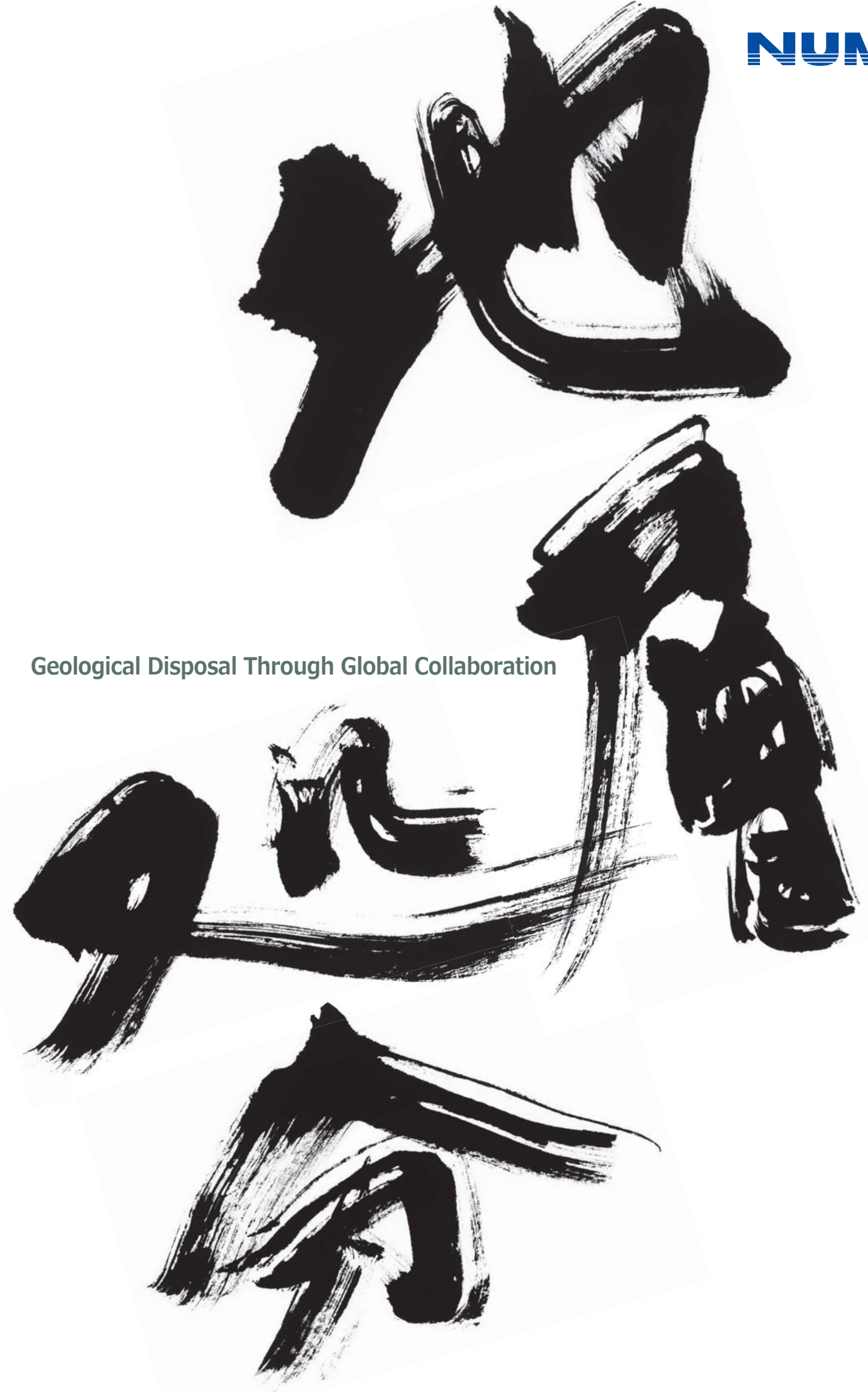


Geological Disposal Through Global Collaboration



NUMO's mission

The safe and reliable disposal of radioactive waste produced by nuclear power generation is a challenge that all countries operating nuclear power plants must address. In Japan, the organization responsible for meeting this challenge is NUMO (Nuclear Waste Management Organization of Japan), which was established in October 2000 based on the "Specified Radioactive Waste Final Disposal Act" (the "Final Disposal Act").

