



Radioactive Waste Management in Japan - An Overview -

IAEA
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Radioactive Waste Management Organisation**

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Hiroyuki Umeki
Japan Atomic Energy Agency
(<http://www.jaea.go.jp/english/index.shtml>)



Presentation outline

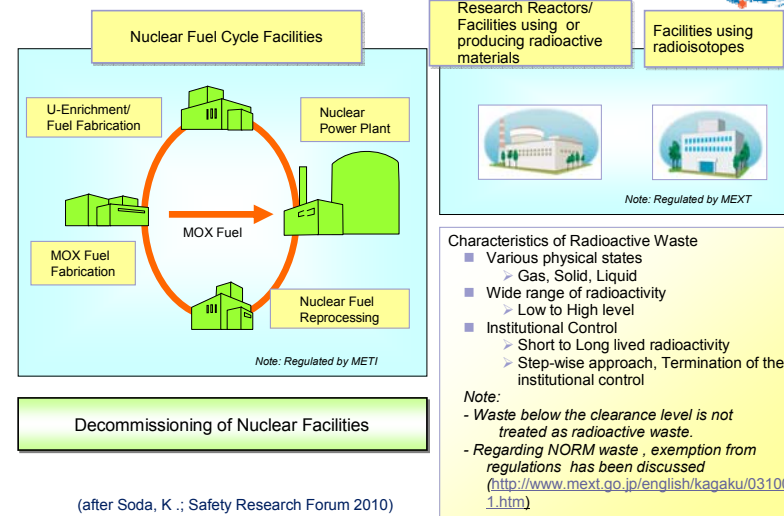
- RWM policy
- Radioactive waste inventory
- Legislative Framework and Regulators
- Implementation – implementers and current status
- R&D organisations
- Key organisational aspects
- Summary

Basic policy for nuclear energy and RWM



- **Atomic Energy Basic Law**
 - Research, development and utilization of nuclear energy shall be done only for peaceful purposes, while ensuring safety
- **“Framework for Nuclear Energy Policy” (Atomic Energy Commission, 2005)**
 - It is the premise of activities related to research, development and utilization of nuclear energy to assure their safety, to limit them to strictly peaceful purposes, to appropriately manage and dispose of radioactive wastes generated through them and to realize the coexistence of them with local communities
 - There are four principles of the treatment and disposal of radioactive waste: 1) the liability of generators, 2) minimization of radioactive waste, 3) rational treatment and disposal, and 4) implementation based on mutual understanding
 - Under these principles, it is important to make appropriate classifications of the wastes and treat and dispose of them safely for each classification

Sources and Characteristics of Radioactive Waste



Database of national inventories



- Waste inventories are strictly recorded and updated by each individual waste generator and can be integrated by the government whenever required.
- Definitions:

Category 1 waste disposal	Activity of geological disposal for HLW and some LLW
Category 2 waste disposal	Activity of the waste disposal other than geological disposal for LLW
Intermediate depth disposal	Underground disposal deeper than the depth utilised for normal human activities (e.g. 50m); this method is classified in Category 2 waste disposal.
Specified radioactive waste	Radioactive waste for geological disposal, which includes HLW
TRU waste (or long-lived, low-heat-generating waste)	LLW generated from MOX fuel fabrication or reprocessing facilities, which generally contains transuranic elements

(After National report of Japan for the 3rd review meeting of JC, Oct 2008)

