Japan Atomic Energy Agency
(JAEA)

Message

The earthquake which occurred on March 11, 2011 was the unprecedented devastating disaster, which should be called as the national crisis unforgettable for the whole country. We offer our deepest condolences for those who lost their lives in the earthquake, as well as express our sympathies to all the victims who suffered from the disaster and those who are still forced to evacuate. We sincerely hope that the national government, disaster-stricken communities and the entire people of Japan make united efforts for the immediate restoration from the disaster.

In the earthquake, an unacceptable nuclear accident involving reactor core meltdown occurred and brought grave consequences causing nuclear disaster affecting wide range of areas. Since immediately after the accident, as the designated public institute under the Disaster Countermeasure Basic Act, JAEA has conducted various activities relating to the assessment of the situation and the early restoration from the accident. The present conditions, however, still remain serious and require our further efforts of cooperation. In the long term point of view, the largest technical challenge in this event is considered to be the decommissioning of the damaged reactors, and we will keep assuming maximum possible role in the process as an organization where the Japanese nuclear specialists are substantially concentrated.

Regarding the environmental contamination caused by the released radioactive materials, we recognize that the highest priority at the moment is to proceed with decontamination work to enable those who evacuated from their living area to return as soon as possible. JAEA has been conducting, under the direction of the MEXT and the Cabinet Office, radiation monitoring of the environment, radiation dosimetry for the local people, decontamination of school and kindergarten yards and demonstration projects for verification of decontamination at the designated areas of certain municipalities. Despite our efforts, however, we must be prepared for a long way to go. We will continue to be engaged in these activities with all our efforts in line with the expectations and requests of the government and local communities.

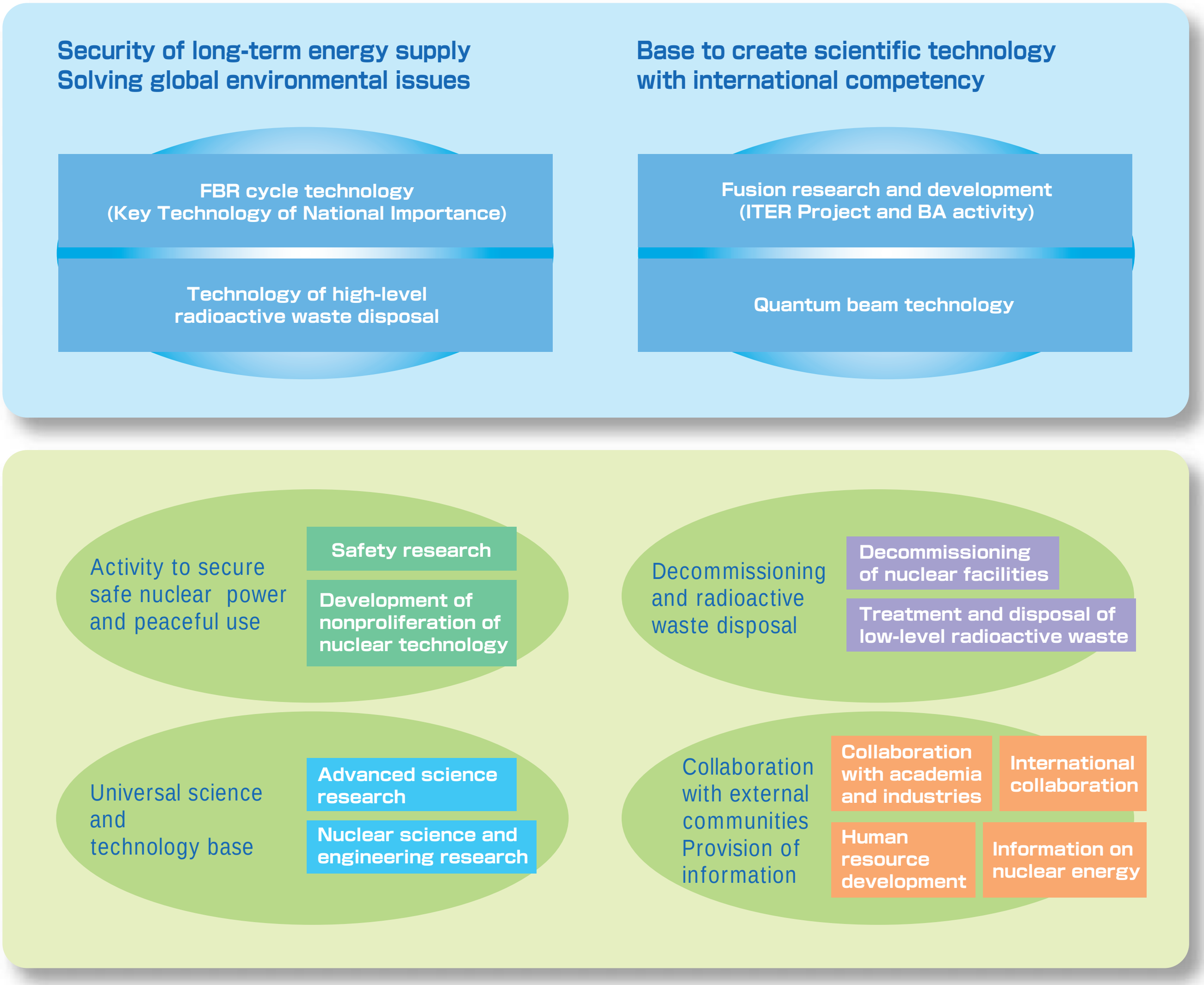
Needless to say, JAEA has missions to achieve its second medium-term (5 years) program goal and implement activities specified in the related medium term plans. The entire staff members of JAEA are determined to strive to fulfill their missions through overcoming current difficulties.

I, as the president of JAEA, highly appreciate all the more continued understanding and support of every individual concerned.

President of JAEA

Atsuyuki Suzuki

Mission of JAEA



CONTENTS

We conduct research and development for establishing cost-efficient nuclear fuel cycle technology using fast breeder reactors in harmony with the environment.

Research and development for commercialization of fast breeder reactor cycle

Fast Reactor Cycle Technology Development ~FaCT Project~

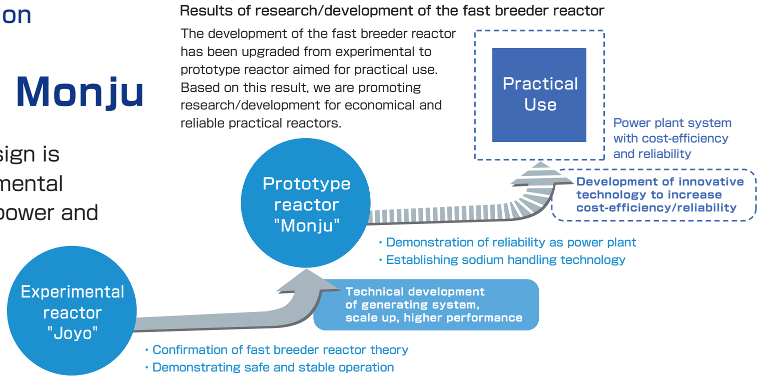
The fast breeder reactor cycle was selected as the "Key Technologies of National Importance" in the "Science & Technology Basic Plan", as it has been possible to maintain a sustainable society through efficient utilization of uranium resources and reduction of environmental impact.
The Fast Reactor Cycle Technology Development (FaCT) Project is promoted for future commercialization, and the research and development of the fast breeder reactor and relative fuel cycle technology are being carried out.
In the FaCT Project, the materialization of the innovative technologies is attempted based on the results of research and development, such as elemental technology developments and "Monju" operation, while positively advancing international cooperation.
Research and development should be implemented in step-by-step approach for commercialization of the fast breeder reactor cycle around 2050.

Prototype fast reactor, the foundation of research/development

Fast breeder reactor Monju

Monju is a prototype fast reactor whose design is based on the research results of the experimental reactor, Joyo. Monju can actually generate power and has the role of confirming technological possibilities that will lead to larger reactors. It also provides a base for international research/development.

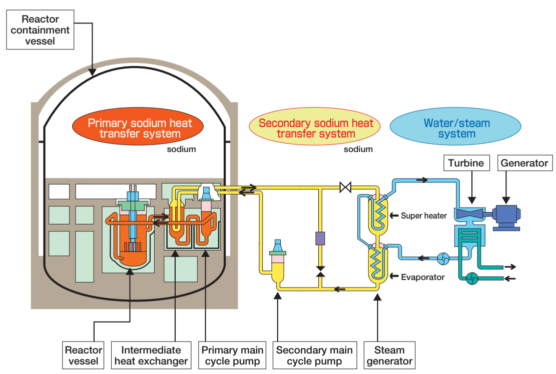
Results of research/development of the fast breeder reactor



+ Focus

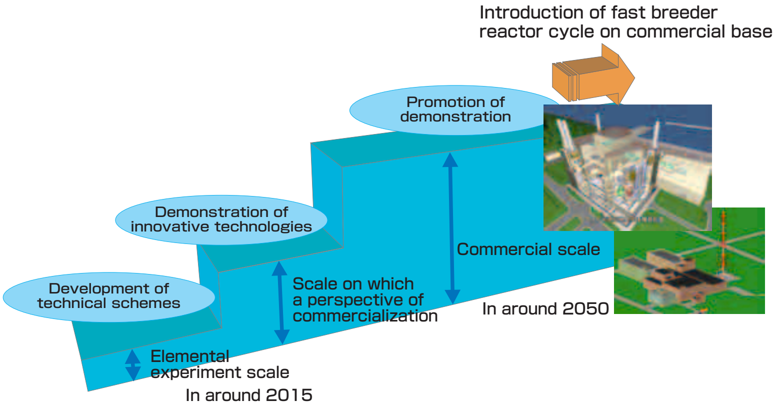
Fast breeder reactor Monju
Efficient collection of heat by using sodium

The mechanism of fast breeder reactor, Monju



Molten sodium metal is used to extract heat from the reactor core at Monju. Since sodium has a low rate of reducing neutron velocity, sodium enables the breeding of fuel. It has outstanding properties of heat transfer, and it has good compatibility with the structural materials used in the nuclear reactor. Furthermore, sodium remains in the liquid phase from 100℃ to 880℃, and is able to rise in temperature without rising in pressure. These attributes enable it to transfer energy efficiently, so that it has the properties desirable in a fast reactor. The heat generated by nuclear fission at the reactor core goes through a series of cooling stages. After the initial heat transfer to the sodium of the primary system, the heat is transferred through an intermediate heat exchanger to the sodium of the secondary system, and then to water in a steam generator (composed of an evaporator and super-heater). Finally, the high-temperature, high-pressure steam from the steam generator is used to rotate the turbine, which generates electricity.

The "fast breeder reactor cycle" means to recycle used reactor fuel repeatedly in fast reactors. This is a technology that is cost-efficient and harmonizes with the environment compared to the present light water reactor cycle. In the fast reactor cycle the research and development aimed at the efficient use of uranium resources and reduction of environmental burden.

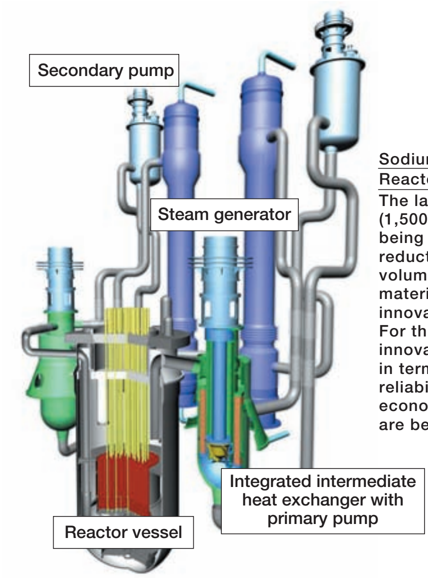


For excellent viability in terms of the economical efficiency, reduction of environmental burden, and other benefits

Development of innovative technologies on the fast breeder reactor cycle

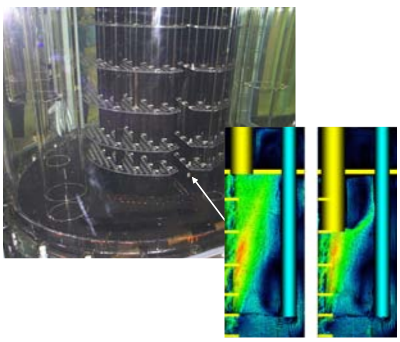
In accordance with current knowledge, the combination of a sodium fast breeder reactor and advanced fuel cycle system (advanced aqueous reprocessing + simplified pelletizing fuel fabrication) was selected as a major concept and various kinds of research and development for the commercialization is being implemented in stages.