NUMO performs a vital role in the safe geological disposal of high-level radioactive waste (HLW) produced from the reprocessing of spent fuel and also TRU waste*.

As the organization responsible for this task in Japan, NUMO moves steadily forward with its program of implementing the geological disposal project openly and responsibly, at the same time striving to coordinate its activities with interested regional and local communities.

*TRU waste : Low-level radioactive waste (LLW) containing more than a specified concentration of long-lived radionuclides, generated by the operation and dismantling of reprocessing plants and MOX fuel fabrication plants.

The Realization of the Geological Disposal of Radioactive Waste

In carrying out our mission, we give top priority to ensure safety above all. It is indispensable for us to act carefully at every measure following principles to ensure safety.

Because we will use large area to construct the facility, it is essential that we live around the area as a member of the local community and contribute to its sustainable development.

To promote our business, we need to be regarded as a socially trustworthy organization.

Based on the above recognised points, we set the following basic policies.

Basic Policies

Top priority will be given to safety during all activities.

We aim to co-exist with the local community.

We aim to become the socially trustworthy organization.

Based on the above basic policies, we will strive to achieve our mission through the following six action guidelines.

Action Guidelines

1. Work continuously to improve technology to ensure safety
2. Actively participate in domestic and international activities to enhance our technology for geological disposal
3. Take into account and incorporate public opinions throughout NUMO's activities
4. Think and act as a member of the local community in order to contribute to its sustainable development
5. Be proactive in providing information on our activities in a comprehensible manner
6. Ensure compliance with relevant legislation and rules, and act with integrity and professionalism, whilst seeking to be cost effective

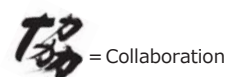
NUMO's initiatives

In moving ahead with the repository site selection process, the understanding and acceptance of residents in the regions concerned is important. In addition to grassroots activities such as forums and symposiums aimed at disseminating an understanding of the importance and safety of the geological disposal project, NUMO has also been engaging in public relations activities using a wide range of up-to-date communication tools.

For regions that have shown an interest in the geological disposal project, NUMO has also been endeavoring to provide information, including explaining details of the project to stakeholders individually.

Since it was established, NUMO has also been involved in promoting various technological developments aimed at improving the reliability of geological disposal.

Against this background, NUMO prepared a Safety Case report. Preparations are in place to allow NUMO to begin site investigation and selection at any time.



Radioactive waste for geological disposal and disposal strategy

Types of radioactive waste for disposal by NUMO

NUMO is responsible for the geological disposal of vitrified high-level radioactive waste from the reprocessing of spent fuel used in the nuclear power plants, as well as TRU waste containing more than a specified concentration of long-lived radionuclides, which is generated by the operation and dismantling of reprocessing plants and MOX fuel fabrication plants.


Waste disposal method

Although radioactivity decays spontaneously with time, HLW and TRU remain radioactive for very long time periods and therefore it is necessary to isolate the waste from the human environment for this time. Different methods for disposing of the waste have been investigated by international institutions and countries worldwide, and the international consensus is that geological disposal in a stable host rock deep underground is the most safe and reliable method.

In Japan, it has been decided that the waste will be disposed of in stable host rock formation more than 300 meters underground. A multi-barrier system consisting of engineered and natural (geological) barriers will isolate and contain the radioactive waste over the long timescales.

HLW

Vitrified waste



Stainless steel canister

Height: ~ 1.3 m
Diameter: ~ 40 cm
Weight: ~ 500 kg
(Specifications of Japan Nuclear Fuel Ltd.)

