

Sector of Fukushima Research and Development

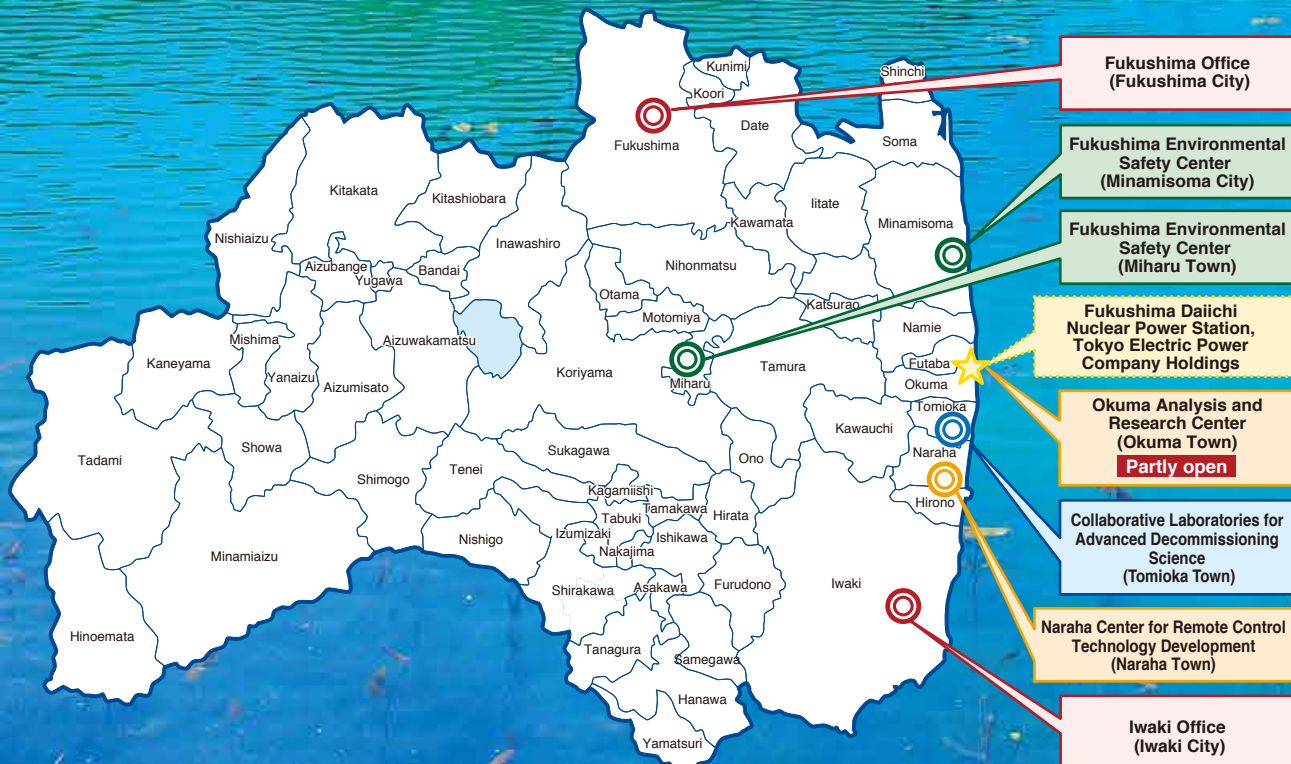


Japan Atomic Energy Agency

Towards the restoration of Fukushima

Japan Atomic Energy Agency is conducting the decommissioning of the Fukushima Tokyo Electric Power Company Holdings, and early return of the residents.

Activity bases of JAEA in Fukushima Prefecture



research and development (R&D) towards Daiichi Nuclear Power Station (1F), restoration of environment in Fukushima,

Organization chart for Sector of Fukushima Research and Development

Sector of Fukushima Research and Development

Planning and Co-ordination Office

Fukushima Research Institute

Safety Management Office

Planning and Management Office

Fukushima Administrative Department

Facilities Management Department

Collaborative Laboratories for Advanced Decommissioning Science (CLADS)

Accelerating basic and fundamental research on decommissioning in the medium- to long term as a research base where domestic and foreign wisdom gathers

Naraha Center for Remote Control Technology Development

Conducting development and demonstration test of remote control equipment (robots, etc.) for the decommissioning of 1F

Okuma Analysis and Research Center

Conducting research and development on analysis and evaluation of solid radioactive waste and methods for processing / disposal of fuel debris towards the decommissioning of 1F

