

Japan's Nuclear Energy R&D Policy and Programs

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Agenda

1. MEXT's Mission to promote R&Ds

2. Topics

- Research Reactors

- Sodium-cooled Fast Reactor (SFR)
- High Temperature Engineering Test Reactor (HTTR)
- Japan Research Reactor -3 (JRR-3)

- R&D for Decommissioning of Fukushima NPS

- Human Resource Development

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- Human Resource Development (HRD)

MEXT is mainly in charge of R&D and capacity building in every science and technology field, including nuclear energy.

6th Strategic Energy Plan (Cabinet Decision in October 2021)

Position of Nuclear Energy

- Required scale of nuclear power is sustainably utilized on the premise of safety.
 - Essential “Base-load power source,” which contributes to stabilization of long-term energy demand structure.
- Expanding decarbonized renewable energy and reducing nuclear power dependency as much as possible, with prioritizing safety.

Nuclear fuel cycle

- Promoting a nuclear fuel cycle that reprocesses spent fuels and effectively utilizes the retrieved plutonium from the viewpoint of effective utilization of resources and reduction of the volume and harmfulness of high-level radioactive waste.

Nuclear technologies and human resources

- Maintaining and developing high-level nuclear technologies and human resources is imperative for smoothly decommissioning aged nuclear power plants, of which the number is expected to increase in the future, as well as TEPCO's Fukushima Daiichi Nuclear Power Station.

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SFR **(sodium-cooled fast reactor)**



JOYO

Current status

- ◆ Joyo has continued the review of the new regulatory standards since 2018.
- ◆ In 2022, we are expecting to obtain approval by NRA.
- ◆ After obtaining the approval, it is scheduled to restart Joyo in 2025 after seismic reinforcement.

Role of Joyo

- ◆ Demonstration of basic sodium-cooled FR technologies.
- ◆ Irradiation testing of fuels and materials, and validation of innovative technologies for the development of future reactors.
- ◆ Basic research using high fast neutron flux.
- ◆ Various Irradiation uses. (eg. medical RI source)



MONJU

Current status

- ◆ Monju is under decommissioning Phase 1 (fuel unloading) since FY2018.
- ◆ In FY2023, we are expecting to move to the Phase 2 (Preparation for dismantling).

Decommissioning cooperation

- ◆ We progress the decommissioning process with the knowledge from the worldwide SFR facilities.

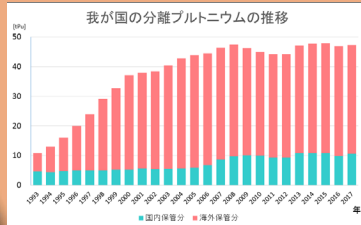
Potential role of "Joyo" as a versatile research platform

For the energy security and innovation to realize a "carbon net zero" society

< Submitted from JAEA >

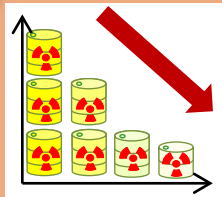
For a world free from the threat of nuclear proliferation and terrorism

- Utilization of separated Pu
- Development of Pu burner reactor

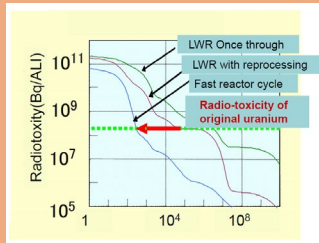


Use of separated Pu

- Minor actinide transmutation
- Transmutation of LLFP

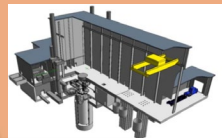


Reduction of Radiological hazard of waste



Sustainable use of nuclear energy

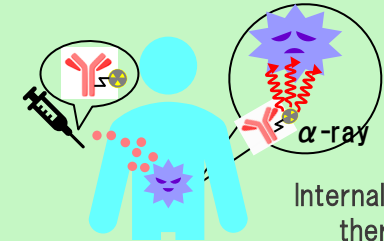
- SMR, next generation reactor development NEXIP
- support for private sector's innovation
- Advanced fuels & materials development, safety improvement
- collaboration with US and France



