Annual Report
Japan Atomic Energy Agency 2018

Aiming for Energy That Leads to the Future

Japan Atomic Energy Agency

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Please write 'annual report' in the subject column.

Your feedback is very appreciated.

Published in December 2018
Printed in Japan

Editorial Policy

We have prepared the Japan Atomic Energy Agency Annual Report 2018 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 2017 (April 2017 - March 2018) and also explains the outlook for fiscal 2018 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 "break new ground for the future of nuclear energy and contribute to the welfare of human society." 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 2017 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 2017 (April 2017 - March 2018).
(Part of the report includes information after this period.)

●Reference Guidelines, etc.
◎ISO 26000: 2010 Guidelines Concerning CSR
◎Environmental Reporting Guidelines 2012 Version (Ministry of the Environment)
◎GRI Standards

●Notation Method
Fractions are rounded to the second decimal in principle.

CONTENTS

JAEA at a Glance

R&D Results

Joint Research Projects **236**

Consigned Research Projects **141**

Releases of R&D Results **4,051**

JAEA R&D Reports **106**

Papers **1,167**

Peer-Reviewed **854**

Others **313**

Oral Presentations **1,611**

External Awards Won **78**

Intellectual Properties **31** (Domestic Patents)

Minister of Education, Culture, Sports, Science and Technology Awards **2**

Awards from Various Academic Associations **76**

JAEA's R&D results or intellectual properties are explained in detail in other publications.
We would be pleased that you read these publications in conjunction with this report.
・Representative academic papers are introduced in JAEA R&D Review.
・Selected patents are shown in the JAEA Technology Collection (in Japanese).

Performance Data

Budget **153.8** billion yen (Fiscal 2018)

* For details on Budget and Personnel, please see P11.

Personnel **3,094** (as of April 1, 2018)

International Cooperation **22** countries, **5** international organizations

* For details on Implementation of JAEA's Strategy for International Cooperation, please see P26.

International Training Courses **80** participants from **11** countries

Emergency Preparedness Drills a total of approx. **4,060** participants

Ratio of Female Employees in JAEA **9.9**% (as of April 1, 2018)

Total Assets **696.9** billion yen

Total Liabilities **265.8** billion yen

Total Net Assets **431.1** billion yen

Ordinary Expenses **158.9** billion yen

Ordinary Income **161.5** billion yen

Total Loss for the Fiscal Year **2.2** billion yen

* For details on Financial Information (Fiscal 2017), please see P11.

Message from the President

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

In pursuing these initiatives at JAEA, the keywords for me are "Safety," "Compliance" and "Action."

"Safety" is obviously a major prerequisite as an operator of nuclear facilities. One year has passed since the contamination and exposure accident on June 6, 2017 at the Fuel Research building at the Oarai Research and Development Center. Mindful that the accident caused a significant loss of trust among local residents and nationwide, we have been striving to implement measures to prevent recurrence based on investigation of the causes.

"Compliance" is indispensable to be trusted by the general public as an organization and as a member of society and means strictly observing 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 implement policies by reflecting them in a tangible form in a concrete implementation plan. Among these policies will be an innovation creation strategy, an international cooperation strategy, a medium- to long-term facility plan and a human resources policy including the intellectual property policy we set in 2016.

Nuclear energy R&D cannot advance without the understanding of Japanese citizens. With this in mind, we are making efforts to disseminate information through measures such as enhancing our website, proactively utilizing social media and issuing public relations literature. We issue the 2018 Annual Report, which summarizes our activities in the 2017 fiscal year, in the hope that it will help readers to cultivate a better understanding of our activities.

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

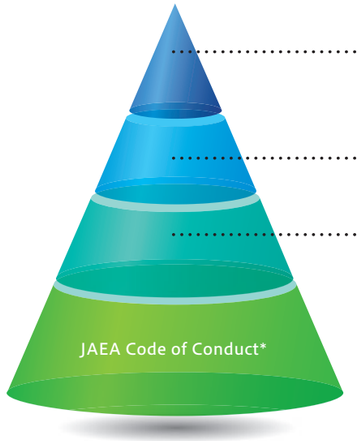
September 2018

児玉敏雄

Toshio KODAMA

President, the Japan Atomic Energy Agency

Management Principles



JAEA's Mission

Break new ground for the future of nuclear energy and contribute to the welfare of human society.

JAEA Slogan

"High aspiration, rich idea and strong will"

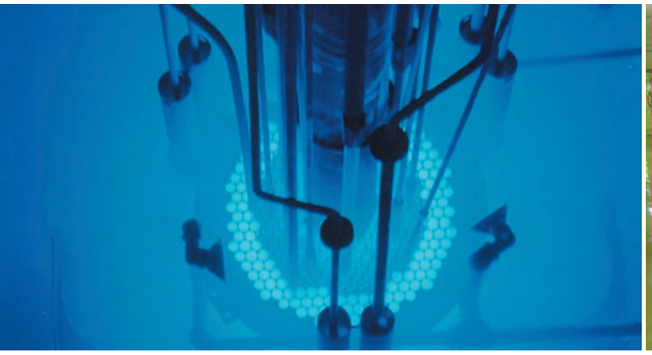
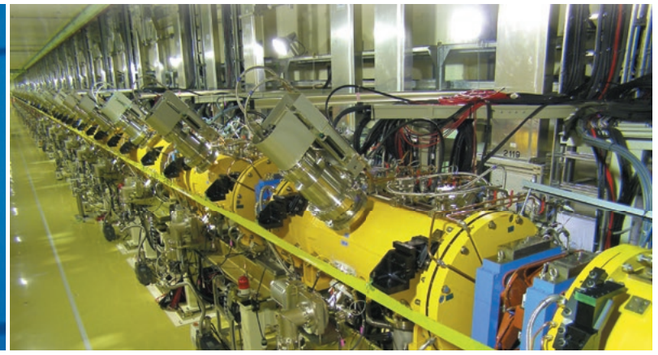
JAEA Basic Policies

- Thoroughly ensure safety
- R&D filled with creativity
- High attention to the on-site activities
- Efficient work management
- Trust of society

* For details on JAEA Code of Conduct, please see JAEA website.
https://www.jaea.go.jp/01/pdf/rinen.pdf (in Japanese)

History and Purpose



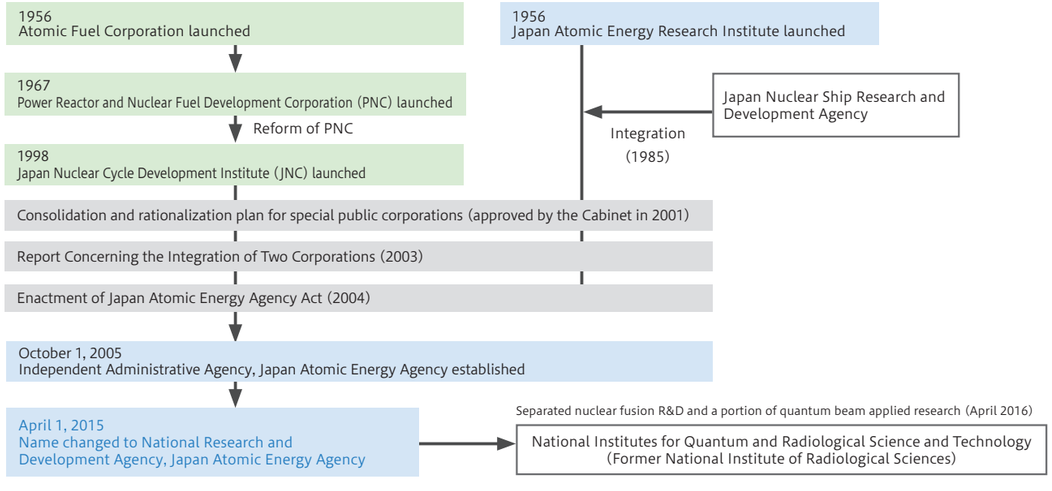



History and Purpose

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).

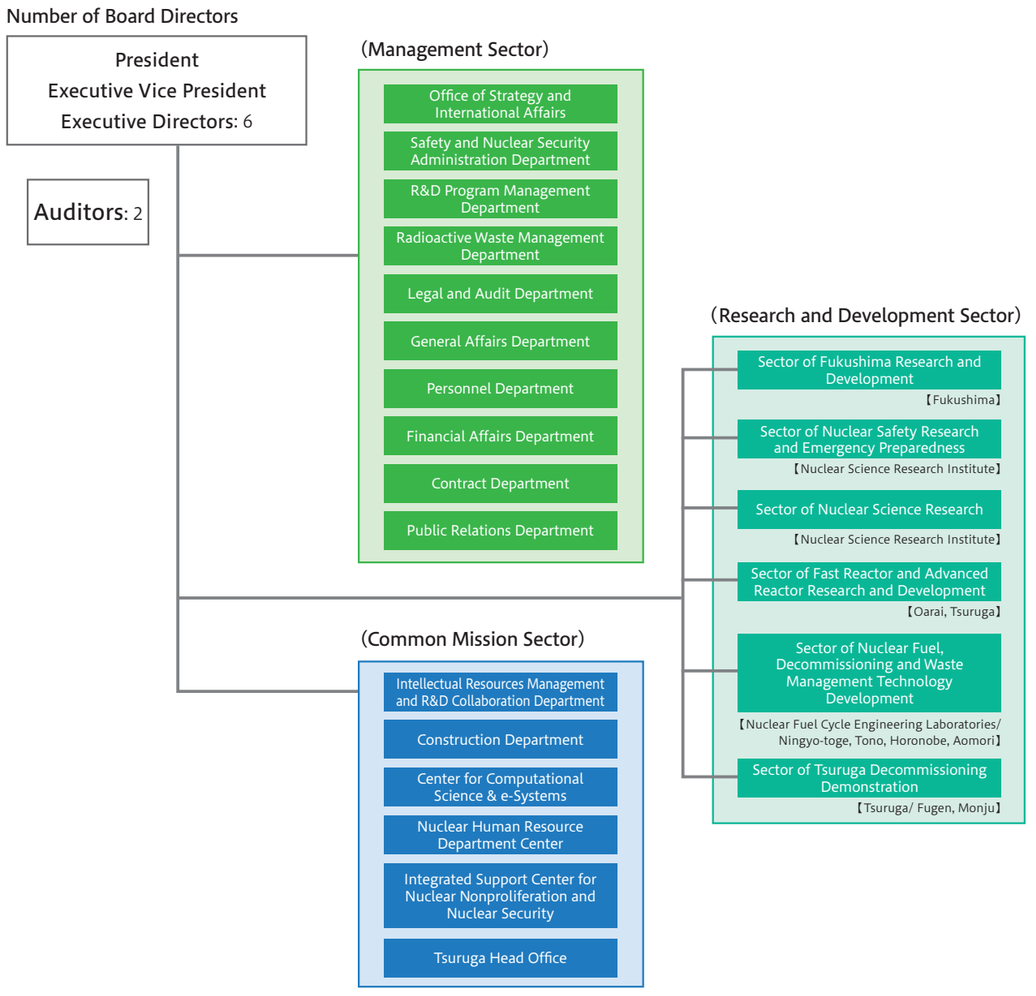
JAERI and JNC were merged in 2005 to form the Japan Atomic Energy Agency (JAEA). In 2015, its name was changed to the National Research and Development Agency, Japan Atomic Energy Agency (JAEA). In 2016, JAEA separated nuclear fusion R&D and a portion of quantum beam applied research from the National Institutes for Quantum and Radiological Science and Technology.

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.



Organization/Management Advisory Council/ Oversight Committee

Organization (as of September 2018)



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 the Executive Vice President assists the President. Executive Directors are in charge of businesses assigned to them in which they have a high expertise and superior knowledge. The Auditors audit the business of JAEA.

A President
Toshio KODAMA

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
Yasushi TAGUCHI

Career Outline
Apr. 1986: Science and Technology Agency
Apr. 2012: Director, Research and Development Policy Division, Research and Development Bureau, Ministry of Education Culture, Sports, Science and Technology (MEXT); concurrently Counselor, Cabinet Secretariat, Cabinet Office
Jan. 2014: Director, Policy Division, Minister's Secretariat, MEXT
Jan. 2015: Deputy Director-General, Research and Development Bureau, MEXT; concurrently Deputy Director-General, Cabinet Office
Aug. 2015: Executive Vice President, JAEA

C Executive Director
Kazumi AOTO

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
Yukitoshi MIURA

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
Tokuhiro YAMAMOTO

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
Hajime ITO

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
Koichi NODA

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
Yutaka MAEDA

Career Outline
Apr. 1989: Science and Technology Agency
May 2013: Director, Research and Infrastructure Division, Research Promotion Bureau, MEXT
Jul. 2013: Director, Research Promotion Bureau (Nano-technology, Material Science), MEXT
Jul. 2014: Director, Sustainable Agriculture Division, Agricultural Production Bureau, Ministry of Agriculture, Forestry and Fisheries
Jun. 2016: Director, General Affairs Department, Japan Aerospace Exploration Agency
Aug. 2018: Executive Director, JAEA

I Auditor
Shigeru NAKAGAWA

Career Outline
Apr. 1987: East Japan Railway Company
Jun. 2006: Director, East Japan Transport Technology
Jun. 2012: Auditor, East Japan Transport Technology
Oct. 2013: Auditor, JAEA
Apr. 2015: Auditor, JAEA

J Auditor
Koichi KONAGAYA

Career Outline
Dec. 1988: KPMG AZSA LLC (then Asahi Audit Company)
Jun. 2006: Senior Partner, KPMG AZSA LLC
Oct. 2013: Auditor, JAEA
Apr. 2015: Auditor, JAEA

Principal Themes in R&D and R&D Sites

Principal Themes

JAEA is prioritizing "establishment of technologies toward 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 April 2018)

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 Area
Research of synchrotron radiation


(C)RIKEN

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). From fiscal 2015, JAEA has been undertaking operations in accordance with its third Medium- and Long-Term Plan (April 1, 2015 to March 31, 2022).

Third Medium- and Long-Term Plan

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 (Cabinet Decision in July 2018) and the Fifth Science and Technology Basic Plan (Cabinet Decision 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
  6) R&D related to the nuclear fuel cycle, such as reprocessing, fuel manufacturing and treatment and disposal of radioactive waste
  7) 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 Incorporated 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 2017, which corresponds with the third year of the third Medium- and Long-Term Plan, was disclosed on September 19, 2018. JAEA received a "B" mark as its comprehensive evaluation and evaluation results by category are as follows.

<Evaluation results of responsible ministries>

Evaluation	Number of items	Item name
S	0	—
A	4	・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
B	7	・Items concerning safety assurance and nuclear security ・R&D on fast reactors ・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 ・Rationalize and enhance efficiency of operations ・Budget (include estimate of personnel expenses), income and expenditure plan, financing plan ・Establish effective and efficient management structure
C	0	—
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)

[Evaluation criteria]

S: Creation of especially noteworthy outcomes toward "maximizing R&D outcomes" under appropriate, effective and efficient business operations and the expectation for the creation of special future outcomes is recognized.

A: Creation of noteworthy outcomes toward "maximizing R&D outcomes" under appropriate, effective and efficient business operations and the expectation for the creation of future outcomes is recognized.

B: Creation of outcomes toward "maximizing R&D outcomes" and the expectation for the creation of future outcomes is recognized and steady business operations are being carried out.

C: Further innovations and improvements are expected toward "maximizing R&D outcomes" and toward "appropriate, effective and efficient business operations."

D: Special measures, including drastic review, as well as improvements are needed toward "maximizing R&D outcomes" and toward "appropriate, effective and efficient business operations."

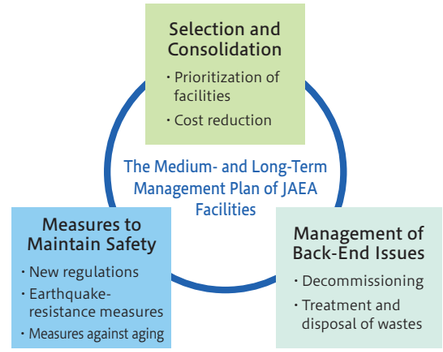
* The above criteria are evaluation criteria concerning "operations and programs pertaining to R&D."

Medium- and Long-Term Management Plan of JAEA Facilities

JAEA formulated the Medium- and Long-Term Management Plan of JAEA Facilities. 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, on March 31, 2017.

