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Tsuruga International Symposium 2025

JAEA's R&D on Decommissioning and Contribution to Local Communities

Japan Atomic Energy Agency
Tsuruga Head Office

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Contents

Prototype Advanced Thermal Reactor Fugen
Decommissioning plan approved on February 12, 2008

Prototype Fast Breeder Reactor (FBR) Monju
Decommissioning plan approved on March 28, 2018

Japan Power Demonstration Reactor (JPDR) of former Japan Atomic Energy Research Institute

Before dismantling

After dismantling

Electricity output: 12.5 MW
Operation: Oct. 26, 1963 – March 29, 1976
Completion of dismantling: March 1996

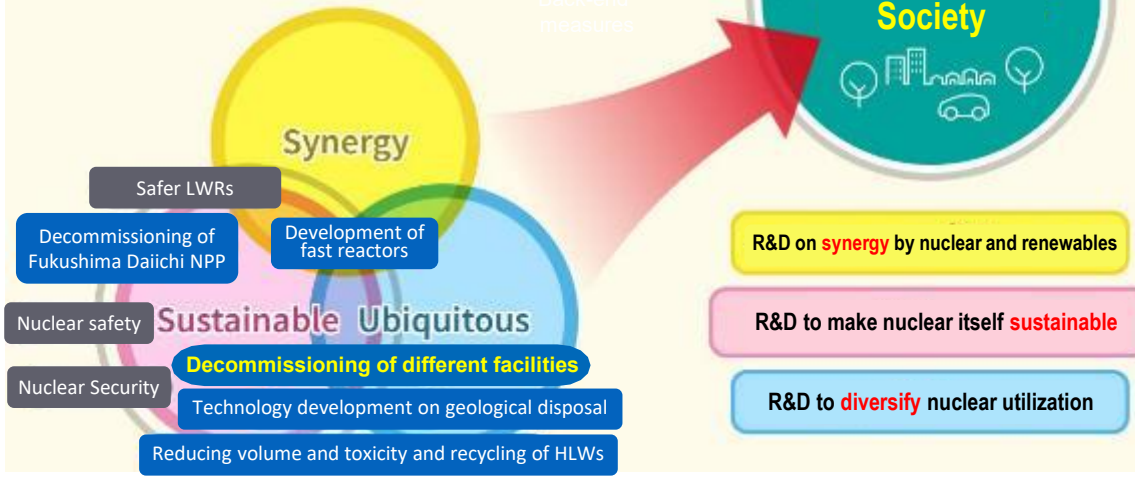
Japan's first demonstration power generation reactor (BWR)
Contributed to the development of power reactor technology and personnel through design, construction, operation, dismantling, and removal.

Significance of the Nuclear Back-End for JAEA

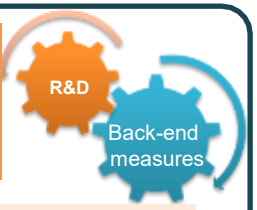
Nuclear back-end measures are critical business challenges for JAEA.

JAEA's vision (target state)

Develop a new future by combining "nuclear and renewable"



For the sustainable use of nuclear power



Long-term use of nuclear power

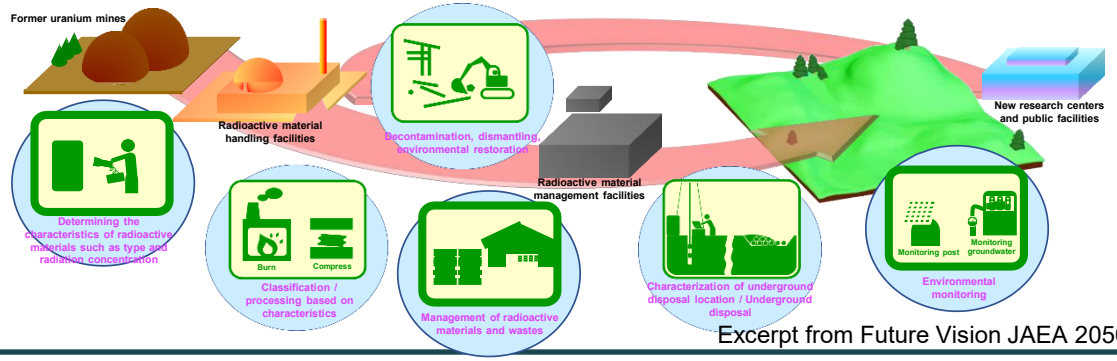
Necessary to establish an R&D cycle

- ✓ Circumstances surrounding nuclear power
- ✓ More nuclear facilities are reaching the end of their service life and being decommissioned.
- ✓ Large amounts of radioactive waste are being stored.

Efforts to solve back-end issues are crucial.

For JAEA, carrying out the dismantling and decontamination of facilities, radioactive waste treatment, and environmental preservation safely, efficiently, and rationally is a critical operational duty. We proactively engage in R&D and technological development, and we secure and train human resources while also aiming to create new industrial areas.

Image of back-end activities essential for establishing an R&D cycle

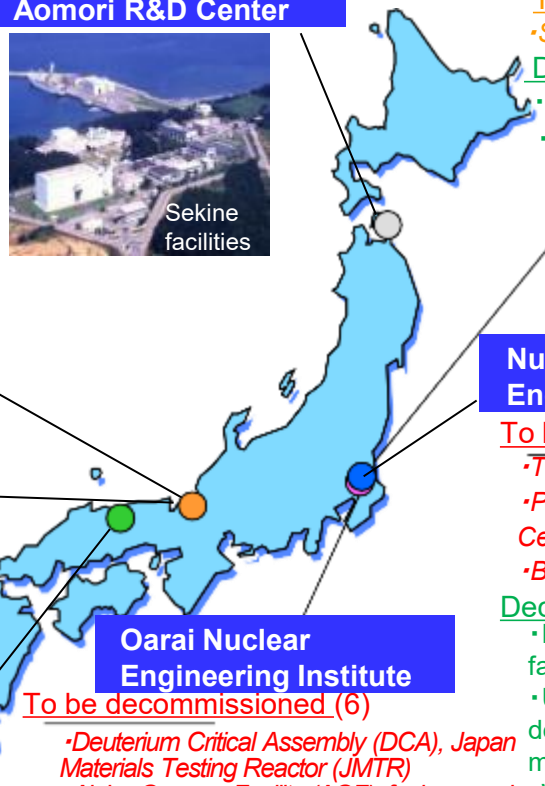


Excerpt from Future Vision JAEA 2050 +

Decommissioning Status of Nuclear Facilities at JAEA

Status of JAEA Facilities	
Under continuous use	46
Under maintenance management	14
To be decommissioned	24 (20 started)
To be utilized (after decommissioning)	5
Decommissioning completed	6

(Based on the medium- to long-term facility plan revised in July 2025)



Aomori R&D Center

To be decommissioned (1)
- Sekine facilities (Mutsu)

Tsuruga

To be decommissioned (1)
- *Monju*

To be decommissioned (2)
- *Fugen*
- Heavy water distillation building

Ningyo-toge Environmental Engineering Center

To be decommissioned (2)
- Enrichment engineering facility
- Uranium enrichment prototype plant

Oarai Nuclear Engineering Institute

To be decommissioned (6)
- *Deuterium Critical Assembly (DCA), Japan Materials Testing Reactor (JMTR)*
- *Alpha-Gamma Facility (AGF), fuel research building*
- *Material Monitoring Facility (MMF), sodium analysis facility*

To be utilized (1)
- *Material Monitoring Facility No.2 (MMF-2)*

To be decommissioned (8)
- *Reprocessing Test Facility*
- *JRR-2 · JRR-4 · TCA* · FCA · *Plutonium Research Building No.1*
- Transient Experiment Critical Facility (TRACY), Waste burial

To be utilized (1)
- *Simulation Test for Environmental Radionuclide Migration (STEM)*

Decommissioning completed (3)
- Safeguard laboratory (SGL), uranium enrichment laboratory
- Special nuclear training center (nuclear fuel material usage facilities)

Nuclear Science Research Institute

Nuclear Fuel Cycle Engineering Laboratories

To be decommissioned (4)
- *Tokai Reprocessing Plant (TRP)*
- *Plutonium Fuel Development Center No.1 (Pu-1)*
- *Building A, building B*

Decommissioning completed (3)
- Plutonium waste storage facility (PWSF)
- Uranium handling facility for development of nuclear fuel manufacturing equipment
- Wastewater treatment facility

To be utilized (3)
- *Pu Fuel Development Center No.2 (Pu-2)*
- *Building L*
- Building M

Medium- to Long-Term Facility Plan and Back-End Roadmap

A short-term plan (medium- to long-term facility plan) and a long-term policy (back-end roadmap) are in place to advance back-end measures in a scheduled manner.

Medium- to long-term facility plan

- A comprehensive plan that is consistent with the three pillars of consolidating and prioritizing facilities, ensuring the safety of facilities, and back-end measures.
- A plan for approx. 5 years (FY2025-FY2029) was formulated through the revision in July 2025.

Consolidating and prioritizing facilities

- Categorizing nuclear facilities

⇒ Under continuous operation : 46 facilities
Under maintenance management : 14 facilities
To be utilized : 5 facilities
To be decommissioned : 24 facilities

Medium- to long-term facility plan

Ensuring safety of facilities

- Meeting the new regulatory standards
- Aging-related measures

Back-end measures

- Measures related to decommissioning and utilization of nuclear facilities
- Measures related to waste treatment and packaging

Formulated in 2017, revised in 2025

Back-end roadmap

- Formulated a long-term (approx. 70 years) policy on back-end measures for existing facilities licensed under the Nuclear Reactor Regulation Law (79 facilities).

