NUMO's Safety Strategy for implementing Geological Disposal Project

Nuclear Safety Research Forum 2010

Tokyo, Japan

23 February, 2010

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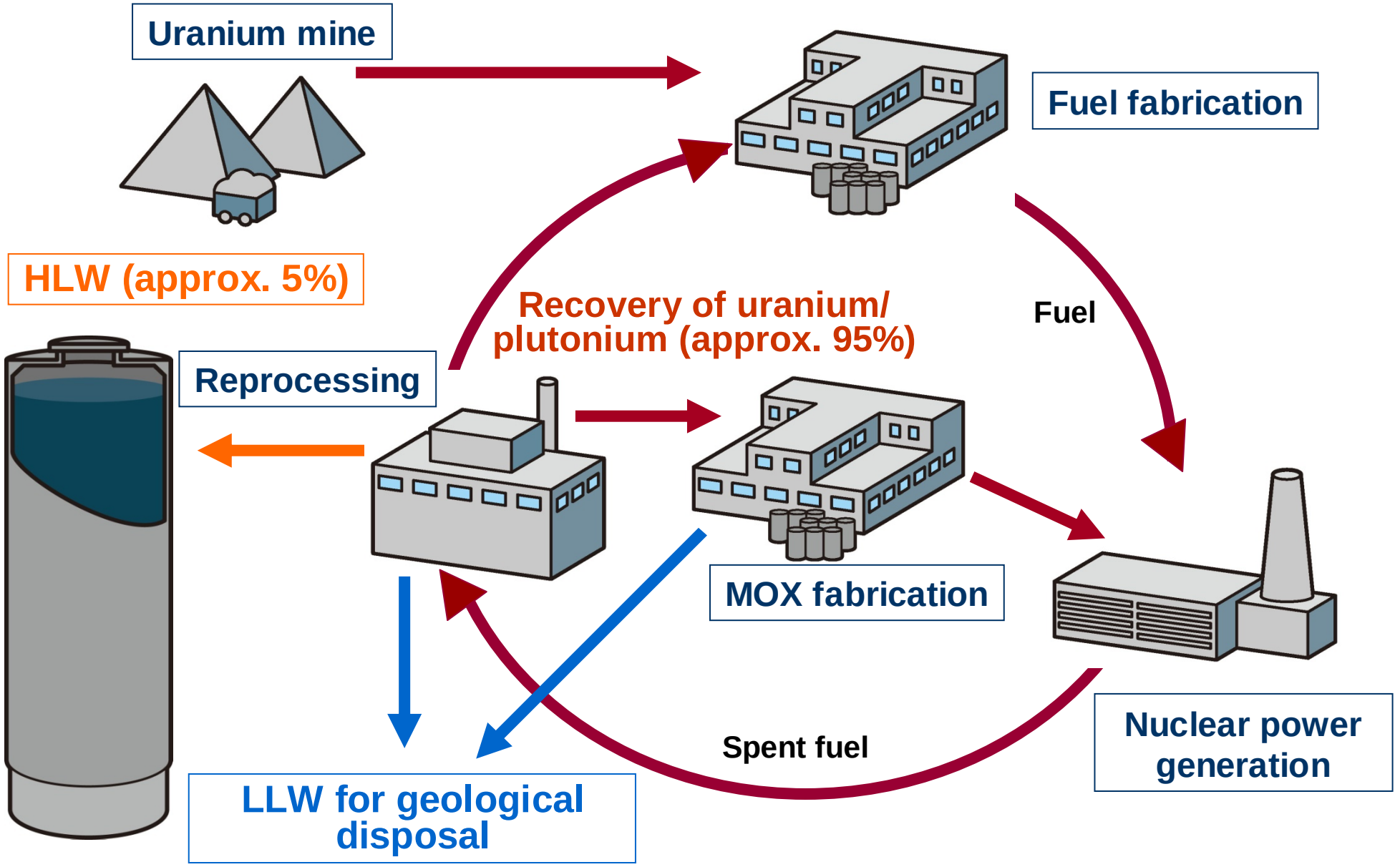
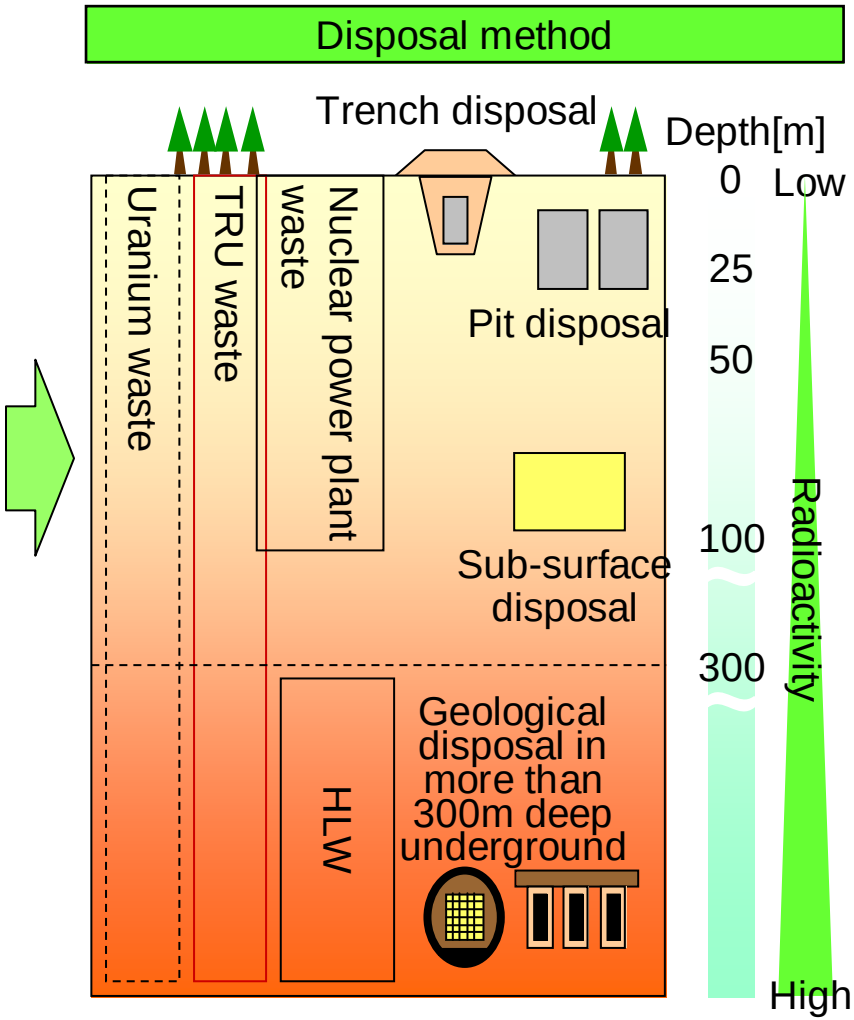
Nuclear Waste Management Organization of Japan (NUMO)

Nuclear fuel cycle



Classification of radioactive wastes & disposal methods

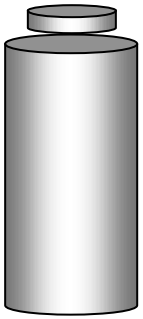
Generation point	Category			Example of disposal
Nuclear power plant	LLW	Nuclear power plant waste	VLLW	Near-surface
			LLW	
			HLLW	Sub-surface
Uranium enrichment/ fuel fabrication plants		Uranium waste		Near-surface
				Sub-surface
				Geological (undecided)
Reprocessing/ MOX fabrication plants		TRU waste		Near-surface
				Sub-surface
				Geological
Reprocessing plant	HLW			Geological