In 2017, we conducted earthquake-resistance measures, risk reduction measures and management of back-end issues according to a formulated plan. We also dealt with a contamination and exposure accident at the fuel research building at the Oarai Research and Development Center. The Medium- and Long-Term Management Plan was reviewed and revised to reflect the situation in 2017 and the 2018 budget on April 1, 2018.

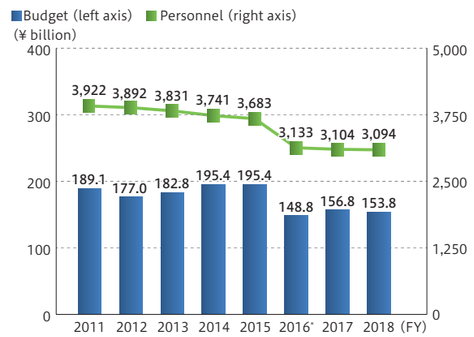
* For details on the Medium- and Long-Term Management Plan of JAEA, please see https://www.jaea.go.jp/about_JAEA/facilities_plan/ (in Japanese)



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 2017)

Summary of Balance Sheets (¥ million)

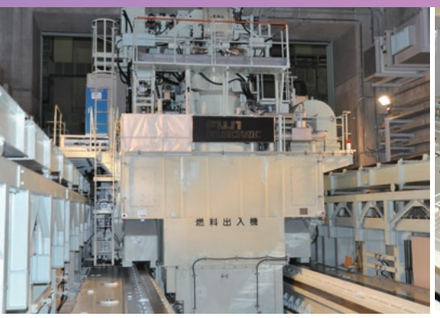
Assets		Liabilities	
Ⅰ. Current assets	159,568	Ⅰ. Current liabilities	61,558
Ⅱ. Fixed assets	537,330	Ⅱ. Long-term liabilities	204,210
1. Tangible fixed assets	472,108	Total liabilities	265,769
2. Intangible fixed assets	2,286		
3. Investments and other assets	62,935	**Net assets**	
		Ⅰ. Capital stock	820,290
		Ⅱ. Capital surplus	-412,575
		Ⅲ. Retained earnings	23,412
		Total net assets	431,128
Total assets	696,898	Liabilities and total net assets	696,898

Summary of Profit and Loss Statement (¥ million)

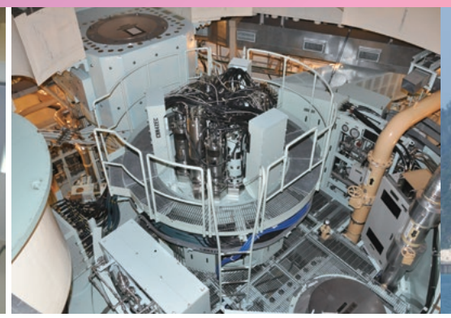
Items	
Ordinary expenses	158,919
Ordinary income	161,541
Extraordinary loss	11,201
Extraordinary income	6,163
Net loss before income taxes	2,416
Income taxes	48
Net loss	2,465
Reversal of reserves carried over from the period of the previous medium- and long-term target period	283
Total loss for the fiscal year	2,182

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

Fiscal 2017 Topics

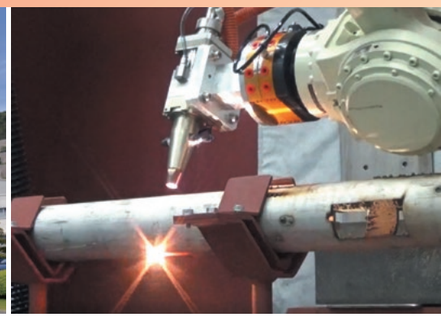

Ex-vessel fuel transfer machine


Main control console of fuel handling and storage system


Upper part of the reactor vessel


"Monju"


"Fugen"


Laser cutting technology

JAEA Has Started Work toward Completion of Decommissioning of Prototype Fast Breeder Reactor "Monju"

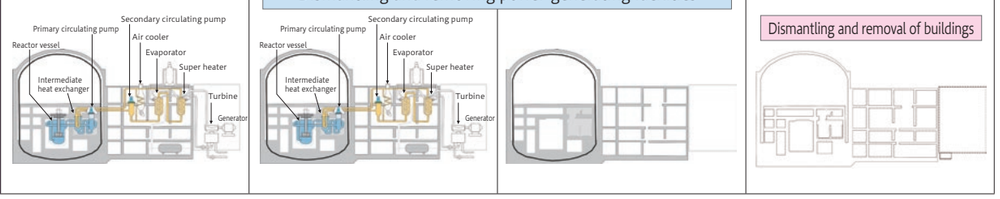
The Decommissioning Plan of Prototype Fast Breeder Reactor "Monju" Approved

The decommissioning plan of the prototype Fast Breeder Reactor "Monju" was approved on March 28, 2018. "Monju" decommissioning is scheduled to proceed in four phases, to be completed in fiscal 2047, about three decades from now. In light of the special consideration that "Monju" will shift to decommissioning with fuel in the reactor vessel, we are planning the decommissioning as indicated in the figure below, placing fuel unloading before any other steps. Details of the work in the second and subsequent phases will be reflected in the decommissioning plan before start of the second phase.

We will strategize on treatment and disposal methods for spent fuel and sodium in collaboration with the government; the detailed plan is to be reflected in our decommissioning plan before the start of the second phase. To this end, we are now investigating and examining technologies adopted in overseas plants. Solid radioactive waste will be classified according to its radioactivity level and will be disposed of in disposal facilities according to its class before the end of decommissioning. Waste not needing to be treated as radioactive material will be recycled as much as possible following certain procedures and certification by the regulatory authority.

Based on the collective wisdom of domestic and foreign professionals, we will make the decommissioning plan for "Monju" safer and more efficient, and proceed with it under the Head Office of Tsuruga Decommissioning Demonstration, established to promote decommissioning in the Tsuruga area.

	1st Phase Fuel unloading Fuel unloading, survey and appraisal of radioactivity	2nd Phase Preparation for dismantling Preparations for the dismantling of sodium-cooling equipment, dismantling and removing power-generating facilities, and survey and appraisal of radioactivity (Continuous work from the previous phase)	3rd Phase Dismantling Ⅰ Dismantling and removal of sodium-cooling equipment and power-generating facilities (Continuous work from the previous phase)	4th Phase Dismantling Ⅱ Removal of radiation controlled area; dismantling and removal of buildings
(FY)	2018～2022	2023～2047		
Activities	Fuel unloading	Preparations for the dismantling of sodium-cooling equipment Dismantling and removing power-generating facilities	Dismantling and removal of sodium-cooling equipment	Dismantling and removal of buildings



The Sector of Tsuruga Decommissioning Demonstration Newly Established to Pursue Decommissioning of Both "Monju" and "Fugen" in an Integrated Manner

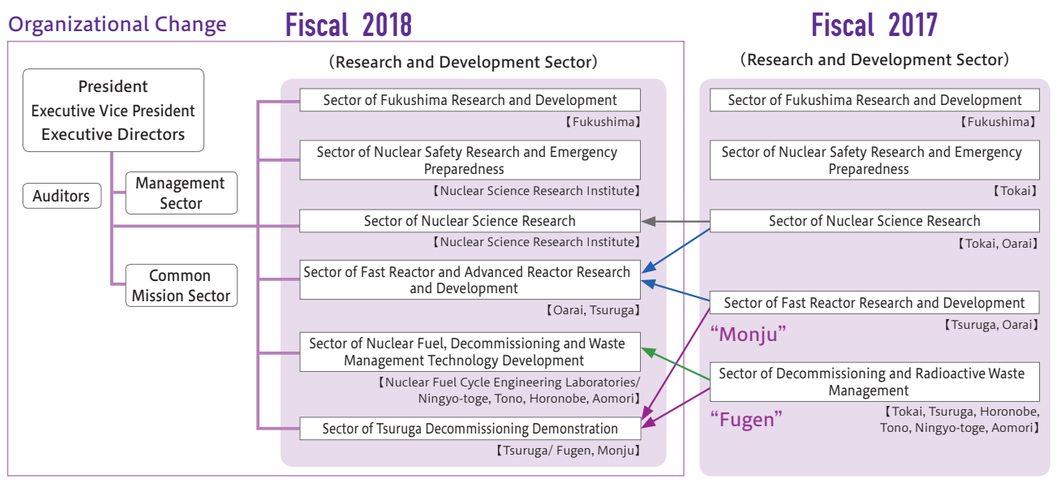
Five Sectors Reorganized into Six to Promote Smooth Operation

Following the "Government's Monju Policy" set forth at the Council of Related Ministers for Nuclear Power on December 21, 2016, JAEA formulated a "Basic Plan on Decommissioning Monju" on June 13, 2017. The "Plan for Decommissioning of the Prototype Fast Breeder Monju" was then filed with the Nuclear Regulation Authority on December 6, 2017, and approved on March 28, 2018.

In line with this plan, JAEA changed its organization by making its five sectors into six. The decommissioning operations for "Monju" and "Fugen" were separated from the Sector of Fast Reactor Research and Development and the Sector of Decommissioning and Radioactive Waste Management, respectively, while the "Sector of Tsuruga Decommissioning Demonstration" was newly established to pursue decommissioning operations of those reactors in an integrated manner. In addition, the R&D operations on fast reactors and the R&D operations related to high temperature gas-cooled reactors of the Oarai Research and Development Center that belonged to the Sector of Nuclear Science Research were combined to form the Sector of Fast Reactor and Advanced Reactor Research and Development.

Under this new organization, the Sector of Fast Reactor and Advanced Reactor Research and Development will engage in R&D of high-temperature gas-cooled reactors with safety as its top priority, as well as pursue R&D activities toward establishing demonstration technologies for fast reactors. The Sector of Nuclear Fuel, Decommissioning and Waste Management Technology Development will conduct R&D activities that support promotion of the nuclear fuel cycle where spent fuel will be reprocessed and Pu and other recovered materials will be effectively used. The Sector of Tsuruga Decommissioning Demonstration will combine the technologies and experiences accumulated at JAEA with technical capabilities of utilities and manufacturers to pursue safety-related activities steadily and promote decommissioning in a systematic and efficient manner.

Organizational Change



Conducted Collaborated with Three Institutes of Fukushima Prefectural Centre for Environmental Creation for Assessment of Environmental Effects of Forest Fire on Radiation and Radioactive Materials

The Evaluation Results Revealed that There was No Effect of the Forest Fire on the Environmental Radiation

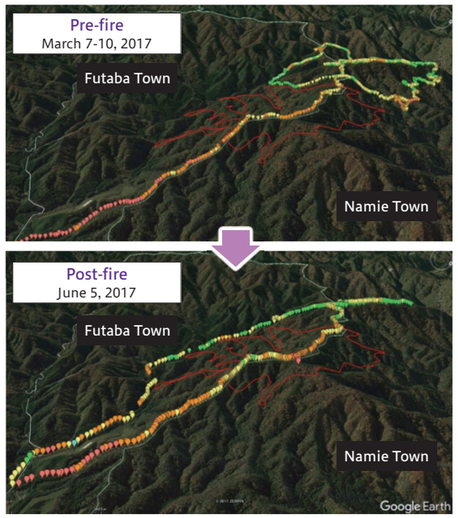
A fire burned in a mountainous forest in the "difficult-to-return zone" of Fukushima Prefecture from late April to early May 2017. The Fukushima Environmental Safety Center of JAEA has been collaborating with Fukushima Prefecture and the National Institute for Environmental Studies of the Fukushima Prefectural Centre for Environmental Creation to assess the forest-fire effects on radiation and radioactive materials in the environment.

The Center has carried out air dose rate measurements in and around the burnt area through airborne (unmanned helicopter) and walk surveys, monitoring of radioactive cesium outflow from the forest slope, and measurement of radioactive cesium activities in soil, litter, and water samples collected from the burnt area and its surrounding river and ponds. For the radiation surveys and field investigations, radiation monitoring technologies (airborne and ground surveys) and field investigation techniques (research for the environmental dynamics of radioactive cesium) developed through research and development activities for the environmental restoration of Fukushima were utilized to the maximum extent possible.

The radiation surveys and investigation results show no effects of the forest fire on the air dose rate and ^{137}Cs activities in river water collected downstream of the burnt area. The results also indicate that radioactive cesium detected in air dust samples is most likely of non-fire origin.

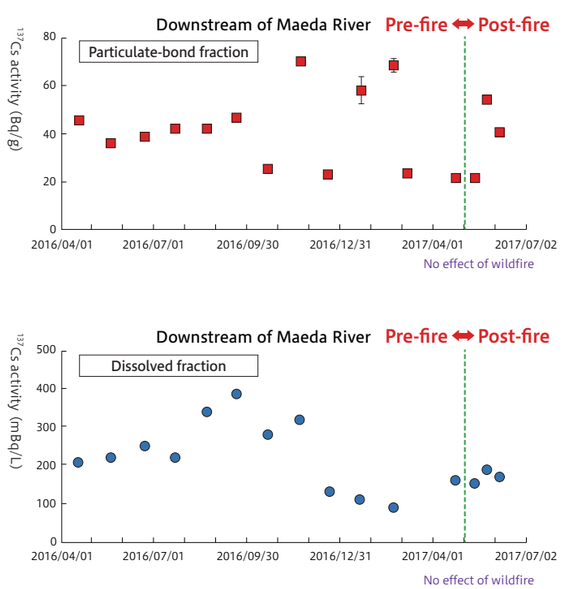
JAEA provided these results as an interim report to Fukushima Prefecture and Namie Town, and the findings have contributed to reducing residents' anxieties, such as radioactive cesium resuspension and outflow to rivers.

Air Dose Rates in Pre- and Post-Wildfire (Red Lines Enclose the Burnt Area)



Walking survey of air dose rate measurement in and around the burnt area

^{137}Cs Activities of Particulate and Dissolved Fractions in River Water Near the Burnt Area



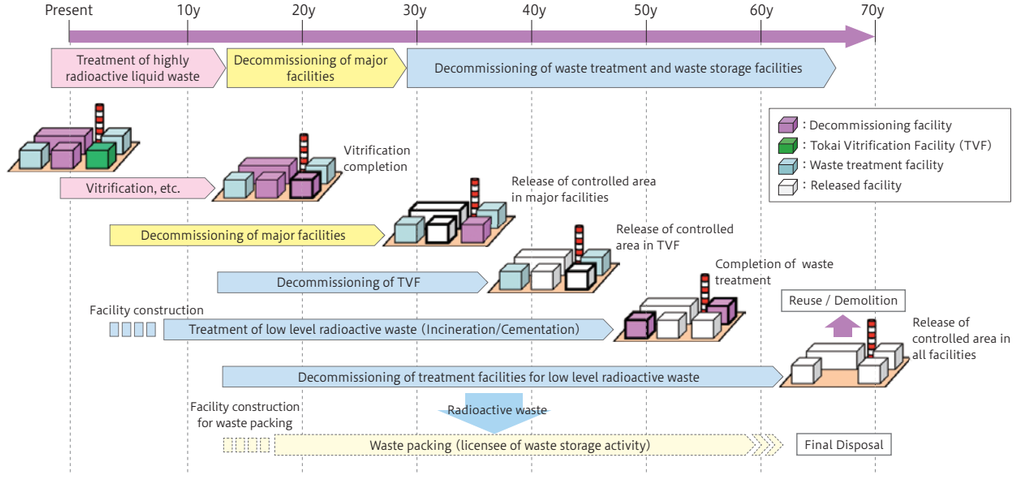
Tokai Reprocessing Plant (TRP) Has Entered a New Stage for TRP Decommissioning

Vitrification of Highly Radioactive Liquid Waste Conducted to Reduce Risk

The Tokai Reprocessing Plant (TRP), the first reprocessing plant in Japan, has reprocessed the spent fuel of Light Water Reactors and the Advanced Thermal Reactor "Fugen" since hot tests began in 1977. The total amount of reprocessed spent fuel is approximately 1,140 tons. TRP has made a significant contribution to the establishment of reprocessing technologies in Japan. After the Great East Japan Earthquake in March 2011, the strengthening of emergency safety measures and risk reduction for storage of radioactive solution were conducted. Conversion from plutonium solution to plutonium-uranium mixed oxide (MOX) powder was finished in July 2016. Vitrification of highly radioactive liquid waste will continue until fiscal 2028, with the highest priority given to safety.