Volume of vitrified HLW to be produced

- Stored and managed in Japan: 2,300 canisters (as of the end of March 2016)
- If spent fuel that has already been produced is reprocessed: ~ 25,000 canisters (as of the end of March 2016)
- Total amount expected to be produced in the future: ~ 40,000 canisters

TRU waste

Example of TRU waste

Emission filter (spent silver absorbent)	Hulls and ends
Concentrated liquid waste (above a specified radioactivity level)	Fuel assembly
Miscellaneous solid waste (above a specified radioactivity level)	

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Packaging

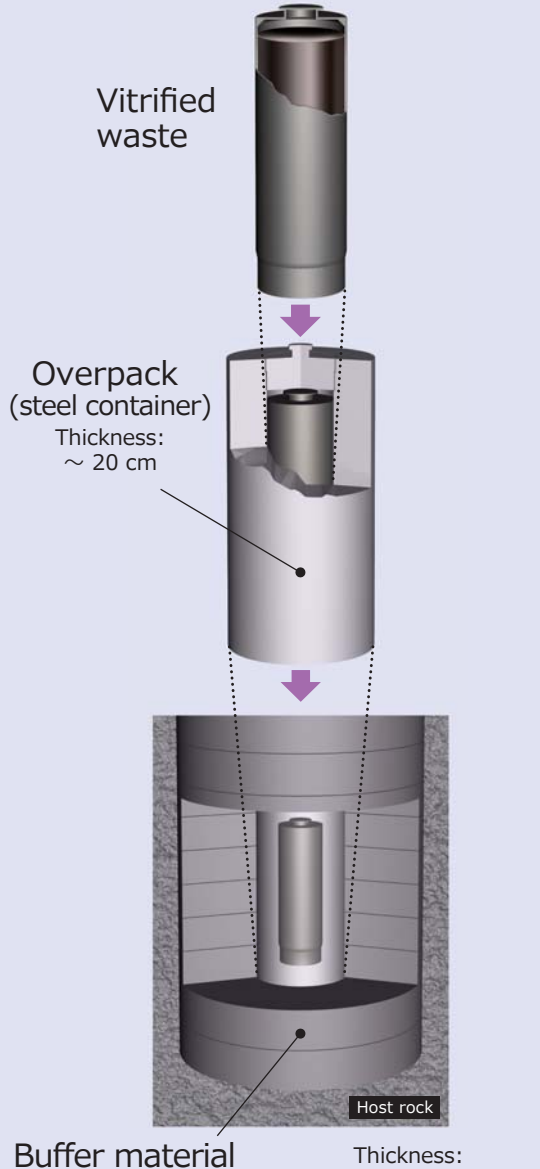
After reducing waste volumes by compacting solid waste and concentrating liquid waste, the waste will be placed in the prescribed containers. In some cases the waste will be immobilized using a solidification agent. In this way, the waste will be processed into waste packages that are suitable for disposal.

Examples of waste packages:

Canister Content: Hulls and ends	Drum Content: Emission filters, miscellaneous solid waste, concentrated liquid waste (solidified after treatment by evaporative concentration, etc.)	Rectangular container Content: Miscellaneous solid waste
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Volume of TRU waste to be produced ~ 18,100 m³ is anticipated

