


The New Approach to Regulating Long-Term Storage of Spent Fuel

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1. Nuclear Fuel Cycle in Japan

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- ▶▶ 1-2. Reprocessing
- ▶▶ 1-3. Long-Term Storage



1-1. National Policy (1)

- ▶ Framework for Nuclear Energy Policy
 - Cabinet decision in October, 2005

◦ “Our basic policy is, aiming at using nuclear fuel resources as effective as reasonable achievable, to reprocess spent fuel and to effectively use the recovered plutonium and uranium, while ensuring safety, nuclear non-proliferation, environmental protection, and paying due attention to economic viability.”

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1-1. National Policy (2)

- ▶ Framework for Nuclear Energy Policy

◦ “Reprocessing of spent fuel is basically to be conducted within the country in view of securing the autonomy of nuclear fuel cycle activities.”

◦ “Spent fuel will be reprocessed, within the available reprocessing capacity, for the time being, and the surplus volume exceeding the capacity will be stored intermediately.”

• http://www.aec.go.jp/jicst/NC/tyoki/taikou/kettei/eng_ver.pdf

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1-2. Reprocessing (1)

- ▶ “Rokkasho” plant will start in 2012.



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1-2. Reprocessing (2)

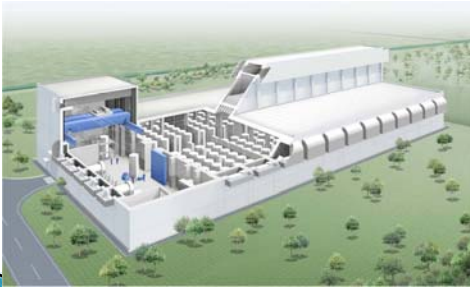
- ▶ Rokkasho capacity is **not** enough.
- Spent fuel being generated by NPPs: 1,000tU/year
- SF to be reprocessed by Rokkasho: 800tU/year
- SF stored at NPPs:
13,150
64% of capacity



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1-3. Long-Term Storage (1)

- ▶ “Mutsu” facility will start in **2012**, too.



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1-3. Long-Term Storage (2)

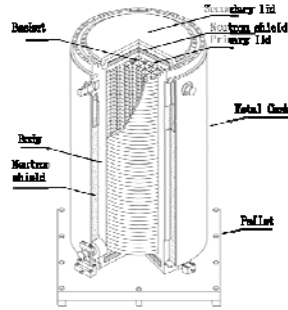
- ▶ Mutsu stores SF for **50 years**.
- First off-site interim storage facility in Japan
 - (Away from reactor)
- Storage capacity: 3,000tU
- Storage way: **Dual-Purpose** Dry Metal Cask

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1-3. Long-Term Storage (3)

▶ Cask is designed for **storage** and **transport**.

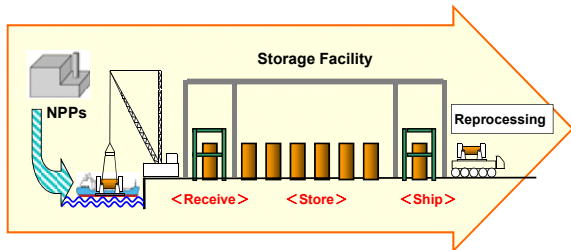
- Length: 5.4m
- Diameter: 2.5m
- Weight: 118t



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1-3. Long-Term Storage (4)

▶ Cask operation is **longer** than storage period.



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2. Holistic Approach to Long-Term Storage

- ▶▶ 2-1. Storage Regulation
- ▶▶ 2-2. Transport Regulation
- ▶▶ 2-3. Holistic Approach

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2-1. Storage Regulation (1)

▶ Storage regulation has **long-term** view.



• Dry metal storage casks for spent fuel at Fukushima-1 NPP

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2-1. Storage Regulation (2)

▶ Storage cask must maintain basic safety functions throughout long **storage period**.

- Containment
- Shielding
- Criticality prevention
- Heat removal



Storage casks at Tokai-2 NPP

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2-2. Transport Regulation (1)

▶ Transport regulation has **short-term** view.