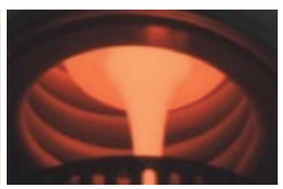
JAEA announced a policy that TRP will shift to a decommissioning stage in September 2014. Decommissioning is the final challenge to safely finish facility life, and is an essential task for the establishment of a nuclear fuel cycle. Since TRP decommissioning is the first large-scale decommissioning of a nuclear fuel cycle facility in Japan, the TRP decommissioning plan was determined based on advice and recommendations from domestic and foreign experts. The need for prompt risk reduction activities as a top priority was also taken into account, and safety improvement measures were fitted to facilities. In this plan, release of the controlled area in TRP facilities occurs after approximately 70 years. The TRP decommissioning plan received approval from the Nuclear Regulation Authority in June 2018. TRP decommissioning is being promoted with the highest priority given to safety and carrying out necessary technological development for overcoming problems.

Road Map of TRP Decommissioning Project



Vitrification of Highly Radioactive Liquid Waste

Remote operation



Pouring molten glass

Simulated vitrified waste

Approved TRP Decommissioning Plan

The Story of 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

Decommissioning of nuclear facilities and management of radioactive waste

Maintenance of international competitiveness

Ensuring nuclear nonproliferation and nuclear security

Safe nuclear energy use

The accident at TEPCO's Fukushima Daiichi Nuclear Power Station

Action to Solve Social Issues

Major Challenges for JAEA

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

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

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

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

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

Implementation of Mission

Break New Ground for the Future of Nuclear Energy and Contribute to the Welfare of Human Society.

Organizational Enhancement by Management

Management by President

VISION

Organization Vision

■ **Fulfill our role as Japan's sole nuclear energy research and development agency**
- An organization that promotes R&D that contributes to nuclear safety
- An organization that can effectively utilize limited management resources (human resources, facilities and equipment, financial resources)
- An organization that contributes to nuclear energy use by the international community

■ **Lead nuclear energy R&D with high organizational IQ**

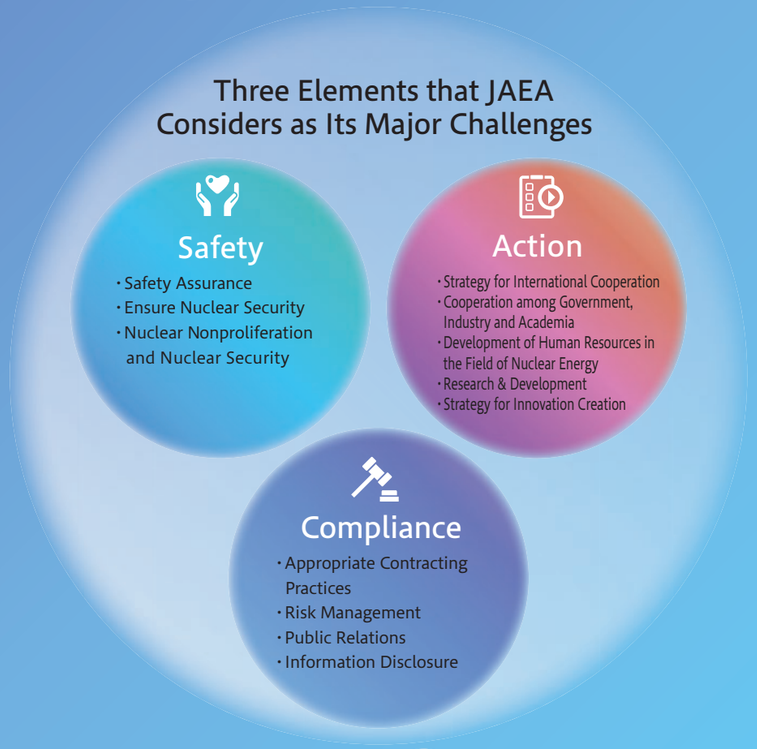
An organization with high organizational IQ that places top priority on safety, that can independently think and act, and continuously undertakes reform

STRATEGY

Organization Strategy

- What should we do to realize our vision into the future?
- Sharing of values
- Strengthening of governance, safety control and internal control functions
- Promotion of prioritization, rationalization and greater use of IT in business operations
- Implementation of management reforms and a clear execution plan

Major Challenges for JAEA



"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.

These efforts for "Safety" are explained under "Operations Placing the Utmost Priority on Safety (P20-P23)," and "Toward a World without Threats of Nuclear Proliferation and Nuclear Terrorism (P24-P25)."

"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.

These efforts related to "Compliance" are explained under "Appropriate Contracting Practices (P40)," "Promotion of Risk Management and Compliance (P41)" and "Public Consultation, Public Relations and Information Disclosure (P42-P43)."

"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. In light of this, 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."

Out of these efforts for "Implementation," those related to "international strategy, industrial-academic-governmental cooperation and development of human resources in the nuclear area" are explained under "Initiatives for Promoting R&D (P26-P27)," and those related to "research and development" are presented under "Sector of Fukushima Research and Development (P28-P29)," "Sector of Nuclear Safety Research and Emergency Preparedness (P30-P31)," "Sector of Nuclear Science Research (P32-P33)," "Sector of Nuclear Fuel, Decommissioning and Waste Management Technology Development (P34-P35)," "Sector of Fast Reactor and Advanced Reactor Research and Development (P36-P37)," and "Sector of Tsuruga Decommissioning Demonstration (P38-P39)."

JAEA's Strategy for Innovation Creation: "Implementation"

Social Challenges for JAEA

As social challenges for JAEA to address, we will discuss "Energy resources," "Back-End of Nuclear Facilities (Decommissioning of nuclear facilities and management of radioactive waste)," "Maintenance of international competitiveness," "Reserve of nuclear nonproliferation and nuclear security," "Safe use of nuclear energy" and "The accident at TEPCO's Fukushima Daiichi Nuclear Power Station."

Efforts toward Solving Social Problems

In the "Strategy for Innovation Creation," we specify our innovation targets and our policies and strategic initiatives for creating them, so that we can fulfill our mission of "exploring the future of nuclear power and contributing to the welfare of human society" through addressing these social challenges.

Specific Strategies for Innovation Creation

In the Strategy for Innovation Creation, we list the following as our basic policies: to promote fusion of different disciplines, to reform research and development methods, to foster customers' viewpoints and to promote utilization of facilities.

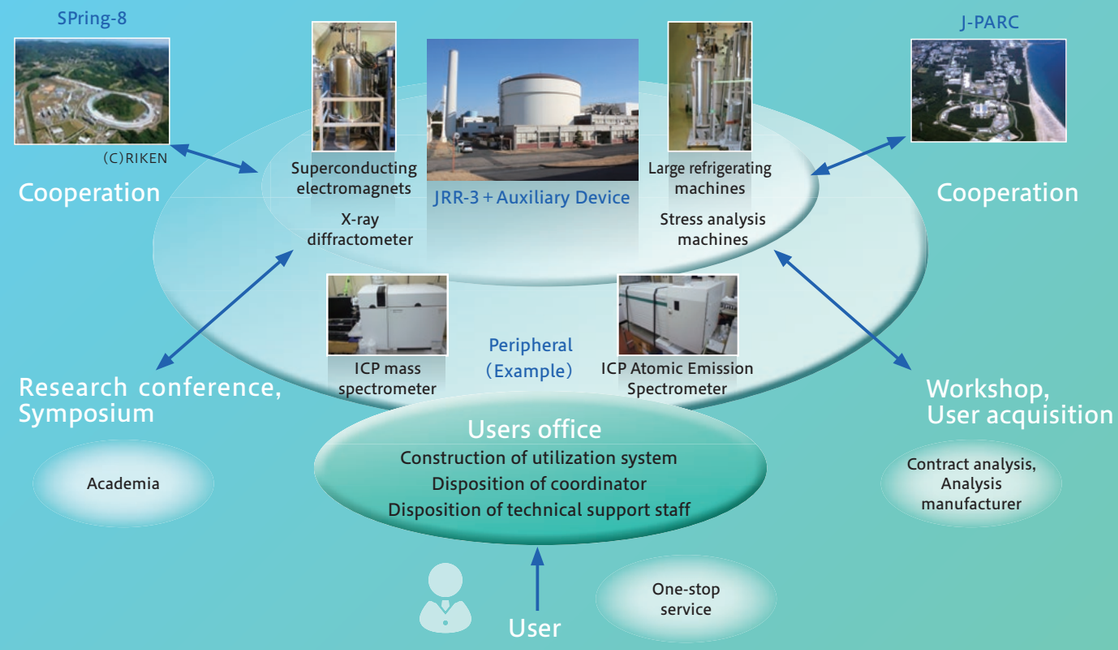
In order to promote fusion of different disciplines, we have started collaborating with financial institutions and think tanks to open technology salons introducing our research and technology seeds widely to private enterprises.

Scenes from the Innovation Lecture "Lifestyle for Researchers in the Fourth Industrial Revolution Age"

To reform research and development methods, we are trying to ensure that simulation techniques are shared horizontally within JAEA so that computational science and simulation will be used more effectively. To foster customers' viewpoints, we give lectures on innovations to introduce means for putting our research and development results to use by society. To promote utilization of facilities, we have started considering construction of a common platform for nuclear facilities and their peripheral devices scheduled to operate again soon.

By continuing to deploy the Strategy for Innovation Creation, we will seek to provide our technology and wisdom, as the only comprehensive nuclear research and development institute in Japan, for the benefit of society.

Concept of In-Service Platform Centered on JRR-3 (Image)



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 an extremely high level 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 onsite work through a range of routines, including the onsite 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 its causes (including measures taken to prevent recurrence) and to incorporate these lessons as necessary into their onsite work. During fiscal 2017, we shared information on 22 cases of accidents or problems both within and outside JAEA, and gave specific directions on 8 cases for investigation and corrective action in order to prevent recurrence.

Occurrence of Accidents and Problems

In fiscal 2017, we had one accident or problem that required reporting pursuant to the Act on Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors; it was a contamination and exposure accident that occurred at the fuel research building at the Oarai Research and Development Center. The Nuclear Regulation Authority noticed a total of four violations of safety regulations, and informed us about them, including one violation involving this accident and three cases related to monitoring. We had eight lost time incidents and received two corrective recommendations by the Labor Standards Inspection Office.

As for the contamination and exposure accident at the fuel research building at Oarai, we shared lessons about organizational factors emerging from investigation of its causes, analysis of its direct cause and analysis of its root cause, and acted upon them across JAEA.

Activities to Foster a Safety Culture

JAEA pursues activities in line with the "Policy for Activities to Foster a Safety Culture and to Ensure Compliance with Applicable Laws and Regulations." In fiscal 2017, officials undertook safety patrols and exchanged opinions with the staff at JAEA sites to promote information sharing and mutual understanding between the management and the staff. At each JAEA site, there was a safety gathering with participation of all workers, including partners and other companies stationed at the site, a safety and health patrol by the director general, a lecture on safety and so on.

In addition, we conducted a questionnaire survey to better understand the status of JAEA's safety culture and trends. The survey results showed improvement as a whole from fiscal 2014, especially in the category of "commitment by top management" where we attained the highest scores.

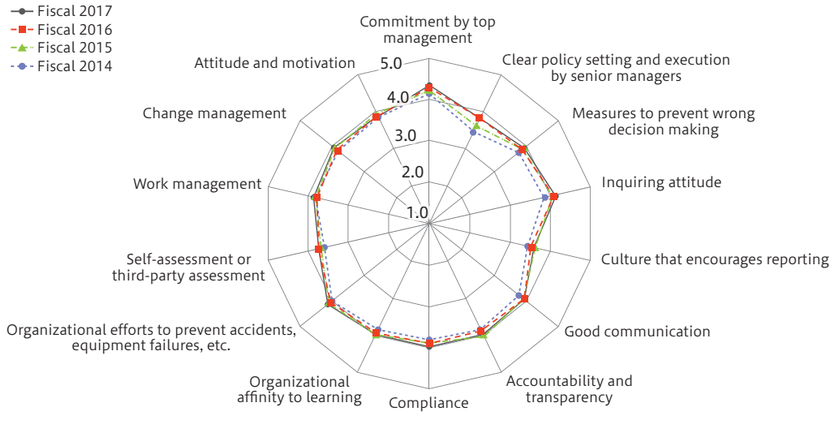
Safety patrols by Executives

Exchange opinions between the management and the staff

Experience-based education

Experience-based education

Results of the Fiscal 2017 Questionnaire Survey (JAEA as a Whole; Compared with Fiscal 2014-2016)



Operations Placing the Utmost Priority on Safety

Initiatives for Our Own Quality Improvement

With a view to ensuring the safety of its nuclear facilities, JAEA has laid down 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 reviews periodic reports from JAEA sites to ensure effectiveness of various safety-related activities at our nuclear facilities and to improve our quality management system and operations. We had three management reviews during fiscal 2017, and based on the results of safety examinations and the status of accidents and problems, we defined responsibilities and authorities of centralized management for Executive Directors, Departments and sites, with a view to strengthening our internal control. With "the senior management's understanding of the challenges and improvement of all safety-related activities" as our quality target, we confirmed that each department's voluntary efforts for improvement should be promoted through Middle-Up-Down management.

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 2017, the committee met 24 times to discuss a total of 44 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 2017 and countermeasures against them and our responses to comments given in safety inspections, and proceeded with our 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 New Regulatory Standards

In response to the new regulatory standards triggered by the accident at TEPCO's Fukushima Daiichi Nuclear Power Station in March 2011, we are taking measures for safety reviews of test reactors and others. In June 2016, a graded approach was introduced as a reasonable safety regulation, taking into account the characteristics and risk levels of nuclear facilities. We consulted with the regulatory authority about application of the standards to test reactors. As a result, in January 2018, we obtained permission for changes in the reactor installation licenses of the Static Experiment Critical Facility (STACY) and the Nuclear Safety Research Reactor (NSRR) as the first test reactors of JAEA conforming to the new regulatory standard.

Efforts to Sort Out 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 old facilities and equipment items pose greater risk in terms of safety and need to be prioritized; in other words, grouped into ones we will continue to use and ones 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 2017, 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 5 in fiscal 2017, from 14 in fiscal 2016.

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 2017, 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

In fiscal 2017, we arranged a lecture by a crisis response expert for our executives with an opportunity for them to exchange views with the expert, while 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, etc.

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 within and 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 the prototype Fast Breeder Reactor Monju, we conducted drills that incorporated support from other JAEA sites and confirmed that the supporting system of the entire organization worked.

Response to Accidents and Problems

Upon occurrence of an accident or a problem, we use the emergency response system to make a swift response in collaboration between the headquarters and the relevant site. In fiscal 2017, we had 31 accidents or problems that necessitated use of the emergency response system within JAEA.

Comprehensive Emergency Preparedness Drills at Sites in Fiscal 2017

Nov. 22, 2017 Ningyo-toge Environmental Engineering Center Approx. no. of participants 320	Nov. 27, 2017 Nuclear Fuel Cycle Engineering Laboratories Approx. no. of participants 1,710
Jan. 17, 2018 Oarai Research and Development Center Approx. no. of participants 1,270	Jan. 26, 2018 Nuclear Science Research Institute Approx. no. of participants 240
Feb. 9, 2018 Fugen Decommissioning Engineering Center Approx. no. of participants 200	Feb. 16, 2018 Prototype Fast Breeder Reactor Monju Approx. no. of participants 320

TOPICS

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

JAEA refers to the initiative to prevent unauthorized removal of nuclear materials and sabotage of nuclear facilities as "Nuclear Security" and the initiative to ensure that nuclear materials are used for peaceful purposes and not diverted to nuclear weapons as "safeguards." We never fail to undertake such initiatives in accordance with relevant international agreements and domestic laws and regulations, respectively.

In terms of nuclear security, our efforts have been confirmed to have reached a certain level through inspections by the national Nuclear Regulation Authority (NRA) and investigations of the United States of America, etc. We have also been making steady progress toward preparing ourselves for the human reliability program*1, a new regulatory requirement. In addition to satisfying these regulatory requirements, JAEA conducts activities to foster a nuclear security culture and raise employees' awareness on nuclear security on a continual basis, through diverse opportunities such as questionnaire surveys and lectures.

With regard to safeguards, we perform nuclear material control and accounting (MC&A) to appropriately manage the amount of nuclear materials and their transfer, and to ensure these materials are not diverted to nuclear weapons.

We work to maintain and improve the level and quality of our MC&A, and at the same time, cooperate with the NRA and IAEA in their safeguard inspections. We also take measures required under Integrated Safeguards by IAEA*2 with transparency, and respond appropriately to requests for information on MC&A data from external entities, such as government ministries and the National Diet.