➢ Phase 1 (approx. 10 years) through FY2028
In this period, back-end measures are driven forward while giving priority to ensuring near-term facility safety.

➢ Phase 2 (approx. 20 years) FY2029 - FY2049
This is a period of transition to full-fledged back-end measures, during which disposal is in full swing and waste treatment facilities are prepared.

➢ Phase 3 (approx. 40 years) FY2050 onwards
In this period, full-fledged back-end measures are implemented and completed.

Key contents

- **Decommissioning**
- **Waste treatment and disposal**
- **Radioactive materials management**
- **Costs for back-end measures (approx. 1.9 trillion yen (approx. 70 years))**
- **Measures for higher efficiency and optimization**

Formulated in 2018

1. Status of Decommissioning at JAEA
2. Status of Decommissioning in Tsuruga
   - ① Prototype Advanced Thermal Reactor Fugen
   - ② Prototype Fast Breeder Reactor Monju
   - ③ Efforts related to Clearance
3. JAEA's Contribution to Local Communities
   - ① "Sumadeco" (Smart Decommissioning Demonstration Base): Overview and Personnel Development
   - ② Briefings on Decommissioning to Local Communities
   - ③ Joint Research with Local Companies
   - ④ Coordination and Cooperation with Local Universities
   - ⑤ Contribution to the Clearance Treatment Facility
4. Conclusion and Next Steps

Fugen's waste from dismantling awaiting measurements for clearance

Clearance monitor of Fugen

Location of Fugen and Monju

Tsuruga City, Fukui Pref.

Area：251.41km^2
Population：61,786
No. of households：29,330
(As of Aug. 31, 2025)

Kansai Electric's Mihama NPP
(3 PWRs, Units 1 and 2 under decommissioning)

Tsuruga
Peninsula

Japan Atomic Power Company's
Tsuruga NPP
Unit 1 (BWR/ Under decommissioning)
Unit 2 (PWR)

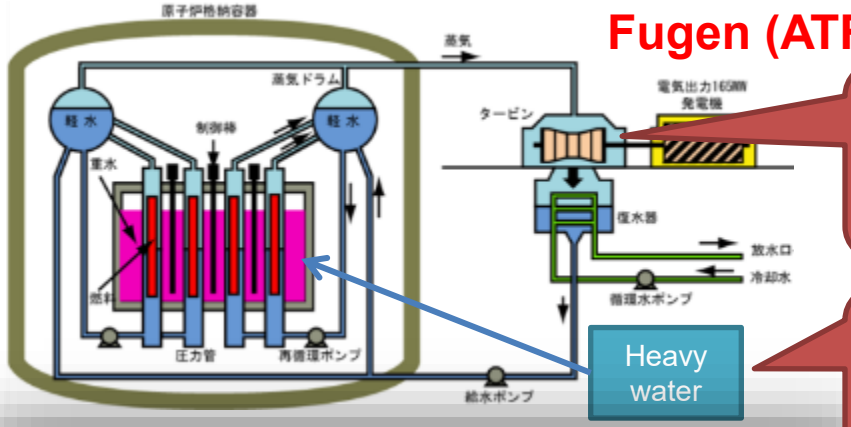
Prototype Advanced Thermal Reactor Fugen
(ATR/ Under decommissioning)

Prototype Fast Breeder Reactor Monju
(FBR/ Under decommissioning)

Tsuruga NPP
Planned site of Units 3 and 4 (APWR)

Description of Fugen

Fugen (ATR: Advanced Thermal Reactor)

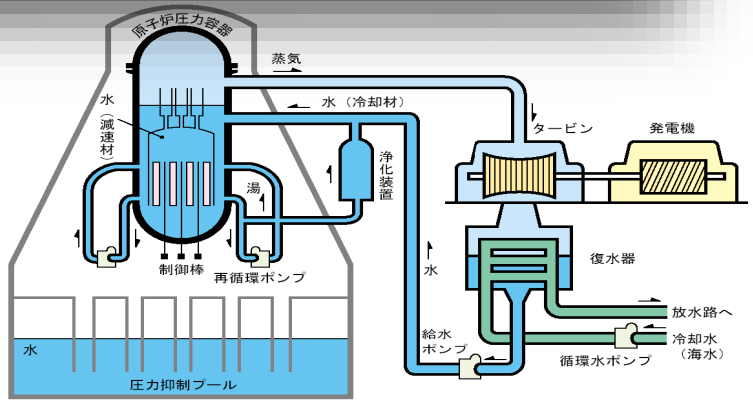


Radioactively contaminated as in the case of BWRs

Including radioactive tritium

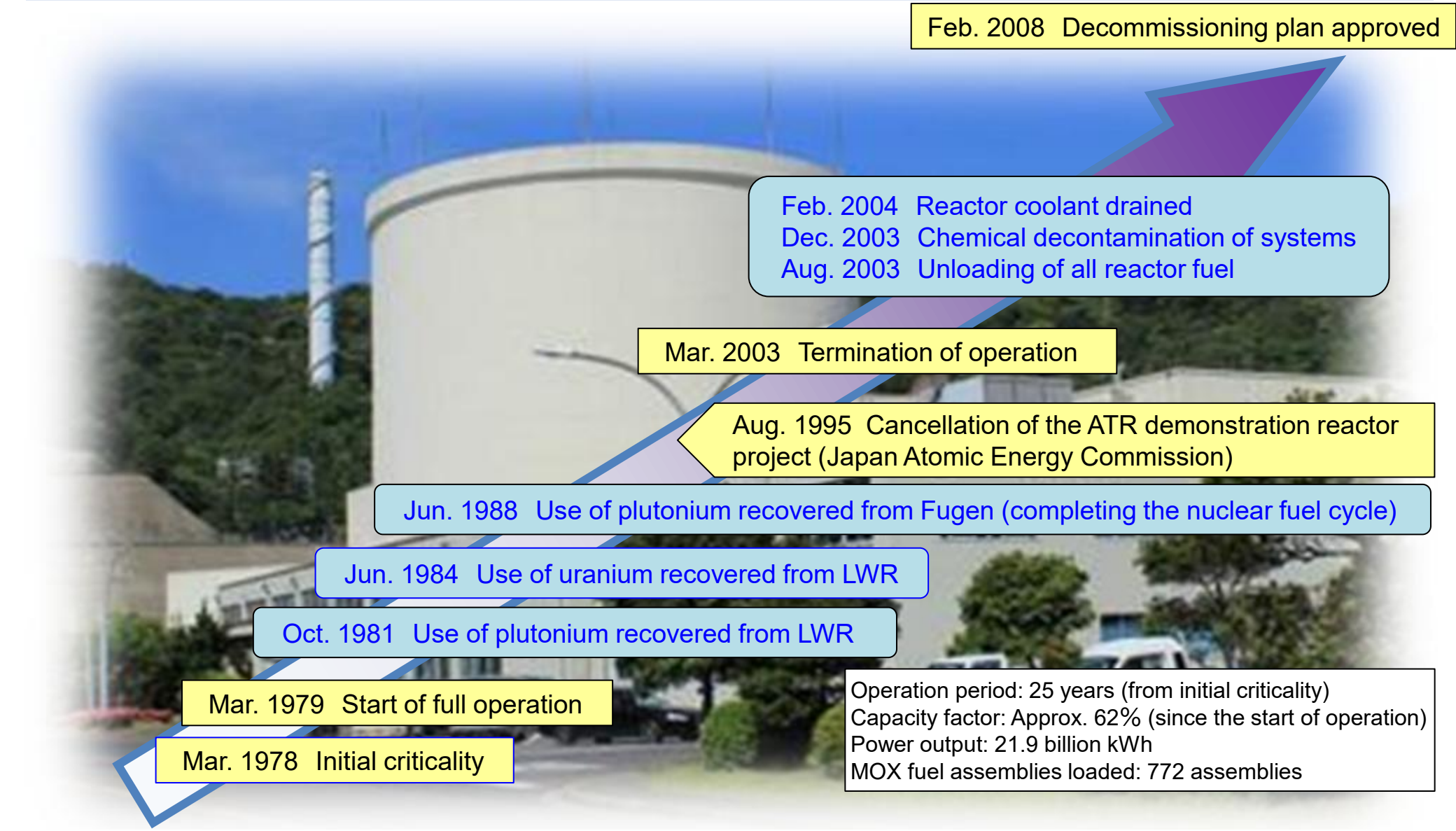
	Type of reactor vessel	Moderator	Coolant
Fugen	Pressure tube type	Heavy water	Light water
LWR	Pressure vessel type	Light water	Light water

Power output	Thermal output: 557 MWt Electricity output: 165 MWe
Core	Height: 3,700 mm Diameter: 4,050 mm Number of fuel channels: 224
Fuel	Mixed oxide (MOX) Slightly enriched uranium
Heavy water system	Weight with heavy water loaded: 160 t Temperature of heavy water: 70°C
Reactor cooling system	Coolant: light water (H_2O) Pressure: 68 kg/cm^2 Temperature: 284°C (Steam drum part) Core flow rate: 7,600 t/h Number of recirculation circuits: 2 loops



LWR (BWR)

History of Fugen



Feb. 2008 Decommissioning plan approved

Feb. 2004 Reactor coolant drained
Dec. 2003 Chemical decontamination of systems
Aug. 2003 Unloading of all reactor fuel

Mar. 2003 Termination of operation

Aug. 1995 Cancellation of the ATR demonstration reactor project (Japan Atomic Energy Commission)

Jun. 1988 Use of plutonium recovered from Fugen (completing the nuclear fuel cycle)

