Japanese Trends and major countries status of Nuclear Backend measures and Fuel cycle policy

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1. What are Backend measures? Include Fuel Cycle Policy

What are Backend measures?

Backend measures are the safe disposal of waste (including unnecessary facilities) generated by the use of nuclear power.

- **Processing and disposal of high-level radioactive waste**
- **Processing and disposal of low-level radioactive waste**
- **Decommissioning of nuclear facilities (including accident reactors)**

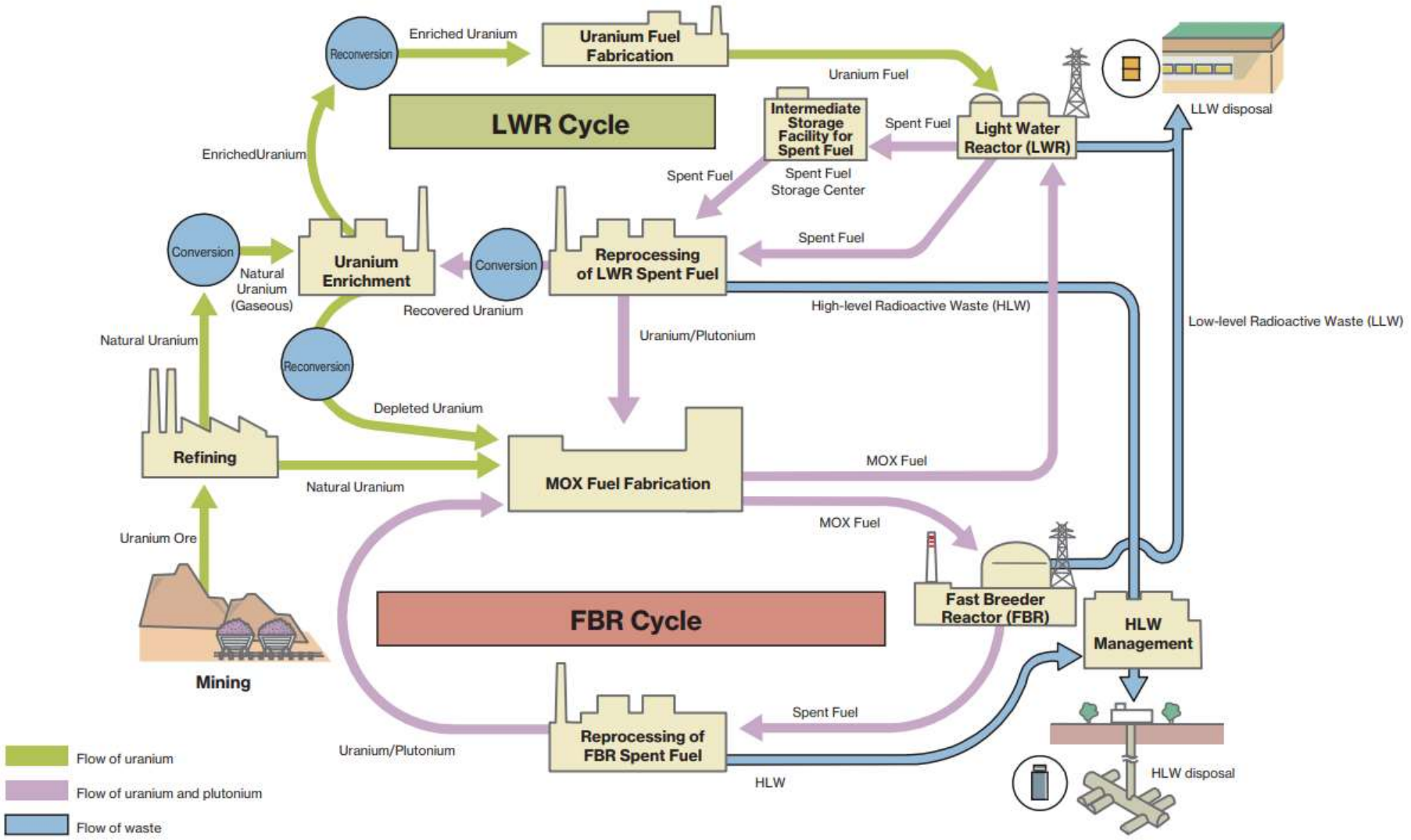
According to the Fuel cycle policy, high-level radioactive waste includes spent fuel or vitrified waste.

Nuclear Power Utilization and Fuel Cycle Policy

In the current use of nuclear energy, nuclear fission energy of U235 and Pu239/241 is used for power generation. The consumption of nuclear fuel material is about 1% even after about one year of operation. Unburned U235, Pu239/241, raw material U238, and fission products remain in the spent fuel.

Reprocessing is the act of processing spent fuel and separating and extracting fuel substances. Considering long-term energy policies and security/nuclear non-proliferation policies, each country selects a comprehensive fuel cycle policy, including environmental impact and economic efficiency.

(Ref)Nuclear Fuel Cycle include Fast Reactor Cycle



Ref: Nuclear power and energy drawing collection

2. History and Current Status of Nuclear Development and Utilization in Japan

Objectives and Scenarios for Introduction of Nuclear Power in Japan

Based on the recognition that ``the war between Japan and the US started with oil and ended with oil'' (from Emperor Hirohito's monologue), nuclear power was used twice as a quasi-domestic energy to solve the permanent resource problem. Introduced under political initiative to prevent wars of aggression. Scenario developed in the following step-by-step flow.