Classification of Radioactive Waste



		Example	Origin of waste	
High-level radioactive waste (HLW)		Vitrified Waste	Vitrified waste that contains fission product separated from spent fuel during reprocessing	
Low-level radioactive waste (LLW)	Long-lived low-heat radioactive waste from reprocessing and MOX fabrication (TRU waste)	Parts of fuel Elements Liquid waste Filters	Waste generated from the operation and dismantling of reprocessing facilities and MOX fuel fabrication facilities	
	Waste from power reactors	Waste of core structures etc. (Relatively higher activity waste)	Control rods Core internals	Waste generated at power reactors
		Low-level radioactive waste (Relatively lower activity waste)	Liquid waste Filters Used equipment Expendables	
		Very low-level radioactive waste (VLLW)	Concrete Metals	
	Uranium waste		Expendables Sludge Used equipment	Waste generated from uranium enrichment and uranium fuel fabrication facilities
	Waste from research facilities, etc.		Liquid waste Metals Concrete Plastics	Waste generated from research, medical and industrial facilities using or producing radioisotopes

Policy and practice on spent nuclear fuel and radioactive waste management



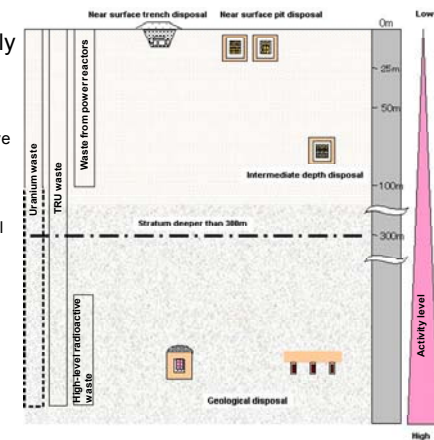
Type of Liability	Long Term Management Policy	Funding	Current Practice / Facilities	Planned Facilities
Spent Fuel	Reprocessing	Utility pays fund for reprocessing	Domestic & foreign reprocessing plants	Interim storage facility
Nuclear Fuel Cycle Waste	Geological, intermediate depth or near surface disposal	Utility pays fund for disposal of waste	HLLW Storage Facility / LLW Disposal Facility	Geological, intermediate depth and near surface disposal facilities
Non-power Waste	Geological, intermediate depth or near surface disposal	user pays fund for disposal of waste (started)	On site storage	Under discussion
Decommissioning Liabilities	Immediate decommissioning of NPP	Operators pays into reserve fund	Decommissioning underway	
Disused Sealed Source	Return to manufacturer / Long-term storage	user	Return to manufacturer / Storage inside facilities	

(National report of Japan for the 3rd review meeting of JC, Oct 2008)

Basic policy for waste disposal



- Radioactive wastes are appropriately categorized and safely disposed of.
 - Waste for geological disposal
 - High-level radioactive waste
 - Long-lived low-heat generating radioactive waste [Higher activity]
 - Waste disposed of at intermediate depth or near surface
 - Waste other than the waste for geological disposal
- Prohibition of sea dumping
 - Amendment of the Reactor Regulation Law in May 2005

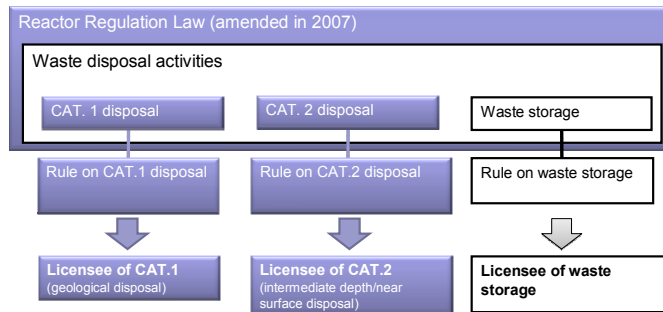


(National report of Japan for the 3rd review meeting of JC, Oct 2008)