Jun. 1984 Use of uranium recovered from LWR

Oct. 1981 Use of plutonium recovered from LWR

Mar. 1979 Start of full operation

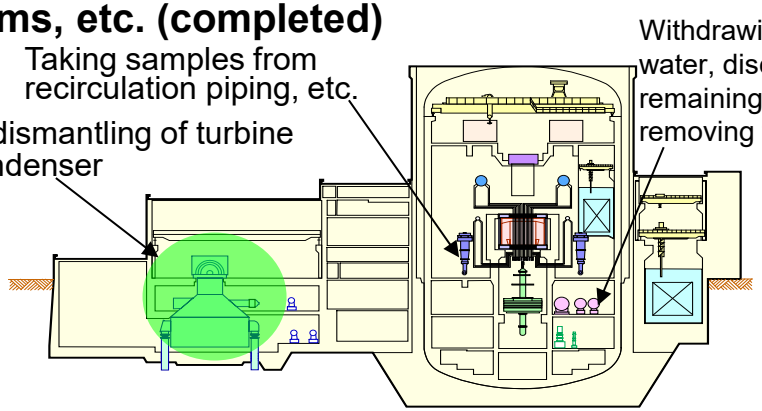
Mar. 1978 Initial criticality

Operation period: 25 years (from initial criticality)
Capacity factor: Approx. 62% (since the start of operation)
Power output: 21.9 billion kWh
MOX fuel assemblies loaded: 772 assemblies

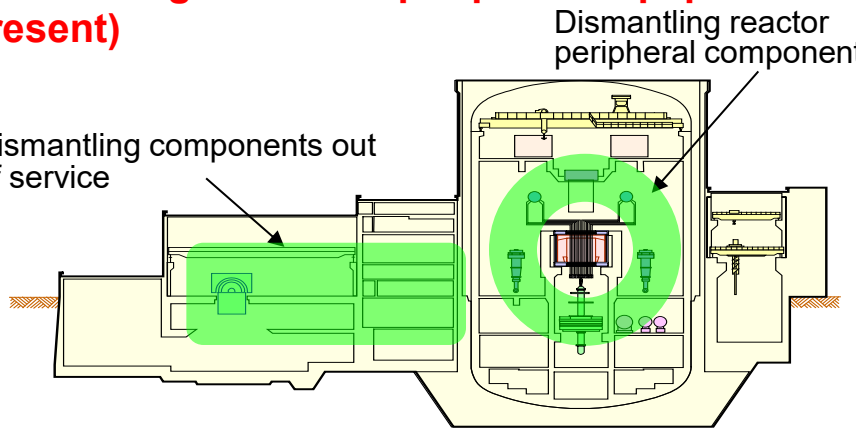
Status of Dismantling and Removal (Overview)

The entire decommissioning process (spanning approximately 30 years) is divided into four phases and decommissioning work is being carried out according to each step.

(1) Decontamination of heavy water and helium systems, etc. (completed)

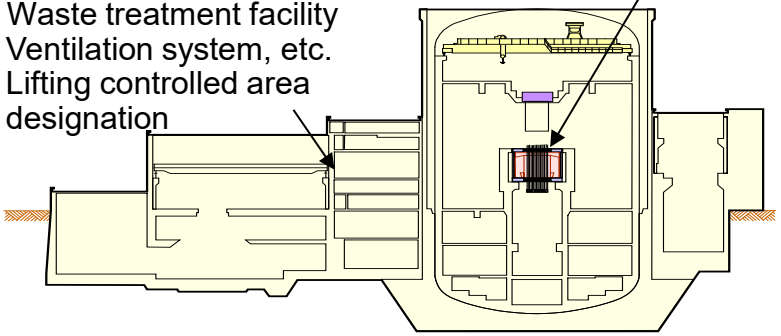


(2) Dismantling of reactor peripheral equipment (at present)



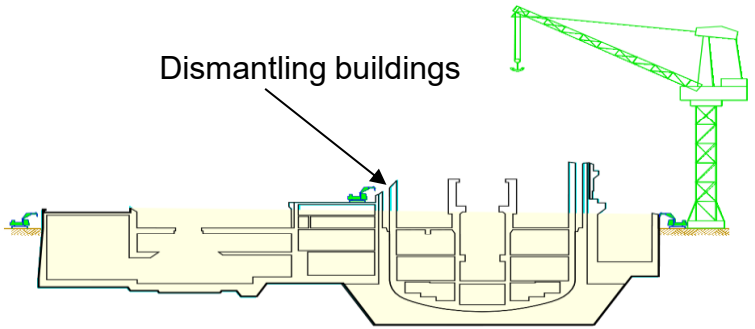
(3) Dismantling reactor core (2030 onward)

Dismantling after removal of reactor core area
- Waste treatment facility
- Ventilation system, etc.
- Lifting controlled area designation



A pool will be installed at the top of the reactor vessel to facilitate the dismantling and removal process.

(4) Demolition of building (2039-2040)



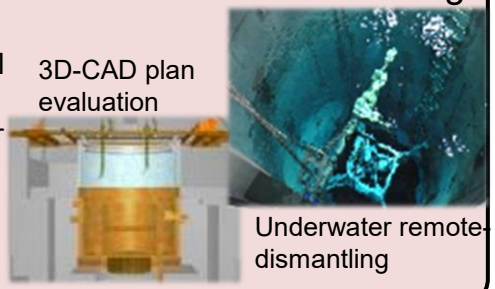
Decommissioning Schedule of Fugen

▼Now

FY	2007 【Completed】	2018	2030	2039
Phase	Heavy water and helium systems decontamination period	Reactor peripheral systems dismantling and removal period	Reactor dismantling and removal period	Building dismantling period
Key Activity	Unloading spent fuel			
	Collection and transport / drying and storage of heavy water			
	Dismantling reactor coolant system facilities, I&C facilities, etc.			
		Dismantling nuclear fuel handling / storage facilities, heavy water and helium systems, etc.		
		Developing remote-controlled / automated equipment	Dismantling the reactor	Lifting controlled area designation
				Dismantling buildings

●Develop technologies for safe and efficient dismantling

Cutting technologies using lasers and measures to reduce -personnel exposure by remote control and automation are being developed for safe and efficient dismantling of the reactor highly, which has been highly irradiated through long-term operation.



Underwater remote-dismantling

●Recycle resources through the clearance system

Most of the scrap materials generated from decommissioning have a negligible impact on human health. We are working to reuse them under the government's clearance system, aiming to build a recycling-oriented society and reduce environmental burden.

Example of reuse (car stopper)

✓ The aim is to demonstrate safe and rational decommissioning technologies, establishing a clear pathway for NPPs after closure.

Towards a future where nuclear power can be used with a stronger sense of security.

Dismantling of Turbine Systems

Nos. 3 & 4 feedwater heaters

Main steam piping

FY 2008

No. 5 feedwater heater

FY 2009

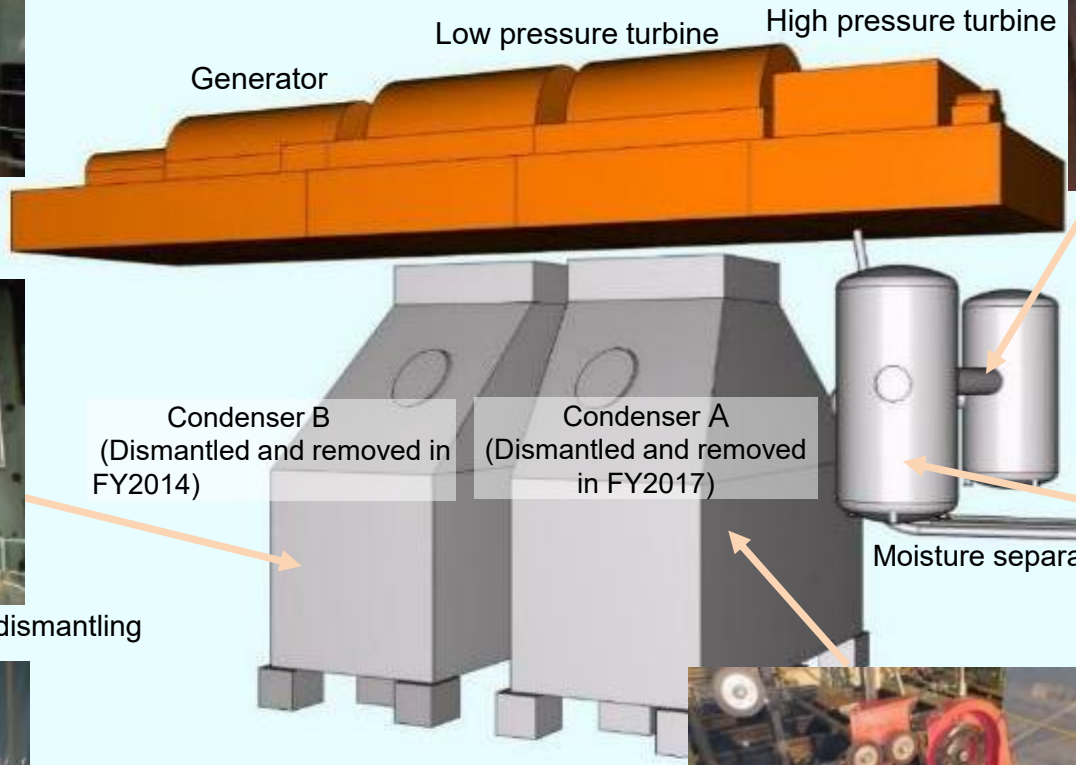
(Including materials to be cleared)

Dismantling and Removal Work Record (Condenser)