*1 A human reliability program: As one of the measures against threats from employees and other insiders, this system surveys the positions, careers and other backgrounds of individuals who have access to the designated inner areas of nuclear facilities or handle secret information regarding physical protection, so as to confirm that they will not conduct any sabotage.

*2 For information regarding the "Integrated Safeguards," please see the JAEA website: https://www.jaea.go.jp/04/iscn/archive/sg_is/index.html (in Japanese)

Toward a World without Threats of Nuclear Proliferation and Nuclear Terrorism

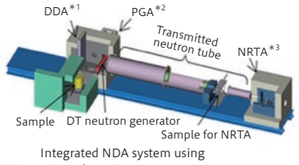
Toward a world without nuclear proliferation and nuclear terrorism, JAEA/ISCN works on technological development, policy research, supporting human capacity building and contribution to the CTBT International Verification Regime in the field of nuclear non-proliferation, nuclear security and denuclearization.

Overview of Integrated Support Center for Nuclear Nonproliferation and Nuclear Security

Technology Development for Japanese and International Applications

JAEA focused on technology development based on Japanese and international needs. The ISCN has been developing technologies to quantify nuclear materials (NM) in fuel debris at the Fukushima Daiichi Nuclear Power Station, to detect NM in heavily shielded containers and to measure NM contained in complex and highly radioactive materials. The ISCN is also working on the development of nuclear forensics technology to determine the origins of NM seized by law-enforcement authorities. In addition, the ISCN holds international symposia and workshops on technology to share needs and technological information with domestic and international researchers.

International symposium on technology



Integrated NDA system using external neutron source

Workshop with participation of domestic and international experts

*1 Differential Die-away Analysis
*2 Prompt Gamma-ray Analysis
*3 Neutron Resonance Transmission Analysis

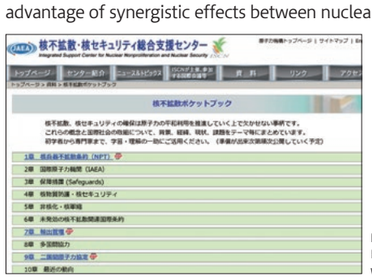
Support for Government Policy Making Based on Technological Expertise

The ISCN conducts policy research, based on its expertise, focusing on the issues of nuclear nonproliferation and nuclear security. The research aims to support Japan's policy making in these areas.

In fiscal 2017, ISCN completed a research study to take advantage of synergistic effects between nuclear nonproliferation (safeguards) and nuclear security measures (collectively called "2Ss"). Challenges and possible solutions to maximize such effects and to expand the feasibility and applicability of detection technologies (e.g., measurement systems, surveillance cameras) which could be shared between the 2Ss in future nuclear fuel cycle facilities are clarified and discussed.

The ISCN also investigates and analyzes international trends related to nuclear nonproliferation and nuclear security and provides information to the relevant government agencies as well as experts and the public. As part of that function, a Nuclear Nonproliferation Pocketbook has been released on the JAEA website.

* https://www.jaea.go.jp/04/iscn/archive/pocketbook/index.html (in Japanese)



Nuclear Nonproliferation Pocket book on JAEA website

Human Resources Development for Emerging Nuclear Countries in Asia

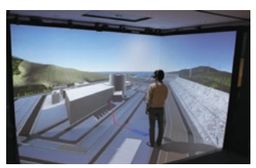
The ISCN was established under JAEA following Japan's national statement at the 2010 Nuclear Security Summit. As of March 2018, 3,798 participants from 75 countries (including Japan) and three international organizations have received training at ISCN's 144 courses. ISCN training programs consist of exercises using training tools such as ISCN's 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 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 the training. ISCN also promotes cooperation with training centers in China and the Republic of Korea and exchanges 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 Comprehensive Nuclear-Test-Ban Treaty (CTBT) prohibits nuclear tests in all environments, and ensures the compliance of member states, by stipulating the establishment of a verification system consisting of an international monitoring system, consultation and clarification, on-site inspections, and confidence-building measures.

Although the CTBT has not yet entered into force, 88% of the international monitoring system for monitoring nuclear tests is already in provisional operation. It consists of 337 certified monitoring facilities at locations around the world.

JAEA is contributing to nuclear non-proliferation and disarmament through its active cooperation with the government. This is achieved by the maintenance of monitoring facilities and the development of analytical systems related to radionuclides, as well as their management and operation.

Monitoring Stations at 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 continued to disseminate information both inside and outside JAEA through its website and the distribution of the ISCN News Letter. It also organized an international forum on nuclear nonproliferation and nuclear security. In addition to dispatching experts to international meetings at the IAEA and other venues, as part of JASPAS activities it provides technical assistance for IAEA safeguards and conducts safeguard training (training courses at reprocessing plants) in cooperation with the IAEA.

ISCN News Letter

International Forum

TOPICS

Contributions Relating to International Nonproliferation Issues

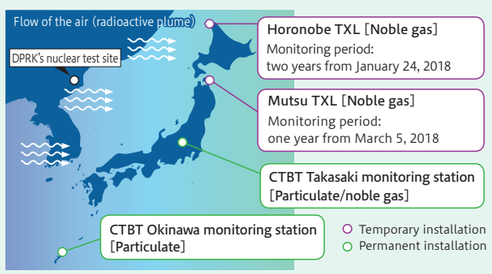
The ISCN hosted the IAEA's National Training Course on Safeguard Implementation for Iran from the 25th through the 29th in September of 2017 at the Nuclear Science Research Institute at JAEA. It was the first safeguard training course for Iranian experts to be conducted outside Iran. Twenty-six individuals from the Atomic Energy Organization of Iran and other relevant entities participated in the course and learned how necessary information can be collected and provided to the IAEA in accordance with a state's Comprehensive Safeguards Agreement and Additional Protocol.

The nuclear issue in Iran is a significant concern that may impact on the international non-proliferation regime. Safeguards are expected to play an important role in ensuring the implementation of the Joint Comprehensive Plan of Action (JCPOA). The training course received a high evaluation from the IAEA and a second national training course for Iran with expanded content is planned for fiscal 2018.

Safeguard training course for Iran

Strengthened Monitoring of Nuclear Tests

Based on the Democratic People's Republic of Korea (DPRK)'s repeated nuclear tests, the Japanese government contributed funds for a noble gas measurement project in February 2017 designed to strengthen the CTBTO's nuclear test detection capability. The CTBTO decided to conduct measurements in the Hokkaido and Tohoku regions of Japan for the time being, and requested that the JAEA, which has sufficient experience and a record of performing noble gas measurements in Japan, be the collaborative organization for the project. In response to this, the JAEA installed two mobile noble gas measurement systems on public land owned by the municipality of Horonobe in Hokkaido and the JAEA Ohminato site in Mutsu city, Aomori Prefecture, and has been carrying out measurements.



Installation maps of CTBT radionuclide monitoring stations and mobile noble gas measurement systems operated by JAEA

Initiatives for Promoting R&D

Implementation of JAEA's Strategy for International Cooperation

For JAEA to execute its mission, various forms of interaction with the relevant nuclear organizations in other countries and international organizations is essential. Such interaction includes international joint research contributing to the maximization of R&D results, contribution to the international nuclear community through means such as support for human resource development efforts in other countries, and dissemination of its R&D results.

Basic Policy for Promoting International Cooperation

- Contribution to ensuring nuclear safety
- Contribution to ensuring nuclear nonproliferation/nuclear security
- Maximization of R&D results
- Support for developing human resources in the nuclear field (support to other countries and development of globally minded personnel at JAEA)
- Overseas dissemination of R&D results and related international outreach

JAEA adopted a Strategy for International Cooperation in March 2017. As a new initiative based on this Strategy, in fiscal 2017, JAEA organized events such as the symposium or workshop outlined below with the cooperation of relevant nuclear organizations.

JAEA commenced cooperation activities as listed below.

- Cooperation with the National Center for Nuclear Research in the Republic of Poland regarding cooperation in the field of High-Temperature Gas-cooled Reactors (May 2017-)
- Cooperation with URENCO Limited in the field of High-Temperature Gas-cooled Reactors (May 2017-)
- Cooperation with ROSATOM on information exchange for R&D relating to Minor Actinoid transmutation (September 2017-)
- Cooperation with the Nuclear Regulatory Commission in the field of nuclear safety research (December 2017-)

In addition, JAEA is actively engaged in cooperation with the following organizations and initiatives.

- IAEA
- Organisation for Economic Co-operation and Development/ Nuclear Energy Agency (OECD/NEA)
- International Science and Technology Center (ISTC)
- Generation IV International Forum (GIF)
- Forum for Nuclear Cooperation in Asia (FNCA)
- European Safeguards Research and Development Association (ESARDA)
- European Commission/Joint Research Centre (EC/JRC)
- U.S. Department of Energy (DOE)
- French Alternative Energies and Atomic Energy Commission (CEA)

* For the full text of our Strategy for International Cooperation, please visit the JAEA website at: https://www.jaea.go.jp/english/about/international_strategy/strategy.pdf

Symposium sponsored by JAEA Washington Office (June 2017)

Workshop sponsored by JAEA Paris Office (February 2018)

Seminar sponsored by JAEA Vienna Office (October 2017)

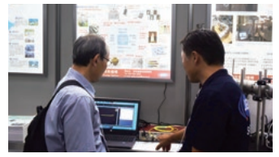
Signing Ceremony with ROSATOM (September 2017)

Promotion of R&D through Industry-Academia-Government Collaboration

JAEA makes proactive efforts to make its R&D outcomes widely available to society and, by doing so, to bring about innovation. Such efforts include R&D through collaboration with industry, academia and government, transfer of R&D outcomes to the private sector by making them subject to patents and other intellectual property rights and the accumulation and dissemination of research papers and other R&D outcomes.

In fiscal 2017, JAEA carried out 236 joint research projects with government, universities and private companies and also undertook 141 consigned research projects. With the aim of making patented technologies available to the private sector, we published the booklet JAEA Technology Collection Version 3 (in Japanese) and organized new technology briefing sessions in collaboration with such expert organizations as the Japan Science and Technology Agency. In these sessions, we presented four new technologies to 80 participants to attract license applications. JAEA also accumulates R&D outcomes such as academic papers using the "JAEA Originated Papers Searching System" (JOPSS) and disseminates them via our website.

* For details of industry-academia-government collaboration and the dissemination of R&D outcomes, please see the JAEA website: https://tenkai.jaea.go.jp (in Japanese)



Innovation JAPAN 2017 (August 31 to September 1, 2017)

Development of Human Resources in the Field of Nuclear Energy

JAEA is developing human resources in the field of nuclear energy by means of Domestic Training Courses and International Training Courses, as well as cooperation with universities and the Japan Nuclear Human Resource Development Network.

Domestic Training Courses

Domestic Training Courses aim at cultivating RI/radiation engineers and nuclear energy engineers and helping examinees who want to obtain national qualifications. In fiscal 2017, JAEA held 21 regular training courses and in addition opened two on-demand training courses based on our customers' various needs. Many of the course graduates are playing important roles as leaders and experts in the field of nuclear energy. Accordingly, JAEA intends to offer and enhance these courses continuously.

Training (Radiation Protection Basic Course)

International Training Courses

In International Training Courses, JAEA accepts trainees from various countries, mainly in 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 2017, 80 course participants from 11 countries).

Training (Environmental Radiation Monitoring)

Cooperation with Universities

Regarding cooperation with universities, JAEA engages in cooperation based on the partner graduate school format, which includes the acceptance of students from the Nuclear Professional School of the University of Tokyo (fiscal 2017: 14 students). JAEA also accepted special research students (27), student trainees (145) and summer vacation trainees (180) from universities. Furthermore, as 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 2017: 184). In fiscal 2018, approximately 50% of researchers and engineers newly hired by JAEA as employees had previously participated in these programs for university students. JAEA will continue to promote this initiative.

A cordial conversation between a young researcher and summer vacation trainees

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 77 industry-academia-government institutions. JAEA acts as the secretariat jointly with another organization. In fiscal 2017, the Nuclear Energy Management School was held in Tokyo and Fukushima Prefecture in collaboration with the International Atomic Energy Agency (IAEA) and language courses were held for promoting the cultivation of young Japanese professionals to play active roles in the international community in the future.

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

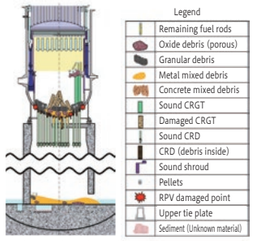
Sector of Fukushima Research and Development

Toward the Establishment of Technology for Regeneration and Reconstruction of Fukushima Area

The Sector of Fukushima Research and Development, through research on decommissioning and environmental restoration to address the aftermath of the accident at the Fukushima Daiichi Nuclear Power Station, has been supporting the formulation of a decommissioning strategy and the planning/promotion of research and development. We are contributing thereby to the lifting of the evacuation order by the government and the drafting of a plan for early repatriation of residents by the relevant municipalities.

Integrated Evaluation of Reactor and Containment Vessel Internal Conditions

The conditions of the fuel debris and related core materials within the reactor vessel and containment vessel of the Fukushima Daiichi Nuclear Power Station have been estimated through an integrated evaluation based on i) photos and various data obtained during surveys into the units, ii) plant data such as pressure and water level obtained during the accident progression, iii) knowledge from existing and newly conducted experiments and iv) computer model simulations of the accident progression. The result of this research will be utilized effectively for debris retrieval and various decommissioning activities in the future.

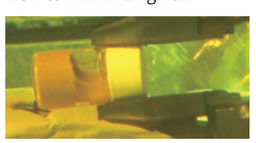


Unit 2 Estimation Diagram

JAEA, a member of IRID (International Research Institute for Decommissioning), has been participating mainly through estimation of Unit 2 conditions.
* This research is subsidized by the Ministry of Economy, Trade and Industry (METI).

Analysis for Research and Development into Waste Processing and Disposal

Various waste stored at the Fukushima Daiichi Nuclear Power Station has been continuously analyzed. Sludge was generated from the Decontamination Device in the process of decontaminating radioactivity from the accumulated waste and the sludge samples were transported to our laboratory (Chemical Processing Facility) and analyzed. The acquired data on density, fluidity and radioactivity concentration are utilized in the investigation into processing and future disposal with a view to minimizing risk.



Sample of sludge from Decontamination Device.

Analysis conducted in shielded cell (hot cell) by remote handling.

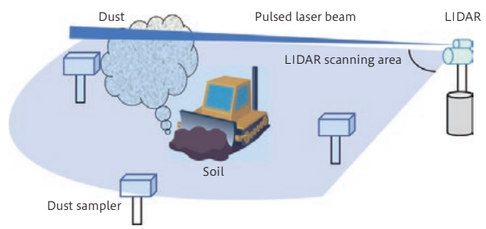
* This research is subsidized by METI.

Technology Development to Contribute to Safe Recycling of Decontaminated Soil

— Demonstration of Monitoring Technology to Measure Dust Distribution from Decontaminated Soil

The government aims to properly process the soil contaminated with radioactive cesium and recycle the processed soil for public works projects such as road embankments to reduce the amount of final disposal of soil generated by decontamination operations. JAEA has developed a technology to monitor the distribution of dust generated in civil engineering works using decontaminated soil, in collaboration with Chiba University, and conducted a demonstration test at the soil storage facility within the intermediate storage facility in the difficult-to-return zone.

In the demonstration test, it was clarified that the distribution area of dust generated in the soil storage operation is relatively limited, and that the radioactivity concentration in the air is considerably lower than the limit specified by related legislation. This technology is expected to be utilized as a monitoring technique for intermediate storage facilities, etc., to announce information that can confirm the safety of surrounding residents and workers.



Dust sampler

LIDAR

"LIDAR" is a technology to measure the distribution of dust using harmless lasers.

TOPICS

Administration Building of Okuma Analysis and Research Center begins operation

JAEA is establishing the Okuma Analysis and Research Center, adjacent to the Fukushima Daiichi Nuclear Power Station, for characterization of radioactive waste and fuel debris generated by the accident. The Administration Building started operation on March 15, 2018. This building consists of office rooms and a workshop which is equipped with actual manipulators, a simulated iron cell and a glove box of actual size for prior confirmation and training in analysis work.

The Administration Building

Renewal of the Website: "Evidence-Based Q&A on Present Condition of Fukushima"

We arranged findings on the Fukushima environment Q&A format with graphical information by re-organizing various scientific findings and insights obtained by JAEA and other institutes in a plain-language. This Q&A contains information that will be useful for people who wish to return to their home town (restricted residence area, etc.).

