The Current Status and the Future of the Nuclear Fuel Cycle Business in JNFL

～Efforts for Safe and Stable Operation～

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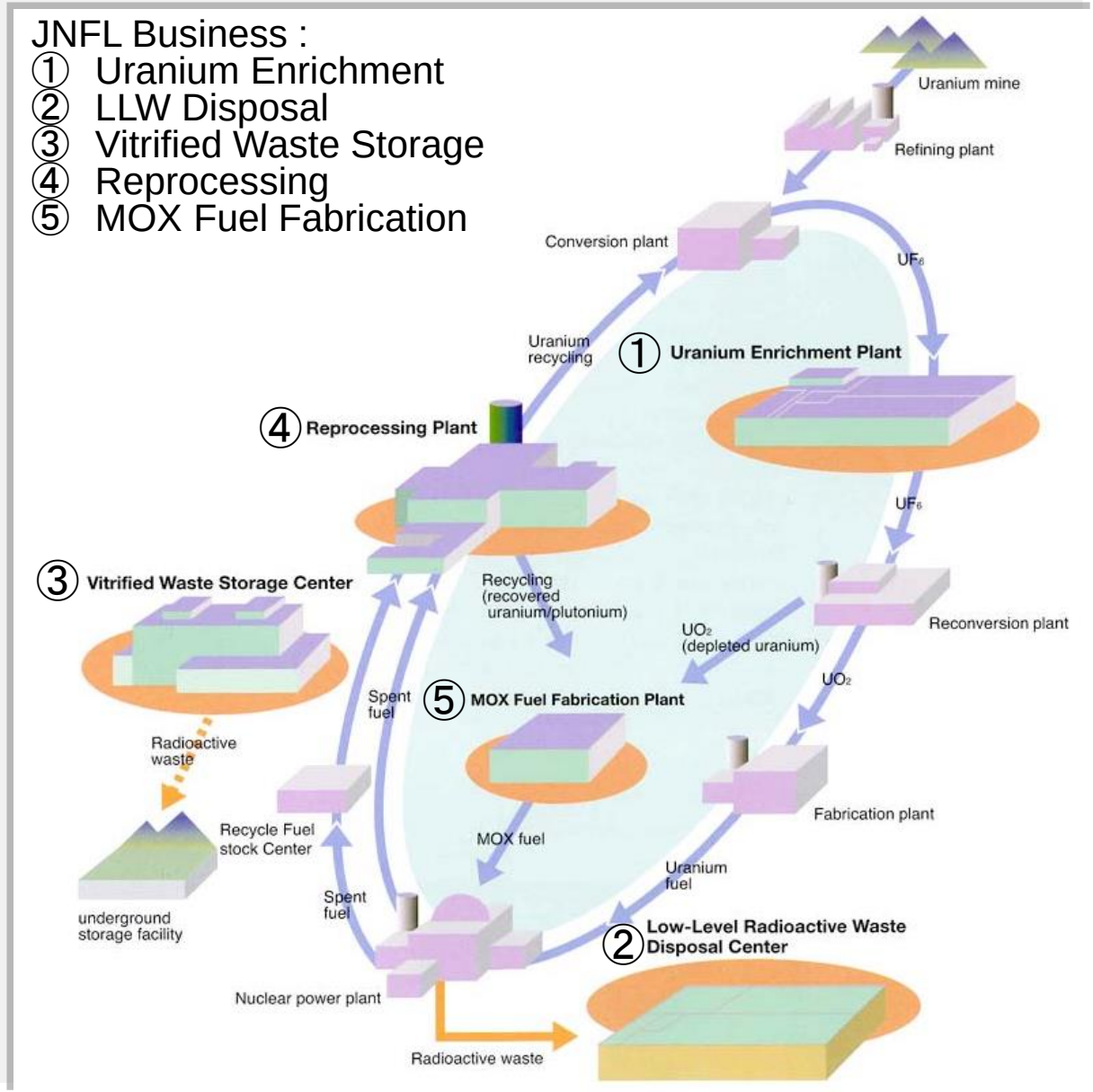
Nuclear Fuel Cycle and JNFL Business

Nuclear Fuel Cycle Conceptual Diagram

JNFL Business :
① Uranium Enrichment
② LLW Disposal
③ Vitrified Waste Storage
④ Reprocessing
⑤ MOX Fuel Fabrication



Business Line

JNFL is responsible for the vital stages of the nuclear fuel cycle.

JNFL' Role and the Significance of Nuclear Fuel Cycle

JNFL' Role	Significance of Nuclear Fuel Cycle
Reprocessing and MOX Fuel Fabrication	Contributes to Japan's energy self-sufficiency rate
・Makes effective use of spent fuel via reprocessing/MOX ・Reduces the volume of high-level radioactive waste ・Makes decay period of HLW shorter	Establishes a good precedent for the peaceful use of reprocessing technology
Storage of high-level radioactive waste	Provides comprehensive support for nuclear power generation
Uranium enrichment	
Disposal of low-level radioactive waste	Regional development

Low-Level Radioactive Waste Disposal Center

- Approx. 296,000 drums of LLW arising from Japanese nuclear power plants are disposed
- Site expansion to be planned

