

Issues of the High-Level Radioactive Waste in Japan

Prof. Dr. Kenji YAMAJI

Director-General, Research Institute of Innovative Technology for the Earth (RITE)

International Symposium on
Nuclear Back-end Issues and the Role of Nuclear Transmutation Technology
after the accident of TEPCO's Fukushima Daiichi Nuclear Power Stations

KUR Research Program for Scientific Basis of Nuclear Safety
Kyoto University Research Reactor Institute

November 28, 2013

@The Shiran Hall, Kyoto University, Kyoto, Japan.

Process for Energy/Environment Policy Making in Japan

Political Power Shift from LDP to DP in Sept. 2009

LDP (Liberal Democratic Party); DP (Democratic Party)

Too ambitious **Climate Target for 2020** (25% reduction from 1990) in 2009

Fukushima Accident in 2011 → Energy and Environment Council (ministerial members, political)

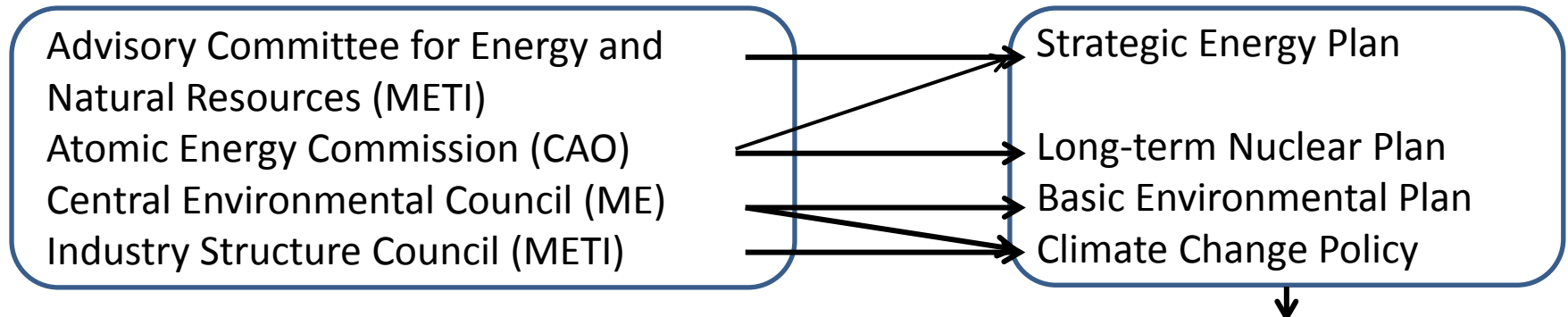
Full scope FIT implemented in 2012

Start of **Power System Reform** (continuing)

National Debates (incl. deliberative poll)

Innovative Strategy for Energy and the Environment in 2012
(Zero Nuclear by the end of 2030s)