Fukushima Environmental Safety Center

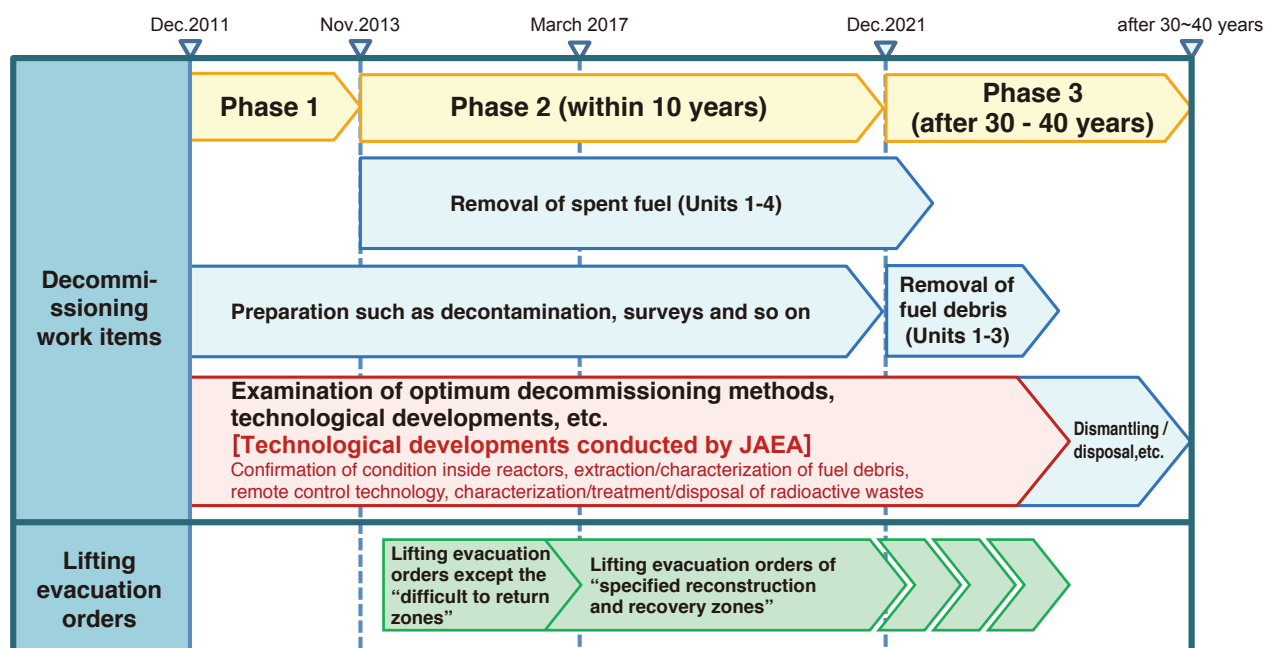
Contributing to the realization of environment where residents can live with peace of mind through the research and development on environmental recovery towards the restoration and regeneration of Fukushima

Efforts towards decommissioning

R&D towards the decommissioning of 1F

Steadily promoting R&D based on the Mid-and-Long-Term roadmap towards the decommissioning of 1F

JAEA carries out research and development with a view to securing and developing human resources in accordance with the Mid-and-Long-Term roadmap towards the decommissioning of 1F, the strategy planned by the Nuclear Damage Compensation and Decommissioning Facilitation Corporation and on-site requirements from medium-to-long-term perspective. Moreover, JAEA provides on-site plants with the technical information and contributes to achieving the highly safe and efficient early decommissioning while enhancing the safety of nuclear energy.



[Source] Reference to Important Stories on Decommissioning – Ministry of Economy, Trade and Industry (addendum)

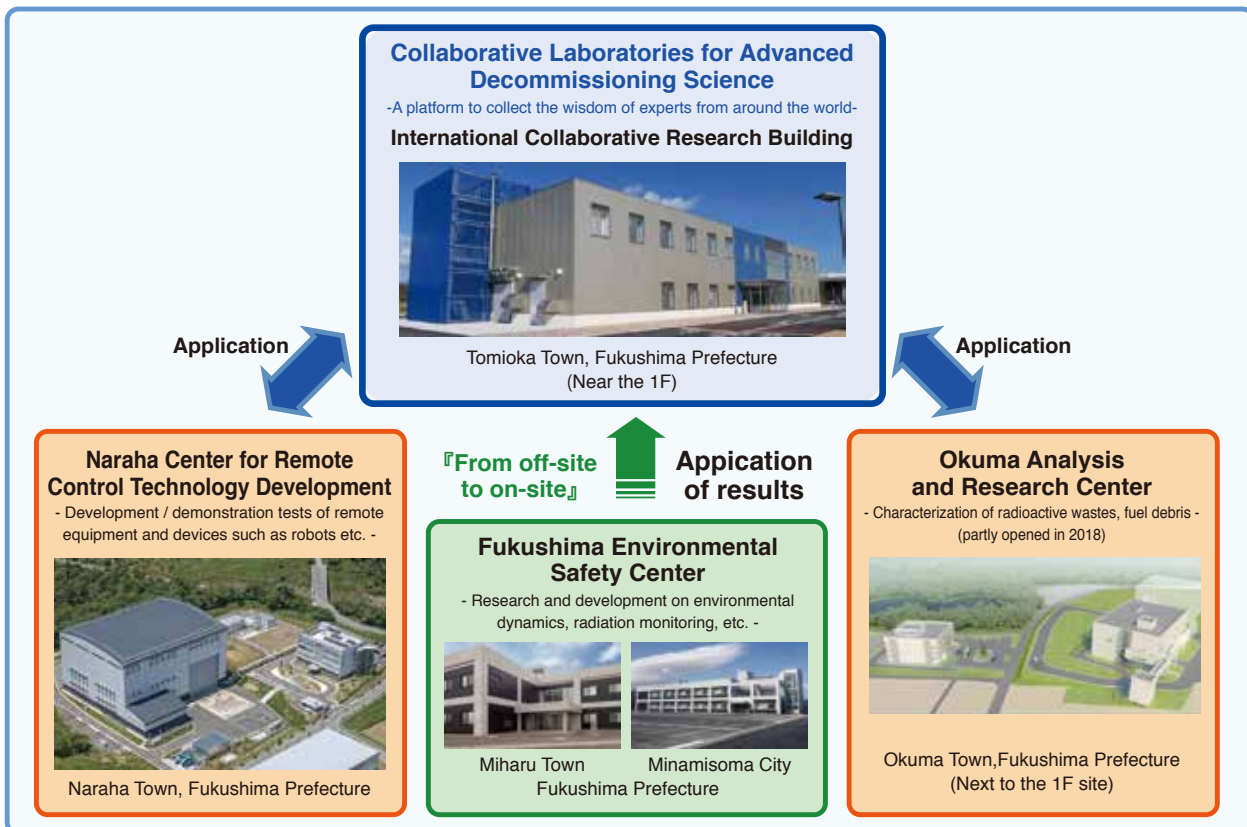
Roadmap of the works on the 1F decommissioning (Overview)