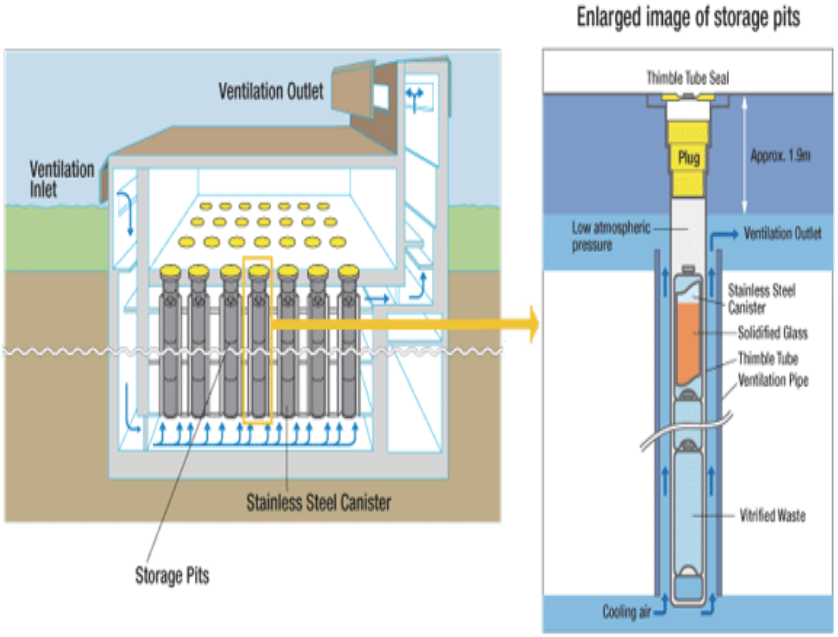

LLW Disposal Center

- Start of operation : December, 1992
- Ultimate capacity : 600,000 m^3
  (Equivalent to 3 million 200 liter drums)
- Current status :
  - Number of drums stored
    No.1 (Solidified liquid waste) approx. 149,000
    No.2 (Solidified miscellaneous waste) approx. 147,000
    (as of December 31, 2016)


State of fixture

Vitrified Waste Storage Center (Interim Storage)


Vitrified Waste Storage Center



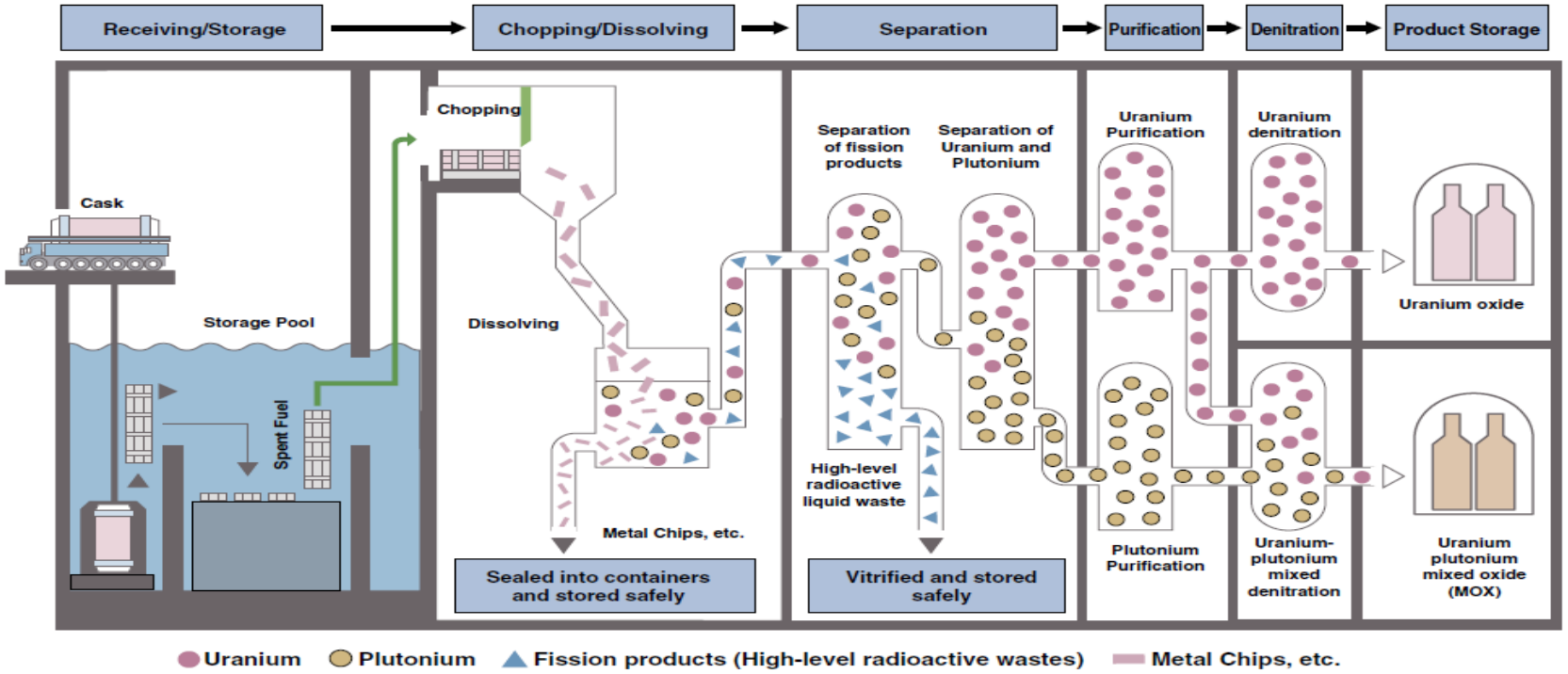
- Start of operation : April 1995
- Storage capacity : 2,880 canisters
- Storage period : 30 - 50 years

Vitrified Waste Storage Center (Interim Storage)

- Current storage status (as of December 31, 2016):
  - 1,310 canisters from France (Completed on March 31, 2007)
    520 canisters from UK as of September 30, 2015.
  - Approx. 2,200 canisters are expected to be returned in total.
  - Storing returned low-level radioactive vitrified waste canisters is also planned.