① Reactor introduced overseas
② Domestic power reactor
③ Domestic breeder reactor/nuclear fuel

(From the 1956 Nuclear Energy Development Long-Term Basic Plan for Use)

Tokai NPP at the start of operation
Ref: JAPC

Energy/nuclear policy is an important national policy directly linked to security.

(1) History of Introduction Nuclear Power Generation(1/2)

1956 AEC and JAERI (now JAEA) established

1957 Government investigation team reports
on UK GCR.
Research reactor JRR-1 first criticality
JAPC Established after cabinet approval
The GCR was selected as the first NPP at Tokai

1963 Power test reactor (JPDR) first power generation

1965 U.S. BWR decided as second NPP at Tsuruga
There is a commitment to supply enriched uranium from the US.

First Critical at MCR
on Tokai NPP
Ref: JAPC

1966 KEPCO decided to build a PWR at Mihama and TEPCO decided to build a BWR at Fukushima
Tokai NPP operation started.

1970 Tsuruga 1 operation started, Mihama 1 operation started.

1971 Fukushima Daiichi Unit 1 started

Ref: AEC archive and Atomic energy Year book

(1) History of Introduction Nuclear Power Generation(2/2)

Since then, LWRs have become mainstream, and nuclear power generation has contributed to the mitigation of the oil crisis and rapid economic growth. Introduced to all 9 electric power companies with the start of operation of Shiga-1 in 1993. Before the Great East Japan Earthquake, the domestic production rate was around 90%, and it became the main power source responsible for 25-30% of electric power consumption (① and ② of the introduction scenario were achieved).

2011 Great East Japan Earthquake, Fukushima accident,
all NPPs shut down

2012 Establishment of the Nuclear Regulation Authority

2013 Cabinet Decision on Electricity System Reform

2020 carbon neutral declaration (46% reduction from 2013 in 2030)

2022: Ukraine crisis, first warning of tight power supply
Determined the policy to utilize nuclear at the GX Committee

2023 Enactment of GX-related revision bill. As of summer 2023, 11 commercial reactors have restarted

Ref: AEC archive and Atomic energy Year book

Current Status of NPPs in Japan

As of End of Aug 2023

Status	Number	NPPs
Commercial operation (including periodical inspection)	11	Sendai-1&2, Ikata-3, Takahama-3&4, Ohi-3&4,Genkai-3&4,Mihama-3、Takahama-1
Preparation for restart	6	Takahama-2, Kashiwazaki-6&7,Tokai-2、Onagawa-2,Shimane-2
Under NRA Review (Application for the reactor establishment license amendment was submitted.)	10	Hamaoka-3&4,Shika-2, Ohma, Tsuruga-2, Shimane-3,Tomari-1,2&3, Tohoku Higashidori-1
Under consideration	9	Kashiwazaki-1,2,3,4&5, Onagawa-3, Shika-1,Hamaoka-5,TEPCO Higashidori-1
Under Decommissioning	18+2	Fukushima Daini-1,2,3&4、Ohi-1&2,Tokai、Ikata-1&2,Onagawa-1,Genkai-1&2、Hamaoka-1&2, Mihama-1&2, Shimane-1, Tsuruga-1,Fugen,Monju
Dealing with the accident for Decommissioning	6	Fukushima Daiichi-1,2,3,4,5&6

Above table Includes NPPs under construction, such as Shimane-3, Ohma, TEPCO Higashidori-1 and R&D stage Plants, such as Fugen and Monju.

(2) History of the development and introduction of the reprocessing facilities

1956 Established NFC (now JAEA)
1966 Decision to privatize nuclear fuel materials
1971 Tokai reprocessing construction approval
1977 US announces freeze on reprocessing
1977-80 International NFCE
1980 Established NFS (currently JNFL Ltd.)
1981 Tokai Reprocessing Plant started operation
1985 Aomori Prefecture agreed cycle facilities siting
1992 Rokkasho reprocessing project designation
2005 The Reprocessing Fund Management Law
2014 Tokai reprocessing plant decommissioning decision
2016 Enactment of the Reprocessing Contribution Act, NURO established
2018 AEC decided not to increase the amount of Pu held at present.
2020～ Rokkasho reprocessing plant is preparing for operation

Bird view of Rokkasho Facilities

Ref: JNFL

Ref: AEC archive and Atomic energy Year book

(3) History of High-Level radioactive Waste disposal

1964 AEC announces deep sea or rock layer disposal policy

1972 London Convention (prohibition of ocean dumping) adopted

1976 AEC announced a policy that the government would be responsible for disposal.

1980 Ratified and signed the London Convention

1993 SHP established

1999 Disposition meeting report

1999 Second Report on Geological Disposal

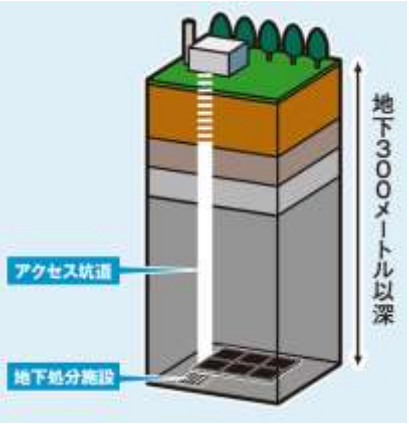
2000 Law for Final Disposal of HLW, NUMO established

2002 NUMO started public offering for literature research

2007 one local expressed its intention to apply, but it was abandoned due to pros and cons. the Nuclear Reactor Regulation Act revised

2015 Cabinet decision revised the basic policy

2020 literature survey is underway at two locations



Concept of HLW disposal

Ref: METI

Ref: AEC archive and Atomic energy Year book

(4) History of Low-Level radioactive Waste disposal

1964 AEC announces policy for ocean dumping

1972 Adoption of the London Convention (international rules)

1976 AEC announced a land disposal/ocean dumping combined policy on the responsibility of the generator.

1980 Ratified and signed the London ConventionIn

1983 completely freeze ocean dumping.

