Annual Report Japan Atomic Energy Agency 2019

Annual Report

Japan Atomic Energy Agency

2019

Aiming for Energy That Leads to the Future

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Japan Atomic Energy Agency

Japan Atomic Energy Agency

Editorial Policy

We have prepared the Japan Atomic Energy Agency Annual Report 2019 based on the following editorial policies as a means for comprehensively reporting on the activities of the Japan Atomic Energy Agency (JAEA). This publication reports on the details of our operations and the state of our R&D for fiscal 2018 (April 2018 - March 2019), and also explains the outlook for fiscal 2019 and beyond as necessary.

- Up to now, JAEA has undertaken a variety of activities with a strong awareness of fulfilling our corporate social responsibility (CSR) and has undertaken various initiatives, including the publishing of environmental reports and social activities. This time, in order to enhance information disclosure, this report is based on the GRI (Global Reporting Initiative) Standard, which is used as a global disclosure guideline for CSR reports/ sustainability reports by enterprises, governmental institutions and others.
- The mission of JAEA is to "Contribute to the welfare and prosperity of human society through nuclear science and technology." We consider our most important watchwords for implementation to be "Safety," "Compliance" and "Action." This report consists of these three important issues.
- Particularly important research and development undertaken in fiscal 2018 are introduced as "Topics."
- Our annual reports in the past contained a large amount of text and conveyed a rigid image. This year, we have taken a creative overall approach by including numerous photos, diagrams and illustrations to produce an "easy-to-view, easy-to-read" report for our readers.

Through this report, we seek to promote an understanding among readers of JAEA's activities and R&D, and to foster mutual understanding and trust.

● Scope of Report

All sites

● Reporting period

The reporting period is basically fiscal 2018 (April 2018 - March 2019).

(Part of the report includes information after this period.)

● Reference Guidelines, etc.

◎ ISO 26000: 2010 Guidelines Concerning CSR

◎ Environmental Reporting Guidelines 2018 Version (Ministry of the Environment)

◎ GRI Standards

● Notation Method

Fractions are rounded to the second decimal, in principle.

● Next scheduled issue is December 2020

CONTENTS

Profile of JAEA

JAEA at a Glance

R&D Achievements

Number of JAEA R&D Reports Published	101
Number of Papers Published	Peer-Reviewed 859 Others 309
Oral Presentations	1,649
New Patents (Domestic Only)	20
Awards from Various Academic Associations	78
Awards from Various Foundations	1
Number of Joint Research Projects	245
Number of Entrusted Research Contracts	128
External Research Funds (Entrusted research, etc.)	15,072 million yen
Number of Facility Time-sharing Contracts	131

Performance Information

Cooperation Agreement with Other Organizations	International 111 (including Joint Research Projects) Domestic 40
International Training Courses	82 participants from 11 countries (Nuclear Human Resource Department Center)
Public Hearings and Public Relations Activities	Outreach Activities 673 A total of approx. 44,000 participants Open Campus/ Accepting Individual Visitors 1,260 A total of approx. 26,000 participants
Number of Researchers Utilizing Cross-Appointment Framework	14

1

The Reconstruction of Fukushima

JAEA is committed to the research and development on visualization of radiation source and environmental dynamics of radioactive materials towards the decommissioning and environmental regeneration/restoration of Fukushima.

2

Reinforcement of Measures against Nuclear Disasters

As a designated public organization under the Basic Act on Disaster Management and Armed Attack and Existential Crisis Situations Act, JAEA is dedicated to the reinforcement of measures against nuclear disasters by conducting training for employees of related administrative organizations and local public organizations.

For example,

JAEA's contributions can be observed in:

3 103

Driving Basic Scientific Research

For the first time in the world, JAEA succeeded in the measurement of the first ionization potential of lawrencium, element 103, which was featured on the cover of Nature, the foremost science journal in the world.

https://www.jaea.go.jp/02/press2015/p15040901/ (in Japanese)

4

Contributing to Automatic Analysis

JAEA is evolving analytical technology using robots to efficiently and safely analyze *radioactive strontium* and other radioactive substances that are difficult to analyze.

Message from the President

Contribute to the welfare and prosperity of human society through nuclear science and technology

The Japan Atomic Energy Agency (JAEA) is Japan's sole comprehensive research and development institute in the field of nuclear energy. It was formed in October 2005 through the integration of the Japan Atomic Energy Research Institute (JAERI) and the Japan Nuclear Cycle Development Institute (JNC).

In accordance with the Medium- and Long-Term Management Plan of JAEA Facilities, we will focus especially on the fields listed below.

- Responding to the accident at the Fukushima Daiichi Nuclear Power Station of Tokyo Electric Power Company Holdings, Inc. (TEPCO)
- Research for improvement of nuclear safety standards
- R&D on the nuclear fuel cycle
- R&D on radioactive waste treatment/disposal technology

"Safety" is the top priority for a nuclear institute. Reflecting on our past accidents and troubles, especially on a contamination incident occurred in a radiation-controlled area of the Plutonium Fuel Fabrication Facility in the Nuclear Fuel Cycle Engineering Institute in January 2019, we are working hard to prevent a recurrence throughout the whole of JAEA. In addition, we will foster a safety culture and promote activities to improve on-site capabilities. We will also promote risk management.

"Compliance" is indispensable for an organization to be trusted by the general public as a member of society. Based most heavily on our management principles and code of conduct, we will strictly observe not only the regulations but also the internal roles and guarantees expected by society. We are also committed to showing greater care for the environment in our activities.

Under the keyword "Action," we will steadily proceed with back-end countermeasures and facility decommissioning based on the back-end roadmap and the Medium- and Long-Term Management Plan of JAEA Facilities. In addition, we will work to prepare for restarting the operation of test reactors, and strive to create world-leading results in research and development. In parallel, our work to formulate a strategic plan called "JAEA 2050 +," which outlines a future vision of JAEA towards 2050, has been settled. We intend to put various initiatives into practice in pursuit of our ideal form for JAEA.

Nuclear energy R&D cannot advance without the understanding of all Japanese citizens. With this in mind, we are striving to disseminate information through measures such as enhancing our website, proactively utilizing social media and issuing public relations literature. We issue the 2019 Annual Report, which summarizes our activities in the fiscal year 2018, in the hope that it will help readers to deepen and achieve a better understanding of our activities.

We ask for and appreciate your ongoing support for and understanding of our activities.

November 2019

児玉 敏雄

KODAMA Toshio
President, the Japan Atomic Energy Agency

Management Principles

- **Thoroughly ensure safety**
- **Focus on on-site activities**
- **Trust of society**
- **R&D filled with creativity**
- **Efficient work management**

History and Purpose

History and Purpose

The Japan Atomic Energy Research Institute (JAERI), one of JAEA's predecessors, was launched in 1956 and integrated with the Japan Nuclear Ship Research and Development Agency in 1985. Meanwhile, the Japan Nuclear Cycle Development Institute (JNC), another JAEA predecessor, was launched as Atomic Fuel Corporation in 1956 and reorganized into Power Reactor and Nuclear Fuel Development Corporation (PNC) in 1967. After the reform of PNC in 1998, it became the Japan Nuclear Cycle Development Institute (JNC).

Japan Atomic Energy Research Institute launched

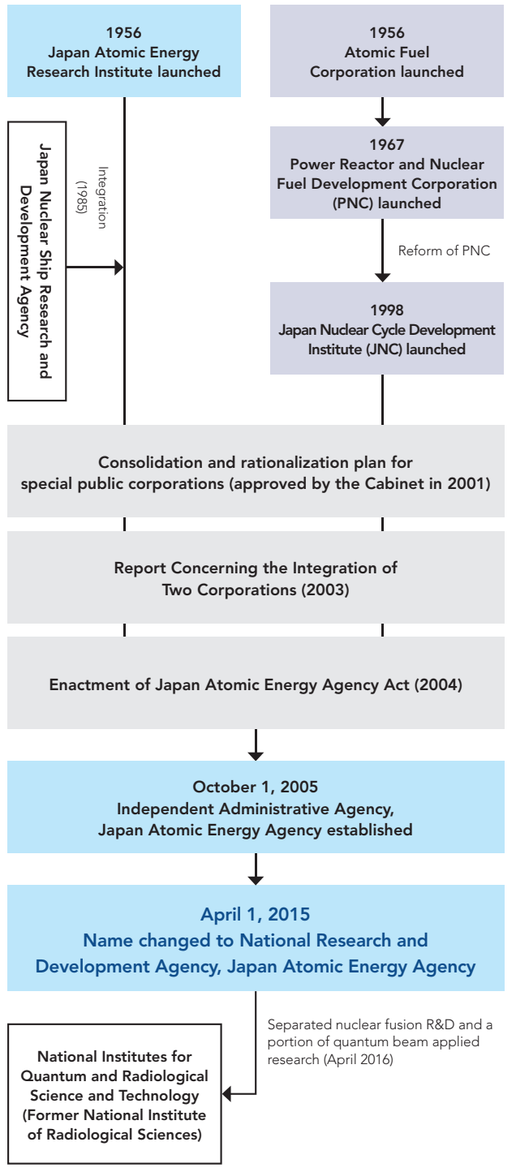
Atomic Fuel Corporation launched

JAERI and JNC were merged in 2005 to form the Independent Administrative Agency, Japan Atomic Energy Agency (JAEA). In 2016, JAEA separated nuclear fusion R&D and a portion of quantum beam applied research from the National Institutes for Quantum and Radiological Science and Technology.

Independent Administrative Agency, Japan Atomic Energy Agency established

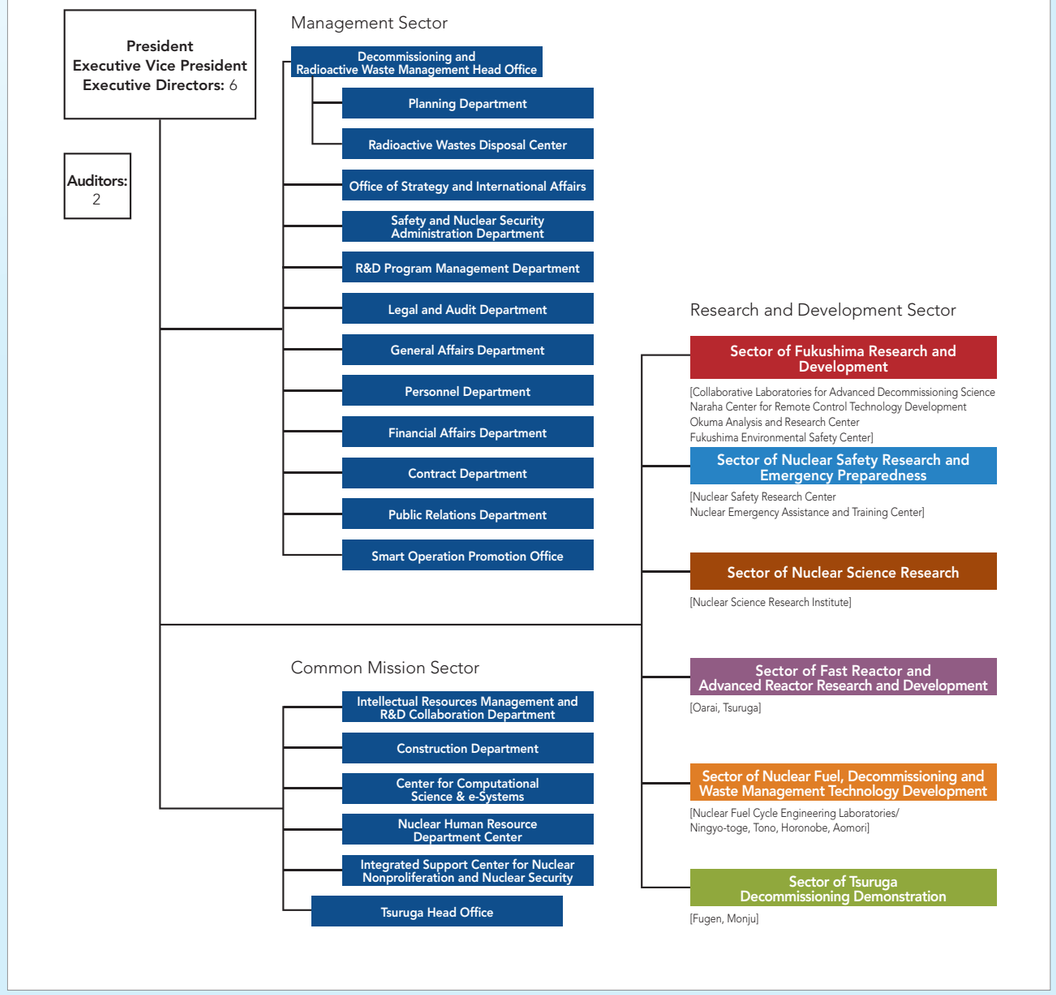
As Japan's sole comprehensive research and development institute in the field of nuclear energy, JAEA aims to secure energy sources indispensable to the lives of citizens through nuclear energy based on the premise of safety assurance and to create scientific technologies and industries through nuclear power. At the same time, JAEA will carry out R&D, from basic and fundamental research to R&D for the application and commercialization of technology, while disseminating the outcomes of this research with the overarching aim of contributing to the welfare of human society and raising the standard of living of Japan's citizens.

History



Organization/Management Advisory Council/ Oversight Committee

Organization (as of November 2019)



Management Advisory Council

JAEA has a management advisory council that provides comprehensive advice and proposals about important management matters. This council consists of members from industry, academia and government.

Oversight Committee

We have established the Oversight Committee, comprising academics, lawyers, certified public accountants and auditors of JAEA, to ensure society's trust in JAEA's operations and contribute to their appropriateness and fairness.

Board of Executive Directors

The JAEA management team is composed of a President, an Executive Vice President, six Executive Directors and two Auditors. The President is in charge of general JAEA organizational management and is assisted by the Executive Vice President. Executive Directors are in charge of businesses assigned to them in which they have high expertise and superior knowledge. The Auditors audit the business of JAEA.

A President
KODAMA Toshio

Career Outline
Apr. 1976: Mitsubishi Heavy Industries (MHI)
Apr. 2009: Executive Officer, Deputy Director General of Technology Headquarters, MHI
Jun. 2013: Managing Executive Officer, Director General of Technology Management, MHI
Feb. 2015: Vice President, Director General of Technology Management, MHI (resigned in March 2015)
Apr. 2015: President, Japan Atomic Energy Agency (JAEA)

B Executive Vice President
ITO Yoichi

Career Outline
Apr. 1982: Science and Technology Agency
Jan. 2001: Director, Private School Department, Higher Education Bureau, Ministry of Education, Culture, Sports, Science and Technology (MEXT)
Jul. 2010: Deputy Director General, Lifelong Learning Policy Bureau, MEXT
Jan. 2012: Executive Director, JAEA
Aug. 2015: Assistant Minister for policy coordination, MEXT
Jan. 2016: Director General, Science and Technology Policy Bureau, MEXT
Jul. 2017: Senior Deputy Minister of Education, Culture, Sports, Science and Technology, MEXT
Apr. 2019: Executive Vice President, JAEA

C Executive Director
AOTO Kazumi

Career Outline
Apr. 2010: Deputy Director General, Advanced Nuclear System Research and Development Directorate, JAEA
Apr. 2013: Director General, Advanced Nuclear System Research and Development Directorate, JAEA
Apr. 2014: Deputy Director General, Fast Breeder Reactor Research and Development Center, Tsuruga Head Office, JAEA
Oct. 2014: Director General, Prototype Fast Breeder Reactor Monju, Sector of Fast Reactor Research and Development, JAEA
Apr. 2015: Executive Director, JAEA

D Executive Director
MIURA Yukitoshi

Career Outline
Apr. 2010: Supreme Researcher/Director, Policy Planning and Administration Department, JAEA
Oct. 2013: Director, Office of Monju Reorganization, Monju Reorganization Headquarters, JAEA
Apr. 2015: Executive Director, JAEA

E Executive Director
YAMAMOTO Tokuhiro

Career Outline
Apr. 2010: Director, Technology Development Department, Tokai Reprocessing Technology Development Center, Nuclear Fuel Cycle Engineering Laboratories, Tokai Research and Development Center, JAEA
Apr. 2014: Deputy Director General, Nuclear Fuel Cycle Engineering Laboratories, JAEA
Apr. 2015: Director General, Nuclear Fuel Cycle Engineering Laboratories, JAEA
Apr. 2017: Executive Director, JAEA

F Executive Director
ITO Hajime

Career Outline
Apr. 1985: Kansai Electric Power Company (KEPCO)
Sep. 2012: Manager, Severe Accident Response Project Team, Nuclear Energy Planning Department, Nuclear Energy Division, KEPCO
Jun. 2013: Chief Manager, Technology Operation Group, Community Outreach Department, Nuclear Energy Division, KEPCO
Jun. 2016: Director, Decommissioning Technology Center, Nuclear Power Generation Department, Nuclear Energy Division, KEPCO
Apr. 2017: Executive Director, JAEA

G Executive Director
NODA Koichi

Career Outline
Apr. 1986: Ministry of International Trade and Industry
Aug. 2012: Director, Nuclear Facilities Development and Nuclear Fuel Cycle Industry Division, Electricity and Gas Industry Department, Agency for Natural Resources and Energy
Sep. 2013: Director, Decommissioning and Contaminated Water Management Office, Nuclear Emergency Response Headquarters, Cabinet Office
Apr. 2015: Vice President, National Institute of Technology and Evaluation
Apr. 2017: Executive Director, JAEA

H Executive Director
SUDO Kenji

Career Outline
Apr. 1989: Science and Technology Agency
Jul. 2009: Director for Resource Allocation, Bureau of Science, Technology and Innovation, Cabinet Office
Aug. 2012: Deputy Director General, Research Strategy Department, Japan Aerospace Exploration Agency
Apr. 2014: Professor at Tokyo University of Agriculture and Technology
Apr. 2016: Director, Department of General Affairs, National Institutes for Quantum and Radiological Science and Technology
Jan. 2018: Director, National Space Policy Secretariat, Cabinet Office
Apr. 2019: Executive Director, JAEA

I Auditor
TANAKA Teruhiko

Career Outline
Oct. 1979: Shinwa Audit Corporation (Currently KPMG AZSA LLC.)
May. 2002: Appointment as a representative partner of the Shinwa Audit Corporation
Jul. 2018: The representative of Tanaka Teruhiko Audit Firm
Sep. 2019: Auditor, JAEA

J Auditor (Part-time)
AMANO Reiko

Career Outline
Apr. 1980: Kajima Corporation
Apr. 2005: Manager of the civil engineering technology of the civil engineering management division of Kajima Corp.
Apr. 2011: Manager of the Intellectual Property and License Department of Kajima Corp.
Feb. 2014: Dedicated Officer of the Intellectual Property and License Department of Kajima Corp.
Oct. 2014: Deputy Director General of the Innovation Center for Meteorological Disaster Mitigation and the Research Center for Disaster Resilience of National Research Institute for Earth Science and Disaster Resilience
Sep. 2019: Auditor, JAEA

Principal Themes in R&D and R&D Sites

Principal Themes

JAEA is prioritizing "establishment of technologies towards the revitalization and reconstruction of Fukushima," "continuous improvement of nuclear safety," "basic and fundamental research that supports nuclear energy," "establishment of decommissioning and waste management technologies," "establishment of fast reactor cycle technologies" and "implementing the decommissioning of 'Fugen' and 'Monju'." These are based on energy policies encompassing nuclear energy and science and technology policies shown in the Strategic Energy Plan (Cabinet Decision in July 2018), the Fifth Science and Technology Basic Plan (Cabinet Decision in January 2016) and the basic policy of decommissioning plan for "Monju" (Cabinet Decision in June 2017).

- **Establishment of Technologies toward the Revitalization and Reconstruction of Fukushima**
- **Establishment of Decommissioning and Waste Management Technologies**
- **Continuous Improvement of Nuclear Safety**
- **Establishment of Fast Reactor Cycle Technologies**
- **Basic and Fundamental Research that Supports Nuclear Energy**
- **Implementing the Decommissioning of "Fugen" and "Monju"**

R&D Sites, etc. (as of November 2019)

Tono Geoscience Center
Research related to technologies for high-level radioactive waste disposal (crystalline rock)

Aomori R&D Center
Decommissioning of nuclear reactor facilities and analysis of trace elements and analysis techniques development of environment samples, etc.

Horonobe Underground Research Center
R&D on geoscientific study and on geological disposal for high-level radioactive waste (sedimentary rock)

Sector of Fukushima R&D
Response operations related to the accident at TEPCO's Fukushima Daiichi Nuclear Power Station

Tsuruga Head Office
Transition of Monju to decommissioning in accordance with government policy; research for the decommissioning of Fugen

Tokai Area
Safety research, basic and fundamental nuclear research and neutron use research; R&D related to technologies for high-level radioactive waste disposal; development of nuclear fuel for FR; promotion of initiatives toward the decommissioning of reprocessing facilities; nuclear training and disaster-prevention training

Nuclear Science Research Institute

J-PARC Center

Nuclear Fuel Cycle Engineering Laboratories

Oarai R&D Institute
FR cycle technology development through the Joyo and post-irradiation examination facility; research on the use of nuclear heat through high-temperature gas-cooled reactors

Ningyo-toge Environmental Engineering Center
Decommissioning research of uranium enrichment facilities

Harima SR Radioisotope Laboratory
Research of synchrotron radiation

Tokyo–Kashiwa Area
Research and development into fundamental technologies for computational science using supercomputers and other facilities

Medium- and Long-Term Plan and Its Evaluation

JAEA promotes its operations in accordance with a Medium- and Long-Term Plan created based on medium- and long-term targets as directed by the responsible ministries (Ministry of Education, Culture, Sports, Science and Technology, Ministry of Economy, Trade and Industry, Nuclear Regulation Authority). Since fiscal 2015, JAEA has undertaken operations in accordance with its third Medium- and Long-Term Plan (April 1, 2015 to March 31, 2022).