Ordinary Administrative Process



Cabinet Decision

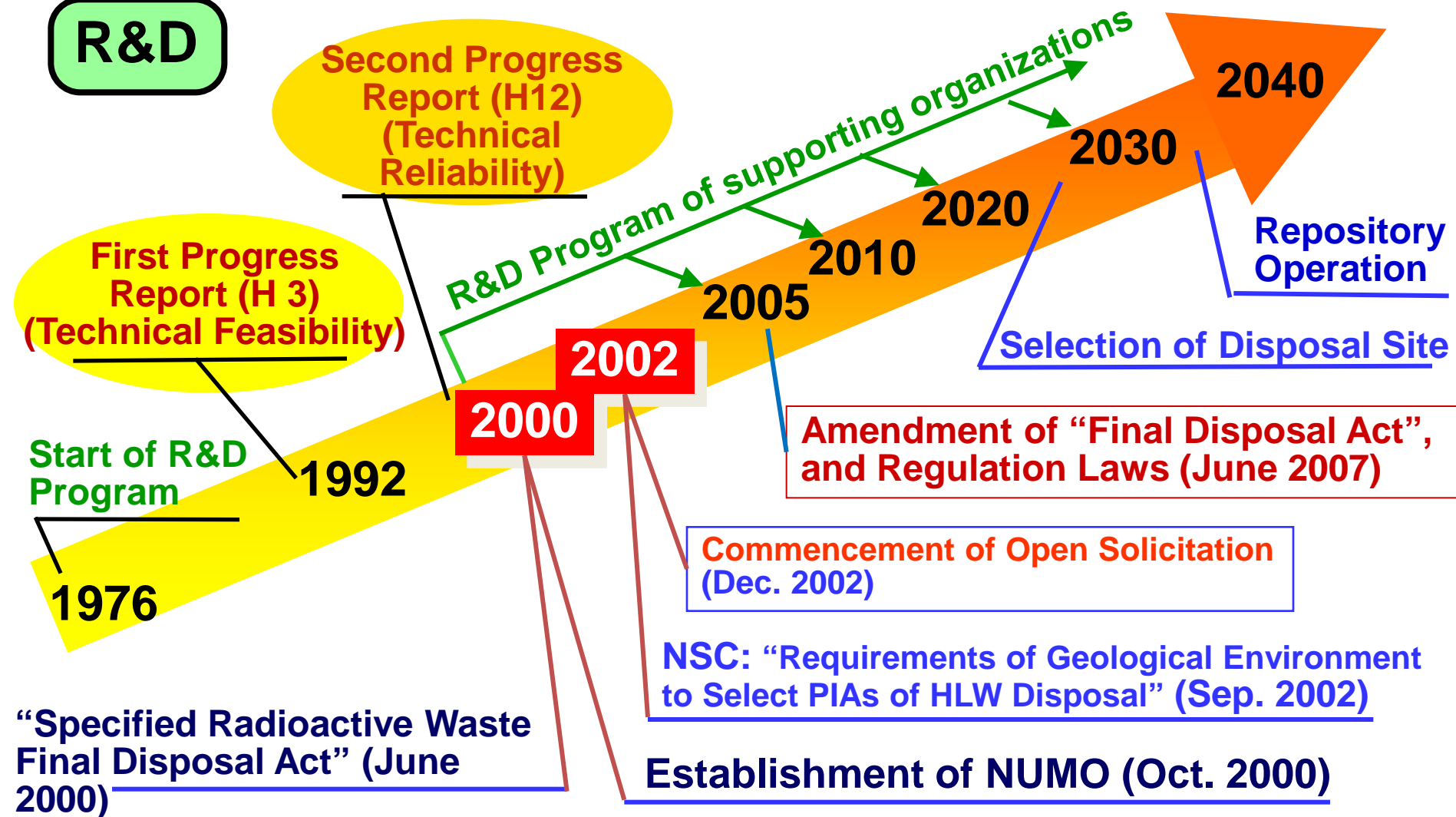
Political Power Shift from DP to LDP in Dec. 2012

Building a responsible energy policy: zero-based review of the Innovative Strategy for Energy and Environment; reconstruct Strategic Energy Plan by the end of 2013
(Keep Nuclear Option)

Re-examination of climate change policy: zero-based review of the 25% reduction target by COP19: minus 3.8% from 2005 (3.1% increase from 1990)

Evolution of HLW Disposal Program in Japan

R&D



NSC: Nuclear Safety Commission of Japan

Implementation

Legislation of Specific Radioactive Waste Final Disposal Act (June 2000)

AEC's Special Panel on Disposal of High-Level Radioactive Waste (May 1996 – May 1998)

- Panel members from broad areas
- 32 panel / subpanel meetings
- 6 public hearings
- Formulated a fundamental scheme for implementation of HLW disposal
 - Site selection process
 - Implementation body
 - Fund collection system
 - Stakeholder's confidence
 - Community partnership

JNC's Second Progress Report (H12 Report) (November 1999)

- Demonstrated technical reliability of HLW geological disposal in Japan based on the results of R&D since 1976
- Reviewed by AEC's special committee and OECD/NEA
- 24 open symposia in various cities
- Report distributed to 2750 public libraries throughout the country

Legislation of Specific Radioactive Waste Final Disposal Act (June 2000)

Specified Radioactive Waste Final Disposal Act

(enacted in June 2000, amended in June 2007)

- Definition of specified waste
- Basic policy, basic and implementing plans for final disposal
- Funding system
- Disposal site selection process
- Provisions for disposal and repository closure
- Implementing entity
- Fund management entity
-

Final Disposal Act (enacted June 2000, amended June 2007)

- As prescribed in the Final Disposal Act, **NUMO** has missions as the implementer of the geological disposal project.
- An amendment to the Act in 2007 added the implementation of geological disposal of some TRU waste.