1985 NFI Established (now JNFL), Aomori Prefecture agreed to a request for location cooperation

1990 Rokkasho disposal business license

1992 Rokkasho disposal operation started

1995 JPDR L3 disposal business permit

1996 JPDR L3 underground facility cover completed

2008 AEC law revision(Implementing body of RI disposal)From

2015 Tokai L3 burial project under review

Rokkasho disposal center

Ref: JNFL HP

Ref: AEC archive and Atomic energy Year book

Current status of Low-Level radioactive waste disposal sites

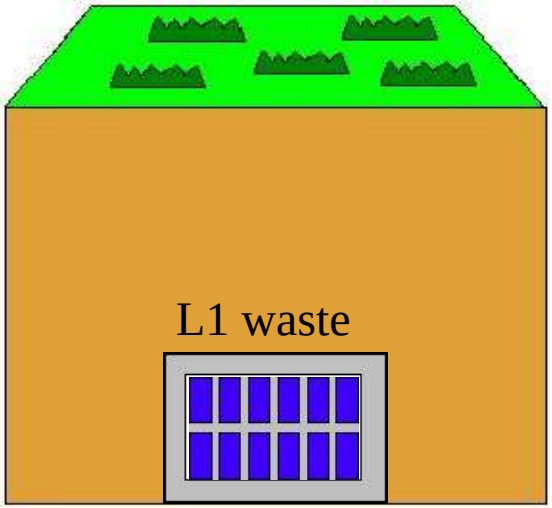
As of August 2023

- Rokkasho disposal center is in operation for L2 waste during commercial reactor operation (Units 1 and 2 are disposed, Unit 3 is under construction)
- JPDR L3 waste disposal facility during the 30-year management period from 1996 (until the mid-2020s)
- Tokai Power Station L3 underground facility under safety review since 2015
- There are no disposal sites for L1 waste, L2 dismantling waste, L3 waste disposal facilities, cycle waste, and RI/laboratory waste.

Low-Level Radioactive Waste Disposal Methodology in Japan

L1: Relatively high radioactive waste

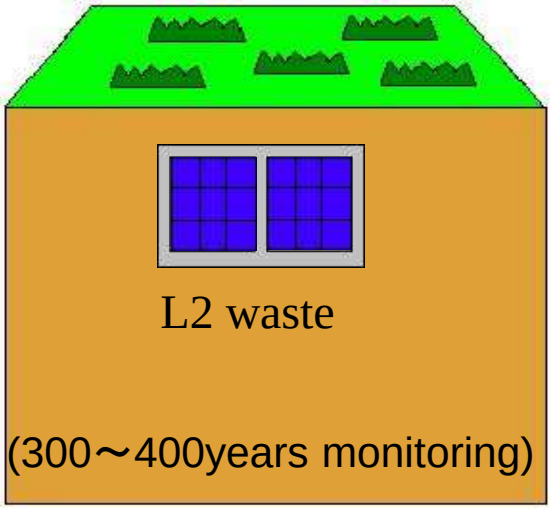
Intermediate depth disposal with artificial structure



Under consideration of Site location

L2: Relatively low radioactive waste

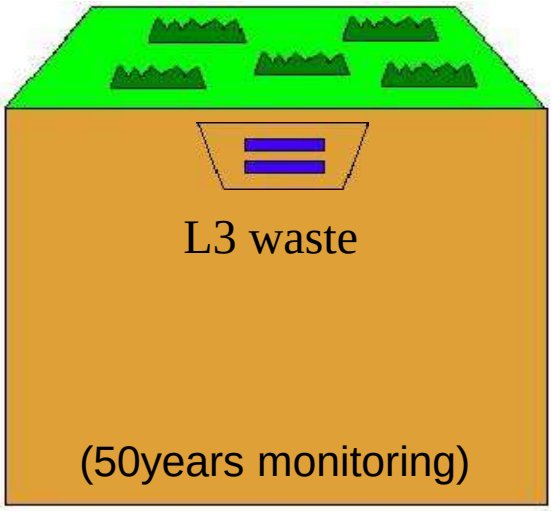
Sub surface disposal with artificial structure