R&D System towards the decommissioning of 1F

As Japan's sole comprehensive R&D institute in the field of nuclear energy, JAEA is conducting R&D towards the decommissioning of 1F with all our strength.

The Sector of Fukushima Research and Development, JAEA, is preparing research bases where technological development that is essential to the 1F decommissioning will be conducted, such as extraction of fuel debris from nuclear reactors and disposal of radioactive wastes produced by the decommissioning. The full-scaled operation of the Naraha Center for Remote Control Technology Development started in April 2016. Also, the International Collaborative Research Building, CLADS fully started operation in April 2017. For the Okuma Analysis and Research Center, the Administration Building started operation in March 2018, and the construction of the Laboratory-1 and the designing of the Laboratory-2 are now being proceeded.

In these facilities, research results obtained by the collaborative research conducted mainly in the CLADS will be fully utilized. Also, we will proceed research/development and human resource development in collaboration with Tokyo Electric Power Company Holdings, Inc., International Research Institute for Nuclear Decommissioning(IRID), Nuclear Damage Compensation and Decommissioning Facilitation Corporation(NDF), domestic/foreign universities, research institutes, industries, and other institutes of JAEA, etc.



【Tokyo Electric Power Company Holdings・IRID・NDF】

【Domestic and foreign universities, research institutes, and industries】

Cooperative course with the University of Tokyo, Tohoku University, Tokyo Institute of Technology, etc. Cooperative research and information exchange with international organizations, research institutes in USA, UK, France, etc., and private companies, etc.

【Fukushima Prefecture, The Ministry of Environment】

Cooperation with Fukushima Prefectural Centre for Environmental Creation, Fukushima Technology Centre, etc.

【Other institutes of JAEA】

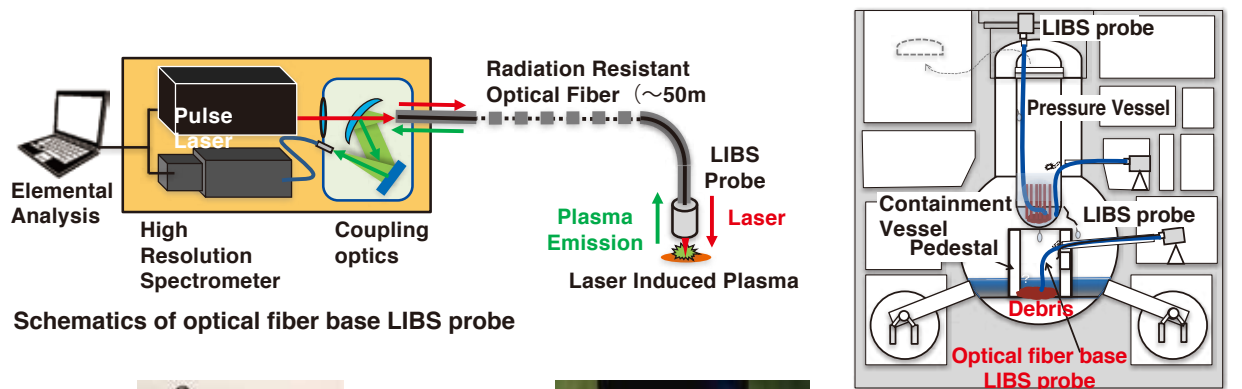
Utilizing facilities for handling nuclear fuels and radioactive materials, and irradiation facilities at Tokai and Oarai districts in Ibaraki Prefecture.