Research and development of fast breeder reactor



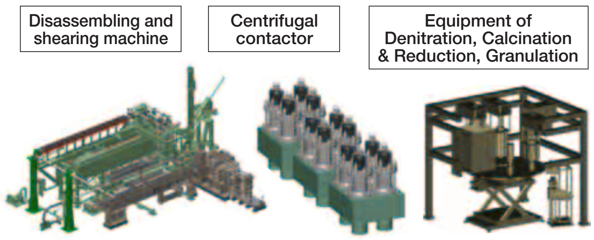
Sodium-cooled Fast Reactor

The large-scale NPP (1,5000 MWe) concept is being established for reduction of building volume and construction material through using innovative technologies. For this concept, 13 innovative technologies, in terms of safety, reliability, and economical efficiency are being pursued.



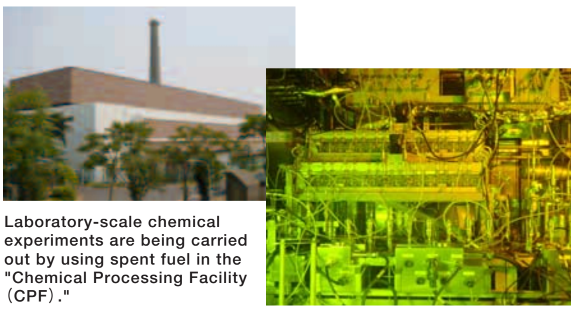
Research and development on the hydraulic characteristics of the compact reactor vessel are being implemented by using the combination of experiments and simulation technology.

Research and development of fuel cycle system



Advanced Fuel Cycle System

The consolidated fuel cycle plant concept, which has drastically simplified reprocessing and fuel fabrication, is being established. For this concept, 12 innovative technologies for uranium and plutonium recycling are being explored.



Laboratory-scale chemical experiments are being carried out by using spent fuel in the "Chemical Processing Facility (CPF)."

The first experimental fast reactor in Japan, Joyo, plays a key role in developing the technological system of fast reactors

Joyo

Joyo started operations in 1977 as the first experimental fast reactor in Japan. In 1984, the nuclear fuel cycle was successfully completed when plutonium extracted from reprocessing spent fuel from Joyo was reloaded into the reactor. The major role of Joyo is to contribute to global fast breeder reactor development through irradiation tests for developing fuels and materials for future fast reactors and technical exchanges with overseas researchers.

Joyo is the first experimental fast reactor in Japan to acquire basic data and train technicians. As a fast neutron irradiation field, various irradiation tests are conducted.

Upgrading Safety & Reliability

Monju

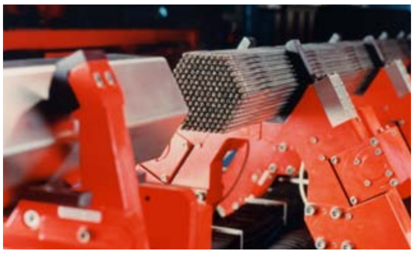
Plant modification work of Monju began in September 2005 to improve the safety and reliability after the shut-down due to the sodium leak accident of December 1995. The function and characteristics of the improved system was confirmed in the Modified System Function Test from December 2006 to August 2007. JAEA has been aiming to restart (re-commencement of the start-up test) in earlier occasion succeeding to the Entire System Function Test to cofirm soundness of the long term stand-by systems and understanding of the local public.
A three step experiments will be carried out in the start-up test: core characteristics confirmation at zero-power criticality condition; start-up and operation of the water/steam and turbine systems up to 40% power generation; and gradual power increase up to 100%. Through the experiments, the skills for operation and maintenance of the whole plant system are expected to be upgraded, and plant characteristics and reliability will be confirmed or demonstrated as a power-generating fast breeder reactor.

Fast breeder reactor Monju

Economical fuel that supports operation of fast reactor by efficient use of uranium resources

MOX fuel fabrication

In Plutonium Fuel Production Facility (PFPF), fully automated and remote operation were introduced into uranium-plutonium mixed oxide (MOX) fuel fabrication as a pioneer in the world. And, MOX fuel fabrication technologies have been developed and demonstrated on an engineering scale through supply of MOX fuel to "MONJU" and "JOYO".



169 MOX fuel pins are bundled into a fuel assembly for "MONJU".

Reprocessing technology Development

Reprocessing

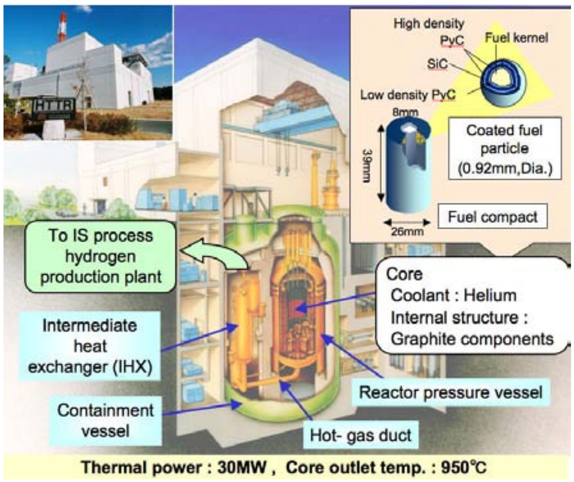
Spent fuel which has been used at a nuclear power plant contains residual uranium, newly produced plutonium, and high-level radioactive waste.
At the Tokai Reprocessing Plant (TRP), reprocessing technology has been developed to separate uranium and plutonium from spent fuel and to recover them for the purpose of making the efficient use of available uranium resources.
The recovered uranium and plutonium can be reused as new fuel, therefore the reprocessing plays a key role in the nuclear fuel cycle.
The TRP will continue research and development toward the advancement of reprocessing technology, carrying out the reprocessing of ATR MOX spent fuel.

Tokai Reprocessing Plant
Spent fuel is stored for a while and then recycled into products after separation and refinement processes.

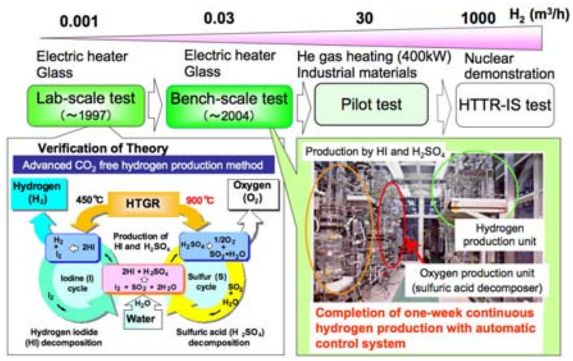
Aiming for diversification of nuclear energy by promoting research and development of the energy system

Research and development of high-temperature gas-cooled reactor system

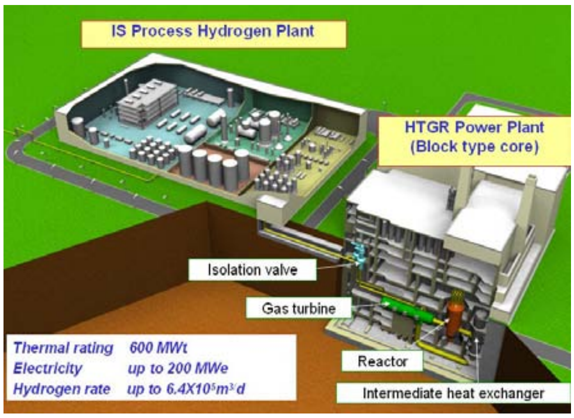
Nuclear energy offers one of the most attractive energy security strategies without green house gas. Strong interest has recently been seen in hydrogen production based on the High-Temperature Gas-cooled Reactor (HTGR) because the HTGR is, in addition to being inherently and passively safe, uniquely capable of producing high temperature heat ideally suited for economical nuclear hydrogen production and power generation.
The High-Temperature Engineering Test Reactor (HTTR) constructed at the Oarai Research and Development Center of JAEA is the Japanese original HTGR and a forerunner technology in the world for the next generation HTGR. The HTTR achieved in April 2004 the operation of 950˚C as high a temperature as required by the next generation HTGR and has been undergoing demonstration of safety performance inherent to the HTGR. Improvement of HTGR design codes and development of advanced fuel and graphite material are also being carried out in JAEA.
The technology of hydrogen production is based on a thermochemical water splitting method known as the IS (Iodine-Sulfur) process. The theory of the IS process was verified by test on a lab-scale apparatus in 1997, and further process experiments have been conducted using a bench-scale test apparatus made of glass, in which June 2004, continuous one-week long hydrogen production of about 31 L/h was successfully achieved. Components tests intended to gain design basis for a pilot plant to be heated by the simulated helium conditions of the HTGR system are being conducted. The pilot plant test precedes the connection of an IS hydrogen production plant to the HTTR to demonstrate nuclear heat assisted hydrogen production for the first time in the world.
The proposed original concept of the next generation HTGR cogeneration system, GTHTR300C, combines a direct cycle gas turbine for generation of electric power and an IS process hydrogen production plant through an intermediate heat exchanger. GTHTR300C yields about 80% thermal efficiency when the use of its sensible waste heat at about 150℃ is made into producing process steam, district heating, seawater desalination, etc., making the GTHTR300C a resource and environment friendly energy production system.



High-Temperature Engineering Test Reactor (HTTR)
The HTTR is a graphite-moderated, helium-cooled gas reactor with 30 MW of thermal power. The reactor core is composed of graphite prismatic blocks and tri-isotropic coated fuel particles with UO2 kernel dispersed in the graphite compact.



Development of thermochemical hydrogen production by IS (Iodine-Sulfur) process.
In the IS process, inter-cyclic chemical reactions take place with a net result of decomposing water thermally into hydrogen and oxygen using heat at temperatures up to 900 °C. Aiming to demonstrate nuclear hydrogen production with the HTTR, component tests for a pilot plant are being carried out under the pilot test program.



Original proposal for next generation commercial HTGR system (GTHTR300C)
The direct cycle gas turbine generates electricity and circulates reactor coolant. Hydrogen cogeneration is enabled by adding an intermediate heat exchanger (IHX) in serial between the reactor and the gas turbine.

Safety of nuclear installations is comprehensively evaluated by various tests and analyses

Research to support safe operation of nuclear installations

Safety research of nuclear facilities

Safety of nuclear facilities

We conduct safety research for nuclear power plants and nuclear fuel cycle facilities with an experimental and analytical approach to investigate the phenomena occurring during various accidents in order for the government to establish safety guides and regulatory criteria. Furthermore, when accidents or problems occur at nuclear facilities, we assist the government in conducting accident investigation or analysis of causes.

Experimental research for ensuring safety

One of the experimental research projects for accidents at light water reactors (LWRs) is the evaluation of fuel integrity during a reactivity initiated accident (RIA) using the nuclear safety research reactor (NSRR). For example, RIA is a power excursion accident caused by control rod ejection from a reactor core. The failure conditions of fuel and the effects to the reactor safety are investigated.
Another is the research on thermal-hydraulic responses of LWRs during a loss-of-coolant accident (LOCA) using the large scale test facility (LSTF). The effectiveness of the emergency core cooling system (ECCS) and operator action during the LOCA is confirmed.
The knowledge obtained from these experiments is useful for prevention of accidents and validation of operator actions to an accident.

The reactor core of the NSRR during a pulse operation.

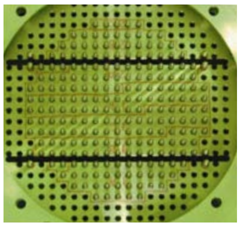
Fuel failure threshold under RIA conditions is clarified by changing the energy deposition and other parameters.

Safety of nuclear fuel cycle

We conduct research related to critical safety management techniques to secure the safety of reprocessing facilities and transport/storing facilities that are the pivots of the nuclear fuel cycle.
Researches are conducted using "Static Experimental Critical Facility " (STACY) and "Transient Experimental Critical Facility" (TRACY).
For instance, in the "Static Experimental Critical Facility" (STACY), the density of uranium nitric acid solution, vessel shape/size and surrounding conditions are changed to measure the critical mass. Research is advanced based on these results.

External appearance of reactor core tank of the "Static Experimental Critical Facility" (STACY). Uranium solution is supplied from underneath this tank to reach critical state.

Uranium fuel pin arranged in uranium solution for simulating melting of fuel pins in a nuclear fuel reprocessing facility.



Risk assessment and management

Probabilistic safety assessment (PSA) methodology is being developed to evaluate risk of nuclear facilities for applying PSAs to safety regulation and management. The PSA methodology for light water reactors has been already completed, and at present, the method of risk informed applications and PSA methodology for other nuclear fuel cycle facilities are under development.