Major prescriptions in the Final Disposal Act

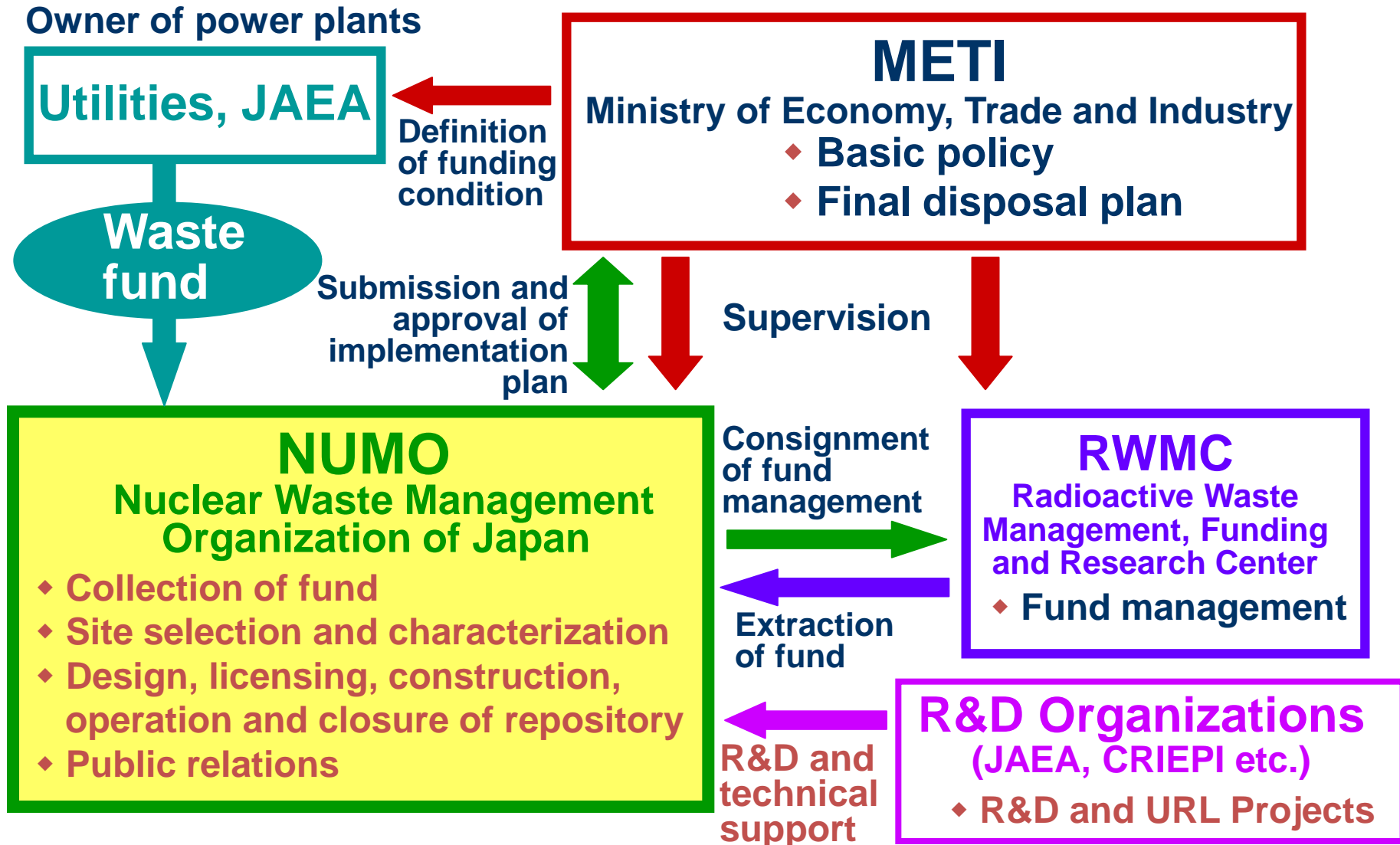
- Definition of specified waste
- Basic policy, basic and implementing plans for final disposal
- Funding system
- Disposal site selection process
- Provisions for disposal and repository closure
- Implementing entity
- Fund management entity

