



# ***Situation on Sustainable Development & Circular Economy in Decommissioning in Japan***

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- **Sustainability Principles and Circular Economy  
in Nuclear Energy  
in Decommissioning**
  
- **Clearance from Decommissioning**

**One of Final Goals in SDGs in Japan:**

**Establishment of Low-carbon Society**

**Key of Low-carbon Society :**

**Development & Application of Low-carbon energy**

**Nuclear Energy is one of candidate Low-carbon energy**

**Sustainable Energy**

**Energy technology can maintain resource utilization in future generations**

- **Establishment of Nuclear Cycler Technology**  
**Reprocessing of Spent Fuel and Fast-breeder Reactor for MOX fuel**
- **Development of Generation IV reactors**  
**Ex. High Temperature Gas Cooling Reactor**  
**Etc.**

## **Recycle & Reuse of used Fuel and Materials**

### ➤ **Establishing Nuclear Fuel Cycle**

- **Reprocessing Technology of Spent Fuel**

**Spent Fuel Reprocessing Facility has been constructed in Rokkasho-mura and its operation is scheduled in 2021.**

**Pu will be used as MOX fuel in conventional NPP.**

- **Fast-breeder Reactor**

**Monju (FBR) was move to decommissioning phase.**

**FBR research will continue in the future.**

### ➤ **Effective use of renewable resources originating from nuclear facilities**

- **Promotion of Clearance**

## ➤ **Principle for Sustainable Development of JAEA**

**In order to respond flexibly to various future aspects, not only sustainability and diversity but also resilience, JAEA pursues nuclear science & technology as a research institute.**

## ➤ **Activities toward Circular Economy**

- **Nuclear Fuel Cycle Development; Fast Breeder Reactor, Reprocessing,**
- **New Nuclear Reactor Development; High-Temperature Gas-cooled Reactor (HTTR),**
- **Hydrogen gas generation; Mixing of HTTR system with IS process,**  
IS Process: Chemical reactions of iodine (I) and sulfur (S) for water decomposition at high temperature (900 °C),
- **Nuclear Fusion Reactor Development; Promotion of ITER plan and BA approach,**
- **Li Material Circular Economy System; Recovery of Li from sea,**
- **Partitioning and Transmutation of long-lived radionuclides.**

## **Sustainable Approach for Decommissioning: Principles**

- ✓ **Comprehensively promoting decommissioning,**  
Many stakeholders need to be involved in deciding how to use the site after decommissioning (end state),
- ✓ **Decommissioning based on integrated long-term thinking,**  
(ex. for NPP) Impact on electricity, local employment, future use of the site, recycling of scraps from decommissioning, radioactive waste management,
- ✓ **Considering all parts as potential assets,**
- ✓ **Creating an appropriate vision after decommissioning prior to it,**  
Decommissioning is what it takes to achieve the vision in the future,
- ✓ **Inheriting knowledge to the next generation and carrying out human resource development,**
- ✓ **Constructing circular decommissioning.**