Engineered barriers for HLW



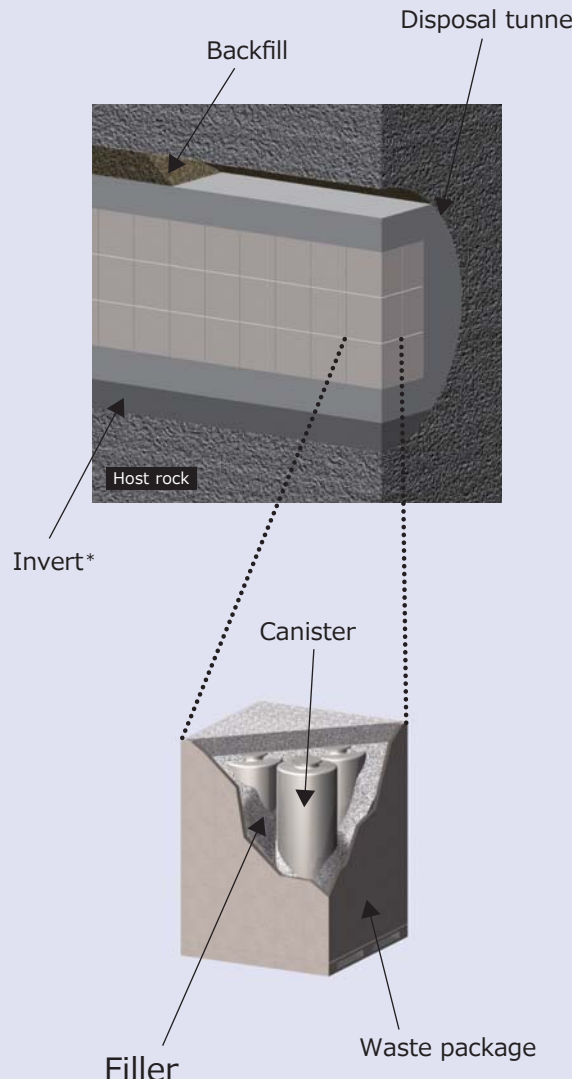
Vitrified waste

Overpack (steel container)
Thickness: ~ 20 cm

Buffer material (compacted clay)
Thickness: ~ 70 cm

Host rock

Engineered barriers for TRU waste (example of hulls and ends)



Backfill

Disposal tunnel

Host rock

Invert*

Canister

Filler

Waste package

* The invert is the base of the tunnel and is composed of concrete or a similar material.

Visual impression of a repository

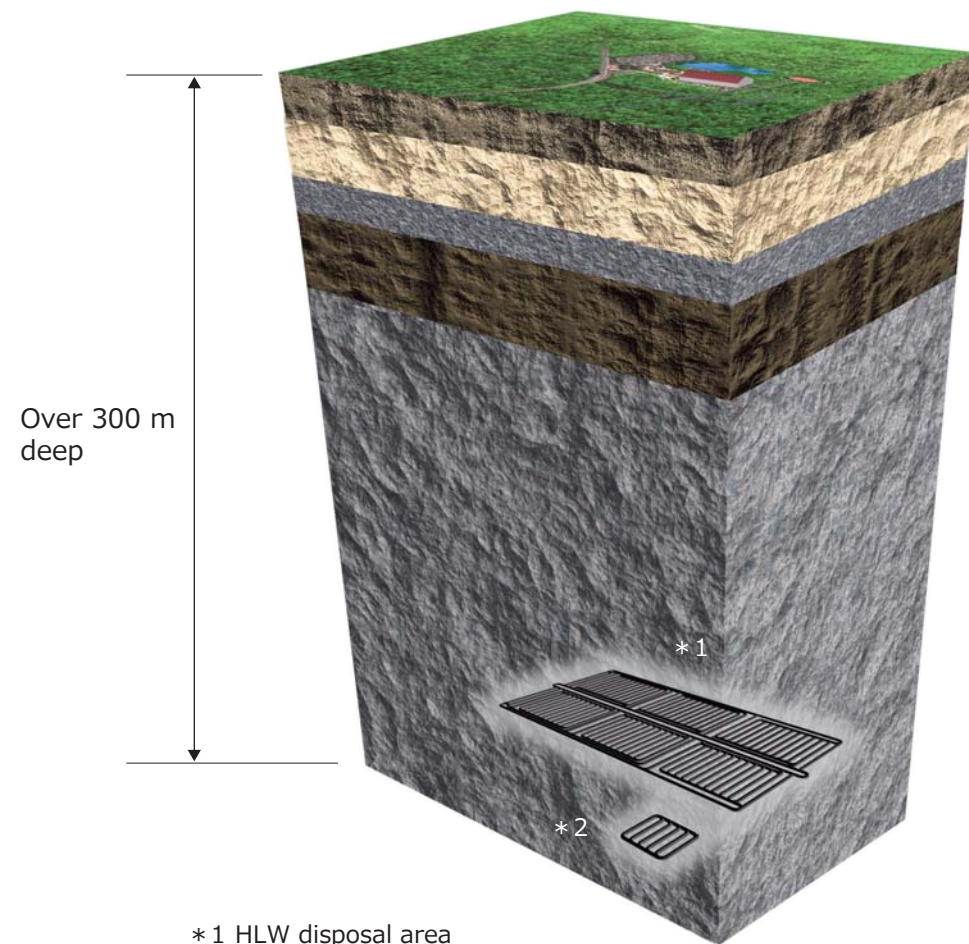
The underground facilities will comprise tunnels for transporting and emplacing the waste packages and will be constructed in a stable host rock formation more than 300 meters underground.