NUMO's Missions as implementing entity

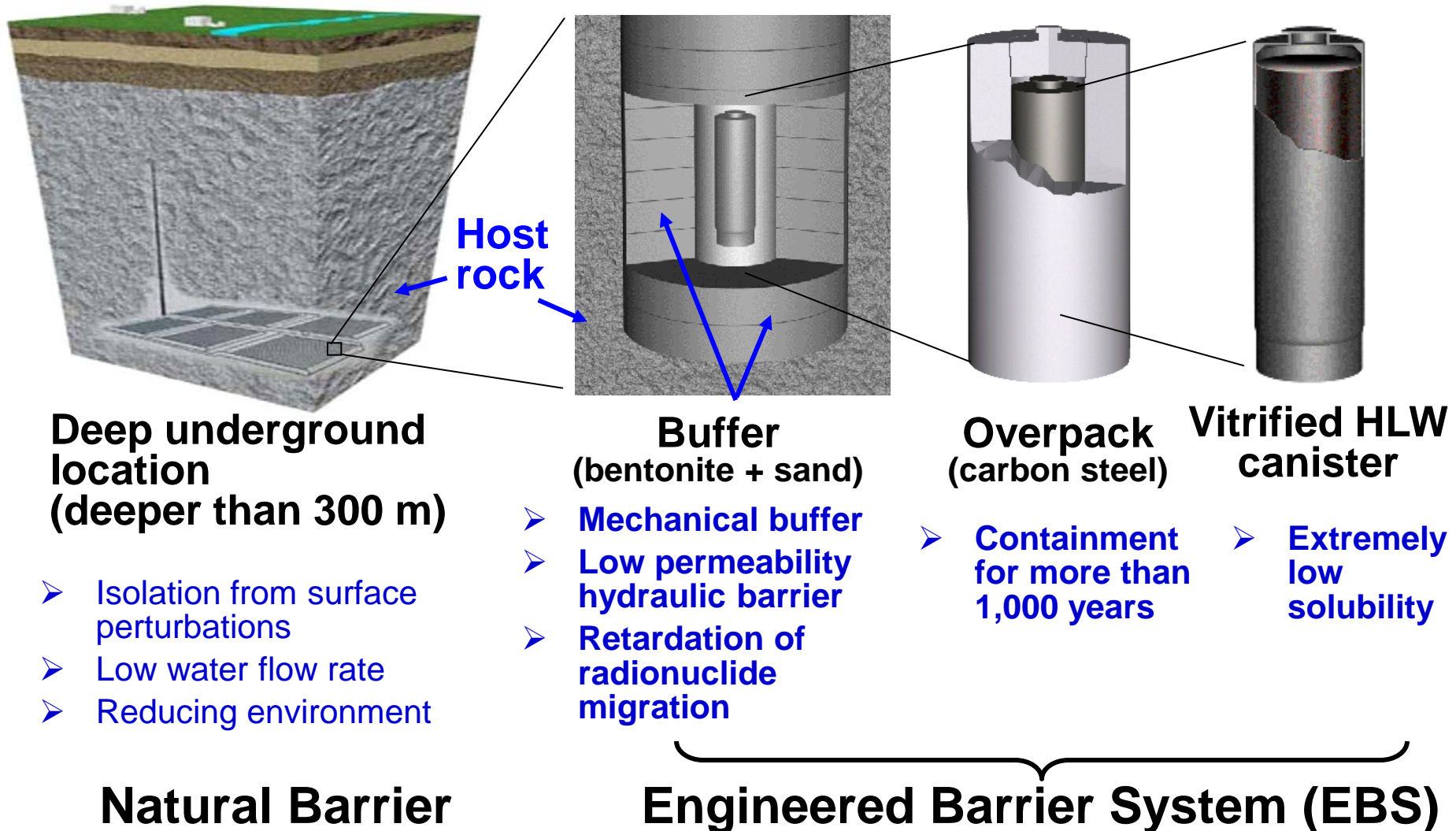
- **NUMO is responsible for disposing of HLW and TRU waste** (wastes from the reprocessing of spent nuclear fuel) in the deep geological formation.
 - Site selection^(*) and characterization
 - Design, licensing, construction, operation and closure of repository
 - Public relations
 - Collection of fund