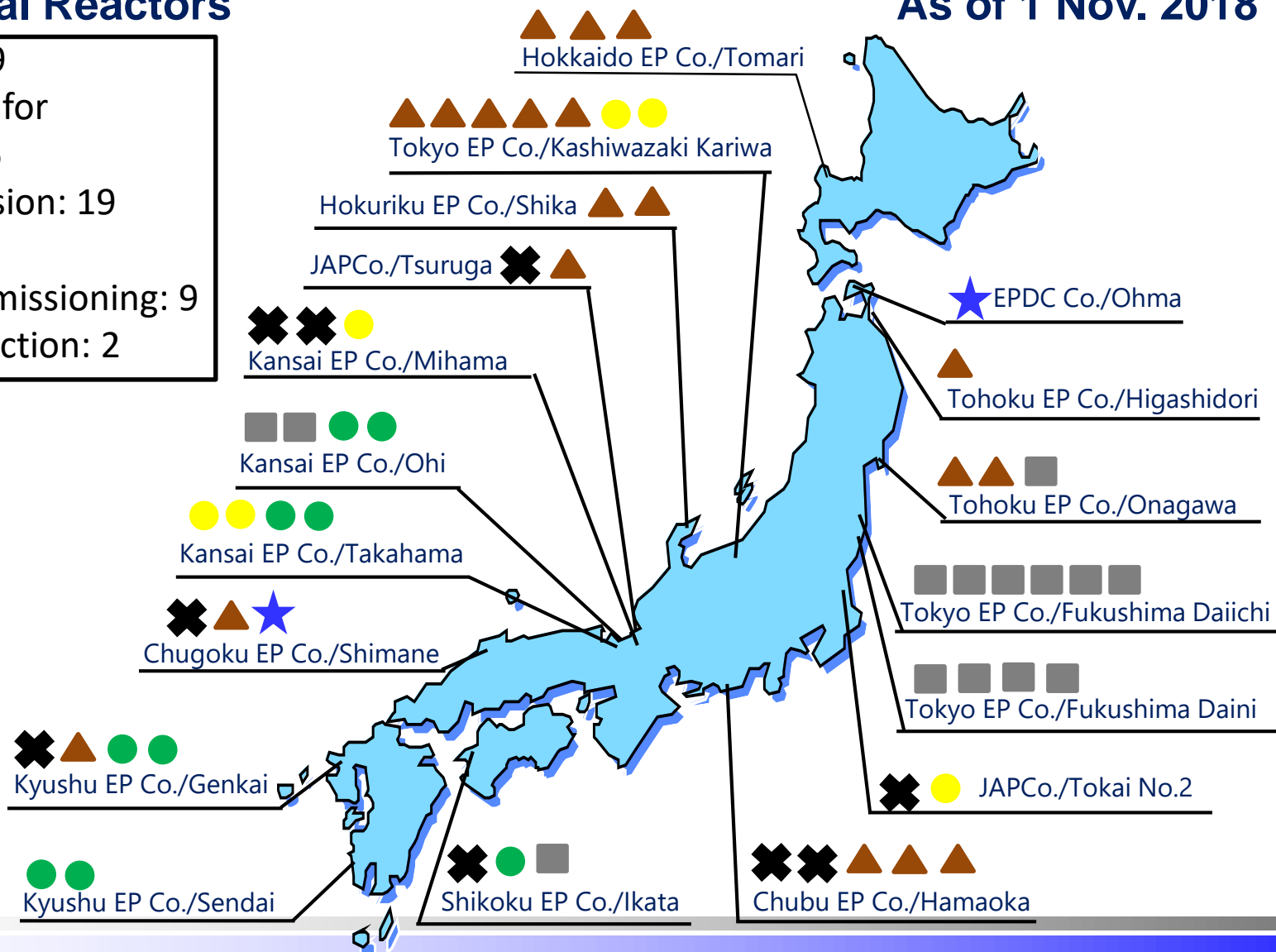
## **Circular Decommissioning:**

- ✓ **Reuse of the site and facility after decommissioning,**
- ✓ **Clearance of materials from decommissioning, and reuse/recycle of them.**

## 59 Commercial Reactors

- In Operation: 9
- In Preparation for Reoperation: 6
- ▲ Under Suspension: 19
- Shutdown: 14
- ✘ Under Decommissioning: 9
- ★ Under Construction: 2

As of 1 Nov. 2018





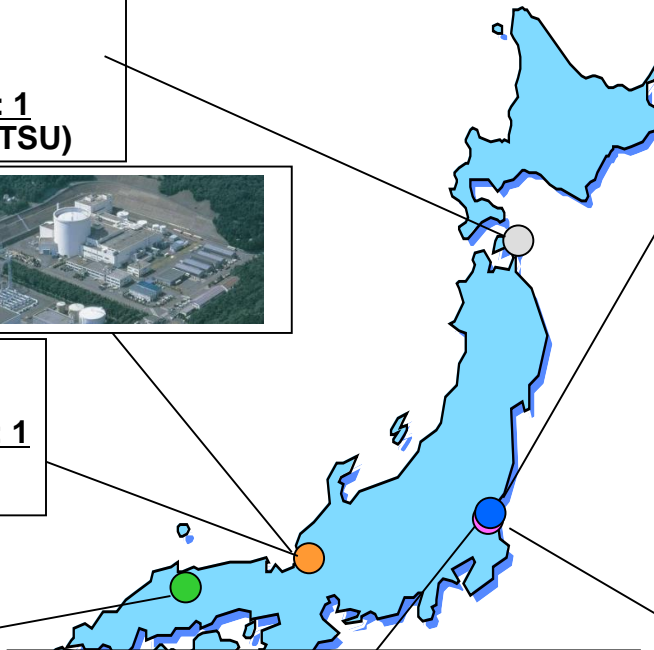
**AOMORI R&D Center**  
**Operating: 1**  
 • Ominato facility  
**Under Decommissioning: 1**  
 • Nuclear Ship No.1 (MUTSU)