Legislative system for waste disposal

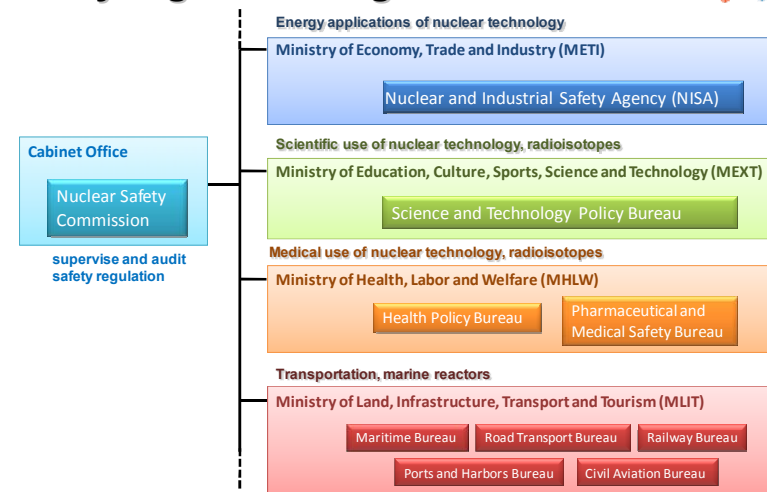


- Category 1 (geological disposal)
- Category 2 (near surface disposal and intermediate-depth disposal)



(National report of Japan for the 3rd review meeting of JC, Oct 2008)

Safety regulation organisations



(National report of Japan for the 3rd review meeting of JC, Oct 2008)

Legal framework for implementation of geological disposal



■ “Specified Radioactive Waste Final Disposal Act”

- Enacted in May 2000, specifying;
 - Establishment of NUMO (Nuclear Waste Management Organization of Japan) to manage HLW
 - Funding system
 - Step-wise siting process
- Amended in June 2007: Specified waste extended to cover long-lived LLW which are appropriate for geological disposal

□ NUMO

- Mission - “To promote the disposal project that includes investigations, selection of repository site(s), construction, operation and closure of the repository with priority of assuring safety”
- December 2002: started open solicitation for candidate sites from municipalities throughout Japan for literature survey as the first step of investigations
- April 2008: established as implementer also for long-lived LLW appropriate for geological disposal

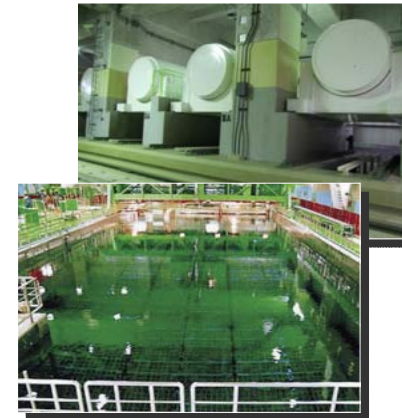
Current Status – interim storage of spent fuel



● Inventory of spent fuel

- **Nuclear Power Plants**
12,260 tons
 - BWR fuel: 6,670 tons
 - PWR fuel: 5,520 tons
 - ATR fuel: 70 tons
- **Reprocessing Plant**
2,576 tons
 - BWR fuel: 1,453 tons
 - PWR fuel: 1,082 tons
 - ATR fuel: 41 tons
- **Research Reactors: 34 tons**

As of March 2008



Current Status – interim storage of HLW



Inventory of high-level radioactive waste

- Vitrified Waste: 1,664 packages
 - Rokkasho Reprocessing site
 - Reprocessing facility: 107 packages
 - Waste storage facility: 1,310 packages (returned from overseas)
 - Tokai Vitrification Facility: 247 packages
- High Level Liquid Waste
 - Tokai Reprocessing facility: 404 m³



JNFL Vitrified Waste Storage Center and HLW storage pits (photos: courtesy of JNFL).