On the surface, the facilities required for supporting underground excavation and operation and closure of the repository will be constructed.

Construction of the disposal tunnels, emplacement of the waste packages and backfilling of the disposal tunnels will be carried out underground. The underground facilities for a HLW repository are extensive and the various operations will be carried out in parallel in separate areas (disposal panels).

In the surface facilities, the vitrified HLW will be encapsulated in overpacks and the TRU waste will be packaged; the necessary inspections of the packages will also be conducted. These tasks will be carried out via remote operation in an area where radiation shielding is in place.

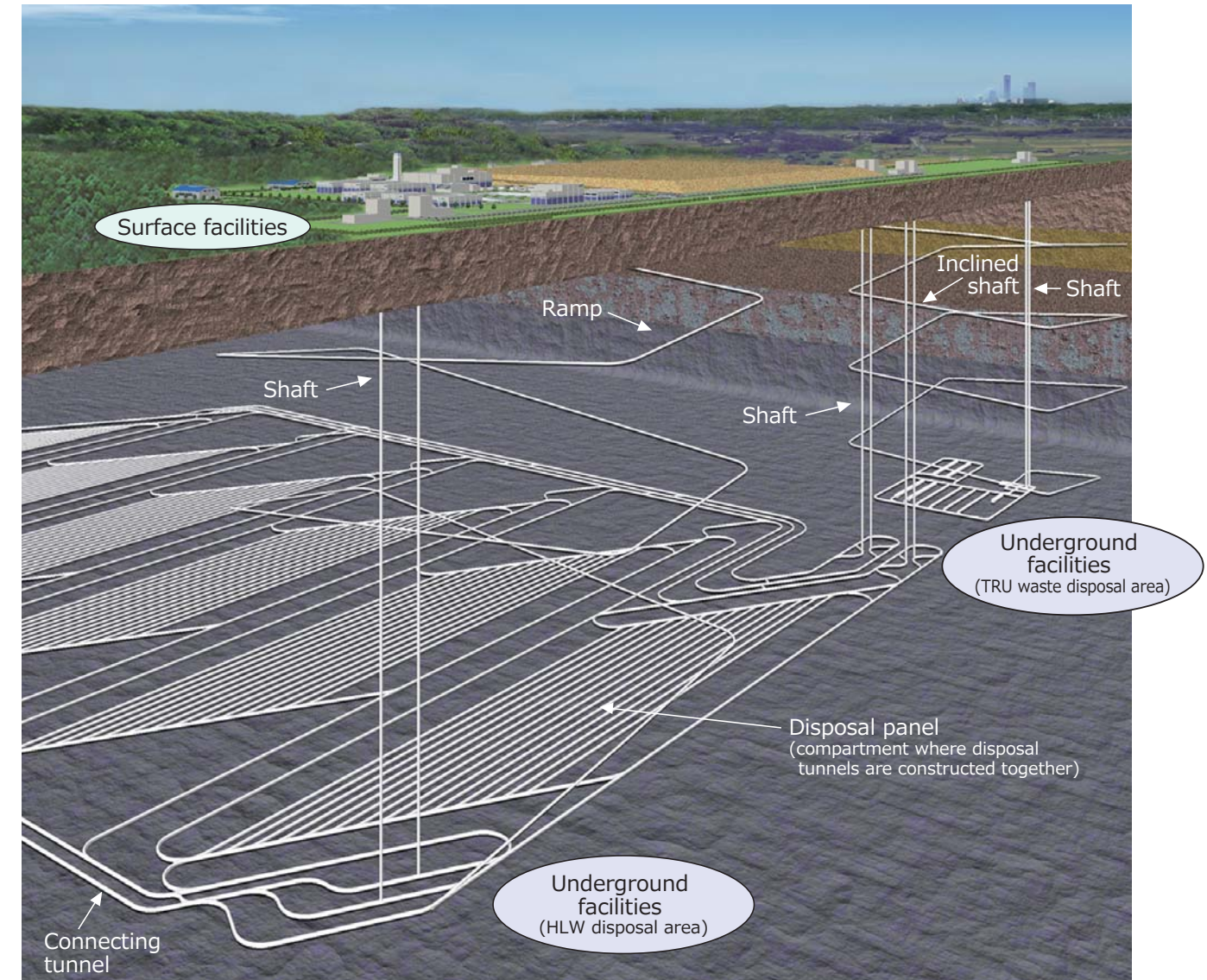
The facilities will also be designed against events such as earthquakes or fires and accidents where waste packages may fall or be overturned.