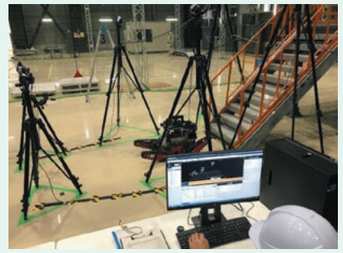
The website has been open to the public since 2016. Currently the site is in Japanese only.

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

Large Increase in Facility Users of the Naraha Center for Remote Control Technology Development

The Center has been utilized as a testing site for operations relating to the decommissioning of the Fukushima Daiichi Nuclear Power Station. For example, a private company conducted "Underwater robot test for investigation inside the Primary Containment Vessel" and IRID conducted "Full-scale verification tests to stop water leakage from the nuclear reactor." The center has also been utilized for "Exhibition & demonstration" related to the robotic technology organized by the Fukushima Technology Centre, "Examinations" conducted by universities and National Institutes of Technology, and Second Creative Robot Contest for Decommissioning. These works contributed to the revitalization of local industry and human resource development.

In fiscal 2017, the number of instances of utilization came to 64, which is about twice the number in the previous year.



Robot test by The University of Aizu

Collecting Global and Domestic Knowledge

"Research Fund for Promoting Project on Decommissioning Research" (hereafter referred to as "CLADS Fund") was founded by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in FY2018. The purpose of the CLADS fund is to promote fundamental research/development and human resource development mainly through JAEA/CLADS in cooperation with domestic and overseas universities/research institutes, based on the needs at the decommissioning site. JAEA will reinforce steady and continuous mid- to long-term efforts by establishing a new system where CLADS plays a leading role in research/development and human resource development.

https://fukushima.jaea.go.jp/initiatives/cat05/index.html

Sector of Nuclear Safety Research and Emergency Preparedness

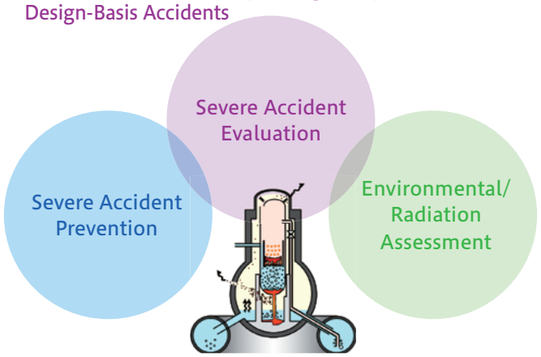
Contribution to the Continuous Improvement of Nuclear Safety

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



NSRC's Main Achievements in Fiscal 2017

- In order to solve the NRA's technical tasks and related issues, 28 delegated safety research projects were conducted and the results submitted as reports.
- In order to develop human resources in the form of young researchers at the NRA, we accepted 13 researchers and started two joint research projects. In addition, we dispatched 46 experts to the NRA review team.
- In order to contribute to securing nuclear safety, including overseas, we published 94 papers, which exceeded the previous year's figure.

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.

NEAT's Main Achievements in Fiscal 2017

- In addition to training for 1,654 national and local government officials, exceeding the initial schedule, we dispatched experts to nuclear disaster drills to support planning and evaluation and actual operation.
- As a new research theme aimed at improving the effectiveness of radiation protection, we developed a method to evaluate the effect of radiation reduction at sheltering facilities and compiled technical knowledge to further improve their effectiveness.
- In order to develop guidelines on the selection and utilization of radiation protection equipment, we surveyed equipment owned by local governments and issued a summary showing the standard performance required and points to be noted for radiation measuring instruments, individual dosimeters, etc.

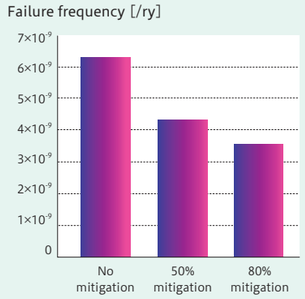
TOPICS

Successful Development for the First Time of an Analysis Code that Enables Failure Frequency Evaluation of Reactor Pressure Vessels in Domestic Light Water Reactors

The reactor pressure vessel (RPV) is one of the most important components of light water reactors (LWRs). For safety evaluation, JAEA has succeeded in developing a unique probabilistic fracture mechanics analysis code, PASCAL4, which is capable of failure frequency* evaluation of domestic RPVs, considering the uncertainties of various influencing parameters. Here, failure frequency is a numerical index to represent the safety level of an RPV. PASCAL4 is expected to make a significant contribution to the structural integrity assessment of LWR components through practical applications such as investigation of the effectiveness of non-destructive inspection for RPVs and safety improvement evaluation.

* Failure frequency = Occurrence frequency of an accident × failure probability when the accident occurs

Effect of Neutron Fluence Mitigation on RPV Failure Frequency



International Cooperation with the French Alternative Energies and Atomic Energy Commission (CEA)
Influence of Control Materials on Transport Behaviors of Fission Products

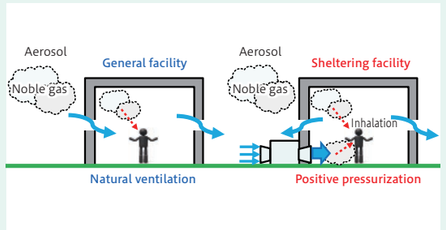
The VERDON-5 experiment, which was carried out under international cooperation with the CEA, provided data on the influence of boron as a reactivity control material on the transport behaviors of fission products, such as cesium, released from fuels under severe accident conditions at nuclear power stations. The data will be used for improvement of the evaluation techniques of the Source Term, a measure of radioactive release to the environment including information on released radionuclides, their amounts, physical and chemical forms, release timing, and so on.

Outline of the VERDON Experimental Setup Located in the CEA Hot Cell

Exposure Dose Assessment in Severe Accidents

In response to the growing need for research into radiation protection measures, we obtained data on items such as natural ventilation rate and particulate matter deposit from experiments using farmhouses in Fukushima Prefecture and laboratory experiments. It was found that the experimental data can be applied to high-accuracy evaluation using a probabilistic risk assessment code. Knowledge of radiation protection measures will contribute to the quality of the technical support provided to national government. Meanwhile, in order to evaluate the radiation reduction effect of sheltering facilities equipped with radiation protection measures based on the building structure and the details of the protective measures, we developed a method of evaluating the radiation dose of shelter occupants under various weather and positive pressure conditions. We analyzed the radiation exposure reduction effect of a number of countermeasures and issued a summary of the relevant technical knowledge for further enhancement of effectiveness.

Radiation Protection of the Inhalation Pathway in General Facilities and Sheltering Facilities



A Logistical First in National Nuclear Disaster Prevention Drills

At the Comprehensive Nuclear Disaster Prevention Drill conducted jointly by national and local government, nuclear power companies, and other entities, NEAT is involved in activities from planning to dispatch of experts to the Nuclear Emergency Response Headquarters. At a relevant drill implemented at the Kyushu Electric Power Company's Genkai nuclear power plant in September 2017, we used a helicopter for the first time to monitor the air dose rate in cooperation with the Japan Self Defense Force. This contributed to the improvement of emergency airborne radiation monitoring, which is promoted by the national government.

Helicopter used for monitoring

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 to support the use of radiation and atomic energy and continuing fundamental support for 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 resources development related to these R&D programs.

Nuclear Science Research Institute

The Nuclear Science Research Institute (NSRI) has various research facilities for nuclear science and technology and functions as an R&D base. The conformity review for the New Regulatory Requirements of the Nuclear Regulation Authority, which were developed taking into account the lessons learnt from the accident at the Fukushima Daiichi Nuclear Power Station, has been completed for the Nuclear Safety Research Reactor (NSRR) and Static Experiment Critical Facility (STACY). The NSRR is operated in fiscal 2018 to perform experimental research on nuclear fuel safety.

Nuclear Safety Research Reactor (NSRR)

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, and SPring-8 as advanced analysis tools for the structure and function of materials.

Research reactor JRR-3. We are making all possible efforts for an early restart.

J-PARC Center

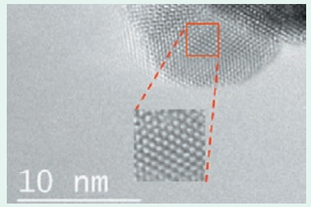
The J-PARC Center conducts a variety of research on the fields from fundamental science to industrial application with domestic and overseas users. The center uses advanced accelerators and beamlines permitting the acceleration of intense proton beams and supply of secondary particles produced by proton beams, and also carries out R&D to improve the efficiency of the facility. The safe and stable operation of the facilities has produced 123 peer-reviewed papers and 8 press releases in fiscal 2017.

Japan Proton Accelerator Research Complex J-PARC

TOPICS

"Self-Curing" of an Irradiation-Damaged Area on a Fluoride Ceramic Surface

A method has been developed to observe nanometer-sized superfine structures (hillocks) formed by heavy-ion irradiation of a surface. This method showed that the hillocks on the surface of fluoride ceramics such as BaF_2 have a crystal lattice, not the amorphous structure seen in other ceramics. This finding suggests that this "self-curing" feature linked to the material's high radiation resistivity can be understood as a result of melting and successive recrystallization. Further study will lead to the use of ceramics under high radiation in various areas such as atomic energy and space exploration.
https://www.jaea.go.jp/02/press2017/p17102702/ (in Japanese)



TEM image of hillock in BaF_2 formed by heavy ion irradiation

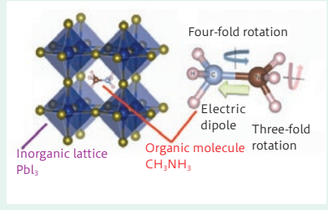
Origin of the Superconductivity with High Magnetic Field Resistance Observed in Uranium Compounds

Nuclear magnetic resonance (NMR) measurements have been performed using a large-volume single-crystal sample of URu_2Si_2 with accurate axis alignment grown using the Czochralski process at the hot lab of Research Building No. 4 in NSRI, which is capable of handling nuclear fuel materials. The NMR measurements revealed that the strong uniaxial spin anisotropy observed in URu_2Si_2 reasonably accounts for the extremely high value of the second critical field strength where the superconductivity must be destroyed. Further study is needed to explain superconducting phenomena which are not fully understood and to give an insight into the exploration of new practical superconducting materials with high magnetic resistance.
https://www.jaea.go.jp/02/press2017/p18011301/ (in Japanese)

Single crystal sample grown by Czochralski process

Pioneering Research at J-PARC into Next-Generation Functional Materials Using Neutron Inelastic Scattering Instruments

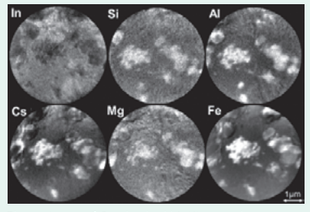
Complementary use of several neutron inelastic scattering instruments, each of them covering different energy ranges, reveals the mechanism of functional materials closely related to atomic and molecular dynamics. In the case of methylammonium lead iodide ($CH_3NH_3PbI_3$), an inorganic-organic hybrid perovskite solar cell material with outstanding photovoltaic performance, measurement using DNA and AMATERAS, together with molecular dynamics simulation, revealed that the orientational disorder of the organic molecules (CH_3NH_3) accompanied by structural phase transition gives rise to suppression of the collective vibration mode of the inorganic PbI_3 lattice. This is responsible for low thermal conductivity and hence leads to an extremely high power conversion efficiency. These fundamental insights are beneficial to further study of the other perovskite solar cells.
https://www.jaea.go.jp/02/press2017/p17081003/ (in Japanese)



Inorganic-organic hybrid solar cell material (Methylammonium lead iodide)

Nanoscale Spatial Analysis by Synchrotron Radiation Photoemission Electron Microscopy

The process of cesium (Cs) adsorption to clay and its physicochemical properties have drawn considerable attention with reference to recovery from the radioactive ^{137}Cs contamination widely dispersed into the area surrounding the Fukushima Daiichi Nuclear Power Station. A synchrotron radiation photoemission electron microscope (SR-PEEM) combined with a technique to deposit a thin carbon layer on the sample surface resulting from the SR irradiation opens the possibility of obtaining information on elemental mapping and chemical bonding state with nanoscale spatial resolution in non-conductive samples. The measured results suggest that Cs^{1+} ions are adsorbed at the SiO_2 sites where Si^{4+} ions are substituted by Fe^{3+} ions to cancel the negative charge. The technique demonstrated brings technological innovation covering a broad range of research fields such as improving the performance of next-generation functional materials.
https://www.jaea.go.jp/02/press2017/p18011101/ (in Japanese)



Element map of Cs adsorbed biotite sample

Sector of Nuclear Fuel, Decommissioning and Waste Management Technology Development

Toward the Establishment of Decommissioning and Waste Management Technology

We are steadily promoting R&D on technologies for radioactive waste processing, geological disposal of high-level radioactive waste and the decommissioning of nuclear facilities, which will realize improved safety and reduced environmental burden. We are also engaged in efforts toward realizing the disposal of radioactive waste generated from research facilities within and outside of JAEA.

Research and Development on Geological Disposal Technology

R&D is being conducted on the safety and reliability of technology for disposal of high-level radioactive waste from nuclear power production in stable geological formations located deep underground.

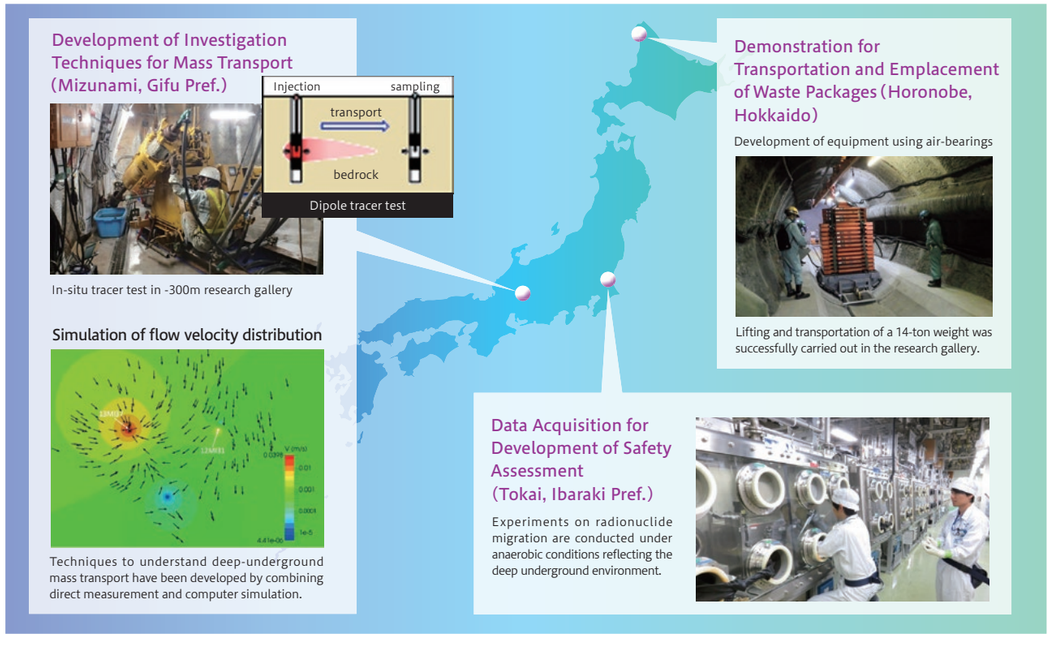
At the underground research laboratories (URLs) in Mizunami-shi, Gifu Prefecture, and Horonobe-cho, Hokkaido, we are pursuing R&D to develop techniques and methods to investigate the properties of rocks and groundwater deep underground. In fiscal 2017, we carried out evaluation of the recovery process of the geological environment after facility closure, development of investigation techniques for mass transport in fractures (Mizunami), in-situ experiments to confirm the performance of engineered barrier systems and demonstrations of the transportation and emplacement of waste packages (Horonobe).

In addition, to evaluate the long-term stability of geological environments in Japan and to develop technologies to predict future trends, studies were carried out on natural phenomena, relating for instance to volcanoes and faults, which have occurred in the past.

At relevant facilities in Tokai-mura, Ibaraki Prefecture, R&D on technologies that are necessary for the design of a disposal system and the evaluation of long-term safety during the post-closure phase are being pursued utilizing information obtained from the R&D at the URLs.

The results of the R&D activities have been summarized as a web-based report (CoolRep), which is available on JAEA's public website.