Third Medium- and Long-Term Plan (permission for change in April 3, 2019)

The third Medium- and Long-Term Plan prescribes the following operations based on energy policies encompassing nuclear energy and science and technology policies shown in the Strategic Energy Plan (approved by the Cabinet in July 2018) and the Fifth Science and Technology Basic Plan (approved by the Cabinet in January 2016).

I. Measures to be taken for attaining targets concerning business operations placing top priority on safety
II. Measures to be taken for attaining targets concerning maximizing R&D outcomes and raising quality in other areas
  1) R&D pertaining to the response to the accident at TEPCO's Fukushima Daiichi Nuclear Power Station
  2) Technological support for nuclear safety regulation and safety research for this purpose
  3) R&D for improving nuclear safety and activities that contribute to nuclear nonproliferation and nuclear security
  4) Basic and fundamental research and human resources development in the nuclear field
  5) R&D on fast reactors and advanced reactors
  6) R&D related to the nuclear fuel cycle, such as reprocessing, fuel manufacturing and treatment and disposal of radioactive waste
  7) Activities for Sector of Tsuruga Decommissioning Demonstration
  8) Activities to strengthen industry-academia-government collaboration and secure the trust of society
III. Measures to be taken for attaining targets related to enhancing the efficiency of business operations
IV. Measures to be taken for attaining targets related to improving the state of finances
V. Important matters concerning other business operations

Fiscal Year Plan

In accordance with Article 35-8 of the Act on General Rules for Independent Administrative Agencies, JAEA prescribes a plan (fiscal year plan) related to business operations for that fiscal year based on the Medium- and Long-Term Plan prior to the start of that business year.

Evaluation of Operational Results

JAEA receives an evaluation of its operational results every fiscal year by the responsible ministries. The evaluation for fiscal 2018, which corresponds with the fourth year of the third Medium- and Long-Term Plan, and the evaluation for the interim period (from April 1, 2015 to March 31, 2019) of the plan were disclosed.

JAEA received "B" marks as its comprehensive evaluations in each, and evaluation results by category are as follows.

Fiscal 2018

Evaluation	Number of items	Item
S	1	• Basic and fundamental research and human resources development in the nuclear field
A	5	• R&D pertaining to the response to the accident at TEPCO's Fukushima Daiichi Nuclear Power Station • Technological support for nuclear safety regulation and safety research for this purpose • R&D for improving nuclear safety and activities that contribute to nuclear non-proliferation and nuclear security • R&D related to the nuclear fuel cycle, such as reprocessing, fuel manufacturing and treatment and disposal of radioactive waste • Activities to strengthen industry-academia-government collaboration and secure the trust of society
B	4	• R&D on fast reactors • Promotion of rationalization and efficiency of operations • Budget (including estimate of personnel expenses), income and expenditure plan, financing plan • Establishment of effective and efficient management system
C	1	• Safety assurance and nuclear security
D	0	–

* For details on the Medium- and Long-Term Plan, fiscal year plan and evaluation results, please see the JAEA website.
http://www.jaea.go.jp/about_JAEA/business_plan.html (in Japanese)

Interim period of Third Medium- and Long-Term Plan

Evaluation	Number of items	Item
S	0	–
A	6	• R&D pertaining to the response to the accident at TEPCO's Fukushima Daiichi Nuclear Power Station • Technological support for nuclear safety regulation and safety research for this purpose • R&D for improving nuclear safety and activities that contribute to nuclear non-proliferation and nuclear security • Basic and fundamental research and human resources development in the nuclear field • R&D related to the nuclear fuel cycle, such as reprocessing, fuel manufacturing and treatment and disposal of radioactive waste • R&D on nuclear fusion
B	5	• R&D on fast reactors • Activities to strengthen industry-academia-government collaboration and secure the trust of society • Promotion of rationalization and efficiency of operations • Budget (including estimate of personnel expenses), income and expenditure plan, financing plan • Establishment of effective and efficient management system
C	1	• Safety assurance and nuclear security
D	0	–

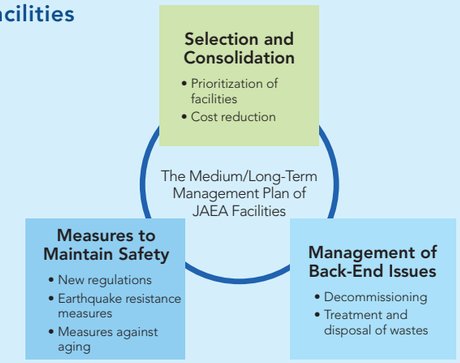
* With regard to "R&D on nuclear fusion," part of quantum beam science research and R&D on nuclear fusion have been transferred to the National Institutes for Quantum and Radiological Science and Technology since fiscal 2016.

Medium/Long-Term Management Plan of JAEA Facilities

JAEA formulated the Medium/Long-Term Management Plan of JAEA Facilities on April 1, 2017. This comprehensive plan focuses on three objectives, namely, selection and consolidation of JAEA's nuclear facilities, measures to maintain the safety of facilities and management of back-end issues. The Medium/Long-Term Management Plan of JAEA Facilities is updated every fiscal year based on progress.

In 2018, JAEA conducted earthquake-resistance measures, risk reduction measures and management of back-end issues according to a formulated plan. The Medium/Long-Term Management Plan of JAEA Facilities was reviewed and revised to reflect the situation in 2018 and the 2019 budget on April 1, 2019.

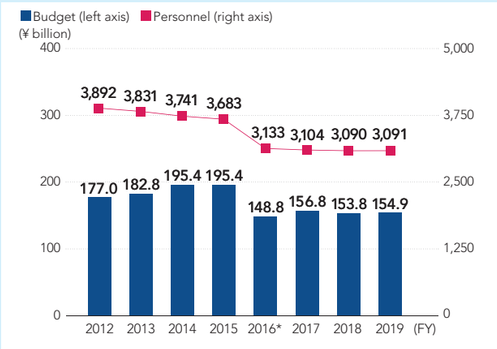
* For details on the Medium/Long-Term Management Plan of JAEA Facilities, please see https://www.jaea.go.jp/about_JAEA/facilities_plan/ (in Japanese)



Budget and Personnel

JAEA works toward rationalizing budgets and personnel by promoting efficient operations and further raising efficiency of management departments and re-evaluating its operations when needed.

Regarding budgets, JAEA works to obtain funding, including competitive funding from a variety of external organizations, by actively carrying out consigned research and joint research. Also, to perform an extensive scope of R&D ranging from basic and fundamental research to project-type R&D, JAEA promotes agency-wide, cross-sectional and flexible personnel allocation to ensure it can make effective use of the abilities and aptitudes of each individual.



* Decreases in budgets and personnel accompanying the transfer and integration to the National Institutes for Quantum and Radiological Science and Technology

Financial Information (Fiscal 2018)

Summary of Balance Sheet

(¥ million)

Assets	
Ⅰ. Current assets	173,815
Ⅱ. Fixed assets	521,575
1. Tangible fixed assets	462,160
2. Intangible fixed assets	2,605
3. Investments and other assets	56,810
Total assets	695,391

Liabilities	
Ⅰ. Current liabilities	64,423
Ⅱ. Fixed liabilities	207,027
Total liabilities	271,450
Net assets	
Ⅰ. Capital stock	820,290
Ⅱ. Capital surplus	- 421,647
Ⅲ. Retained earnings	25,297
Total net assets	423,940
Total liabilities and net assets	695,391

Summary of Profit and Loss Statement (¥ million)

Items	
Ordinary expenses	173,063
Ordinary income	175,020
Extraordinary loss	1,469
Extraordinary income	1,448
Net income before income taxes	1,936
Income taxes	51
Net income	1,884
Reversal of reserves carried over from the period of the previous medium- and long-term target period	117
Total income for the fiscal year	2,002

Donations from External Supporters

In fiscal 2018, we received donations totaling 84 million yen from 251 supporters. These donations will be effectively utilized in support of emerging research and various other JAEA activities.

* For details on financial statements, please see the JAEA website.
https://www.jaea.go.jp/about_JAEA/financial/ (in Japanese)

Fiscal 2018 Topics

TOPIC 1

“Monju” has safely completed the first fiscal year of decommissioning, while “Fugen” has shifted to a new phase toward dismantling of the reactor.

Under the system of the Sector of Tsuruga Decommissioning Demonstration, we are steadily promoting completion of decommissioning.

For the Prototype Advanced Thermal Reactor Fugen (hereafter referred to as “Fugen”), decommissioning started in fiscal 2007 and “Decontamination of the Heavy Water System, Helium System, etc.” was completed and the major components in the turbine building with less contamination (condensers, moisture separators, etc., excluding turbine generators) were dismantled and removed by fiscal 2017. Since fiscal 2018, in preparation for dismantling of the reactor from fiscal 2022, we have started dismantling of peripheral devices and piping around the reactor, such as the interfering cooling system. Moreover, in order to reduce exposure to radioactive dust, which is generated when cutting pressure pipes loaded with fuel assemblies in the reactor, and to prevent fire, we are planning to install a dismantling pool at the reactor top to dismantle it underwater by remote operation, for which we have started preparing and are moving ahead steadily to the dismantling operation of the reactor.

For the Prototype Fast Breeder Reactor Monju (hereafter referred to as “Monju”), unloading of fuel assemblies, which is the first phase of decommissioning, started in August 2018, and 86 spent fuel assemblies were transferred from the ex-vessel fuel storage tank (sodium) to the spent fuel pool (water) by January 2019.

Since fiscal 2019, we have started unloading of fuel assemblies from the reactor vessel, aiming for completion of fuel unloading operations in fiscal 2022.

Moreover, aiming for the completion of decommissioning in fiscal 2047, we have started preparing also for dismantling of the sodium-cooling equipment. One of our staff was sent to France, the leading nation in the field of decommissioning of sodium-cooled fast reactors, to proceed with the dismantling plan, the method of treatment and disposal of sodium and so on, which are led by the Sector of Tsuruga Decommissioning Demonstration.

In the future, under the system of the Sector of Tsuruga Decommissioning Demonstration, by collecting domestic and global knowledge, we will continue dealing with decommissioning of “Fugen” and “Monju,” aiming for the completion as scheduled.

Fuel Unloading Process for “Monju” (First phase of decommissioning)

Fiscal year	2018	2019	2020	2021	2022
Treatment of fuel assemblies (530 units) Ex-vessel fuel storage tank → Fuel pool	86 units Completed	130 units	140 units	174 units	
Unloading of fuel assemblies (370 units) Reactor vessel → Ex-vessel fuel storage tank		100 units	130 units	140 units	
Preparation of dummy fuel assemblies Transfer → Ex-vessel fuel storage tank	103 units	127 units	140 units		

TOPIC 2

Back-end Roadmap formulated by JAEA as the long-term prospect and policy for back-end measures.

Individual policies for decommissioning, as well as processing and disposal of radioactive waste and management of nuclear fuel materials stored in facilities are described for each facility.

In April 2017, JAEA formulated the Medium/ Long-Term Management Plan of JAEA Facilities, a detailed and concrete execution scenario through fiscal 2028 designed to implement a threefold strategy in an integrated manner: selection and consolidation of facilities, measures to maintain the safety of facilities and management of back-end issues. Through formulation of the Plan, JAEA is aiming for the maintenance and development of its R&D capabilities by strengthening the safety of its nuclear facilities and ensuring steady implementation of back-end measures.

Implementation of back-end measures requires a long-term perspective, as illustrated by the expectation that it will take about 70 years to complete the decommissioning of the Tokai Reprocessing Plant. From that standpoint, JAEA formulated the Back-end Roadmap as the long-term prospect and policy for back-end measures.

The Back-end Roadmap describes individual policies for decommissioning for each facility, as well as the processing and disposal of radioactive waste and management of nuclear fuel materials stored in facilities. Viewing the cost of implementation of back-end measures over a period of about 70 years, the cost for facility dismantlement and that for processing and disposal of radioactive waste generated by decommissioning are estimated at approximately 1.9 trillion yen. In working toward achieving the execution of back-end measures, JAEA should also make continuous efforts to streamline and optimize the tasks such as R&D, management system, securing and training human resources, securing sufficient funding and effective fund use based on knowledge acquired domestically and abroad.

The specific measures necessary for the implementation of the Back-end Roadmap will be incorporated in future revisions of the Medium/ Long-Term Management Plan of JAEA Facilities. Additionally, the Back-end Roadmap will be revised as needed as decommissioning progresses.

Back-end Roadmap (Overview)

Facilities considered: All existing facilities licensed by “Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors.” (Excluding 10 facilities handling radioisotope.) → **79** facilities (as of Dec. 2018)

Promotion of Back-end Measures (Policy for about 70 years)

- Decommissioning
- RW Processing & Disposal
- Management of nuclear fuel material

→ Distribute to the 3 periods For each facility

The 1st period (-2028, about 10 years)
Period to implement back-end measures while giving priority to ensuring safety of facilities

The 2nd period (2029-2049, for about 20 years)
Transitional period 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)
Period to implement full-scale back-end measures toward completion

Cost for Back-end Measures: To estimate cost for decommissioning and RW processing & disposal. → **About 1.9 trillion yen** (for about 70 years)

Effort for Streamlining and Optimization: To discuss the policy on the development of technology and management system, etc.

* For details on the Back-end Roadmap, please see https://www.jaea.go.jp/english/about/backend_roadmap/backend_roadmap.pdf

TOPIC 3

Nuclear Safety Research Reactor "NSRR" first JAEA research reactor to resume operation after enforcement of new regulatory standards.

On June 28, 2018, NSRR became the first JAEA reactor to restart operation after the enforcement of new regulations. Preparations are also moving favorably toward resumption of operations at other research reactors.

Many research reactors have been temporarily shut down in response to new regulatory standards that were tightened after the accident at Fukushima Daiichi Nuclear Power Station (hereinafter referred to as "1F"). The new regulatory standards, which came into force in December 2013, have enhanced or added safety requirements, especially regarding natural phenomena such as earthquakes, tsunamis and tornadoes, and internal fires, based on the lessons learned from the 1F accident. In March 2015, NSRR (Nuclear Safety Research Reactor) applied for permission for the establishment of a nuclear facility to demonstrate that NSRR complies with the requirement. After more than 100 review meetings and interviews with regulatory authorities, NSRR obtained permission in January 2018, and resumed operation on June 28, 2018.

Operation resumption is generally permitted after the completion of seismic reinforcement work. However, as a result of discussion with regulatory authorities about the safety requirements pertaining to reactors of only small residual radioactivity and low safety risks like NSRR, a grace period for completing seismic reinforcement work was granted if the reactors are classified as seismic non-S class and the reinforced building is classified as C class. Subsequently, NSRR was able to resume operation before the completion of seismic reinforcement work.

From June to September 2018, we carried out six fuel irradiation experiments and acquired valid data utilized for national regulations on the advanced fuel developed for further improving the safety of nuclear power plants.

NSRR will complete the seismic reinforcement work carried out from October 2018, and will resume operation in February 2020 after periodic inspection of the facilities.

The Nuclear Science Research Institute has research reactors "JRR-3 (Japan Research Reactor No. 3)" and stationary criticality test equipment "STACY (Static Experiment Critical Facility)" as research reactors aimed at resuming operation. JRR-3 and STACY obtained permission for the establishment of a nuclear facility on November 17, 2018 and January 31, 2018, respectively. In the future, JRR-3 will work on safety measures such as installation of facilities in preparation for an accident exceeding previous assumptions and seismic reinforcement work, in preparation for resumption of operation in February 2021. During this non-operational period, we will transition from Ni-mirror guides to super-mirror guides. As a result, neutron beam intensity will increase and bring more speed and precision to neutron experiments. Regarding STACY, in preparation for resumption of operation in January 2021, we will work on renewal efforts for remodeling from an experiment critical facility using solution fuel to an experiment critical facility using solid fuel and a water moderator. To contribute to support for regulations related to the decommissioning of 1F, we will develop criticality control technologies related to fuel debris retrieval.

TOPIC 4

Contamination incident in radiation-controlled area of the Plutonium Fuel Fabrication Facility in the Nuclear Fuel Cycle Engineering Laboratory

Plutonium Fuel Fabrication Facility

In future projects, JAEA will take all possible measures to prevent similar incidents and to ensure safety.

On January 30, 2019, a contamination incident occurred in a radiation-controlled area of the Plutonium Fuel Fabrication Facility in the Nuclear Fuel Cycle Engineering Laboratory. We would like to express our deepest apologies to the people of Japan, especially local people and parties concerned, for the tremendous worry and inconvenience caused by this incident.

We have confirmed that nine workers in the room at that time had no internal exposure and that there is no impact on the environment from this incident. In addition, we completed decontamination in the room by the end of June 2019.

This incident occurred while taking measures to prevent recurrence related to an internal exposure accident at the Plutonium Fuel Research Facility in the Oarai Research and Development Institute (formerly Oarai Research and Development Center) in June 2017. JAEA has taken special note of this fact. After ensuring that every employee understands the cause and background of this incident, we will take all possible measures to prevent similar incidents and to ensure safety.

We recognize JAEA's responsibility as the only comprehensive research institute of nuclear power in Japan and strive to gain understanding and trust of nuclear power from the people of Japan. Furthermore, we will put forward our best effort to become a model for nuclear power operators, while sharing information and living in harmony with residents.

We submitted a nuclear facility failure report that summarized the causes and countermeasures* of this incident to the Nuclear Regulatory Authority. As of the end of July 2019, we continue striving to develop and deploy improvement activities.

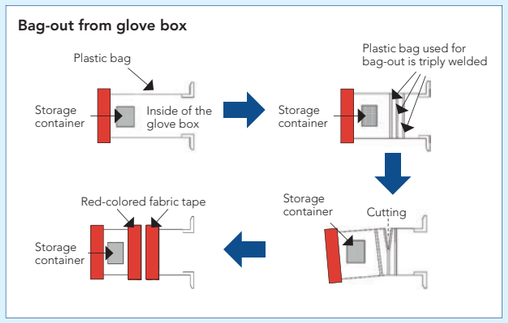
* Please visit our website for details of the nuclear facility failure report.
https://www.jaea.go.jp/02/press2019/p19040401/ (in Japanese)

[Summary of contamination]

Contamination occurred during the replacement of the two double plastic bags individually enclosing two metal storage containers (an aluminum can was in the first double bag and a stainless steel can was in the second) containing nuclear fuel material.

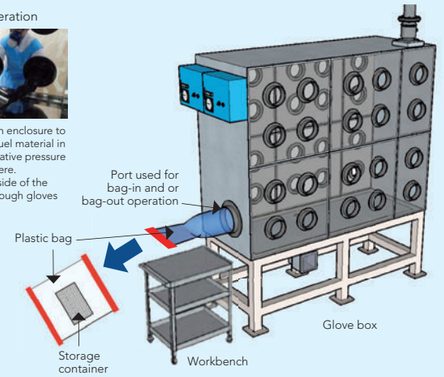
[Causes]

1. Inadequate removal of nuclear materials on the outer surface of storage container (stainless steel can) before bag-out operation
2. Continuation of bag-out operation without noticing that there was a hole in the plastic bag, resulting in contamination.
3. Began packing second plastic bag without contamination and appearance inspections of the bag-out item. Usually, contamination and appearance inspections of the bag-out item are required before starting the second packing.



Glove box operation

"Glove box" is an enclosure to confine nuclear fuel material in the box with negative pressure against atmosphere.
All operations inside of the box are done through gloves as shown above.



The Path to JAEA's Social Value Creation

The most important watchwords of JAEA are "Safety," "Compliance" and "Action." We will seek to use our technology and wisdom, as the only comprehensive nuclear research and development institute in Japan, for the benefit of society.

Social Issues around JAEA

- Energy resource problems
- Safe nuclear energy use
- The accident at TEPCO's Fukushima Daiichi Nuclear Power Station
- Decommissioning of nuclear facilities and management of radioactive waste
- Maintenance of international competitiveness
- Ensuring nuclear nonproliferation and nuclear security

Action to Solve Social Issues

Major Challenges for JAEA

* For details on "Major Challenges for JAEA," please see P18.