Current JNFL facility is for only operating waste of Commercial NPPs

L3: Very low level waste

near surface trench disposal



JAPC Tokai L3 facility is under licensing review

(5) History of Decommissioning

1990 Started provision for dismantling commercial reactors

1986-96 Dismantling of JPDR

2001 Start of decommissioning of Tokai NPP

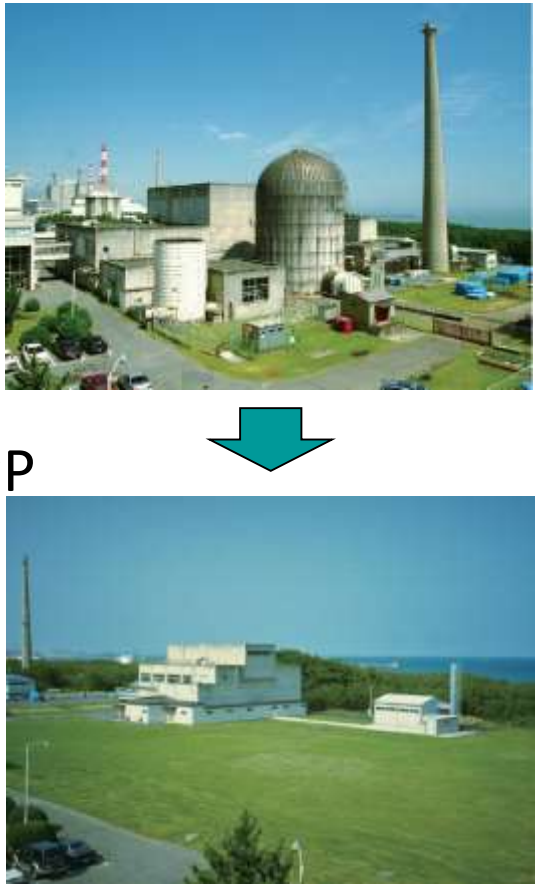
2008 Start of decommissioning of Fugen NPP

2009 Start of decommissioning of Hamaoka-1/2 NPP

2015～ Due to changes in regulatory standards after the earthquake,
15 reactors was shutdown
(30-40 years process for each plant)

2018 Commenced decommissioning of Tokai Reprocessing Plant

2022 Preparing to establish a new decommissioning organization for domestic comprehensive management



Before and After of JPDR dismantling

Ref: JAEA HP

Ref: AEC archive and Atomic energy Year book

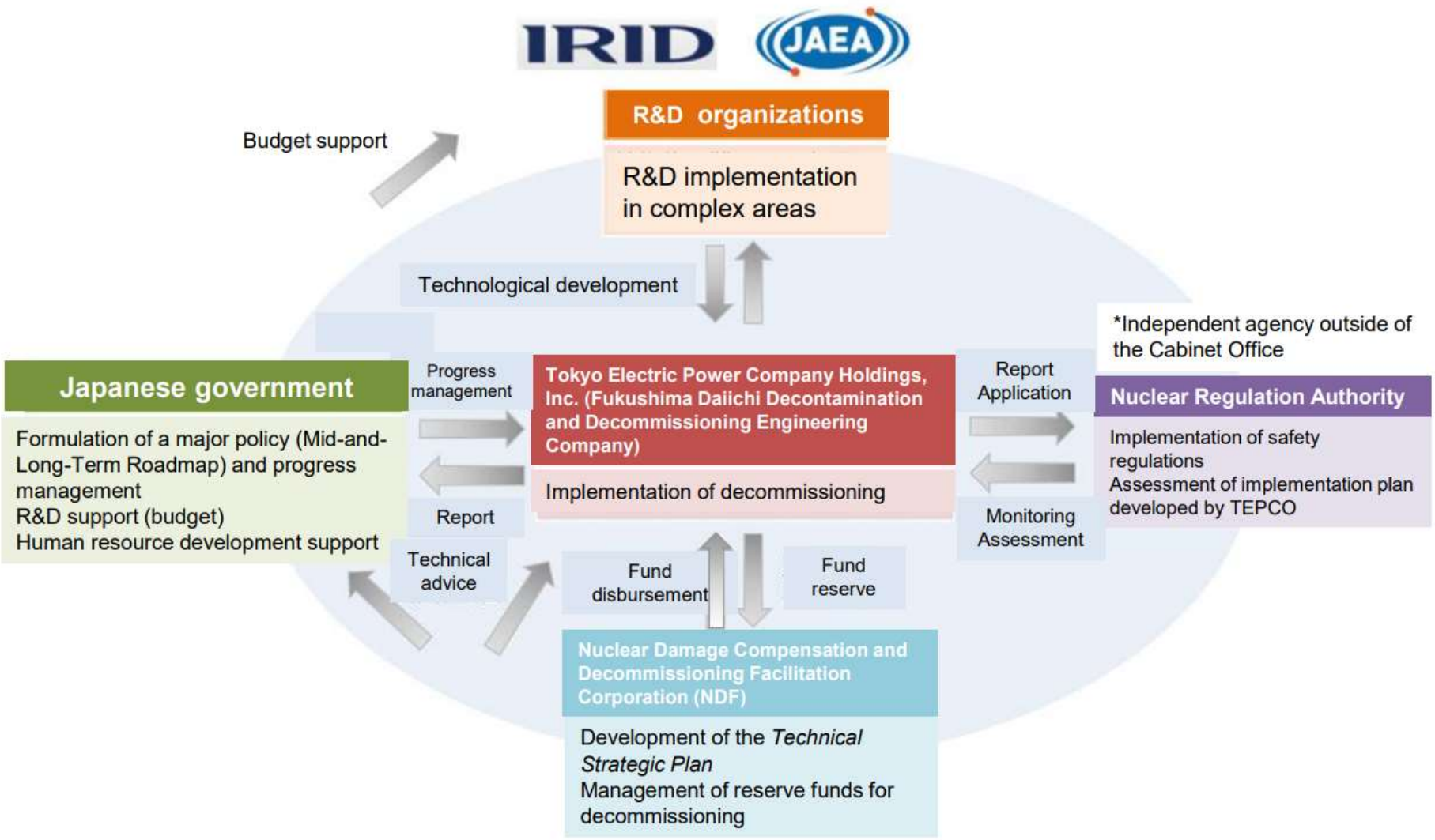
(6) History of Fukushima-Daiichi decommissioning

2011 Great East Japan Earthquake
Fukushima Daiichi accident(1F1-3 core damaged)
Established Nuclear Damage Compensation Organization
2012 Established NRA
2013 Established IRID
Remake from NDC to NDF
2014 Established 1F Decommissioning Company in TEPCO
2017-2022 Investigation in PCV of 1F 1-3
2023 Release start of treated water into the sea
Currently working for decommissioning (Preparation for fuel debris retrieval, etc.)