- 346 canisters were produced at Rokkasho Reprocessing Plant in Active Test.

Reprocessing (Main Process)



- Capacity : Max. 800 tU/y
- Reprocessing technology : PUREX method
- Nuclear security measures : U-Pu Co-denitration
- Safeguards : Under continuous inspection by IAEA and Japan Safeguards Office

Reprocessing (Main Process)

1968 US-Japan Nuclear Cooperation Agreement

1988 US-Japan Nuclear Cooperation Agreement (Present)

1989 Licensing application

1992 Licensing approval

1993 Commencement of construction

2001 Commencement of Water Test

2002 Commencement of Chemical Test

2004 Commencement of Uranium Test

2006 Commencement of Active Test

Tests almost completed at the main process by 2008

Reprocessed SF in Active Test : 425 tU

Recovered MOX product in Active Test : 6.7 tHM

2011 Great East Japan Earthquake happened

2013 Completion of vitrification tests

Construction Progress: 99%

Completion of RRP：First half of Japanese FY 2018

New Regulatory Requirements

- New regulation on safety was enforced in December 2013, reflecting Fukushima daiichi NPP accident.
  - ➢Design standards
  - ➢Seismic evaluation
  - ➢Severe accident
- JNFL submitted applications for conformance to the new safety regulations to the NRA in January 2014.
- Reviews by NRA are undergoing.

Review of Seismic Standard

Evaluation items
Evaluation of underground structures
Faults in the JNFL site
Evaluation of active faults around the site (Inland Crustal earthquake: Deto West fault, fault on the outer edge of the continental shelf)
Seismic ground motions with specific hypocenters (Inter-plate earthquake and oceanic intra-plate earthquake)
Seismic ground motion without specific hypocenters

Design-standards seismic ground motion 700 gals

MOX Fuel Fabrication Plant (under construction)

(MOX: Mixed Oxide)

- MOX powder produced from the reprocessing plant is fabricated to MOX fuel at the MOX Fuel Fabrication Plant in Rokkasho
- Application for compliance with the new safety regulations was filed in January 2014 and is currently under the review by the NRA
- Completion of the construction is scheduled to the first half of Japanese FY 2019

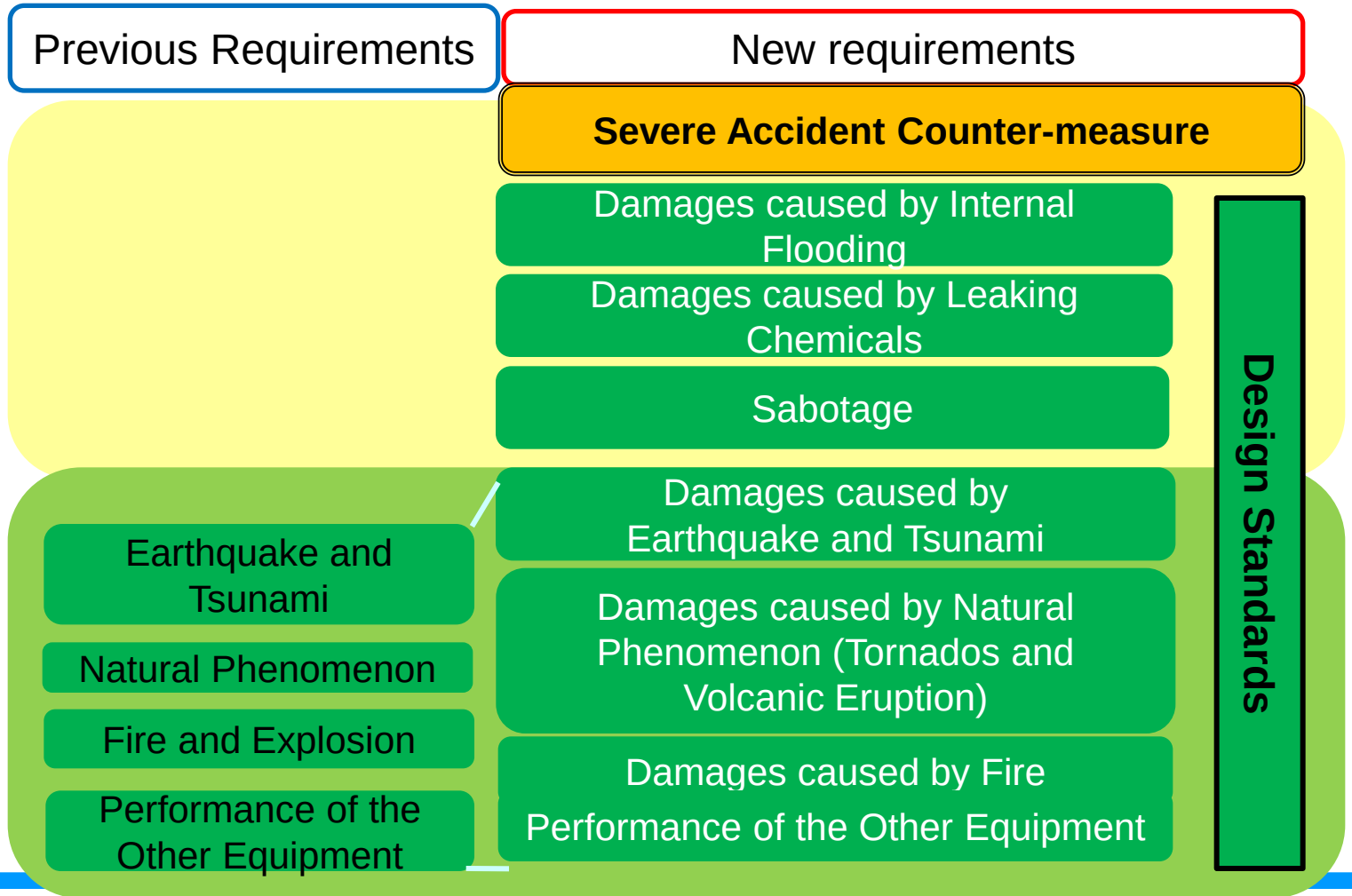
- Capacity : max.130 tHM/y
- Location : adjacent to RRP
  - MOX product is automatically transferred from the reprocessing plant to MOX plant through underground tunnel.