(*) **The site selection approach consists of three stages:** 1) Literature Survey, 2) Preliminary Investigation, 3) Detailed Investigation.

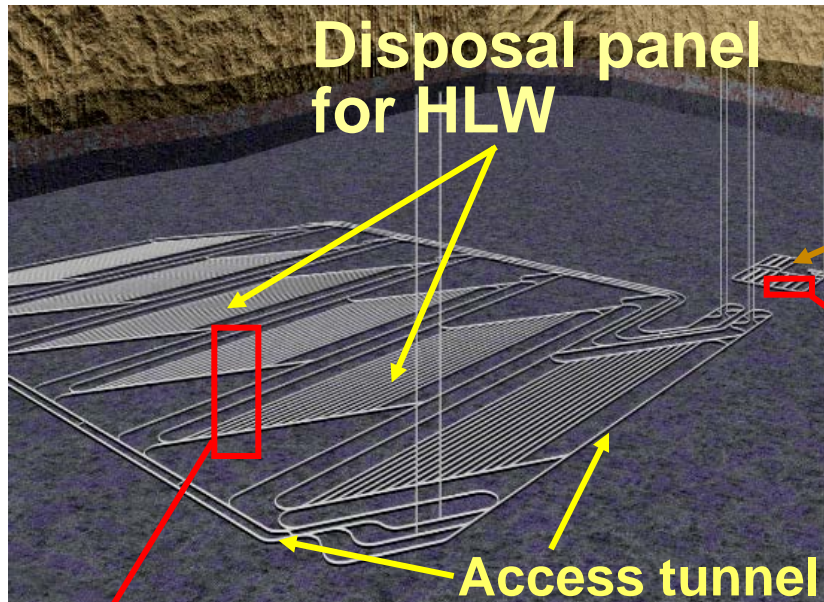
Organizations and Roles in the HLW Disposal Program



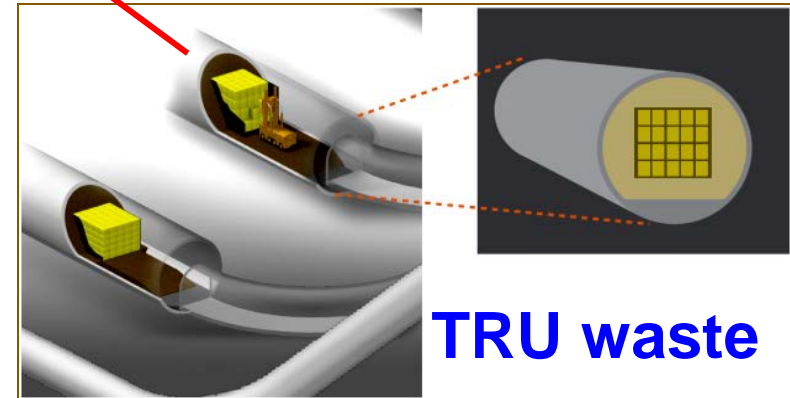
HLW disposal concept in Japan (Multi-barrier concept)



Typical repository layout



(HLW/TRU co-location option)



	Pit disposal	Tunnel disposal
Hard rock		
Soft rock		

HLW

Emplacement of waste packages

Three Stages of Site Selection Process

(*) This route was added after **Toyo town case (2007)**

Municipalities invited by the Government (*)

Volunteer municipalities

Literature survey

Selection criteria

1st stage

Selection of PIAs

Preliminary Investigation
- Geophysical survey
- Borehole drilling etc.