Classification of specified radioactive wastes

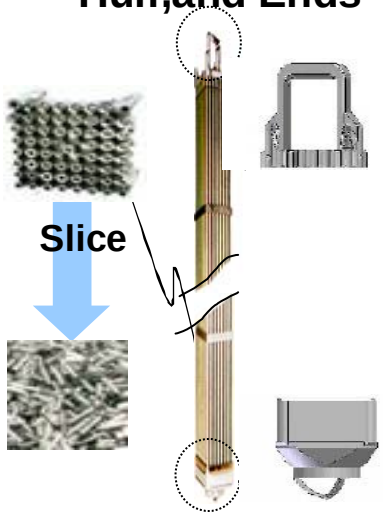
Specific 1st radioactive Waste

HLW

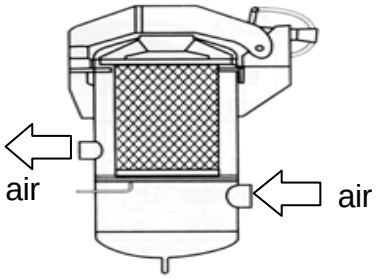


Specific 2nd radioactive Waste

Hull,and Ends

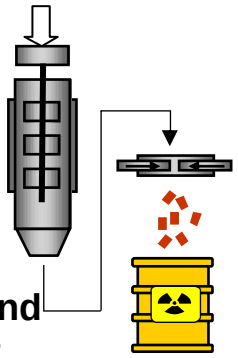


TRU



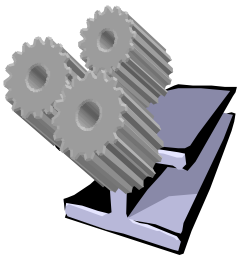
Spent silver adsorbent

Nitric acid drain

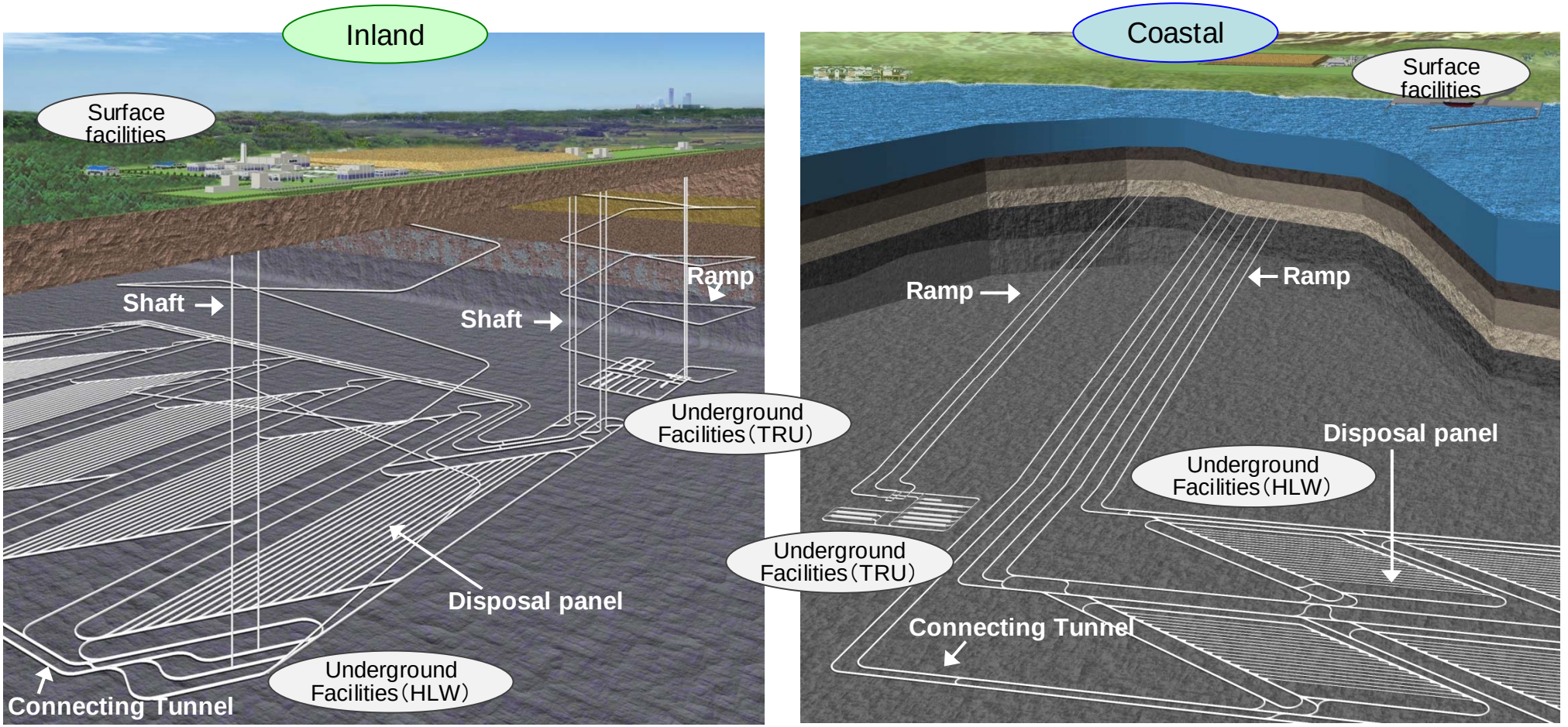


Dry and pellet

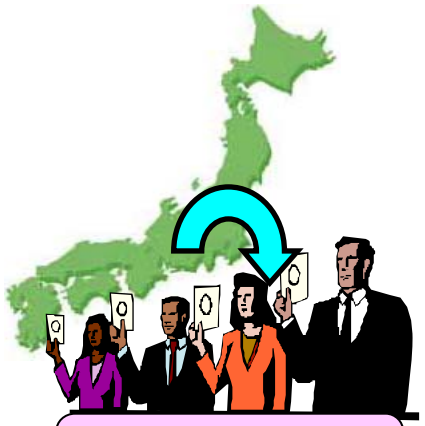
High concentration radioactive waste



Layout example of disposal facilities

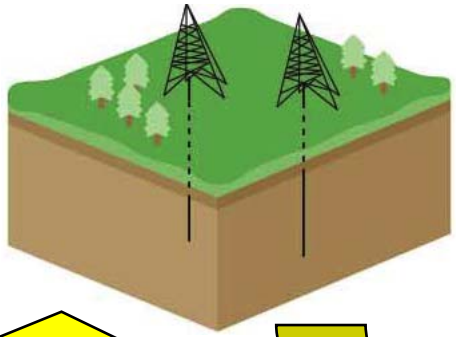


Three Stages of the Selection Process

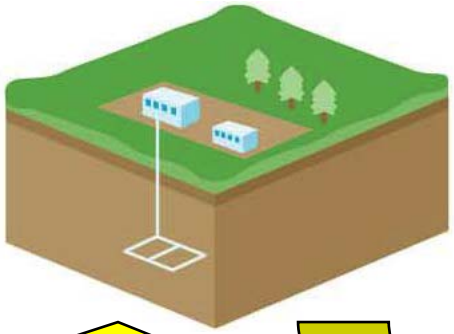


Volunteer Areas

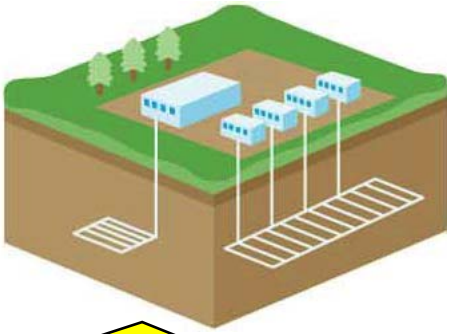
Preliminary Investigation Areas (PIAs)



Detailed Investigation Areas (DIAs)



Repository Site (RS)

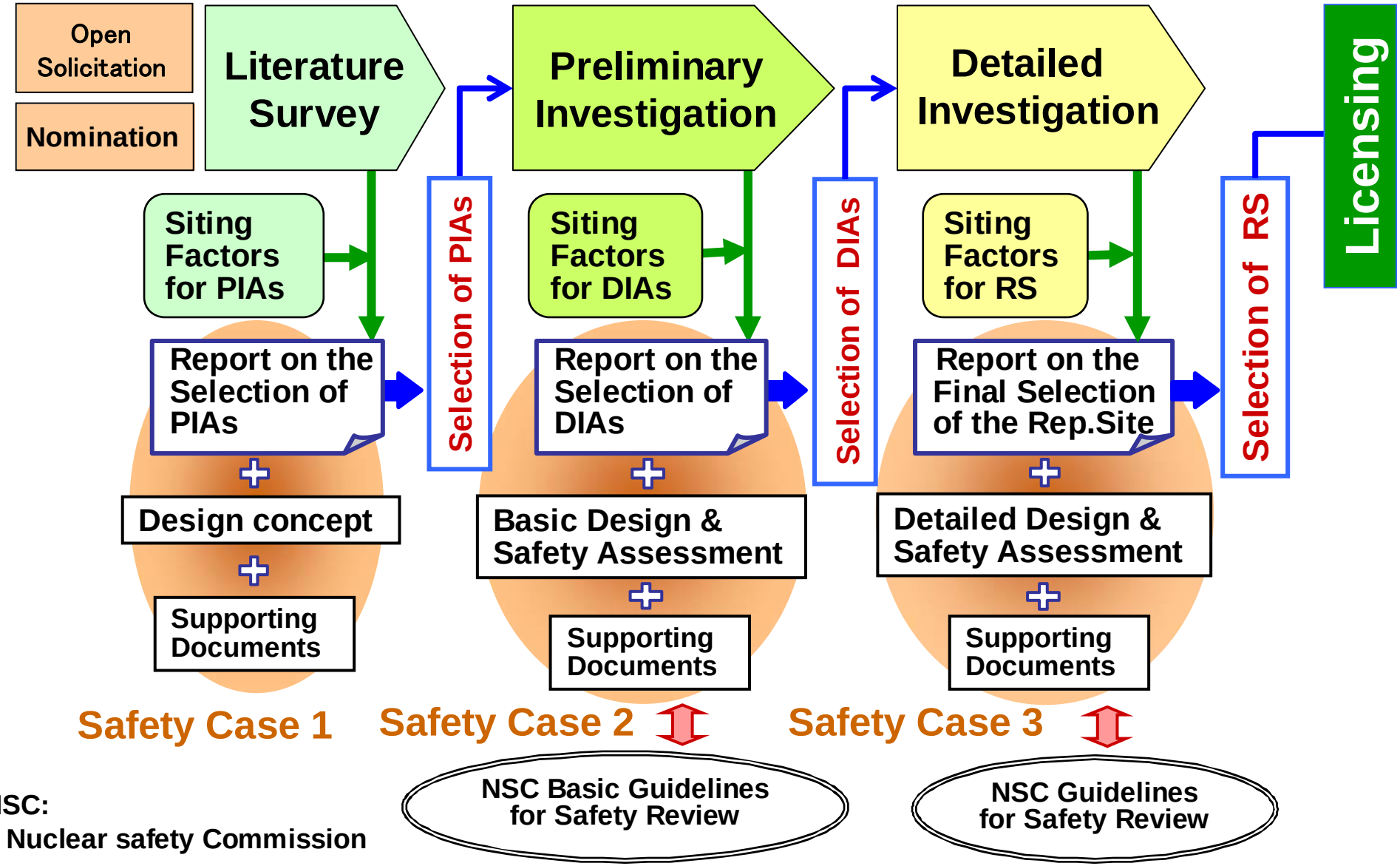


Selection of PIAs by Literature Surveys

Selection of DIAs by Surface-based Preliminary Investigation
- Geophysical survey
- Borehole drilling, etc