- * 1 HLW disposal area
- * 2 TRU waste disposal area

Example of repository layout

Example of co-located geological disposal facilities for HLW and TRU waste.



Scale of facilities

Surface facilities: 1-2 km²

Underground facilities : HLW disposal area: around 3 km by 2 km
 TRU waste disposal area: around 0.5 km by 0.3 km

The repository site selection process

The geological disposal program

The selection of a repository site will be undertaken via a three-stage process based on the “Final Disposal Act” and involves the selection of Preliminary Investigation Areas (PIAs), the selection of Detailed Investigation Areas (DIAs) and the selection of a repository construction site.

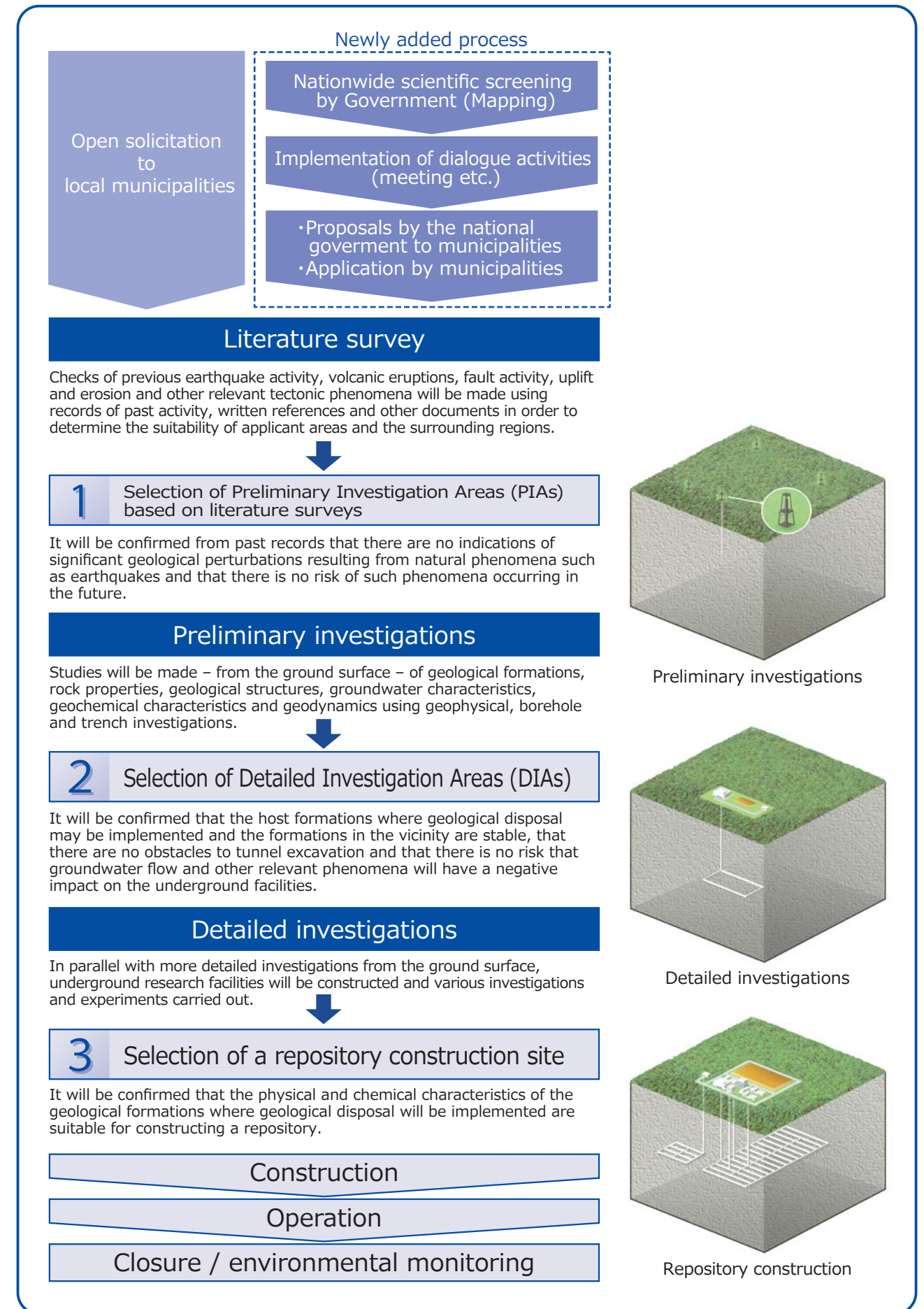
In 2002, NUMO initiated open solicitation of municipalities nationwide, seeking areas to carry out a literature survey as the first step in selecting a final disposal site, however no survey has yet been carried out. Considering this situation, the Japanese government decided to carry out nationwide scientific screening in order to identify municipalities which could be suitable for a literature survey, if accepted.