(As of December 2009)

Current Status – Decommissioning



Facilities in decommissioning phase

- 2 Power Reactors (plus 2 reactors in preparation)
- 8 Research Reactors

Name of facility	Power	Operation	Status
Tokai Power Plant	166MWe	1966~1998	Under decommissioning
ATR Fugen	165MWe	1979~2003	Under decommissioning
Hamaoka NPS unit 1	540MWe	1976~2009	Preparing for decommissioning
Hamaoka NPS unit 2	840MWe	1978~2009	Preparing for decommissioning
JRR-2	10MW	1960~1996	Under decommissioning
VHTRC	10W	1985~1999	Under decommissioning
Nuclear ship Mutsu	36MW	1974~1992	Dismantled
DCA	1kW	1969~2001	Under decommissioning
HTR	100kW	1961~1975	Under decommissioning
TTR-1	100kW	1962~2001	Under decommissioning
RUR	100kW	1961~2001	Under decommissioning
MITRR	100kW	1963~2004	Under decommissioning

(As of April 2009)

Implementing organisations for disposal



		Disposal concept	Implementing organisation	
High-level radioactive waste (HLW)		Geological Disposal	NUMO	
Low-level radioactive waste (LLW)	Long-lived low-heat generating radioactive waste (TRU waste)	Geological Disposal Intermediate-depth disposal Near-surface disposal	NUMO not specified not specified	
	Waste from power reactors	Waste of core structures etc. (Relatively higher radioactive waste)	Intermediate-depth disposal	not specified
		Low-level radioactive waste (Relatively lower radioactive waste)	Near-surface disposal (pit)	JNFL
	Very low-level radioactive waste (VLLW)	Near-surface disposal (trench)	(each nuclear facility)	
	Uranium waste	Intermediate-depth disposal Near-surface disposal	not specified	
Waste from research facilities, etc.	Intermediate-depth disposal Near-surface disposal	not specified JAEA		

Current status – LLW disposal



Inventory of low-level radioactive waste:

- Power station waste
 - 630,000 (200L drums)
 - 29 used steam generators
 - Used control rods, etc.
- Other facilities
 - 590,000 (200L drums)
 - 5,400 m³ (liquid)



(Low Level Radioactive Waste Disposal Center at Rokkasho)

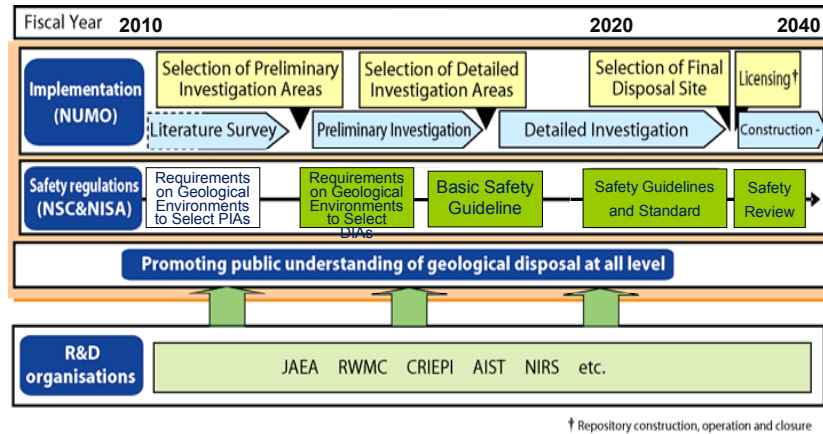
Amount of LLW disposed of:

- JNFL Rokkasho LLW Disposal Center (as of June 1, 2010)
 - No.1: 143,355 (200L drums)
 - No.2: 76,312 (200L drums)
- JAEA Tokai R&D Center (as of March 2008)
 - Disposal site: 1,670 tons