**FUGEN Decommissioning Eng. Center**  
**Under Decommissioning: 2**  
 • FUGEN nuclear Power Plant,



**Prototype Fast Breeder Reactor Monju**  
**Under Decommissioning: 1**  
 • Monju

**NINGYO-TOGE Environmental Eng. Center**  
**Operating: 4**  
 • Waste treatment facility, Others  
**Under decommissioning: 3**  
 • Enrichment Engineering Plant  
 • Uranium Enrichment Demonstration Plant  
 • Refining & Conversion Facility



**OARAI R&D Center**  
**Operating: 10**  
 HTTR, Joyo, Others  
**In preparation or transition to D&D: 7**  
 Pu Fuel Research Facility, MMF, Japan Material Test Reactor, Others  
**Under decommissioning: 2**  
 Deuterium Critical Assembly (DCA), Fuel Sodium Interaction Test Facility

**Nuclear Science Research Inst. (NSRI)**  
**Operating: 18**  
 JRR-3, STACY, NSRR, WASTEF, Tandem accelerator, Others  
**In preparation or transition to D&D: 9**  
 Plutonium Research Facility No.1, Tank-type Critical Assembly (TCA), Fast Critical Assembly (FCA), Backend R&D facility, FNS, Others  
**Under decommissioning: 9**  
 JRR-2, JRR-4, JAERI Reprocessing Test Facility, Liquid Waste Treatment Facility, U Enrichment Research Facility, Safe Guards Laboratory (SGL), TRACY, Others

**Nuclear Fuel Cycle Eng. Labs (NCL)**  
**Operating: 11**  
 PFFF No.3, PWTF-2, Others  
**In preparation or transition to D&D: 7**  
 Chemical Processing Facility, Plutonium Waste Storage Facility, Others  
**Under decommissioning: 3**  
 • Plutonium Fuel Fabrication Facility  
 • Building B  
 • Tokai Reprocessing Plant (TRP)

Stats	Operating	In preparation or transition to D&D	Under decommissioning
<b>Facilities</b>	45	23	21



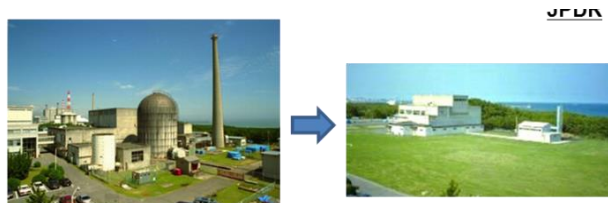
## Facilities that have completed decommissioning: ca. 20 facilities

5 Research reactors: JRR-1, JPDR, Critical assemblies

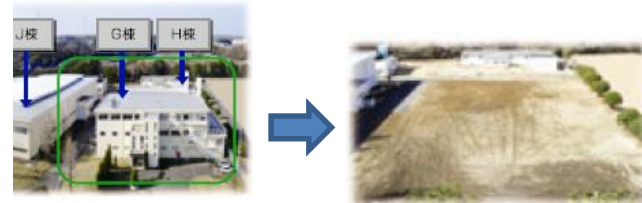
12 Nuclear facilities

3 RI facilities

- Almost all facilities were demolished to Green field, but some are being reused after license returned.



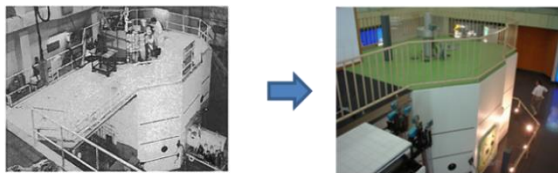
Japan Power Demonstration Reactor (JPDR)



Nuclear Fuel Facility for R&D of U enrichment

## Examples of Reuse

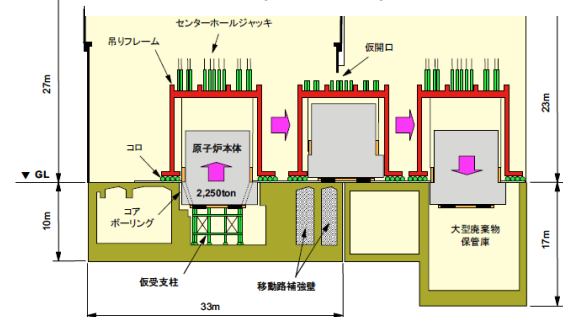
As monument (JRR-1)



