

# **Geological Disposal of Radioactive Waste in Japan**

**July 2008**

**Nuclear Waste Management Organization of Japan**

# Nuclear Waste Management Organization of Japan (NUMO)

The Specified Radioactive Waste Final Disposal Act (the Act) was promulgated in June 2000, with a view to ensuring systematic and safe disposal of high-level radioactive waste (HLW). The Act calls for the establishment of an implementing body responsible for disposal, funding arrangements to cover the costs of disposal and a three-step site selection process. The body specified under the Act, NUMO – the Nuclear Waste Management Organization of Japan – was established at the initiative of the electric power companies and other organizations and authorized by the Ministry of International Trade and Industry (now the Ministry of Economy, Trade and Industry) without government participation in October 2000. In June 2007, the Act was revised to provide a framework for management of TRU waste requiring geological disposal. As of April 2008, NUMO was designated as the authorized implementing organization for geological disposal of TRU waste, in addition to its original mission of HLW disposal.

TRU waste is low-level radioactive waste generated during reprocessing and MOX fabrication. The name comes from the transuranium (TRU) elements, i.e. elements with atomic numbers higher than that of uranium.

The Act defines Class 1 specified radioactive waste as vitrified high-level radioactive waste extracted or produced from the reprocessing of spent fuel.

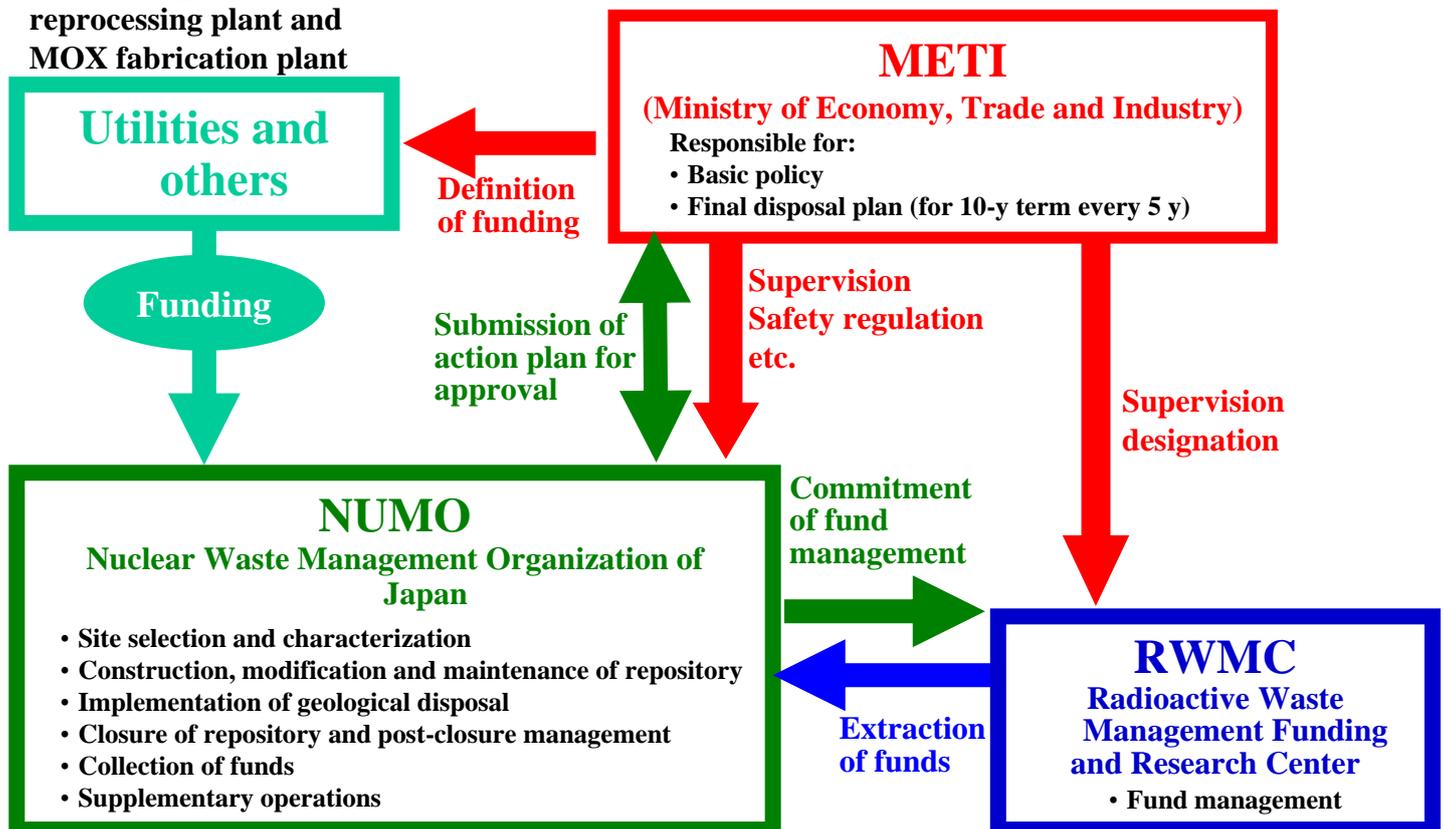
The Act defines Class 2 specified radioactive waste as TRU waste requiring geological disposal.

Class 1 specified radioactive waste is referred to as HLW and Class 2 specified radioactive waste as TRU waste in this brochure.