PSA level 1	PSA level 2	PSA level 3
Evaluation of functions for preventing core damage	**Evaluation of containment integrity**	**Evaluation of public risk**
・Accident scenarios ・Reliability of safety systems ・Human error ・Core damage frequency	・Physical phenomena during accident ・Measures for accident mitigation and termination ・Containment failure frequency ・Source terms	・Transfer of radionuclides in the environment ・Protective actions ・Dose analysis ・Health effects ・Economic consequences

Examples of risk informed applications

- Identification of important safety features, such as accident scenarios, system equipments and protective actions
- Consideration of effective/practical accident management and emergency plan
- Effective/practical safety regulation/operating management for facilities
- Consideration of safety goals linked to public risk

Safety maintenance is particularly important at nuclear facilities. Therefore, various tests and researches are being conducted with the hypothesis of incidents that rarely happen in ordinary circumstances. Safety of nuclear facilities is strengthened here.

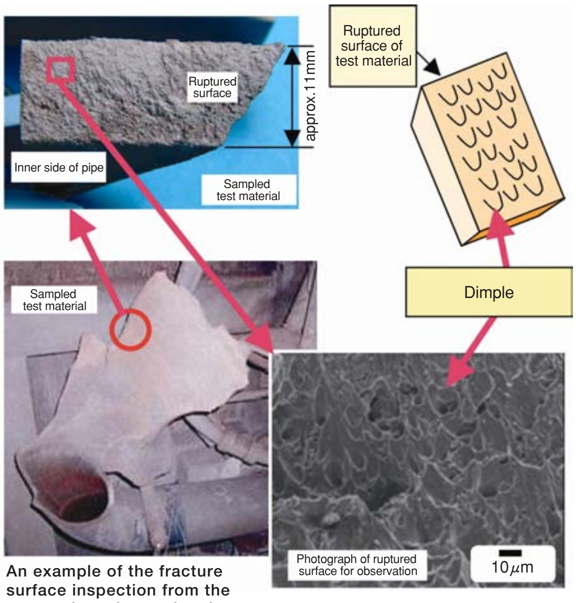
Radioactive Waste Disposal and Decommissioning of Nuclear Facilities

We have developed a range of technical expertise, computer software, and experimental data to address the long-term safety assessments and to provide the technical basis for regulations on radioactive waste disposal. Our evaluation on near-surface and intermediate-depth disposal of low-level radioactive wastes gave the regulatory radioactivity criterion for the disposal. Also the safety analysis for decommissioning of nuclear facilities and for release from the regulatory control of the sites after use has been performed.

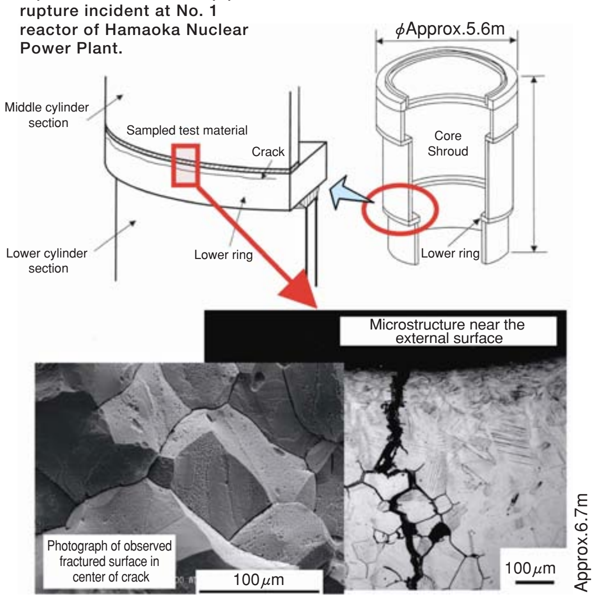
Atmosphere controlled glove box with argon for experiments on geochemical behavior of radionuclides under deep underground redox environments

Contribution to the investigation of accidents or safety-related events

We are contributing to the national governments' activity to clarify the causes and influences when accidents or safety-related events occur at domestic or foreign nuclear facilities. We have cooperated in case of the accident of Three-Mile Island Unit 2 reactor (1979), Chernobyl accident (1986), SG tube rupture at Mihama Unit 2 (1991) and the JCO accident (1999). We have provided material examination and evaluation of reliability and causes when the pipe rupture incident occurred at No.1 reactor of Hamaoka Nuclear Power Station in 2001, the core shroud-cracking problem at Unit 3 of Fukushima Daini Nuclear Power Station in 2002 and secondary system pipe rupture at Mihama Unit 3 of Mihama Nuclear Power Plant in 2004. In addition, we cooperated in the investigation on the cracks in the control rods with hafnium plates installed at Fukushima-Daiichi Unit 6 in 2006.



An example of the fracture surface inspection from the ruptured section at the pipe rupture incident at No. 1 reactor of Hamaoka Nuclear Power Plant.



An example of the inspection of a surface Sampled from the cracked section of the core shroud at No. 3 reactor of Fukushima No. 2 Nuclear Power Plant.

Research activities are being promoted to realize fusion energy to secure energy for the future

Integrated research and development is conducted for early realization of fusion energy

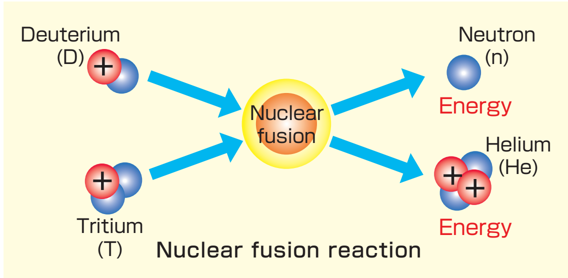
Research and development of nuclear fusion

● Research and development of fusion energy

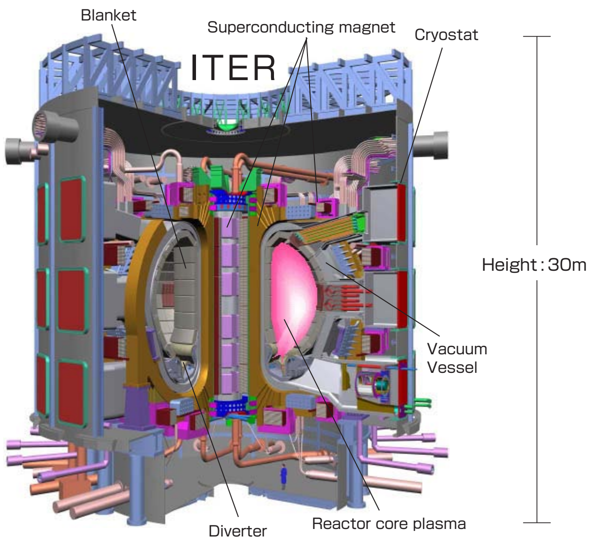
Nuclear fusion is the fusion reaction that light atomic nuclei form heavier ones. The fusion process releases a large amount of nuclear energy. In Japan, research and development has progressed since 1961, and has achieved steady results towards the realization of nuclear fusion power reactors.

● International Thermonuclear Experimental Reactor (ITER) project

ITER project was started in 1985, and is being development under the cooperation of 7 participants: Japan, EU, US, Russia, China, Korea and India. This project aims to realize the world' s first full-scale burning-plasma experiment of nuclear fusion. In June 2005, ITER construction site was selected on Cadarache, France. On October 24, 2007, the ITER Organization has been established formally and the JAEA was nominated as a Japanese domestic agency for the ITER project by Japanese government. Site preparation, fabrication of superconducting magnets, and the fabrication R&Ds for the preparation to start the fabrication of ITER components are in progress.

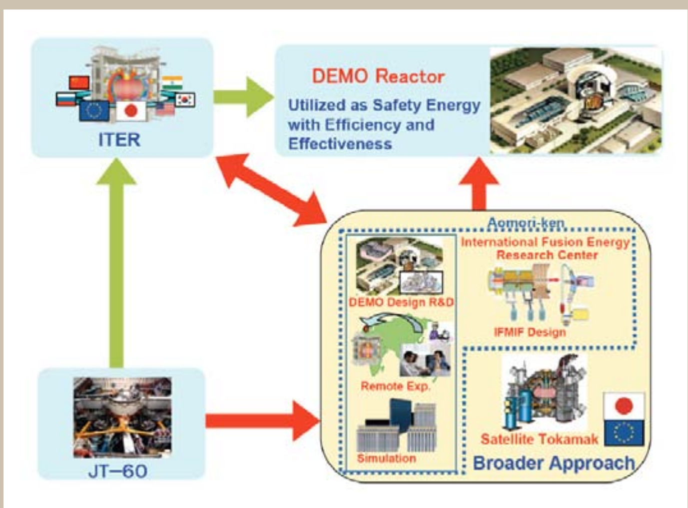


General concept of ITER



+ Focus

International Cooperation on Fusion Research and Development
Broader Approach Activities Toward the Early Realization of Fusion Energy



Japan and EU have agreed to implement, in parallel with the ITER project, the Broader Approach (BA) activities for the purpose of facilitating the research and development on the future demonstration power reactor (DEMO) as well as the ITER project with contributions shared equally between the two parties. Three projects, (1) Engineering Validation of and Engineering Design for the International Fusion Materials Irradiation Facility (IFMIF/EVEDA), (2) International Fusion Energy Research Center (IFERC), performing a conceptual design for DEMO, computational simulation of the fusion plasma and materials and ITER remote experiments, and (3) the satellite tokamak program (JT-60SA), supporting the ITER project and advancing the design concept of a compact fusion reactor, are being implemented under the BA activities.

In our country, Japan Atomic Energy Agency (JAEA) is central in achieving results in research and development of nuclear fusion that lead the world. Fusion energy research, which draws attention as a source for nuclear power, is introduced here.

Research for sustaining burning plasma using energy generated by nuclear fusion

Fusion plasma research and development

● Nuclear fusion plasma

When gas is heated over 10 thousand ℃, the electrons and atomic nucleus structuring the atom separate and move independently. This condition is called plasma.
To generate the nuclear fusion energy, the plasma is first heated to over 100 million℃, to create high enough temperatures to fuse atomic nuclei, then it is necessary to sustain this nuclear fusion reaction.

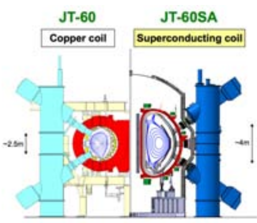
● Large tokamak device "JT-60"

It is necessary to maintain the plasma at a high temperature to generate/sustain the nuclear fusion reaction.
This is called plasma confinement, and this research/development was conducted on the large tokamak JT-60.

Large tokamak device (JT-60). The world's highest temperature, 520 million℃ was reached. (diameter: approximately 15m, height: 13m, weight: 5000t)

● JT-60 will be renewed as JT-60SA

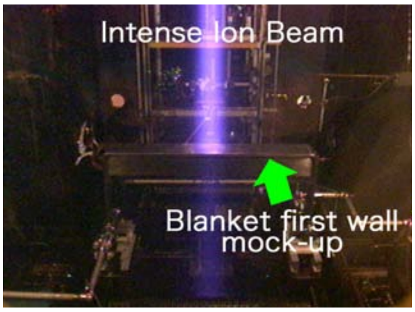
The JT-60 experiment continued for over 23 years was successfully completed in August 2008. The satellite tokamak programme has been started as one of the Broader Approach Projects promoted in collaboration with the EU and Japan, and the JT-60 is modified to the superconducting tokamak JT-60SA (Super Advanced) spending 7 years.



Development of the advanced technology necessary for practical use of fusion energy

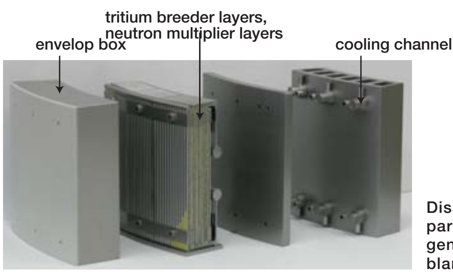
Fusion engineering research

Various advanced technologies are being developed to utilize fusion energy. A blanket is one of the key components of fusion reactors, which produces high performance thermal power from plasma for power generation and the tritium fuel. JAEA is extensively developing blanket related technologies, and going to test the blanket in ITER.
In plasma heating technologies, a new gyrotron has succeeded to produce highest power in the world. Moreover, the advanced technologies such as plasma heating devices with high power and materials with endurance for intense thermal and neutron loads are being developed.
In parallel with these activities, it is also progressed to spin-off these advanced technologies such as a low activation concrete.



A full scale mock-up of the blanket first wall has been fabricated and tested.

The new gyrotron produces the highest power of 1 MW for 1000 s in the world.



Disassembled parts of a power generation blanket

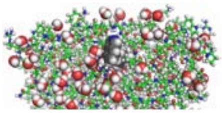
Quantum beam technology: a new realm of technology leading to a dynamic improvement of the level in science and technology as well as industries

Neutrons are utilized to investigate microscopic structure of lives and matters, as well as the origin of the vast universe.

Neutron science research

● Life science

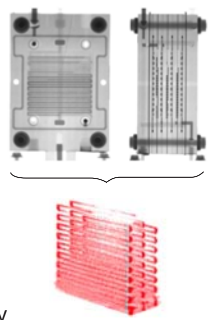
Collaborative use of neutrons and X-rays has been developed to investigate the structure, dynamics and function of proteins. This approach will give us new insights which are useful for molecular design of new drugs.