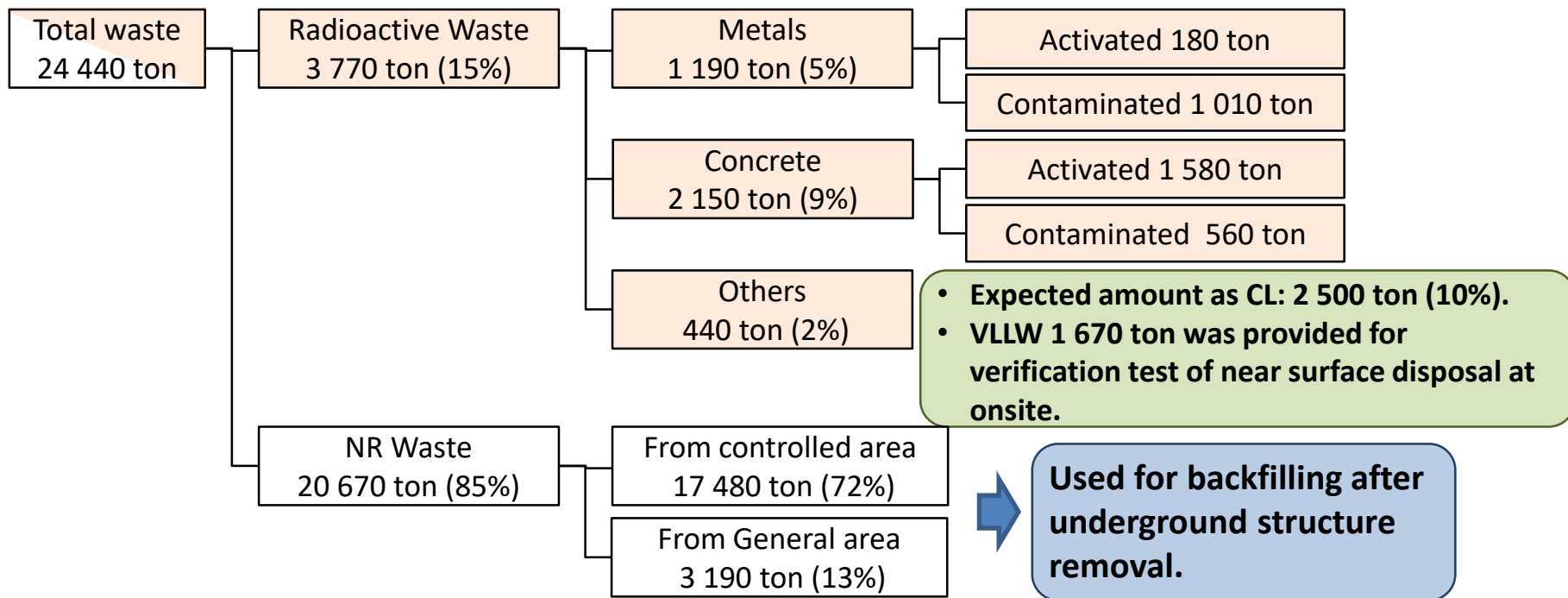
As non radioactive R&D facilities

6 nuclear and RI facilities

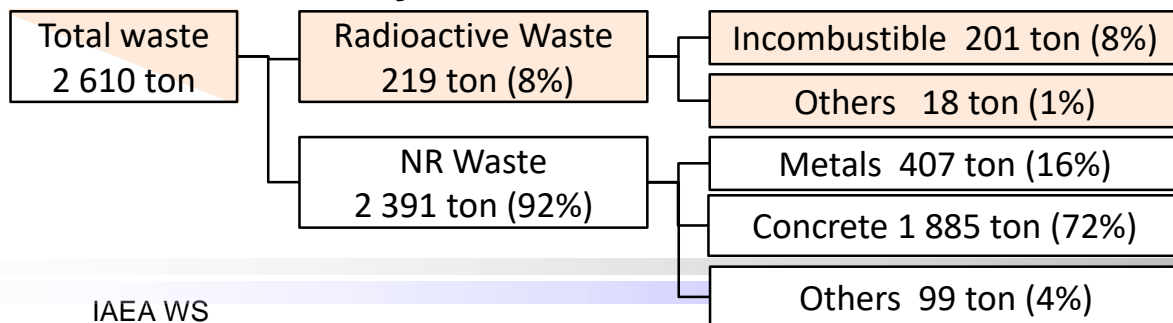
As a building of a new reactor (JRR-3)