Lower shell of condenser before dismantling
Left: Condenser B lower shell

Lower shell of condenser after dismantling

Condenser pit after dismantling the foundation



Cutting a high-pressure turbine exhaust pipe

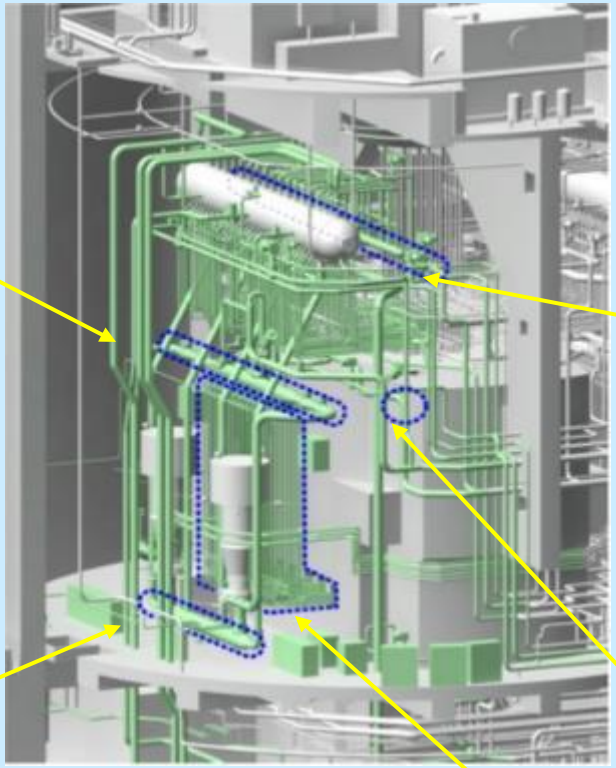
Cutting the internal structure of a moisture separator

Cutting coolant pipes simultaneously using a wire saw

Dismantling of Loop A Reactor Peripheral System

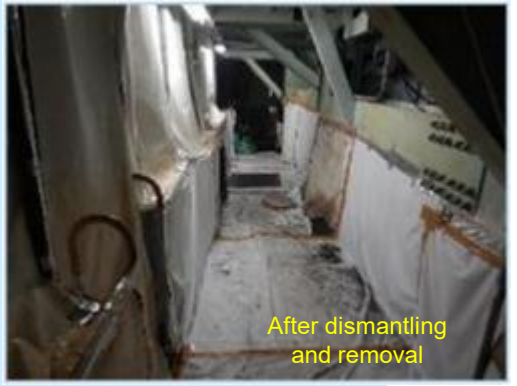
Dismantling and removal period【FY2019 - 2020】

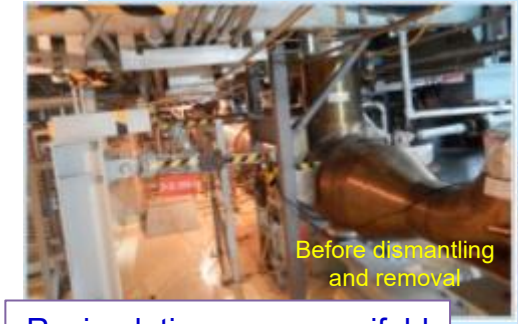
(3D－CAD for inside of the reactor containment vessel)



Lower header

Main steam piping





Recirculating pump manifold

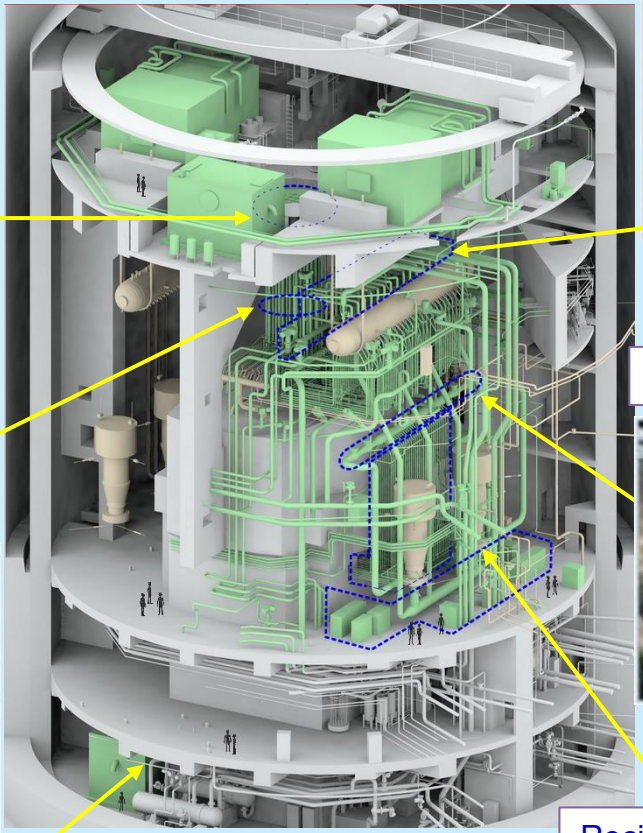
Cutting inlet pipes

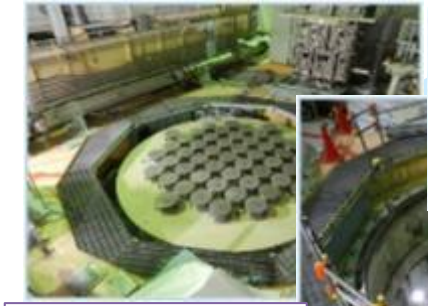
Cutting ECCS pipes

Dismantling of Loop B Reactor Peripheral System

Dismantling and removal period【FY2020 - 2024】

(3D－CAD showing the inside of the reactor containment vessel)