Tertiary structure of HIV-protease

● Material science

Advanced neutron scattering methods are being developed and utilized to investigate crystal structure and lattice dynamics, magnetic structure and spin dynamics of materials with innovative function.
In addition, neutrons are very useful for internal residual stress analysis, image analysis by radiography and prompt gamma-ray analysis of impurities to evaluate safety of industrial products.



Neutron radiography image of a stacked fuel cell.

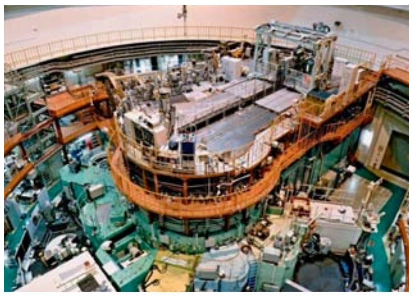
(collaborative research:Kobe University)

● Muon science / nuclear and particle physics

At J-PARC, materials' structure research using muons, nuclear and particle physics experiments using kaons, long baseline neutrino oscillation experiments and so on are carried out as well as the neutron science research.

● Nuclear transmutation technology

Nuclear transmutation technology is expected to be effective in reducing the amount of long-lived nuclides in high-level radioactive wastes by neutron irradiation. The Transmutation Experimental Facility is being planned under the framework of the J-PARC project to study the basic and engineering aspects of transmutation technology to be used in accelerator-driven systems and fast reactors.



Steady-state neutron source JRR-3, with continuous neutron beams that will be used complementarily with the pulsed neutrons from the co-located J-PARC.

+ Focus

J-PARC(Japan Proton Accelerator Research Complex) Research facility of foremost science and technology

J-PARC

Drift tube linac

Neutron beam experimental hall

The atomic nucleus of the metal is broken by making the proton that accelerates to the speed of light collide with the target of the metal in J-PARC. Using the secondary particles such as neutrons, muons, and K mesons generated there to see the world of the atom that has not been seen well before. Therefore the most advanced research of science can be done in the field of the materials and life sciences, the atomic nucleus physics, the elementary particle physics, and nuclear engineering.
A part of Materials and Life sciences Facilities use has already been begun since December, 2008. The research with Hadron Experimental hall and Neutrino Experimental facility is going to be begun successively. J-PARC aims to become a worldwide research hub as world class multipurpose research facilities in the future.

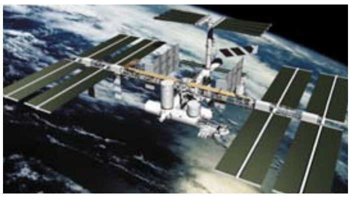
Various kinds of quantum beams-high-intensity, high-quality photons, synchrotron radiation, neutrons, electrons, ions, high power laser, etc. -are utilized, contributing to the progress in advanced academic sectors as well as various areas of science and technologies and industries.
Some highlights of quantum beam technology research are introduced.

Ion beams, electron beams and gamma-rays are extremely useful for advancing R&D of new functional materials and devices, environmental conservation, resource security, biology and medicine.

Advanced radiation research

● Materials development

On the basis of characteristics of radiation interactions with matter, new functional materials and devices, e.g., fuel cell membranes, hydrogen separation membranes and radiation resistant semiconductors, are developed for industrial application as well as contribution to advancements in space and energy engineering.



Radiation resistance of semiconductor devices used in artificial satellites is investigated using ion beams, as adapted for simulating the radiation environment of space. (NASA/JAXA photo)

● Environmental conservation

The decomposition/removal of organic pollutants in flue gas/wastewater by radiation induced radical reactions, the removal of toxic metal ions with grafting polymers and the crosslinking of biodegradable polymers are investigated.

Electron beam processing to treat polluted flue gas under real conditions (left) and biodegradable adsorbents for metal ions based on polysaccharide (right) are developed.

● Biological application

Research on investigating biological effects of radiation, creating gene resources and analyzing plant function by using quantum beams such as ion beams and gamma-rays.

Radioresistant bacterium from which a new DNA repair promoting protein was discovered (left top), chrysanthemum with reducing axillary buds that was created with carbon ion irradiation (left bottom), cultured mammalian cell that was sniped at with heavy ions (red dots) (right top), positron imaging of cadmium-107 introduced into rice plant (right bottom).

"Observe" with advanced laser or photoradiation what we could not previously see

Laser/ Synchrotron Radiation science research

● Advanced photon research

Researches on the development of a compact accelerator where high energy particles are generated with compact, ultra-short, high-intensity lasers, the surface structure dynamics of ferroelectric and high-temperature superconducting materials by using a fully coherent X-ray laser, are being pushed forward aimed at a wide variety of applications to the fields of medicine, materials and nuclear energy, etc.

A fully-coherent X-ray laser with a wavelength of 13.9 nm and some chambers for experiments such as the speckle measurement of material surface structure and non-linear spectroscopy.

● Synchrotron radiation science

Dynamic as well as static properties in atomic and electronic structures of various kinds of materials, such as strongly correlated electron systems, catalysts, metal hydrates and nuclear energy-related materials are investigated using Synchrotron Radiation X-rays at SPring-8 to develop new materials.

"SPring-8" is the largest 3rd generation synchrotron radiation facility in the world, providing the intense lights from infrared to X-ray. JAEA has four beamlines, three for hard X-ray diffraction and spectroscopies, one for soft X-ray spectroscopies. (Photo: SPring-8)

Photo shows a soft X-ray beamline of JAEA, where the spectroscopic research is carried out on live organisms, strongly correlated materials and actinides materials.

We are endeavor to develop innovative nuclear technologies through basic research areas.

Establishment of technical bases for creation of advanced and innovative nuclear systems

Nuclear Data and Reactor Engineering

Reactor Physics

An advanced reactor physics code system and an evaluation method of its prediction accuracy have been developed to establish the nuclear design method without large-scale mockup tests for design of advanced LWRs and innovative reactors.

Nuclear Data Evaluation and Measurements

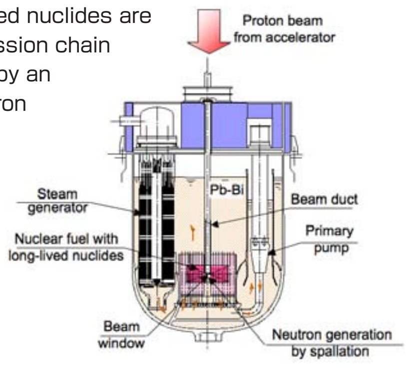
Japanese Evaluated Nuclear Data Library (JENDL) has been reinforced, especially for minor actinides (MA) and fission products (FP), to support research and development of advanced and innovative nuclear systems. Nuclear reaction mechanism and structure have been studied to get reliable and accurate nuclear data for MA and long life FP as well as development of new measurement instruments, facilities and analysis methods.

Thermal and Fluid Engineering

Detailed two-phase analysis codes with supercomputing technology have been developed to establish new thermal design method without large-scale thermal hydraulic tests. Advanced fluid, material and ultrafine particle measurement techniques which uses neutron, X-ray, laser and so on as the probe have been developed for the development of the nuclear energy system and industrial applications.

Nuclear Transmutation System

For effective reduction of long-lived nuclides in high-level radioactive wastes, research for the Accelerator-Driven System (ADS) has been in under way. In the ADS, the long-lived nuclides are transmuted by fission chain reactions driven by an accelerator neutron source. Transmutation technology is expected to decrease the long-standing radio toxicity and to increase the space efficiency of waste disposal.



Accelerator Driven System (ADS)

Formation of the basis of the advanced nuclear fuel cycle and the safety and reliability of nuclear power plants

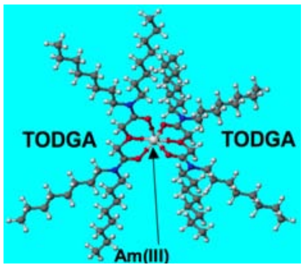
Fuels and Materials Engineering

Basic and fundamental research on advanced nuclear fuel and cycle technology

Research and development on fabrication technology and property measurements of minor actinides (MA)-bearing fuels and electrochemical behavior of MA in molten salt and liquid metal are made.


A research facility, TRU-HITEC in NUCEF, where grams of americium (Am) and ten-milligrams of curium (Cm) can be handled.

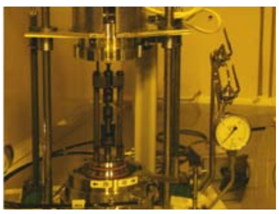
Research and development on new extractants for MA separation based on actinide solution chemistry and fundamental technology for advanced aqueous MA separation

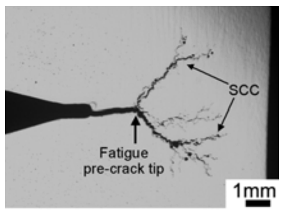


An excellent extractant, tetraoctyldiglycolamide, TODGA -Am(III) complex. Three oxygen atoms (red) in TODGA bond strongly to Am(III).

Basic and fundamental research on degradation of nuclear power plant materials caused by corrosion under irradiation

Research and development on irradiation effects of materials for nuclear reactors, corrosion damage mechanism of stress corrosion cracking of reactor structural materials, and corrosion mechanism of reprocessing plant materials are made.


Apparatus for corrosion test of irradiated materials in high temperature pressurized water under gamma ray irradiation installed in WASTEF.



MD (Molecular Dynamics) simulation of Cu atom cluster (red region) formation in bcc-Fe during neutron irradiation of reactor pressure vessel of light water reactors.

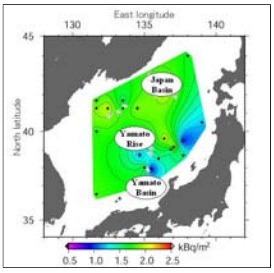
Basic areas of research consisting of nuclear data and reactor engineering research, fuels and materials engineering research, environment and radiation science research, advanced science research and advanced calculation science technology research are being conducted. From these researches new possibilities of nuclear energy are sought, while grappling with development of nuclear energy systems with reduced environmental burden, environmental restoration and various technical innovations.

To realize a safe and secure society through research in environmental sciences and radiation protection

Environment and Radiation Sciences

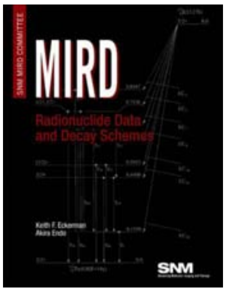
Research on behavior of radionuclides in atmospheric, oceanic and terrestrial environment and the technical development of analysis and monitoring of tracer-level radionuclides in the environment are being carried out. The development of recycle and detoxification technology for waste materials utilizing nuclear technology is also undertaken.
Furthermore, to establish sophisticated radiation protection based on scientific study, the basic mechanism of radiation effects on human body, dosimetry for neutron generated in high-energy accelerator facilities and methods of transport and shielding for various types of radiation are studied.

Distribution of Cs-137 deposition on the ground at the Chernobyl accident is well reproduced by numerical simulations with a large-sized computer.



Through oceanographic expeditions over a long period of time, distribution of Cs-137 in the water of the Japan Sea, which originated from global fallout due to atmospheric nuclear weapons testing, is clarified.

Fine particulates of uranium were detected, for ultra-trace analysis of nuclear fuel materials, through microscopic observation of the tracks of fission fragments produced by neutron irradiation.

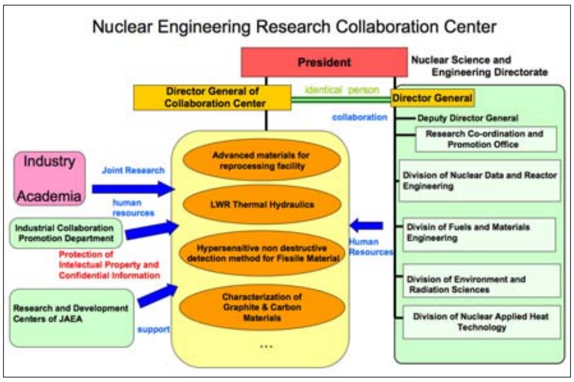


JAEA and ORNL have developed the 2nd Edition of "MIRD: Radionuclide Data and Decay Schemes" published by the Society of Nuclear Medicine. The database is used as standard data in nuclear medicine dosimetry.

Japanese adult male and female (right) voxel phantoms. The organs are realistically represented based on CT images. The phantoms are used for precise dose calculation.