• Wet metal transport cask for Spent Fuel (Type B(M) package)

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2-2. Transport Regulation (2)

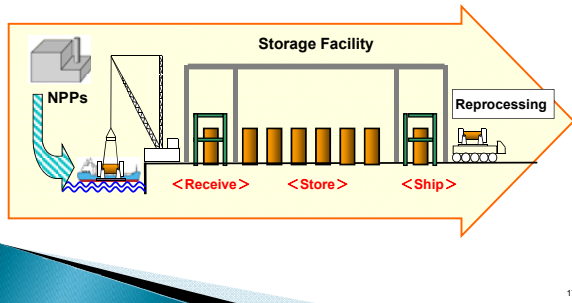
- ▶ Transport cask must maintain basic safety functions in case of **serious accident**.
 - Based on IAEA standards.
 - Five-year license.



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2-3. Holistic Approach (1)

- ▶ To keep regulatory **comformity** from loading to post-storage transport.



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2-3. Holistic Approach (2)

- ▶ **NPP** is additionally required to;
 - Conduct thorough inspection when loading SF,
 - Pass on those records to storage operator,
 - Renew transport license every five years during storage period,
 - Receive SF after storage period.

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2-3. Holistic Approach (3)

- ▶ Storage operator is additionally required to;
 - Receive records of SF from NPP,
 - Keep Monitoring the conditions of cask,
 - Keep above records during storage period.

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2-3. Holistic Approach (4)

- ▶ The records must encompass;
 - At NPP 50 years ago,
 - SF was intact.
 - Loading operation was conducted properly.
 - At storage facility during storage period,
 - Integrity of SF and cask is maintained.
 - Deterioration is within safety limits.
 - Chemical, thermal, mechanical, radiological

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2-3. Holistic Approach (5)

- ▶ Storage operator is **not** required to;
 - Open the lids of cask to inspect inside.
 - Equip storage facility with hot cell.



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2-3. Holistic Approach (6)

- ▶ **Licensing** procedures of;
 - Storage and transport are in line with safety analysis of storage facilities.
 - Storage require clear identification of the role of related operators.
 - Transport require sufficient demonstration that post storage transport is safe.

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3. Technical Basis of Holistic Approach

- ▶▶ 3-1. BWR Fuel and Cask
- 3-2. PWR Fuel
- 3-3. Demonstration Test

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3-1. BWR Fuel and Cask

- ▶ Long-term integrity was **confirmed**.
 - Open casks at two NPPs in Japan.



Fuel cladding



Metal gasket

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3-2. PWR Fuel

- ▶ Long-term integrity was **confirmed**, too.
- Research reports of Idaho National Engineering and Environmental Laboratory.



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3-3. Demonstration Test (1)

- ▶ Make **doubly sure** of long-term integrity of PWR spent fuel.
- Three major power companies using PWR, and
- JNES
 - The expert organization
 - Ensure safety in the use of nuclear energy
 - In cooperation with NISA.



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3-3. Demonstration Test (2)

- ▶ Storage test & inspection will start in **2012**.

Fiscal year	2009	2010	2011	2012	2013 -2022	2023 -2032	2033 -2042	2043 -2052	...
Planning & Designing		Planning Designing Safety analysis							
Manufacture & Preparation			Licensing Manufacturing of test container (48GWd/t fuel)	Thermal test (55GWd/t fuel)	Preparation & Fuel inspection Loading to container				
Storage test & Inspection		48GWd/t type fuel test	55GWd/t type fuel test	Gas sampling					

Ref. JNES

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3-3. Demonstration Test (3)

- ▶ Two types of PWR spent fuel assemblies.

	Type 17×17 48GWd/t Fuel Assembly	Type 17×17 55GWd/t Fuel Assembly
Burn-up (MWd/t)	42,800 (past record)	≤55,000 (assumption)
Cooling period	19 years (as of October, 2012)	≥10 years (as of October, 2022)
Cladding material	Zircalloy-4	MDA or ZIRLO

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3-3. Demonstration Test (4)

Outline	
Item	Description
Components	- Lid (Steel, Resin, Double metal gasket) - Body (Steel, insulator, Resin) - Basket (Steel, Boron-Al) - Outer thermal insulator
Size	- Height : Approx. 5.2m - Outer diameter : Approx. 2.2m
Contents	Max. 2 PWR spent fuel assemblies
Cover gas	Helium (negative pressure)

Conclusion

- ▶ Japan will start reprocessing and interim long-term storage of spent fuel **next year**.
- ▶ Japan adopted a **holistic approach** to regulating long-term storage of SF.
- ▶ Japan is conducting **demonstration test** of long-term integrity of SF.
- ▶ **International cooperation** is vital in this field.

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Atoms For Peace.

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