Control rod drive mechanism support plug

Before dismantling and removal

Main steam piping

After dismantling and removal

Before dismantling and removal

Control rod guide tubes

After dismantling and removal

Lower header

Before dismantling and removal

After dismantling and removal

Before dismantling and removal

Emergency filter unit

After dismantling and removal

Recirculation pump seal pipes

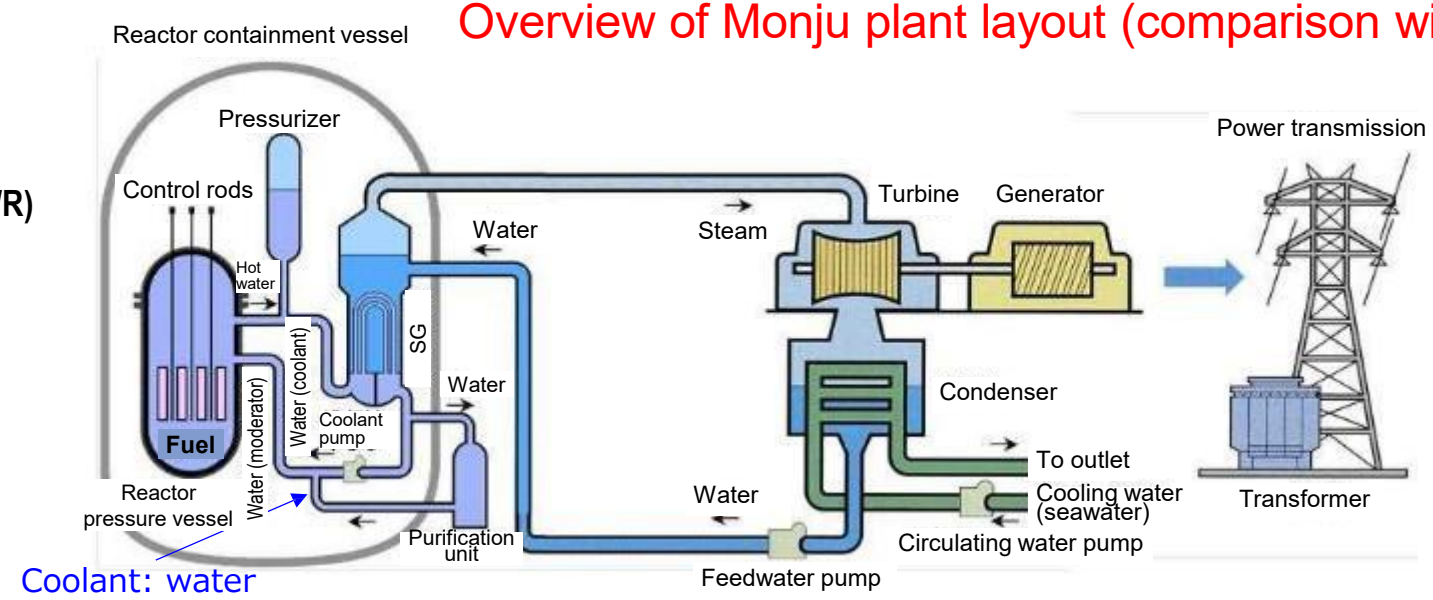
Before dismantling and removal

After dismantling and removal

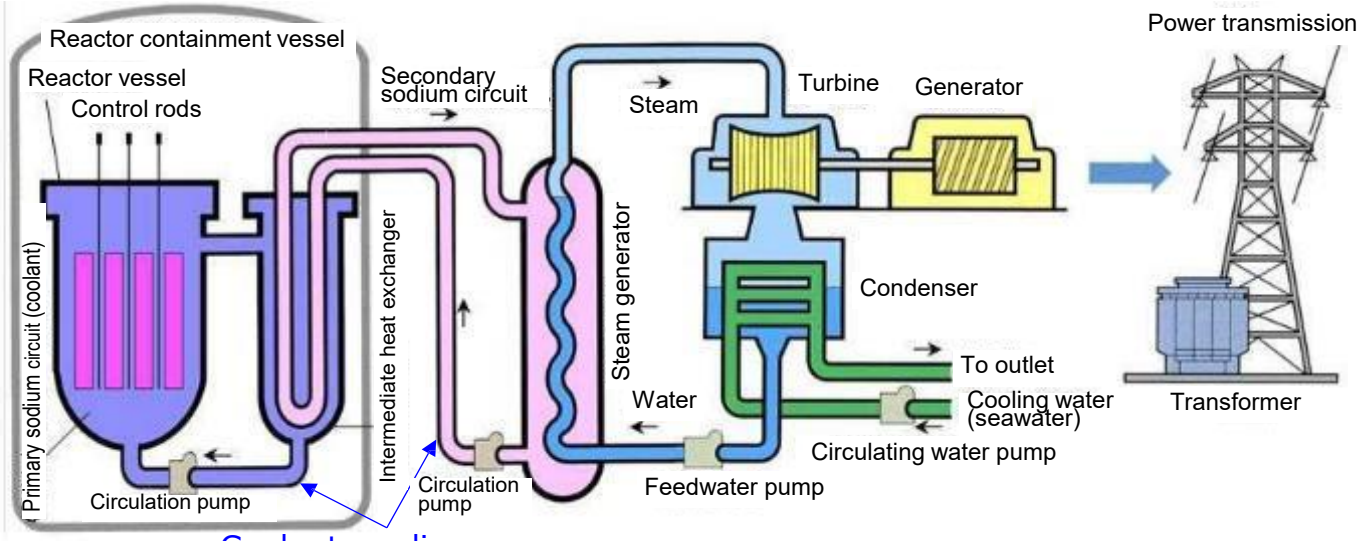
Overview of Monju

Overview of Monju plant layout (comparison with LWR)

Light Water Reactor (PWR)



Fast Breeder Reactor



History of Monju


February 1983


October 1985


October 1986


April 1991


April 1994
Initial criticality

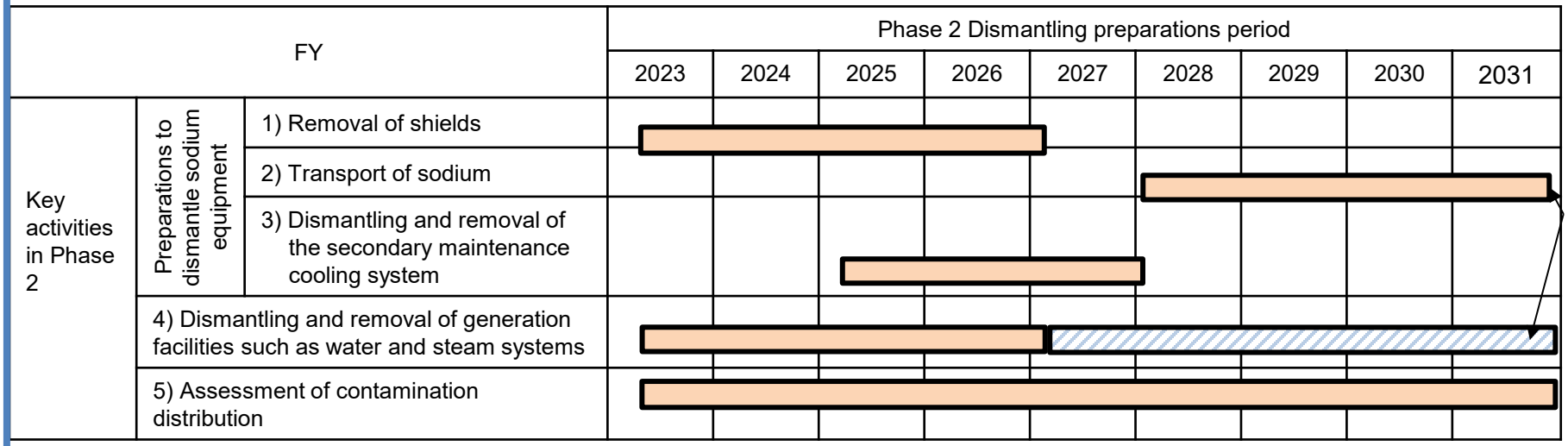

May 2010
Performance tests restarted

May 27, 1983	Reactor installation permit	December 21, 2016	Meeting of nuclear power-related cabinet members Fast Reactor Development Policy, government's final decision on the Prototype Fast Breeder Reactor Monju →Monju placed on the decommissioning path
April 5, 1994	Initial criticality reached		
August 29, 1995	Initial grid connection (initial power transmission)	December 6, 2017	Application for decommissioning Monju submitted to the Nuclear Regulation Authority (NRA)
October 13, 1995	40% electricity output reached		
December 8, 1995	Secondary system sodium leak accident occurred	February 9, 2018	Application for modification of the reactor facility operation manuals submitted
March 3, 2005	Preparatory work for modification work started	March 28, 2018	Permit granted for the decommissioning plan and reactor facility operation manuals
August 30, 2007	Work confirmation test for modification work completed		
May 6, 2010	Characteristics tests restarted	August 30, 2018	Fuel assembly unloading started
November 27, 2012	O&M issues made public	April 22, 2022	Unloading of all fuel assemblies from the reactor vessel completed
May 29, 2013	NRA issued orders to take security measures	October 13, 2022	Transfer of all fuel assemblies to the fuel pool (water pool) completed
November 13, 2015	NRA issued recommendations to the Minister of Education, Culture, Sports, Science and Technology	April 1, 2023	Phase 2 (preparations for dismantling) started

Overall Timeline of the Monju Decommissioning Plan and Key Activities in Phase 2

Stage	Phase 1: Fuel assembly unloading period	Phase 2: Dismantling preparation period	Phase 3: Decommissioning period Ⅰ	Phase 4: Decommissioning period II
FY	2018 – 2022	2031	2032 –	2047
Key activities	Fuel assembly unloading	Preparations to dismantle sodium equipment	Dismantling and removal of sodium equipment	
	Assessment of contamination distribution			
		Dismantling and removal of generation facilities such as water and steam systems		
				Dismantling and removal of buildings, etc.
	Treatment and disposal of solid radioactive waste			

Key activities of the decommissioning plan (Phase 2)

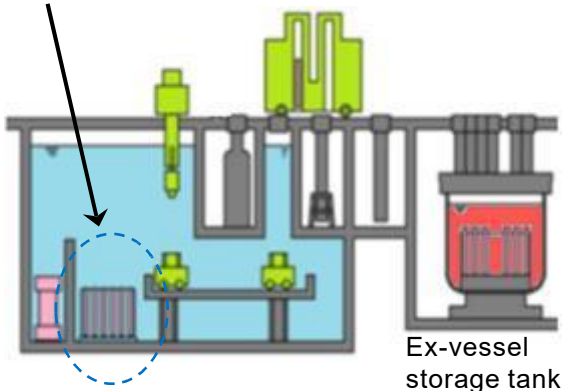


Activity details will continue to be discussed and will be finalized in the next application for the decommissioning plan modification permit.

Current Status of Monju

- Started the removal of in-vessel shields, mock-up fuel assemblies, etc. in June 2023

- The 530 fuel assemblies in the reactor and ex-vessel storage tank are now all stored in the storage pool (water pool).

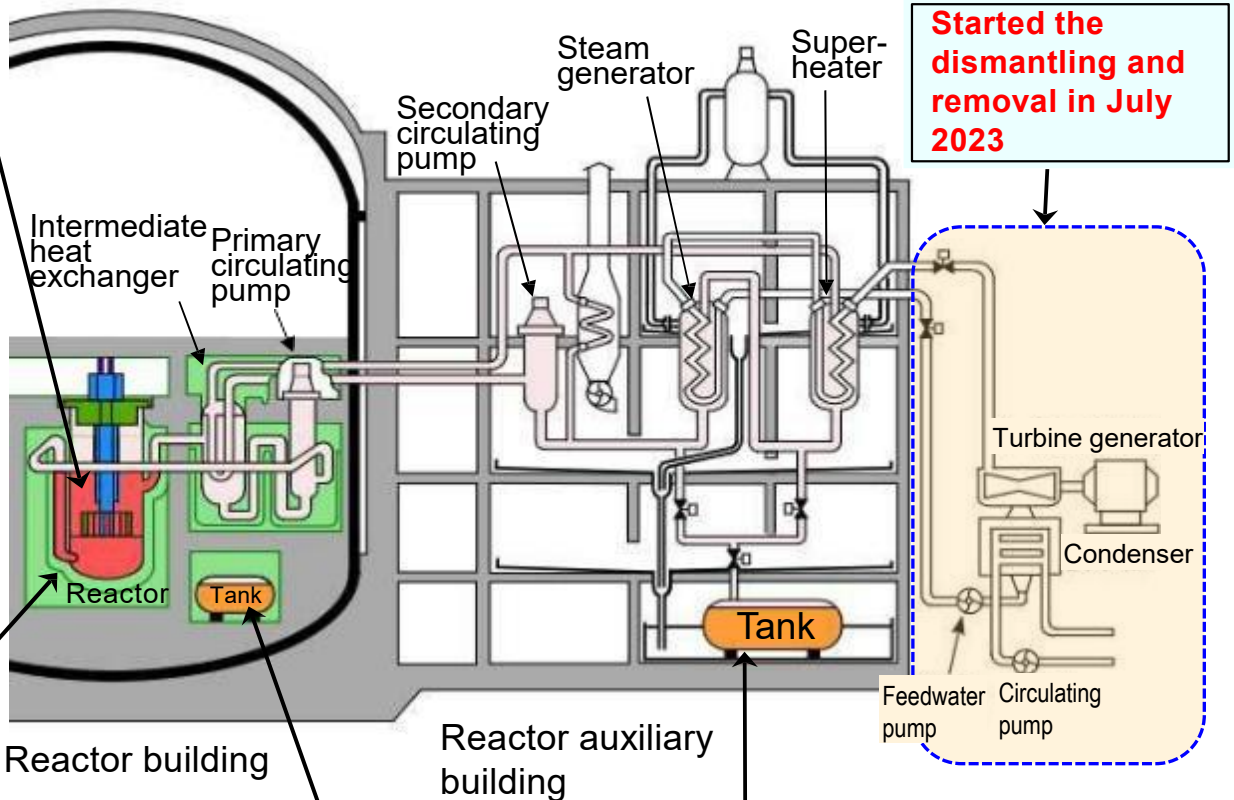


Primary system

Secondary system

Water and steam systems

Started the dismantling and removal in July 2023



・The reactor and ex-vessel storage tank contained liquid sodium.