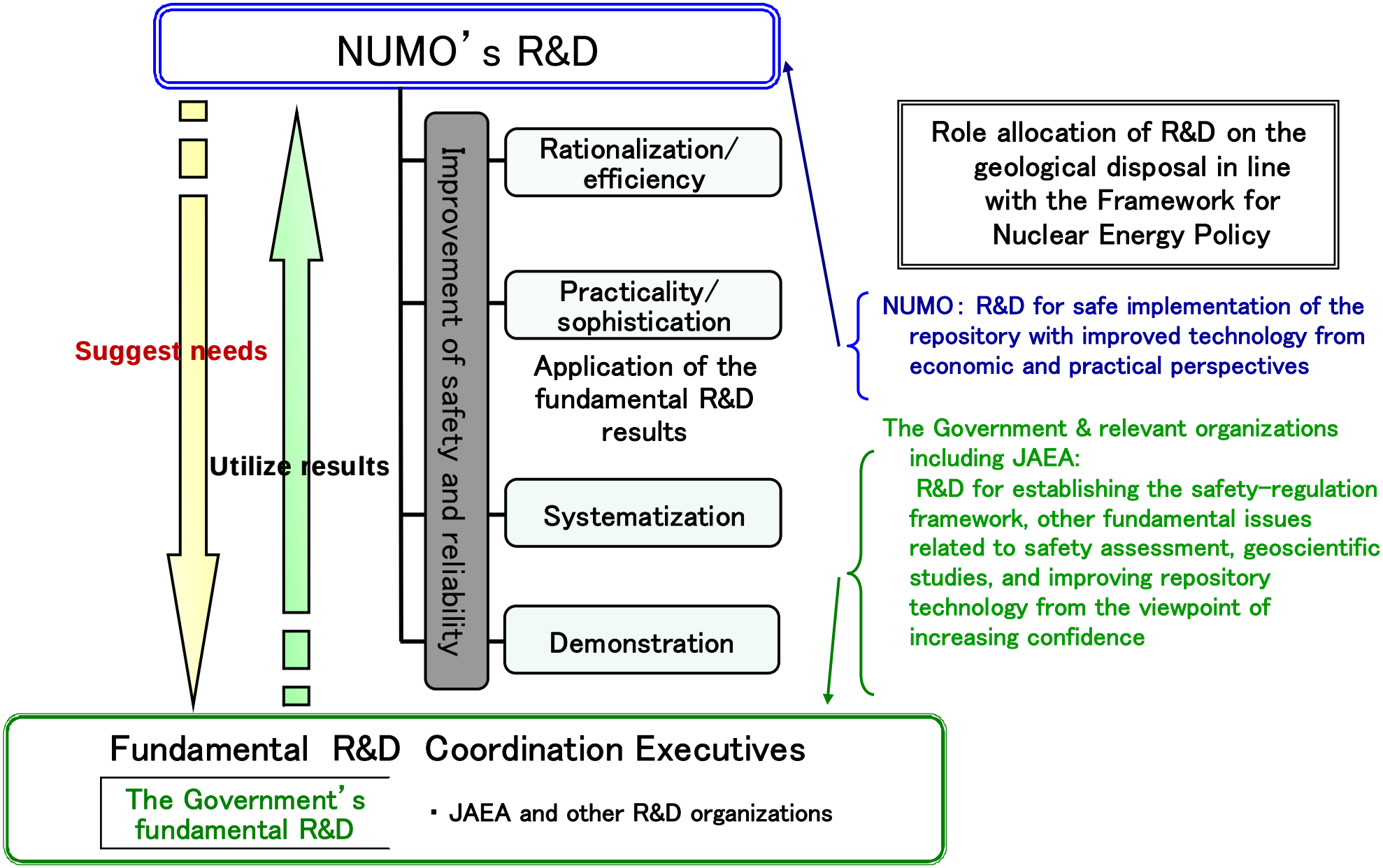
Final Selection of Repository Site by Detailed Investigation including measurements and tests in the underground facility

Stepwise Refinement of the Safety Case

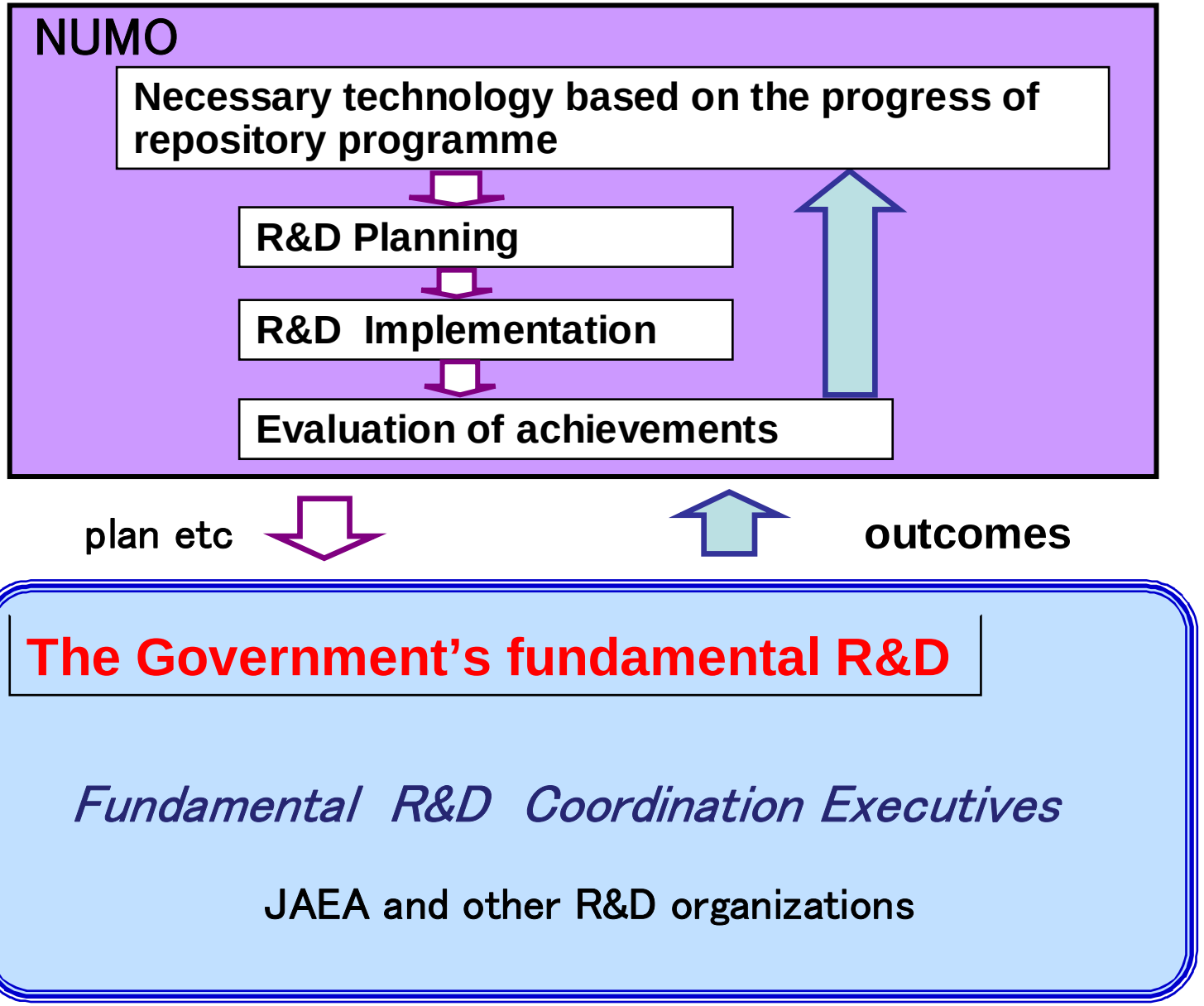


NSC:
Nuclear safety Commission

NUMO's R&D Roles



Close cooperation with R&D organizations



Reflection of NUMO needs in Government's fundamental R&D

Objective:

For implementing the geological disposal in line with the recommendation by the Advisory Committee on the Evaluation of Framework for Nuclear Energy Policy of AEC, NUMO develops and reflects its R&D needs to the Government's fundamental R&D plan, from the perspective of the implementer.