## Framework for implementation

In close cooperation with the government and the electricity utilities, NUMO will work towards implementing the safe disposal of high-level radioactive waste and TRU waste.

Owners of power reactors,  
reprocessing plant and  
MOX fabrication plant



## **Organization of NUMO**

### i ) Board of Directors

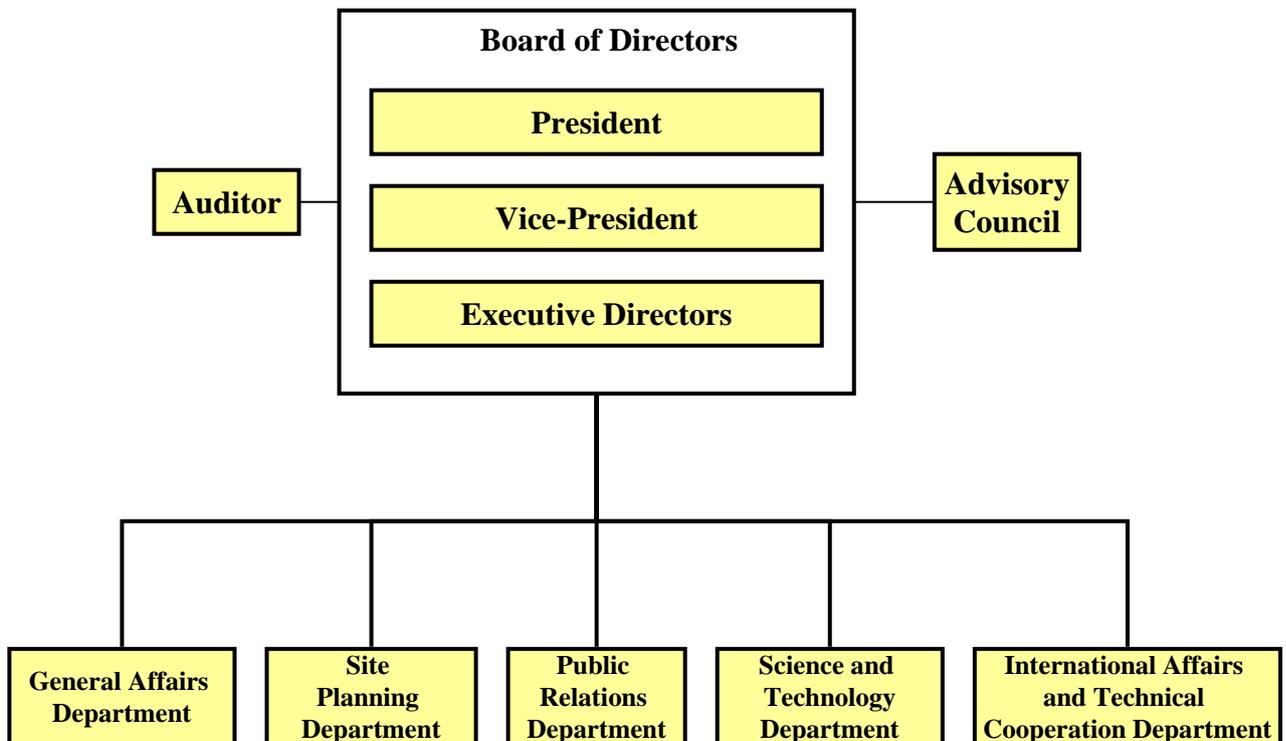
The Board of Directors makes decisions on basic issues concerning applications for approval, organizational rules and management of operations. The Board consists of a President, a Vice-President and Executive Directors appointed by the Advisory Council.

### ii ) Advisory Council

The Advisory Council discusses and deliberates on important matters related to the management of NUMO.

### iii ) Office

The head office is located in Tokyo and, as of July 2008, NUMO had no local offices or laboratory facilities.



## **Basic Policy for the Selection Procedure**

In order to ensure the transparency of its activities, NUMO announced a “Basic Policy for the Site Selection Procedure”. The basic policy adopts an open solicitation approach for inviting volunteer candidate sites, in the belief that the support of local communities is indispensable to the success of this highly public, long-term project. In December 2002, NUMO announced the commencement of open solicitation of volunteer municipalities and related information packages were sent to all 3,239 municipalities in Japan.