Safety

- Safety Assurance
- Ensure Nuclear Security
- Nuclear Nonproliferation and Nuclear Security

Compliance

- Appropriate Contracting Practices
- Risk Management
- Public Relations
- Information Disclosure

Action

- Strategy for International Cooperation
- Cooperation among Government, Industry and Academia
- Development of Human Resources in the Field of Nuclear Energy
- Research & Development
- Strategy for Innovation Creation

Innovation Creation through Major Challenges for JAEA

Innovation for the Use of Nuclear Energy

1. Solution of energy resource problems
2. Reduction in amount and toxicity of radioactive waste
3. Decommissioning of nuclear facilities and management of radioactive waste
4. Development of new types of nuclear systems
5. Establishment of safety systems
6. Response to the Fukushima Daiichi Nuclear Power Station Accident

Innovation through Nuclear Science

1. Basic and fundamental research, cutting-edge nuclear science research and research using neutrons
2. Creation of innovation in wide-ranging fields by making JAEA facilities available to outside users or jointly using them

Organizational Enhancement by Management

Management by the President

Mission
Contribute to the welfare and prosperity of human society through nuclear science and technology

Vision
To meet the expectations of Japanese citizens as Japan's sole comprehensive nuclear research and development institute (we shall aim for the following)

- An organization that contributes to the development of nuclear science and technology, to the peaceful use of global nuclear energy and to regional development
- An organization that promotes research into improving nuclear safety
- An organization that creates innovation through interaction and collaboration with other fields of technology
- An organization that contributes to the solution of global climate change, to ensuring energy stability and to the achievement of Society 5.0

To lead nuclear research and development with a high organizational IQ

- An organization with high organizational IQ that always ensures safety first, always thinks independently and always continues to improve its efficiency
- An organization that can best utilize limited resources (budget, assets, manpower)

Strategy
To share a sense of value and uplift the level of job quality

To enhance efforts toward establishment of public acceptance

To promote job prioritization, job streamlining, introduction of information technology and introduction of all cutting-edge technology

To enact management reform with the establishment of clear and straightforward plans

The Path to Realization of Mission

Realization of Mission

Contribute to the welfare and prosperity of human society through nuclear science and technology

Contribution to the achievement of SDGs

"Sustainable Development Goals (SDGs)" are international goals through the year 2030 adopted at the *UN Sustainable Development Summit* in September 2015. Comprising 17 goals and 169 targets, these are the goals shared by the international community to realize a sustainable world. JAEA will launch various measures as part of its efforts to contribute to the solution of these issues.

Future Vision

"JAEA 2050 +"

* For details of "JAEA 2050 +," please see P54-P55.

Major Challenges for JAEA

Three Elements That JAEA Considers as Its Major Challenges

Safety

JAEA holds ensuring safety as a fundamental premise for its operations, and lists it as the top priority in its basic policy of management and operation. In the recognition that our nuclear facilities handle potentially hazardous materials, we take all measures to ensure safety, quality assurance and nuclear security. Thus, ensuring safety is cited as the top priority in our conduct standard.

*** For details on "Safety," please see the pages below.**

P20-P23: "Operations Placing the Utmost Priority on Safety"
P24-P25: "Toward a World without Threats of Nuclear Proliferation and Nuclear Terrorism"

Compliance

JAEA defines "compliance" as "respecting its management principles and conduct standards, complying with applicable laws, regulations and rules, its obligations under contracts and corporate ethics, and behaving in conformance with social norms" in order to be an entity trusted by the public and the local community. We actively address compliance, and make appropriate responses to any notification concerning compliance.

*** For details on "Compliance," please see the pages below.**

P26: "Promotion of Risk Management and Compliance"
P27: "Appropriate Contracting Practices"
P28-P29: "Public Consultation, Public Relations and Information Disclosure"

Action

JAEA's mission is to contribute to the welfare of human society through nuclear technologies. On the other hand, many outcomes of JAEA's research and development activities can be widely used for purposes other than utilization of nuclear energy. Accordingly, JAEA reviewed its mission and formulated "JAEA's Strategy for Innovation Creation" to construct a new R&D mechanism for fulfilling its mission. It was published on March 31, 2017.

Through implementing the "Strategy for Innovation Creation," we will seek to use our technology and wisdom, as the only comprehensive nuclear research and development institute in Japan, for the benefit of society. In implementing it, we classify innovations we are aiming at as "Innovation for the Use of Nuclear Energy" and "Innovation through Nuclear Science."

*** For details on "Action," please see the pages below.**

P30-P31: "Initiatives for Promoting R&D"
• JAEA's R&D
P32-P33: "Sector of Fukushima Research and Development"
P34-P35: "Sector of Nuclear Safety Research and Emergency Preparedness"
P36-P37: "Sector of Nuclear Science Research"
P38-P39: "Sector of Fast Reactor and Advanced Reactor Research and Development"
P40-P41: "Sector of Nuclear Fuel, Decommissioning and Waste Management Technology Development"
P42-P43: "Sector of Tsuruga Decommissioning Demonstration"

TOPICS

JAEA Technology Salon
Measures to Give the Results of Research and Development Back to Society

Japan Atomic Energy Agency (JAEA) launches measures that lead to the creation of innovation while giving back to society the results of research and development it has cultivated. As a new step in fostering the fusion of different fields and disciplines based on its innovation creation strategy, the "JAEA Technology Salon" was held in FY2018. Representatives from businesses and other organizations were invited to attend the salon, where scientists briefed them on JAEA's technologies that may be applicable to industry. Working with outside experts knowledgeable on industry-academia-government collaboration and startups, the salon has provided an opportunity for an exchange of opinions on various topics, including ways to return the results of research and development to society and issues concerning commercialization.

Following the "JAEA Technology Salon," companies with no business relationship in the past have come to JAEA for technology consultation. Also, the salon has served as a "bridge" in endeavors that encompass deployment in joint research that utilizes the technologies described on the day of the salon session.

As the only integrated nuclear research and development organization in Japan, JAEA will continue its efforts to use its technology and know-how for the benefit of society, not only in energy utilization fields but also in other domains of everyday life.

The results of research and development, including papers and patents released by JAEA (totaling approximately 100,000), can be viewed on the "JAEA Originated Papers Searching System (JOPSS)."

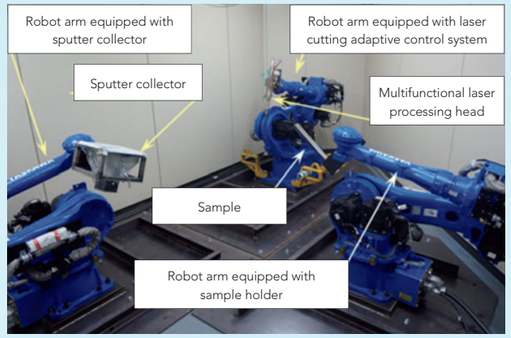
* For details on industry-academia-government collaboration and results of research and development, please visit the JAEA website.
https://tenkai.jaea.go.jp

JAEA's technologies introduced at the 1st session of JAEA Technology Salon

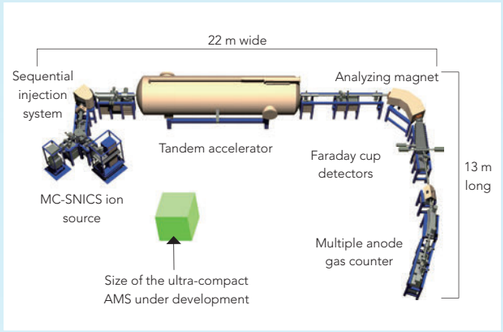
Some Technologies of the JAEA Introduced at the 1st JAEA Technology Salon

- Compact and simple technology for the recovery of valuable metal
- Dichlorination technology for *chlorinated ethylenes*
- Unique Teflon microfabrication technology with wide applications from medicine to industry
- Revolutionary laser cutting technology that seeks to reduce environmental impact
- On-site detection of hazardous metals and biomarkers using wearable devices
- Hydrogen isotope/ion storage/separation technology using single-layer thin graphene film
- Advanced metal selection/separation technology that utilizes molecular template-recognition complex structure
- Table-top, pretreatment-free miniature accelerator mass spectrometry device
- Status and future prospects of spintronics research

Wearable Devices



Laser cutting control system for reducing environmental burden

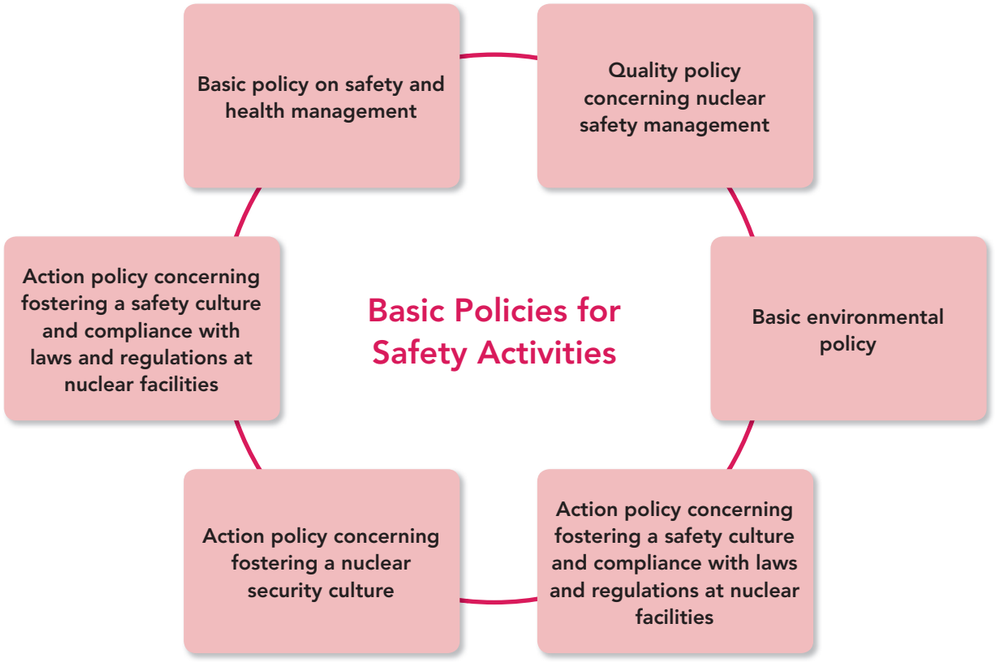


Ultra-compact accelerator mass spectrometer

Operations Placing the Utmost Priority on Safety

Basic Policies Concerning Safety Management

In its Basic Policy, JAEA specifies ensuring safety as the matter of utmost priority for its management and operations. In addition, based on the six Basic Policies concerning safety management set out by the President, JAEA continuously seeks to foster a safety culture and a nuclear security culture to ensure safety of its facilities and operations and proper control of its nuclear materials.



Ensuring Safety before Anything Else

As a national R&D institute handling a large quantity of radioactive materials, JAEA is required to demonstrate extremely high levels of safety and reliability. As such, we formulated basic policies concerning safety, quality and nuclear security and have been promoting operations according to them, placing safety before everything else.

Each JAEA site undertakes safety-related activities, with its own quality targets based on the "Quality Assurance Policy on Nuclear Safety," and with its own action plans in accordance with the "Policy and Measures for Activities to Foster a Safety Culture and to Ensure Compliance with Applicable Laws and Regulations." Each site also seeks continuous operational improvement by repeating the plan-do-check-act (PDCA) process. In addition, by instilling recognition of the importance of pre-determined routine actions at the level of each workplace, we strive to ensure the safety of on-site work through a range of routines, including the on-site 5S activities (*seiri* (proper arrangement), *seiton* (orderly arrangement), *seiketsu* (maintenance of good sanitary conditions), *seisou* (cleaning activities) and *shitsuke* (discipline)) and pre-work activities such as risk assessments and hazard prediction activities.

Agency-Wide Sharing of Lessons Learned from Accidents and Acting upon Such Lessons

To prevent occurrence of similar events, JAEA has in place a system in case of an accident or a problem to provide all JAEA sites with lessons learned from investigation of its causes (including measures taken to prevent recurrence) and to incorporate these lessons as necessary into their on-site work. During fiscal 2018, we shared information on 26 cases of accidents or problems both within and outside JAEA, and corrective action in order to prevent recurrence.

Occurrence of Accidents and Problems

In fiscal 2018, we had one accident or problem that required reporting pursuant to the Act on Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors; it was a contamination accident that occurred in the controlled area of the Plutonium Fuel Fabrication Facility at the Nuclear Fuel Cycle Engineering Laboratories. There was one violation of safety regulations relating to this accident.
In addition, we had four lost workday injuries incidents and received two corrective recommendations by the Labor Standards Inspection Office.

As for the contamination accident in the controlled area of the Plutonium Fuel Fabrication Facility at the Nuclear Fuel Cycle Engineering Laboratories, pursuant also to the instructions of the Minister of Education, Culture, Sports, Science and Technology "Future measures for recurrence prevention of accident or problem following on the contamination accident in the controlled area of the Nuclear Fuel Cycle Engineering Laboratories" in April 2019 and referring to the improvements based on the cause investigation of the accident, we have executed an agency-wide sharing of information.

Activities to Foster a Safety Culture

JAEA pursues activities in line with the "Policy for Activities to Foster a Safety Culture and Ensure Compliance with Applicable Laws and Regulations at Nuclear Facilities."
In fiscal 2018, officials undertook safety patrols and exchanged opinions with the staff at JAEA sites to promote information sharing and mutual understanding between management and the staff. In addition, at each JAEA site, there was a safety gathering with participation of partners, a safety and health patrol by the director general, safety sensory training to enhance safety consciousness and so on.

Moreover, in fiscal 2018, there were frequent accidents caused by human error and resulting in injury, such as the one at "Monju," where a staff member who did not notice a height difference in floors fell and was injured, and another at Oarai Research & Development Center, where a staff member fell off a ladder and was injured. Following these accidents, JAEA deployed staff specialized in safety management at each site, established a system of instruction and advice on safety activities, and introduced a certification system of the person in charge of safety management at the site. In addition, with the aim to enhance field capabilities and to promote safety consciousness, we arranged lectures and training by visiting lecturers. We will continue our efforts to further enhance safety consciousness.

Initiatives for Our Own Quality Improvement

With a view to ensuring the safety of its nuclear facilities, JAEA has detailed its quality policy concerning nuclear safety management in accordance with the operational safety program of reactors and other facilities. We are ensuring proper operation and continuous improvement of safety-related activities under our quality management system.

Management Review by the President

The President himself receives and reviews periodic activity reports from each facility to ensure effectiveness of various safety-related activities at our nuclear facilities and to improve our quality management system and security operations. We had three management reviews during fiscal 2018, when managers (executive directors in charge of each site) reported the implementation status of quality assurance activities, their evaluation, improvements and so on at each site. As per instruction for improvement by the President, it was decided to set quality targets for the next fiscal year and to work on quality assurance activities, considering the lessons learned from the contamination incident that occurred in the controlled area of the Plutonium Fuel Fabrication Facility, which are executed at each site.

Agency-Wide Safety Review and Quality Assurance Committee

We have established the Agency-wide Safety Review and Quality Assurance Committee to deliberate on safety reviews required for licensing of nuclear facilities and basic matters of quality assurance activities across JAEA. In fiscal 2018, the committee met 19 times to discuss a total of 41 matters, including the license application of nuclear facilities and application for approval of decommissioning plans. In addition, we shared information about causes of accidents or problems in fiscal 2018, countermeasures against them and our responses to comments given in safety inspections; we also proceeded with initiatives to ensure safety through close collaboration between the Safety and Nuclear Security Administration Department and each JAEA site.

Strict Compliance with Laws and Regulations and Coping with Aging Facilities

Compliance with Regulatory Standards and Response to Introduction of New Inspection Program

Certification of compliance with the new regulatory standards triggered by the accident at TEPCO's Fukushima Daiichi Nuclear Power Station must be obtained for research reactors and other facilities. Following the permission obtained for changes in the reactor installation licenses of the STACY and the NSRR in fiscal 2017 (January 2018), permission for three facilities was granted in fiscal 2018: installation of the Oarai Research and Development Institute Waste Management Facility (August); changes in the installation licenses of the Nuclear Science Research Institute Waste Management Facility (October); and changes in reactor installation licenses for the JRR-3 (November). Accordingly, we are proceeding to obtain approval for their design and construction methods.

Elsewhere, ahead of transfer to the New Inspection Program by the revision and enforcement of the Act on Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors in April 2020, we have been proceeding with preparation within JAEA and adjustments with the Nuclear Regulation Authority since January 2018. For the New Inspection Program, we have established policies (guidelines) such as formulation of a maintenance plan, securing of independence of an operator's inspection, free access measures by the inspector of the Nuclear Regulation Authority, indicators for continuous improvement of safety activities (PI: Performance Indicators), improvement activities (CAP: Corrective Action Program) and so on, which were shared with all JAEA sites subject to inspection to promote test operations.

Efforts to Organize and Prioritize Aging Facilities for Utilization

Because JAEA started its R&D operations in the 1960s, many of its facilities and equipment items are now aging. These older facilities and equipment items pose greater risk in terms of safety and need to be prioritized; in other words, these facilities must be grouped into those we will continue to use and those we will no longer use and have to decommission. We need to carry out upgrades and repairs in a systematic manner for the former group, while we need to implement measures necessary for decommissioning for the latter group, ensuring safety.

According to this recognition, we conducted priority (risk) assessments again in fiscal 2018, and promoted management of these facilities by incorporating plans to address aging into the Medium- and Long-Term Management Plan for JAEA Facilities. As a result, the number of facility and equipment failures or breakages due mainly to aging dropped to 2 in fiscal 2018, from 5 in fiscal 2017.

Crisis Management at JAEA

In preparation for various crises, including nuclear facility accidents/failures and natural disasters, we operate and maintain emergency response systems (e.g. teleconferencing system, broadcast fax system, and emergency call-up system) to enable us to unfailingly share information within JAEA and send out information to external parties. We also provide periodic education and training to emergency response staff.

Maintenance of Emergency Response Systems

To ensure continued operation of emergency response systems, we conduct periodic inspections and carry out system upgrades in order in accordance with our upgrade plan.

In fiscal 2018, we conducted repairs and other maintenance work on the teleconferencing system and the emergency call-up system to counter their aging and maintain our ability to distribute and send out information. Additionally, on the Integrated Nuclear Emergency Preparedness Network that connects JAEA with the Secretariat of the Nuclear Regulation Authority, we conducted periodic connection testing to ensure availability of services in case of a nuclear emergency.

Efforts Related to Crisis Management Education and Training

We provided education events for the members of the JAEA Emergency Response Headquarters and local emergency response headquarters on their respective roles in the event of emergencies.

To provide training on emergencies that may originate from facilities of JAEA, we conducted a total of 20 drills involving the JAEA Emergency Response Headquarters. To improve our emergency response capabilities, we dispatched experts from outside JAEA to comprehensive emergency preparedness drills at the sites subject to the Act on Special Measures Concerning Nuclear Emergency Preparedness. In the drills, we conducted exercises on providing information to the Secretariat of the Nuclear Regulation Authority via the Integrated Emergency Network, with the aim of refining JAEA's system to share and send out information. In addition, during the comprehensive emergency preparedness drills at the Oarai Research and Development Center and the site of "Monju," we conducted drills that incorporated support from other JAEA sites and confirmed that the supporting system of the entire organization worked.

Comprehensive Emergency Preparedness Drills at Sites in Fiscal 2018

Sept. 25, 2018	Oct. 16, 2018	Nov. 22, 2018	Jan. 15, 2019	Feb. 19, 2019	Mar. 5, 2019
Nuclear Science Research Institute	Nuclear Fuel Cycle Engineering Laboratories	Ningyo-toge Environmental Engineering Center	Oarai Research and Development Institute	Prototype Fast Breeder Reactor Monju	Fugen Decommissioning Engineering Center
Approx. 320 individuals	Approx. 1,800 individuals	Approx. 280 individuals	Approx. 310 individuals	Approx. 330 individuals	Approx. 190 individuals

Response to Accidents and Problems

Upon occurrence of an accident or a problem, we use the emergency response system to mount a swift response in collaboration between the headquarters and the relevant site. In fiscal 2018, we had 31 accidents or problems that necessitated use of the emergency response system within JAEA.

Initiatives for Nuclear Security and Safeguards to Ensure Peaceful Use of Nuclear Energy

Japan Atomic Energy Agency (JAEA) steadily promotes "nuclear security" that is designed to prevent the theft of nuclear and radioactive materials and the sabotage of nuclear facilities in accordance with laws and regulations. In addition, JAEA actively cooperates with the safeguards activities launched by the Japanese government and the International Atomic Energy Agency (IAEA) to ensure that nuclear materials are not diverted to the manufacture of nuclear weapons.

In relation to "nuclear security," JAEA plans to step up its vigilance and appropriately operates the "trustworthiness determination program"* as part of its measures against internal threats in view of upcoming large-scale events, including the Olympic and Paralympic Games to be held in Tokyo in 2020. Furthermore, JAEA will take appropriate measures and follow the guidelines, etc. of the government concerning power plants, transportation and other vital infrastructure facilities to prevent and deflect cyber-terrorism acts that occur via computer networks, which pose a significant challenge.

As part of its response to safeguards activities, JAEA monitors the exact amount of incoming and outgoing nuclear materials as well as its inventory and submits nuclear material accounting reports to the government in accordance with laws and regulations. JAEA is working to ensure the transparency of nuclear material utilization by accepting, as the occasion demands, safeguards inspections (verification) by the government and the IAEA as a mechanism for confirming the validity of nuclear accountancy. In fiscal 2018, JAEA cooperated with the IAEA so that appropriate safeguards inspections could be carried out at facilities where decommissioning is planned in ways that correspond to the status of decommissioning already underway. JAEA's cooperation is also designed to support the smooth introduction of new safeguards approaches (inspection method) that the IAEA has been promoting, which take the status of the nuclear fuel cycle in Japan into consideration.

* Trustworthiness determination program: As one of the measures against threats from employees and other insiders, this program surveys the positions, careers, relation with terrorism and other backgrounds of individuals who have access to the designated inner areas of nuclear facilities and handle confidential information regarding physical protection, so as to confirm that they will not conduct any sabotage.

Towards a World without Threats of Nuclear Weapon and Nuclear Terrorism

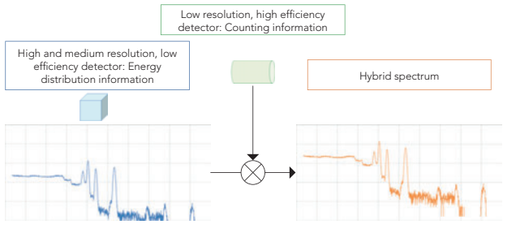
To move towards a world without nuclear Weapon and nuclear terrorism, JAEA/ISCN works on technological development, policy research, supporting human capacity building and contributing to the CTBT international verification regime in the field of nuclear non-proliferation, nuclear security and denuclearization.