Basic policy:

- Develop NUMO's R&D needs systematically, in particular, focusing on the detailed investigation phase which involves important decision making;
- Cover a wide distribution of geo-environmental conditions, considering the situation where the sites for investigation cannot be identified due to the volunteer siting approach;
- Determine overpack materials, emplacement methods among other important judgments to be made during the detailed investigation period;
- The site-specific needs will be additionally evaluated as appropriate after volunteer applications received.

Important NUMO needs (tentative) – 1/2

From viewpoint of “engineering feasibility”

- Knowledge accumulation on long-term behaviors/ interactions of the engineered barriers

  (e.g. re-establishment of overpack corrosion rate; assessment technology of corrosion resistance of welded parts, etc.)

- Alternative technologies of the engineered barrier system

  (e.g. alternative solidification method of TRU waste, etc.)

- R&D for improving engineering feasibility of fabrication/ transportation/ emplacement of the engineered barriers

  (e.g. sophistication of element technologies on transportation/ emplacement of engineered barriers using PEM/ block/ pellet)

- Confirmation/ demonstration of technologies for investigation/ assessment of geological environment

  (e.g. applicability of technologies for deep geological investigation in coastal/ marine areas)

Important NUMO needs (tentative) – 2/2

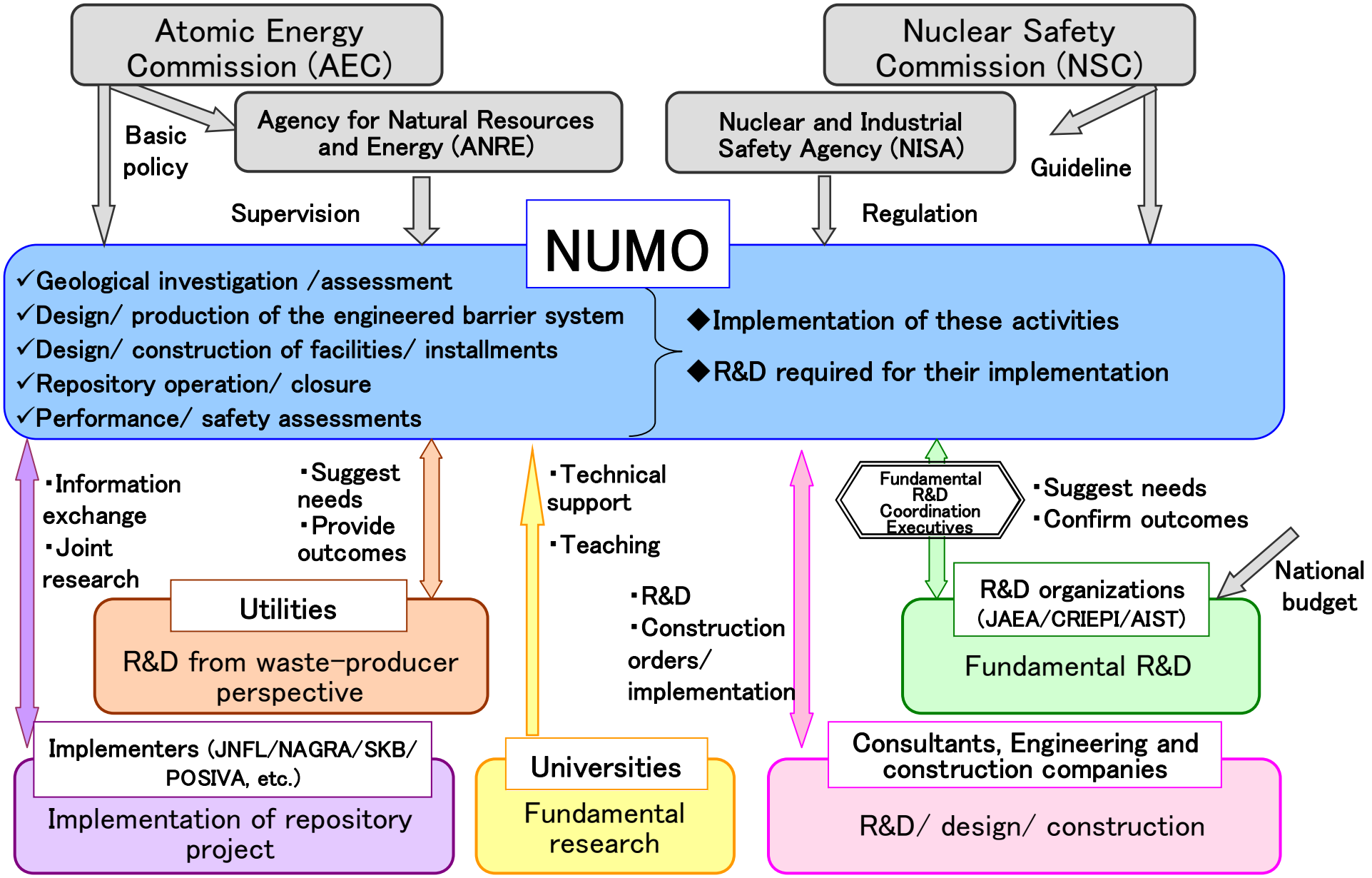
- **Needs from viewpoint of "safety assessment"**
  - R&D on the performance assessment scenarios based on probability
  - R&D on the performance assessment considering the long-term evolution of geological environment

    (e.g. standardization/ validation of conditions for performance assessment)

- **Needs from viewpoint of "long-term safety assessment of geological environment"**
  - Review on methods/concepts of extremely long-term assessment

    (e.g. more than 100,000 years)

Overview of R&D system



Evaluations and advices by third-party

Promote the project getting evaluations and advices about the issues such as promotion of public understanding from domestic and international experts.

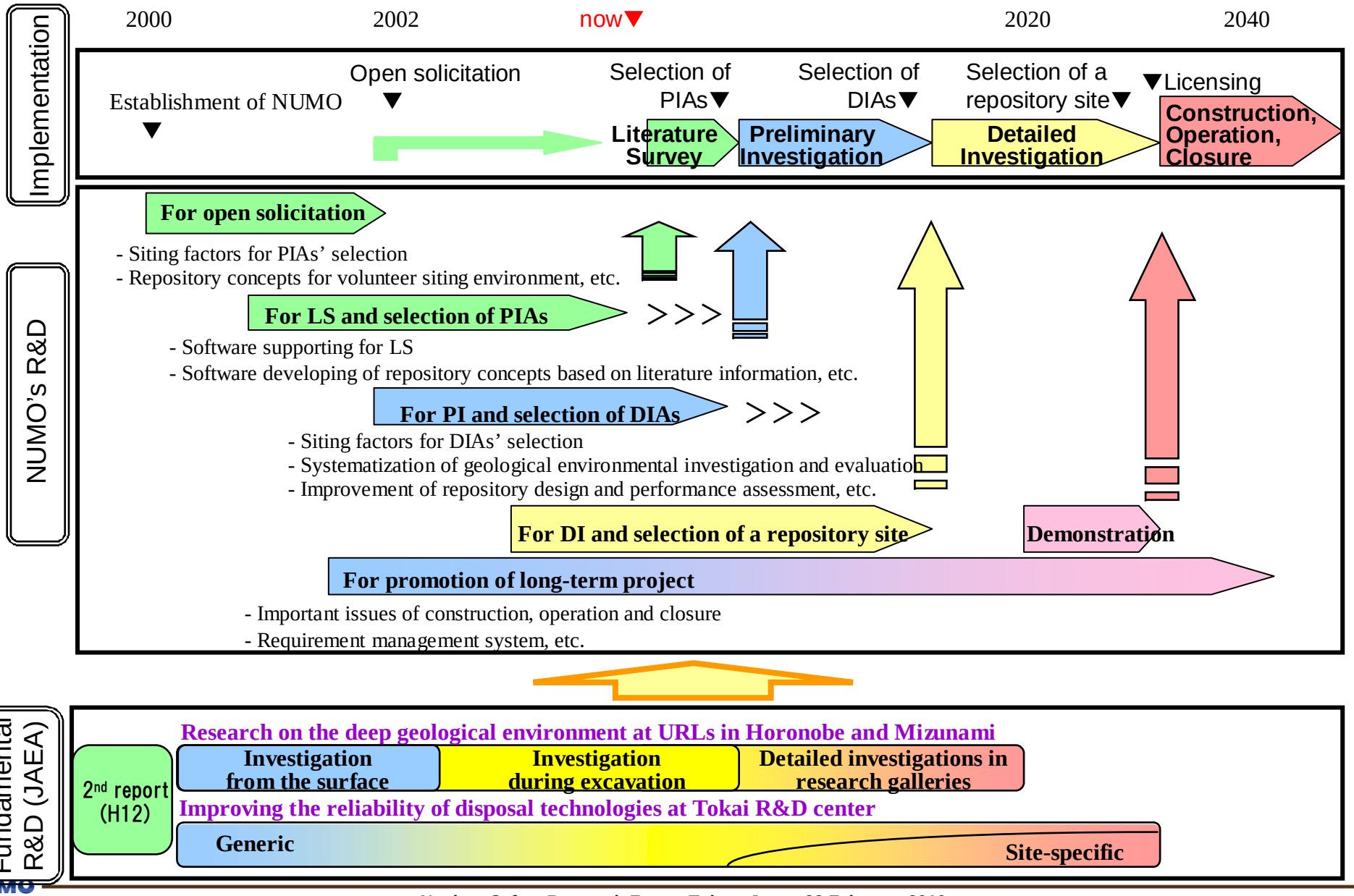
- **NUMO-hosted international meetings**
  - **ITM（International Tectonics Meeting）**