CLADS-Collecting the wisdom of experts from around the world

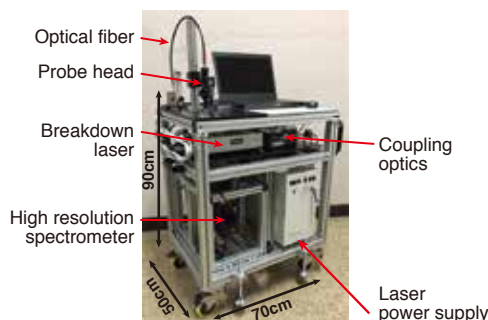
The CLADS was established in Tokai-mura, Ibaraki Prefecture aiming to conduct research and development towards the decommissioning of 1F while collecting the wisdom from around the world. As a core of the research and development, the "International Collaborative Research Building" was constructed in Tomioka Town near the 1F site. Also, we constructed the network where human resources in domestic/foreign universities, research institutes, and industries can interact. Thereby, we are integrally proceeding research/development and human resource development for the decommissioning of 1F.

(I) Example for R&D: Technology for remote analysis of fuel debris using laser.

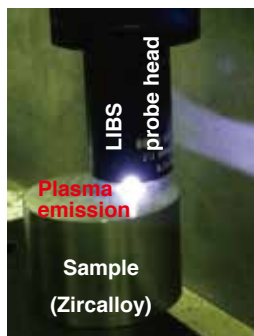
The Laser Induced Breakdown Spectroscopy (LIBS) is a method to analyze chemical composition of a sample by irradiating laser using an optical fiber. In order to apply the LIBS to the analysis of fuel debris that cannot be brought out due to the high radiation, the tip of the radiation-resistant optical fiber is brought close to the fuel debris. By doing so, we are developing remote-analysis technology that can determine the chemical composition of the sample in a short time.



Schematics of optical fiber base LIBS probe



Prototype of portable LIBS probe



Basic concept of In-situ monitoring

Analysis of Zircaloy alloy in high radiation environment using portable LIBS probe. Plasma emission can be observed near the LIBS probe end. We were confirmed that it can be analyzed in high radiation environments.

(II) Strengthening the domestic/foreign collaboration in decommissioning research

- Inviting researchers from overseas
- Collaborative research with overseas research institutes
- Forming working groups including external researchers and experts in the fields necessary for decommissioning.
- Foundation of "Research Fund for Promoting Project on Decommissioning Research"



Holding the Fukushima Research Conference (FRC)

(III) Medium-to-long term human resource development

- Opening a collaborative course with the organizations where the research proposal was adopted in "Decommissioning Basic Research : Human Resource Development Program" etc. Thereby, integrating technology owned by universities, and promoting human resource development.



- In order to gather a variety of talented people, the cross-appointment system, etc. are utilized.

(IV) Development of information dissemination function

- In cooperating with the National Diet Library, JAEA arranges information released by the government and Tokyo Electric Power Company Holdings on the basis of IAEA's nuclear accident information categories and disseminate the information as the "JAEA Archive".
- Spreading information on documents including JAEA's original research results



Okuma Analysis and Research Center-Analysis and research of fuel debris etc.

The Okuma Analysis and Research Center is a facility where radioactive wastes and fuel debris produced in the 1F are analyzed and researched. The Center is now under construction in Okuma Town, adjacent to 1F.



Administration Building
(in operation from March 2018)



Completion image of the Laboratory-1
(under construction)

●Administration Building

The Administration Building is used for office works and data analysis, so radioactive materials are not used in this facility. The building consists of meeting spaces, office rooms, workshop, etc. In the workshop, mock-up iron cells and mock-up glove boxes will be prepared, which will be used for the simulation of analyzing works.



Iron cell for mock-up test

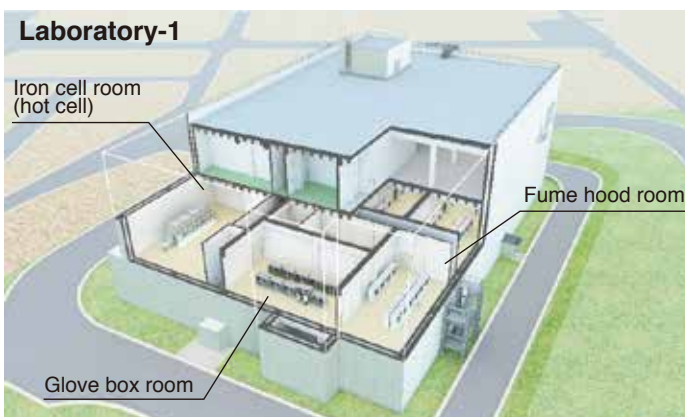
●Human resource development and technological development

In order to foster analytical workers, training for analysis and handling of radioactive materials is conducted in cooperation with the other institutes of JAEA (Nuclear Science Research Institute, Nuclear Fuel Cycle Engineering Laboratories and Oarai Research and Development Institute). Also, along with the improvement of the skills in chemical analysis through lecture courses and seminars, we are upgrading the analytical methods.



●Radioactive Materials Analysis and Research Facilities

The Laboratory-1 is a radioactive material treatment facility where low-to-medium radiation level rubbles and secondary waste are analyzed, which is necessary to develop methods for the 1F waste disposal. For this purpose, the Laboratory-1 equips with facilities such as iron cells, glove boxes, and fume hoods.