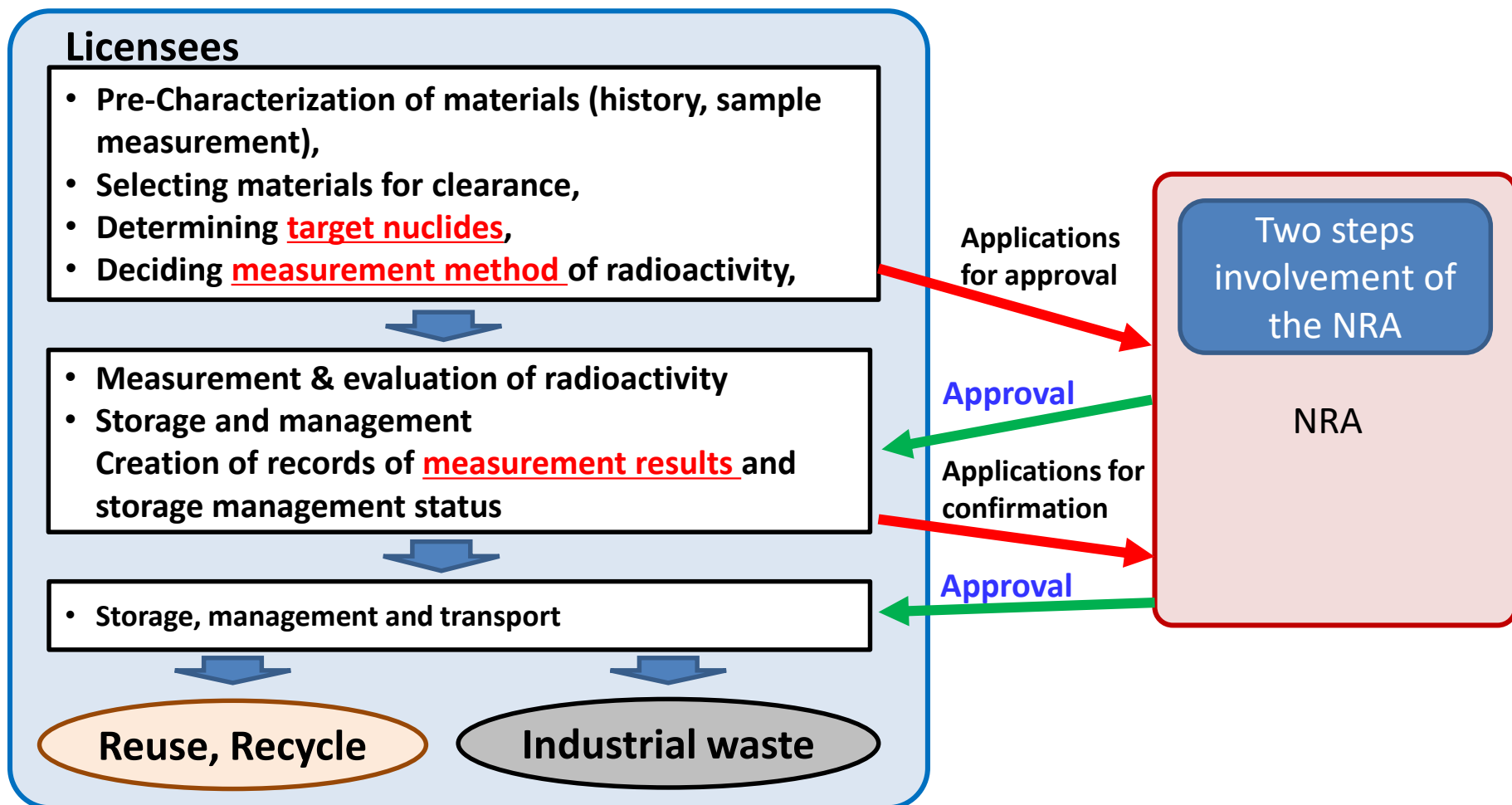
## Japan Power Demonstration Reactor (JPDR): Decommissioning 1986 - 1996



## Nuclear Fuel Facility for R&D of U enrichment: Decommissioning 2008-2014



- ✓ Clearance system was established in 2005.
- ✓ The clearance level adopts the value of the IAEA Safety Guide (RS-G-1.7).