    Example of achievement; Probabilistic assessment of magmatism
- **Evaluations and advices for NUMO's activities by domestic and international experts**
  - **ITAC （ International Technical Advisory Committee)**
  - **DTAC（Domestic Technical Advisory Committee）**

Example of achievement; Information Package
(「Repository Concepts」,「Siting Factors for the Selection of Preliminary Investigation Area」)
Technical Reports
(「Technology and Safety of High Level Radioactive Waste Geological Disposal Background and Technical Justification of Siting Factor for the Selection of Preliminary Investigation Area」)

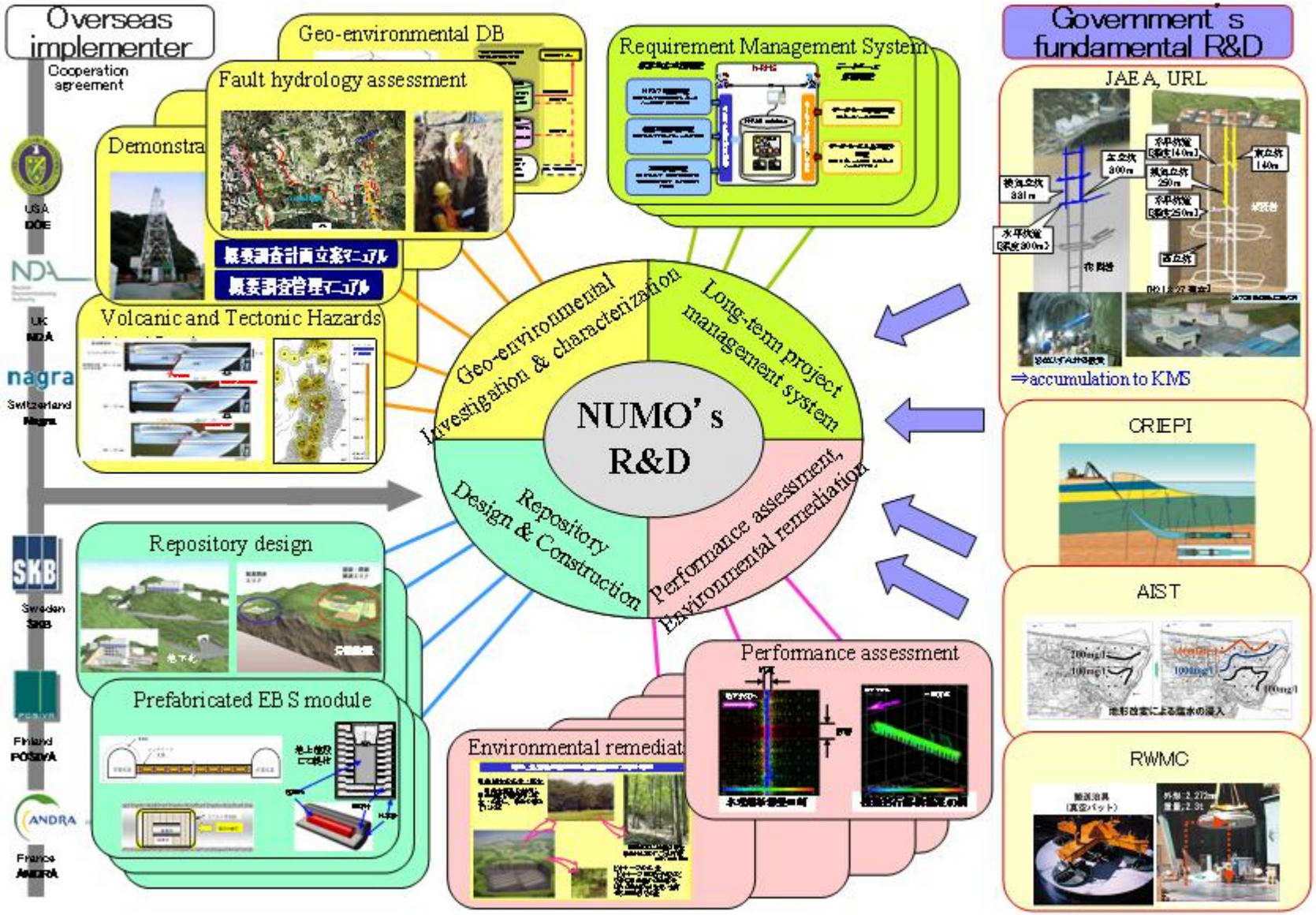
Schedule of implementation and R&D of NUMO

NUMO is driving to implement the deep geological disposal by doing NUMO's R&D.



Current situation of NUMO's R&D

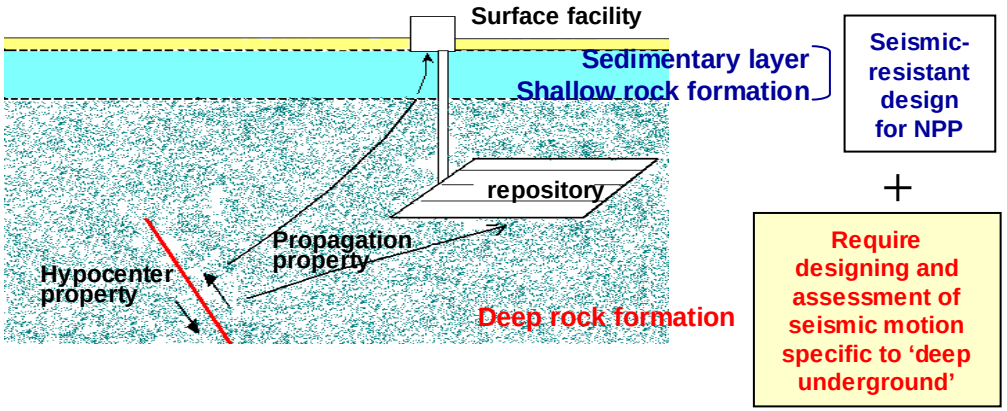
On-going R&D activities



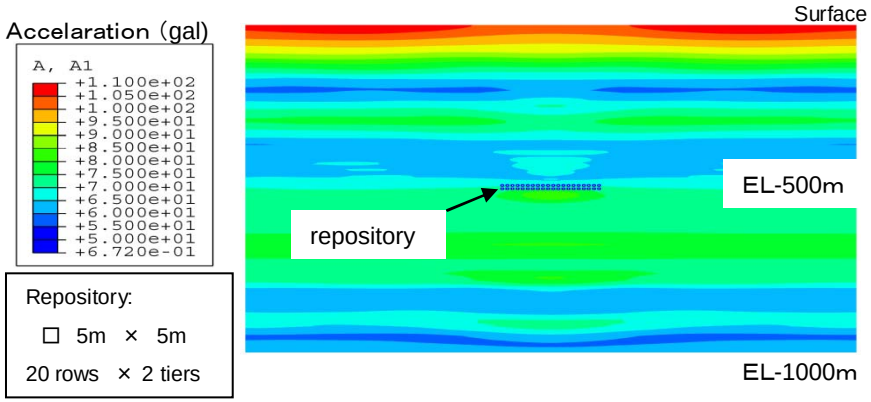
Case1: Improvement of assessment technology for seismic/fault activities

Objective: Establish methods for designing seismic-resistant repository; assessing active folds

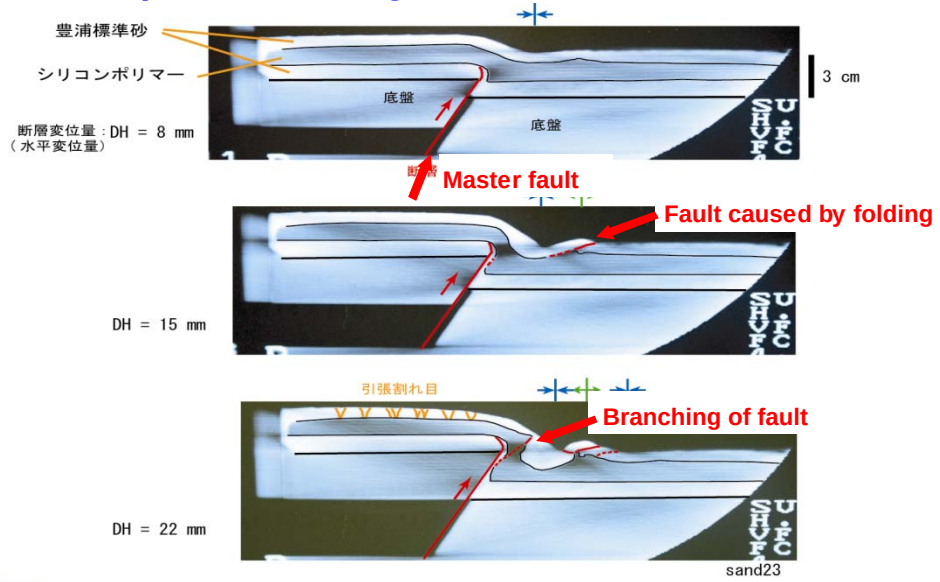
Characteristics of deep-underground seismic motion