Example of iron cell (hot cell):

The materials with medium radiation level are handled in the iron cell of several decimeters thickness that enough shields radiation and separates from outside air.



Example of glove box:

Low radiation-level materials which are easy to be scattered, are handled in the glove box that is isolated from outside air.



Example of fume hood:

A work top with the ventilation equipment. It is mainly used in handling low dose radioactive materials.



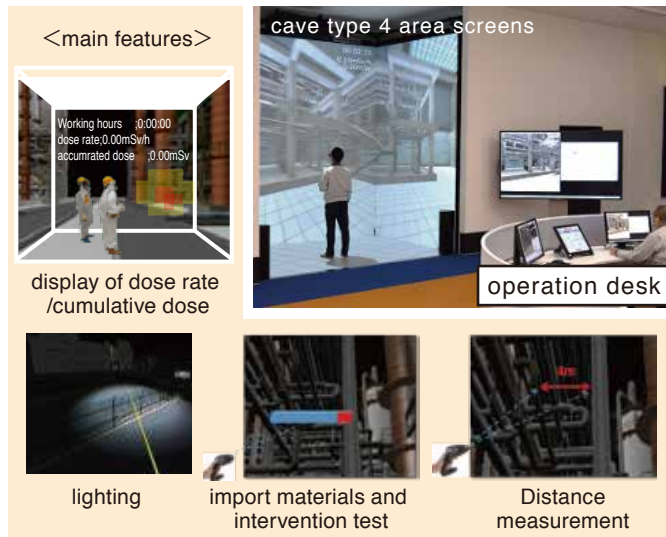
The Laboratory-2 is a facility where materials with high radiation level such as fuel debris are analyzed. The detailed designing is now under way.

The Naraha Center for Remote Control Technology Development is a facility where workers engaged in the research/development on remote-controlling instruments that are necessary to the 1F decommissioning and disaster responses conduct demonstration tests, element tests, and training. The Center equips with the up-to date Virtual Reality (VR) system for training workers, Element Test Area for the demonstration tests of remote-controlling instruments, and the Full-scale Test Area for the demonstration test of decommissioning technology.



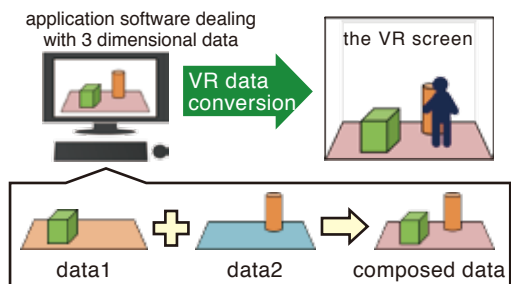
●Virtual reality (VR) system

By reproducing the environment in the 1F reactor buildings, the examination/confirmation of the decommissioning working plan and education/training of workers can be conducted as if we were really in the reactor site.



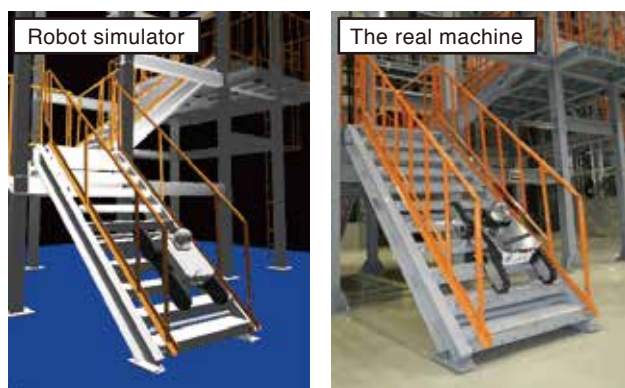
link application softwares dealing with 3 dimensional data

The system imports 3 dimensional data, for example 3D-CAD data, point cloud data etc., and project these data on the VR screen in a full scale. Further, the system compose and display various data which is produced on different application software.



●Development of robot simulator for nuclear severe accidents

JAEA develops robot simulator *1 to make robot design and fabrication efficient by accumulating environmental data where robots are used. The simulator is also applicable to training for robot operators.



A robot moving on the stairs.

*1 based on Choreonoid developed by National Institute of Advanced Industrial Science and Technology (AIST)

●Develop Standard Testing Methods for remote operated equipment, such as response robots employed in nuclear severe accidents

JAEA develop Standard Testing Methods to evaluate the abilities to perform basic common tasks, which reveal required specifications for the robots and technical level of the operator.

① Test place for evaluating the dragging cables



② Test place made of metals for evaluating driving performance



-Demonstration tests for remote-controlling instruments etc.

●Element Test Area

The element test area equips with the facility where the environment in the 1F reactor building can be simulated. The demonstration tests for robots and operation training can be conducted in the area.



Robot testing pool

Cylindrical water tank simulating the underwater environment.

- 6 m × 7 m × 5.5 m (L•W•H)
- Depth 5 m, Diameter 4.5 m
- Temperature can be controlled up to 60°C.
- Environment in salt water can be simulated.



Mock-up stairs

Simulating various kinds of stairs in the 1F reactor buildings. Movable motion capture can be used.