* For details on R&D achievements, please see JAEA website.
https://kms1.jaea.go.jp/CoolRep/english.html



Technical Development of a Uranium-Plutonium Mixed Oxide Fuel Fabrication Process

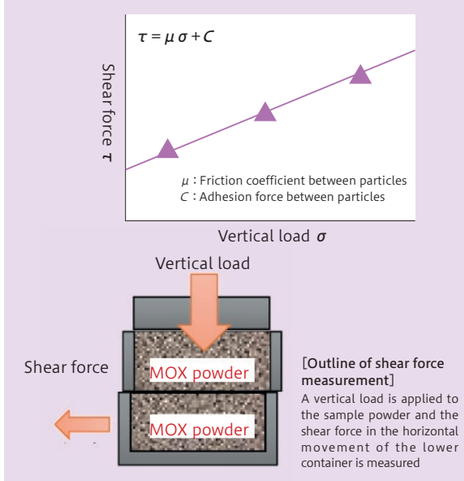
The Plutonium Fuel Development Center at the Nuclear Fuel Cycle Engineering Laboratories has developed a uranium-plutonium mixed oxide (MOX) fuel pellet fabrication process for use with fast reactors using plutonium recovered from reprocessing.

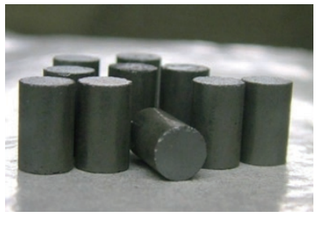
MOX fuel pellets are fabricated through powder blending into predetermined specifications followed by pelletizing with a cylindrical configuration die and sintering at high temperature. Since the sintering behavior of the raw material powder influences certain properties of the MOX fuel pellets such as density and dimensions, these properties are different depending on the raw material powder used.

To maintain high quality in the MOX fuel pellets, pre-fabrication to ensure the best fabrication conditions for each raw powder variety is necessary.

For advanced MOX fuel pellet fabrication, we are now conducting research to clarify from a scientific approach the relationship between the fabrication conditions of MOX fuel pellets and the characteristics of the raw material powder. This approach will contribute to streamlining the pre-fabrication process.

Example of Property Evaluation of Raw Material Powder (Relationship Between Shear Force and Vertical Load)





MOX fuel pellets

TOPICS

The Uranium and Environmental Research Platform

In December 2016, the Ningyo-toge Environmental Engineering Center of JAEA announced our new concept of the "Uranium and Environmental Research Platform" as a framework aimed at contributing to regional and international society through R&D programs that are needed to steadily carry out decommissioning of uranium handling facilities.

To move forward with this concept, we believe it is important to explain the R&D plan and its outcomes in an open venue and to ensure the reliability and transparency of the project through two-way communication with local communities. In fiscal 2017, we held discussion meetings to receive opinions and recommendations from local citizens and experts. It was concluded that it would be appropriate to continue research to further enhance safety.

Discussion meeting on "Uranium and Environmental Research"

Sector of Fast Reactor and Advanced Reactor Research and Development

Toward Further Improvement of Nuclear Safety and Reduction of Global Environmental Burden

The mission of our sector is to develop advanced reactors [e.g., fast reactors (FR) and high-temperature gas reactors (HTGR)] and fuel cycle systems which satisfy future requirements such as safety, reliability, economic efficiency, and sustainability.

FR cycle technology is one of the most promising options to realize national energy security and resolve global environmental issues. Based on the latest governmental policy on fast reactor development, which was issued in December 2016, discussion for the development of a Strategic Roadmap is in progress in which JAEA participates as a top priority.

Concerning HTGR, the government also designated it as a priority energy technology in the fifth Strategic Energy Plan issued in July 2018 and our sector is playing a leading role in its development. The establishment of a reactor system free of serious accidents and the utilization of heat from nuclear power are expected to realize a carbon-free world through hydrogen generation or other direct forms of thermal usage.

We are also developing decommissioning technology for retired material irradiation reactors and other nuclear facilities.

International Cooperation for FR R&D

International cooperation plays an important role in FR system R&D in Japan. JAEA promotes specific topics with overseas partners in the framework of bi- or multi-lateral agreements such as Generation IV International Forum.

Major Achievements in Fiscal 2017

- In a collaborative project with France to develop an Advanced Sodium Technological Reactor for Industrial Demonstration (ASTRID), we reached an agreement that includes proposals from Japan. The proposals are regarding basic requirements for common design between the two countries, which is intended as an international design standard, and the technology that we would incorporate into ASTRID. In addition, JAEA successfully broadened the scope across which France's design specifications are identical to Japan's.

Design Concept of ASTRID

- JAEA believes that international standardization of R&D products is one of our important missions. We successfully developed an innovative technique that enables researchers to derive a target value for structural reliability of systems, structure, and components from a target safety value for a plant (e.g., core damage frequency). A maintenance code based on this technique was approved by the American Society of Mechanical Engineers (ASME)* and issued as Code Case N-875 in May 2017. It is expected to become a worldwide standard common to different reactor types.

* ASME codes: major standards used in over 100 countries.

Code Development Toward Global Standard

ASME Code Case N-875
- JAEA developed the base technique.
- It allows researchers to flexibly select testing approaches based on plant characteristics.

It will be further developed to be applied to any reactor systems.

Outcome

A joint task group of ASME and the Japan Society of Mechanical Engineers was established to create the code by, for example,
- understanding what is required of the code; and
- gaining knowledge of design and inspection techniques.

Sodium-cooled fast reactor

R&D on Advancement of Sodium Treatment Technology

At the Sodium Engineering Research Facility, we conduct R&D on the advancement of sodium treatment technology with research into areas such as sodium chemical reaction to improve fast reactor safety, technical development for inspection and maintenance of fast reactors in high-temperature, high-radiation environments. This facility is also expected to be utilized for the development of effective technology for fast reactor decommissioning in the future.

Sodium Engineering Research Facility

Multipurpose Sodium Test Loop

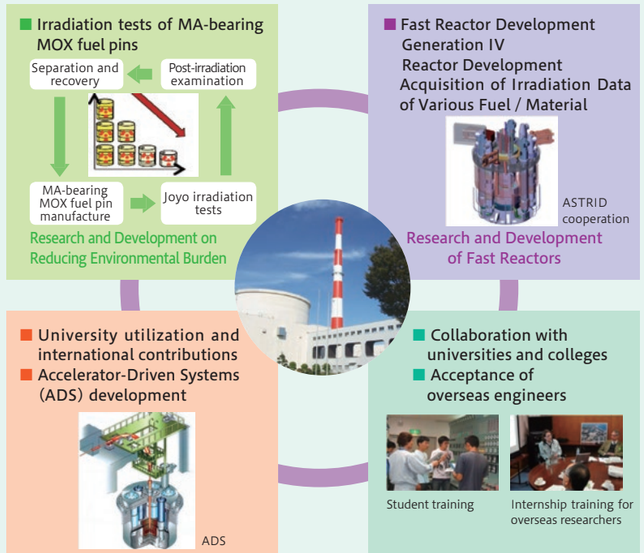
TOPICS

Toward the Restart of Joyo

The Joyo Experimental Fast Reactor located at the Oarai Research and Development Institute is expected to be utilized in a wide range of science and technology fields as a fast neutron irradiation facility unique in world terms. Experiment plans are under discussion in collaboration with universities and overseas research institutions. The fast reactor development policies decided by the Inter-Ministerial Council for Nuclear Power included active efforts to restart Joyo on account of the reactor's importance.

JAEA has positioned Joyo as the most important facility in the development of fast reactors, and, with the highest priority on securing safety, we are preparing for an application to the Nuclear Regulation Authority to ensure compliance with its new regulatory standards, adopted after the accident at the Fukushima Daiichi Nuclear Power Station.

Future Roles for Joyo



R&D on High-Temperature Gas-Cooled Reactor and Related Heat Application

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 on HTGR technology, technology for hydrogen production through high-temperature water-splitting, and technology for helium gas turbines. The HTGR is expected to be used not only for high-efficiency electric power generation but also for hydrogen production, high-temperature steam production, desalination, etc. Recently, emerging nuclear countries are investigating the introduction of the HTGR as Small Modular Reactors (SMRs).

In fiscal 2017, to restart HTTR operation, we implemented a review of conformity with the new regulatory requirements formulated by the Nuclear Regulation Authority in response to the accident at the Fukushima Daiichi Nuclear Power Station. In addition, we established a framework for domestic cooperation with industry, academia and government to promote international cooperation with Poland that was announced in plans to introduce commercial HTGR.

HTTR (High Temperature Engineering Test Reactor)

Hydrogen Production by Thermochemical IS Process

As a heat application project utilizing the HTGR, JAEA is promoting research and development on thermochemical hydrogen production via an IS process that thermally decomposes water using chemical compounds of iodine (I) and sulfur (S). In 2004, one-week continuous hydrogen production using a glass test apparatus was successfully conducted for the first time in the world. Currently, we are engaged in R&D whose goals include to improve thermal efficiency, develop corrosion- and heat-resistant components, confirm equipment reliability and establish operation technology using continuous hydrogen production test facilities made of industrial materials.

Continuous hydrogen production test facility made of industrial materials
H_2 production rate: up to 0.1m^3/h-H_2 Size: W18.5×D5×H8.1 (m)

Sector of Tsuruga Decommissioning Demonstration

Toward Safe and Steady Decommissioning

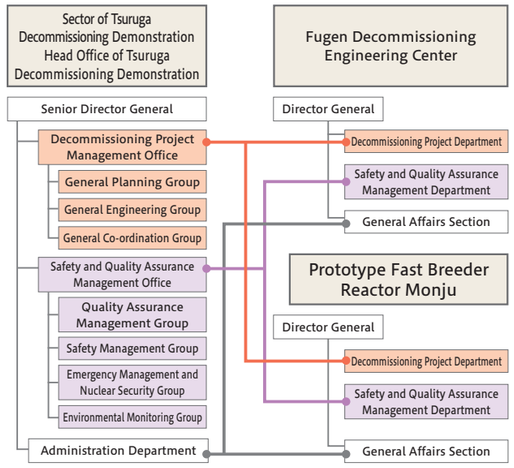
To ensure steady decommissioning of the "Fugen" and "Monju" facilities according to our decommissioning plan, the Sector of Tsuruga Decommissioning Demonstration was established on April 1, 2018. Giving top priority to safety, we will pursue decommissioning with the understanding of the public and the local community.

Decommissioning "Fugen" and "Monju" as a Single Team

We established a new sector, the Sector of Tsuruga Decommissioning Demonstration, on April 1, 2018, to put a system in place to shift "Monju" to full-fledged decommissioning and to promote the completion of the decommissioning of "Monju" and "Fugen" as a single team in a centralized manner.

The Head Office of Tsuruga Decommissioning Demonstration will oversee all decommissioning operations in the Tsuruga area, including general management of the "Fugen" and "Monju" decommissioning projects. We have strengthened collaboration between the Head Office of Tsuruga Decommissioning Demonstration and the "Fugen" and "Monju" sites by reorganizing the on-site systems into a Decommissioning Project Department, a Safety and Quality Assurance Management Department, and a General Affairs Section so that they correspond, respectively, to the Decommissioning Project Management Office, the Safety and Quality Assurance Management Group, and the Administration Department at the Head Office of Tsuruga Decommissioning Demonstration.

Under this new system, we will pursue safety-related activities steadily and decommission the plants in a systematic and efficient manner by combining the technologies and experiences accumulated by JAEA so far with the technical capabilities of utilities and manufacturers.



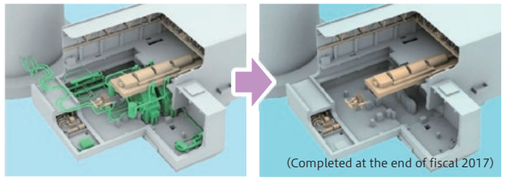
Toward the Completion of Decommissioning of "Fugen"

"Fugen" shifted to its decommissioning phase before "Monju." The decommissioning is moving ahead steadily toward scheduled completion in fiscal 2033. In fiscal 2017, we completed decontamination (tritium removal) of the heavy-water cooling and other systems and dismantled the condenser and the moisture separator (large-sized components of the turbine system), which means that dismantlement of the major components of the turbine system was completed. Making progress towards clearance of radioactive waste, we obtained regulatory approval on August 31, 2018, concerning the radioactive concentration measurement and evaluation method of dismantled waste (about 1,100 tons of metal) generated from the turbine building.

As part of the development of a device to collect structural materials from Fugen by accessing its complicated and narrow structure, we have finished functional confirmations of such a device in a mockup and have started sampling from pressure pipes loaded with fuel when the reactor was in service.

In September 2014, meanwhile, we adopted the policy of decommissioning a spent nuclear fuel reprocessing facility at the Nuclear Fuel Cycle Engineering Laboratories in Tokai-mura, which necessitated changing our plan for processing spent fuel from "Fugen." So, on February 28, 2018, we filed with the Nuclear Regulation Authority an application for changes in the license relating to the destination of spent fuel and the timing of its extraction, and the changes were approved on May 10, 2018.

We will soon move ahead from the planning stage to the action stage to ensure that the spent fuel is removed at an early stage.



Example of Dismantling Equipment (Turbine facility)

Change of Spent Fuel Transfer Schedule

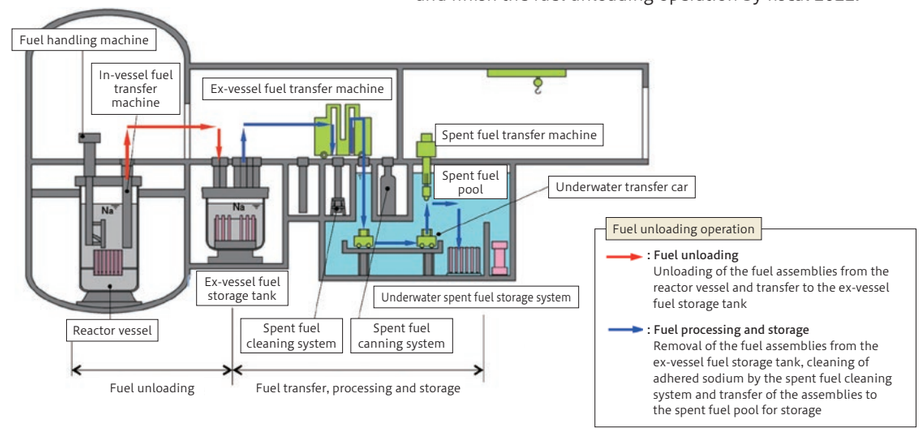
2007–2017	2018–2022	2023–2031	2032–2033
Decontamination of the Heavy Water System, the Helium System, etc.	Dismantling of Peripheral Facilities of the Reactor	Dismantling of the Reactor	Dismantling of Buildings
Transfer of spent fuels		2026	
Transfer of heavy water and removal of tritium			
	Dismantling of the heavy water system, the nuclear fuel handling facility, etc.		
Dismantling of the reactor coolant system, I&C system, etc.			
		Dismantling of the reactor	
			Dismantling of buildings

Toward the Completion of Decommissioning of "Monju"

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

We have established a working system consisting of a manager with responsibility and an operating team and an equipment team for fuel unloading (the first phase of decommissioning). Under the system, we undertook simulation exercises in handling fuel and started processing the first fuel assemblies in August 2018.

We plan to transfer all 530 fuel assemblies to the fuel pool and finish the fuel unloading operation by fiscal 2022.



TOPICS

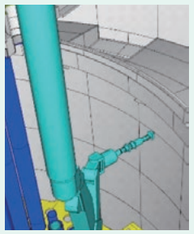
Development of New Techniques for Decommissioning
—World's First Underwater Dismantling using Laser Cutting

We are steadily dismantling the peripheral facilities of "Fugen," including the turbine facility, and plan to start dismantling the reactor itself soon.

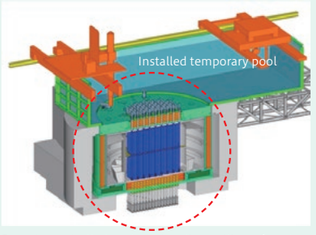
"Fugen" used heavy water as its moderator, so it is made of special materials (zirconium alloys, carbon steel, etc.) and has a complicated structure compared with common power reactors (light water reactors). In addition, the materials have been activated due to about 25 years of operation.

We have therefore decided to dismantle the reactor underwater by remote operation and have chosen laser cutting as the cutting method in order to ensure safe and efficient dismantling of the reactor in such a working environment. These techniques are expected to reduce the amount of radioactive waste generation.

After going through validation tests, we will verify the dismantling method and will design a remote dismantling device that can be used for the application.