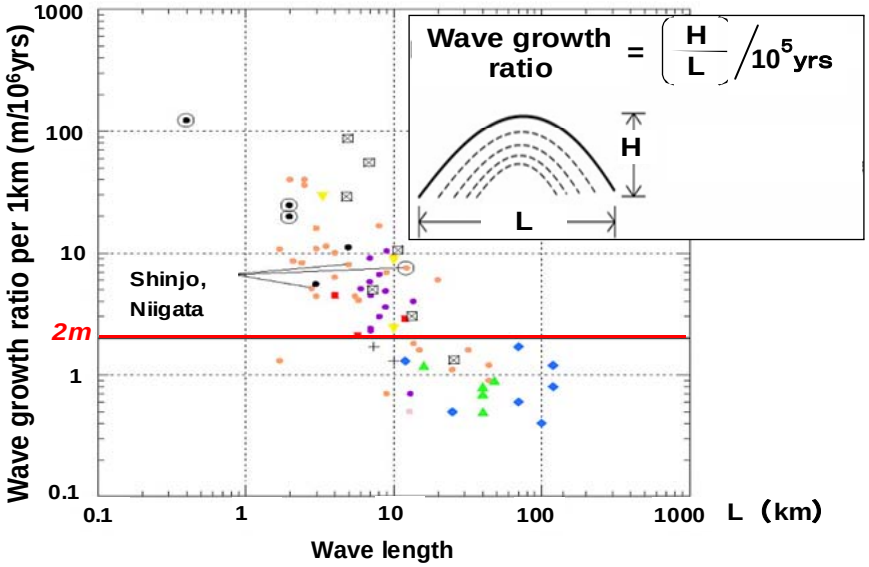
Seismic response identified by 2D dynamic analysis



Model experiment using CT- scanner



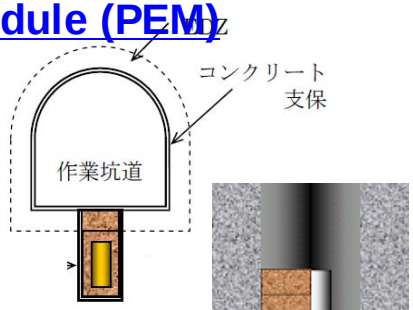
Identification of relevant active fold zones



Case2: Improvement of technologies for construction/operation systems

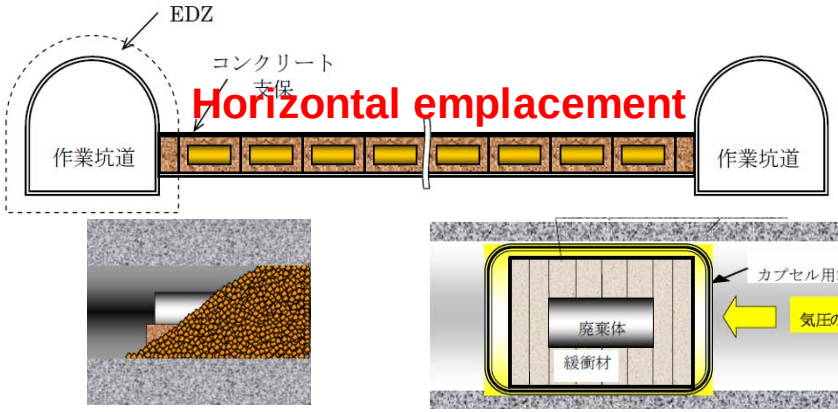
Objective: Review comparison of waste emplacement methods; applicability of low alkaline cement

Assessment of vertical/ horizontal emplacement using the Prefabricated EBS Module (PEM)



Vertical emplacement

Block type



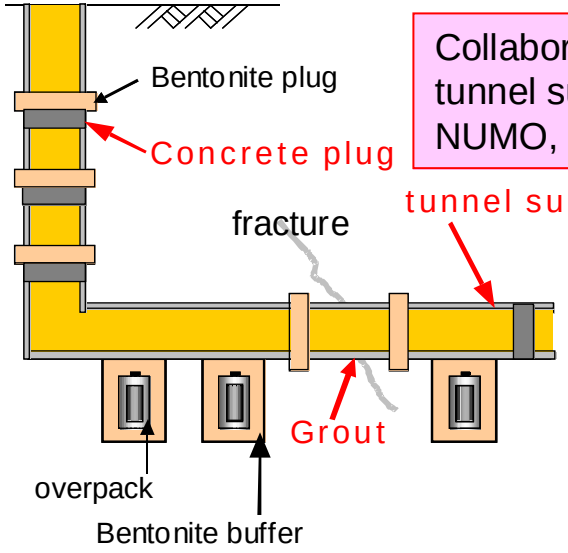
Horizontal emplacement

Pellets type

Combination of PEM and the capsule transportation system

Repository construction technology using low alkaline cement

Corrosion test in low alkaline environment, using carbon fiber material – alternative for steel material (photo images: production of test material)



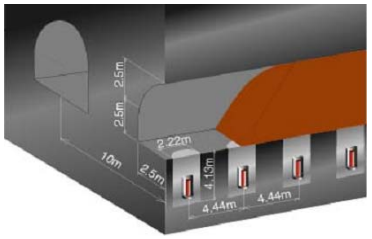
Collaborative research on tunnel support, plug, etc. (e.g. NUMO, CRIEPI)

Collaborative research on applicability to grout (e.g. NUMO, SKB, POSIVA, Nagra)

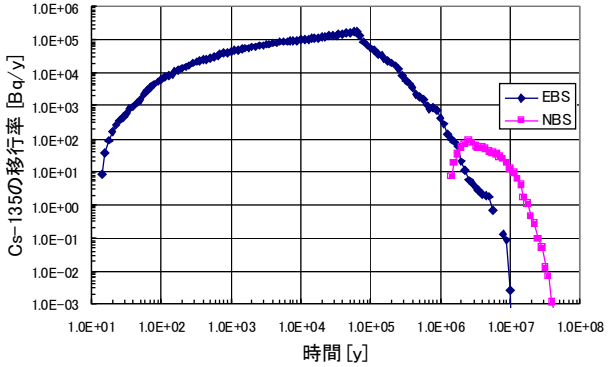
Case 3: Improvement of repository design by 3D analysis of radionuclide migration

Objective: Develop the 3D analysis code of radionuclide migration, which allows simulation of its detailed behaviors, to study their effects on different repository designs

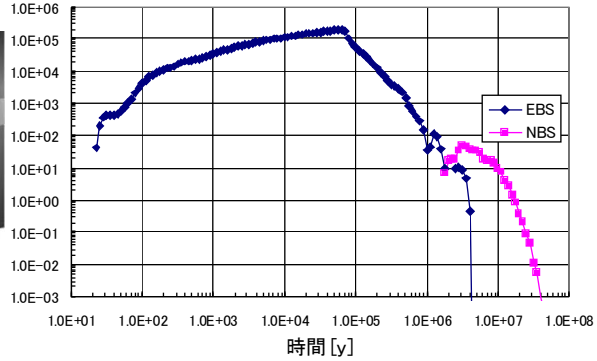
Comparison of release between different waste emplacement methods



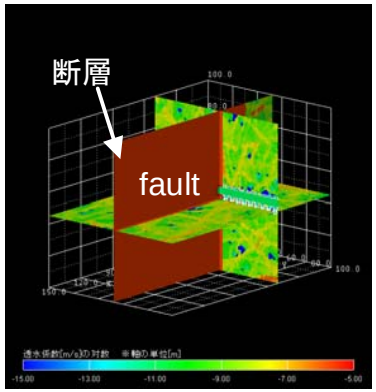
Vertical emplacement



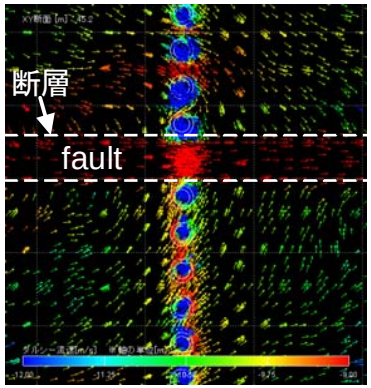
Horizontal emplacement



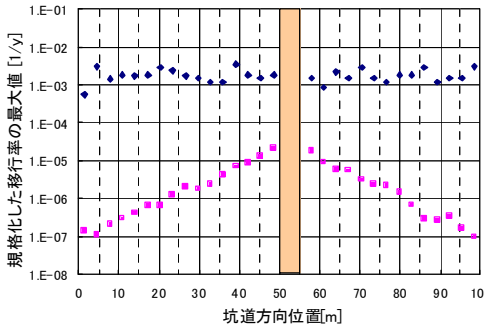
Effect of plug for a fault – groundwater flow analysis



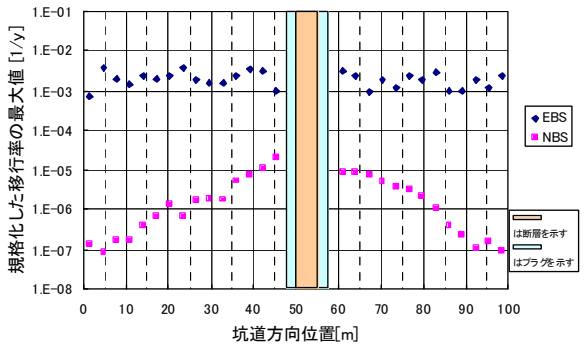
3D model



Cross-sectional flow velocity distribution



Without plug

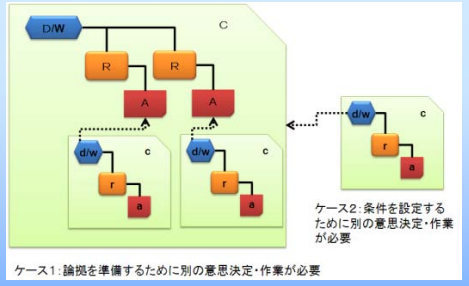


With plug at crossing of fault and tunnel

Case 4: Development of Requirements Management System

Conceptualization of requirements management and engineering works

Works and RM process for the stepwise program.