- Construction status
  - October 2010: Construction started

  (Construction work was suspended from March 2011 to March 2012 due to the Great East Japan Earthquake.)

(Reference) New Regulatory Requirements for Reprocessing Plant

In the New Regulatory Requirements, the previous requirements are strengthened and clarified, and four new items including severe accident countermeasures are added.



(Reference) Results Achieved and Future Plans

	Reprocessing plant	MOX fuel fabrication plant
Results achieved	・Pre-use inspection passed for main process ・Internal test passed for the vitrification facility	・Building under construction ・Equipment being manufactured
Conformance to new regulatory requirements	NRA safety review regarding basic design Approval by NRA regarding detailed design Modification, construction NRA pre-use inspection (Reprocessing plant first half of FY2018) (MOX fuel fabrication plant first half of FY2019)	

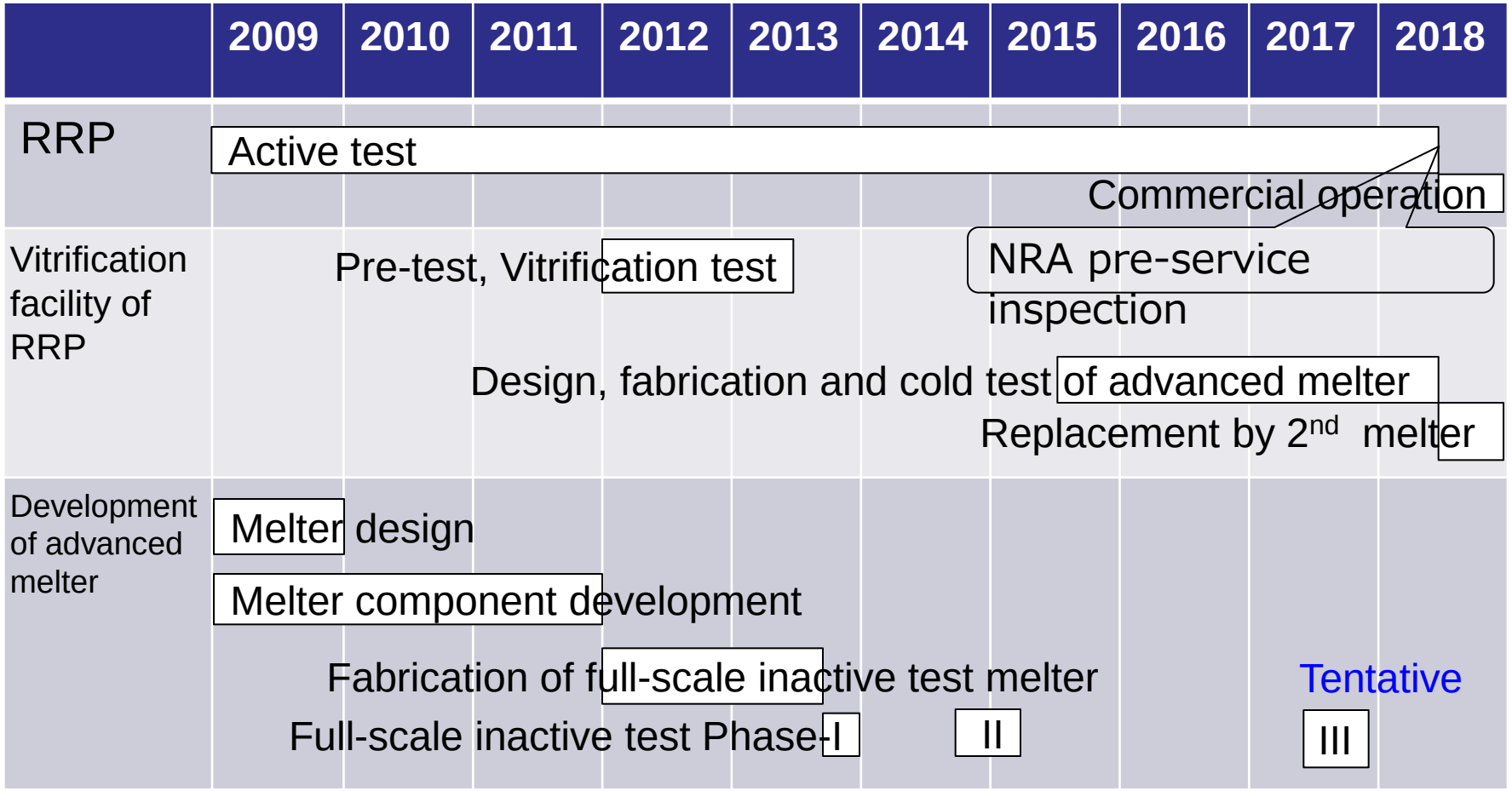
Safety Agreement with Aomori Prefecture and Rokkasho Village