The site selection procedure specified in the Final Disposal Act consists of three steps, namely literature survey, preliminary investigation and detailed investigation.

NUMO will compile reports on the investigation results at each stage of the process and will hold explanatory meetings. The opinions of local people expressed at these meetings will be made known to the relevant prefectures and municipalities together with NUMO’s views and selection will proceed on the basis of respecting local opinions, obtaining stakeholder agreement and securing the government approval.

The government has stipulated that, when approving each stage of the site selection process, the opinions of the municipality mayors and the governors of the prefectures concerned must be listened to and respected. Selections that oppose these views will not take place.

Following the selection of a repository construction site, the disposal facilities will be designed and a safety evaluation will be undertaken; construction will only begin after a safety review by government experts.



NUMO profile

Corporate history

NUMO was established in October 2000 based on the Final Disposal Act, as an “authorized implementing entity” approved by the Minister of Economy, Trade and Industry (METI).

In December 2002, NUMO launched an open solicitation of municipalities nationwide in a search for areas to carry out feasibility studies on sites for repository construction. Information packages supporting this open solicitation were sent to 3,236* municipalities.

In June 2007, the Final Disposal Act was amended and some TRU waste was also included for geological disposal; this waste type was therefore added to NUMO’s sphere of operations.

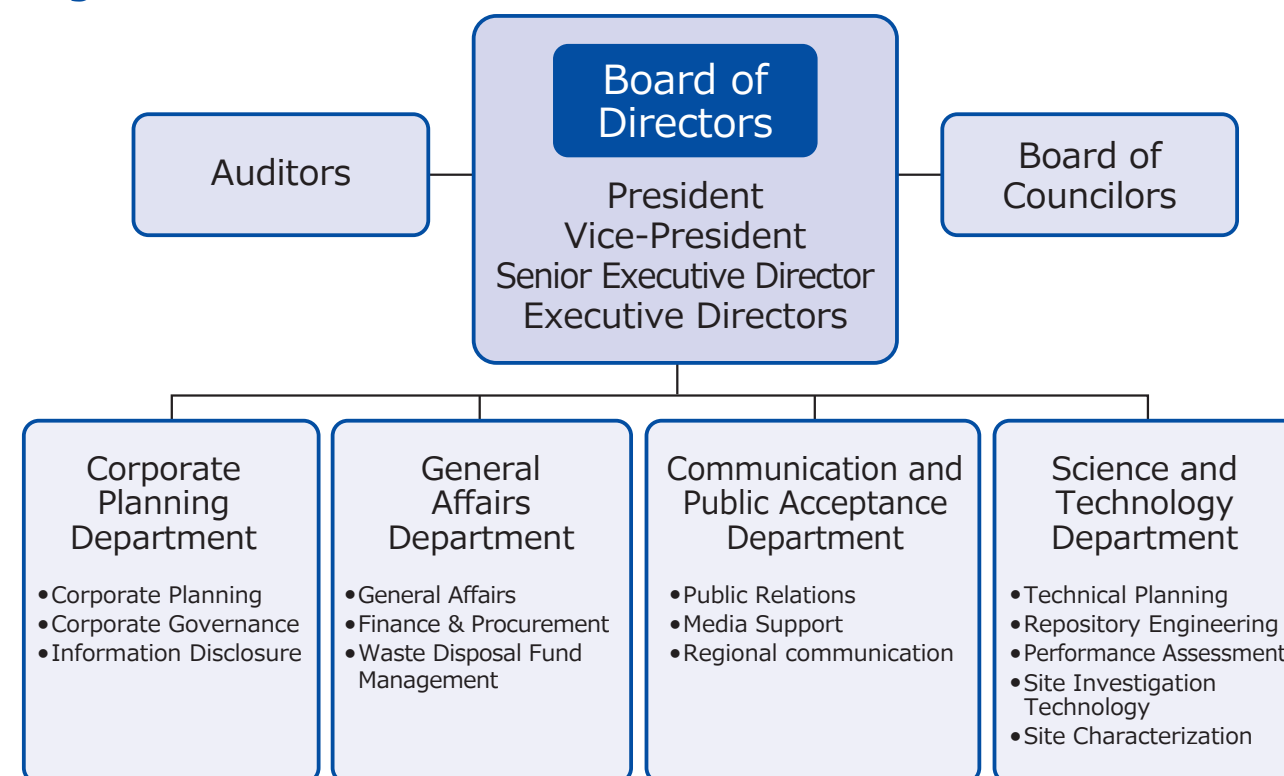
*As a result of mergers, there are currently 1,718 municipalities (as of September, 2016).