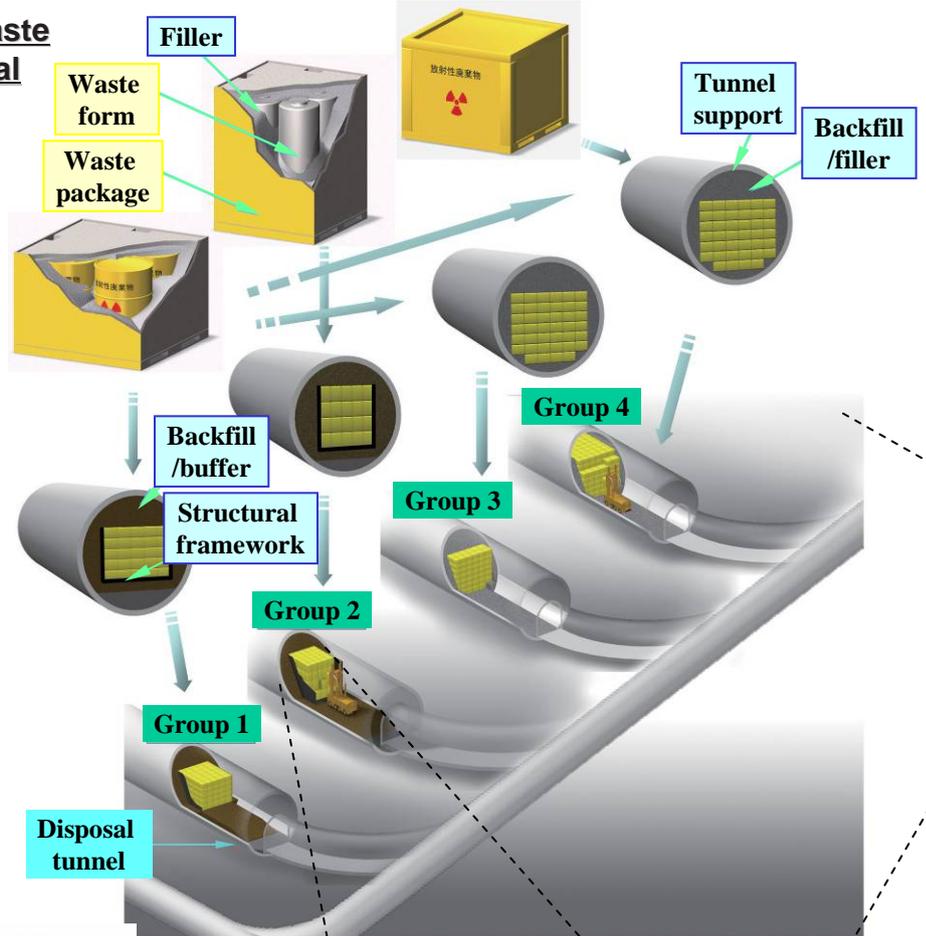
# Multibarrier System for Geological Disposal

The underground disposal facilities will be constructed in stable rock formations at least 300 m below the surface. The rock formations themselves function for a long time period as a natural barrier between the waste and the human environment.

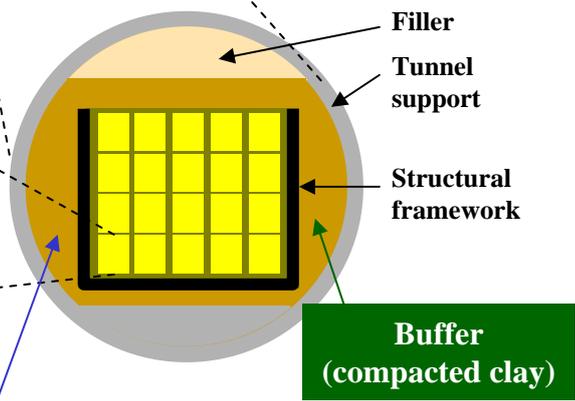
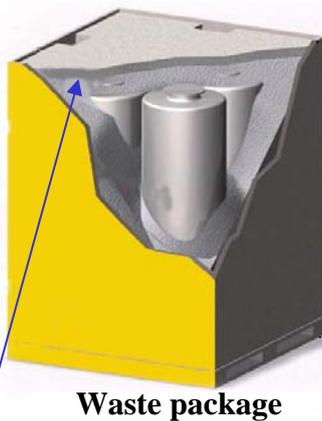
## Engineered barriers for TRU waste allocated for geological disposal

The waste will be classified according to its properties and the engineered barriers will be designed taking this classification into account. The waste will be isolated from the human environment on the long term by a system of engineered and natural barriers.

- Group 1: Spent silver absorbent, etc.
- Group 2: Hulls and ends
- Group 3: Concentrated low-level liquid waste, etc.
- Group 4: Miscellaneous solid waste