Full-scale mock-up test for demonstration of underwater dismantling (from fiscal 2018)



Remote-controlled underwater dismantling of nuclear reactor by laser (planned from fiscal 2023)

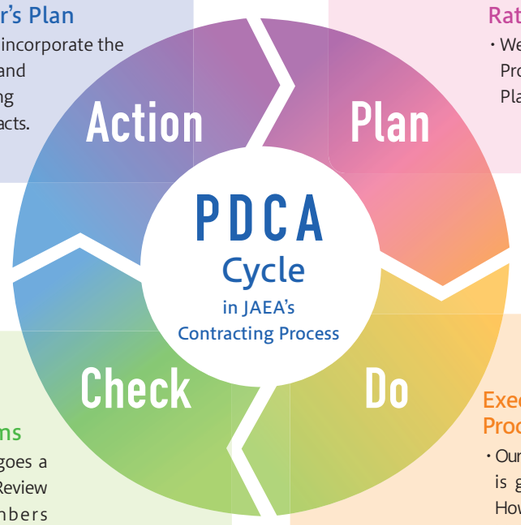
Appropriate Contracting Practices

(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. Also, we contracted 22 public works.



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.

Procurement Rationalization Plan

- We formulated the Fiscal 2018 Procurement Rationalization Plan in June 2018.

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.

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.

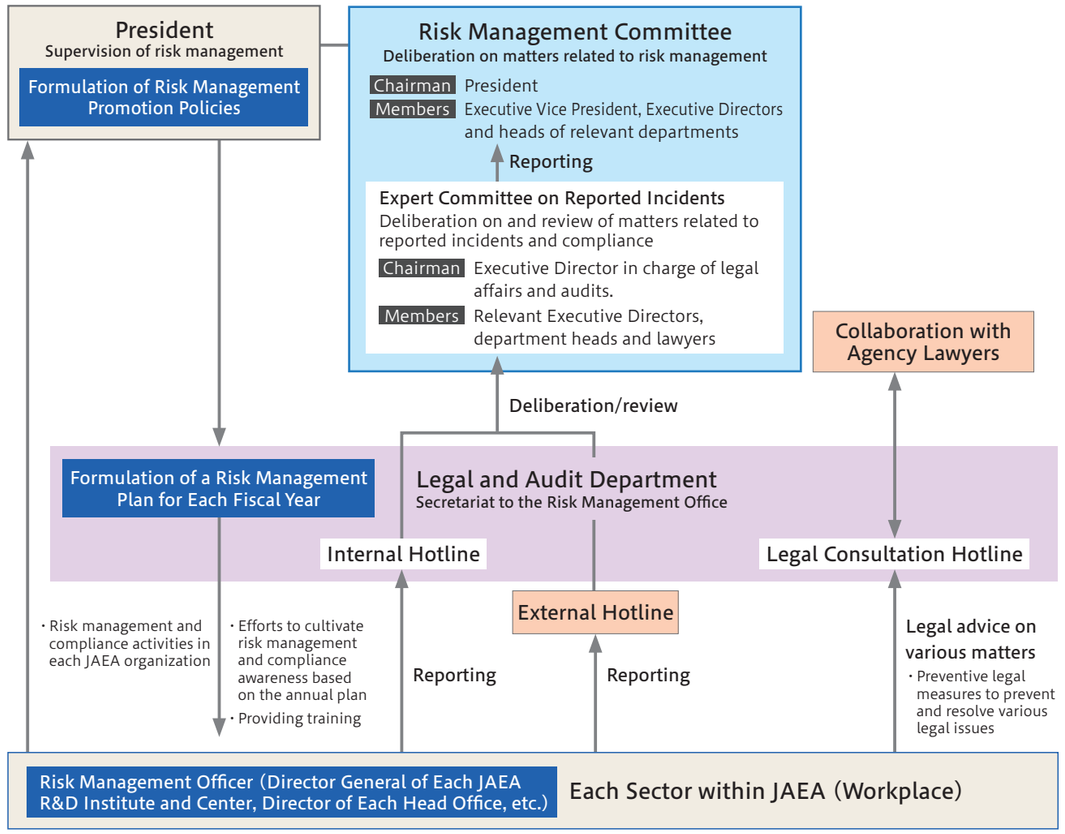
* For details on the Procurement Rationalization Plan, please see JAEA website.
https://www.jaea.go.jp/for_company/supply/contract/ (in Japanese)

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 the 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 will continue to work harder to meet the trust placed upon us by society, as an institute engaging in nuclear R&D.

JAEA provides compliance training every fiscal year, by job class and subject. In fiscal 2017, we held training for new hires and employees newly promoted to the assistant manager level (twice, 201 participants) as well as under the joint auspices of some departments (eight times, 695 participants) to re-recognize and consolidate their awareness of compliance.

Training on compliance (Fugen Decommissioning Engineering Center)



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

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.

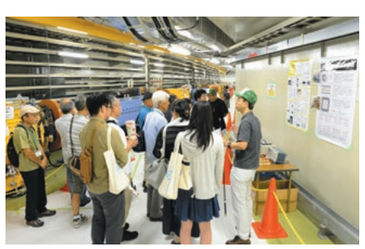
GENKI (vol.46,2017)

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. JAEA also conducts "open facility" days and facility tours to provide the public with the opportunity to directly observe and learn its operations.


A facility open to the public

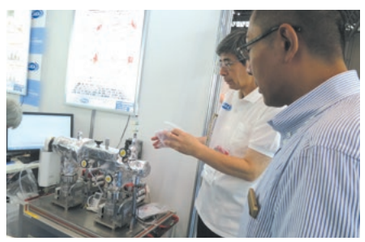
Science Cafe

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.


Participation in an event in JASIS 2017

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," "Cesium Workshop," "International Forum on Peaceful Use of Nuclear Energy and Nuclear Non-proliferation and Nuclear Security," and "Marine Science and Environmental Science Symposium in Mutsu."


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 radiation and nuclear disaster prevention, 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 i.e., "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 Ningyotoge Environment Technology Center are risk communication-related activities aiming at future "collaboration" with stakeholders.

Phase 1

Information

Explain good and bad aspects of the subject matter in an easy-to-understand manner

Website, exhibition halls, facility tours, symposia, etc.

Phase 2

Dialogue

Have a two-way dialogue of opinions both on risks and benefits (merits) and deepen mutual understanding.

Small-scale meetings to exchange opinions, lesson programs conducted at schools, etc.

Phase 3

Collaboration

Stakeholder's involvement and engagement.

Meetings with community council, monitoring system, etc.

Human Resource Development

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.

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

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

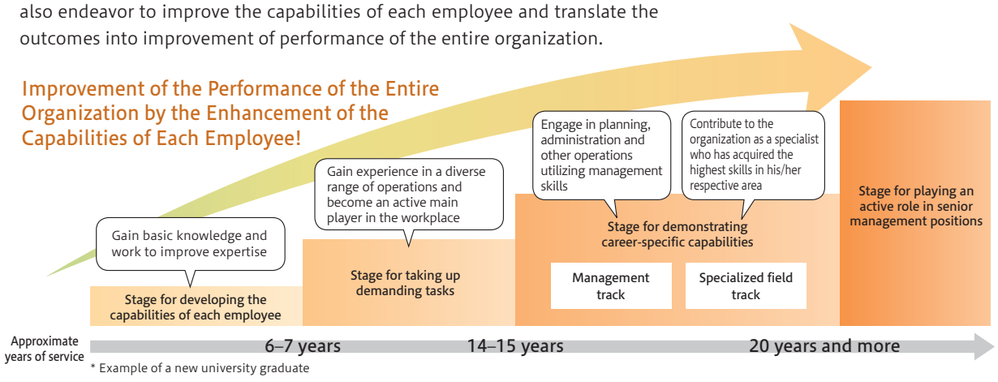
Ideal Image of JAEA Employees to Be Pursued

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.



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 program; and assignment to integrated departments in JAEA and temporary assignment to central government ministries and agencies

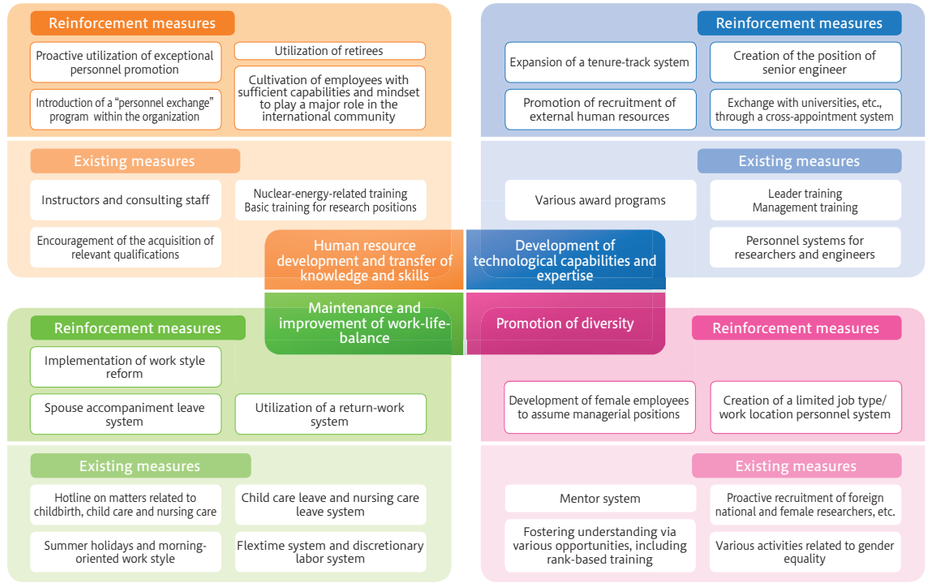
Various training programs

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

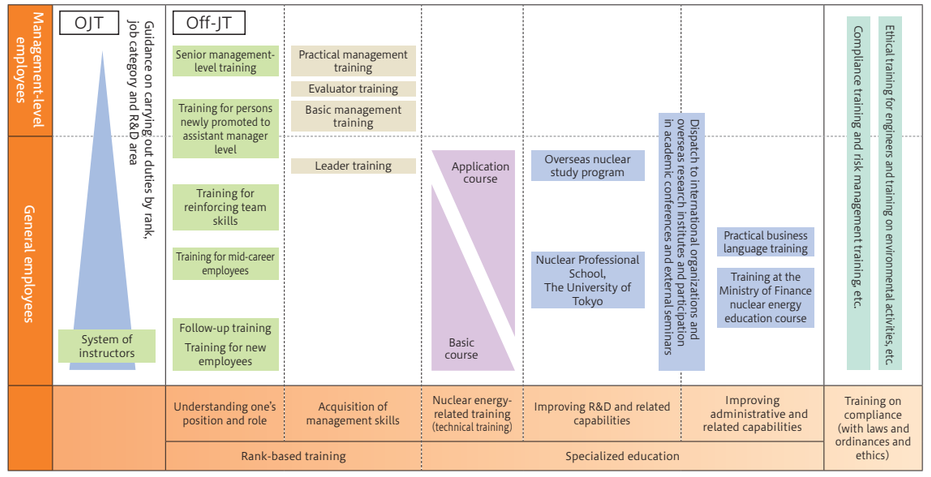
Based on the main points of the Human Resources Policy, we have been implementing human resource management measures based on flexible utilization and well-planned development of human resources as an important management resource. Using these measures, we intend to improve the individual qualities of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



Creating an Employee-Friendly Workplace

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.

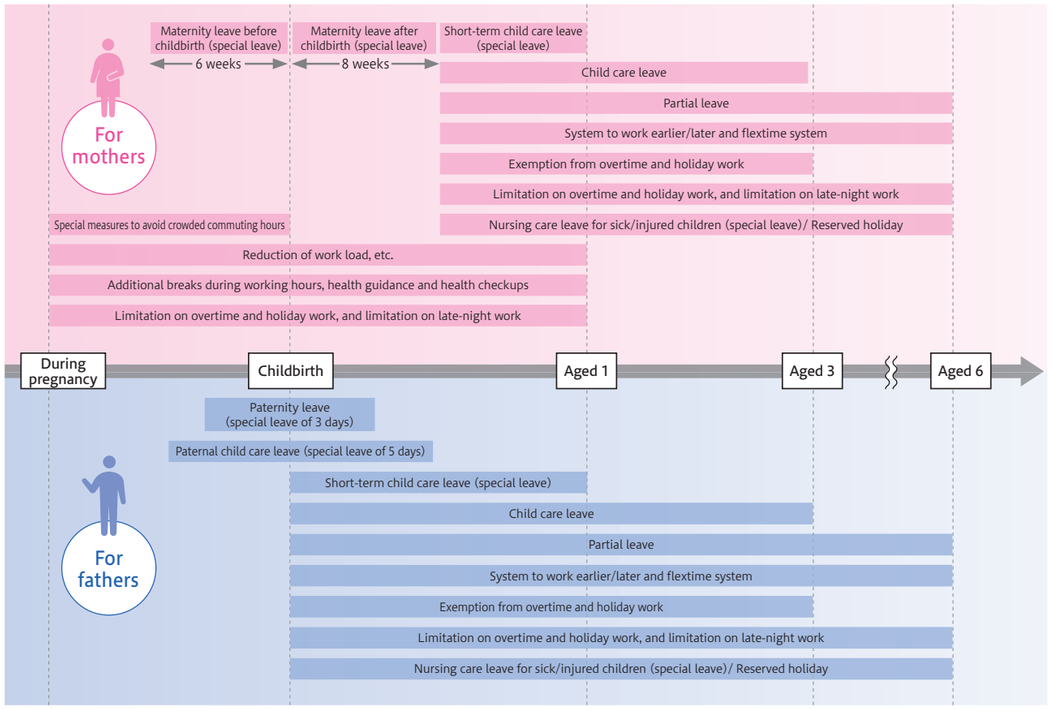
JAEA undertakes an array of activities to promote work-life balance by creating a pleasant work environment that helps employees keep a balance between their lives at work and at home and enables all persons to fully exercise their capabilities and devote themselves to their tasks.

In fiscal 2017, we expanded the scope of our flextime system and launched an additional system for employees engaging in child care and nursing care.

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.



- Ratio of child care leave usage (Result of fiscal 2017)

Female employees ..... **95.8 %**

- Ratio of female employees among new employees (as of April 1, 2018)

..... **22.2 %**

- Ratio of female employees in JAEA (as of April 1, 2018)

..... **9.9 %**

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 the unit of days or hours (maximum of four hours per day), up to three times, for one continued care-requiring condition of a family member requiring ongoing 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 a year in case they have only one person requiring nursing care or a leave of ten days if there are multiple persons in need of nursing care.
- **Partial leave:** A system that allows employees with reasons other than nursing care leave and short-term nursing care leave to work shorter hours by either starting later or ending 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 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.

Activities Undertaken During Fiscal 2017

We considered introducing new systems and implemented new support, and we acted positively.

- **Consideration of teleworking system**
  While paying attention to information security and management of working hours, we have started a teleworking monitor test.
- **Lunch meetings**
  We held lunch meetings to encourage more employees to participate and discuss gender equality in a friendly atmosphere while having lunch together.

- **Gender equality questionnaire**
  We had a questionnaire in order to grasp employee awareness of gender equality.

* 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 actively to 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.

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 2017, 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.

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

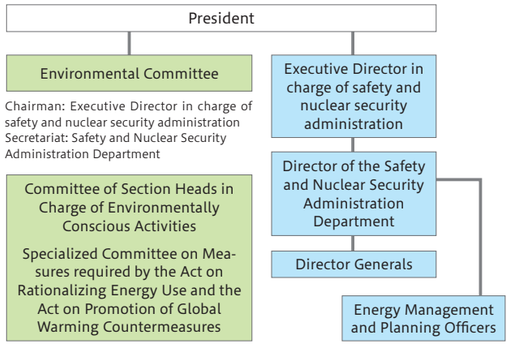
Environmental Management

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 2017 Framework




Meeting of the Environmental Committee

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.