Selection criteria

2nd stage

Selection of DIAs

Detailed Investigation
- Excavation of test tunnel
- Investigation in the test tunnel

Selection criteria

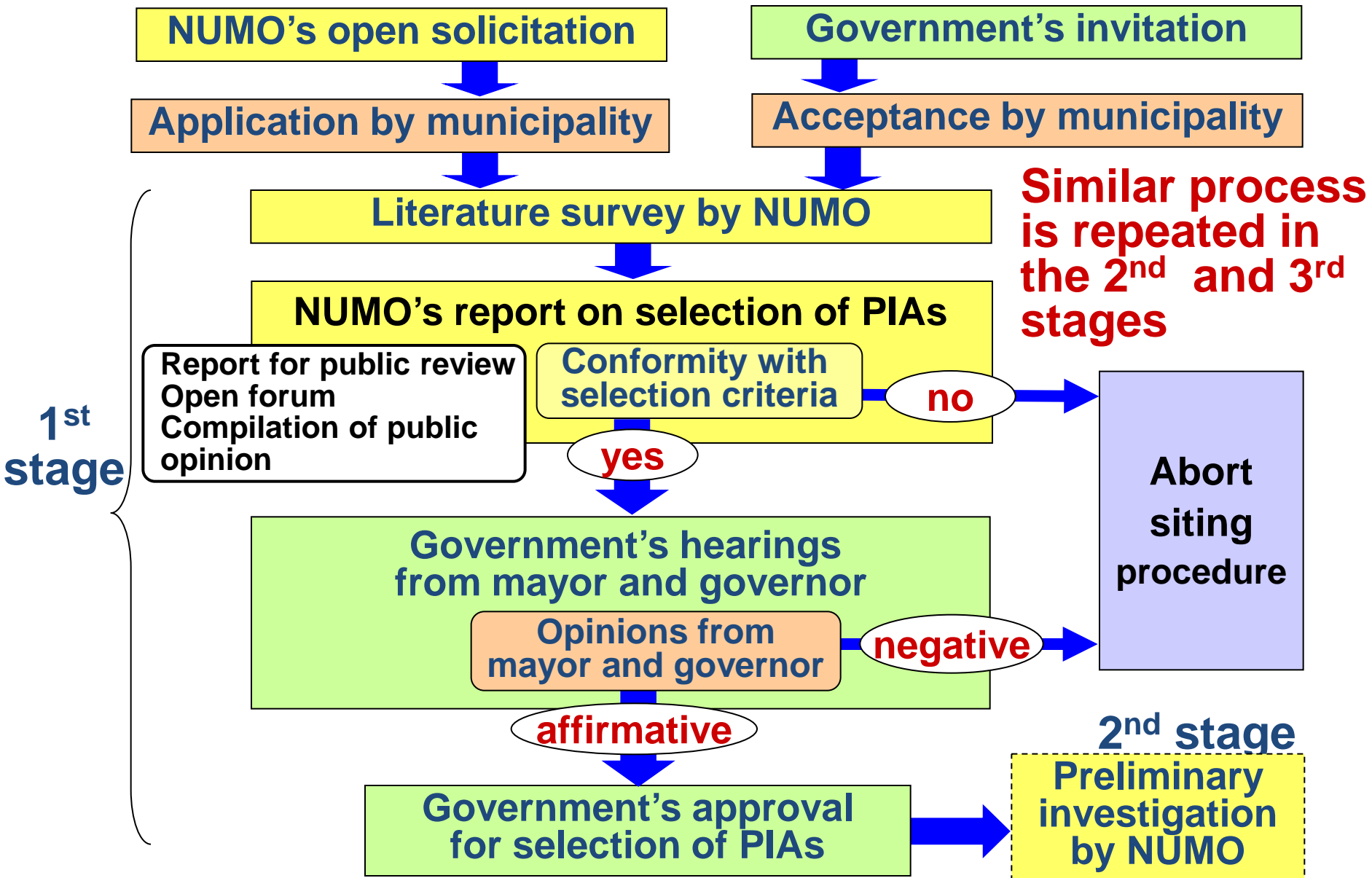
3rd stage

Selection of RS

Late 2020s

● Government's hearings from governor and mayor

Siting procedure (1st stage)