Info. exchange with oversea organizations

"**RMS2010**" held in Tokyo at 26/Jan./2010

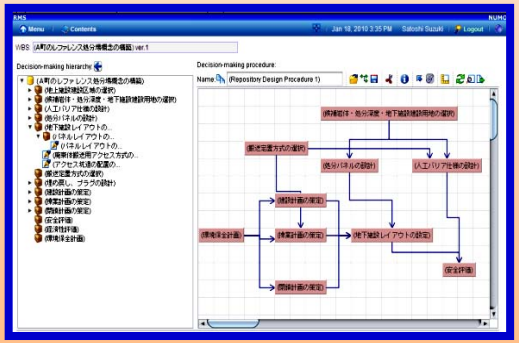
NUMO, SKB, POSIVA, ONDRAF/NIRAS, Nagra, domestic organizations

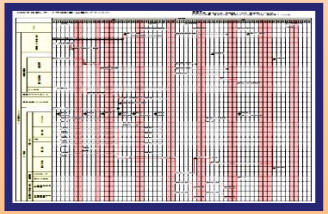
Preparation of *e*-contents

- Contents for "repository design at each site-selection stage
- Trial use of the outcomes of the fundamental R&D (e.g. JAEA-KMS)

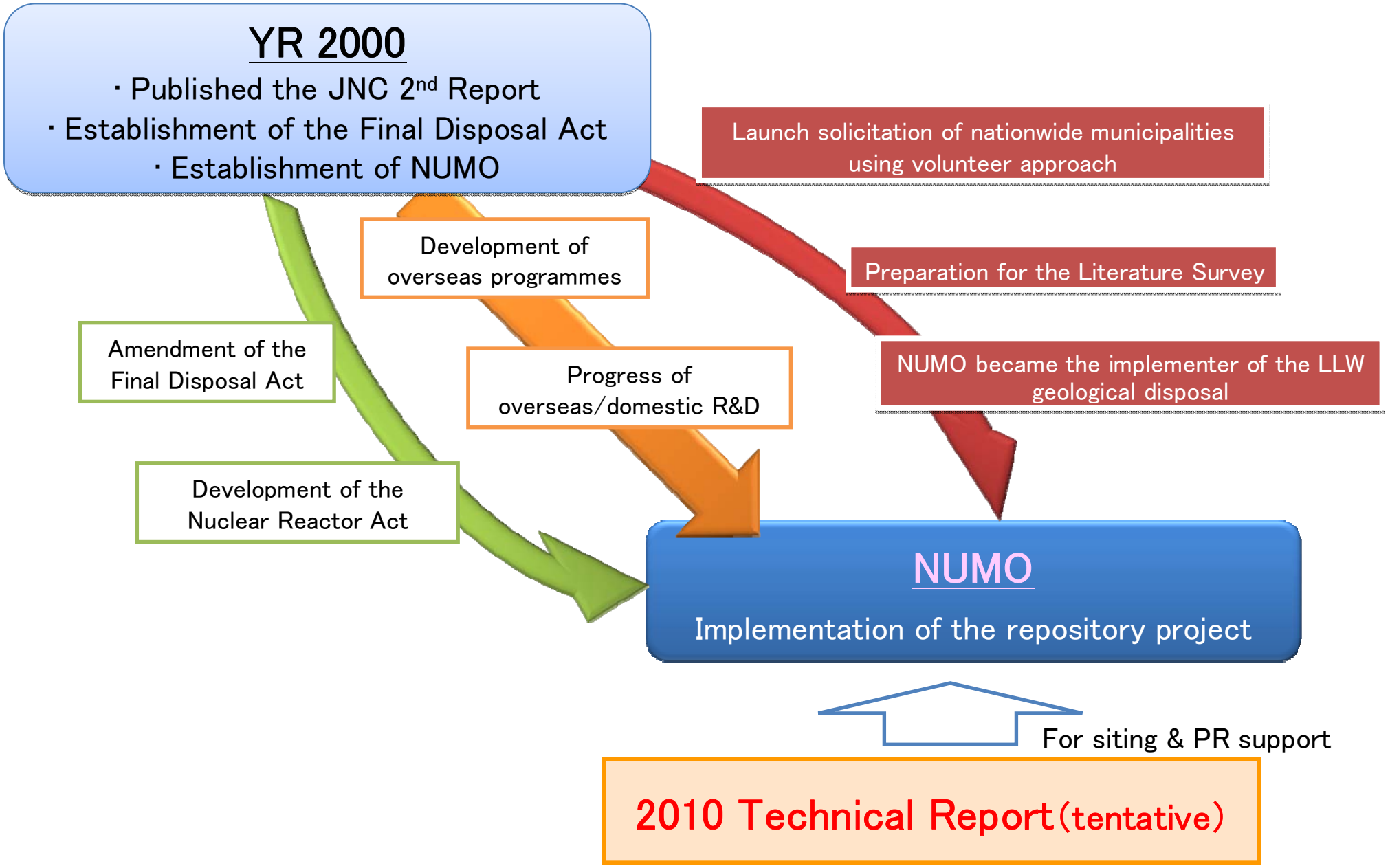
Developments of NUMO-RMS

- Original system suitable for RM in NUMO and the stepwise program.