Sodium has been completely removed from the primary loop and is now stored in a tank in solid form.

Sodium has been completely removed from the secondary loop and is now stored in a tank in solid form.

Progress in the Dismantling of the Water and Steam Power Generation System

- To secure space for dismantling and ensure a transport route for large non-radioactive sodium equipment after its removal, turbine generators, condensers, and feedwater-heaters on the third floor of the turbine building and below are being dismantled and removed from FY2023 to FY2026.
  - The steam turbine*, feed-water-heaters, condensers, and other equipment have been dismantled and removed from their original positions by FY2024.
  - Dismantling began in July 2025 for coolant pipes and in August for power generators.
  - The dismantling of the oil tank and main feedwater pump will start in stages hereafter.

*: The steam turbine has been removed from the original position. Some large dismantled materials will be stored in the T/B, and cut into smaller pieces and transported off-site in FY2025 or later.

The dismantling and removal work is proceeding smoothly, and dismantling should be completed up to the third floor of T/B within FY2026.

【Equipment dismantled and removed from original positions FY2024 (samples)】

Condenser (before dismantling/removal)

High-pressure feedwater-heaters 1 and 2 (before dismantling/removal)

Condenser (after dismantling/removal)

High-pressure feedwater-heaters 1 and 2 (after dismantling/removal)

【Equipment to be dismantled from FY2025 (samples)】

Generator

Oil tank (high-pressure oil unit)

Main feedwater pump

Coolant pipe

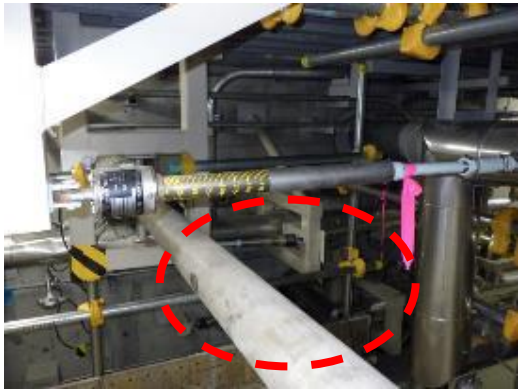
Progress of Dismantling and Removal of the Secondary Maintenance Cooling System

- To demonstrate/verify technologies through the dismantling of actual non-radioactive sodium equipment, relatively small equipment with low residual sodium, such as circulating pumps and air coolers of the secondary maintenance cooling system, are being dismantled and removed from FY2025 to FY2027.
  1) Dismantling of preheating and warming equipment: Started in April 2025 and completed in May 2025
  2) Isolation of the dismantled area: Started in June 2025 and completed in September 2025
  3) Stabilization treatment: To start in FY2025 (incl. installing stabilization treatment equipment)

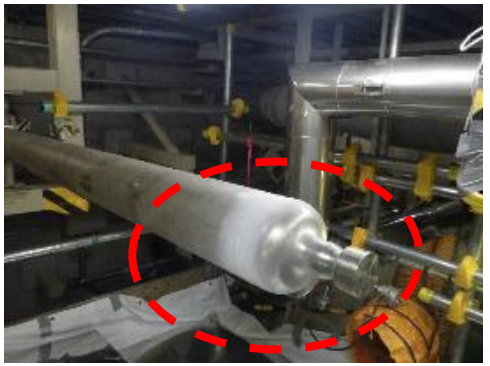
  ➡ **The work is proceeding smoothly without issues, paving the way for the dismantling of sodium equipment.**

Preheating/warming equipment (before dismantling)

Preheating/warming equipment (after dismantling)



Before isolation (inlet pipe for the intermediate heat exchanger)



After isolation (inlet pipe for the intermediate heat exchanger)

Status of Clearance at JAEA

- Any clearance objects generated from the dismantling of nuclear facilities are promptly verified by the NRA for designation as cleared materials.
- Cleared objects are actively used within and outside JAEA.

Nuclear Science Research Institute

- Concrete from the modification of JRR-3 Approx. 4,000 tons
- Clearance period: FY2009 - FY2014
- Reused for: roadbed materials within JAEA premises


Ningyo-toge Environmental Engineering Center

- Clearance candidate metals from uranium-handling facilities (approx. 600 tons)
- Clearance period: FY2012 onwards (approx. 86 tons have been verified by authorities to date)
- Reused for: Flowerbeds in the Center, tables, and benches (approx. 11 tons)


Prototype Advanced Thermal Reactor Fugen

- Clearance candidate scraps from dismantling associated with the decommissioning (approx. 1,100 tons)
- Clearance period: FY2018 onwards (approx. 722 tons have been verified by authorities to date)
- Reused for: Car stoppers, bicycle racks, lighting, tables, and benches (approx. 20 tons)

- Information on clearance activities will be disclosed proactively to enhance public understanding, with support from electric utilities.

Clearance Records at JAEA

Applicant	Nuclear Facility/ Material	Date of Application for Measurement and Evaluation Methods	Date of Approval of Measurement and Evaluation Methods	Date of Verification of Measurement and Evaluation Results	Weight Verified	Total
JAEA	JRR-3 (Concrete debris: the value included in about 4,000 t with verification completed)	November 8, 2007	July 25, 2008	May 14, 2010	377 t	**Approx. 3,866 t** (All were recycled)
				December 17, 2010	381 t	
				August 17, 2011	385 t	
		July 9, 2010	August 3, 2010	December 13, 2011	344 t	
				February 21, 2012	365 t	
				July 23, 2012	394 t	
				June 10, 2013	368 t	
				October 25, 2013	381 t	
				February 28, 2014	359 t	
				February 6, 2015	512 t	
	Ningyo-toge Environmental Engineering Center (Metal: the value included in about 607 t)	December 12, 2011	August 31, 2012	March 26, 2014	11 t	**Approx. 86 t** (11 tons were recycled)
				June 6, 2016	11 t	
				January 26, 2017	11 t	
				June 30, 2017	10 t	
				January 30, 2019	4 t	
				July 17, 2019	4 t	
				June 26, 2024	3.4 t	
				August 25, 2025	7.7 t	
		October 30, 2015	January 25, 2019	March 30, 2020	5 t	
				October 22, 2021	10.5 t	
				July 11, 2022	8.4 y	
	Prototype ATR Fugen (Metal: the value included in about 1,100 t)	February 13, 2015	August 31, 2018	November 12, 2019	49 t	**Approx. 722 t** (Approx. 20 tons were provided for recycling)
				September 23, 2020	126 t	
				May 25, 2021	132 t	
				May 12, 2022	108 t	
				May 17, 2023	111 t	
				June 10, 2024	102 t	
				July 23, 2025	95 t	

(the total may not match up due to rounding off figures)

Implementation of the Clearance System for Fugen

Main contents of application for approval
- Metal generated from turbine building: approx. 1,100 t
- Radioactive material to be measured and evaluated: the 10 important nuclides including Co-60 and H-3
- Radioactive concentration of Co-60 is measured by dedicated radiation measuring equipment. Radioactive concentrations of the other 9 nuclides are evaluated based on the results of sample analysis.

Generation of dismantling waste — Controlled Area

↓

Cutting into smaller pieces and decontamination (if needed)

↓

Temporary storage (waiting for measurement)

↓

Application for measurement and evaluation methods to the government and obtaining approval

↓

Evaluation and measurement of all targets

↓

Temporary storage (waiting for verification) — Non-controlled Area

↓

Verification by the government

↓

Temporary storage (waiting for shipment) — Non-controlled Area

↓

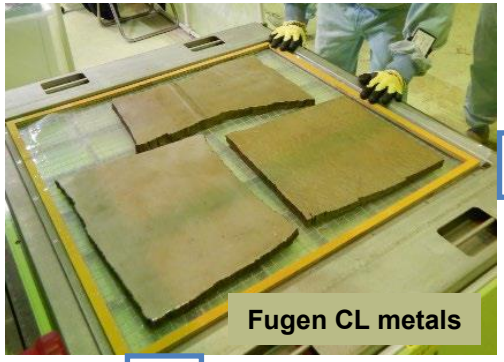
Transport

Status of clearance measurement

Dec.10, 2018: Start of clearance measurement
Nov. 12, 2019: 1st certification received (approx. 49 t)
Sep. 23, 2020: 2nd certification received (approx. 126 t)
May 25, 2021: 3rd certification received (approx. 132 t)
May 12, 2022: 4th certification received (approx. 108 t)
May 17, 2023: 5th certification received (approx. 111 t)
June 10, 2024: 6th certification received (approx. 102 t)
July 23, 2025: 7th certification received (approx. 95 t)

Uses of Cleared Metals from Fugen

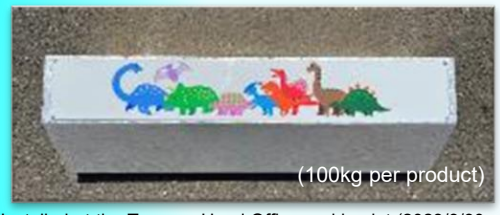
➢ To enhance public understanding of the reuse of cleared (CL) metals, CL metals from Fugen have been processed into products and installed and exhibited at multiple locations across the prefecture.