Just after Hydrogen explosion on 1F1&1F3

Ref: News footage

Roles of Organizations in Decommissioning of Fukushima-Daiichi



Reference: The Agency of Natural Resources Energy, Ministry of Economy, Trade and Industry of Japan website

Reprocessing & backend countermeasures organization and roles (Excluding Fukushima Daiichi)

	Reprocessing	HLW Disposal	LLW Disposal	Decommissioning
Implementation Responsibility	NURO (Can be entrusted)	NUMO	Nuclear/RI licensee	Nuclear/RI licensee
Responsibility on Regulation	Reprocessing licensee (JNFL、JAEA)	Waste disposal licensee I (unapplied)	Waste disposal licensee Ⅱ (JNFL、JAEA)	Nuclear /RI licensee
Cost Payer	Spent Fuel Generator(Utilities, JAEA)	HLW Generator(Utilities、JAEA)	LLW Generator(Nuclear/RI licensee)	Nuclear/RI licensee
Fund Management	NURO	RWMC	Nuclear/RI licensee	Utilities⇒ D&D licensed Corp. Nuclear/RI licensee
Siting Responsibility	-	RWMC	Nuclear licensee、JAEA	-

出典: 関係法律及び各組織HP情報より作成

(Ref) List of Reprocessing/Backend Related Law

Reprocessing and decommissioning

"Law Concerning Implementation of Reprocessing of Spent Fuel and Promotion of Decommissioning"

High-level radioactive waste disposal

"Law Concerning Final Disposal of Specified Radioactive Waste"

Safety Regulations for Nuclear and RI Facilities

"Law Concerning Regulation of Nuclear Source Materials, Nuclear Fuel Materials and Nuclear Reactors"

"Law Concerning Regulation of Radioisotopes, etc."

Support for decommissioning related to the accident reactor

"Nuclear Damage Compensation and Decommissioning Facilitation Corporation Act"

3. Status of Backend measures in major countries

Characteristics of Fuel cycle Policy and Backend measures

- **Fuel Cycle policy is not only a long-term energy strategy, but also an issue related to national security, so a long-term and consistent policy is necessary.**

- **Back-end measures are issues related to public safety (do not leave existing radioactive materials unattended) and debts (ultimately electricity bills or taxes), and are a long-term project that will take more than 100 years. Fundamentally a cost center, unlike the private sector where short-term profits are prioritized, an overall optimal strategy is important.**

(1) Outline of Fuel cycle Policy

- In order to establish a nuclear fuel cycle at the beginning of nuclear power development, each country aims at reprocessing.
  Note) The once-through direct disposal of spent fuel is a concept that emerged after the reprocessing freeze policy of the United States.
- After that, each country will decide its reprocessing policy based on the international situation related to security, such as the nuclear non-proliferation treaty and the possession of nuclear weapons.
- Reprocessing, which is chemical separation, is relatively easy at the laboratory level compared to enrichment, which is isotope separation. However, with large, complex commercial plants with high radiation levels, there are problems with stable operation and economic efficiency such as material corrosion and troubles, so many countries are withdrawing from the plant based on a comprehensive judgment.

Fuel cycle Policy on Major countries

Country	Policy	nuclear	Comments
US	once through	Possession	Since the Carter administration, commercial reprocessing has been frozen due to nuclear non-proliferation policy. However, R&D will continue
Russia	Reprocessing	Possession	The goal is to establish the FBR cycle. An FBR is in operation, but the future is unclear.
China	Reprocessing	Possession	It is now being developed independently. Currently in the pilot plant stage and planning for full scale.
UK	Both	Possession	It was a both policy, but all reprocessing facilities was shutdown. Actually, reprocessing is not possible.
France	Reprocessing	Possession	Accepting from overseas, continuing the reprocessing policy. Aiming for the fast reactor cycle, but stagnating.
Japan	Reprocessing	Non	The only non-nuclear weapon to accept reprocessing under strict inspections.
India	Reprocessing	Possession	Although it has not signed the Nuclear Non-Proliferation Treaty, it is developing cycle.
Germany , Belgium	once through	Non	Reprocessing development (up to small-scale plant) was underway, but development was discontinued
Canada etc	once through	Non	Reprocessing not adopted due to nuclear non-proliferation policy

Ref: Made by AESJ Reprocessing & Recycle Department HP

Reprocessing Facility on Major Countries

Country	Operator	Place	Facility name	Capacity* per year	Operaton period
France	Orano R La hague	La hague	La hague Faciity	1700tHM	1966-
UK	Sellafield Ltd	Cumbria Sellafield	THORP & Magnox reprocessing facility	1000	1964-2022
Russia	PA Mayak	Ozerks	Mayak reprocessing facility RT-1 plant	400tHM	1977-
	Mining & Chemical Complex (MCC)	Zheleznogorks	Pilot Demonstration Center(PDC)	4.4tHM	2016(Part)
				226tHM	Planned2024
			RT-2 plant	800tHM	Planned 2035
Japan	JAEA	Tokai-mura	Tokai Reprocessing Facility	120tHM	1981-2018
	JNFL	Rokkasho-mura	Rokkasho Fuel Cycle Facilities	800	Planned 2024
China	Lanzhou fuel complex facility	Lanzhou city	Lanzhou pilot reprocessing plant	0.1tHM	2006Constraction start
India	BARC	TARAPUR	PREFRE-1&2	100tHM	1977
	IGCAR	KALPKKAM	KAPP	100tHM	1998