- 7 m × 5 m × 7.5 m (L•W•H)
- Slope and width of the stairs can be changed.



Motion capture

The movement of robots in a wide space can be measured.

- Measurement area: 10 m × 10 m × 2 m (L•W•H)
- Number of cameras: 16
- Guaranteed accuracy of data: 1.5 mm

●Full-scale Test Area

In the Full-scale test area, the demonstration tests for repairing and stopping the leaking parts of coolant at the lower part of the reactor containment vessel were conducted using the 1/8 sector mock-up of the lower part of the reactor containment vessel made by the International Research Institute for Nuclear Decommissioning (IRID).



Image of reactor containment vessel



[Provided by the International Research Institute for Nuclear Decommissioning (IRID)]



●Use of Facility

You can use the Naraha Center for Remote Control Technology Development not only for the decommissioning research but also for the other various purposes. The application to use the facilities is accepted in the website of the Center throughout the year. From the view point of the promotion of 1F decommissioning research and human resource development, the usage fee of the facilities is discounted to half price for the users in education institutions and small/medium-sized enterprises.

The detailed information about the procedures and fee for facility usage can be referred in the following homepage.
<https://naraha.jaea.go.jp/en/use/flow.html>

Naraha JAEA Use of facility

Search



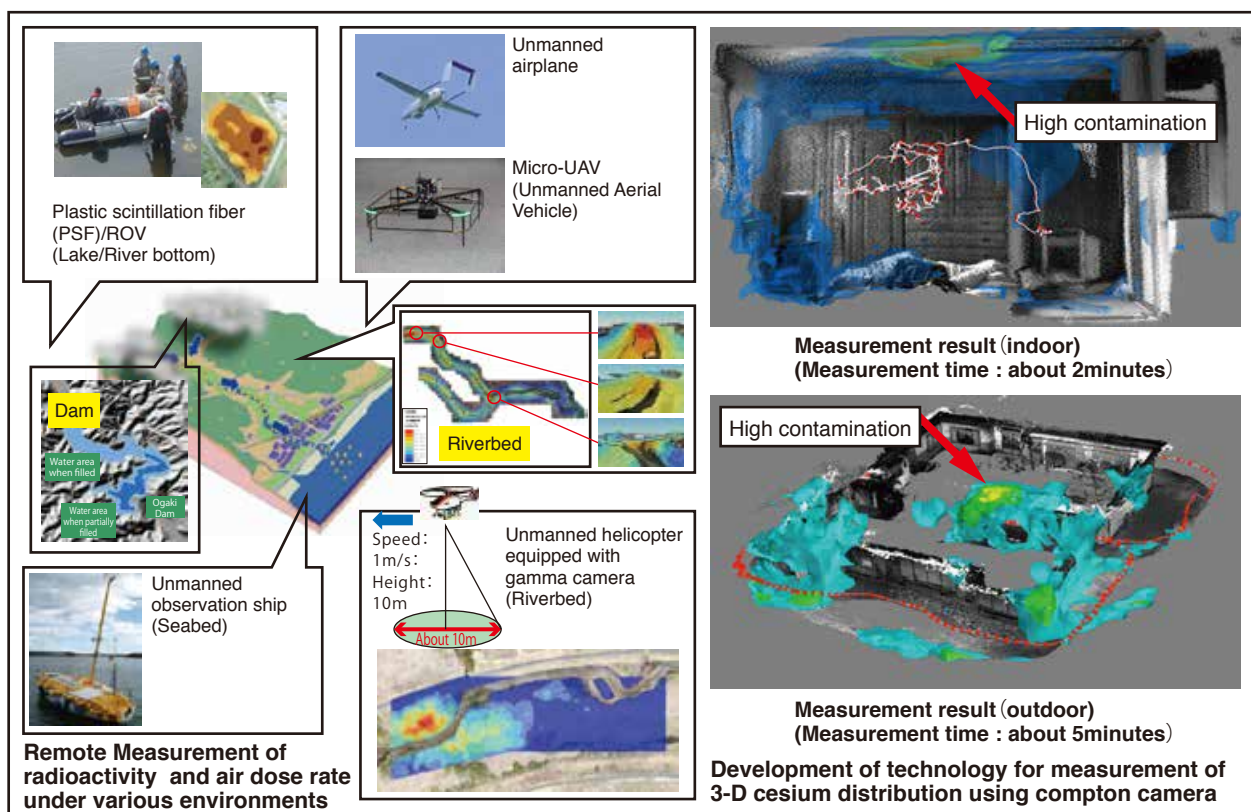
Homepage of the Naraha Center for Remote Control Technology Development
Flow of the facility usage

Efforts towards the environmental restoration

According to the Medium-and Long-Term Activities of the Centre for Environmental Creation, the Sector of Fukushima Research and Development, JAEA is initiatively conducting research/development and supporting activities for environmental restoration of Fukushima and residents' early returning home in cooperation with Fukushima Prefecture, National Institute for Environmental Studies, mainly in the Fukushima Prefectural Centre for Environmental Creation as a base. Also, we are disseminating research results as information based on the scientific evidence in order to contribute to the municipalities' planning towards the local restoration and regeneration of agriculture, forestry and fisheries.