Overview of Integrated Support Center for Nuclear Non-proliferation and Nuclear Security

Technology Development for Domestic and International Applications

JAEA implements technology development to strengthen nuclear non-proliferation and nuclear security based on national and international needs. We are making attempts at development of technology to detect nuclear materials in heavily shielded containers, technology for non-destructive analysis of nuclear materials contained in highly radioactive and complex materials, etc. As for nuclear forensics, which analyzes the origins of nuclear materials seized by law-enforcement authorities, efforts involve the development of handheld radionuclide identification devices to support initial on site response on nuclear and radiological terrorism and AI for analyzing signatures of nuclear forensics. We are also working on the development of methods for characterization of nuclear materials and methods for reduction of threat as countermeasures against nuclear and radiological terrorism in collaboration with the United States.

Delayed gamma-ray analysis test equipment capable of measurement of nuclear materials contained in highly radioactive and complex materials



Development of handheld radionuclide identification devices to support initial response to nuclear and radiological terrorism

Support for Government Policymaking Based on Technological Expertise

In order to support government policymaking, the ISCN conducts political research on nuclear non-proliferation and nuclear security based on our technical knowledge.

Since fiscal 2018, at the request of relevant administrative authorities, the ISCN has started a "study on factor analysis and technical process for achievement of denuclearization." The analyzed factors are motivation for nuclear development, national or international situations and implementation of denuclearization efforts using examples from South Africa, which achieved denuclearization, Libya, which made attempts at nuclear development, and other countries that have possessed or tried to develop nuclear weapons.

Moreover, the ISCN conducts research and analysis on the international trend of nuclear non-proliferation and nuclear security, and publishes the results on its website, and provides the information to the relevant authorities in the form of "nuclear non-proliferation trends," a "nuclear non-proliferation pocket book" and so on.

Human Resources Development for Emerging Nuclear Countries in Asia

The ISCN was established under JAEA following Japan's national statement at the 2010 Nuclear Security Summit. As of March 2019, there are 4,212 participants from 86 countries (including Japan) and five international organizations that have received training through ISCN's 165 courses. ISCN training programs consist of exercises using training tools such as ISCN's proprietary virtual reality (VR) system and the Physical Protection Exercise Field, as well as lectures and group discussions. They are designed to meet the needs of each partner country and have drawn high praise from the U.S. government as well as the Japanese government.

The ISCN's major focus is on participants from nuclear emerging countries in Asia who do not typically have the experience of visiting a nuclear power plant. The virtual experience with VR technologies and the hands-on training with nuclear security equipment at the Physical Protection Exercise Field, therefore, enhance the effectiveness of training. ISCN also promotes cooperation with training centers in China and the Republic of Korea, and exchanges of lecturers.

Lectures by experts

On-site training at JAEA facilities

Training with real equipment on physical protection exercises

VR system

Contributing to the CTBT International Verification Regime

The CTBT prohibits all nuclear weapon test explosions anywhere in the world, and stipulates the establishment of a regime to ensure the compliance of member states. Though it has not yet entered into force, 88% of the international monitoring system consisting of 337 monitoring facilities worldwide are already established and in provisional operation.

As well as conducting operation and maintenance of the radionuclide monitoring facilities and developing verification systems, JAEA is contributing to disarmament and nuclear non-proliferation through its active cooperation with the Japanese government in the analysis and evaluation of the past six nuclear tests in North Korea, and in the noble gas measurement project to improve nuclear test monitoring capability.

Radionuclide Monitoring Stations operated and maintained by JAEA

Okinawa monitoring station (measurement of particulates)

Takasaki monitoring station (measurement of particulates and noble gases)

Efforts to Promote Understanding and International Contribution

The ISCN is disseminating information both inside and outside JAEA through its website and the distribution of the ISCN Newsletter. It also organizes an international forum on nuclear non-proliferation and nuclear security. In addition to dispatching experts to international meetings at the IAEA and other venues, as part of JASPAS activities the ISCN provides technical assistance for IAEA safeguards and conducts safeguards training (training courses at reprocessing plants) in cooperation with the IAEA.

ISCN Newsletter

International Forum

TOPICS

Contributions Relating to International Non-proliferation Issues

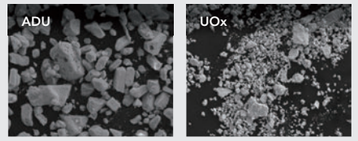
Same as in fiscal 2017, with participants from the Atomic Energy Organization of Iran (AEOI), the Training Course on Safeguard Implementation for Iran was held in July 2018. It received a high evaluation from the IAEA as this cooperation has smoothened communication with Iran in preparation for the implementation of the "Joint Comprehensive Plan of Action (JCPOA)" on the nuclear issues in Iran.

Moreover, in response to a request by the IAEA, a new training sponsored by the IAEA for safeguards implementation for member countries with Small Quantities Protocol (SQP) was held. It was the first time that this course was held in Asia, of which the practical training received a high evaluation from the IAEA, with a decision for it to be held again in fiscal 2019.

Training for safeguards implementation for member countries with Small Quantities Protocol (SQP)

Prevention of Nuclear Terrorism and Cooperation in Response to Incidents

Ahead of the 2020 Tokyo Olympics and Paralympics, strengthening of measures against nuclear terrorism at large events is required and, based on the development of nuclear material detection technology and nuclear forensics technology by the ISCN, we are promoting cooperation with security authorities in the prevention of nuclear terrorism and response to incidents.



Analysis by nuclear forensics technology (microscopic image example)

Compliance

Promotion of Risk Management and Compliance

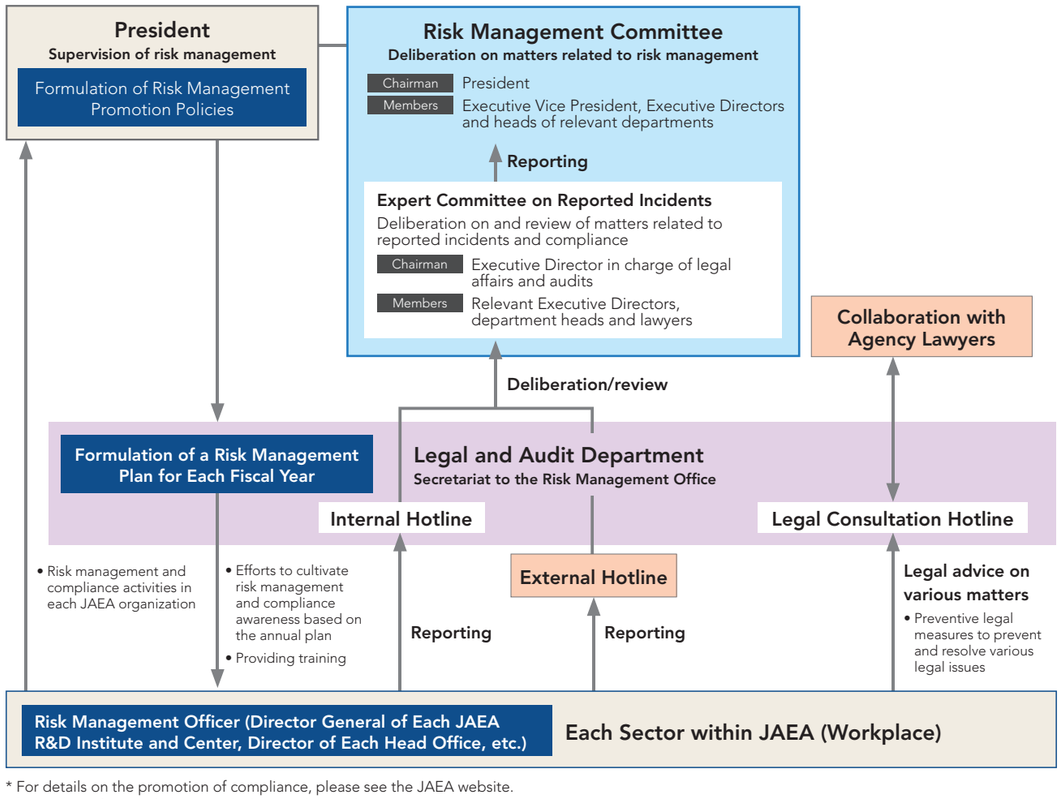
JAEA is promoting risk management activities to reduce and prevent various potential risks, including compliance risk. Efforts include monitoring risk management activities of each sector within JAEA, distributing Risk and Compliance Newsletters to all employees and raising awareness in each workplace via training. Through these efforts, we, as an institute engaging in nuclear R&D, will continue to work harder to merit the trust placed upon us by society.

JAEA provides compliance training every fiscal year, by job class and by subject. In fiscal 2018, training was held for new hires and employees newly promoted to the assistant manager level (202 participants, in total) and under the joint auspices of some departments (all sites, 675 participants) to reacknowledge and improve mindfulness of compliance.

JAEA has participated in the work of the Expert Committee on Compliance, the Association for National Research & Development Agencies, enhancing a compliance-minded atmosphere.

Training on compliance (Tsuruga Head Office)

Compliance enlightening poster



* For details on the promotion of compliance, please see the JAEA website.
https://www.jaea.go.jp/about_JAEA/compliance/ (in Japanese)

Appropriate Contracting Practices

(Seeking to Ensure Fairness, Transparency and Rationality)

JAEA formulates a Procurement Rationalization Plan every fiscal year. According to this plan, we implement the plan-do-check-act (PDCA) cycle to promote autonomous and continuous rationalization of procurement and related activities, while ensuring fairness and transparency.

Furthermore, we promote procurement of eco-friendly products, such as those designated under the Act on Promoting Green Procurement, from the viewpoint of environmental preservation. We also purchase products preferentially from organizations supporting persons with disabilities.

Under the Act on Promoting Green Purchasing, JAEA procured 99% eco-friendly goods for supplies and services. We also contracted 12 public works.

PDCA Cycle

in JAEA's Contracting Process

Check

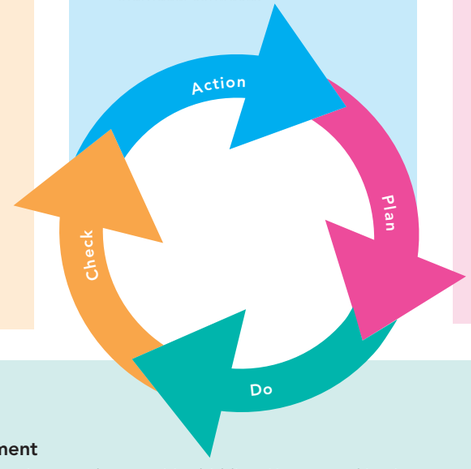
Rigorous Review and Monitoring Systems

- A potential contract undergoes a prior review by the Contract Review Committee, whose members include external experts. This review checks the entry conditions, and in the case of negotiated contracts, the reasons for using single tendering and whether competitive bidding is indeed unfeasible.
- The Contract Monitoring Committee, which comprises the Auditors of JAEA and external experts, checks the progress on implementing the Procurement Rationalization Plan and carries out follow-up inspections on individual contracts.

Action

Incorporation of Inspection Results into the Following Year's Plan

- To ensure fair contracts, we incorporate the results of follow-up checks and inspections into the following year's plan and individual contracts.



Plan

Procurement Rationalization Plan

- We formulated the Fiscal 2019 Procurement Rationalization Plan in June 2019.

Do

Execution of Rational Procurement

- Our basic, main tool for procurement is general competitive bidding. However, taking into account our highly specialized R&D operations that require a high level of expertise, we make flexible use of diverse modes of contracts to conduct rational procurement that is also fair and transparent.

Efforts to Ensure Competitive Opportunities in Our Contracting Process

- When conducting bidding, we strive to provide competitive opportunities to participants by not imposing unnecessarily strict entry conditions, creating easy-to-understand specifications, providing a sufficient public notice period and posting our annual procurement plan on our website.
- We also make efforts to increase the number of bid participants. As part of these efforts, we conduct questionnaire surveys to ask companies that did not participate in the bidding about the reasons for their withdrawal. For contracts involving a large amount of money, we hold a bidding briefing session in advance to promote an understanding of our specifications.

Efforts to Prevent Collusive Rigging Involving Government Agencies

- Conducted education and awareness campaign through an e-learning system to all employee in efforts to prevent collusive rigging involving government agencies.

* For details on the Procurement Rationalization Plan, please see the JAEA website.
https://www.jaea.go.jp/for_company/supply/contract/ (in Japanese)

Compliance

Public Consultation, Public Relations and Information Disclosure

JAEA ensures the transparency of its operations by proactively communicating facility safety and other information in addition to disseminating the outcomes of its R&D activities. At the same time, JAEA works to foster mutual understanding with local communities and society as part of its efforts to earn their trust through dialogue and similar activities.

Proactive Provision and Disclosure of Information and Transparency

JAEA aims to disclose to the public an array of R&D results obtained from its activities in a timely manner through mass media, using such means as press releases.

As additional means to disseminate information to a broader audience, JAEA makes use of its website and social networking service account. Its website features a collection of short videos called "Project JAEA," in which researchers and engineers present their respective R&D results. JAEA also has various publications on its website, like "GENKI," a series of public relations magazines that describes its R&D initiatives in an easy-to-understand manner, and "graph JAEA," a more visual series featuring numerous interesting photographs. Lastly, JAEA makes use of its official Twitter account (@JAEA_en) to provide the latest information on these videos and magazines.

GENKI (vol. 53, 2019)

graph JAEA

Information Disclosure

JAEA confirms the objectivity and transparency of its operations. Concurrently, JAEA promptly and appropriately responds to disclosure requests as provided for in the so-called Act on Access to Information. JAEA also holds meetings of the Public Information Committee constituted by external experts to verify the proper operation of its information disclosure system.

Dialogue and Facilities Open to the Public

JAEA promotes direct dialogue with local community members mainly at its R&D site locations to explain various matters. This also includes JAEA's R&D plans and outcomes to seek the community's comments and opinions. Additionally, JAEA conducts "open facility" days and facility tours to provide the public with the opportunity to directly observe and learn about its operations.

Science Café

JAEA provides "Science Cafe" on a regular basis as a venue for mutual communication where researchers and engineers can directly talk with the public about science in a friendly atmosphere.


Science Cafe

Exhibition at Events

JAEA actively participates in external exhibition events. At the "Youngsters' Science Festival" held every summer, JAEA provides science experiment classes for primary school and junior high school students. The experiments have included quality tests of mineral water and observation of natural radiation using a cloud chamber. At one of the biggest specialized exhibition events of analytical instruments and science equipment in Asia, the Japan Analytical & Scientific Instruments Show: JASIS 2017, JAEA demonstrated a highly sensitive gas analysis device.



Youngsters' Science Festival



Participation in an event in JASIS 2018

Briefing Results of Activities

The annual symposium for reporting events for the JAEA, as a whole, was held. In addition, briefing sessions were held covering the following areas: "Briefing Session on the activity outcomes of the Sector of Fukushima Research and Development," "Marine Science and Environmental Science Symposium in Mutsu," "EReTTSa Symposium," and "OECD/NEA Crystalline Club Meeting."


A JAEA annual symposium

Special Open Seminars

JAEA provides lecturers to speak on radiation and nuclear disaster prevention at "special open seminars." In support of information dissemination on these topics, university-level special open seminars are held to address the needs of technical college or university students and administrative agencies.

Support for School Education

Each JAEA R&D site has a public relations team (e.g. "Sweet Potato" at Tokai-mura, "Apple" in the Tsuruga area and "Sugars" in the Oarai area) assigned to introduce nuclear energy to the public. They provide classes, upon request, for primary school, junior and senior high school students. Lessons are also delivered by JAEA's researchers at Designated Super Science High Schools.


An anniversary of 20,000 participants to the lectures by "Sweet Potato"

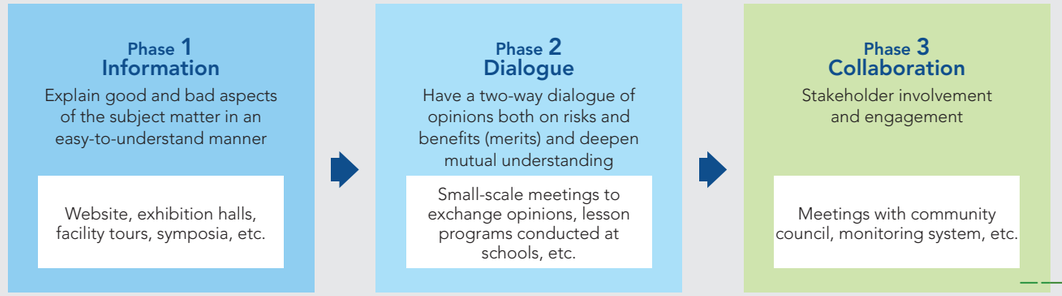
TOPICS

Risk Communication Activities

The aim of risk communication is to cultivate a relationship of trust and credibility among stakeholders by encouraging the exchange of opinions while imparting the good and bad aspects of the subject matter. As shown in the chart below, risk communication is divided into three phases: information, dialogue and collaboration. The "informal gathering with the local community" held in Tokai-mura and the "social meeting on uranium and environmental studies" at the Ningyo-toge Environment Technology Center are risk communication-related activities aiming at future collaboration with stakeholders.


Social meeting on uranium and environmental studies


Informal gathering with the local community



Efforts to Promote Research and Development

Implementation of JAEA's Strategy for International Cooperation

For JAEA to execute its mission, various forms of interaction with the international nuclear community, including relevant nuclear organizations in other countries and international organizations, is essential. JAEA's activities for international cooperation include among other things: implementation of international joint research contributing to maximization of R&D results; expanding human networks through international contribution via such means as support for human resource development efforts in other countries; and increasing the visibility of JAEA in the global nuclear community through dissemination of and international outreach regarding JAEA R&D results.

2018 special notes are underlined.

Dr. Kamide, Deputy Director General of the Sector of Fast Reactor and Advanced Reactor Research and Development of JAEA assumed the role of Chair of the GIF Policy Group on January 1, 2019.

Events Organized by Our Overseas Offices (We have expanded the scope and enhanced the content of events from previous years)

Events Attended by Key Persons from the Nuclear Community of the US and Europe.

The Second Symposium on US-Japan Nuclear Energy Research Cooperation held in Washington, DC, in June 2018.

The symposium included features on the enhancement of Light Water Reactor safety in addition to advanced reactor development.

CEA-JAEA Workshop on Decommissioning of Research Facilities held in Paris, in February 2019.

We invited organizations from the UK, Italy and EU in addition to the French organizations and the Organization for Economic Co-operation and Development/Nuclear Energy Agency (OECD/NEA).

Other Activities

- JAEA co-organized the International Mentoring Workshop in Science and Engineering, "Joshikai-II," with OECD/NEA to expand human resource bases for female students studying science in Tokyo, in August 2018.
- In terms of global orientation, JAEA has been striving to improve the living/working environment for foreign researchers stationed at JAEA.

* Please visit https://www.jaea.go.jp/about_JAEA/international_strategy/ for more detailed information on JAEA Strategy for International Cooperation.

Implementation of Facility Construction and Technical Assistance Pertaining to Earthquake Resistance Evaluation

In fiscal 2018, JAEA newly constructed a facility for volume reduction and treatment of solid wastes (OWTF), renovated not only nuclear but also general facilities for aseismic retrofit work, performed aseismic design for the renovation of JRR-3 and conducted a borehole drilling survey for near the Joyo reactor building.

In order to reopen the operation of test and research reactors including HTTR, JAEA has also been formulating the *design basis for ground motion* caused by earthquakes and the *design basis for tsunamis* and performing aseismic retrofit design as one of the steps for submission of the confirmation application to satisfy new safety standards.

OWTF (Oarai Waste Reduction Treatment Facility)

Acceleration of R&D by Using Advanced Computing Technologies

In the nuclear science and engineering research fields, it is necessary to explain and forecast phenomena that are difficult to observe directly or access in experiments.

JAEA is conducting R&D of simulation and high-speed computing technologies that make full use of supercomputers. JAEA is also proactively introducing modern computing technologies such as AI and big data analysis to elucidate complex real phenomena using these technologies.

Supercomputer

Development of Human Resources in the Field of Nuclear Energy

JAEA contributes to the development of human resources in the field of nuclear energy through providing Domestic Training Courses and International Training Courses, as well as cooperating with universities and the Japan Nuclear Human Resource Development Network.

Domestic Training Courses

Domestic Training Courses aim at cultivating RI/radiation engineers and nuclear engineers, as well as helping examinees who want to obtain national qualifications. In fiscal 2018, JAEA held 20 regular training courses and opened three on-demand training courses based on our clients' various needs. Many of the graduates are playing important roles as leaders and experts in the field of nuclear energy.

Radioisotope separation experiment (Radiation Protection Basic Course)

International Training Courses

In International Training Courses, JAEA accepts trainees from various countries mainly from Southeast Asia, and holds various types of training courses to develop instructors with expertise in radiation and nuclear energy. JAEA also holds seminars for cultivating human resources to disseminate basic knowledge on radiation (in fiscal 2018, 82 individuals from 11 countries attended the courses). Moreover, Japanese experts are dispatched to Asian countries to support their training courses by giving lectures and technical advice (in fiscal 2018, 59 experts dispatched to 9 countries).