Operation

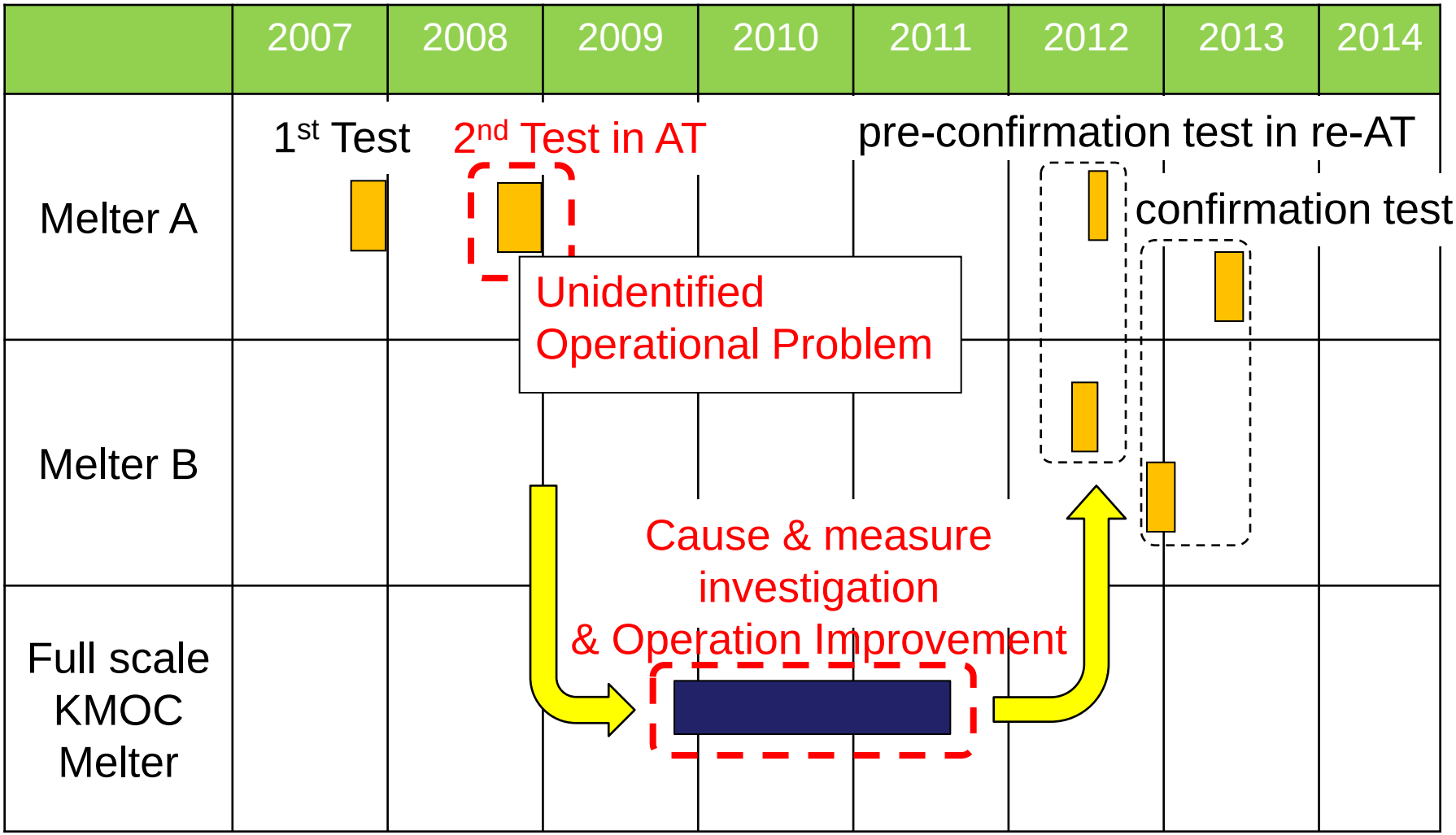
・Efforts for safe operation
・Continued safety operation
・Continuous activities to gain understanding of local residents and regional development
・Continued enhancement of safety