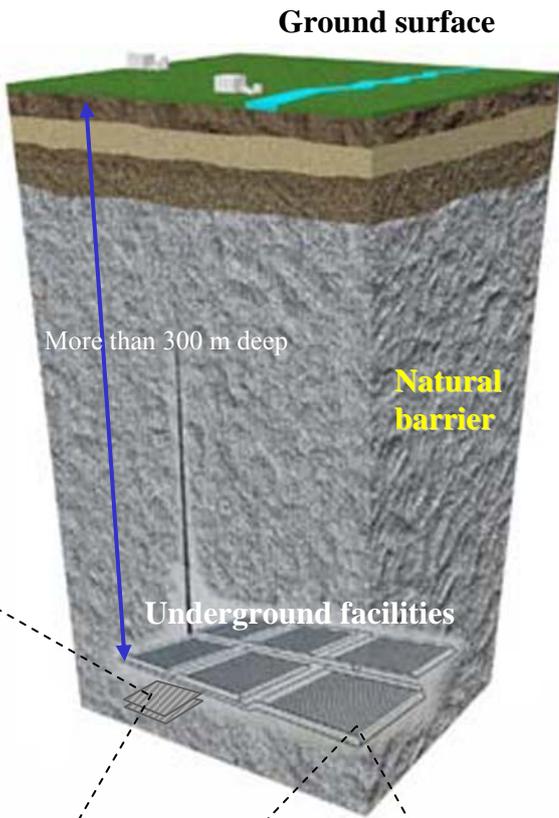


### Hulls and ends

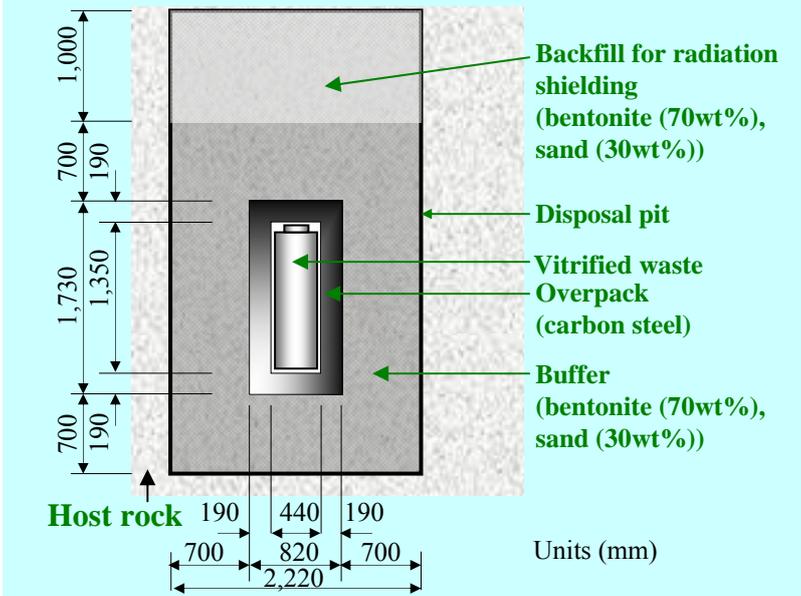


**Filler (cement material)**  
Waste canisters will be placed in a large container to form a waste package, which is infilled with cement material to fix the waste. The cement material has sorbing properties and can retard the migration of radionulides.

**Buffer (compacted clay)**  
The structural framework in which the waste packages are emplaced is surrounded by buffer material consisting mainly of natural compacted clay such as bentonite. The buffer material has a low permeability and sorbing properties and can retard the migration of radionulides.



**Example of design specification**



**Vitrified waste**

Radionuclides are immobilized in a glass matrix and are released only very slowly as the glass dissolves.

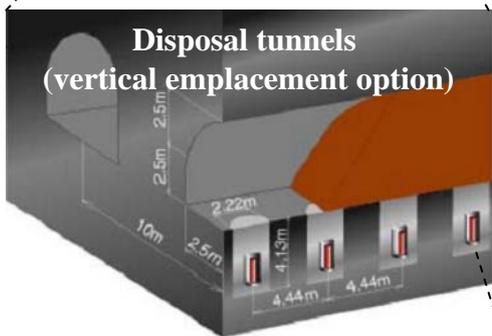
**Overpack**

Vitrified HLW is encapsulated in an overpack to prevent contact with groundwater during the time when its radioactivity and heat generation are high.

**Buffer**

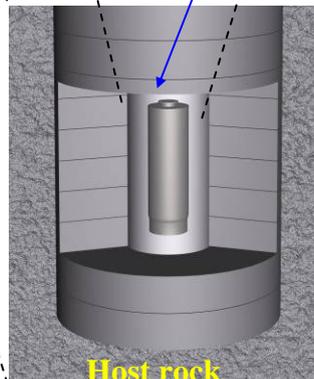
The buffer is mainly bentonite clay compacted to high density, resulting in a low permeability; this slows the movement of dissolved radionuclides. The buffer is also designed to physically protect the overpack

**Disposal tunnels (vertical emplacement option)**



**Engineered barriers for high-level waste**

High-level liquid waste is vitrified and encapsulated in metal containers, which are surrounded by a compacted clay buffer and emplaced in tunnels in the repository as shown above. The vitrified waste, overpack and clay buffer are termed the engineered barrier system.