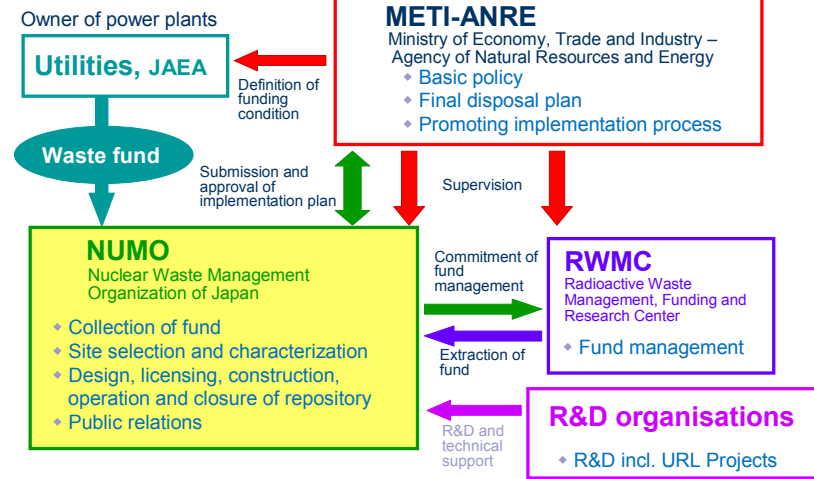
The Japanese geological disposal programme



- Stepwise implementation



Organisations and roles: geological disposal programme



Research and development waste disposal



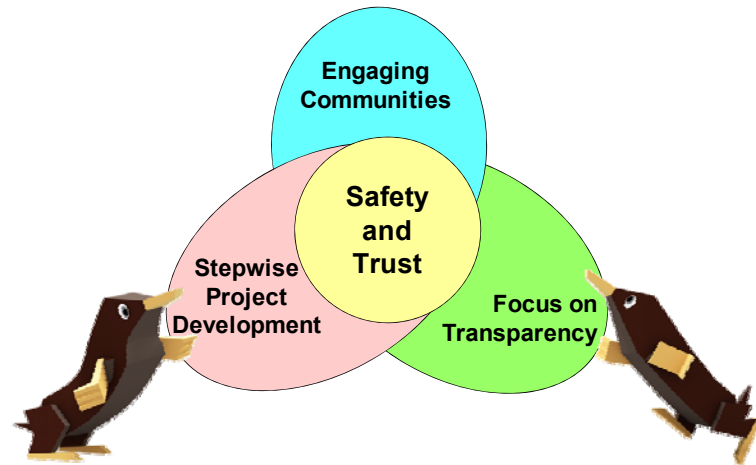
		Major organisations	
High-level radioactive waste (HLW)		NUMO JNES JAEA METI-ANRE (AIST, RWMC, NIRS, CRIEPI) etc.	
Low-level radioactive waste (LLW)	Long-lived low-heat generating radioactive waste (TRU waste)	NUMO JNES JAEA METI-ANRE (RWMC) FEPC NUMO etc.	
	Waste from power reactors	Relatively higher activity waste	JNFL CRIEPI
		Relatively lower activity waste	JNES JAEA etc.
		Very low-level radioactive waste (VLLW)	
	Uranium waste	JAEA RWMC etc.	
Waste from research facilities, etc.	JAEA CRIEPI etc.		

Key organisational aspects



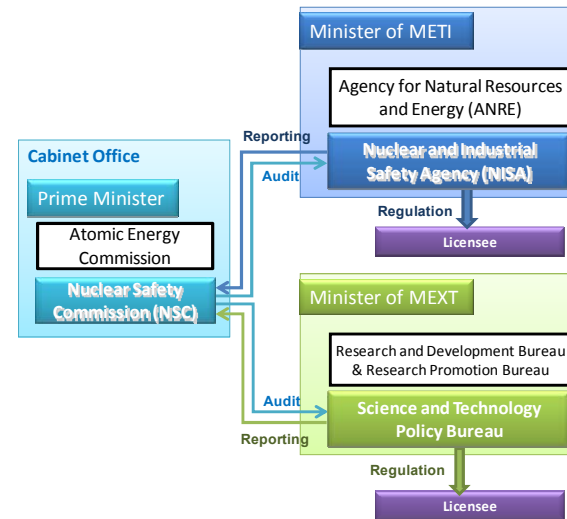
- Consistent policy and clear allocation of responsibilities
- Organisational credibility: adequate human and infrastructure resources
- Independence of regulatory functions
- Open and transparent processes
- Public understanding / fostering dialogue
- Advanced knowledge management system
- International collaboration / optimising use of scarce resources