VTR

Production of medical and industrial isotopes

- Production of isotopes for medical purpose
- Isotopes for industrial application



Internal cancer therapy



Experimental fast reactor "Joyo"

- Collaboration with universities
- Acceptance of foreign engineers

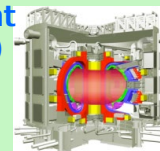


Training



Internship for foreign researchers

- Basic research, multipurpose use
- International collaboration
- Fusion reactor development (R&D of first wall materials)



Pursuit of nuclear potential

Human resources development



Thermal power	30 MW
Fuel	Coated fuel particle/ Prismatic block type
Core material	Graphite
Coolant	Helium
Inlet temperature	395°C
Outlet temperature	950°C
Pressure	4 MPa

HTTR

(High Temperature Engineering Test Reactor)

- High inherent safety
- Flexible siting conditions
- Multi-purpose heat applications including hydrogen production
- The power generation and heat utilization efficiencies are higher than those of LWR

History

- Operated by JAEA at Oarai R&D Institute
- First criticality: 1998
- Full power operation: 2001
- 50 days continuous 950°C operation: 2010
- Loss of forced cooling test at 9MW: 2010
- **Restart its operation : July 30, 2021.**

- JAEA will carry out the safety demonstration tests by using the HTTR under the framework of OECD/NEA project.
- Also, JAEA has a plan to conduct various tests to confirm safety, core physics including thermal-fluid characteristics and fuel performance. Furthermore, the demonstration plan of hydrogen production by the HTTR is under discussion.

JRR-3



JRR-3 (Japan Research Reactor - 3)

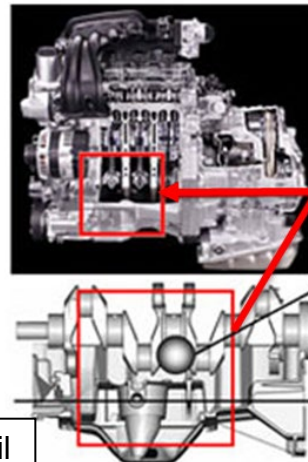
- Research reactor with a thermal power of 20 MW
- Purpose:
 - Beam experiments
 - Irradiation experiments of fuels and materials
 - RI production
 - Activation analysis etc.

History:

- **Restart its operation : February 26, 2021.**

Neutron Beam Experiments

- Unique properties of neutrons make neutron scattering as a versatile probe to explore matter.
- The radiography image has sharp contrast between heavy element materials and hydrogen containing materials.

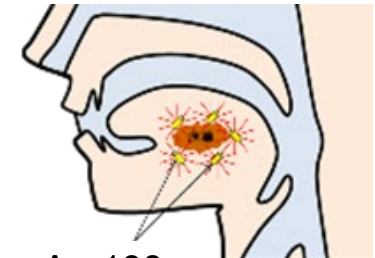


behavior analysis of engine lubricating oil

Neutron Irradiation

JRR-3 has the ability to make two nuclides.

- Au-198 (Gold grain)
- Ir-192 (hairpin, single pin)



Au-198

- JAEA will create the innovation of neutron research by using the JRR-3 and J-PARC complementarily.