Nuclear Engineering Research Collaboration Center

Establishment of the JAEA Nuclear Engineering Research Collaboration Center
— Promoting Collaborative Research with Industry —



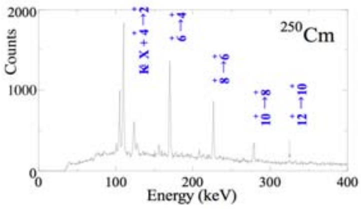
The Center for Nuclear Engineering Research Collaboration (CNERC) was established in January 2006 to promote cooperation with industries. The Center provides an organizational framework and makes JAEA's resources of scientific expertise, equipment and facilities available for joint research and development of innovative nuclear technology between public and private sectors. The framework organizes necessary technology working groups established with industry partners, whose researchers may work as members of JAEA. The Director General and the Deputy Director Generals of the Nuclear Science and Engineering Directorate serve concurrently in the respective managerial positions of the CNERC.
Presently, four technology working groups have been formed by researchers and experts of industries and JAEA. These groups have succeeded in cooperation with industry partners in developing original alloys for advanced reprocessing, advancing technologies of LWR thermal hydraulics, pioneering hypersensitive nondestructive analyses of U and Pu waste matrix interiors, and developing high strength carbon and graphite materials for high-temperature gas-cooled reactors.

Advanced Science Research

The advanced Science Research Center is aiming to be an international COE for the new frontier research of atomic energy sciences to discover new principles and phenomena, and to create new materials and methods in the following research fields.

● Physics of heavy nuclei

Studying shell structures, fusion mechanisms, and synthesis processes of superheavy nuclei using heavy-ion beams.



The world's first in-beam gamma-ray measurement for neutron-rich transuranium nucleus ^{250}Cm at the JAEA-Tokai TANDEM accelerator and other facilities.

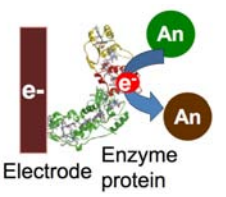
● Nuclear chemistry of superheavy elements

Studying ion-exchange behavior and other chemical properties of transactinide element ions in aqueous acid-solutions using rapid and repetitive liquid-chromatography with the apparatus of the AIDA.

The AIDA apparatus (the Automated Ion-exchange separation-apparatus coupled with the Detection system for Alpha-spectroscopy) for the study of liquid-chromatographic behavior of superheavy elements.

● Heavy elements biogeochemistry

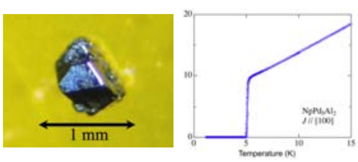
Studying the accumulation mechanism of actinide ions on the surface of biological cells in aqueous solutions using TEM, electrochemical methods, and UV-visible, ICP-MS, XAFS spectroscopy methods.



Electron transfer occurred on microbial cell surface through enzyme protein to reduce oxidation state of actinides.

● Magnetism and superconductivity in actinide compounds

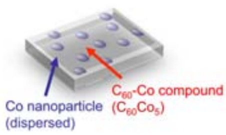
Studying magnetism and superconductivity of newly synthesized pure actinide compounds using μSR, NMR, and neutron-scattering spectroscopy methods as combined with a new theory of f-electrons in actinide compounds.

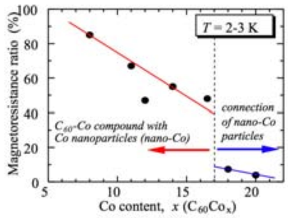


Discovery of the first Np-based heavy fermion super-conductor with large upper critical magnetic field(15T)

● Material design and experiments under extreme conditions

Studying the translation of constituent atoms in solids under applied huge G-force fields, the synthesis of a new C_{60}-Co compound film by crossed molecular beams and the new characteristic behavior of solid materials interacting with impinged accelerated ions.

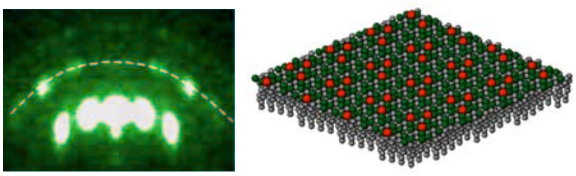




Finding of anomalously large tunnel magnetoresistance effect (~90%) unpredictable from existing theory

● Positron beam material science

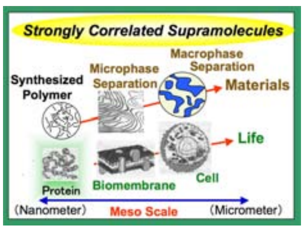
Studying atomic configurations of surface superstructures of solids using a newly developed total-reflection positron diffraction apparatus. Studying further the new developments of a positron microbeam and a positron spin-polarized beam.



Reflection high-energy positron diffraction pattern from a Si(111)-√21x√21-Ag surface (left) and its structure determined through the analysis (right).

● Strongly correlated supramolecules

Studying the mesoscale structures of intra- and inter-molecular correlations in polymer systems using ultra-small-angle neutron-scattering spectroscopy with the important objective to bridge between material science and life science.



Hierarchical structures of strongly correlated supramolecular systems found in soft materials and life.

● Basic radiation research

Studying the primary and fundamental processes in the interactions of ionizing radiation with matter, e.g., supercritical water/alcohols, and DNA using picosecond pulse-radiolysis and in situ ESR/QMS measurements with synchrotron radiation spectroscopy.

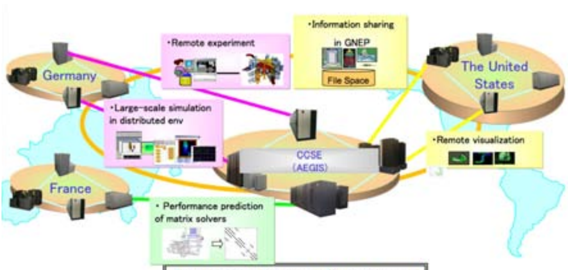
ESR measurements at a SPring-8 synchrotron radiation beamline to study DNA radicals.

Stairway to the integrated nuclear engineering with computer and computational science

Research for advanced computer science

● Cutting edge technology for IT infrastructure

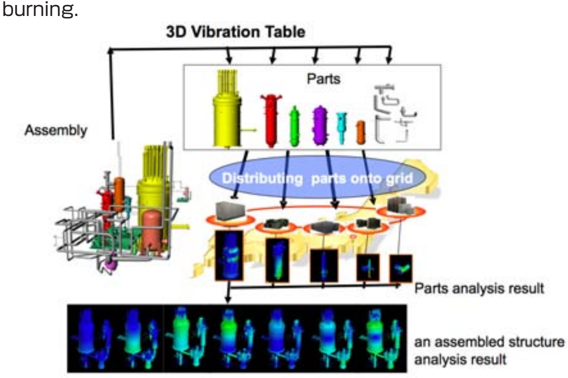
It becomes more and more important to introduce IT technology into both theoretical and experimental nuclear research.



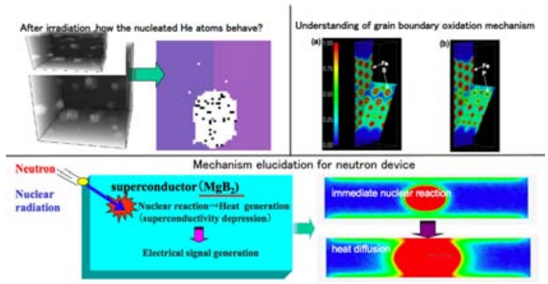
International grid computing enviroment

● Research for numerical simulation of complex phenomena

The computational simulations based on advanced theories predict how a nuclear plant vibrates on an earthquake and how a nuclear fuel changes with its burning.



Analyzing over 10million parts as an assembled structure



Simulation of complex phenomena regarding particle continuum system

+ Focus | The evolution of the Japan Material Testing Reactor, JMTR

The JAEA planned the JMTR as a testing reactor, which supports the basic technology of nuclear energy, and decided the refurbishment of the reactor facilities during the four years from FY 2007. Operation of the new JMTR will be started from FY 2011. At the same time, irradiation facilities corresponding to user needs, such as the Nuclear and Industrial Safety Agency, will be installed to contribute to the lifetime extension of LWRs by the user's fund. Additionally, the contribution to the development of the ITER and industrial use and other such issues are discussed in the JAEA. For the practical use of JMTR, the JAEA will promote the expansion of use and improvement of usability (e.g., improvement of the reactor-operation rate, shortening of the turnaround time, achievement of an attractive irradiation cost, establishment of a satisfied technical support system, retention of business confidence) taking account of the opinions obtained from external experts, such as the JMTR use examination committee, the Council for Science and Technology Policy and others, and also taking account of management considering the outside-user industry.

The renewed and upgraded JMTR will be operated for a period of about 20 years (by around FY 2030).

Research and development for safe geological disposal of high-level radioactive waste

To safely dispose of high-level radioactive waste

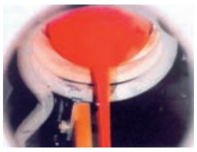
From treatment to disposal

After reprocessing of spent fuel, the resulting high-level radioactive liquid waste is mixed with glass fiber additive. The mixture is melted in a glass melter and solidified into vitrified waste with good physico and chemical stability. The vitrified waste is then placed into pits in a storage cell for 30 to 50 years to cool down. Vitrified waste, which contains long-lived radionuclides, must be safely isolated from the human environment for long periods of time. Several methods to accomplish this aim have been investigated, such as disposal into space, sub-sea beds, ice sheets or deep underground formations. The international scientific consensus at the moment favors "geological disposal" as the most practical and realistic option.

High-level radioactive liquid waste into stable form of glass

Development of vitrification technology

High-level radioactive liquid waste is melted together with glass fiber additive in a glass melter. Then, it is poured into a stainless steel vessel (canister), and eventually cooled and solidified to become vitrified waste. At the Tokai Reprocessing Plant, one canister (ca.110 liter) of vitrified waste is generated from the reprocessing of approximately 1 tU (metric ton of uranium) of spent fuel.



Glass melted in the glass melter is poured into a canister located at the bottom of the melter.

Vitrified waste produced at the Tokai Reprocessing Plant
Height : 104cm
Outer Diameter : 43cm
Weight : 400kg

Management steps of high-level radioactive waste

Reprocessing → High-level radioactive liquid waste → Vitrification → Vitrified waste → Storage → Geological disposal

+ Focus: Research on long-term stability of the geological environment

Since the Japanese archipelago is situated in a region where the tectonic movements of the earth's crust are active, earthquakes and volcanic activities frequently occur. For that reason, the following investigative research, is being conducted through the case research to establish predicting methods of how geological environment might change in the future and to clarify the characteristics and influence levels of changes in the earth's crust and volcanic activities in Japan.

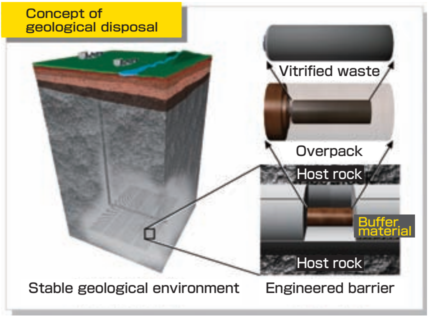
● Research on volcanic activity

We are consolidating scientific knowledge relevant to the effects of volcanic activity on the geological environment by investigating the characteristics of volcanic areas. Additionally, development of investigative methods for the relations between geothrermal structure and volcanic activity is being advanced.

● Methods for long-term prediction and impact assessment

We have conducted investigative research to develop methods for predicting and evaluating the future evolution of natural phenomena such as uplift and erosion. Additionally, we have developed databases and simulation models for long-term stability of the geological environment of the Japanese islands.

The research and development results for high-level radioactive waste disposal in deep underground will contribute to the safety regulations issued by the government and disposal operations conducted by Nuclear Waste Management Organization of Japan (NUMO). The concept of management of high-level radioactive waste and the contents of research and development are introduced.



Improvement on the reliability of disposal technologies and development of advanced safety assessment methods

R & D on geological disposal

JAEA is carrying out Engineering-scale tests and developing assessment models have been developed at the Engineering-scale Test and Research Facility (ENTRY). Additionally, at the Quantitative Assessment Radionuclides Migration Experimental Facility (QUALITY), using glove boxes that can simulate the deep underground environment (low-oxygen atmosphere), we conduct experiments to study migration behavior of radionuclides. Meanwhile, in Horonobe, we carry out R&D to verify engineering technology and safety assessment methods through testing and research in actual deep geological environments.

NETBLOCK
This apparatus is used to study hydrology in the fractured rock.

Atomospheric-controlled globe boxes in QUALITY
The globe boxes can simulate the chemical environment of the deep underground.

Two underground research laboratories are fully equipped to research deep underground environments from various aspects

Scientific research of the deep underground

It is necessary to understand underground environments to improve technical reliability of geological disposal. The geological conditions in Japan could be classified mainly into crystalline rock and sedimentary rock environment and characteristic differences, such as groundwater flow, may exist between two rock types. Consequently, to develop technologies and knowledge for both geological environments, we have promoted two URL projects: one at Mizunami, Gifu Prefecture in crystalline rock and the other at Horonobe, Hokkaido in sedimentary rock. Additionally, the two URLs also provide a place for the general public to experience/study the deep geological environment.