(Reference) Schedule of the Development of the Advanced Melter

- Development of the advanced melter was started at 2009



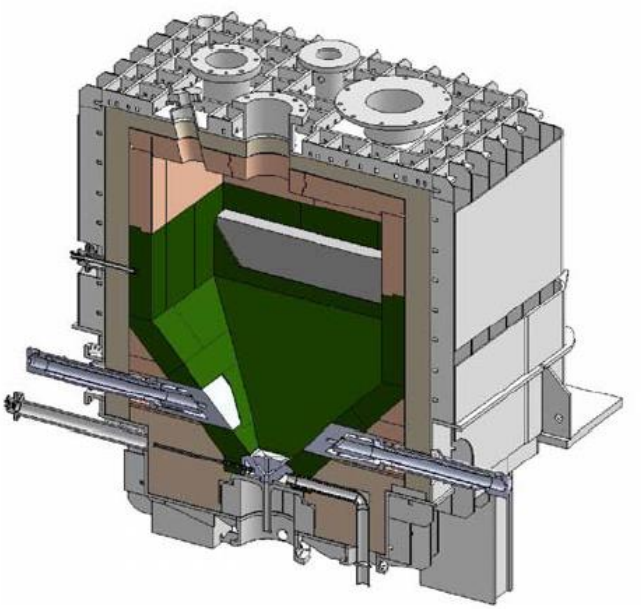
(Reference) Problems in Existing-Melter Operation in AT



(Reference) Advanced Melter in RRP

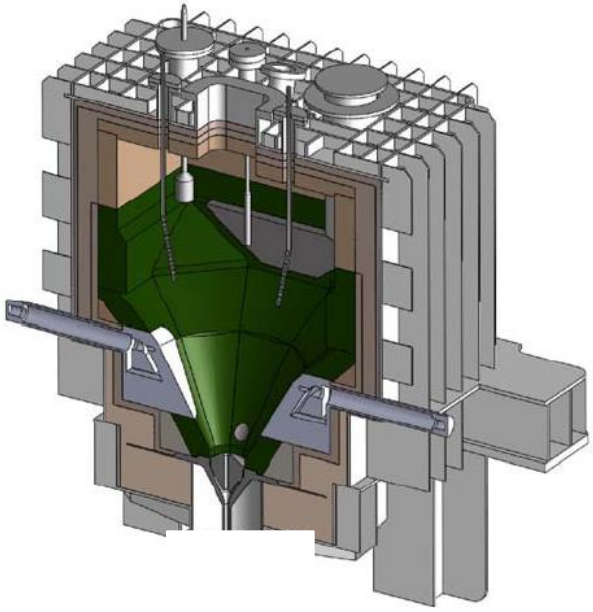
- The advanced melter is Liquid Fed Joule-heated ceramic melter
- The advanced melter was developed considering the following points
  - ✓ Suppressing deposition of noble metals in bottom part of melter
  - ✓ Increasing operation availability and throughput