Background of 2010 Technical Report

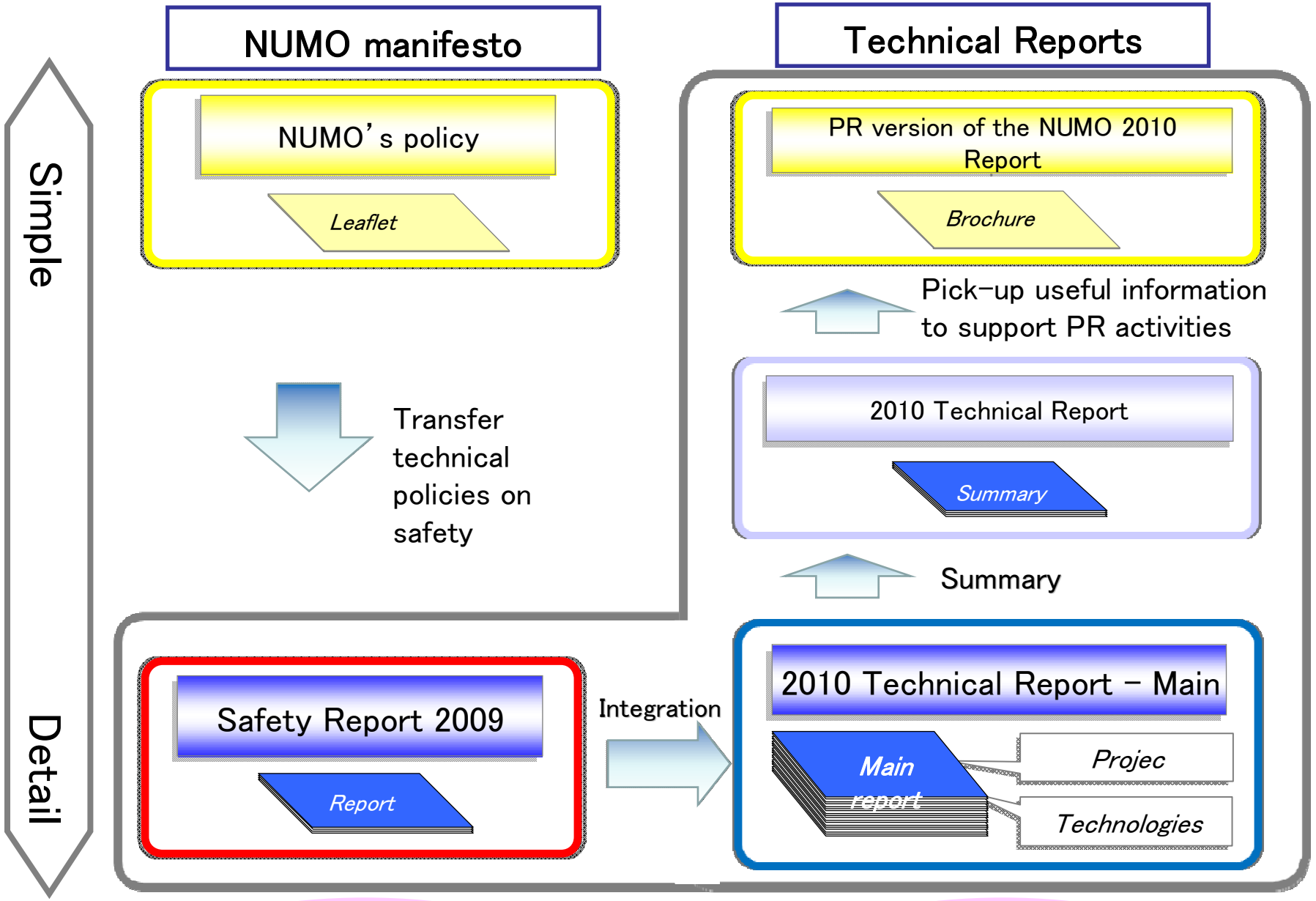


Objectives of 2010 Technical Report

For building public confidence in NUMO's repository project,

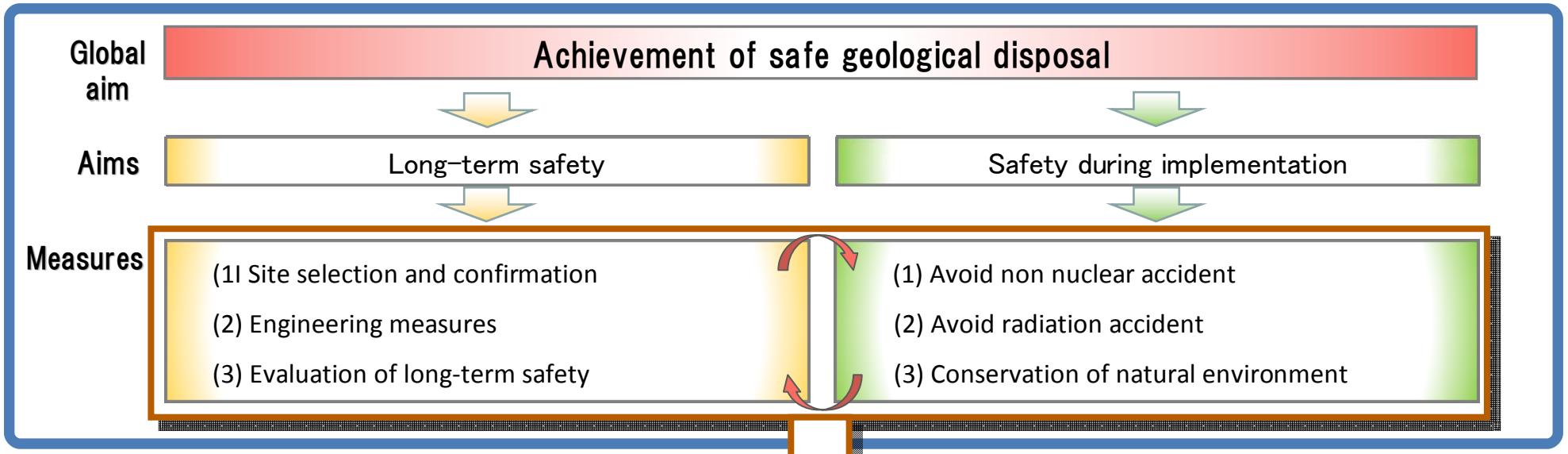
- Clarify NUMO's safety concepts (precedent publication in 2009):
  - Specify the safety measures
  - Express NUMO's policies on its technical activities for ensuring safety
- Demonstrate Japanese technology advancement, which supports NUMO's safety concept
  - Incorporate NUMO's R&D and the Government's fundamental R&D activities since 2000

Series of the NUMO 2010 Report group



Structure of the Safety Report 2009

Chapter 2: Breakdown of the structure of safety



Chapter 3: Policies and measures for implementation of safety geological disposal project

Policies

Policy 1

Implementation by step-wise decision making based on repetitious confirmation of safety

Policy 2

Implementation by credible (reliable) technologies

Policy 3

Technical works toward public confidence building

Breakdown of policy

- Implementation by step-wise decision making based on the advance planning
- Repetitious confirmation of safety by coordination between 3 measures
- Ensuring safety during implementation

- Well planned R&D
- QA of technical information
- Organizational

- Implementation based on understanding of safety by local residence
- Information disclosure (e.g. demonstration of technologies)
- Consideration for future generation

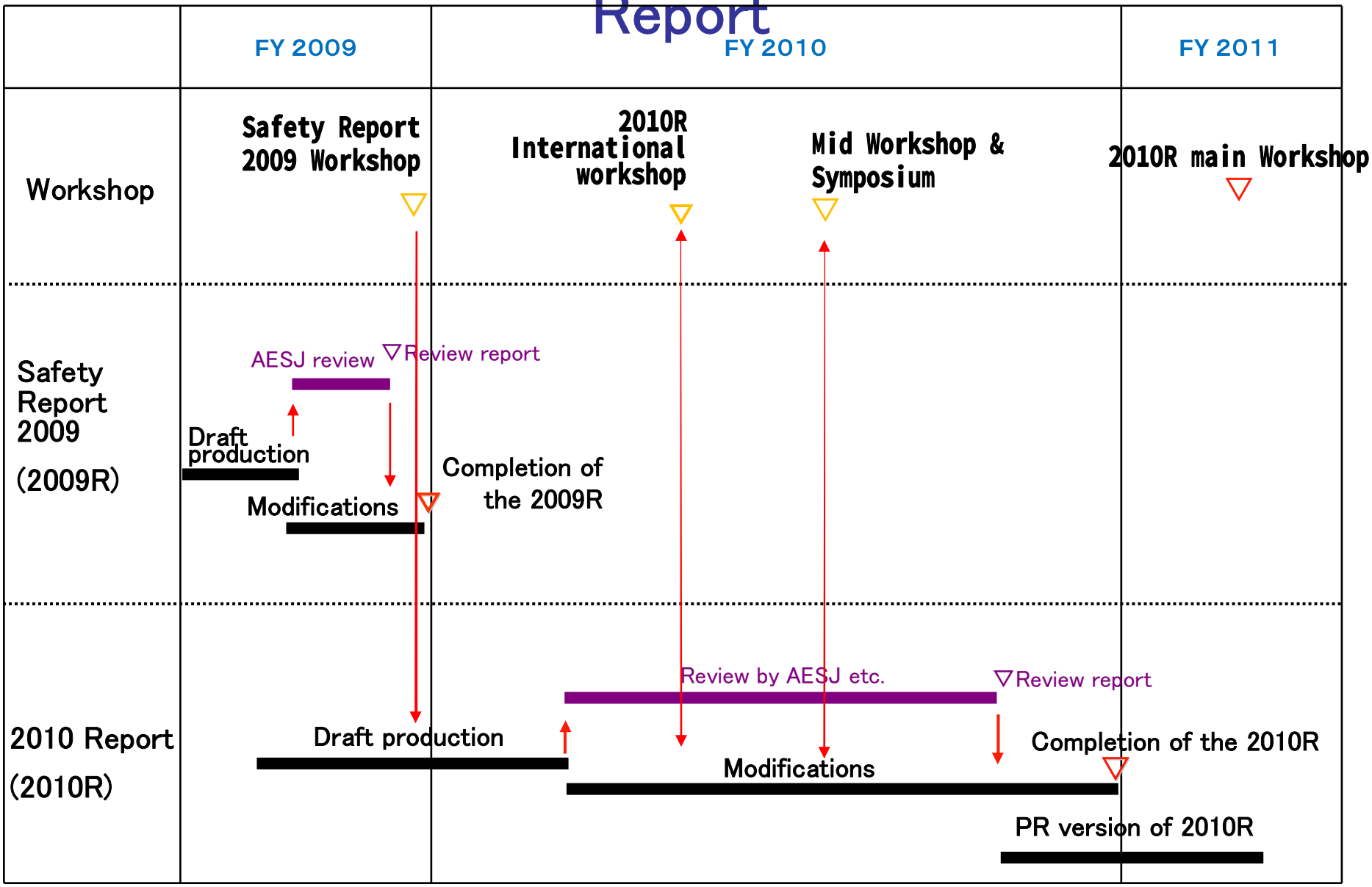
Chapter 4: Detail descriptions

Section 4.1

Section 4.2

Section 4.3

Drat schedule for production of the 2009 & 2010 Report



Summary

✓Preparation for the literature survey has completed.
- Reliability improvement by showing recent findings -

✓Develop & publish the 2010 Technical Report for obtaining the public confidence toward NUMO's repository project and its safety; promoting its project implementation

✓In regards to stepwise research & technical development, their comprehensive visions and progress will be laid out to the general public in an easily understood manner;

✓For ensuring the transfer of NUMO's technology, the required human resources will be secured and fostered with the mid and long term vision.

Thank you
for your attention

For further information:
www.numo.or.jp/en/index.html