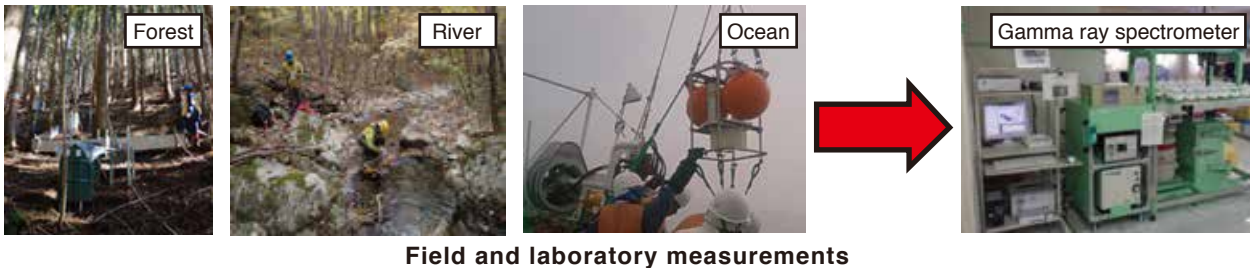
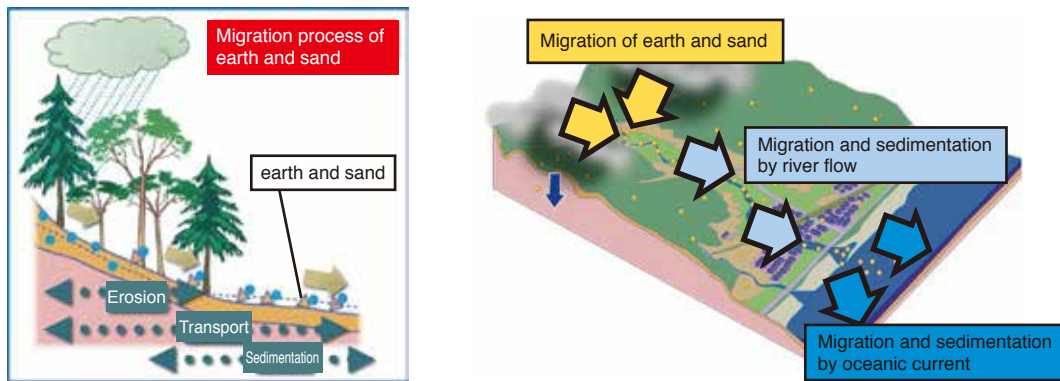
Environmental Monitoring and Mapping

JAEA has been developing the technologies for highly accurate, simple, rapid monitoring of the deposition amount of radioactive materials expansive areas of mountains, forests, rivers and lakes. Also, JAEA has been challenging in the development of measurement technology to visualize more radiation in the immediate environment.



Assessing natural mobilization of Cs in the environment

Understanding the phenomenon of radioactive cesium migration through water flow from forests to rivers, dams, and estuaries.



Preparation of analysis tools and displaying research outcomes

Preparation of analysis tools to estimate future radioactive materials distribution or exposure dose (Comprehensive Evaluation System) and displaying research outcomes as information based on scientific evidences.

Monitoring Database

Database of air dose rate and radioactive material concentration(soil, surface and under surface water, food)

<https://emdb.jaea.go.jp/emdb/en/>

Simulation Unit

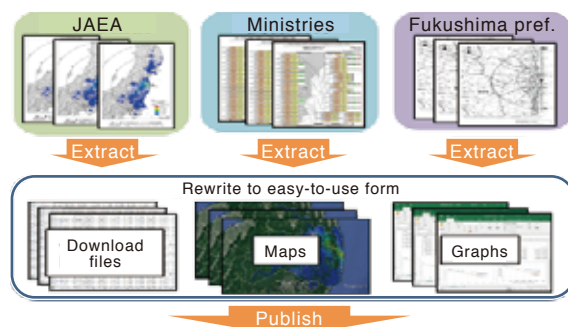
Integration of various numerical models to evaluate radioactive material migration and air dose rates under various conditions

Knowledge Base

Summary of research insights in the form of questions and answers classified for different knowledge- or interest-level users(general, expert)

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

Support municipal planning of the reconstruction of areas or agriculture, forestry and fishery etc.