*) tU/y by metallic U weight。HM is metallic weight of U & Pu in MOX

Ref: Nuclear power and energy drawing collection

(2) Outline of HLW Disposal

- Depending on the reprocessing policy, disposal targets are spent fuel or vitrified waste.
- Taking into account the half-life of radioactivity that exceeds hundreds of years, each country disposes by geological disposal and generally by public organizations.
- Site location requires not only technical feasibility but also a local consent process (with the exception of some countries). Currently, disposal sites have been tentatively decided in Sweden, Finland, and France.

HLW disposal system and current situation in each country(1/2)

Country	Implementing body	Fund system	Current situation
Finland	Poshiva(Utilities invested)	National Waste Management Fund(VYR)	Site selected in Olkiluoto. Construction Permit 2015. 2021 operating license application.
Sweden	SKB(Utilities invested)	Nuclear Waste Fund (Include D&D and ILW/LLW)	Site selected in Forsmark. 2022 Government license for business, under review for safety.
France	ANDRA (Public Sector)	Provisions (Future Funds)	Unofficially appointed in the Bures area. 2023 Cigeo Facility Permit Application.
Switzerland	NAGRA(Government & Utility invested)	D&D/Waste Management Fund	NAGRA proposed Northern Lageren as a Site candidate.
Germany	BGE(Public Sector)	Waste Management Fund(Government Pay for withdrawal nuclear)	Publish site requirements map and select site
Canada	NWMO(Private sector Invested)	Trust Fund	21 regions participating, in the site selection process.
Spain	ENRESA (Public Sector)	External Fund for ENRESA	Currently in interim storage with plans for geological disposal after 50-100 years

Ref: Made from "Disposal of high-level radioactive waste in foreign countries (2023 edition)" by RWMC

HLW disposal system and current situation in each country(2/2)

Country	Implementing body	Fund system	Current situation
UK	NWS(former RWM) under NDA	NDA Badget、Provisions(Operating Plants)	During the site selection process. Established WG with 3Local Gov. and Decided 4 Research area
US	DOE(Government)	NWF	Yucca Mountain disposal plan on hold
China	CNNN(Public Sector)	Spent Fuel Treatment Fund	Select 6 regions as primary selection. Researching at underground Lab.
South Korea	KORAD(Public Sector)	Radioactive Waste Fund	Publication of basic plan for disposal
Japan	NUMO(Licensed Corp.)	Contribution (To NUMO)	Publish a map of scientific characteristics. Literature survey underway at 2 locations
Russia	NORAO(State-run)	Special Deposit Fund	Underground Lab. under construction

Ref: Made from "Disposal of high-level radioactive waste in foreign countries (2023 edition)" by RWMC

(3) Outline of Low-Intermediate level waste Disposal

Note) Internationally, there are many expressions of low-intermediate level, so it is written as low-intermediate

- Generated from each nuclear facility and RI facility (including hospital)

- Disposal concepts are classified according to the radioactivity level and half-life according to the standards of each country, and disposal is carried out by government sector or private organizations.

- There are differences in the current state of disposal site development depending on conditions such as the national land and political system of each country.

ILW/LLW disposal system in major country

Country	Implementing Body	Siting Body	Disposal Concept	Object
US (Private)	Private Companies (US ecology、ES、WCS)	State Government、DOE(GTCC)	Class A～C、GTCC	Depend on Compact
France	ANDRA(Public Sector)	ANDRA	Long-life ILW, Short-life ILW/LLW,VLLW	No restriction
UK	NWS(Former LLWR & RWM) under NDA	NDA	Intermediate、Low	No restriction
Japan	JNFL(Utilities)、JAEA	Originator	LLW(L1/L2/L3)	Each facility
Germany	BGE(Public Sector)	BGE	Non-heated	No restriction
Spain	ENRESA(Public Sector)	ENRESA	ILW,LLW,VLLW	No restriction
Canada	Utility(OPG)、AECL	Same as left	ILW(Long-life,Short-life)、LLW(V Short-life,VLLW)	Not decided
Finland	Utilites	Utilities	ILW,LLW,VLLW	Each NPP
Sweden	SKB(Utilities invested)	SKB、Utilities	Short-life ILW、Short-life LLW、Short-life VLLW	Each NPP
Swizerland	NAGRA((Gov.&Utility invested)	NAGRA	α、ILW	Not decided
South Korea	KORAD(Public Sector)	KORAD	Low/Intermediate level	
China	Subsidiary (GNPE、PEEEC)	CNNN	ILW、LLW、VLLW、Short-life	Each region

Ref: Made from "Facilities and Sites Related to Radioactive Waste in Other Countries (2023 edition)" by RWMC