Fiscal 2017 Basic Environmental Policy

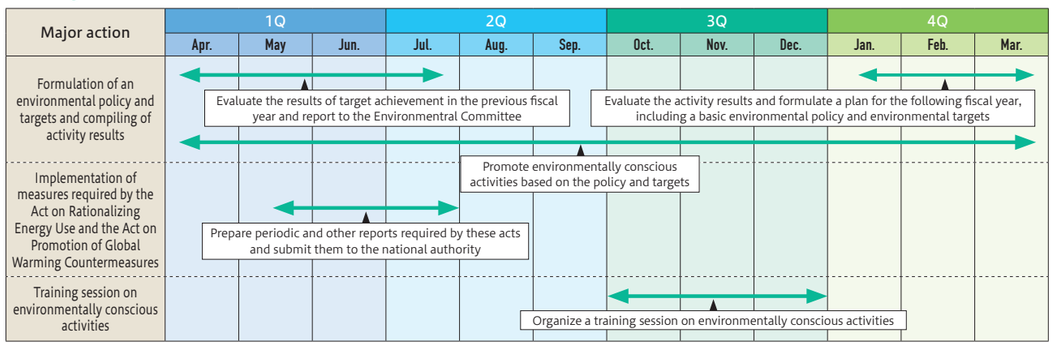
As a national R&D institute engaging in comprehensive nuclear energy R&D, JAEA endeavors to maximize its R&D outcomes in the field of nuclear science and technology and simultaneously places its highest priority on safety. We therefore promote comprehensive R&D on nuclear energy with the aims of ensuring 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 2017, 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.

Planning of Fiscal 2017 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.


Lecture given during a training session on environmentally conscious activities

Environmental Beautification Activities

As part of our environmental activities, each JAEA site engages in various cleanup and planting activities. Some of these activities are highlighted below.


Tokai-mura Spring Cleanup Campaign


Oarai Cleanup Campaign


Fukui Cleanup Campaign


Tottori Cleanup Campaign


NEAT-Ibaragi (Greening Panel)


Planting activity near Shino and Oribe

Summary of Fiscal 2017 Environmentally Conscious Activities

Action Item	Environmental Target	Results	Evaluation
Promotion of energy conservation	Reduction of energy consumption per unit output by 1% or more on an annual average by the end of fiscal 2017 (with fiscal 2013 as a base year) or reduction of energy consumption per unit of output based on a new evaluation system designed to encourage the levelling of electricity demand by 1% or more on an annual average by the end of fiscal 2017 (with fiscal 2014 as a base year)	・Annual average of energy consumption per unit of output was up 0.4% compared with the previous fiscal year. ・Annual average of energy consumption per unit of output based on the new evaluation system was up 0.3% compared with the previous fiscal year. We didn't achieve our target of a 1% reduction by either of the metrics above.	Our target was not achieved. We have to address energy conservation by upgrading equipment for energy efficiency.
	Consideration and promotion of efficient and effective use of electricity and fossil fuel	・Electricity consumption was up 2.2% compared with the previous fiscal year. ・Fossil fuel consumption was down 1.5% compared with the previous fiscal year.	The increase in electricity consumption was due to progress in the experimentation plan at experiment facilities. Ignoring this effect, the level of electricity consumption was the same as the previous fiscal year. The results are good.
Promotion of resource saving	・Promotion of water conservation	・Water usage was up 6.4% compared with the previous fiscal year, and the average year-on-year figures for the past few years show an annual increase of 1.2%.	Water consumption increased from the average for the past five years. We have to make further efforts to conserve water.
	・Reduction of copy paper consumption	・Copy paper consumption was up 2.6% compared with the previous fiscal year, and the average year-on-year figures for the past few years show an annual decrease of 1.9%.	Copy paper consumption decreased from the average of the last five years. The results are good.
Reduction of waste	Promotion of wastepaper recycling	・Provided boxes to collect copy paper and collected and classified wastepaper by type.	With dismantling of facilities, waste hard to classify was generated, which resulted in a drop in the rate of recycling. However, we are continuing to make efforts to recycle disused articles that can be recycled. The results are good.
	Implementation of thorough classification of waste and recovery of valuables	・51% of disused articles were recycled (compared with 64% in the previous fiscal year).	
	Promotion of reduction of radioactive waste	・Provided education as necessary to operators and other staff to limit and minimize the amount of unnecessary items being taken into areas subject to radiation control. ・About 10 tons of waste was cleared for recycling by the national authority.	We provide education aimed at reducing radioactive waste and ensure that waste clearance goes on. The results are good.
Promotion of dissemination of environmental conservation information	Consideration of effective ways to communicate environmental conservation information and promotion of the dissemination of such information	・Posted information about environmentally conscious activities on the intranet at the Head Office and at each JAEA site.	We posted information about environmentally conscious activities in an easy way to understand. The results are good.

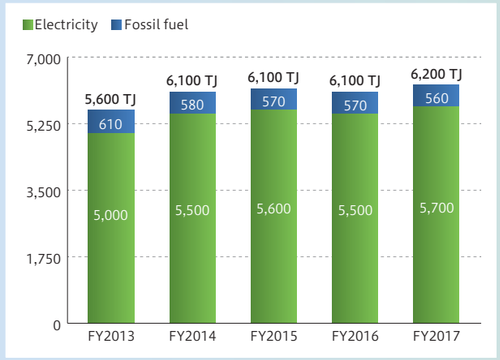
With regard to environment-related laws and regulations, we comply with the applicable regulatory standards of air pollutants, radioactive gaseous waste emissions into the atmosphere, discharges of water pollutants and radioactive liquid waste, noise, vibrations and others. We have confirmed all of these were within the regulatory limits. We have therefore made the self-assessment that, overall, JAEA pursued its mission with due consideration for the surrounding environment. We will continue to engage in comprehensive activities that give due consideration to the environment.

* For details on environment-conscious activities, please see JAEA website.
https://www.jaea.go.jp/about_JAEA/environment/ (in Japanese)

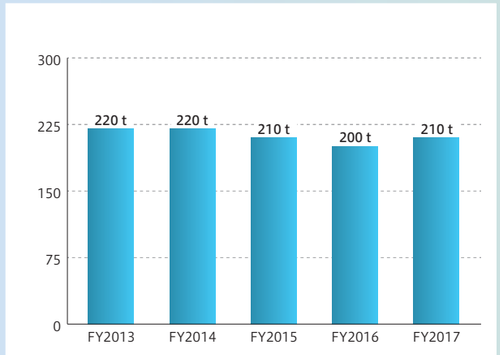
Overview of Environmental Performance in Fiscal 2017

INPUT

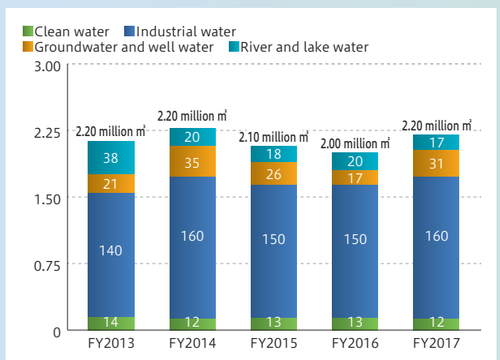
Total Energy Consumption



Copy Paper Consumption

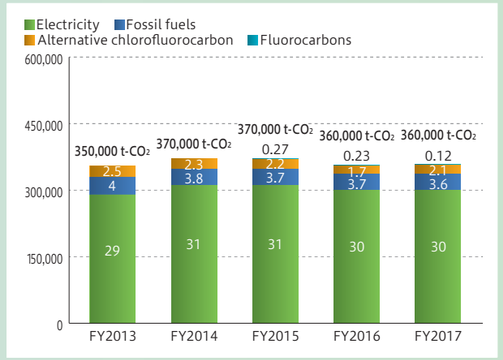


Water Intake

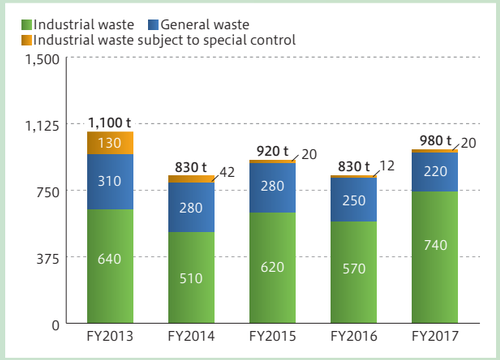


OUTPUT

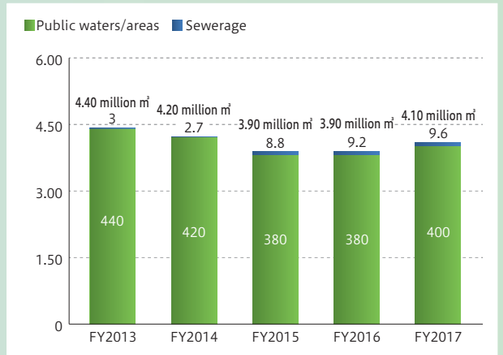
Total GHG Emissions



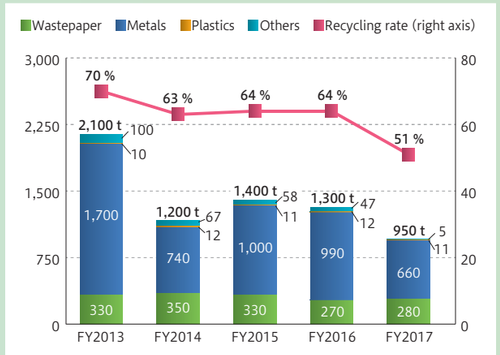
Total Amount of Waste



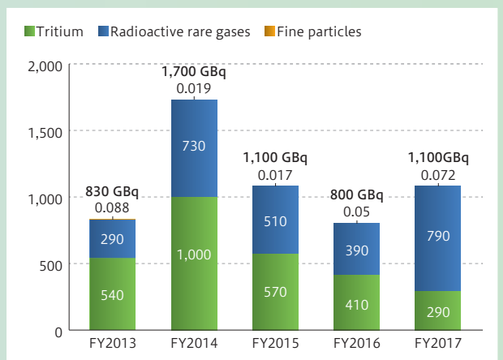
Wastewater Discharge



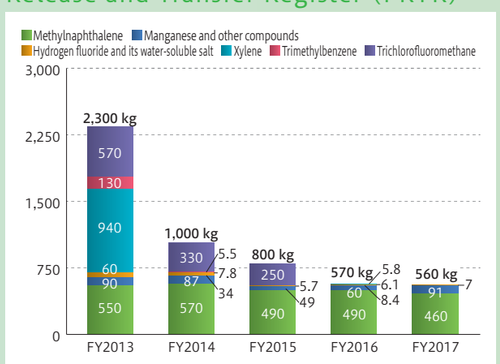
Main Resources Recycled



Radioactive Waste



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



- Amount of incinerated general waste **45 t** (FY2016 45 t)
- Disposal of polychlorinated biphenyl (PCB) waste **240 units** (FY2016 486 units)
- Recycling of construction materials **2,800 t** (FY2016 2,200 t)
- Promotion of acquisition of clearance for recycling **10 t** (FY2016 20 t)

* For inquiries about our environment-conscious activities, please send e-mail to: kankyo@jaea.go.jp
* 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 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: Horonobe Yukinko Festival

Aomori: Mutsu Industrial Festival

Fukushima: Fukushima Environmental Safety Center First Opening Anniversary

Tokai: Tokai Festival

Major Activities Undertaken During Fiscal 2017

Horonobe
- Enjoy Science Museum 2017 in Horonobe
- Horonobe Meirin Park Festival
- Horonobe Yukinko Festival
- Hokkaido Spring and Fall Cleanup Campaigns
- North Garden flower volunteer work at Tonakai-farm

Oarai
- Oarai Citizens' Sports Festival
- Oarai Chamber of Commerce and Industry Thanks Fair
- Oarai ANKO (anglerfish) Festival
- Oarai Cleanup Campaign
- Oarai Farm Products Festival

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

Tono
- 21st TOKI (pottery) Festival
- Enjoy Science Museum 2017 in Mizunami
- Science Festival 2017
- Toki River (Hazama River) Cleanup Campaign
- Weeding activities led by the Shizuhora neighborhood association

Fukushima
- First Opening Anniversary of Fukushima Prefectural Center for Environmental Creation
- Robot Festival in Fukushima 2017
- Clean up in Naraha (Naraha-naradewa-gomihiroi)

Tsuruga
- Tsuruga Festival, Mihama Navi Festival
- Fukui Cleanup Campaign
- Sho-no-kawa River Cleanup Campaign
- Cleanup activities along prefectural roads

Tokai
- Hitachinaka Industrial Exchange Fair,
- Tokai Festival,
- Katsuta Marathon
- Tokai-mura Spring and Fall Cleanup Campaigns
- Kuji River System Collective Cleanup Campaign
- Invasive Species Cleanup

Ningyo-toge
- Misasa Hot-Spring Curie Festival
- Kagamino-cho Industrial Festival
- Ombara-Kogen Hyomon Festival
- Kamisaibara Furusato Festival
- Cleanup activities around the Ningyo-toge office

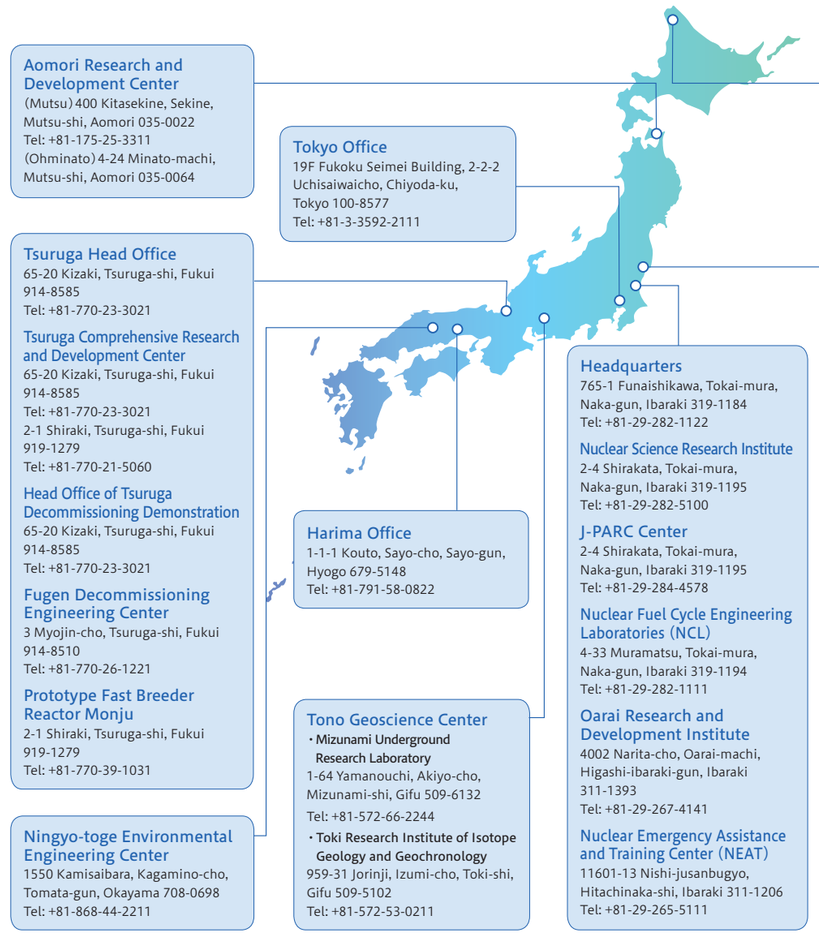
Oarai: Oarai Chamber of Commerce and Industry Thanks Fair

Tono: 21st TOKI (pottery) Festival

Tsuruga : Tsuruga Festival

Ningyo-toge: Ombara-Kogen Hyomon Festival

R&D Institutes and Centers as of April 2018



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(Ohminato) 4-24 Minato-machi, Mutsu-shi, Aomori 035-0064

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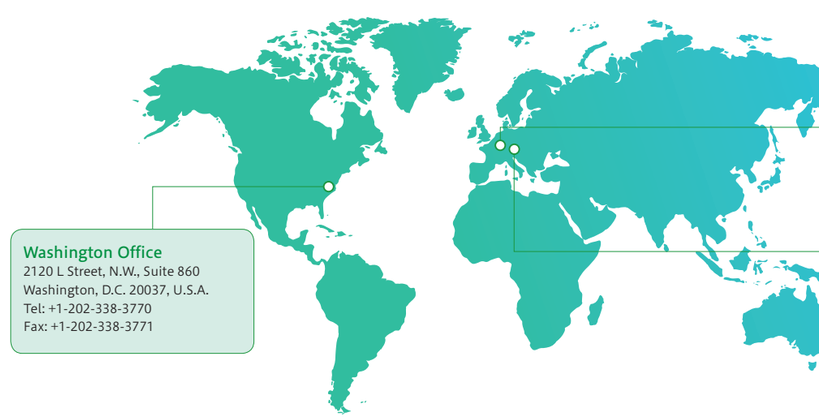

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