Mizunami Underground Research Laboratory for crystalline rock

Horonobe Underground Research Laboratory for sedimentary rock

Note:Detailed dimension and layout of URLs will be determined according to geological environment and construction condition.

Decommissioning of retired nuclear facilities and measures to cope with rational treatment and disposal of low level radioactive waste

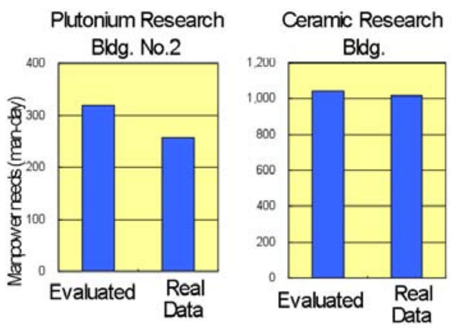
Optimizing dismantling activities and reducing the amount of radioactive waste

Decommissioning of Nuclear Facilities

● Development of technology for decommissioning

We are developing common and/or facility-specific technologies of decommissioning in order to implement rational decommissioning by reducing the amount of waste and cost on the premise of ensuring safety.
As to common technology development, two computer systems are being developed. One is the decommissioning engineering system, and the other is the clearance level verification/evaluation system.
Real data of decommissioning are input to the system and analyzed, project management data will be evaluated, and useful information on rational decommissioning planning and implementation will be produced.
As to facility-specific technology development, major subjects are underwater cutting for reactor core and tritium decontamination at Fugen, uranium decontamination and centrifuge dismantling at Ningyo-toge Environmental Engineering Center, and large-size tank dismantling and TRU decontamination at JAEA Reprocessing Test Facility of Nuclear Science Research Institute.

Evaluation of dismantling manpower needs until release of controlled area



In order to verify the decommissioning engineering system, manpower needs for dismantling small-scale research facilities were evaluated and the evaluated data were compared with real data.

Fugen appearance

The Fugen ceased to operate in 2003, and the decommissioning project was started in 2008.

Treatment of radioactive waste by taking its characteristics into consideration

Treatment of Waste

● Development of waste treatment technology

Processing of waste is a necessary approach to adjust appropriate waste form for its disposal. It includes stabilization, volume reduction, and encapsulation in treatments such as mineralization of organic material, compaction, and cementation, respectively.
We are developing treatment technology for low-level radioactive waste in order to minimize the cost of treatment and ensuring safety during disposal.

● Technology on reducing waste volume

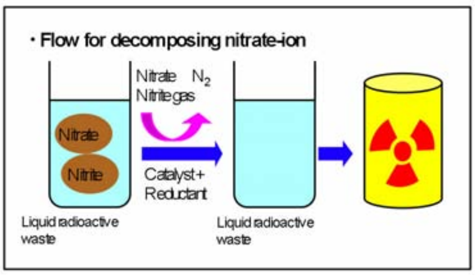
We are developing a technique to reduce volume and mineralize organic liquid waste by pyrolysis with high temperature steam.

● Technology for removing radioactive substances from wastes

We are developing a technique for the removal of uranium and plutonium from radioactive wastes by dissolving uranium and plutonium in supercritical carbon dioxide.

● Technology of denitration to reduce environmental burden of wastes

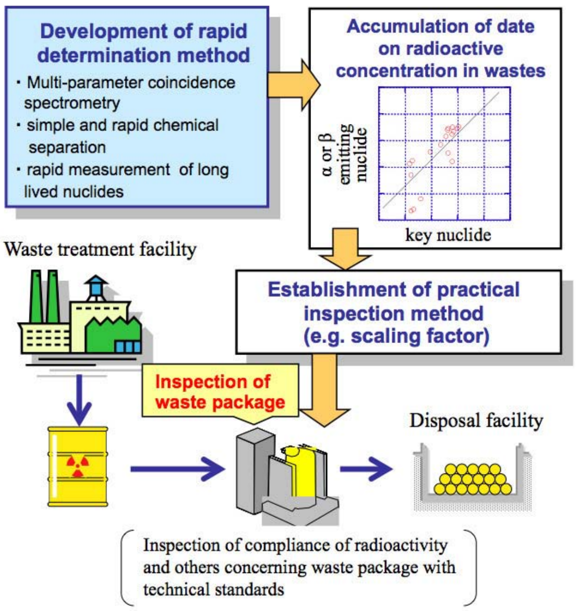
Low-level radioactive liquid waste generated from reprocessing facilities includes nitrates that affects the environment. We are developing a technique to decompose the liquid waste by using a catalyst and reduction method.



Development of simple and rapid analytical method

The inspection of the radioactive inventory of a waste package is required in order to efficiently evaluate the radioactive nuclide concentrations. For this purpose, we are developing a practical evaluation method such as the utilization of scaling factors. A scaling factor is defined as the ratio of radioactivity of α-ray or β-ray emitting nuclides to that of γ-ray emitting nuclides for which radiations can be easily measured directly. For establishing the practical method, a large number of measurements are necessary to accumulate date on the radioactive concentrations in wastes. Therefore, a method for simple and rapid analysis has been developed to analyze about 30 nuclides.

Flow for establishment of practical inspection method



Multi-parameter coincidence spectrometer

This spectrometer allows for the detection of very low concentration of nuclides in the presence of high concentrations of Co-60 by reducing background counts resulting from Compton scattering.

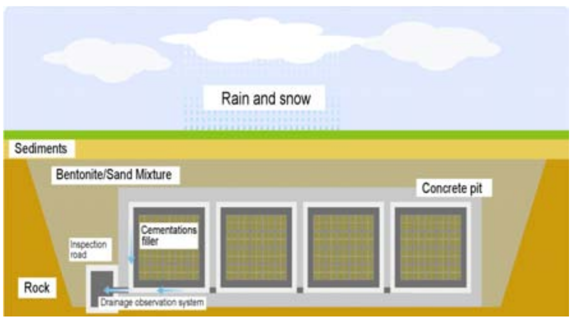
Disposal of radioactive waste generated from utilization of radioisotopes and in nuclear research and developmenta

Disposal of Waste

Promoting of waste disposal business

JAEA is promoting the project on near-surface disposal of low-level radioactive wastes that are generated from nuclear research and development and from the use of radioisotopes in medicine, education, research, agriculture, and industry.
The numbers of waste forms for near-surface disposal are estimated to be about 530,000 drums of 200 liters by MEXT's research in March, 2008. These figures also include about 100,000 drums from waste generators other than JAEA.
It is planned to design and build the facility in eight years after site selection in this project. It includes site acquisition and site investigation, fundamental design of the disposal facilities, safety assessment, design of the facility, license application of the project, equipment work, etc. The disposal facility is going to be operated for 50 years.
Depending on the radioactive levels of the wastes, two methods of disposal are under consideration: near-surface disposal with engineered barriers for low-level wastes and near-surface disposal without engineered barriers for very-low-level wastes.
After the waste disposal is completed, the disposal facility is closed. The areas are managed to ensure safety until the radiation levels return to safe levels by decay with time.

Image of Near-surface disposal with Engineered barriers



Prevention from accidents/incidents, rigorous safety activities and preparedness with technological support systems to respond appropriately and promptly to emergencies are prepared.

Safety Assurance/Risk Management/ Preventive System against Disaster

Safety each facility

For rigorous safety assurance, safety activities are conducted at each facility, for example, safety checks by risk assessment suited to the situation of each working place. In order to be more effective emergency preparedness and response in case of nuclear accidents and incidents, safety activities are constructed based on learning from past ones. Safety of the people surrounding areas of nuclear facilities is ensured by environmental radiation monitoring, and safety of employee is administrated by radiation control in the facilities.

Monitoring car

Monitoring boat "Seikai"

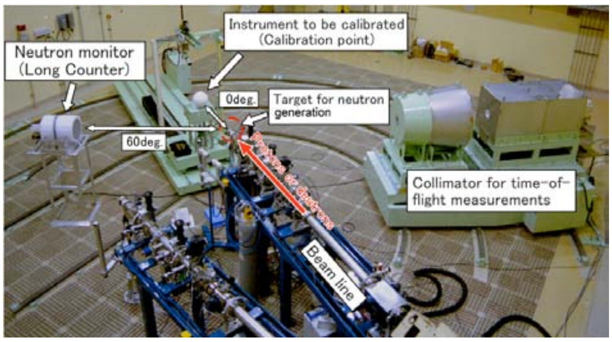
Monitoring station

Basis for Safe Handling of Radiation Sources

Radiation Control

● Radiation measurement and detector calibration

Reliable radiation measurement technology is essential to develop for an atomic energy and isotope utilization. The appropriate calibration technology is developed for radiation detectors to correctly measure radiation.



Detector is irradiated by neutron, generated by van-de-Graff accelerator to check a Sensitivity and characteristics.

Establishing "Quality Policy" with the aim to achieve High Qualities for Research and Development

Promotion of Quality Assurance Activities

Nuclear development is based on the presupposision of public and environmental safety as well as securing social trust. Additionally, in the aim to secure safety and reliability of nuclear facilities, requirement is decided and audit team included the third party expert. Furthermore, obtaining/maintaining activities for certification of international standards (ISO9001, ISO14001 and OHSAS18001) is encouraged.

Training/study during normal times to substantiate nuclear disaster prevention through technical support

Technical support for nuclear disaster

We will participate in countermeasures against national emergencies that might occur in domestic nuclear energy facilities or accidents during transportation of nuclear fuel materials. As a designated public agency under the Basic Law on Disaster Countermeasures, we are to play a role in technological assistance in countermeasures of government, local communities, police, firefighters, nuclear operators and others involved in emergencies. "Nuclear Emergency Assistance and Training Center" at Hitachinaka City, Ibaraki Prefecture and its branch in Tsuruga city, Fukui Prefecture were set up as the core centers for specialists to give assistance.

Nuclear Emergency Assistance and Training Center

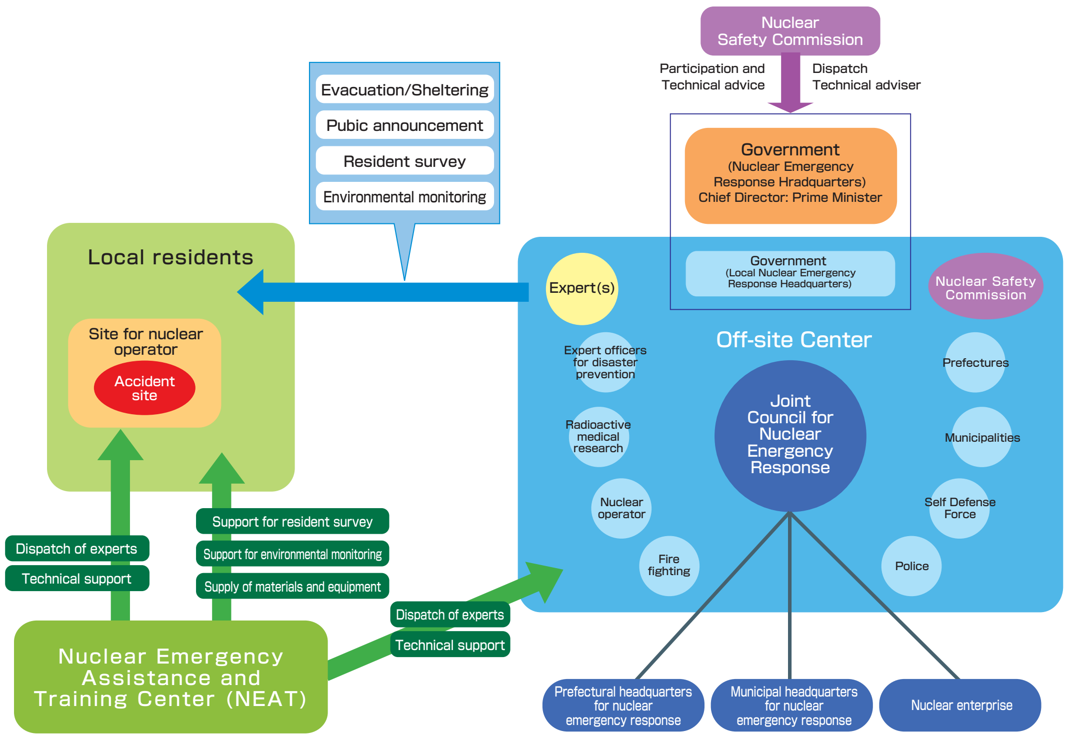
Special vehicles

Training for survey for residents

Lecture for personnel involved in disaster prevention

Fukui Branch

Nuclear disaster prevention system



Nuclear energy for peaceful purpose, contribution to international society by nuclear nonproliferation regime and support activities for nuclear energy