Processing

Processing

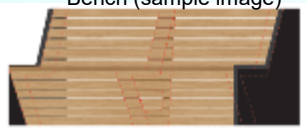
Car stoppers: 3 pairs (6 units)
Cleared metals from Fugen were made into car stoppers in accordance with the FY2022 Reinan E-Coast Plan of Fukui Prefecture.



・Installed at the Tsuruga Head Office parking lot (2023/3/30 (introduced to the press))
・Exhibited at the KEPCO PR Center (2023/3/31)

Benches: 4 units
Produced in FY2024
(to be installed in FY2025)

Bench (sample image)



Bicycle stands: 3 units
Produced in FY2023 and installed in Tsuruga city (*1) and Awara city (*2) in FY2024
・(*1) In front of Chobei inn on Wakasa Bay cycling route (2025/2/27)
・(*2) At Yunomachi square, Awara hot springs (2024/8/5)
Kanaz Forest of Creation museum (2025/2/27)

Bicycle stands, as installed
(Yunomachi square, Awara hot springs)

Manufacturing lightings, bicycle stands, and other products
・Under an FY2021 national project, approx. 4.6 tons of CL metals were melted and processed into ingots at a company in Fukui.
・Under a FY2022 - 2023 national project, the ingots were reprocessed and made into light fixtures and bicycle stands at high schools and companies in the prefecture.

・3 light fixtures (boat-shaped) were installed at Tsuruga Technical High School (on Feb. 24, 2023).
・5 light fixtures (flower-shaped) were installed at Fukuiminami High School (on Mar. 9, 2023).
・Bicycle stands were installed at 10 places along the Wakasa Bay cycling route (through Mar. 16, 2023).
・2 bicycle stands were installed in Sabae and Echizen cities (on Mar. 15, 2024).
・2 stand tables were installed at Fukui Prefectural Office and Tsuruga City Office (on Mar. 14, 2024 (Tsuruga City Office) and March 25 (Fukui Prefectural Office)).

Light fixtures, as installed
(above: Tsuruga Technical HS,
below: Fukuiminami HS)

CL reuse product information plate

Bicycle stands, as installed
(Fukui Prefectural Varve Museum)

Stand table, as installed
(Fukui Prefectural Office)

1. Status of Decommissioning at JAEA
2. Status of Decommissioning in Tsuruga
   ① Prototype Advanced Thermal Reactor Fugen
   ② Prototype Fast Breeder Reactor Monju
   ③ Efforts related to Clearance
3. JAEA's Contribution to Local Communities
   ① "Sumadeco" (Smart Decommissioning Demonstration Base): Overview and Personnel Development
   ② Information Sessions on Decommissioning to Local Communities
   ③ Joint Research with Local Companies
   ④ Coordination and Cooperation with Local Universities
   ⑤ Contribution to the Clearance Treatment Facility
4. Conclusion and Next Steps

Anchor with the same shape as that of the Arctic research ship Mirai II, produced from Fugen CL objects (Polar Science Museum)

https://www.jaea.go.jp/04/be/anchor_exhibit.pdf

Data for MR obtained by laser scanner (Fugen sodium cleaning system)

Contribution to the Local Communities Related to Decommissioning (Overview)

○JAEA hosts information sessions for local companies and actively provides information necessary for their participation.

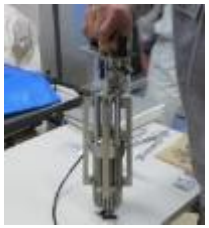
○We support local companies to develop and hire by conducting joint research using the newly established technology demonstration base and developing human resource in collaboration with the Wakasa Wan Energy Research Center and other organizations.

Information sessions on the decommissioning work plan

○ We disseminate information on an ongoing basis to enhance opportunities for local companies to participate.

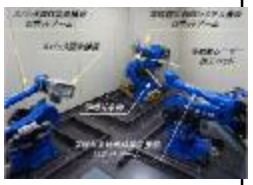
Joint Research with Local Companies

Laser technologies are being developed, and joint studies on on-site issues are conducted in line with the progress of decommissioning. The results are actively utilized at the site.

Improving technical capabilities using “Sumadeco”

At the Fukui Smart Decommissioning Technology Demonstration Base (Sumadeco), R&D on laser application technologies and technical capability building using the MR system and mock-up test facility are being carried out to promote participation in decommissioning.


Human resource development

In collaboration with the Wakasa Wan Energy Research Center, lectures and training on decommissioning activities and required skills are provided to develop human resources.

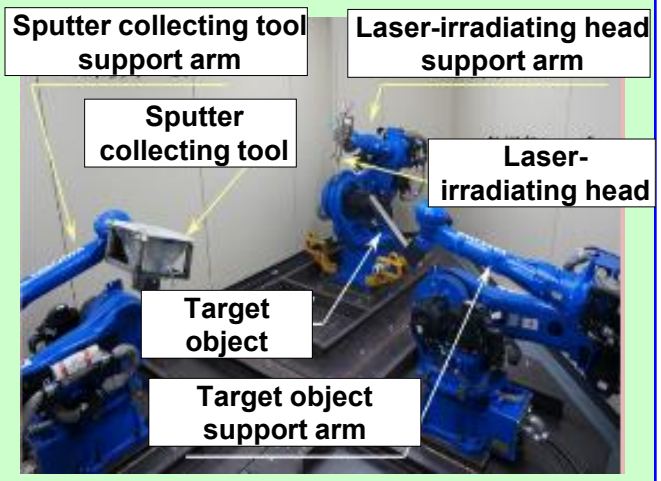

The Fukui Smart Decommissioning Technology Demonstration Base (Sumadeco)

- On June 16, 2018, JAEA established the Fukui Smart Decommissioning Technology Demonstration Base (Sumadeco) as a hub for supporting local companies in strengthening their decommissioning-related capabilities, while fostering collaboration among industry, academia, and government to promote regional economic development and jointly address decommissioning challenges.
- As a center for regional growth, Sumadeco covers the entire range of decommissioning technologies from basic research to demonstration.
- Sumadeco is open for use also by companies and universities outside Fukui prefecture (see link).
- The facility comprises 3 fields:
  1. Decommissioning and dismantling technology verification field
  2. Laser beam machining training field
  3. Decommissioning mock-up test field

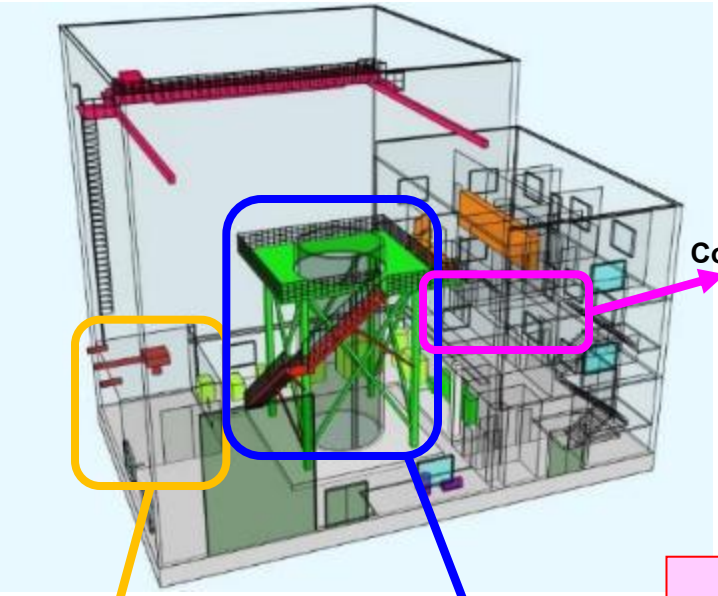
Reference: 2018.03.30 Journal of the RANDEC No.57
Establishment of the Fukui Smart Decommissioning Technology Demonstration Base

https://www.jaea.go.jp/04/tsk/fsd/index.html

Sumadeco Facilities (Three Fields)



Laser beam machining training field



Confirm and consider dismantling procedures

Consider work efficiency

Decommissioning and dismantling technology verification field

【In-air cutting test area】

Demonstration of cut off by thermal cutting

Demonstration of cut off by mechanical cutting

【Underwater cutting test area】

10-meter-deep cylindrical tank and a multi-articulated, remote-controlled underwater robot

Decommissioning mock-up test field

Improving Technical Capabilities Using Sumadeco

- Decommissioning and dismantling technology verification field (MR system)



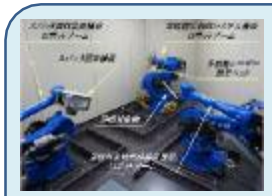
  - Facilitates virtual experience of the dismantling site in full scale and 3D

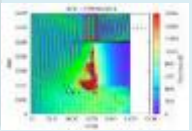
Uses

- Decommissioning training
- MR experience


Specialized lectures on decommissioning (practical training)

- Laser beam machining training field

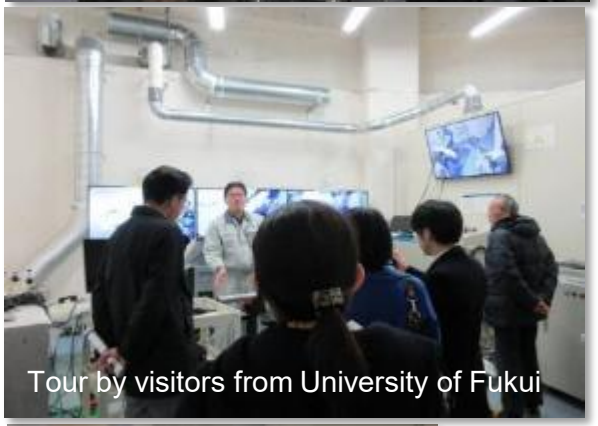




  - Improves, verifies, and provides hands-on experience and learning in laser beam machining

Uses

- Study utilization of laser melting and solidifying calculation code
- Discuss laser beam machining conditions


Tour by visitors from University of Fukui

- Decommissioning mock-up test field





  - Allows users to demonstrate and verify dismantling technologies, gain experience and learn about on-site activities

Uses

- Decommissioning training (special training)
- Laser cutting test


Specialized lectures on decommissioning (practical training)

Human Resource Development Related to Decommissioning

JAEA cooperates in technical training sessions hosted by the Wakasa Wan Energy Research Center and other organizations (training for nuclear-related workers) to enhance the skills of engineers from companies in Fukui Prefecture.