JRR-1 Simulator practice (Environmental Radiation Monitoring Course)

Cooperation with Universities

JAEA engages in cooperation with many universities based on the agreement, which includes the acceptance of students from the Nuclear Professional School of the University of Tokyo (fiscal 2018: 15 students). In addition, JAEA also accepts Research Fellowship (38 students), Guest Student Researcher (171 students) and Summer Intern (211 students) students from various universities.

Furthermore, as part of activities of the Japan Nuclear Education Network, JAEA provides courses on nuclear engineering to seven universities through a distance learning system (number of attendees in fiscal 2018: 142 students). More than 40% of the JAEA's 2019 newly hired researchers and engineers had experienced our student acceptance programs.

A dialogue with young researchers and engineers concerning job-hunting consultation

Japan Nuclear Human Resource Development Network

The Japan Nuclear Human Resource Development Network aims to build a nationwide unified nuclear human resource development network based on mutual cooperation with 79 industry-academia-government institutions, and JAEA is acting as the secretariat jointly with another organization. The network held the Nuclear Energy Management School in collaboration with the International Atomic Energy Agency (IAEA) (held in Tokyo and Fukushima Prefecture in fiscal 2018) and also held language courses aimed at promoting the cultivation of young professionals in Japan who should play active roles in the international community in the future.

Closing ceremony of the 2018 Nuclear Energy Management School

* For details on human resources development, please see the JAEA website. https://nutec.jaea.go.jp/english/

Sector of Fukushima Research and Development

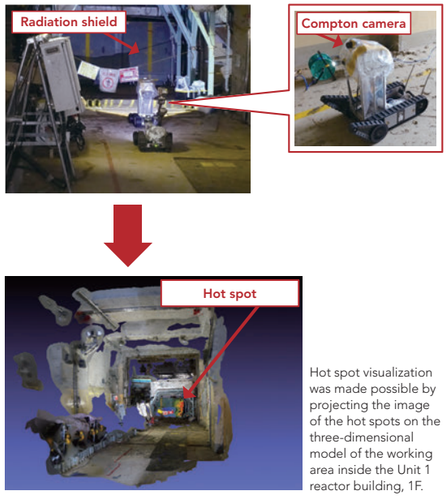
Establishment of Technologies toward the Recovery of Fukushima

The Sector of Fukushima Research and Development, Japan Atomic Energy Agency (JAEA), is working on research and development toward decommissioning of the Fukushima Daiichi Nuclear Power Station (hereafter referred to as "1F") and environmental restoration. Those results are supporting the formulation of decommissioning strategies and their subsequent planning/promotion by the government. Further, the results are contributing to the formulation of the plan toward the lifting of relief from the evacuation order by the government and that of the reconstruction plan by the local governments.

Technology Development to Visualize Contaminated Spots in Working Area –Radiation Imaging by Using Remote-controlled Robots–

In the formulation of the 1F decommissioning plan, it is required to obtain correct information on the distribution of radioactive materials, namely "hot spots" in reactor buildings, in order to reduce radiation exposure for the workers. However, it has been difficult to measure the distribution of radioactive materials directly, because the rubble and various equipments scattered in the area with high-dose rates inside the building become obstacles.

To challenge this problem, JAEA has succeeded in detecting hot spots inside buildings by mounting a small and light "Compton camera" on a remote-controlled robot. Further, a three-dimensional model inside the building was constructed in virtual space by combining photographs of the working area, as well as images of the hot spots obtained. Consequently, it is now possible to check the contamination status three-dimensionally, despite being visually difficult to do with the naked eye. These results expanded the possibility that we can formulate a detailed working plan that can minimize radiation exposure to workers, and could enable us to realize pre-trainings for workers.

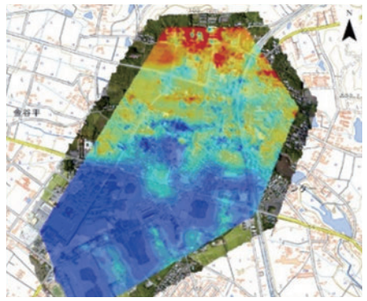


Hot spot visualization was made possible by projecting the image of the hot spots on the three-dimensional model of the working area inside the Unit 1 reactor building, 1F.

Simple but Detailed Assessment of Radiation Exposure at Specified Reconstruction and Revitalization Bases

By applying the research and development results of environmental restoration, JAEA advanced evaluation of radiation exposure at "Areas of the Specified Reconstruction and Revitalization Base (Reconstruction Base)."

First, we applied measurement technology currently using unmanned helicopters. Also, we succeeded in evaluating more detailed surface distribution of air dose rates on the ground by applying a mathematical method. Further, we evaluated radiation exposure via the Monte Carlo method using typical lifestyles of residents in the Reconstruction Base area based on hearings from local governments. In addition, internal radiation exposure from inhalation was estimated based on measurements of the radioactive-material concentration in the atmosphere. As a result, we clarified that internal radiation exposures in the Reconstruction Base area were less than 1% of the external ones in the same area. These results were reported to the Nuclear Regulation Authority, and utilized in the planning of radiation protection measures.



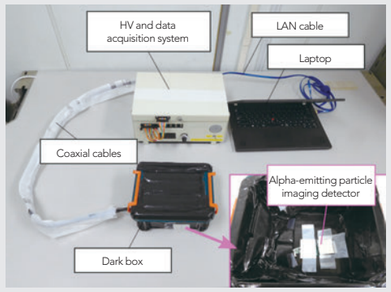
The detailed air dose distribution on the ground was evaluated based on mathematical analysis of results measured by unmanned helicopter.

Legend
Air dose rate at 1 m height on the ground (μSv/h)
6.5< 6.0–6.5 5.5–6.0 5.0–5.5 4.5–5.0 4.0–4.5
3.5–4.0 3.0–3.5 2.5–3.0 2.0–2.5 1.5–2.0 1.0–1.5
0.5–1.0 <0.5

TOPICS

Collaborative Laboratories for Advanced Decommissioning Science Succeed in Developing "Alpha-emitting Particle Imaging Detector"

In decommissioning research, detecting alpha-emitting particles (AEPs) is critical due to the significant effects of internal radiation exposure. JAEA attempted to measure smeared samples collected inside the 1F reactor building by using an "alpha-emitting particle imaging detector" developed in house. From the obtained energy distribution, we succeeded in detecting AEPs, which are thought to originate from nuclear fuel. By this method, it is possible to determine whether the AEPs originate from nuclear fuel or nature. Additionally, since the two-dimensional distribution and the radioactivity of the AEPs can be measured by this method, it has become possible to observe the distribution status of AEPs simply and quickly. The developed detector is expected to be applied to the radiation management of working areas and the radiation protection of workers.



Alpha-emitting particle imaging detector

Naraha Center for Remote Control Technology Development Contributing to the Development of Domestic Human Resources on Remote Control Technology

In the Naraha Center for Remote Control Technology Development, JAEA, various test facilities are equipped for the development and demonstration tests of remote-controlled instruments. These facilities are utilized by students not only from Fukushima but also from all over Japan. For example, Kobe University conducted training on the highly difficult operation of underwater robots using a test pool, the simulated experience of environment inside the 1F reactor by virtual reality (VR) and so on. Nihon University conducted the test to elucidate the flight characteristics of drones using motion capture, and Tokyo Institute of Technology performed the crawler robot test of traversing over rough terrain using mock-up stairs. In this way, through the training and technological cooperation for various tests by using the facilities, JAEA contributes to the development of human resources who will steward this technology in the future among students nationwide.

Training conducted by Kobe University

Okuma Analysis and Research Center Enhanced Analytical Training Functions of Workshop in the Administration Building

Toward the decommissioning of 1F, the Okuma Analysis and Research Center, JAEA, is conducting research and development to characterize fuel debris produced by the March 2011 accident. For this purpose, the facilities for analysis and research are being prepared at the Center, located near the 1F site. In order to enhance the function of the workshop (working place for tests and training) in the Administration Building that began operations in 2018, various analytical instruments are being installed. The facilities are utilized for training of analysis engineers and preparation of manuals.

Germanium (Ge) semiconductor detector for low-energy gamma rays equipped in the workshop.

Fukushima Environmental Safety Center "Fukushima Comprehensive Environmental Information Site (FaCEIS)" Prepared

A new information website named "Fukushima Comprehensive Environmental Information Site (FaCEIS)" has been established, which summarizes the information on radioactive cesium in the environment from diversified perspectives. On this site, visitors can view various kinds of information such as actual observation data, distribution and migration of radioactive cesium based on field work, and the results of numerical analyses based on observed data. A wide range of effects are expected through availability of this information, including answering people's questions and providing a knowledge base to local and national governments for formulating measures related to Fukushima reconstruction, such as reduction of radiation exposure and lift of relief from the evacuation order.

https://fukushima.jaea.go.jp/ceis/
(This site is only available in Japanese.)

Action

JAEA's R&D

Sector of Nuclear Safety Research and Emergency Preparedness

Contribution to the Continuous Improvement of Nuclear Safety

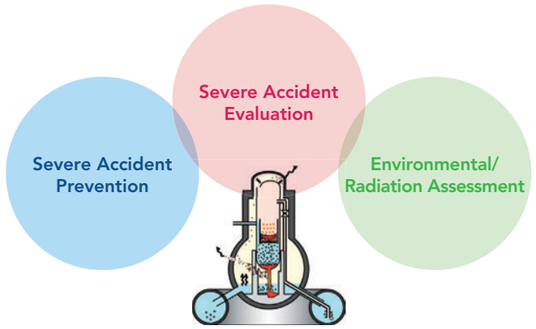
The Sector of Nuclear Safety Research and Emergency Preparedness contributes to the improvement of nuclear safety and emergency preparedness regulations and response through scientific studies and investigations.

Safety Research for Contribution to Nuclear Safety Regulations

Based on the lessons learned from the Fukushima Daiichi Nuclear Power Station accident, the Nuclear Safety Research Center (NSRC) is carrying out research to enhance the defense-in-depth safety concept through continuous improvement toward the highest standards of safety. We conduct near-term research according mainly to the safety research needs of the Nuclear Regulation Authority (NRA) to establish scientific and rational regulation under a risk-informed regulatory system.

We also perform advanced studies of long-term technical aspects. Our activities are based on the principles of transparency and technological neutrality. We have a cooperative relationship with research institutes and universities in other countries and with international organizations.

Research Focused on Responding to Beyond Design-Basis Accidents



Technical Assistance for Nuclear Emergency Preparedness and Response

Activities in Nuclear Emergency

JAEA provides technical support for the nuclear disaster response activities of the national and local governments as the designated public institutions based on laws. The Nuclear Emergency Assistance and Training Center (NEAT) serves as the base for JAEA's technical support.

Activities in Normal Times

NEAT supports the nuclear disaster drills of the national and local governments and personnel training related to nuclear disaster prevention. We also conduct research to support strengthening of the nuclear disaster prevention system and provide technical assistance for nuclear disaster countermeasures in Asian countries and elsewhere.

Main Achievements in Fiscal 2018

1. Safety Research for Contribution to Nuclear Safety Regulations

- We acquired data such as fuel failure limits using the Nuclear Safety Research Reactor (NSRR), which is the first JAEA research reactor to be restarted under new regulatory requirements. In addition, we conducted various safety research necessary to deal with severe accidents at nuclear facilities.
- In order to solve the NRA's technical tasks and related issues, we conducted 24 delegated safety research projects and contributed to the technical evaluation of academic standards at the NRA through the provision of research results.
- A cooperation agreement on human resource development through nuclear safety research was concluded with NRA as a forerunner to future personnel exchanges.
- OECD/NEA joint project "Analysis of Information from Reactor Buildings and Containment Vessels of Fukushima Daiichi Nuclear Power Station (ARC-F) Project" was started. JAEA serves as the operating organization.
- We have developed techniques for efficiently and accurately analyzing fine uranium particles in environmental samples taken at nuclear facilities, and passed the analytical capability certification test as one of the IAEA Network of Analytical Laboratories.

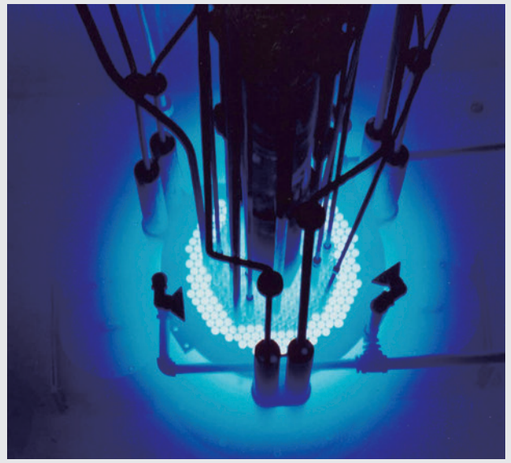
2. Technical Assistance for Nuclear Emergency Preparedness and Response

- In addition to training for 1,512 national and local government officials, we have newly developed, implemented and tested a training program for training core personnel who are responsible for decision-making in an emergency.
- In the nuclear disaster prevention drills conducted by national and local governments, we supported everything from planning to actual work and evaluation, which contributed to the improvement of response capabilities in nuclear disasters.

TOPICS

Experiments with "NSRR," Which Resumed Operation

NSRR is a research reactor that can safely obtain extremely high power instantaneously. JAEA used it to simulate the situation of reactivity accidents in light water reactors, and obtained failure limit data for high burnup improved fuel. The knowledge gained will be used not only in NRA, but also overseas, for fuel safety research and for ensuring the safety of nuclear power plants.



Nuclear Safety Research Reactor "NSRR"

Aircraft Monitoring in Disaster Drills

Jointly with NRA and the Ministry of Defense, NEAT implemented emergency monitoring using aircraft in the "National Nuclear Energy Disaster Prevention Drill" and the "Hokkaido Prefecture Nuclear Emergency Drill" to verify the effectiveness of the emergency aircraft monitoring system.

Aircraft monitoring in Hokkaido Prefecture Nuclear Emergency Drill

"ARC-F" Project Started

ARC-F is an OECD/NEA joint project proposed by JAEA initiated with the aim of investigating the detailed circumstances of the Fukushima Daiichi Nuclear Power Station accident and contributing to the safety improvement of light water reactors. Twenty-two organizations from 12 countries are participating, and the following tasks will be performed during the three-year duration until December 2021.

Meeting of ARC-F project

Task 1: Refinement of analysis for accident scenarios and associated fission product transportation and dispersion

Task 2: Compilation and management of data and information

Task 3: Discussion for future long-term projects

JAEA's R&D

Sector of Nuclear Science Research

Basic and fundamental research to support and advance atomic energy

The Sector of Nuclear Science Research (SNSR) has the following mission: "Advancing the latest science and technology that supports the use of radiation and atomic energy and continuing the fundamental support of atomic energy development." The activities of the SNSR are spread over a broad range of R&D such as basic and fundamental nuclear research, advanced nuclear science research, materials science research using neutrons and synchrotron radiation, R&D to improve nuclear safety, and R&D on accelerator-based techniques to reduce the volume and toxicity of radioactive waste. These activities also include human resource development related to these R&D programs.

Nuclear Science Research Institute

The Nuclear Science Research Institute has various research facilities for nuclear science and technology and functions as an R&D base. Seismic construction work has been carried out for the restart of operation of the research reactor JRR-3 after completion of the conformity review for the New Regulatory Requirements of the Nuclear Regulation Authority, which were developed considering lessons learned from the accident at the Fukushima Daiichi Nuclear Power Station. The Nuclear Safety Research Reactor restarted operations and made a significant contribution to nuclear fuel safety through irradiation experiments in fiscal 2018.

Research Reactor JRR-3

Nuclear Science and Engineering Center

The Nuclear Science and Engineering Center conducts basic and fundamental R&D on nuclear data and reactor engineering, fuels and materials engineering, nuclear chemistry, and environment and radiation science. The R&D meets a variety of social demands, contributes to the creation of innovative nuclear technology and provides a foundation for atomic energy use.

Advanced Science Research Center

The Advanced Science Research Center promotes leading-edge nuclear science research on advanced actinide science and advanced nuclear materials science, which provides a very strong academic and technological impact and contributes to the evolution of nuclear science.

Materials Science Research Center

The Materials Science Research Center promotes materials science research that contributes to nuclear science and the utilization of nuclear energy with high scientific and social significance. The R&D has been performed through the full use of neutron and synchrotron radiation instruments installed at JRR-3, J-PARC MLF, and SPring-8 as advanced analysis tools for the structure and function of materials. Especially, we have begun developing analytical systems for the fuel debris and related materials derived from the Fukushima Daiichi Nuclear Power Station.

J-PARC Center

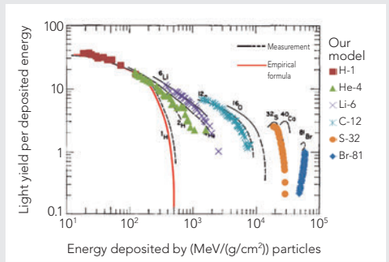
J-PARC Center conducts a variety of research on fields ranging from fundamental science to industrial applications using various secondary particles produced by high-intensity proton beams with domestic and overseas users. The center also carries out R&D to improve the efficiency of the facility, leading to successful operation of the neutron user program, with a beam power equivalent to 1 MW (the rated power of the facility) for one hour in fiscal 2018.

Japan Proton Accelerator Research Complex, J-PARC

TOPICS

Precise Prediction of Scintillation Light Intensity by Microscopic Radiation Transport Calculation and Föster Quenching Model

A calculation model based on a track-structure simulation code has been developed to precisely predict the light yield of a generally used plastic scintillator irradiated by electrons, protons and heavy ions. We considered the quenching effect resulting from the energy transfer between molecules (Föster effect), after calculating the excitation of scintillator molecules by the incident particles. The simulated light yields reasonably agreed with the measured data for various particles, with an energy range from a few hundred keV to a few GeV. The model proposed here will lead to a new detector design, experiment planning, and scintillator material development.

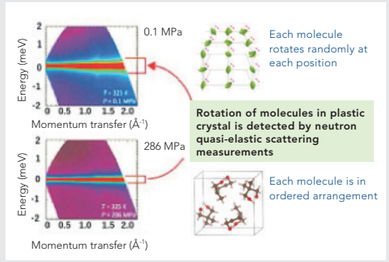


Relations between energy deposition by heavy ions and light yield by our numerical model

https://www.jaea.go.jp/02/press2018/p18083001/ (in Japanese)

Mechanism of Colossal Barocaloric Effect in Plastic Crystals

Inelastic neutron scattering measurements carried out by using the direct geometry chopper spectrometer AMATERAS, together with molecular dynamics simulations, revealed that the colossal barocaloric effect of a plastic crystal, neopentylglycol (NPG), results from the disorder-to-order phase transition induced by pressure. The analyzed result indicated that the orientational disorder of organic molecules consisting of NPG is enhanced under ambient pressure, corresponding to the quasi-elastic scattering spreading over the energy transfer range less than 4 meV, whereas it is suppressed at a high pressure of 286 MPa, above the phase transition threshold. Plastic crystals are promising for practical refrigeration applications given that they are abundantly available, environmentally friendly, easily driven and have high performance. The obtained result opens a new direction for solid-state refrigeration technologies.

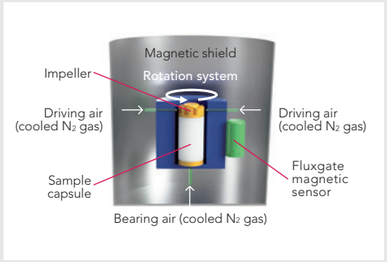


Result of inelastic neutron scattering measurement for NPG indicating pressure-induced disorder-to-order phase transition

https://www.jaea.go.jp/02/press2018/p19032902/ (in Japanese)

Direct Observation of Gyromagnetic Reversal

An apparatus with a non-magnetic air-driven rotor system inserted into a cryostat has been developed to measure the magnetization induced by mechanical rotation through the coupling between rotation and total angular momentum of electrons. This apparatus demonstrated that the magnetization and angular momentum of a ferrimagnetic insulator $Ho_3Fe_5O_{12}$, composed of multiple magnetic ions with opposing moments, become parallel within the temperature range from 135 to 240 K, where the net magnetic moment and angular momentum cancel out (the magnetic and angular momentum compensation temperatures (T_M and T_A)), respectively. The technique proposed here offers a possibility to develop next-generation magnetic devices, as recent research results on the domain wall mobility enhanced at T_A have drawn considerable attention.

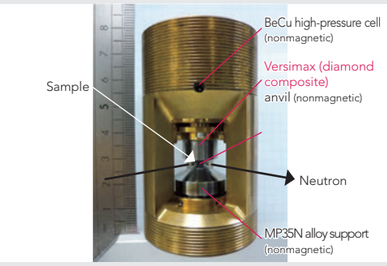


Schematic of apparatus to measure magnetization induced by mechanical rotation

https://www.jaea.go.jp/02/press2018/p18083102/ (in Japanese)

Three-dimensional Neutron Polarization Analysis under High Pressure for Complex Magnetic Materials

We have developed a high-pressure cell for three-dimensional neutron polarization analysis. The newly developed high-pressure cell was made completely of non-magnetic materials and hence has no effect on neutron polarization. The polarized neutron scattering measurement on the delafossite $CuFeO_2$ determined the detailed magnetic structures in the pressure-induced ferroelectric phases. The present technique covers a wide range of pressure-induced phenomena associated with complex magnetic orderings such as magnetoelectric multiferroics, simultaneously exhibiting (anti)ferromagnetic and ferroelectric orderings and attracting much attention over the past decade.