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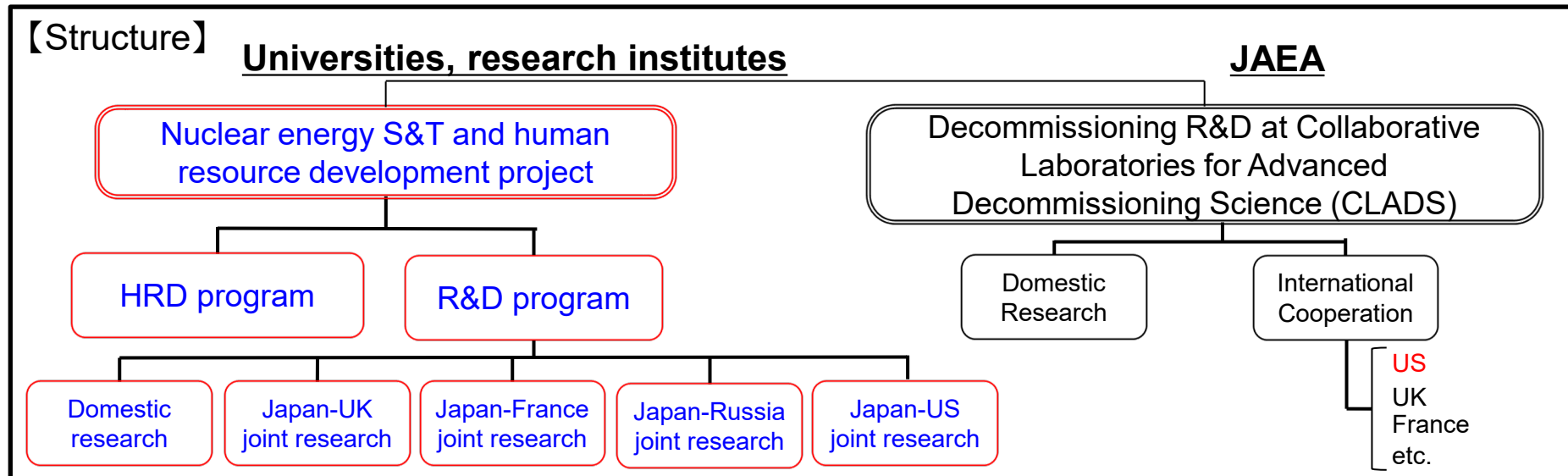
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Action Plan for Decommissioning Fukushima NPS



【Research topics】

- Waste management and other environmental measures (domestic, Japan-US, Japan-UK)
- JAEA/CLADS-SRNL Collaboration
Collaboration Research of “Measurement of alpha energy spectra of Pu-239 oxide particles”.
<BSRA: Battelle Savannah River Alliance>
- Removal of fuel debris (domestic, Japan-UK)
- Basic and fundamental technologies for operation under extreme severe environment (Japan- France)

【HRD efforts】

- Lectures to students who help decommissioning Fukushima NPS
- Courses set up jointly by universities and private corporations in Japan and overseas

JAEA Sector of Fukushima Research and Development

ADS Collaborative Laboratories for
Advanced Decommissioning Science

-A platform to collect the wisdom of experts from around the world-

CLADS Main Building



Utilizing JAEA's special facilities for handling nuclear fuels and radioactive materials, and irradiation facilities at Tokai and Oarai in Ibaraki Prefecture.

OECD/NEA NEST*1 Framework

CLADS leads ARTERD*2 project of NEST Framework

Goals

- Maintenance and enhancement of practical knowledge and technical expertise in nuclear technology for decommissioning among young researchers
- Establishment of the international education network

Objectives

- To provide state-of-the-art science and technology for decommissioning
- To offer hands-on training opportunities to young researchers
- In cooperation with partners, to establish the international education network of R&D on decommissioning step by step

*1 Nuclear Education, Skills and Technology

*2 Advanced Remote Technology and Robotics for Decommissioning

Educational Activities



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Concerns for Nuclear Education in Higher Education

- Lack of young faculty members to replace retiring faculty members
- Ageing research facilities, which are being closed and not replaced

Establishing a Consortium of Japanese Nuclear Education and Training
ANEC: Advanced Nuclear Education Consortium for the Future Society



**National Institute
of Technology**



University A

University B

- ① **Constructing comprehensive educational programs and sharing lectures utilizing information technology**
- ② **Providing opportunities for practical training utilizing research reactors or other nuclear research facilities**
- ③ **Providing opportunities for international study through systematic collaboration with international organizations and overseas universities**
- ④ **Promotion of collaboration with industry and other fields**



Company D

Research institution C



Thank you!



M E X T

MINISTRY OF EDUCATION,
CULTURE, SPORTS,
SCIENCE AND TECHNOLOGY-JAPAN