Facility		Materials	Nuclides*
NPP & RR		Metal, Concrete, Glass	33
Fuel Fabrication	U	Metal	5
	MOX	-	
Nuclear Facility	Hotlab	Metal, Concrete, Glass	49
	Others (reprocessing, etc.)	-	
RI Facility	Contaminated	Metal, Concrete, Glass, combustion residue	53
	Activated	Metal, Concrete	37

\* Number of nuclides to be evaluated.

Licensee	Material	Period	Amount
Japan Atomic Power Company (JAPC), Tokai	Metal	2007 - 2008	398 t
Japan Atomic Energy Agency (JAEA), JRR-3	Concrete	2010 - 2015	3 866 t
JAEA, Ningyo	Metal	2014 – 2017*	43 t
Chubu Electric Power Co., Inc., Hamaoka	Metal	2015 – 2017*	524 t

\* be going on.

Material	Licensee	Reprocessing	Where to use*	Product	Number
Metal (Fe)	JAPC	Local metals manufacturers	JAEA: J-PARC	Shield	79
			METI, MEXT, MOV, Cabinet Office JAEA FEPC, JAPC, Hokkaido, Tohoku, TEPCO, CHUBU, Hokuriku, KANSAI, SHIKOKU, CHUGOKU, KYUSHU, JRIA, JAIF, Others	Bench	88
				Table	10
				Interlock block	600
				Vehicle entry prevention block	329
				Mounting bracket for piping support	223
				Weights for crane	89
Metal (Al)	JAEA	JAEA	Flowerbed	10 t	
		Local metals manufacturers	Table, Bench	1 t	
Concrete	JAEA	JAEA	JAEA	Backfill for sagged road & building removal site	2 100 t
				Base course material	1 700 t

METI: Ministry of education, culture, sports, science and technology

MOE: Ministry of the Environment

JRIA: Japan Radioisotope Association

JAIF: Japan Atomic Industrial Forum, Inc.

MEXT: Ministry of economy, trade and industry

FEPC: The Federation of Electric Power Companies of Japan

JAPC: Japan Atomic Power Company

## Recycle of Metal (Fe) (JAPC Tokai)



Bench\*



Table

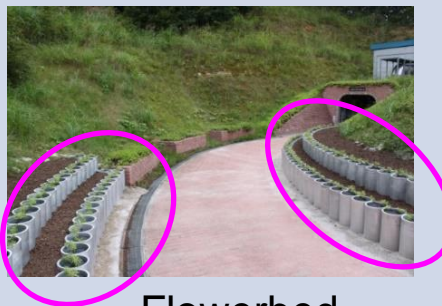


Shield (J-PARC)



Block

## Recycle of Metal (Al) (JAEA Ningyo)



Flowerbed



Table & Bench

## Recycle of Concrete (JAEA Tokai)



(After)

Backfill for  
sagged road

(Source) Japan Atomic Power Company HP, [http://www.japc.co.jp/haishi/clearance\\_results2.html](http://www.japc.co.jp/haishi/clearance_results2.html)