Newly developed non-magnetic hybrid-anvil-type high-pressure cell

https://www.jaea.go.jp/02/press2018/p18102202/ (in Japanese)

Action

JAEA's R&D

Sector of Fast Reactor and Advanced Reactor Research and Development

Seeking nuclear innovation with enhanced safety, economic competitiveness and flexibility

In the "Sector of Fast Reactor and Advanced Reactor Research and Development (SeFARD)," we are implementing R&D on advanced reactor technologies such as fast reactors, high-temperature gas-cooled reactors, and related fuel cycle technologies, in order to attain further enhancement of future energy sustainability, safety, economic competitiveness and a flexible load-following ability. R&D is also being conducted in the fields of decommissioning and radioactive waste management.

Oarai Research and Development Institute

Using different types reactors – the High Temperature Engineering Test Reactor (HTTR) and the Experimental Fast Reactor JOYO – and related research facilities, based on national policy such as the Strategic Energy Plan, R&D programs are conducted on development of fast reactor technology, and high-temperature gas-cooled reactor technology and related heat application technology. Also, decommissioning and technological development of the Japan Material Testing Reactor (JMTR), and R&D into technical support for decommissioning of the Fukushima Daiichi Nuclear Power Station and others, are conducted.

Oarai Research and Development Institute

Fast Reactor Cycle System Research and Development Center

Studies related to fast reactor system design, nuclear reactor behavior and development of standards for safety evaluation of the plants are conducted for the establishment of a nuclear fuel cycle with fast reactors that contributes to long-term energy security and the resolution of global environmental issues.

Experimental Fast Reactor JOYO

HTGR Research and Development Center

The High Temperature Gas-Cooled Reactor (HTGR) is an attractive nuclear reactor since it has inherent safety and can reach high helium gas temperatures of around 950 degrees C. We are carrying out R&D of multipurpose heat utilization effective for global warming countermeasures on HTGR technology, such as the technology for hydrogen production through high-temperature water-splitting, with high-temperature heat and the helium gas turbine technology for power generation.

High Temperature Engineering Test Reactor (HTTR)

Waste Management and Decommissioning Technology Development Center

Decommissioning of the JMTR (Japan Materials Testing Reactor) and development of related technology were started in JMTR, which had been widely used most notably for irradiation tests of light water reactor fuel and materials. We also develop treatment technologies for radioactive waste, which is gathered from experimental nuclear reactors or laboratories at Oarai Research and Development Institute.

Oarai Waste Reduction Treatment Facility (OWTF)

Tsuruga Comprehensive Research and Development Center

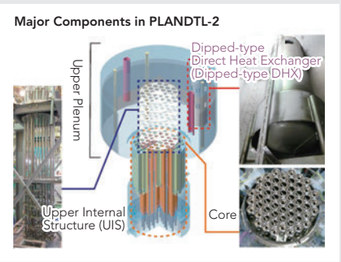
The center is engaged in knowledge preservation related to "Monju," technology development on the inspection and maintenance of sodium-cooled fast reactors, and research and development on applied laser technology for nuclear facilities.

Sodium Engineering Research Facility (SERF)

TOPICS

Research and Development of Sodium-cooled Fast Reactor

Within the framework of the research cooperation program with the French Alternative Energies and Atomic Energy Commission (CEA) to promote development of sodium-cooled fast reactors, JAEA has conducted an experiment using its sodium facility (PLANDTL-2). The experiment demonstrated the effectiveness of a decay heat removal system that utilizes a heat exchanger installed in the upper plenum of a reactor vessel. JAEA will validate numerical simulation models using the obtained data and strive for further improvement of prediction accuracy so that demonstrations with a large-scale experiment can be replaced by highly reliable numerical simulations in the future. This approach would significantly reduce development costs related to the construction and operation of large full-scale experimental facilities.



Test section and major components of sodium experimental apparatus (PLANDTL-2)

Development for Decommissioning of Reactor Facilities

The application for approval of the decommissioning plan of the JMTR was prepared based on evaluation such as distribution of contamination within the facility, amount of radioactive solid waste and radiation exposure during normal times and accidents, and assessment of facilities to maintain during the decommissioning period.

JMTR

Development of Technologies for Radioactive Waste Treatment and Management

The OWTF, constituted for radioactive waste treatment, completed all construction work in 2018. Furthermore, the Japan Nuclear Regulation Authority approved the site's compatibility with the revised nuclear regulations.

Incineration and Melting Equipment in OWTF

Continuous H_2 Production for 150 Hours by Thermochemical IS Process Using Test Facility Made of Industrial Materials

JAEA is working energetically to develop a thermochemical water-splitting iodine-sulfur process (IS process) for promising HTGR hydrogen production systems. The IS process splits raw material H_2O into H_2 and O_2 by combining three chemical reactions using sulfur and iodine compounds. A test facility was constructed applying corrosion-resistant components developed using industrial materials. Technical issues for instrumental improvements (prevention of leakage, etc.) were solved for stable hydrogen production tests, so that the H_2 production facility in connecting the three chemical processing sections was successfully operated for 150 hours at a rate of ca. 30 L/h (January 2019). The next challenge is development of an automatic control system to maintain solution composition circulating in the process.

Continuous hydrogen production test facility made of industrial materials. H_2 production rate: 0.1 m^3/h-H_2 Size: W18.5×D5×H 8.1 (m)

* https://www.jaea.go.jp/02/press2018/p19012502/ (in Japanese)

"Fukui Smart Decommissioning Technology Demonstration Base" Established

In June 2018, the operation of "Fukui Smart Decommissioning Technology Demonstration Base" (hereinafter abbreviated as "Sumadeco") started with the aim of providing technical seeds on decommissioning to local companies and improving their technical capabilities by conducting technical demonstrations. This facility was planned and established in collaboration with JAEA, Fukui Prefecture, University of Fukui and the Wakasa Wan Energy Research Center. It consists of three distinctive fields, including MR (Mixed Reality) systems, cooperative robot movement and adaptive laser-cutting control systems and an underwater technical demonstration test area with a cylindrical water tank.

In fiscal 2018, external organizations used the Sumadeco 14 times, among which 8 times were by organizations in Fukui Prefecture.

Panoramic view of "Sumadeco"

Action

JAEA's R&D

Sector of Nuclear Fuel, Decommissioning and Waste Management Technology Development

Toward the Establishment of Back-End Technology

—Sector of Nuclear Fuel, Decommissioning and Waste Management Technology Development

We are steadily promoting R&D on the processing technology of radioactive waste, the technology for geological disposal of high-level radioactive waste and the technology for the decommissioning of nuclear facilities, which lead to the improvement of safety and reduction of the environmental burden.

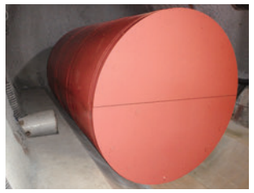
Research and Development Sites on Geological Disposal Technology

Fundamental R&D is being conducted to support a national disposal program for high-level radioactive waste at three sites.

At Tono Geoscience Center, the Mizunami Underground Research Laboratory project targeting crystalline rock and study of the long-term stability of the geological environment are being implemented in the framework of research on the deep geological environment.

At Horonobe Underground Research Center, another Underground Research Laboratory project on sedimentary rock is ongoing, in which R&D to develop engineering technology using an underground gallery and other features is being conducted, as well as research on the deep geological environment.

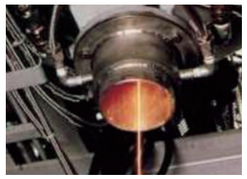
Nuclear Fuel Cycle Engineering Laboratory (NCL) is involved in repository design and the development of technology necessary for evaluating safety as part of its R&D activities regarding geological disposal.



[Horonobe] *In-situ* demonstration of PEM (Prefabricated Engineered barrier system Module)

Nuclear Fuel Cycle Engineering Laboratories

NCL is the R&D site where practical and advanced R&D work has proceeded to establish the nuclear fuel cycle for effective use of atomic energy. NCL continues to contribute to the creation of innovation in atomic energy use and the resolution of energy resource issues by advancing R&D for the plutonium-uranium mixed oxide (MOX) fuel, the development of a minor actinide (MA) separation technique with the purpose of reducing the volume of radioactive waste and the degree of harmfulness, countermeasure for the accident at Fukushima Daiichi Nuclear Power Station and so on. At Tokai Reprocessing Plant, the decommissioning of large-scale nuclear fuel facilities, which is a major long-term project, has been progressing as a top runner in Japan.



Flow-down of molten glass

Ningyo-toge Environmental Engineering Center

The Ningyo-toge Environmental Engineering Center of JAEA has been working as a pioneer in the first decommissioning of large nuclear fuel facilities in Japan. We conduct research and development on rational processing methods for centrifuges, with safety as the highest priority. Regarding uranium mine closure, we are conducting research and analysis of surface and subsurface flow characteristics, as well as the behavior of uranium and radium in groundwater.

Uranium Enrichment Demonstration Plant DOP-2 centrifuge

Aomori Research and Development Center

Aomori Research and Development Center is based in Mutsu City, Aomori Prefecture, and has achieved results such as elucidation of migration behavior of radioactive materials in the marine environment using an accelerator mass spectrometer (AMS) that measures the very small quantity of radionuclides in the global environment with the highest level of accuracy.

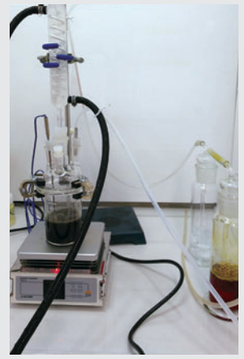
Accelerator mass spectrometer (AMS)

TOPICS

Treatment of Various Radioactive Liquid Waste

Nuclear Fuel Cycle Engineering Laboratories has launched a research project for development of new technologies to treat radioactive liquid waste involving a range of chemicals. Various collaborators from universities, a national institute and private companies joined this project.

Ammonium ions are one of the target species to be treated in this project, and we achieved decomposition of ammonium ions through ozone oxidization with the existence of cobalt and chloride ions as catalysts. This process satisfies the safety issue for hot laboratories, because it does not require the high temperatures and pressure typically necessary for practically available procedures. This technology is expected to be widely applied for treatment of other hazardous nitrogen compounds.

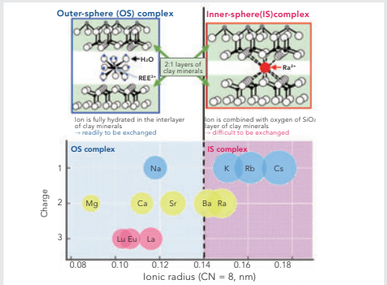


Decomposition test of liquid waste including ammonium salts (heating and stirring equipment)

Research on Radium Behavior for the Closure of the Open-pit Mine Site and the Mill Tailings Pond

The Ningyo-toge Environmental Engineering Center of JAEA has been conducting research to understand the behavior of radium (Ra) in the surface environment of the center in order to proceed with the closure of the mine facilities.

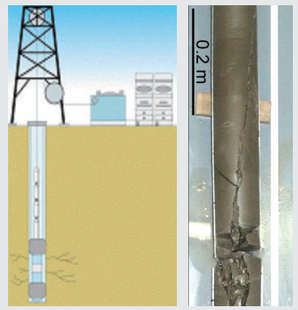
By applying advanced methods such as synchrotron radiation analysis and quantum chemical calculation to the samples of the open-pit mine site and the mill tailings pond, we are attempting to estimate the behavior and the adsorption structure of Ra in these sites based on the atomic-level chemical reactions. These studies are expected to contribute to construction of the technology related to the closure of mine facilities.



Adsorption structure on 2:1 type clay minerals (two types of surface complexes) and relationship between charge and ionic radius of various ions

Development of Method to Assess Hydraulic Connectivity of Subsurface Fractures through Surface-based Investigations

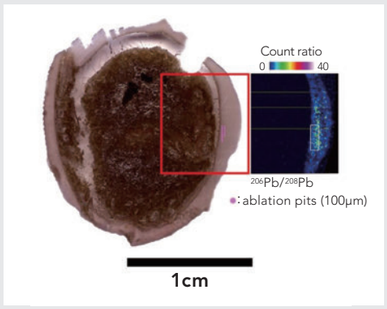
Although it has been difficult to properly assess the hydraulic connectivity of subsurface fractures through surface-based investigations, Horonobe Underground Research Center has developed a new, practical method allowing the assessment by highlighting the nature of pressure responses depending on the hydraulic connectivity of fractures. The developed method will be useful for not only geological disposal but also for resource exploration and/or geological carbon storage, in which assessment of the storage performance of geological formations is needed.



(left) Image of borehole investigation
(right) Natural fracture observed in drill core

The Development of *In-situ* U-Pb Dating Method for Calcite Using LA-ICP-MS

At the Tono Geoscience Center Toki Geochronology Research Laboratory, we developed an *in-situ* U-Pb dating method for calcite (calcium carbonate) by using laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS). This new method enables dating of extremely fine areas (up to μm) for calcite by combining isotopography, and is the first reported use of this technique in Japan. This dating method contributes to the development of scientific studies to estimate the past geological environment.



A well-preserved calcareous Carboniferous fossil specimen (*Pentremites* sp.). We applied our method to the *Pentremites* sp.

JAEA's R&D

Sector of Tsuruga Decommissioning Demonstration

Toward a Safe and Steady Decommissioning

The decommissioning of the "Fugen" and "Monju" reactors is proceeding steadily in accordance with the decommissioning plan, giving top priority to ensuring safety.

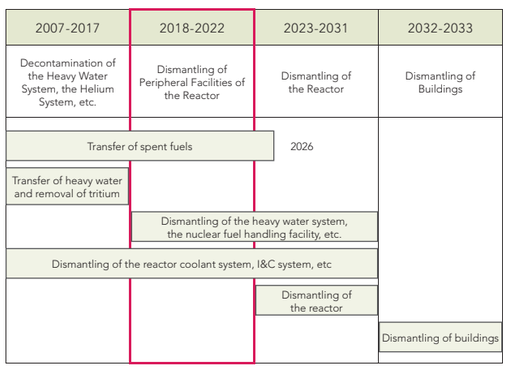
"Fugen" has shifted to the phase of dismantling of peripheral facilities of the reactor, while "Monju" has started the unloading of fuel assemblies. Both are moving ahead steadily toward the completion of decommissioning.

Toward the Completion of Decommissioning of "Fugen"

For "Fugen," we are smoothly proceeding with dismantling operations and so on toward the completion of decommissioning in fiscal 2033.

For "Fugen," operations in the phase of "decontamination of heavy water, helium and other systems" were completed in fiscal 2017, and shifted to the phase of "dismantling of peripheral facilities of the reactor" in fiscal 2018. Presently, dismantling and decontamination of peripheral equipment of the reactor, turbines, generators and so on in relatively low-dose areas are being executed.

Moreover, in preparation for dismantling of the reactor itself in the phase of "dismantling of the reactor" from fiscal 2023, preparation and examination are under way for safe and efficient dismantling procedures, such as sampling inside the reactor vessel to grasp radioactivity of the structural material of the reactor with high precision.



Toward the Completion of Decommissioning of "Monju"

We are decommissioning "Monju," the first fast reactor in Japan, according to the decommissioning plan, harnessing the wisdom of domestic and overseas professionals and giving top priority to ensuring safety.

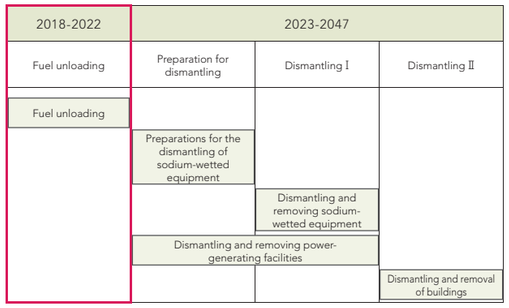
According to the decommissioning plan approved in March 2018, after the first phase to transfer fuel assemblies to a fuel pool, the second phase to prepare for dismantling of sodium-cooling and other equipment, the third phase to dismantle sodium-cooling equipment and the fourth phase to dismantle and remove buildings, the completion of decommissioning is scheduled for fiscal 2047. We started the first phase of "fuel unloading" in August 2018, which marks the first step of decommissioning for almost 30 years.

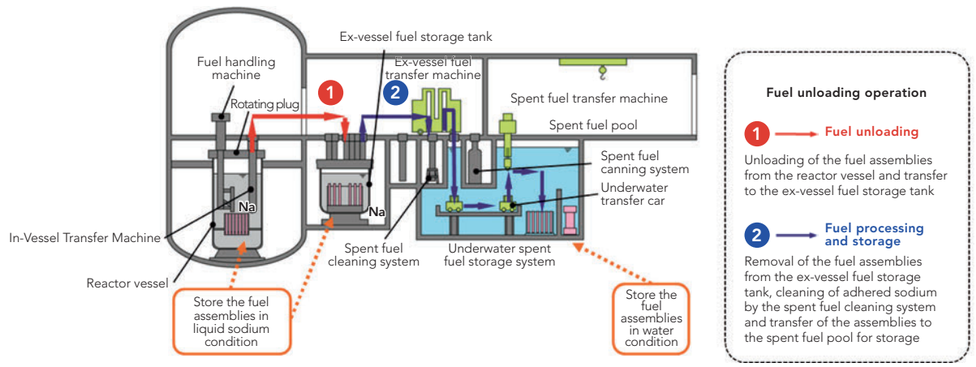
"Fuel unloading" consists of "unloading of fuel assemblies" to transfer the fuel assemblies from the reactor vessel to the ex-vessel fuel storage tank and "treatment of fuel assemblies" to clean the adhered sodium from the surface of the fuel assemblies in the ex-vessel fuel storage tank and store them in the fuel pool. In fiscal 2018, we executed operations giving top priority to ensuring safety and checking each process, and completed "treatment of fuel assemblies" for 86 fuel assemblies by January 2019. Through the operations, by finding points for improvement and achieving refinement and proficiency of operators, we obtained a more certain perspective for the completion of "fuel unloading" scheduled for fiscal 2022 according to the decommissioning plan.

In fiscal 2019, as well as ensuring the improvements based on knowledge obtained during fiscal 2018, we are planning to execute "unloading of fuel assemblies" for 100 fuel assemblies from October and "treatment of fuel assemblies" for 130 fuel assemblies after that.

In this manner, we will proceed steadily with operations toward the completion of "fuel unloading" in fiscal 2022, giving top priority to ensuring safety.


Control room for the Fuel Handling Facility



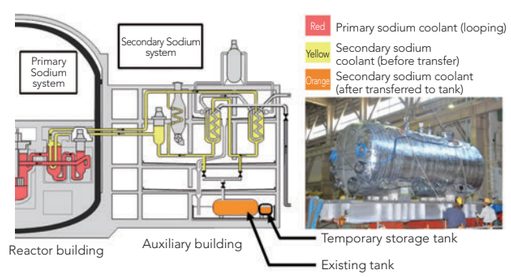


To Reduce Risks – Completion of Sodium Drainage in the Secondary Cooling System –

In parallel with "fuel unloading," in order to ensure safety and reduce potential risks for the facilities, we are reviewing facilities' operations and maintenance for each phase of decommissioning.

In fiscal 2018, to reduce risks of sodium leakage and combustion, in December 2018, all sodium in the secondary cooling system (about 750 tons) was transferred to a tank, then solidified to be stored in safer conditions.

Looking forward, by fiscal 2022 when "fuel unloading" is completed, we will consider the method and timing of sodium drainage from the primary cooling system, and the method of treatment and disposal for sodium drained from both systems.



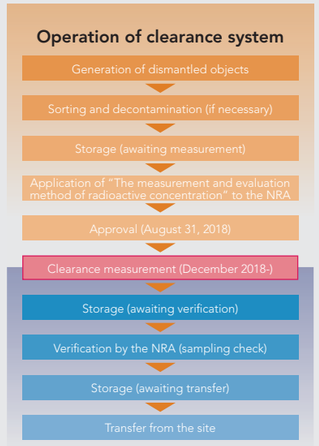
TOPICS

Efforts for Reduction of Radioactive Waste – First operation of clearance system in Fukui Prefecture started –

The system to enable reuse and disposal of radioactive waste generated by decommissioning of nuclear facilities with low radioactivity concentration, which have negligible effects on human health, as general waste with approval and verification by the government is called a "clearance system."

Under the system, for "Fugen," we obtained approval by the Nuclear Regulation Authority concerning the "measurement and evaluation method of radioactive concentration" in August 2018, and started the clearance measurement in December 2018. There are other nuclear power plants that had already introduced the clearance system, but "Fugen" was the first example in Fukui Prefecture.

At "Fugen," among the roughly 1,100 tons of dismantled objects generated in the radiation-controlled area so far, measurement and evaluation of about 49 tons were completed in fiscal 2018. We will receive verification by the government in fiscal 2019, and continue thorough examinations regarding the reuse of the dismantled objects thereafter to gain a social understanding of their impact.



Human Resource Management

In August 2017, JAEA formulated our Human Resources Policy with a view to maximizing R&D outcomes and carrying out efficient operations. The policy specifies the main points as shown below and describes the ideal image of employees JAEA should pursue as well as the career path policies leading them closer to this ideal image. By increasing the motivation of employees and improving their qualifications and capabilities, we are promoting human resource development in a systematic and organized manner.