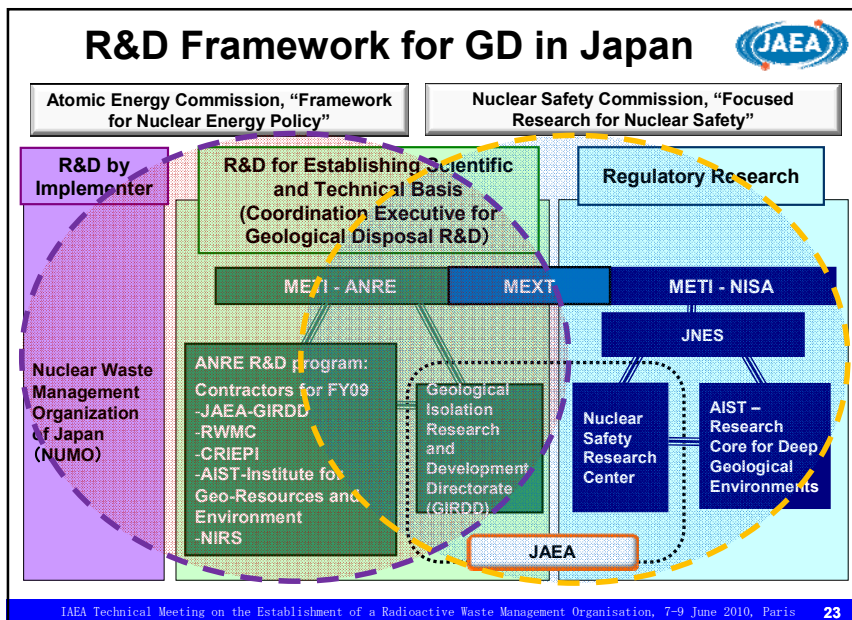
NUMO organisational principles



(see NUMO HP; <http://www.numo.or.jp/en>)

Independence of regulatory functions





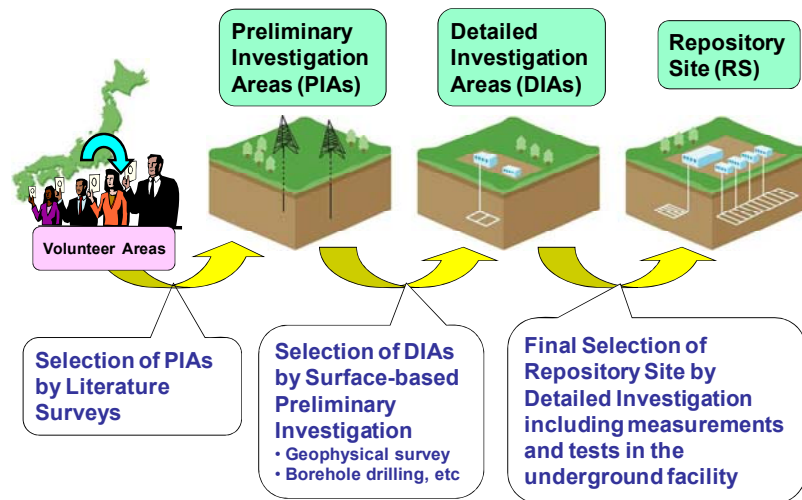
Activities for promotion of geological disposal – a role of the government

Based on required measures for promotion of geological disposal by a METI-ANRE advisory committee in November 2007, METI-ANRE is making efforts for better public understanding, coordinated with NUMO and electricity utilities

Major developments

- Activities to enhance understanding of disposal projects
 - To increase the interest of public, 35 public meetings were held in all prefectures in Japan (as of May 2009)
 - Holding 20 workshops which accept local residents' cooperation with NPOs (as of May 2009)
 - Other kinds of activities to improve understanding, such as operating the "geological disposal concept exhibition vehicle" and production of a range of PR material
- Presentation of ideas of regional development
 - The "Research Group for Regional Development" (a research group organized in METI-ANRE) issued a report regarding the regional development plan in September 2008
 - The regional development plan was sent to all governors, mayors and chambers of commerce and industry. Such activities to improve understanding are ongoing now.