**Engineered barriers**

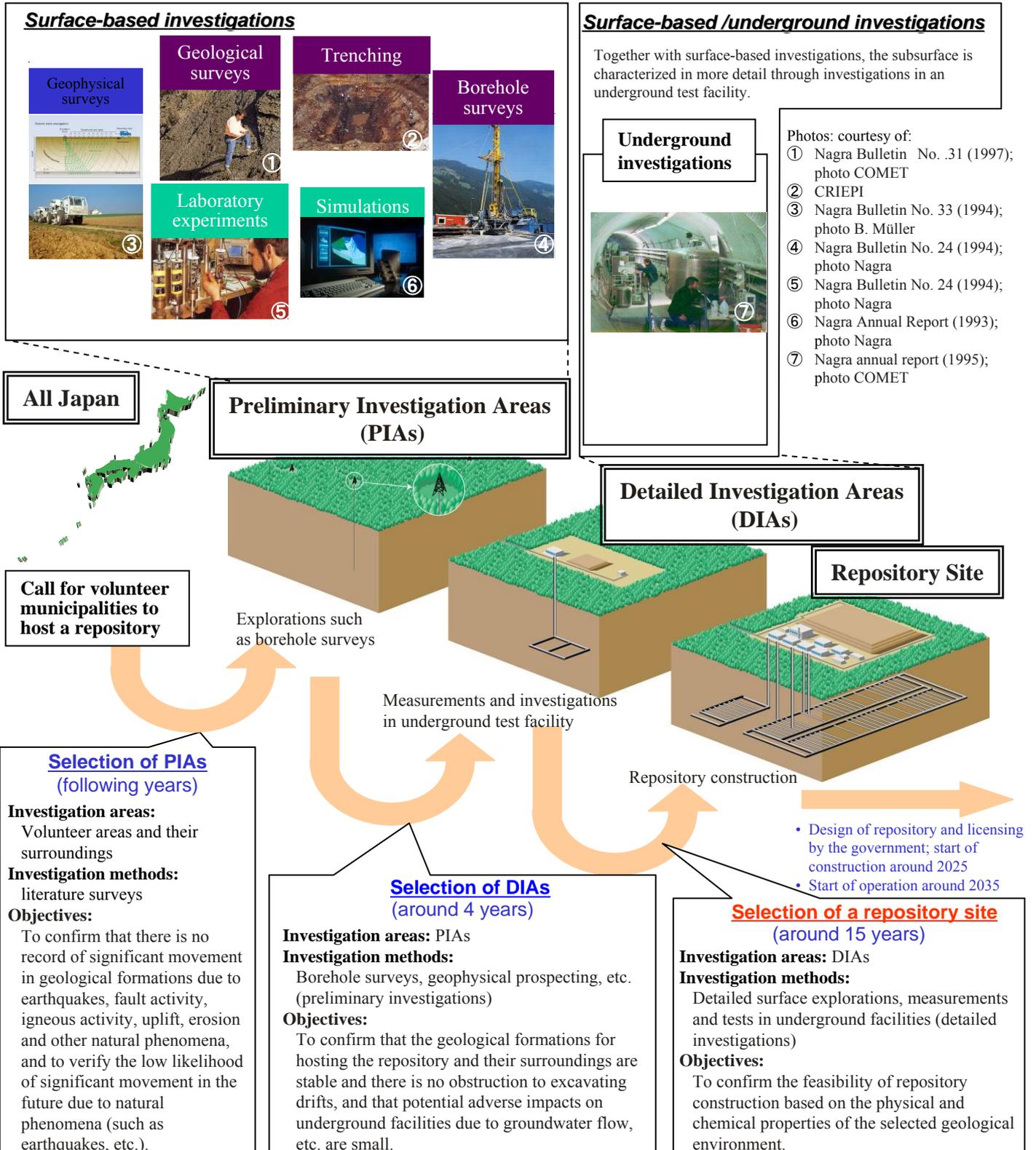
# Stepwise Site Selection Procedure

A final repository site will be selected via a stepwise procedure as specified in the Final Disposal Act:

Selection of Preliminary Investigation Areas (PIAs)

→ Selection of Detailed Investigation Areas (DIAs)

→ Selection of a repository site



# Selection of Preliminary Investigation Areas (PIAs)

## **Siting Factors for the Selection of PIAs**

NUMO has established Siting Factors for the Selection of PIAs, which define the factors and principles applied in the selection process. Siting factors consist of factors related to legal requirements (Evaluation Factors for Qualification: EFQ) and favorable factors for additional assessment (Favorable Factors: FF).

## **Evaluation Factors for Qualification**

PIAs must satisfy specified legal requirements. EFQ are used to assess compliance with legal requirements and to define specific assessment criteria. Areas with the following characteristics must be excluded as PIAs:

- |                                       |  |
|---------------------------------------|--|
| ① Earthquakes, fault activity:        | Areas with clearly identified active faults  |
| ② Igneous activity:                   | Areas within a 15 km radius of recently active volcanoes identified in the Japanese Quaternary Volcano Catalogue |
| ③ Uplift / erosion:                   | Areas with uplift amounting to more than 300 m during the last 100,000 years                                     |
| ④ Unconsolidated Quaternary deposits: | Areas with geological formations in relevant depth ranges consisting of unconsolidated Quaternary deposits       |
| ⑤ Mineral resources:                  | Areas with geological formations bearing economically valuable mineral resources                                 |

## **Favorable Factors**

FF were defined in accordance with NUMO's policy of promoting the disposal project, while taking into account aspects of economic and operational efficiency based on a fundamental assurance of safety. They include groundwater and host rock properties, availability of land, ease of transportation, etc. These will be evaluated to allow comparison of potentially suitable candidate areas.

- Properties and conditions of geological formations
- Hydraulic properties
- Investigation and assessment of the geological environment
- Natural disasters during construction and operation
- Procurement of land
- Transportation

## **Applicants**

Municipalities (total number: 3,239 (December 2002) ⇒ 1,788\* (April 2008, application base) )