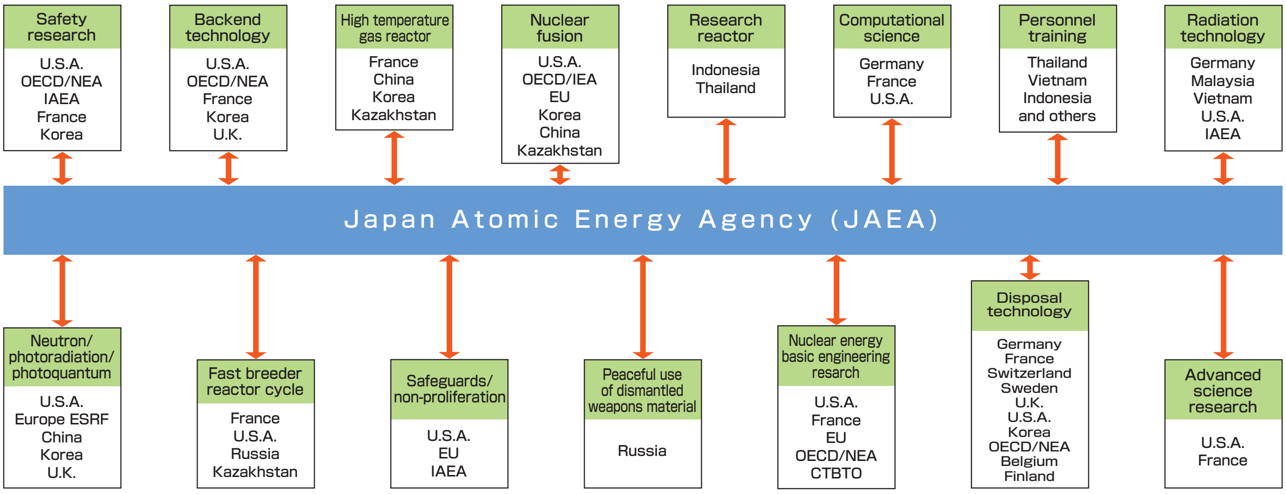
Various research and development for peaceful use of nuclear power and cooperation with international organizations

Promotion of international cooperation

International cooperation with nuclear energy institutions overseas is indispensable to promote our research and development activities effectively.
We are engaged in planning and management of international cooperation with foreign organizations on nuclear energy research and development. We arrange cooperation agreements and negotiate with foreign organizations.
Another important role is to promote support for the regional research and development activities including active exchange of researchers and training of personnel, especially for Asian, so that we can promote safe and peaceful utilization of nuclear energy technology.

Annual meeting with the French Atomic Energy Commission (CEA)

Concept of international cooperation



Contribution to the international nuclear nonproliferation regime

International society is continuing efforts to maintain the nuclear nonproliferation regime based on the NPT to avoid further proliferation.
While performing research and development to realize the nuclear fuel cycle, JAEA is developing the technologies to prevent the misuse of nuclear material for a nuclear weapon.
The results of this development will help the State's authority and IAEA (International Atomic Energy Agency) to perform their inspections of nuclear facilities efficiently and effectively. For example, development of accurate techniques to quantify nuclear material amounts by measuring the radiation from nuclear material to replace the complicated chemical analysis process and development of remote information transfer techniques for surveillance cameras or measuring devices to help the inspectors acquire necessary information without going to the facility.

JAEA studies and analyzes various nonproliferation movements based on its own technical knowledge and proposes nonproliferation policies to the Japanese government and the international society.
JAEA supports the CTBT (Comprehensive Test Ban Treaty) regime by operating a nuclear test monitoring stations in Japan and performing related R&D activities.
Besides these activities, JAEA maintains strict control of its own nuclear material to prevent theft or illegal use of those materials and developing human resources for nonproliferation issues through cooperation with Universities.

JAEA cooperates with the State's authority and IAEA at a Safeguards inspection.

JAEA proceeds R&D activities for social needs with industries, universities and governmental organizations and promotes use of research results to return to society.

JAEA actively collaborates with private sectors for implementing various technology transfers based on the intellectual properties of R&D results.

R&D on Technology transfer

Based on the intellectual properties of R&D results, GRAVI-MASS and BREATH-MASS as shown below were successfully commercialized. The GRAVI-MASS is very useful for improving the quality of automobile parts, where the control of gas gravity in such as aluminum castings within some levels brings positive impacts on their qualities and more than 1,000 requests for the measurement were commercially responded. The BREATH-MASS is attempted for applying health checks through the breath analysis, and is actively utilized for characterizing alcohol aromas in brewing industries and for controlling freshness of various foods by the foul odor analysis.

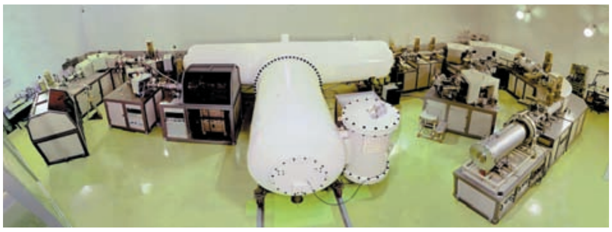
GRAVI-MASS
(Metal inclusion gas gravity measurement system)

BREATH-MASS
(Breath analysis system)

Various facilities open to public users for R&D and industrial usage.

JAEA facilities open to public

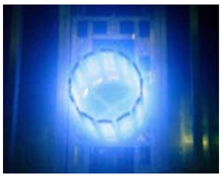
Facilities are applicable to various fields, neutron beam, ion beam, electron and gamma ray usage for R&D or industrial activities. MUTSU FURTHER development can be expected.
JAEA recruits research program for facility utilization.



Accelerator Mass Spectrometry

AVF cyclotron

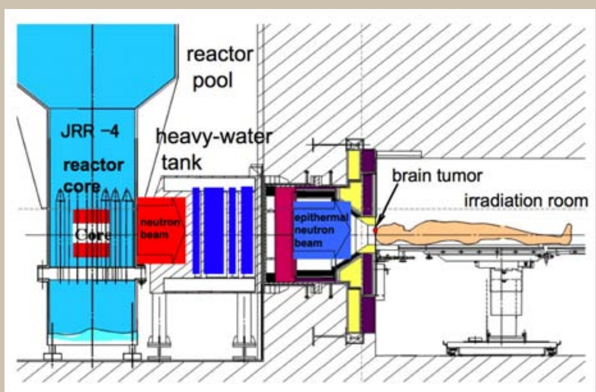
2 MeV electron accelerator



^{60}Co gamma-ray sources

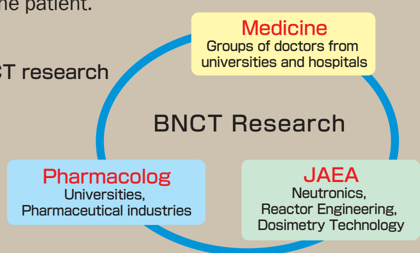
+ Focus

Contribution to the clinical study on boron neutron capture therapy(BNCT)



Clinical study on boron neutron capture therapy (BNCT) expected as an advanced treatment for malignant brain tumors, skin cancer etc., is carried out by medical organizations using neutrons from the research reactor JRR-4 in the JAEA-Tokai site. Cancer cells are selectively destroyed by particle radiations from boron atoms as a result of capturing neutrons. A medicine including boron, which tends to be selectively caught by cancer cells, is previously administered to the patient.

Sharing on BNCT research



We consider it important to gain the understanding and trust of the general public for promoting research and development.

Transmit business contents in simple and comprehensible methods

Public relations activities

To gain understanding and cooperation for nuclear energy, we are actively communicating with many people, including the local society. In addition to timely transmission of research and development topics through publications and Internet pages, we are aiming at communication of information through meetings to report research/development results. We are also making efforts in educating young people who will be responsible for the next generation and conducting activities aiming for promotion of understanding towards nuclear energy and scientific technology. In addition, we promote activity for "Out Reach" such as bidirectional communication through researchers and engineers.

Science cafe in Ricotti

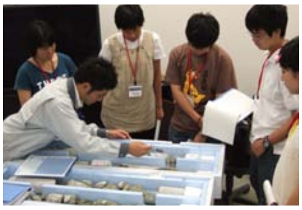
● Activities in exhibition halls

Exhibition halls are installed at research/development bases to organize a variety of activities, including exchanges with local community and science experiment classes for schoolchildren who will carry the burden of the next generation. In the exhibition rooms, various events are held such as memorial events of "Science Technology Week" in spring, "Day of Atomic Energy" in autumn, while science experiment classes are opened during vacation in spring, summer and winter.

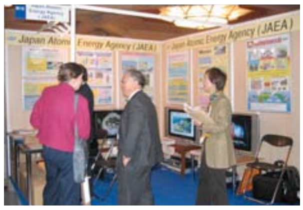
Atom World (Tokaimura, Ibaraki Prefecture) Scene from a handicraft class

● Activities of exhibitions and instructive experience classes

With the aim the expanding understanding towards promotion of scientific technology and nuclear energy, we participate in various exhibits. We also participate in science camp for high school students every year to expand student understanding of nuclear energy and radioactivity. In addition, we participate in exhibits in other countries.



Science camp



Activity of exhibitions in other countries

Participation in local activities as a member of the local society

Participation in local activities

We are aiming for public understanding of our work and to become familiar and trusted by the local community. We participate with enthusiasm in various festivals, events, and volunteer activities as a community member. We are also organizing a variety of public acceptance activities with the aim of deepening understanding and increasing the public interest in nuclear energy.

Participating in beach clean-up

Scene from 'class on delivery'

We promote information disclosure and dissemination of our R & D results to the public and contribute human resources development in the field of nuclear energy.

Active disclosure of various information

Information disclosure

We are actively disclosing information based on "Law Concerning Access to Information Held by Incorporated Administrative Agencies, Etc." (enforced on October 1, 2002). Results of research and development are disclosed in the information room and materials are free for perusal. Information is also transmitted internally and externally through the Internet.

Techno Community Square Ricotti (Tokaimura, Ibaraki Prefecture)

Collecting nuclear energy information and disseminating the JAEA research and development results

The research and development results of JAEA are published as seven kinds of technical and reseach reports, such as JAEA-Research, as well as over 1,000 articles contributed annually to worldwide scientific academic journals. The Library of JAEA is one of the largest specialized libraries in Japan. It holds collections, such as 150,000 technical books, 2,000 titles of journals, over 2.8 million technical reports, and other materials and provides photocopy service to users inside and outside JAEA. In addition, since 1970 JAEA has participated in IAEA / International Nuclear Information System (INIS) as the national center for Japan. "JAEA Abstracts" containing research results abstracts is updated monthly and "JAEA R&D Review" is updated annually. The full-texts of JAEA research and technical reports are also available though the Library Web Site.

JAEA Library web site

Training courses for human resources development of engineers

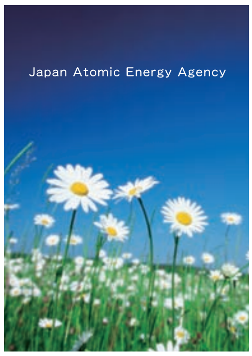
Human resources development

NuTEC has been conducting human resources development (HRD) in the field of nuclear/radiation engineering and safety. Training courses are designed so as to satisfy the needs in industrial, regulatory and local governmental sectors and institutions. Training courses for the preparation of licenses (radiation protection supervisor, reactor engineer and nuclear fuel engineer) and qualifications are included. HRD activities in cooperation with Nuclear Professional School of The University of Tokyo and with some universities under the cooperative Graduate School Program have been conducted to support nuclear engineering education for student. International training programs to strengthen the training system for nuclear/radiation engineers in Asian countries have also been conducted.

Scene from the training course

About the cover page:

The floral language of daisies is "sincerity." We have entrusted our sincere intentions to make our best efforts by spreading deep roots like the daisies blooming in the fields.