【Decommissioning-related training】

This program provides training tailored to the skill levels of engineers and on-site needs. It includes basic knowledge on decommissioning works, and practical training designed to build skills and knowledge of on-site work, such as decontamination, dismantling, and construction management.

1) Introductory lectures on decommissioning

Overview of systems related to decommissioning, and acquiring general knowledge

2) Specialized lectures on decommissioning (exercises)

Classroom lectures on practical work including decontamination and dismantling, site visits, and practical training

Training at Fugen

Decommissioning training at Sumadeco

Dismantling and Removal Work Plan for Fugen for the Coming 3 Years

Work title	Work summary	FY 2025	FY 2026	FY 2027
Dismantling and removal of key facilities and equipment	1) Dismantling and removal of equipment in the reactor building	Dismantling and removal of large equipment		
	2) Dismantling and removal of equipment in the reactor auxiliary building	Dismantling and removal of equipment from heavy water and helium systems		
Installation of equipment introduced for decommissioning	3) Installation of cement kneading and solidifying equipment	3) Installation of cement kneading / solidifying equipment		
	4) Installation of backup power supply	Installation of backup power supply		
5) Loading out spent fuel	Preparations for loading out spent fuel	Preparations for loading out spent fuel		
	Loading out spent fuel			Loading out spent fuel
6) Maintenance and management of performance maintenance facilities		Periodic inspection by power company	Periodic inspection by power company	
		Maintenance and management of facilities and equipment		
		【Clearance operations】		

* The details, range, and timeline of work are subject to change.

Examples of External Explanations (on Dismantling and Removal Works)

Work type	Description
Preparations for dismantling and removal	○Examination, pre-check, and demarcation of the work area ○Formulation of work procedures (create specific work procedures including safety measures) ○Transport and delivery of materials and equipment (including brought-in materials) to the work site ○Installation of materials and equipment (such as dismantling equipment) in accordance with the work procedures ○Installation of covers and scaffolding (covers are used to prevent the spread of contamination)
Dismantling and removal	○Dismantling and cutting using mechanical and thermal cutting methods in accordance with the work procedures (including safety and status checks by setting hold points) ○Collecting and organizing data from the actual dismantling work (collecting and organizing data on dismantling work as specified in work procedures)
Post-process	○Removal of covers and dismantling of scaffolding ○Cleaning and restoration of work site (including decontamination and grouping waste) ○Removal of materials and equipment (including decontaminating objects and transfer outside the control zone)
Evaluation of actual data (conducted by JAEA)	○Work details such as man-hours, and equipment weight are entered into a database for use in planning future dismantling activities.

Joint Research with Local Companies

Business project for resolving technical issues

This project aims to develop solutions to JAEA's technical issues and decommissioning-related challenges proposed by local companies (company suggestions). The feasibility of practical application is assessed at an early stage, while leveraging and enhancing the technical capabilities of local companies.

Business project overview

Business project timeline

Number of themes for the business project (last 3 years)

FY	2022	2023	2024	Total
Related to the resolution of technical issues and customer proposals	9 themes	8 themes	8 themes	25 themes

Past Joint Study Related to Decommissioning

【Study on ensuring safety in stacking 4 clearance containers and prototype development】 NAKATEC (Sakai city)

Summary:

We studied and discussed how to safely add a fourth mesh box on top of the three-box stack in Fugen's metal waste warehouse, and a prototype tool was developed.

Issue:

As dismantling progresses, the amount of removed material continues to increase, reducing available warehouse space and prompting the need for an urgent solution.
Currently, mesh boxes are stacked in 3 levels and secured with lashing belts. However, when a fourth level is added, this method becomes impractical due to work limitations at elevated heights.

Study result and prototype:

【Study outcomes】

・Increasing the number of stoppers on upper levels to prevent mesh boxes from slipping.
・Enhanced stability by installing a cover equipped with lashing belts.
・Further strengthen stability by connecting upper and lower mesh boxes.

【Prototype】

・A structure to connect the first through fourth mesh boxes was adopted.
・The support tool can be set in place by working from the front, eliminating the need for work at height.
・The tool is made of iron and is relatively inexpensive to produce.
・The tool can be installed on existing mesh boxes.

Tool connecting mesh boxes together

Prototype installation test (four layers)

Collaboration with Universities: Establishing a Wide-Area University Partnership Base

Comprehensive partnership agreement with the University of Fukui

〔Signed〕October 3, 2006

JAEA ⇔ University of Fukui

- Shared use of research facilities
- Expanding joint research
- Exchange of researchers
- Enhancing human resource development
- Expanding joint courses

* Faculty structure when the agreement was signed

(Undergraduate)
School of Engineering
School of Education and Regional Studies
School of Medical Sciences

(Graduate)
Graduate School of Engineering
Graduate School of Education
Graduate School of Medical Sciences

Partnership agreement with Fukui University of Technology

〔Signed〕March 23, 2007

JAEA ⇔ Fukui University of Technology

- Personnel exchange
- Collaborative activities

(Undergraduate)
Department of Engineering
Department of Applied Nuclear Technology

Partnership council meetings

Overseas researchers and trainees

Practical exercises by students

Practical exercise (sodium handling training building)

Practical exercise on valves (maintenance building)

Dispatch of guest professors

Joint research with the University of Fukui

Dispatch of part-time lecturers

Resource development business management committee

(radioactive waste engineering, decommissioning engineering, crisis control studies, emergency support studies, etc.)

Facility tours

Ningyo-toge Environmental Engineering Centre, Fukui Branch of the Nuclear Emergency Assistance and Training Center, etc.)

Cooperation with the Centralized Clearance Treatment Facility

➢ Support for the Centralized Clearance Treatment Facility establishment plan

- Together with other operators, JAEA proposed the need for a centralized treatment facility to efficiently process clearance candidate materials generated during the decommissioning of Fugen and Monju.
- We provide technical assistance on matters related to the NRA.

➢ Providing technical know-how

- We provide technical know-how on measurements and verifications for the clearance process, drawing on experience from Fugen and Tokai facilities.

  Other examples: Provided research results on the uniformity of molten materials and radionuclide migration, developed through our melting treatment technology development project at Tokai (see image on the right).

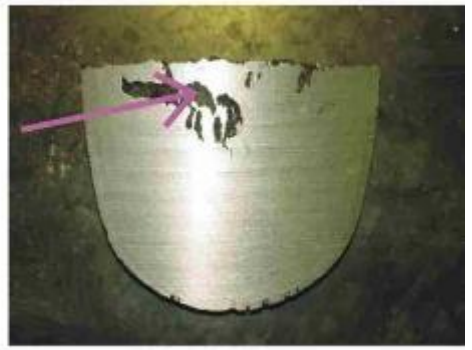
Casting status

➢ Support for the Fukui Nuclear Recycling Business Preparation Company

- We cooperate with the company under a comprehensive partnership agreement and memorandums.
- Dispatch of engineers to the new company
- Plan for future supply of estimated clearance objects
- Technical support for detailed design, geological surveys, and licensing procedures

➢ Building trust with local communities

- Enhancing understanding of clearance and its firm establishment in society by cooperating in information sessions for residents and organizing facility tours.
- For the purpose above, we continue to install objects made from reused clearance metals (described earlier).
- Encouraging participation of local companies, improving technological capabilities, developing human resources.



Cross section of metal phase

Source: JNC TN8400 2003-044

4. Conclusion and Next Steps

- JAEA is currently decommissioning many of its nuclear facilities and has accumulated a stock of know-how and experience in clearance and other areas.
- In the Tsuruga region, full-fledged decommissioning activities, including the dismantling of Fugen, are underway, and clearance verifications are proceeding as scheduled.
- JAEA is contributing to local communities through decommissioning-related R&D, human resource development using the Sumadeco facilities, and joint studies with local companies.
- JAEA is collaborating with the University of Fukui and Fukui University of Technology to train students in decommissioning and other areas, and to conduct joint research with them.

- Hereafter, full-fledged decommissioning of seven NPPs is scheduled to begin across Fukui Prefecture. As a result, the amount of estimated clearance objects from these plants is expected to increase.
- Based on its experience in decommissioning actual plants, JAEA will continue to conduct decommissioning-related R&D and provide technological support to the centralized treatment project, while further promoting regional collaboration and public understanding.

Thank you for your attention.

Fugen on the last day of operation