Existing melter



45° slope and pyramidal form with 4 corners

Advanced melter



60° slope and conical form

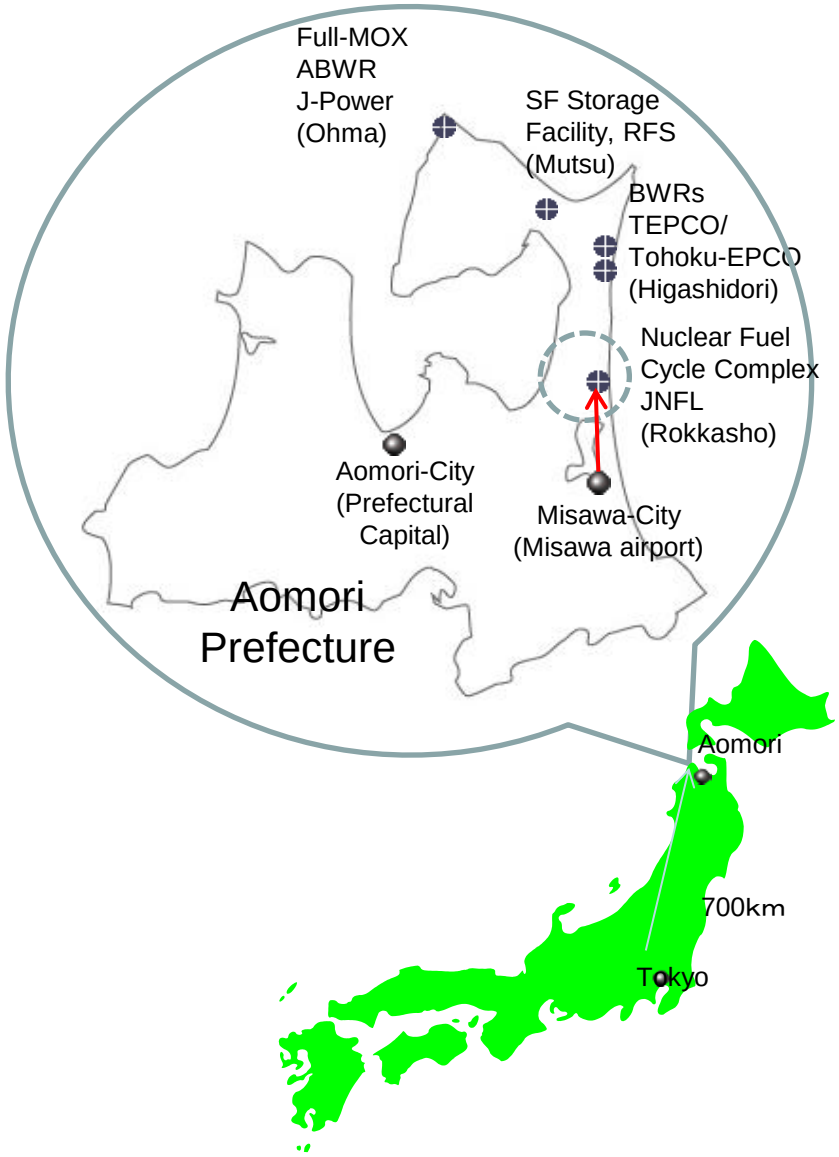
(Reference) History of JNFL

Some thirty years have passed since “The Basic Agreement about Cooperation in the Siting of the Nuclear Fuel Cycle Plant” was concluded with Aomori prefecture and Rokkasho village.

History of JNFL

Apr. 1985	“The Basic Agreement about Cooperation in the Siting of the Nuclear Fuel Cycle Plant” was concluded
Oct. 1988	Construction of the Uranium Enrichment Plant started
Nov. 1990	Construction of the Low-level Radioactive Waste Disposal Center started
Mar. 1992	The Uranium Enrichment Plant started operation
May 1992	Construction of the High-level Radioactive Waste Storage Center started
Dec. 1992	The Low-level Radioactive Waste Disposal Center started operation
Apr. 1993	Construction of Reprocessing Plant started
Apr. 1995	The High-level Radioactive Waste Storage Center started operation
Mar. 2006	The active test was started at the Reprocessing Plant
Oct. 2010	Construction of the MOX Fuel Fabrication Plant started
Mar. 2011	Great East Japan Earthquake happened
Dec. 2013	New Regulatory Requirements became effective
Jan. 2014	NRA began screening of reprocessing facilities to check conformance to new regulatory requirements

(Reference) Location: JNFL

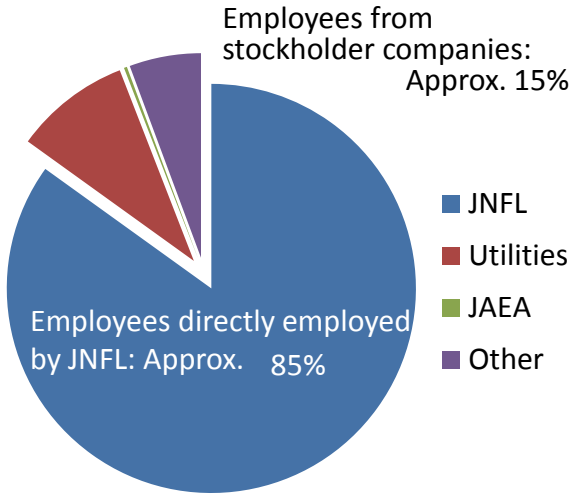


Overview of the Reprocessing Plant

(Reference) JNFL Corporate Profile

- Establishment : July 1, 1992
- Customers : Japanese nuclear power plant operators
- Stockholders : Ten Japanese electric power utilities (approximately 90% of interests) and 74 other Japanese companies
- Capital Stock : 400 billion yen + Capital reserve 200 billion yen
- Net sales : 295.4 billion yen (FY 2015)
- Gross assets : 2,414.5 billion yen (FY 2015)
- Employees : 2,589 (as of May 1, 2016)

Approx. 62% of all employees (1,618) is from Aomori Prefecture.