ILW/LLW disposal Facilities in major country

Country	Facility	Operator	Object	Capacity(m3)	No of NPPs
US	Richland	US ecology	Class A～C	1,700,000	135
	Barnwell	ES	Class A～C	880,000	
	Clive	ES	Class A	8,820,000	
	WCS	WCS	Class A～C	4,350,000	
France	La Manche	ANDRA	Short-life ILW	527,000	70
	Aube	ANDRA	Short-life ILW	1,000,000	
	CIRES	ANDRA	VLLW	650,000	
UK	Drigg	LLWR	LLW	2,100,000	45
	Dounreay	DSRL	LLW	175,000	
Germany	Morsleben	BGE	Non-Heated	37,000	37
	Konrad(Planned)	BGE	Non-Heated	303,000	
Japan	Rokkasyo	JNFL	LLW(L2)	122,000	60
	Tokai(JAPC Planned)	JAPC, JAEA	VLLW(L3)	28,000	
Spain	El Cabril	ENRESA	ILW	100,000	10
	El Cabril	ENRESA	VLLW	120,000	
Finland	Olkiluoto	TVO(Utility)	ILW	8,400	5
	Lovisa	FPH(Utility)	ILW	5,400	
Sweden	SFR	SKB	ILW	63,000	9
	Forsmark	FKA(Utility)	VLLW	17,000	
Switzerland	Northern Lageren(Proposed)	NAGRA	ILW (& HLW)	72,000	5
South Korea	Wolseong	KORAD	ILW	20,000	24
China	Veyron	GNPEP	ILW	240,000	51
	Seapay	EEEC	ILW	200,000	
	Feifengshan	EEEC	ILW	180,000	

Ref: Made from "Facilities and Sites Related to Radioactive Waste in Other Countries (2023 edition)" by RWMC

(4) Outline of Decommissioning

- Except for special cases, decommissioning will eventually be required for nuclear facilities that have finished their role.
- There are 188 nuclear power plants in the world that have already been decommissioned*, but the US and other have completed decommissioning of less than 20 reactors. There are 431* nuclear power plants in operation in the world, which will be phased out.

  * : World Nuclear Power Development Trends 2023 Edition (JAIF)
- The implementation system of decommissioning differs from country to country, and there are differences in the time and effort required for dismantling and the amount of waste generated depending on the type of reactor (GCR, LWR, FBR, HTTR, etc.).

Decommissioning system on major countries

Country	Implementing body	Method of decommissioning	Fund system
US	D&D company(ES、Northstar、CDI)	Standard is within 60 years, Mainly Immediate dismantling method	External funded trust system
UK	Magnox Ltd under NDA(Public Sector)	GCR is deferred method, but a part of GCR will be preceding	NDA budget(GCR) and External funded trust system(operating plants)
France	DP2D in EDF	immediate dismantling method	Internal reserve system
Japan	Each Utility	immediate dismantling method	Internal allowance ⇒ to change to a contribution system
Germany	Each Utility (only dismantling)	immediate dismantling method	Internal allowance
Spain	ENRESA(Public Sector)	immediate dismantling method	External reserve from electric charge for ENRESA
Sweden & Finland	Each Utilities	immediate dismantling method	Fund system

Ref: AESJ Vol.61, 2019 "Decommissioning System in major Countries and Japan"

Summary about backend organization on each countries

country	Summary
UK	Concentrated backend work on NDA. Since the land is small and it is difficult to locate many disposal site, they are working on 3R* for waste in cooperation with regulations and local communities. The large and complex GCR is scheduled for delayed dismantling.
France	It looks like a disjointed system, but France is a centralized state, and under government policy, related organizations are working together to work on the backend. Each organization separates backend departments within the organization.
US	SF is managed at the responsibility of Federal Government. Decommissioning companies and LLW disposal sites have been successful as private businesses and are proceeding most rationally.
Germany	Roles were divided between the government and the utilities in terms of withdrawal from nuclear power. The dismantling of the facilities is progressing, but it is unclear whether the waste disposal will go well.
Spain	Spain stablished ENRESA as a backend player for the withdrawal from nuclear. We are making good progress by dismantling each nuclear facility one by one and optimizing domestic LLW disposal.

*: 3R of waste refers to the principle of Reuse, Reduce and Recycle.

Ref) Status of decommissioning of the accident reactor

US TMI-2

- The core was partially damaged due to insufficient cooling, but the fuel debris remained in the reactor vessel.
- Cleanup activities by DOE, NRC, GPU (power), and EPRI have removed almost all fuel debris and stored it at the Idaho Lab.
- After the shutdown of TMI-1, it was sold to EnergySolutions and is expected to be dismantled in the future.

Ukraine (Former Soviet Union) Chernobyl

- A nuclear runaway and a steam explosion caused a massive explosion of the facility, releasing a large amount of radioactive material.
- Restrictions on habitation within 30km surroundings due to global scale pollution.
- It cannot be dismantled. And is disposed of in situ in a sarcophagus. Then a shelter was built
- There are concerns about the occupation by the Russian military and the long-term deterioration of the sarcophagus.

Organizational Structure for Backend on UK

(Brown is Public Organization)

Nuclear Decommissioning Authority

- Nuclear Backend Overall strategy
- Affiliated organization management
- Budget management
- Stakeholder Management(Local People, Regulator)

Sellafield Ltd

- Reprocessing
- D&D for Reprocessing facility and research reactor

Magnox Ltd

- D&D for GCR
- D&D for AGR (in future)
- D&D for research facilities include FBR

Magnox and DSRL have been integrated

Nuclear Waste Services

- LLW/HLW disposal

RWM and LLWR have been integrated

Springfields Fuels & UNS

- D&D for Legacy factory

The site owner is an NDA, but fuel processing, etc. is carried out under a lease agreement with private company.

Nuclear Transport Solutions

- Nuclear Transport

INS and DRS have been integrated

Note) D&D means from dismantling of facilities to transportation of waste.