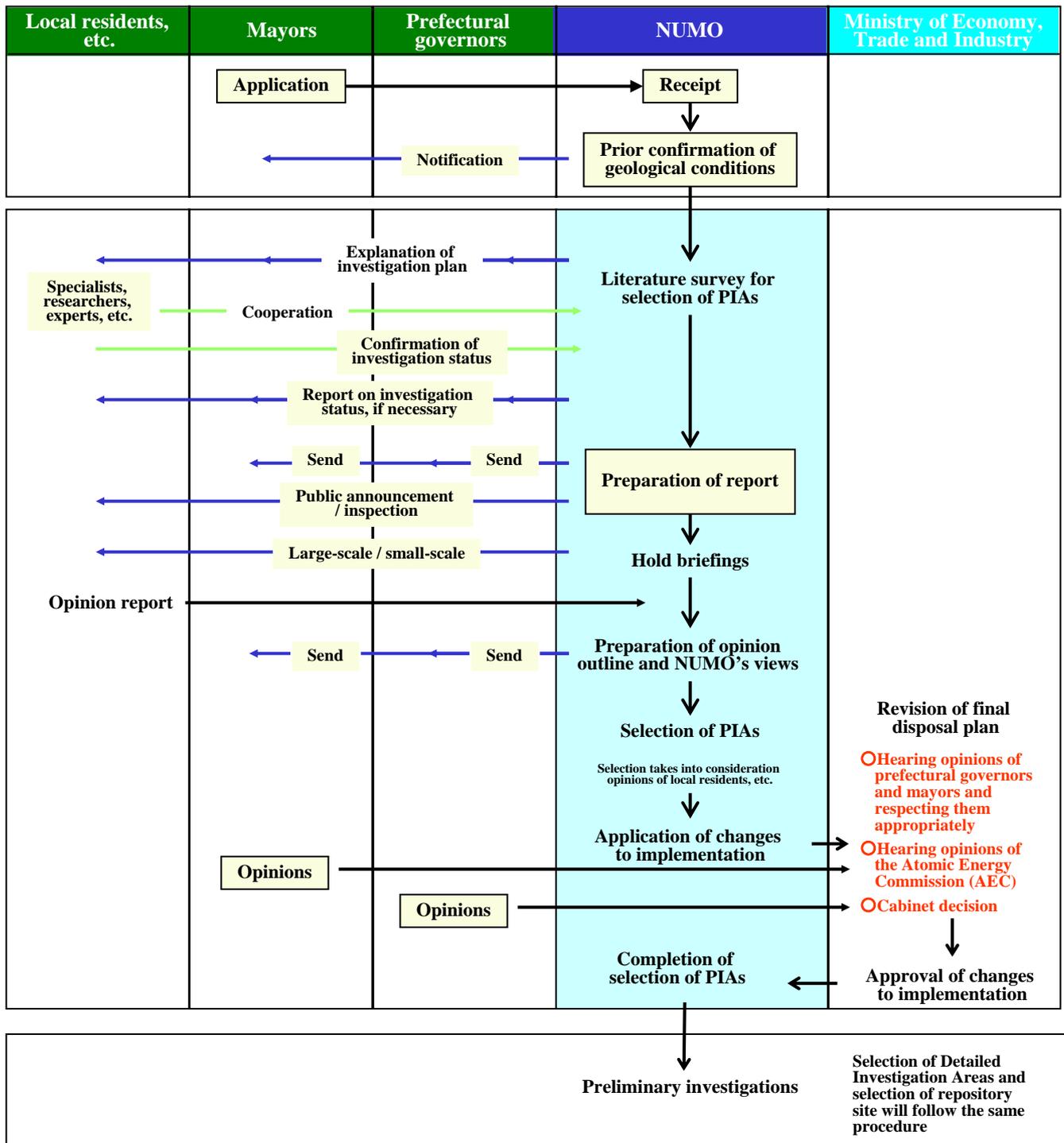
\*the number of municipalities has decreased due to consolidation

## **Application period**

Open solicitation started on December 19, 2002 without a specified deadline (a deadline may be set based on the application status; this would be officially announced in advance).

**Actions following receipt of an application**

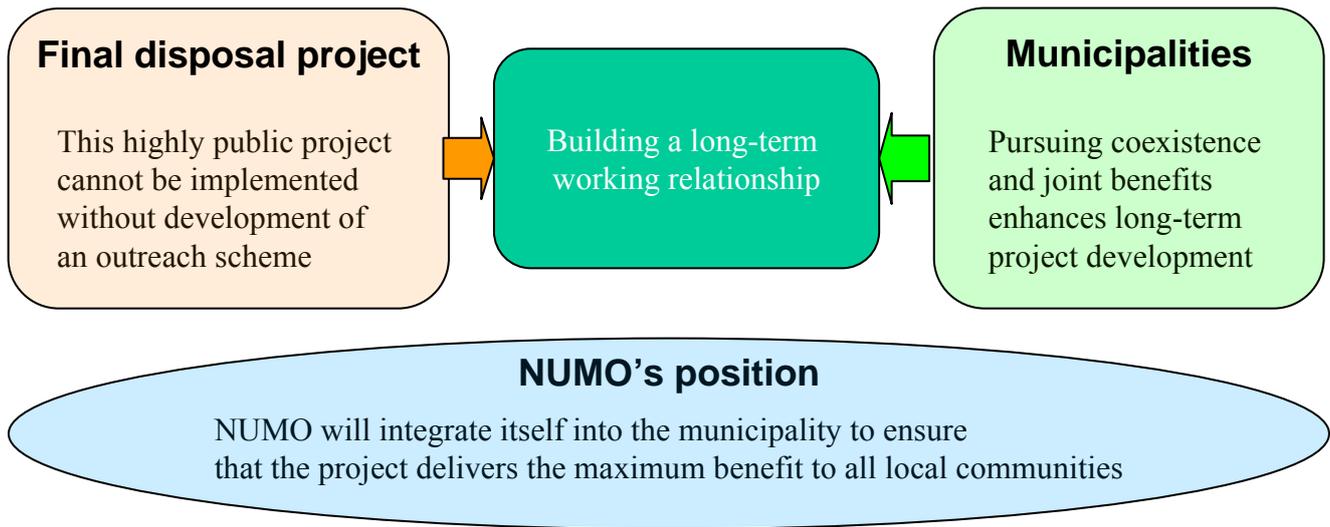
Once the necessary preparations have been made, NUMO will conduct a literature survey. The results of the survey, together with NUMO’s recommendations, will be documented in a report and an opportunity will be provided for local residents to give their comments. The figure below shows the selection of Preliminary Investigation Areas (first stage). The selection of Detailed Investigation Areas (second stage) and the selection of the site for repository construction (third stage) will follow the same procedure, based on the results of preliminary and detailed investigations.



