato of Kyoto University

Overview of a research reactor

The research reactor is a water-cooled one with thermal output less than 10 MW. Using thermal and/or cold neutrons, we will respond to user demands by placing various experimental equipment around reactor and at beam hall. In addition, we have equipped the irradiation ports for irradiating neutrons to produce radioisotopes (RIs) and so on.



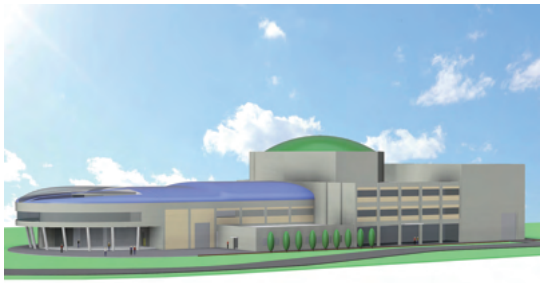
Images of new research reactors



Neutron diffraction equipment at JRR-3*

Small angle scattering goniometer at JRR-3*

A research reactor facility consists of the main reactor building; a beam hall used to perform experiments using neutron beams; a post irradiation examination facility with hot cells to handle the neutron-irradiated samples; and an administrative building. Through exchanges of ideas between users in a variety of research fields, creation of new innovation will be expected.



* Equipment considered to be preferentially installed, which expects to the application to the industrial field.

Neutron reflectometer at JRR-3*

Imaging instrument at JRR-3*

2024.4

JOYO, a Next-generation Innovative, Experimental Fast Reactor

https://www.jaea.go.jp/04/o-arai/joyo/index.html

As an fast neutron irradiation facility, JOYO will contribute to the development of fast reactors and radiopharmaceuticals.

JOYO, an experimental fast reactor

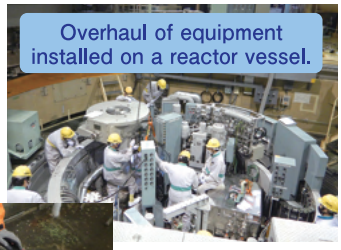
JOYO, an experimental fast reactor, is expected to play the role of a research facility to develop innovative reactors toward achieving carbon neutrality and reducing radioactive waste as a fast neutron※ irradiation facility that is valuable worldwide.
The production of actinium-225 (Ac-225) is also receiving attention from the medical world and other fields, which is expected to demonstrate high efficacy in the treatment of cancer.

※ fast neutron: high-energy neutrons

Reactor power : 100MW
Coolant : Sodium
Fuel : Mixed oxide of uranium and plutonium

Toward resumption of operation

While maintaining and managing facilities and upgrading equipment, JAEA is adding and modifying equipment for safety in response to new regulatory standards.



Overhaul of equipment installed on a reactor vessel.

Power feeding training using a portable generator

Operation training for operators using a simulator

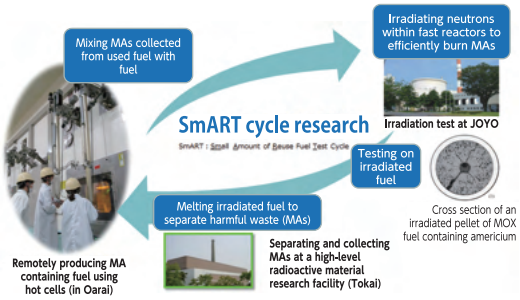
Main measures toward responding to new regulatory standards

Start of seismic reinforcement work (ground improvement and excavation)

JAEA will improve safety mainly by enhancing measures against accidents, earthquake resistance of equipment, and measures against fire.

Research for reducing radioactive waste

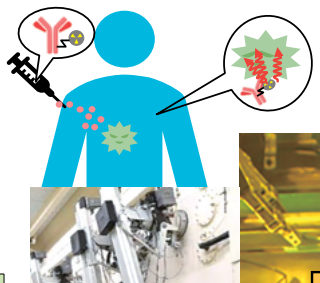
JAEA is developing technology for separating and collecting minor actinoids from used fuel to reuse them as fuel.



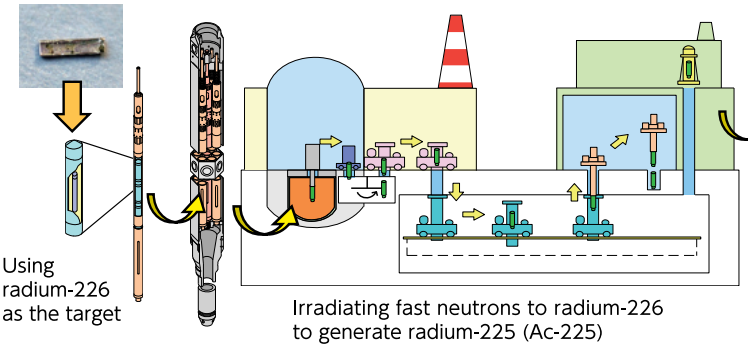
Production of medical (therapeutic) radioisotopes (RIs)

Producing cancer therapeutic drugs (actium-225 (Ac-225)) at JOYO

A case was reported in a foreign country where Ac-225 killed cancer cells that had spread. However, with a small supply, it is not sufficiently available in Japan. Under this situation, JAEA plan to produce Ac-225 using fast neutrons owned by JOYO.

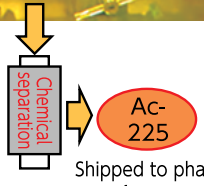


Ac-225 makes a pinpoint attack against only cancer cells without a significant impact on other organs.



Using radium-226 as the target

Irradiating fast neutrons to radium-226 to generate radium-225 (Ac-225)



Shipped to pharmaceutical manufacturers

Promptly extracting and shipping short-life Ac-225 using a test facility adjoining JOYO.

2024.4

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Japan Atomic Energy Agency
https://www.jaea.go.jp/