Main Points of the Human Resources Policy

1. Development of professionals in a well-planned manner and promotion of generational transfer of knowledge and skills
2. Acquisition and development of human resources with technological capabilities and expertise
3. Maintenance and improvement of work-life balance
4. Promotion of diversity
5. Optimization of personnel and age compositions

* For details on the Human Resources Policy, please see JAEA's website.
https://www.jaea.go.jp/about_JAEA/hr_policy/ (in Japanese)

Ideal Image of JAEA Employees to Be Pursued

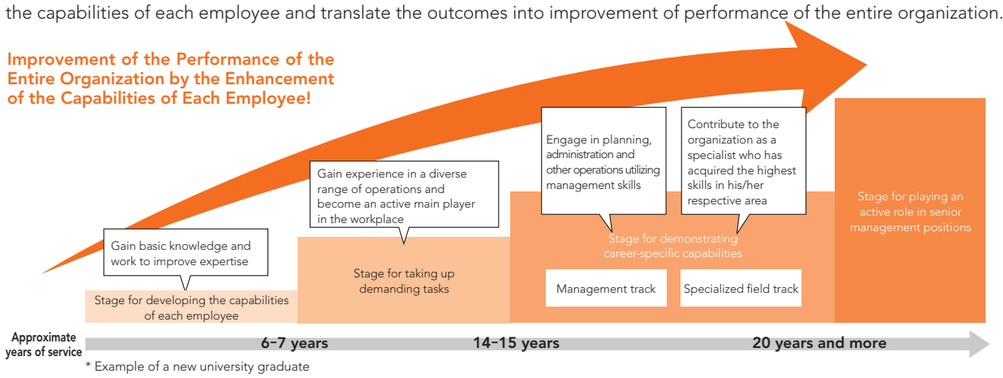
By sharing the ideal image of JAEA employees among the employees, we encourage them to voluntarily commit themselves to their tasks, which include setting their own goals. In this way, we, as an organization, take responsibility for promoting their growth and strive to maximize the motivation and capabilities of every employee.

- Persons who understand JAEA's management philosophy and can implement it in a steadfast and voluntary manner
- Persons who play an active role in the international community while demonstrating originality and an innovative mindset in their respective areas of specialty
- Persons who understand their respective roles within their organizational structure and demonstrate a high level of expertise while collaborating with others

Career Path Policies

JAEA clearly states its career path policies, and by doing so, helps employees cultivate an awareness of career development. By conducting follow-up activities through interviews with superiors regarding career development, we also endeavor to improve the capabilities of each employee and translate the outcomes into improvement of performance of the entire organization.

Improvement of the Performance of the Entire Organization by the Enhancement of the Capabilities of Each Employee!



* Example of a new university graduate

Research positions

Conduct original and innovative R&D and carve out the future of nuclear energy

Example efforts: Supporting acquisition of a doctoral degree; basic training for research positions; seminars on drafting methodology of research papers; support for presentations in academic conferences; dispatch to overseas research and other organizations and overseas nuclear study programs; and utilization of a cross-appointment system

Administrative positions

Contribute to the smooth business execution of JAEA and serve as a bridge between specialists and society

Example efforts: Gaining experience in different administrative operations through a job rotation system; transfer to international organizations or overseas offices and temporary assignment to central government ministries and agencies; and increasing expertise through participation in external seminars

Engineering positions

Play an active role as an engineer, engaging in the latest technology development or operating cutting-edge facilities

Example efforts: On-the-job training (OJT) by senior colleagues at nuclear facilities; encouragement of the acquisition of government-sanctioned qualifications and nurturing legally required chief engineers; dispatch to overseas research and other organizations and overseas nuclear study programs; and assignment to integrated departments in JAEA and temporary assignment to central government ministries and agencies

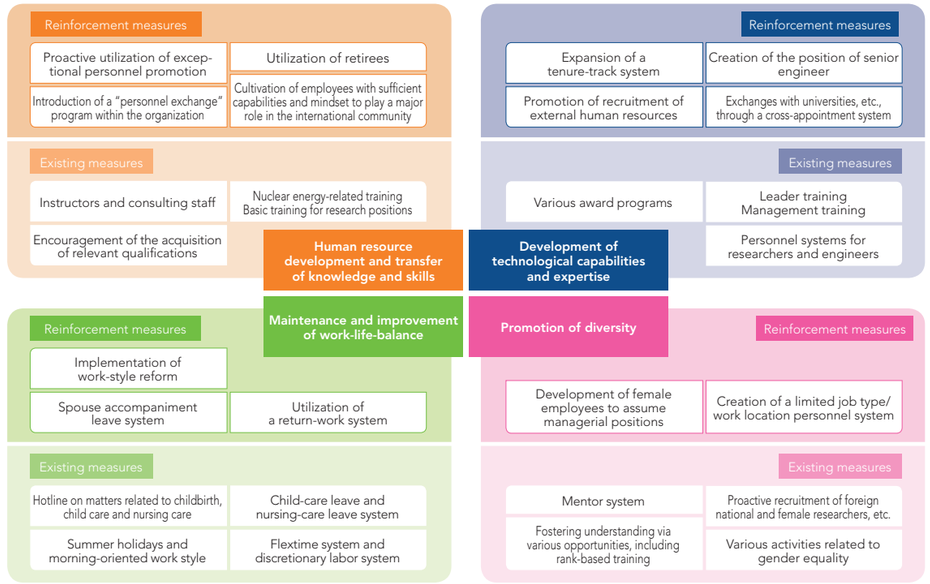
Various training programs

Efforts geared to demonstrate capabilities as a group of specialists trusted by society

Example efforts: Training for new employees; training for mid-career employees; training for employees promoted to managerial positions; basic and applied courses in nuclear energy; and practical business language training

Principal Human Resource Management Measures

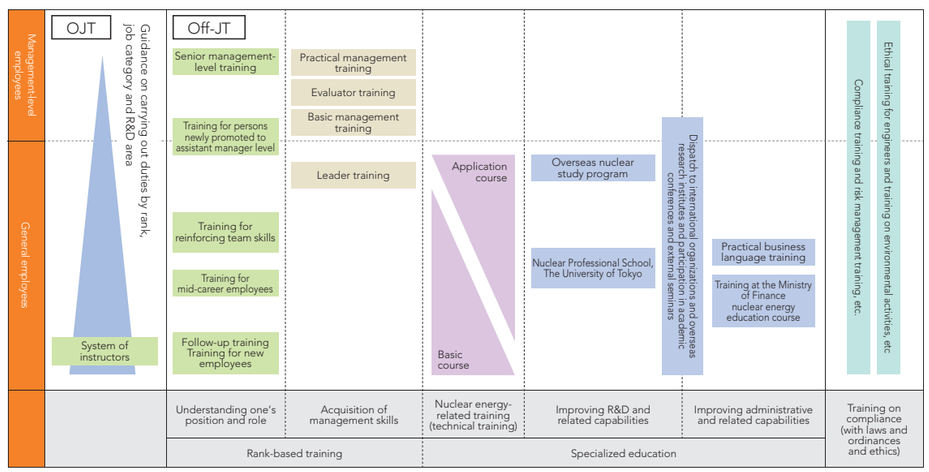
Based on the main points of the Human Resources Policy, we have been implementing human resource management measures based on flexible utilization and well-planned development of human resources as an important management resource. Using these measures, we intend to improve the individual qualities of each employee and strengthen our organizational foundation.



Framework of Employee Development

Our efforts to promote human resource development in a well-planned and systematic manner comprise OJT, which provides guidance in each workplace on carrying out duties, and off-the-job training (Off-JT) that complements OJT.

Human resource development =
Effective OJT in the workplace × Appropriate Off-JT based on job categories and ranks × Willingness for self-development



Promotion of Work-Life Balance

We strive to create an employee-friendly workplace full of vitality, while respecting the personality and individuality of each employee.

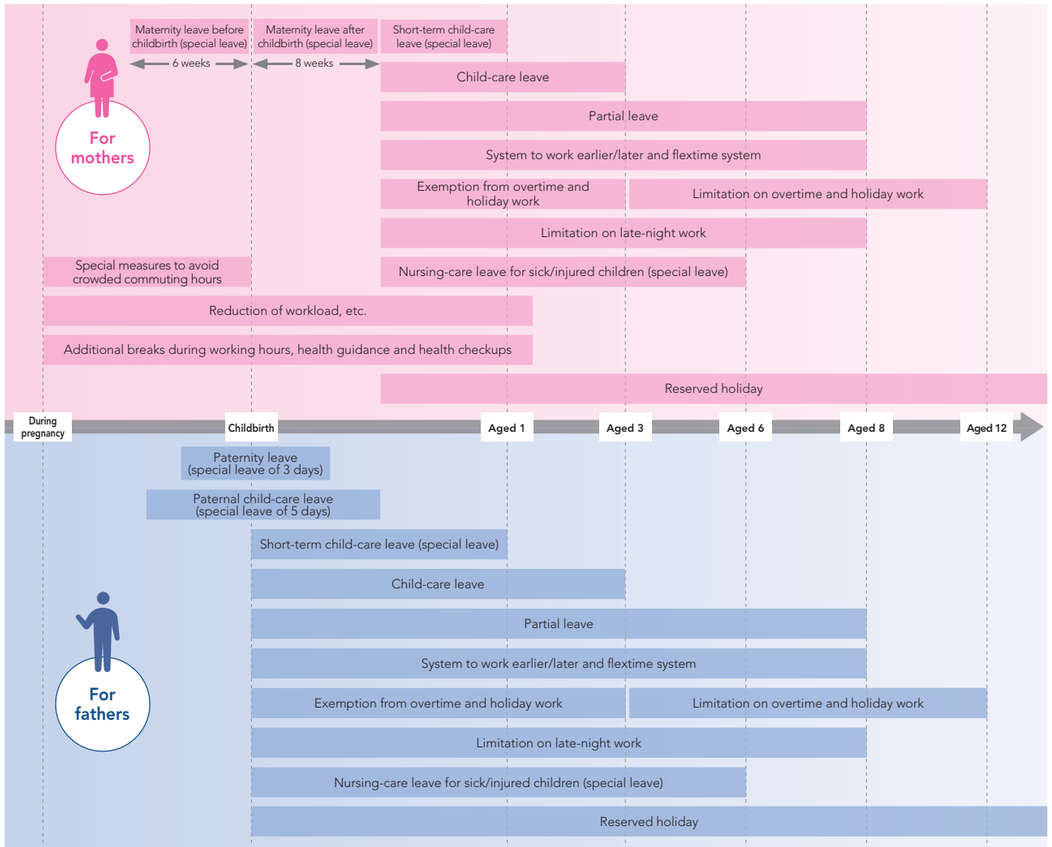
JAEA undertakes an array of activities to promote work-life balance by creating a pleasant work environment that helps employees keep a balance between their lives at work and at home and enables all persons to fully exercise their capabilities and devote themselves to their tasks.

We expanded the scope of our flextime system and launched an additional system in fiscal 2017 for employees engaging in child care and nursing care, and again in fiscal 2019 for employees undergoing disease treatment. Furthermore, in fiscal 2019 we will launch telecommuting as a trial.

To respond to the diverse needs of employees, we will proactively adopt new systems and promote activities to spread and instill an awareness of work-life balance throughout JAEA.

"Genki! Ikukatsu Menu" for balancing work and child care

JAEA has in place a variety of short- and long-term leave systems collectively called "Genki! Ikukatsu Menu" both for female and male employees to assist them in achieving a balance between their work and child care.



- Rate of child-care leave usage (Fiscal 2018 result)

Female employees ····· **92.31%**

Male employees ····· **2.5%**

Menu of Leave Systems for Balancing Work and Family Care

JAEA also offers the following systems to help balance work and family care for employees who have family members in need of nursing care.

- **Nursing-care leave:** Available in units of days or hours (maximum of 4 hours per day), up to three times, for one continued care-requiring condition of a family member in need of nursing care, provided that such leave in total does not exceed six months.
- **Short-term nursing-care leave:** A special leave system that allows employees to take a leave of five days per year in cases of one person requiring nursing care or a leave of 10 days if there are multiple persons in need of nursing care.
- **Partial leave:** A system that allows employees aside from nursing-care leave and short-term nursing-care leave to work shorter hours by either starting a day later or ending it earlier for a maximum of two hours per day and for three years in total.
- **Exemption from and limitation on working extra hours:** A system in which employees submit an application for exemption from or limitation on overtime and holiday work, or for limitation on late-night work.
- **System to work earlier/later:** A system that allows employees to shift the start time and end time of their work without changing the required number of working hours per day
- **Reserved holiday:** A special leave system that allows employees to take a leave of reserved holidays unused in the previous year in cases in which employees have persons requiring nursing care or other circumstances.

Activities Undertaken during Fiscal 2018

We considered the introduction of new systems and implemented new support, and took proactive steps forward in these areas.

- **Joshikai-II for Future Scientists: International Mentoring Workshop in Science and Engineering**
  We held the international workshop for promoting the interest of female junior high school students in STEM (science, technology, engineering, and mathematics) and broadening female junior and senior high school students who might major in the STEM field in the future.

- **Lunch meetings**
  We held lunch meetings to encourage more employees to participate and discuss gender equality in a friendly atmosphere.

* For details on our activities to promote gender equality, please see JAEA's website. https://www.jaea.go.jp/about_JAEA/gender_equality/ (in Japanese)

Activities to Promote Gender Equality and Diversity

JAEA engages in a variety of activities to promote gender equality from the viewpoint of acquiring and utilizing diverse human resources; in other words, to ensure diversity. We will continue to actively promote these activities, always seeking new support systems and better solutions.

(1) **Recruiting more female employees:** We encourage proactive public relations in our recruitment process, using female recruiters to appeal to female students.
(2) **Career development of female employees:** By operating mentor and other systems, we aim to utilize female employees to serve as role models.
(3) **Creating a better work environment:** We are raising the awareness of both the employees using our support systems and their superiors and providing information in a more effective manner through public relations magazines and other means.
(4) **Facilitating understanding of gender equality:** We hold exchanges and other meetings to increase the level of recognition among employees for our activities and aim to raise their awareness through such means as rank-based training.

- Ratio of female employees – newly employed in fiscal 2018 **10.8%**
- Ratio of female employees (as of April 1, 2019) **10.1%**

Prevention of Sexual, Power and Other Workplace Harassment

JAEA is working to establish an appropriate structure for the prevention of sexual and power harassment, and as part of this effort, has assigned consulting staff to handle harassment-related matters. In fiscal 2018, we again provided training to the consulting staff for cultivating additional skills and enhancing our consulting service system. Moreover, we have designated the first week of every December as "Sexual and Power Harassment Prevention Week," during which we put up posters in each workplace and work to raise the awareness of employees regarding this matter. We will continue our efforts to create a working environment friendly to every employee and implement measures to prevent any form of harassment in the workplace.

Measures to Improve and Streamline Business Operations

JAEA has launched measures to improve and streamline its business operations to improve work-life balance, which include the "JAEA Diet Project" that promotes paperless meetings and "Kaizen activities" that encourage employees to come up with new and innovative ideas and suggestions. The goal is to create a "worker-friendly, worthwhile and transparent workplace" with these activities that translate into higher work efficiency for the entire organization and greater organizational capability.

Environmental Impact and Status of Our Activities for Reduction of the Impact

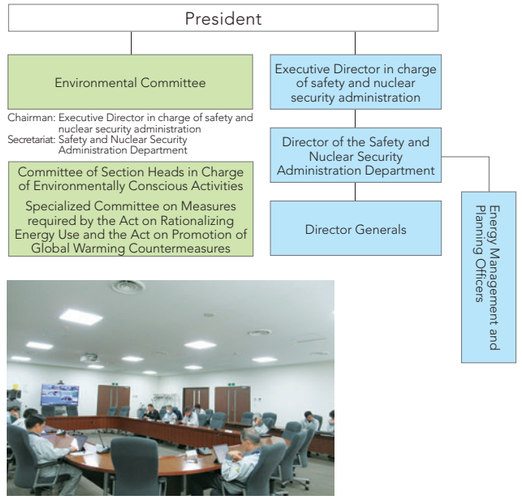
Environmental Management

Conducting operations with due attention to the environment is essential for JAEA to become an accepted member of society. It also means making the environment surrounding JAEA sites cleaner and more comfortable, and at the same time, it serves to increase our operational efficiency.

Thus, JAEA regards consideration for the environment as a matter of high priority in carrying out business operations, and we have formulated the Rules on Environmental Management. The President adopts a basic environmental policy for each fiscal year based on the Rules. Under the policy, we define environmental targets and proactively undertake environmentally conscious activities.

Moreover, we have set up an environmental management framework for promoting environmentally conscious activities, which includes the Environmental Committee and the Meeting of Section Heads in Charge of Environmentally Conscious Activities.

Fiscal 2018 Framework



Meeting of the Environmental Committee

Fiscal 2018 Basic Environmental Policy

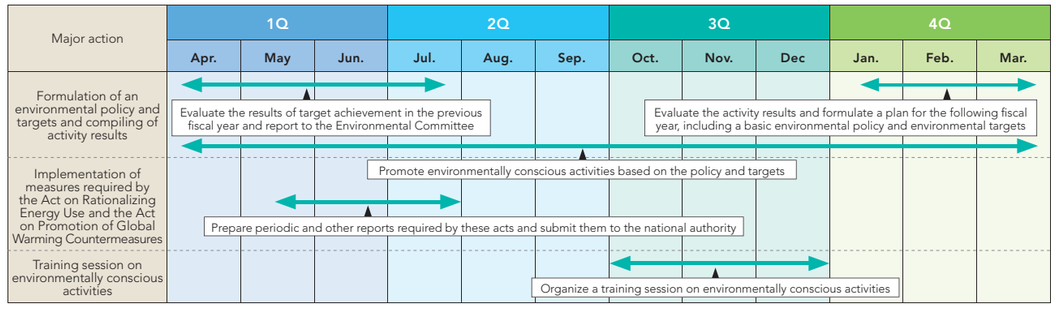
As a national R&D institute engaging in comprehensive nuclear energy R&D, JAEA endeavors to maximize its R&D outcomes in the field of nuclear science and technology and simultaneously places its highest priority on safety. We therefore promote comprehensive R&D on nuclear energy with the aims of ensuring a stable energy supply for the future in Japan, making effective use of resources, and conserving the global environment through reduction of environmental impact and prevention of environmental contamination.

In conducting environmentally conscious activities in fiscal 2018, we continued to pursue improvements based on the principles above. Thus, we stipulate the following basic policies pursuant to the Rules on Environmental Management:

- ○ We regard consideration for the environment as a priority matter in conducting our business operations, and we will work to conserve the global environment by saving energy and resources and reducing waste.
- ○ We will promote dissemination of environmental conservation information in order to build a relationship of trust with the public and the local community.

The chart below shows how we plan and implement our environmentally conscious activities in each fiscal year. The results of these activities will undergo a review by the relevant committees, including the Environmental Committee, and will be incorporated into the following year's basic environmental policy and environmental targets.

Planning of Fiscal 2018 Environmentally Conscious Activities



Training Session for Environmentally Conscious Activities

Every year, JAEA invites an external lecturer to give training to employees and other staff and hosts a meeting to encourage an exchange of views. These training sessions are expected to serve the purpose of the promotion and active implementation of environmentally conscious activities and the improvement of the skills of relevant personnel.

Measures for Energy Conservation

Japan Atomic Energy Association (JAEA) promotes environment-conscious activities for energy conservation.

JAEA's sites at six locations (Nuclear Science Research Institute, Nuclear Fuel Cycle Engineering Laboratories, Oarai, "Monju," "Fugen" and Ningyo-toge) are designated Energy Management Factories under the Act on the Rational Use of Energy (hereinafter "Energy Conservation Act"). Consequently, these locations promote energy conservation activities according to medium- and long-term plans drawn up based on the Energy Conservation Law. Other locations and business offices have also formulated their own plans and engage in energy conservation efforts.

Energy-saving Activities and Promoting Efficient Energy Use

JAEA is working to improve and beautify the environment inside the compounds of its business offices and locations. Concrete examples actively promoted include the planting of greenery outside windows to block the sun's rays during the summer to reduce energy consumption and equipment renewal aimed at improving the efficiency of energy use. The renewal of air-conditioning facilities at Oarai Research and Development Institute cut electricity consumption by about 10% from pre-renewal levels and contributed to energy conservation. JAEA will continue to promote effective energy utilization as much as is feasible.