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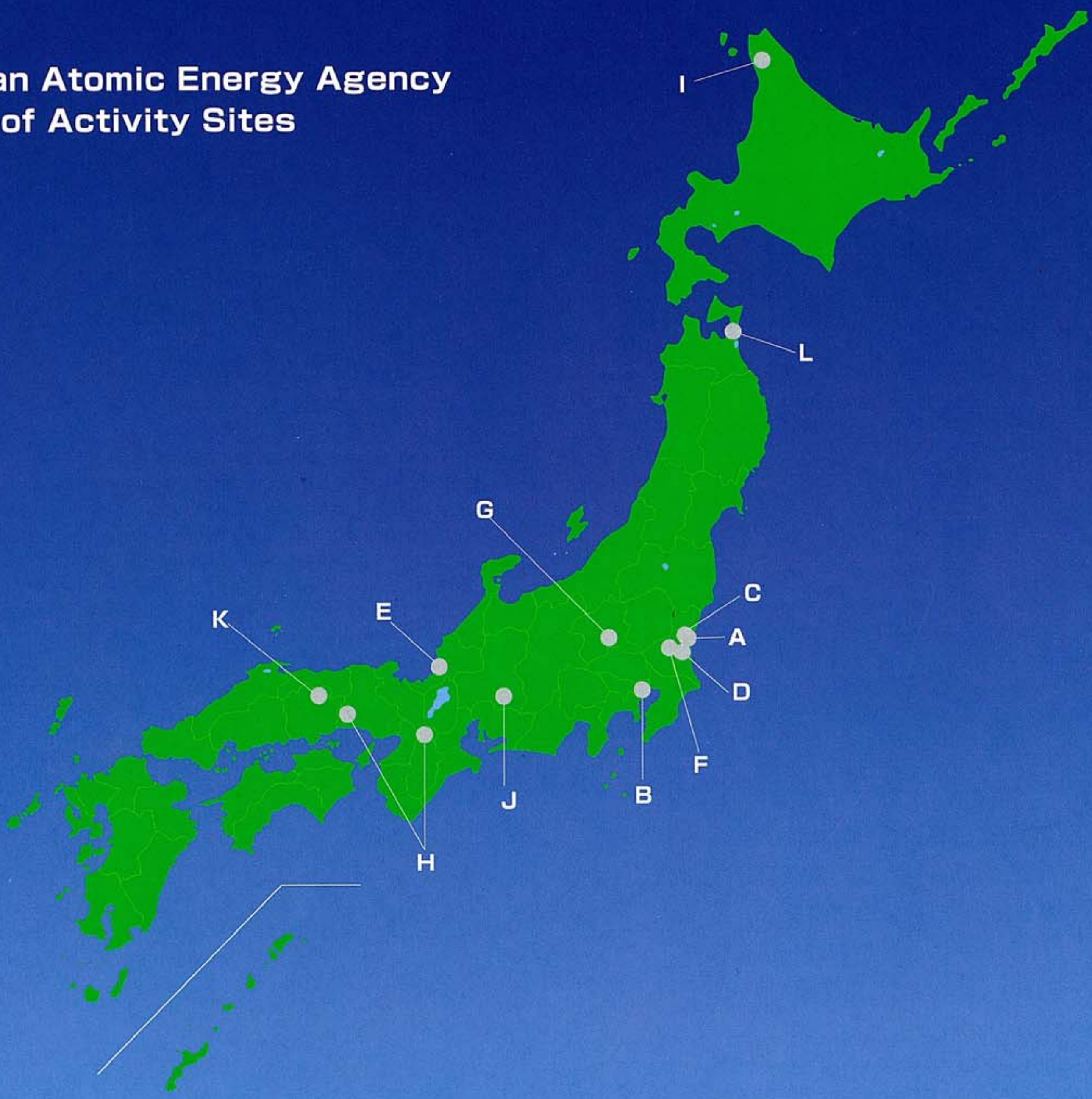
Japan Atomic Energy Agency
List of Activity Sites



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TEL : 029-282-1122

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11601-13 Nishi-jyusanbugyo Hitachinaka-shi, Ibaraki 311-1206, Japan
TEL: 029-265-5111

B Tokyo District

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2-2-2 Uchisaiwai-cho, Chiyoda-ku, Tokyo 100-8577, Japan
TEL : 03-3592-2111

Center for Computational Science & e-Systems
5-1-5 Kashiwanoha, Kashiwa-shi, Chiba 277-8587, Japan
TEL : 04-7135-2350

C Tokai Research and Development Center
2-4 Shirakata-shirane, Tokai-mura, Naka-gun, Ibaraki 319-1195, Japan
TEL : 029-282-5100

Nuclear Science Research Institute
2-4 Shirakata-shirane, Tokai-mura, Naka-gun, Ibaraki 319-1195, Japan
TEL : 029-282-5100

Nuclear Fuel Cycle Engineering Laboratories
4-33 Muramatsu, Tokai-mura, Naka-gun, Ibaraki 319-1194, Japan
TEL : 029-282-1111

J-PARC Center
2-4 Shirakata-shirane, Tokai-mura, Naka-gun, Ibaraki 319-1194, Japan
TEL: 029-282-5100

D Oarai Research and Development Center
4002 Narita-cho, Oarai-machi, Higashi-ibaraki-gun, Ibaraki 311-1393, Japan
TEL : 029-267-4141

E Tsuruga District

Tsuruga Head Office
65-20 Kizaki, Tsuruga-shi, Fukui 914-8585, Japan
TEL : 0770-23-3021

Fast Breeder Reactor Research and Development Center
2-1 Shiraki, Tsuruga-shi, Fukui 919-1279, Japan
TEL : 0770-39-1031

Fugen Decommissioning Engineering Center
3 Myojin-cho, Tsuruga-shi, Fukui 914-8510, Japan
TEL : 0770-26-1221

F Naka Fusion Institute
801-1 Mukoyama, Naka-shi, Ibaraki 311-0193, Japan
TEL : 029-270-7213

G Takasaki Advanced Radiation Research Institute
1233 Watanuki-machi, Takasaki-shi, Gunma 370-1292, Japan
TEL : 027-346-9232

H Kansai Photon Science Institute

Kizu
8-1-7, Umemidai, Kizugawa-shi, Kyoto 619-0215, Japan
TEL : 0774-71-3000

Harima
1-1-1 Kouto, Sayo-cho, Sayo-gun, Hyogo 679-5148, Japan
TEL : 0791-58-0822

I Horonobe Underground Research Center
432-2 Hokushin, Horonobe-cho, Teshio-gun, Hokkaido 098-3224, Japan
TEL : 01632-5-2022

J Tono Geoscience Center
959-31 Jorinji, Izumi-cho, Toki-shi, Gifu 509-5102, Japan
TEL : 0572-53-0211

Mizunami Underground Research Laboratory
1-64 Yamanouchi, Akiyo-cho, Mizunami-shi, Gifu, 509-6132, Japan
TEL: 0572-66-2244

K Ningyo-toge Environmental Engineering Center
1550 Kamisaibara, Kagamino-cho, Okayama 708-0698, Japan
TEL : 0868-44-2211

L Aomori Research and Development Center
2-166 Oaza-Obuchi-Omotedate, Rokkasho-mura, Kamikita-gun, Aomori 039-3212, Japan
TEL : 0175-71-6500

History of Japan Atomic Energy Agency (JAEA)

'55/12 Established The Atomic Energy Basic Law providing that the research/development/utilization of atomic energy in Japan will be restricted to peaceful purposes, and will be promoted under the basic rule of democracy, autonomy and open to the public. (Based on this law, Japan Atomic Energy Research Institute and Atomic Fuel Corporation were established.)

Japan Atomic Energy Research Institute (JAERI)

'56/06 Inauguration of Japan Atomic Energy Research Institute
'57/08 Japan's first nuclear reactor, JRR-1 reaches criticality
'60/10 JRR-2 reaches criticality
'62/09 Japan's first domestically made nuclear reactor, JRR-3 reaches criticality
'63/10 JPDR, Japan's first nuclear generation of electricity
'65/01 JRR-4 reaches criticality
'68/03 JMTR reaches criticality
'68/05 Succeeds in our country's first separation/extraction of high purity plutonium
'70/02 FCA reaches first criticality with plutonium fuel
'73/03 World's longest confinement confirmed at JFT-2 (tokamak model)
'75/06 NSRR reaches criticality
'75/07 FCA reaches first criticality at simulation reactor core for "MONJU"
'77/03 Succeeds in world's first photographing of the atomic configuration of silicon crystal
'78/04 JT-60 starts production
'80/01 Atomic Research Team achieved the world's highest plasma electric current 1MA with U.S. Tablet Ⅲ device
'82/08 Atomic Research Team achieved the world's highest plasma β value 4.6% with U.S. Tablet Ⅲ device
'85/03 Integration of Japan Atomic Energy Ship Research and Development Institute
'86/12 Japan's first atomic reactor dismantling test starts at JPDR
'87/09 JT-60 reaches target area of critical plasma condition
'90/07 Nuclear ship "MUTSU" begins our country's first nuclear power voyage
'92/07 ITER Engineering Design Activity begins
'94/01 Completion of TIARA / Start of facility utilization for R&D
'94/07 World's highest confinement capacity achieved at JT-60
'96/03 Actual dismantling test completed at JPDR
'96/07 World's highest ion temperature (0.52 billion degrees) achieved at JT-60
'97/03 First beam of photo-radiation generated at SPring-8
'98/11 HTTR reaches criticality
'02/03 Completion of earth simulator, world's fastest super computer
'02/06 Construction begins at extreme-strength proton accelerator facility
'04/04 World's first success in extracting gas at the high temperature of HTTR950°C

Japan Nuclear Cycle Development Institute (JNC)

'56/08 Inauguration of Atomic Fuel Corporation
'58/05 Uranium mineral (Ningyoseki) found at Ningyo-toge
'59/01 Operation starts at Uranium refinement test plant
'65/11 Completion of Plutonium Fuel First Development Chamber
'67/10 Inauguration of Power Reactor/Nuclear Fuel Development Institute
'69/05 Succeeds in uranium concentration test by centrifugal process
'69/12 Heavy water criticality test device achieves criticality
'70/01 Construction of reprocessing facility approved
'70/02 Establishment of fast test reactor "JOYO" approved
'72/05 Construction starts on main building of new model converter prototype reactor "FUGEN"
'77/04 Fast test reactor "JOYO" reaches first criticality
'77/11 First plutonium extraction at recycling facility
'78/07 "FUGEN" begins power transmission
'79/12 Success in recovering concentrated uranium at Uranium Concentration Pilot Plant
'83/05 Establishment of fast prototype reactor "MONJU" permitted
'84/09 Completed cycle of fast reactor fuel cycle (Plutonium recovered from "JOYO" MOX fuel is recycled into "JOYO".)
'88/06 Completed cycle of new converted reactor fuel cycle (Plutonium recovered from "FUGEN" MOX fuel is recycled.)
'89/05 Start of full-scale operation of concentrated uranium prototype
'91/02 Overseas uranium prospecting Midwest deposit rights and interests transferred to private enterprise
'94/04 "MONJU" reaches first criticality
'95/12 "MONJU" sodium leak disaster occurs
'97/03 Fire/explosion disaster occurs at asphalt solidifying processing facility of reprocessing facility
'98/10 Inauguration of Japan Nuclear Cycle Development Institute
'00/11 Operation resumed at reprocessing facility
'02/07 Construction of Mizunami Underground Research Center starts
'03/07 Construction of Horonobe Underground Research Center starts
'04/04 U.S. Atomic Power Society Landmark Award Ceremony held at "FUGEN"
'04/06 Achieved accumulated processed quantity of 1,000 tons at reprocessing facility
'05/09 Renovation of "MONJU" starts

'05/10 Inauguration of Japan Atomic Energy Agency
'07/10 Designation as the domestic agency of ITER project
'08/12 J-PARC becomes in service partially
'10/05 "MONJU" restarts

Japan Atomic Energy Agency — Outline of Organization —

President
Executive Vice President
Executive Director

Auditor

Management Sector

- Policy Planning and Administration Department
- General Affairs Department
- Auditor Office
- Legal Office
- Personnel Department
- Labor Relations Department
- Financial Affairs Department
- Contract Department

Research and Development Directorates

- Nuclear Safety Research Center
- Advanced Science Research Center
- Nuclear Science and Engineering Directorate
- Quantum Beam Science Directorate
- Fusion Research and Development Directorate
- Advanced Nuclear System Research and Development Directorate
- Nuclear Fuel Cycle Technology Development Directorate
- Geological Isolation Research and Development Directorate
- Nuclear Cycle Backend Directorate

Research and Development Institutes/Centers

- Tsuruga Head Office
  - Fast Breeder Reactor Research and Development Center
  - Fugen Decommissioning Engineering Center
- Tokai Research and Development Center
  - Nuclear Science Research Institute
  - Nuclear Fuel Cycle Engineering Laboratories
- J-PARC Center
- Oarai Research and Development Center
- Naka Fusion Institute
- Takasaki Advanced Radiation Research Institute
- Kansai Photon Science Institute
- Horonobe Underground Research Center
- Tono Geoscience Center
- Ningyo-toge Environmental Engineering Center
- Aomori Research and Development Center

Project Promotion Sector

- Headquarters of Fukushima Partnership Operations
- Safety Administration Department
- Public Relations Department
- Industrial Collaboration Promotion Department
- International Affairs Department
- Construction Department
- Intellectual Resources Department
- Department of Science and Technology for Nuclear Material Management
- Center for Computational Science & e-Systems
- Nuclear Human Resource Development Center
- Nuclear Emergency Assistance and Training Center
- Low-level Radioactive Wastes Disposal Project Center
- Integrated Support Center for Nuclear Nonproliferation and Nuclear Security

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