JAEA HP,

<https://www.jaea.go.jp/04/zningyo/profile1059.html>,

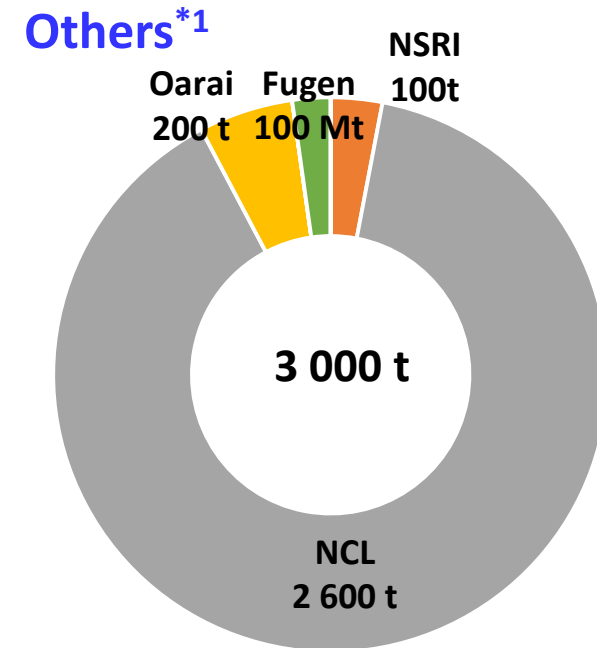
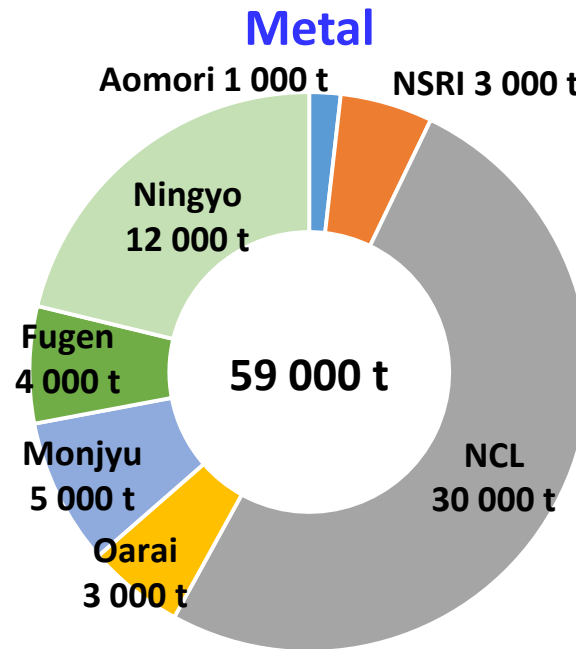
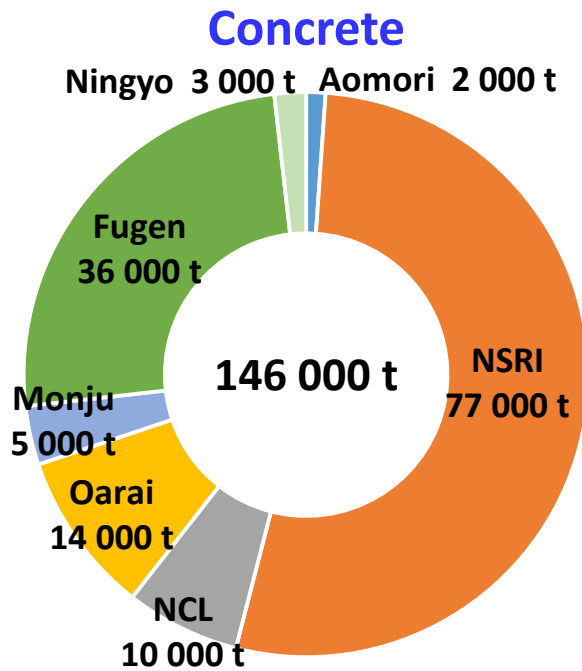
<https://www.jaea.go.jp/04/zningyo/kurians.pdf>,

[https://www.jaea.go.jp/04/ntokai/backend/backend\\_01\\_01\\_03.html](https://www.jaea.go.jp/04/ntokai/backend/backend_01_01_03.html)

- ✓ Reuse and recycle of materials verified for clearance are limited into the facilities of nuclear licensees. One cannot release the clearance materials freely.
- ✓ The establishment of the rules for the clearance system has not been complete. Several types of material and materials from several types of facilities cannot be apply for clearance permission.
- ✓ It takes a lot of time to apply for approval of the radioactive concentration evaluation method and to verify materials after determining the radioactive concentration to the NRA.



# Expected Amount for Clearance from JAEA in Future



\*1: Glass, Plastic, Rubber, etc.

From Back-end Roadmap of JAEA (established in Dec. 2018)  
<https://www.jaea.go.jp/english/about/>

## ***Sustainability Principles in Decommissioning***

- ✓ Development of a total management system for decommissioning considering with worker safety, public safety, decommissioning duration, and total cost of decommissioning is imperative for the decommissioning project involving many facilities and installations.
- ✓ It is also necessary to build a good relationships of trust with the regulators and stakeholders.
- ✓ Development of this complicated management system is imperative, and this should be tested in the actual decommissioning projects and improved.

## ***Circular Economy in Decommissioning***

- ✓ Reuse of facilities & sites after returning their license.
- ✓ Reuse and Recycle of materials from decommissioning.

*Grazie per l'attenzione*

*Thank you for your attention*