Site selection process for geological disposal



(Tsuchi, H.; Safety Research Forum 2010)

Need for KMS: Information explosion in R&D supporting geological disposal in Japan ...with a limited (and aging) work force



- Over the last 2 decades, key integration and overview tasks have been carried out by teams whose experience has grown over that period
...these are now completely overloaded
...and most experienced members are nearing retirement
- Development of next generation KMS (JAEA-KMS) and CoolRep



International cooperation



- Active in particular in R&D for geological disposal:
 - Bilateral basis, e.g. NUMO, JNES, JAEA, RWMC, CRIEPI, etc.
 - International projects, organised by e.g. IAEA, NEA, EC, etc.
- Regional network: e.g. ANSN (Asian Nuclear Safety Network), FNCA (Forum for Nuclear Cooperation in Asia), etc.

Infrastructure for international collaboration: JAEA's R&D Facilities for Geological Disposal



Tono Geoscience Center

- Mizunami URL
- Crystalline rock
 - ~1,000 m depth
 - Fresh water



image view

Construction Site

Horonobe Underground Research Center

- Horonobe URL
- Sedimentary rock
 - ~500 m depth
 - Saline water



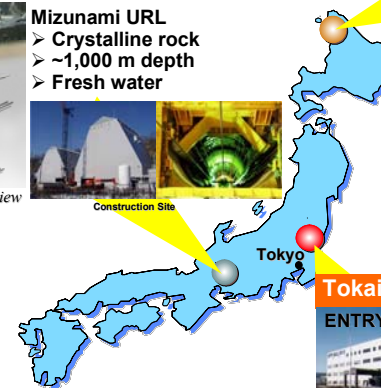
image view

construction site

Tokai R&D Center



- Engineering technology
- Safety assessment method, etc.



Summary



Holistic waste management is a key for sustainable nuclear energy and utilisation of radionuclides in medicine, industry and research:

- **Should be planned and implemented with proper legal and regulatory systems, organisational structures and defined roles.**
- **Can be implemented only with public acceptance, which will be gained by open communication and involvement of stakeholders in all relevant processes.**
- **R&D organizations play an important role in developing and maintaining a quality-assured, state-of-the-art knowledge base.**
- **An advanced KMS is important for collation, synthesis, QA and application of huge fluxes of both explicit and tacit knowledge.**
- **International cooperation is important, both to share experience and knowledge and to optimise use of limited funding and human resources.**

Acknowledgement



Valuable input to this presentation from

- **CAO** (Cabinet Office, Government of Japan) / **AEC** (Atomic Energy Commission) <http://www.aec.go.jp/jicst/nc/eng/>; and **NSC** (Nuclear Safety Commission) <http://www.nsc.go.jp/nscenglish/>;
- **METI** (Ministry of Economy, Trade and Industry) / **NISA** (Nuclear and Industrial Safety Agency) <http://www.nisa.meti.go.jp/english/>;
- **METI / ANRE** (Agency for Natural Resources and Energy) <http://www.enecho.meti.go.jp/english/>;
- **MEXT** (Ministry of Education, Culture, Sports, Science and Technology) <http://www.mext.go.jp/english/>;
- **MHLW** (Ministry of Health, Labour and Wealth) <http://www.mhlw.go.jp/english/>;
- **NUMO** (Nuclear Waste Management Organization of Japan); <http://www.numo.or.jp/en/>
- **JNFL** (Japan Nuclear Fuel Ltd.); <http://www.jnfl.co.jp/english/disposal.html>

is gratefully acknowledged.



Thank you for your attention!