# Outreach Scheme

## Outreach policy

It is important for the relationship between the implementer of the waste disposal project and the municipality that has accepted the project to grow and develop together over time. NUMO's outreach scheme is intended to build a relationship involving integration of NUMO activities with community needs, communication with all interested parties and building the community's trust.



## Approach for outreach scheme planning

NUMO has four main policies for outreach scheme planning

**Building an outreach relationship with the local community through formulation and implementation of a long-term regional vision**

**Implementation of the project to ensure sustainable regional development**

**Implementation of activities aimed at promoting mutual understanding with local communities**

**Formulation of an outreach scheme designed to adapt to social change**

## Aiming towards outreach

Together with the Japanese government and the electricity utilities, NUMO will make efforts to secure sufficient funding, establish conditions for smooth project implementation and develop a good working relationship with the local community.

**Expected economic benefits associated with repository construction and operation**



Production inducement: 1.7 trillion yen;  
creation of employment: approximately 130,000 jobs;  
fixed property tax revenue: 160 billion yen

**National power utilities subsidy program**



Literature survey period: 1 billion yen/year/site (limit: 2 billion yen/site); preliminary investigation period: 2 billion yen/year/site (limit: 7 billion yen/site); amount not fixed for detailed investigation period

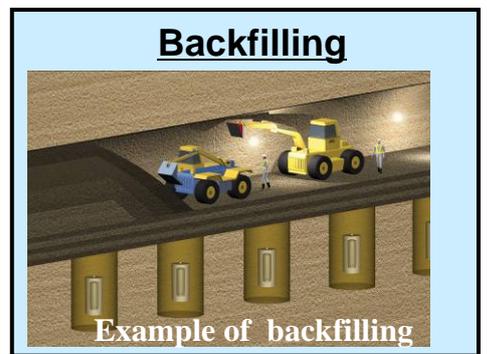
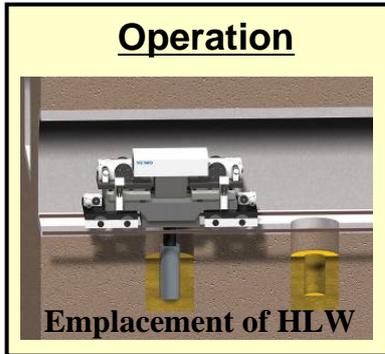
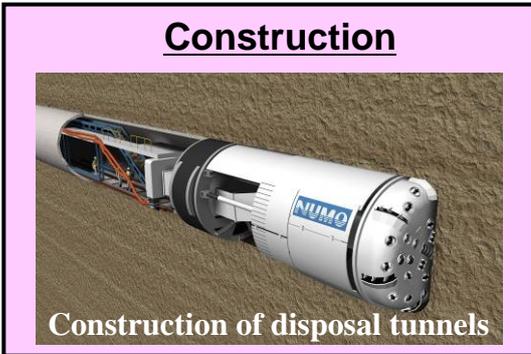
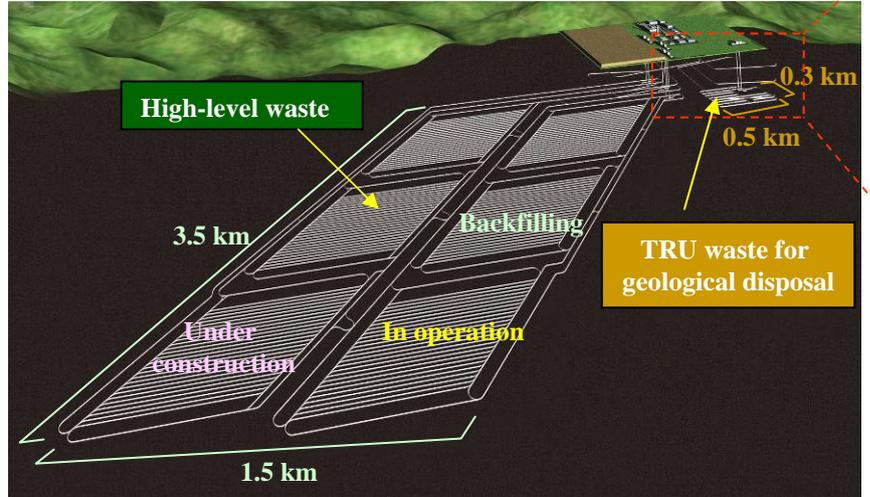
# Repository Layout

## Example repository layout

Co-location of repository for HLW and TRU waste possible if local community accept.