Description of projects

The projects undertaken by NUMO include:

- Selection of PIAs, DIAs and the repository site
- Construction and operation of the repository
- Repository closure
- Collection of fund
- Other supporting operations

Organization



As of July 1, 2016

Basic framework of the geological disposal project

NUMO shares its waste management duties with the government, the power companies and other responsible organizations and is moving forward with its activities in close collaboration with these entities. The government supervises and regulates the work undertaken by NUMO and designates and monitors the organization responsible for administering and managing the waste disposal funding.

Based on relevant legislation, the power companies and other entities make financial contributions to NUMO according to the electrical output of the nuclear power plants. These financial contributions are administered and managed by the Radioactive Waste Management Funding and Research Center, as designated by the Minister of Economy, Trade and Industry.

International collaboration

In the interests of moving the disposal project forward smoothly, NUMO has entered into collaborative agreements with overseas implementing organizations responsible for radioactive waste disposal, based on the principles of mutual benefit and reciprocity. It undertakes information exchanges and joint research with these organizations in areas such as disposal technology, safety assessment, site selection and public relations activities. The organizations with which NUMO has collaborative agreements (or memoranda) are: Posiva (Finland), Nagra (Switzerland), SKB (Sweden), DOE (USA), ANDRA (France), NDA (UK), KORAD (Republic of Korea) and the Taiwan Power Company (Taiwan).

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