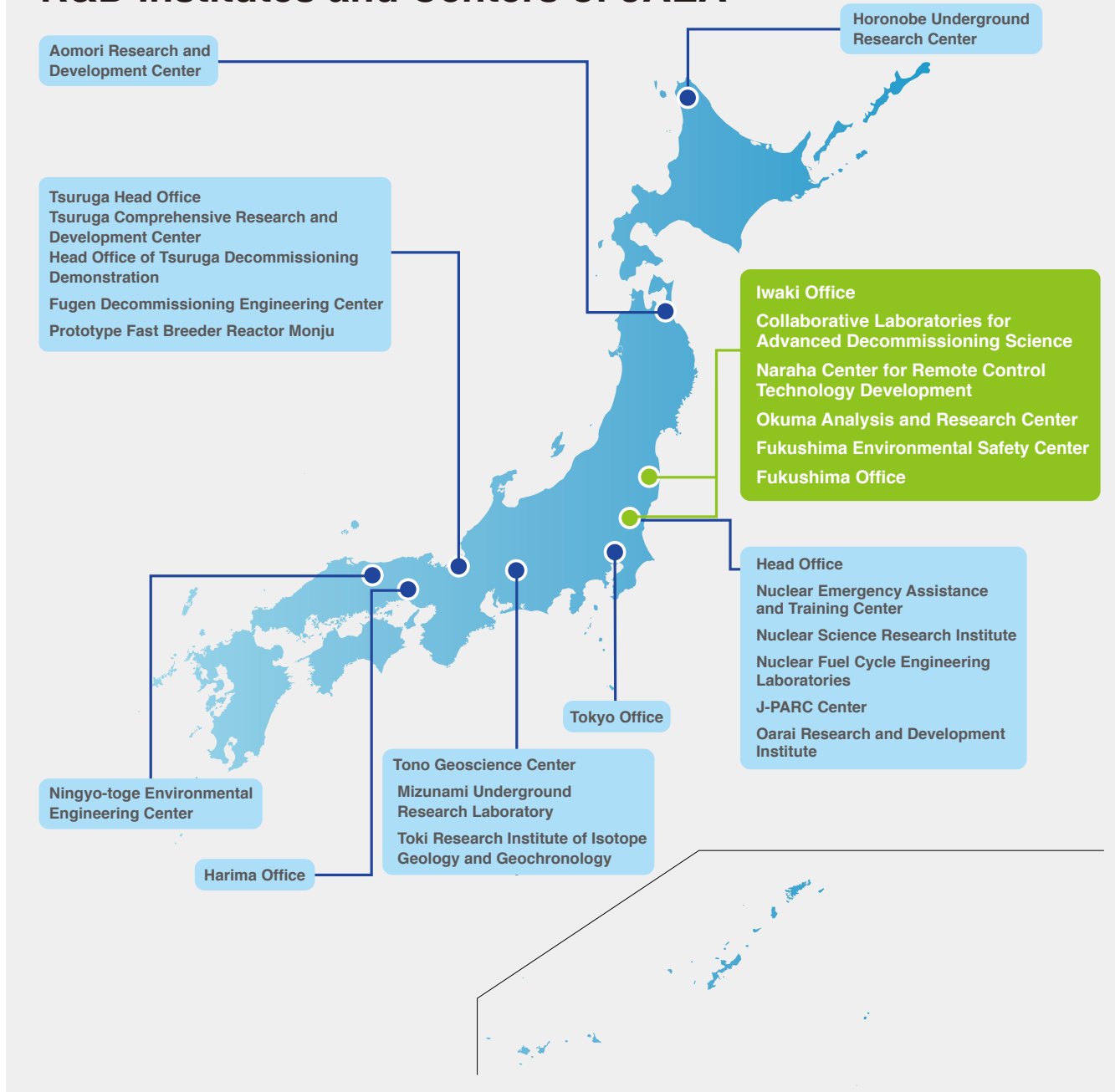
Database for Radioactive Substance Monitoring Data HP



Evidence-based information Q&A HP



R&D Institutes and Centers of JAEA



Sector of Fukushima Research and Development Japan Atomic Energy Agency



■Fukushima Administrative Department

Iwaki Office

8F Taira Central Building, 7-1 Omachi, Taira, Iwaki City, Fukushima 970-8026, Japan
Telephone: +81-246-35-7650 Fax: +81-246-24-4031

Fukushima Office

7F NBF Unix Building, 6-6 Sakae-machi, Fukushima City, Fukushima 960-8031, Japan
Telephone: +81-24-524-1060 Fax: +81-24-524-1069

■Collaborative Laboratories for Advanced Decommissioning Science

790-1 Motooka Ohtsuka, Tomioka Town, Futaba County, Fukushima 979-1151, Japan
Telephone/Fax: +81-240-21-3530

■Okuma Analysis and Research Center

Telephone: +81-246-35-7650 (Iwaki Office)

■Naraha Center for Remote Control Technology Development

1-22 Nakamaru Yamadaoka, Naraha Town, Futaba County, Fukushima 979-0513, Japan
Telephone: +81-240-26-1040 Fax: +81-240-26-1041
<https://naraha.jaea.go.jp/en/>

■Fukushima Environmental Safety Center

c/o Fukushima Prefectural Centre for Environmental Creation
10-2 Fukasaku, Miharu Town, Tamara County, Fukushima 963-7700, JAPAN
Telephone: +81-247-61-2910 Fax: +81-247-62-3650

c/o Environmental Radiation Centre, Fukushima Prefectural Centre for Environmental Creation 45-169 Sukakeba, Kaibama, Haramachi-ku, Minamisoma City, Fukushima 975-0036, Japan

Telephone: +81-244-25-2072 Fax: +81-244-24-2011



Homepage of the Sector of Fukushima Research and Development, JAEA

<https://fukushima.jaea.go.jp/english/>