Efficiency improvement by renewing air-conditioning equipment

Greenery planted outside the windows

Summary of Fiscal 2018 Environment-Conscious Activities

Input

Total energy input: .....Approx. **6,000** TJ
Electricity consumption:....Approx. **5,500** TJ
Fossil fuel consumption:..... Approx. **520** TJ
Water resource input:.....Approx. **2.1** million m^3
Photocopying paper input: ....Approx. **200** t

Emission

Greenhouse gas emissions: .....Approx. **340,000** t-CO_2
Emissions from domestic waste:....Approx. **270** t
Emissions from industrial waste:....Approx. **290** t
Emissions from specially managed industrial waste: .....Approx. **15** t

Environmental Targets, Results of Activities and Evaluation for Fiscal 2018

Action Item	Environmental target	Results	Evaluation
Promotion of energy conservation	• Reduction of energy consumption per unit of output or electricity consumption per unit of output based on a new evaluation system designed to encourage the leveling of electricity demand by 1% or more on an annual average by the end of FY2018, with FY2014 as a base year. • Adopt one or more new measures that lead to energy conservation, leveling of electricity demand or equipment improvement that had not been introduced until the previous fiscal year and put them into action.	• Energy consumption per unit of output dropped by approximately 0.2% and electricity consumption per unit of output based on a new evaluation system designed to encourage the leveling of electricity demand by approximately 0.2%, both on an annual average, during the target five-year period. Both figures were below the reduction target of 1% on an annual average. • New measures implemented for the leveling of electricity demand include changing the operational time of air-conditioning systems to the extent where safety and operational execution are not impacted, turning off lights near the windows and conducting the periodic inspection of receiving and transforming facilities during the summer.	• The target was not achieved. We will continue our efforts to reduce energy consumption.
Promotion of resource conservation	• Reduce the consumption of water and photocopying paper to levels below the average in the past five years.	• The water input was approximately 98% of the amount in the previous fiscal year and approximately 99% of the average in the most recent five fiscal years. • The consumption of photocopying paper was approximately 96% of the amount in the previous fiscal year and approximately 96% of the average in the most recent five fiscal years.	• Consumption fell below the average amount consumed in the most recent five fiscal years. We will continue our efforts to reduce consumption.
Reduction of waste	• Reduce the volume of domestic waste to levels below the average in the past five years. • Increase the sales amount of valuables to above zero.	• The emission of domestic waste was approximately 103% of the amount in the previous fiscal year and approximately 100% of the average in the most recent five fiscal years. • The recycling rate of resources including the recovery of valuables was approximately 65% (approximately 52% in the previous fiscal year).	• The waste we produced was at the same level as the average waste discharged in the most recent five fiscal years. Also, we discharged approximately 820 t as valuables. We will continue our efforts to recycle resources.
Promotion of the dissemination of environmental conservation information	• Examine and promote effective ways to communicate environmental conservation information.	• Posted information about environment-conscious activities on the intranet at the Head Office and at each JAEA site.	• Efforts were made to transmit information about our environment-conscious activities in an easy-to-understand format. We will examine ways to transmit information even more effectively in the future.

With regard to environment-related laws and regulations, JAEA executes management to comply with the applicable regulatory standards for environmental items such as air pollutants, radioactive gaseous waste emissions into the atmosphere, discharge of water pollutants and radioactive liquid waste, noise and vibrations.

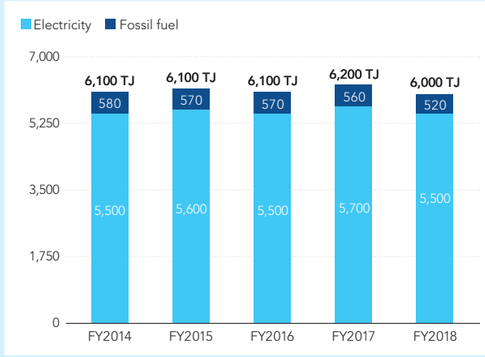
During the period from fiscal 2018 to July 2019, equipment malfunctions and other factors caused an incident at the Nuclear Science Research Institute that resulted in temporary deviations from the wastewater standard under the Water Pollution Control Law on three occasions. Consequently, we improved the equipment that malfunctioned and took other measures to prevent the recurrence of such incidents. The incidents have had no impact on the environment. JAEA will continue to exercise appropriate wastewater management.

* Visit the JAEA website (Environmental Information) for details on information on environment-conscious activities.
https://www.jaea.go.jp/about_JAEA/environment/ (in Japanese)

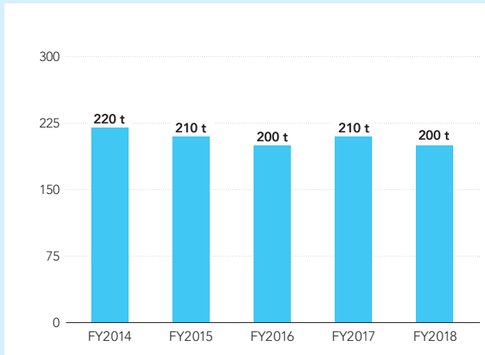
Overview of Environmental Performance in Fiscal 2018

INPUT

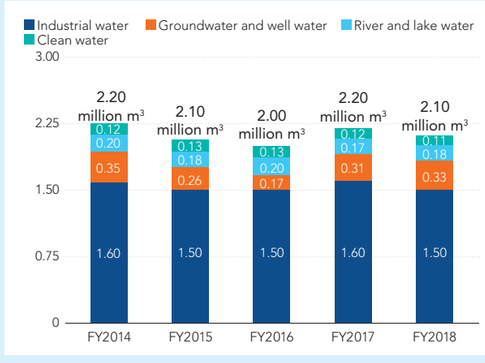
Total Energy Consumption



Copy Paper Consumption

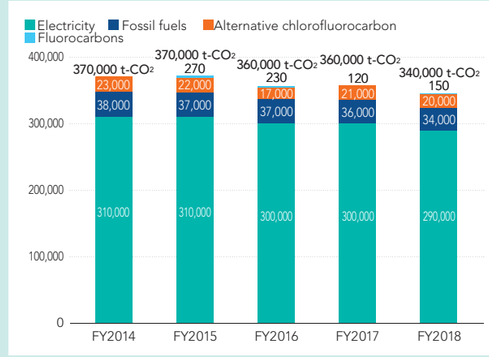


Water Intake

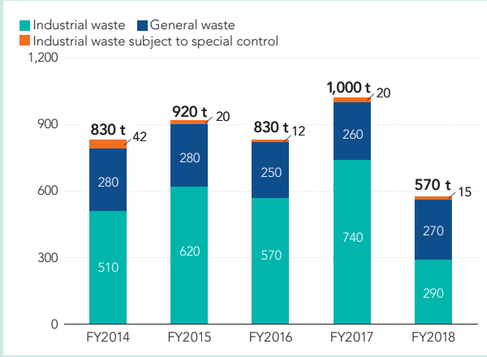


OUTPUT

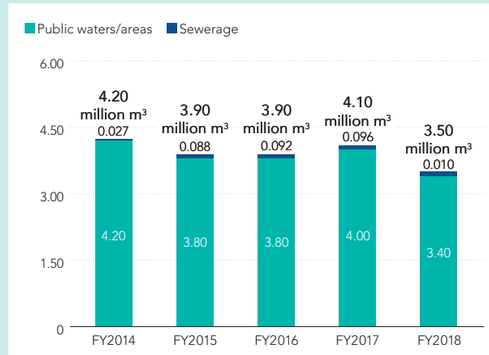
Total GHG Emissions



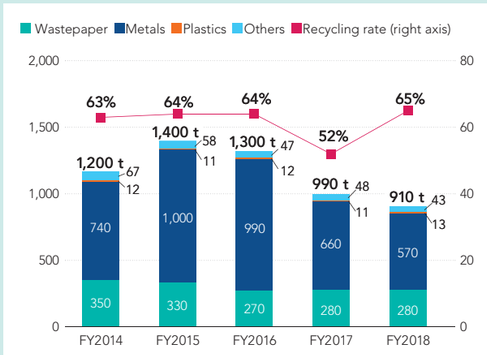
Total Amount of Waste



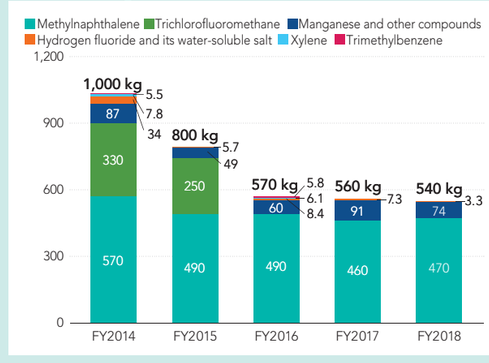
Wastewater Discharge



Main Resources Recycled



Substances Subject to the Pollutant Release and Transfer Register (PRTR)



- Amount of incinerated general waste
  ..... 47 t (FY2017 45 t)
- Recycling of construction materials
  ..... 9,200 t (FY2017 2,800 t)

* The itemized totals may not agree exactly with the figure in the total due to fractional amounts being rounded.

Activities for Local Communities and Society

Contribution to Local Communities and Society

JAEA conducts R&D operations on the basis of the trust placed in us by the local community. Accordingly, we always keep in mind our contribution to sustainable local growth, value interactions with the local community and undertake a range of activities to achieve co-existence as a member of local communities.

Horonobe: Enjoy Science Museum 2018 in Horonobe

Aomori: Mutsu Industrial Festival

Fukushima: Futaba World Festival 2018 in Namie

Tokai: Tokai Festival

Major Activities Undertaken During Fiscal 2018

Horonobe

- Hands-on classes and experimental workshop in Horonobe
- Enjoy Science Museum 2018 in Horonobe
- Horonobe Meirin Park Festival
- Horonobe Yukinko Festival
- Horonobe Spring and Fall Cleanup Campaigns

Oarai

- Mito Environmental Fair
- Oarai Hassaku Festival
- Hokota Food Festival
- Oarai Industrial Festival
- Oarai ANKO (anglerfish) Festival
- Oarai Cleanup Campaign

Aomori

- Kitadori District Bon Dance
- Mutsu Industrial Festival
- Environmental activities around the Mutsu Office

Tono

- TOKI (pottery) Festival
- Science Festival 2018
- Mizunami Mino Genji Tanabata Festival
- Enjoy Science Museum 2018 in Mizunami
- Toki River (Hazama River) Cleanup Campaign

Fukushima

- Tomioka Sakura Festival
- Futaba World Festival 2018 in Namie
- Comutan-Fukushima Autumn Festival
- Miharu Autumn Festival
- Naraha-machi Spring and Fall Cleanup Campaigns

Tsuruga

- Tsuruga Festival
- Summer Festival in Mihama
- Family Festival
- Hanakae (Flower Exchange) Festival
- Fukui Cleanup Campaign

Tokai

- ECO Fes Hitachi 2018
- Tokai Festival
- Hitachi Port Festival
- Katsuta Marathon
- Hitachinaka Industrial Exchange Fair
- Tokai-mura Spring and Fall Cleanup Campaigns

Ningyo-toge

- Misasa Hot-Spring Curie Festival
- Kagamino-cho Industrial Festival
- Kamisaibara Furusato Festival
- Youngsters' Science Festival in Kurashiki
- Ombara-Kogen Hyomon Festival
- Volunteer cleaning
- Tottori Symbiotic Forest Project

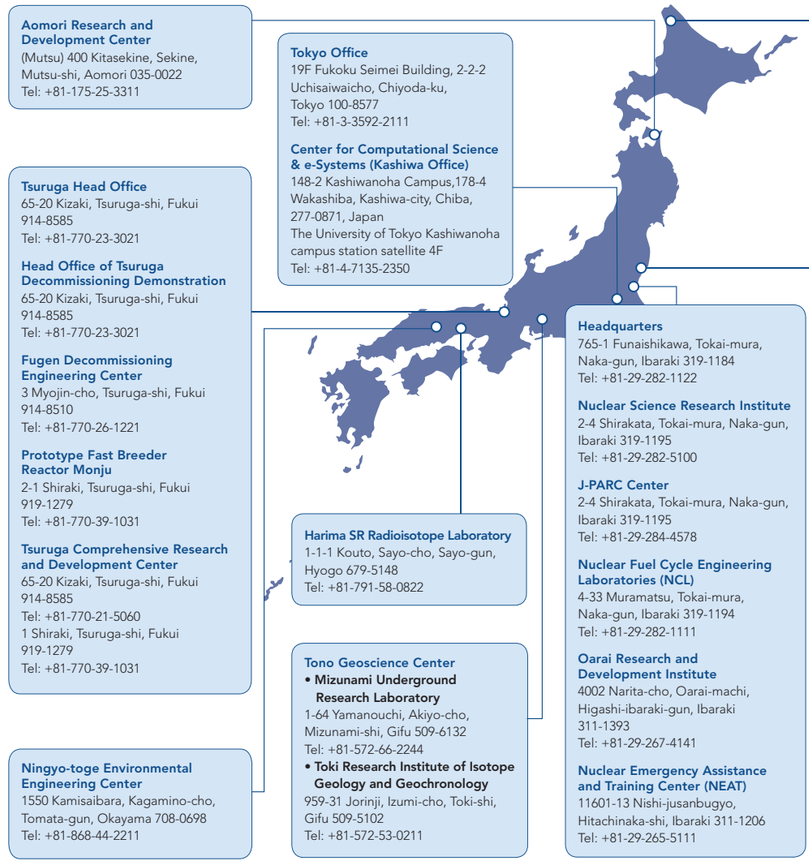
Oarai: Hassaku Festival

Tono: Enjoy Science Museum 2018 in Mizunami

Tsuruga: Tsuruga Festival

Ningyo-toge: Kagamino-cho Industrial Festival

R&D Institutes and Centers as of April 2019



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Tono Geoscience Center
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- **Toki Research Institute of Isotope Geology and Geochronology**
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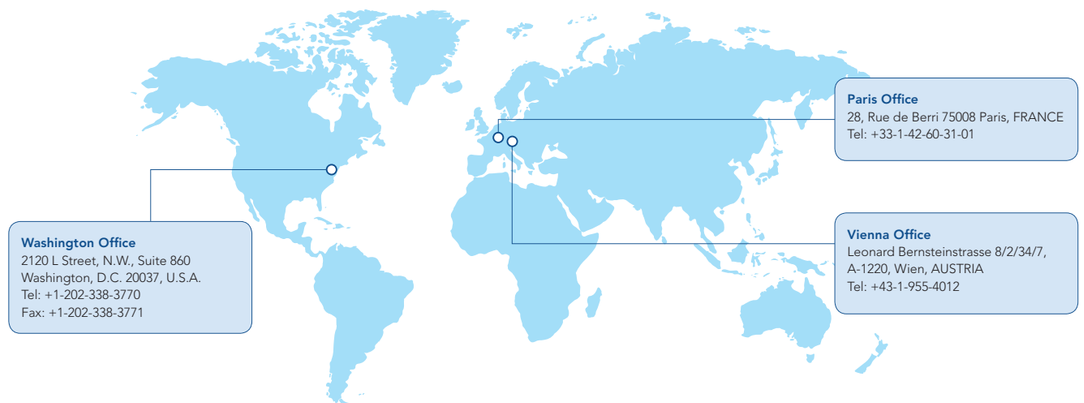

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Moving towards Transformation of the Future Society

Future Vision “JAEA 2050 +”

JAEA has developed a future vision titled “JAEA 2050 +,” which outlines its ideal image for the future, namely the goal we should seek and the actions we should take toward this goal in order to continue our social contribution into the future. (“JAEA 2050 +” was released to the public on October 31, 2019.) The vision is in line with the policy goals of Japan (“Strategic Energy Plan,” “The Long-Term Strategy under the Paris Agreement,” Society 5.0*1 and Sustainable Development Goals (SDGs)).

1 Goals toward 2050

◆ Seeking to contribute to the transformation of future society **by pursuing the full potential of Nuclear Science and Technology (S&T)**

1) Contribute to alleviating the risk of global climate change with Nuclear S&T
2) Contribute to energy security using nuclear energy systems with enhanced safety, including the nuclear fuel cycle
3) Contribute to the realization of future society (Society 5.0) through Nuclear S&T

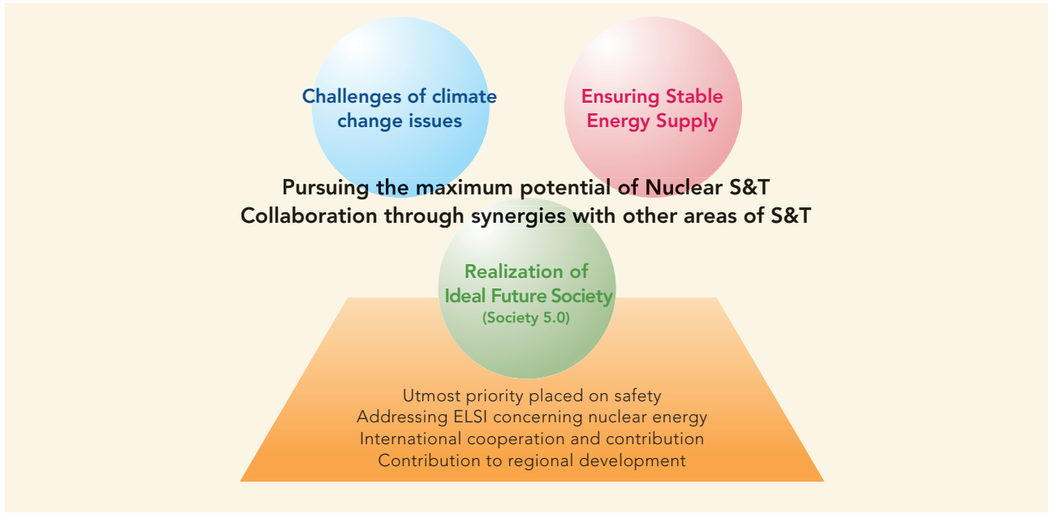
◆ **Striving for “New Era Nuclear S&T” reflecting on lessons learned from TEPCO’s Fukushima Daiichi Nuclear Power Station accident and a reacknowledgement of the value of nuclear safety**

“New Era Nuclear S&T”: renewed efforts to contribute to future society by ensuring an interactive dialogue with society and the following:

→ Development of a Nuclear S&T system that addresses “S+3E,”*2 including further enhancement of safety, and delivers the solutions to social challenges
→ Creation of innovations through synergies with other areas of science and technology

◆ **In terms of striving for “New Era Nuclear S&T,” taking full advantage of Nuclear S&T to tackle the challenges, including Ethical, Legal and Social Issues (ELSI),*3 associated with Nuclear S&T and present solutions**

Overall Image of the Future Vision of JAEA

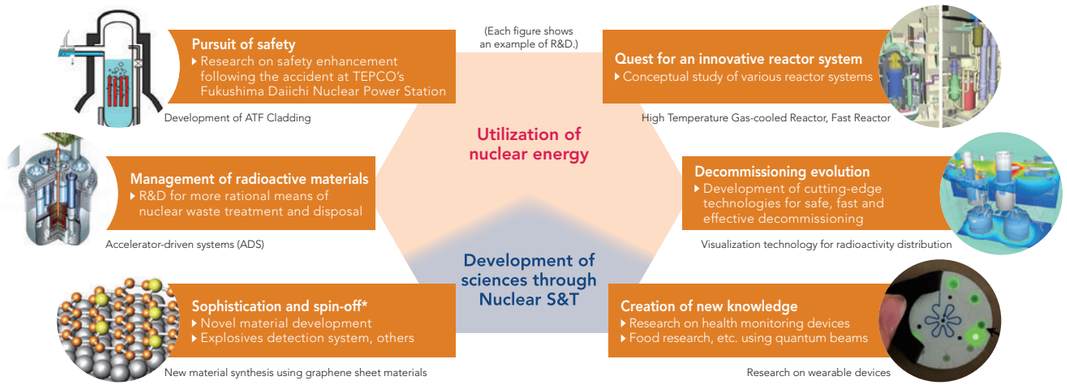


*1 “Society 5.0” refers to a future society to which Japan should aspire. Proposed for the first time in “The 5th Science and Technology Basic Plan” compiled by the Cabinet Office of Japan, this is a society in which IoT would connect all people and things, enable the sharing of all sorts of knowledge and information and create new values. In “Society 5.0,” AI is expected to help free humans from the burdensome work of analyzing huge amounts of information, with robots and self-navigating cars used to overcome issues such as Japan’s falling birthrate, its aging population and underpopulation in rural areas.
*2 The “Strategic Energy Plan” defines the basic principles of Japan’s energy policy, which are based on the premise of Safety, Energy security, Economic efficiency and Environment, or “S+3E.”
*3 ELSI stands for Ethical, Legal and Social Issues that inevitably arise in association with the utilization of Nuclear S&T.

2 Actions toward 2050

R&D for Making “New Era Nuclear S&T” a Reality

◆ **Establishing six research themes** and promoting multidimensional R&D **cross-sectionally** and **strategically**



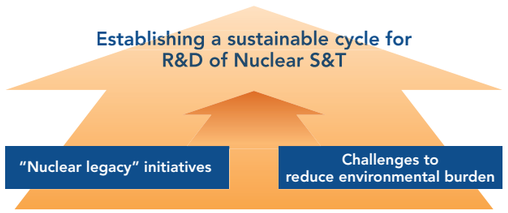
* Spin-off: Application of the technology developed in a certain domain to other domains

Efforts/Challenges for Sustainable Utilization of Nuclear S&T

◆ **Steadily tackling fuel cycle back-end issues** through **“Management of radioactive materials”** and **“Decommissioning evolution” to develop an R&D cycle for Nuclear S&T**

- “Nuclear legacy” initiatives tied to current and future use of nuclear energy and the creation of new industrial fields
- Challenges to reduce environmental burden

Seeking to realize sustainable Nuclear S&T that is trusted and accepted by society



International Cooperation/International Contribution and Regional Development

◆ Actively participate in **R&D cooperation** with advanced nuclear energy countries, **contribute to international organizations and emerging nuclear energy countries,** and **disseminate and conduct outreach** concerning R&D results

◆ **Contribute to strengthening the nuclear non-proliferation and nuclear security regime**

◆ **Contribute to regional development as a community member**

- Further foster trust by community members
- Contribute to the daily lives of regional members
- Develop partnership with the community
- Contribute to nurturing of future scientists and engineers

Redefining the Organizational Concept and Securing/Training Human Resources

◆ Reorganize JAEA to **coordinate and collaborate with other sectors** beyond the nuclear community and contribute to future society

◆ **Secure and train human resources** from a wide range of fields

The Vision for Human Resources Sought by JAEA

- **Personnel with the ability to implement successful global activities in society**
- **Personnel with the ability to create new outputs and values**
- **Personnel with the ability to play active roles in a wide range of fields**
- **Personnel with the ability to work with other people and ensure the safety of facilities**
- **Personnel with the ability to deepen mutual understanding with society through dialogue**