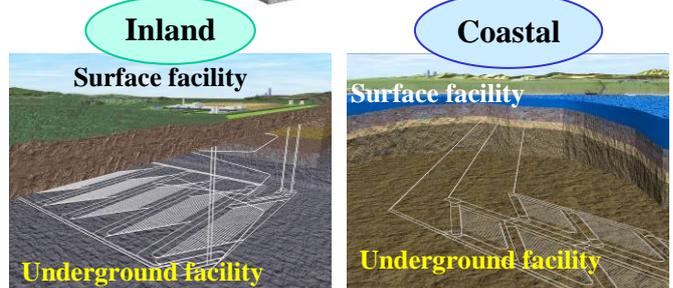
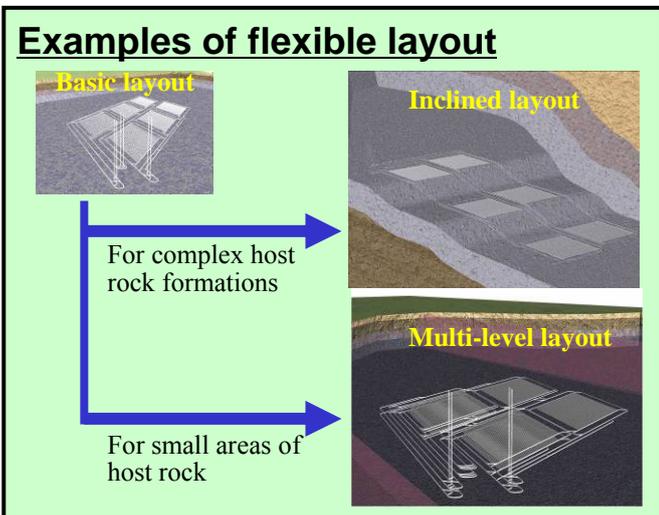
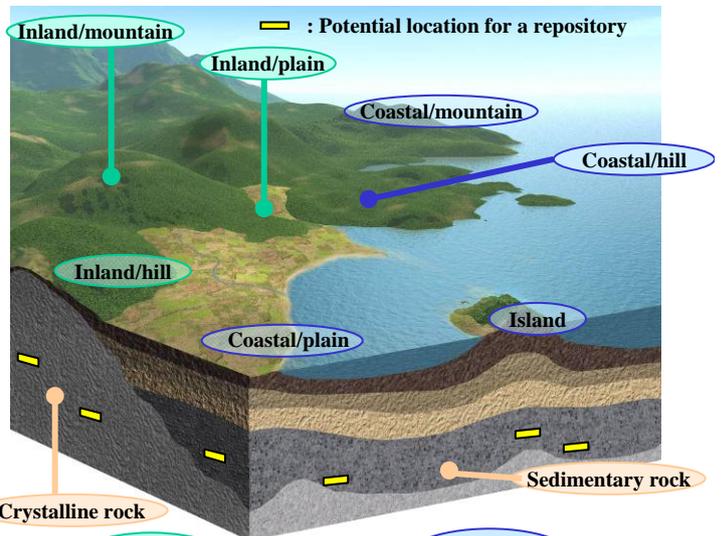
According to previous R&D, adverse effects can be prevented by ensuring an adequate distance between the two facilities.

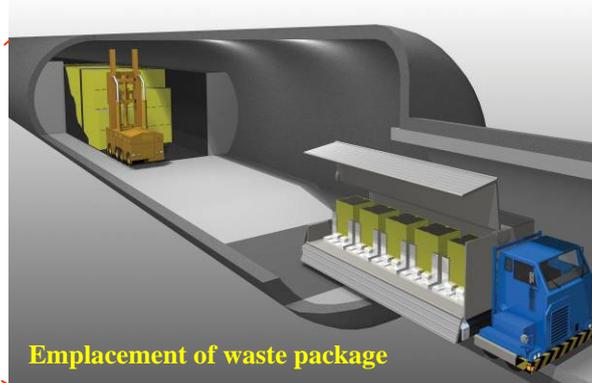
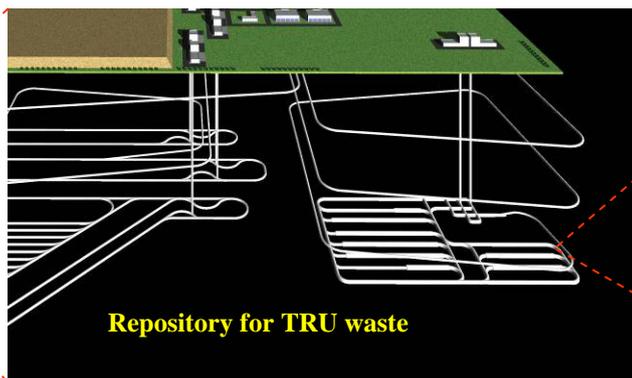
In the HLW repository, construction, operation and backfilling can be carried out in parallel in separate panels.



Surface and underground facilities are designed and constructed taking into account the characteristics of the siting environment. In the case of a coastal site, underground facilities can be constructed beneath the sea-bed.

The layout of the surface and underground facilities can be modified flexibly in accordance with the features of the site and the geological environment.





Since most of the TRU waste for geological disposal has low heat generation, for economic reasons it can be disposed of with a high emplacement density in relatively large caverns. The waste will be classified into several groups according to its properties and the engineered barriers will be designed specifically for each waste group.

## International collaboration

International collaboration is important for enhancing confidence in NUMO's activities. Bilateral information exchange agreements have been signed with Posiva, Nagra, SKB, ANDRA, DOE and NDA. NUMO became a member of EDRAM (International Association for Environmentally Safe Disposal of Radioactive Materials) in May 2001.

### Members of EDRAM

(International Association for Environmentally Safe Disposal of Radioactive Materials)



### Collaboration agreements with NUMO



### Collaboration areas

- Approach to site selection
- Methodology and techniques for characterization of geological formations, repository design and performance assessment
- Quality assurance
- Public acceptance and confidence-building

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Toei Mita Line  
Toei Asakusa Line (Mita Station) 3-minute walk  
JR (Tamachi station) 5-minute walk

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