Excerpt from “Basic policies on the final disposal of specific radioactive waste”

(METI Order 591, amended 2008-3-14)

- Pursue the programme while gaining understanding and support from the electricity consumers who receive the benefit of nuclear power generation, in addition to local residents concerned with the siting process.
- The government, the implementer, reactor owners and other relevant research institutions ensure transparency through thorough information disclosure with mutual cooperation.
- The government, together with the implementer and utilities, proactively engage in outreach activities for the public to gain knowledge and to raise the awareness of energy issue, the benefit of nuclear energy, and the importance and safety of the final disposal, through diverse PR media.
- The government, utilities and the implementer perform each duty with proper role sharing and mutual cooperation, for sufficiently providing regional support to the communities concerned with the final disposal project.
- The government and the implementer clarify the costs required for the final disposal project and the subsidy program for fostering public understanding.

Six Proposals in a Reply of Science Council of Japan (SCJ) to Atomic Energy Commission (AEC) Sept. 11, 2012*

- 1) Fundamental reconsideration of policies related to disposal of high-level radioactive waste (HLW**);
- 2) Awareness of the limits of scientific and technical abilities and securing scientific autonomy;
- 3) Rebuilding a policy framework centered on temporal safe storage and management of the total amount of HLW;
- 4) Necessity of persuasive policy decision procedures for fairness of burdens;
- 5) Necessity of multiple-stage consensus formation by establishing opportunities for debate; and
- 6) Awareness that long-term persistent undertakings are necessary for problem resolution.

* In September 2010, the Science Council of Japan (SCJ) received a deliberation request from the Japan Atomic Energy Commission (AEC), and SCJ formed a Review Committee for Disposal of High-Level Radioactive Waste. The Review Committee made a Reply on Disposal of High-Level Radioactive Waste in September 2012

HLW** : **Vitrified HLW and/or Spent Nuclear Fuel** in the Reply of SCJ to AEC

Setting a Moratorium Period of “Temporal Safe Storage”

The temporal safe storage is characterized by securing **a moratorium period of several dozen or several hundred years** in order to establish appropriate handling measures for problems.

It provides the advantages of using this period to **refine technological developments and scientific knowledge** and guaranteeing the possibility of creating handling measures that target a longer period.

For example, improvement of the durability of containers, development of **nuclear transmutation technology** to reduce volume and toxicity of HLW, and research related to the stability of geological layers ,

In addition, the temporal safe storage makes it possible to **keep various options for future generation** to choose for final disposal of HLW.

“Management of the Total Amount” of HLW

Management of the total amount has two connotations:

“Setting an upper limit for the total amount”

and/or

“Controlling increases of the total amount”

“Setting an upper limit for the total amount” corresponds to the **withdrawal from nuclear power**; setting upper limits in accordance with the tempo of that withdrawal.

“Controlling increases of the total amount” corresponds **to keeping nuclear power in future** with strictly controlling increases of the total amount, and the amount of waste per unit of generated power must be controlled to the smallest amount possible.

To respond to the **concerns on the limitless increase of HLW**

Current Status of HLW and Challenges

Current Status:

1,984 HLW canisters (vitrified wastes) (1,734 (1,442 from France/UK and 295 from test operation of Rokkasho) at Rokkasho and 247 at Tokai) + 770 HLW canisters (vitrified wastes) will be sent back from UK

Highly radioactive liquid waste of 406 m³ (corresponds to 630 HLW canisters) at Tokai

Some 17,000 ton Spent Nuclear Fuels (14,000 ton at reactor sites + 3,000 ton at Rokkasho reprocessing plant) : corresponds to some 21,000 HLW canisters (vitrified wastes) if reprocessed (1.25HLW canisters/ton of spent fuel)

Challenges:

- **Nuclear Future in Japan must be decided**
- **Reconstruction of HLW disposal strategy (required in any nuclear future scenarios)**
 - **Securing temporal safe storage (of HLW and/or spent fuel) in any way,**
 - **Reappraisal of the safety of geological disposal,**
 - **Total amount management (less volume, less toxicity)**
- **Siting of HLW disposal (required independent from the choice of nuclear future)**