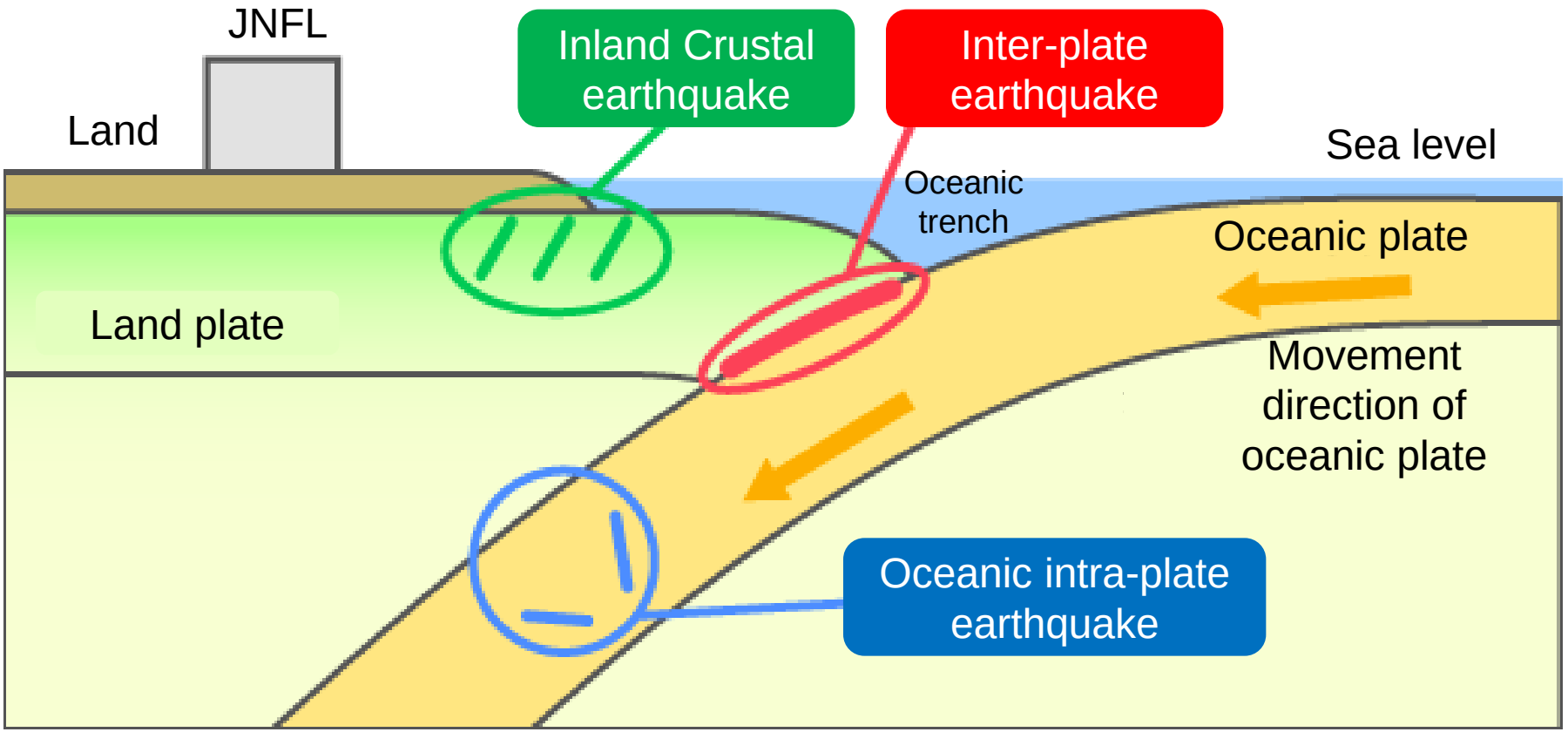
Employment Structures

(Reference) Type of Radioactive Waste in Japan

Type of Radioactive Waste				**Waste (Example)**	**Source**	**How to Dispose (Example)**
High level radioactive waste				Vitrified waste	Reprocessing plant	Deeper ground (300m-)
Low level radioactive waste	Waste from NPP	High ↑ Activity ↓ Low	Waste with relatively high activity (L1)	Control rod, components inside reactors	Nuclear power plant	Deep ground (50-100m)
			Waste with relatively low activity (L2)	Effluent, filter, consumables, etc. which are solidified		Shallow ground (Low level radioactive waste disposal center, Rokkasho)
			Waste with very low activity (L3)	Concrete, metal		Shallow ground
	TRU			Fuel rod parts, effluent, filter	Reprocessing plant, MOX fuel fabrication plant	According to the level of radioactivity
Waste below clearance level				Most of wastes coming from dismantling of nuclear facilities	All plants mentioned above	Can be reused or disposed as general waste

Source: *"Type and Source of Radioactive Waste"* and
"*Disposal Depending on the Type of Radioactive Waste*", Agency for Natural Resources and Energy

(Reference) Type of the Earthquake



(Reference) New Regulatory Requirements for the Reprocessing Plant

- Design standards
  (To prevent damage caused by fire, internal flooding, impact from the outside, etc.)
  The basic policy was confirmed, and the review of respective measures was almost completed

[Examples of measures against tornado: Preventing damage caused by impact from outside]

(Reference) New Regulatory Requirements for the Reprocessing Plant

- Severe accident
  - Criticality accident, dryness due to loss of cooling function, explosion due to hydrogen generated by radiolysis, etc.
  - Concrete measures for events of severe accidents including the superimposition of accidents and assessments of effectiveness of measures continues to be reviewed.

- Improvement of the quality of training


Night-time cable connection training


Water supply training in winter

(Reference) Examples of Measures against Severe Accidents

Securing hydrogen scavenging function

Power supply truck

Securing cooling functions

Large-size pumping truck, Hose extension vehicle, Medium-size pumping truck, All terrain vehicle

(Reference) Activities to Gain Understanding from Region: Promoting Communication

○Visiting all households

Employees visit households in the Rokkasho village to explain. They also hear opinions towards JNFL.
（3,090 households in Rokkasho village [June 2015], conducted twice a year since FY1984）

○Ladies' monitor in Aomori

Request for opinions from the ladies' perspective in Aomori.
(Commenced in 1996, conducted about seven times an year, one year term of service)

○Cultivating a sense of safety using an example of troubles.

Explain potential troubles and their impact.

(Reference) Collaboration with Relevant Organizations both Domestic and Abroad

■ France:
- AREVA
  ⇒ International partner
- Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
  ⇒ Joint research

■ United Kingdom:
- Nuclear Decommissioning Authority (NDA)
  ⇒ International partner

■ United States:
- United States Department of State
  ⇒Provide information
- United States Department of Energy, national laboratories
  ⇒Participation to the DOE program

Connect with the world as a comprehensive nuclear fuel cycle company, and aim to make Rokkasho known worldwide.