Organizational Structure for Backend on France

<Public Sector>

Nuclear/Alternative Energy Agency (Nuclear application development organization including munitions)

CEA

- D&D for research faciity

Radioactive Waste Management Institution

ANDRA

- HLW disposal
- LLW disposal

<Private Sector>

Electric Power Company (Private company with over 80% government shareholder)

EDF(DP2D)

Cyclife

- D&D for GCR,LWR,FBR
- Waste Interim Storage (ICEDA)
- LLW Treatment(by Subsidary Company Cyclife)

Fuel Cycle Company (Private company with over 90% government shareholder)

Orano

- Reprocessing
- D&D for Reprocessing facility
- Waste Treatment & Technical Service

Organizational Structure for Backend on US

There are no private reprocessing facility

<Government>

Administration for Energy

(Munitions, R&D, Waste disposal etc)

Department of Energy
(There are many Institutes such as Hanford, SavannaRiver, Sandia, Idaho, OakRidge, LosAramos etc under DOE)

- D&D for munitions & research facility
- HLW disposal include GTCC*
- LLW disposal

*: Exceeding Class C LLW

<Private Sector>

LLW disposal Company

(Local Government is responsible for siting and final management)

- **Energy*Solutions***
- **WCS**
- **US Ecology**

- LLW disposal

Decommissioning Company

(Transfer Ownership or License from Electric Company)

- **EnergySolutions**
- **Northstar**
- **CDI(Holtec)**

- D&D for Commercial reactor
- LLW Treatment
- LLW Transportation

Organizational Structure for Backend on Germany

Nuclear power withdrawal policy, and reprocessing pilot facility is now on decommissioning.

<Public Sector>

Radioactive Waste Management Institute

BGE

- HLW disposal
- LLW disposal
- Waste Storage

R&D Institute

WAK(Karlsruhe)etc

- D&D for research facility

<Private Sector>

Electric Power Company

(Division of roles with the government in withdrawal from nuclear power)

Each Utilities (RWE,E.ON,EnBW ,Vattenfall)

- Until dismantling facility and transportation of waste to interim storage

Organizational Structure for Backend on Spain

Nuclear power withdrawal policy, and
No reprocessing facility

<Public Sector>

Implement total backend work through transporting Nuclear Facility from Utilities and research institute, etc.

ENRESA

- Overall Strategy
- Fund management(collect from electricity bills)
- HLW disposal
- LLW disposal
- D&D from NPPs and research facility
- SF/Radioactive Waste Storage

4. Issues such as backend measures in Japan

Organizational Structure for Backend on Japan

Reprocessing

NURO

- Obligation to reprocess & Fund Management

JNFL

- Reprocessing
- D&D of Reprocessing (Future)

HLW disposal

NUMO

- HLW disposal

RWMC

- HLW Fund Management

LLW disposal

JAEA

- RI/Research waste disposal

JNFL

- L2 waste disposal from Utilities

Each Owner

- Discharger liability

D&D

New Licensed Corporation (Append to NURO)

- Overall Management & Fund Management

Utilities

- D&D work (By owner)

JAEA

1F D&D

NDF

- Support 1F D&D and Fund Management

TEPCO (Decom-C)

- 1F D&D work

Spent Fuel storage & Pu use

Each Utility

Issues on Japanese Backend

- **Because the organizational structure is subdivided by field and by each operator, issues such as disposal site location, spent fuel storage, Pu utilization, etc. are handled only by individual companies or industry groups. Overall optimization is required, including nuclear material/waste related facilities and transportation infrastructure.**

- **Electricity liberalization (abolition of comprehensive cost, introduction of competitive market) was implemented without sufficient consideration of back-end support.**

New Challenge
Abstract of New D&D Licensed Corporation

Partially excerpted and modified from "The outline of the interim report (draft) ", on 3rd Meeting of Working Group on Facilitation of Decommissioning, (Oct.5 2022)

National Government

Appropriate Involvement, Oversight

(Approval of establishment, restrictions on dissolution, supervision orders, etc.)

Licensed corporation

*Excluding accident reactor

(1) Comprehensive management of decommissioning in Japan

(2) Responding to common issues to operators (R&D, procurement of equipment, promotion of understanding of the region, etc.)

(3) Securement, management and payment of funds

Payment of contributions

¥ ¥ ¥

Nuclear Power Operator

Nuclear Power Operator

Nuclear Power Operator

- After taking into consideration the costs required for the entire operations of (1) to (3), the licensed corporation decides and notifies the amount of contribution for each nuclear operator every fiscal year.
- Contributions are set at a level that takes into account the uncertainty of the future, and also in consideration of the business situation of each nuclear power operator.

- Based on the Nuclear Reactor Regulation Law, the basic principle is that the nuclear power operator is responsible for decommissioning individual reactors.
- The nuclear power operator is responsible for paying the annual amount notified by the licensed corporation as a contribution.

Alignment

JAEA

Local Gov. etc.

Source : ANRE in METI

Summary

- **Energy prices (economic efficiency) change with the times and the environment, but technology that has been parted cannot be easily returned. We should formulate and share strategies for resolving back-end issues and how Japan's nuclear power, which lacks energy resources.**

- **Regardless of whether nuclear power will be used in the future, risks and liabilities will not disappear unless all stakeholders, including regulatory bodies and local governments, recognize that back-end measures are a “100-year plan”. In order to maintain human resources and supply chains, it is necessary to make the business attractive to young people.**