Dialogue Meeting among Students of Nagaoka University of Technology and Seniors of SNW of AESJ,
December 16, 2025 at Nagaoka University of Technology, Nagaoka

Keynote Speech

"How should we dispose of high-level radioactive waste (HLW)？"

December 16, 2025

SNW　Hirohisa Ishikawa

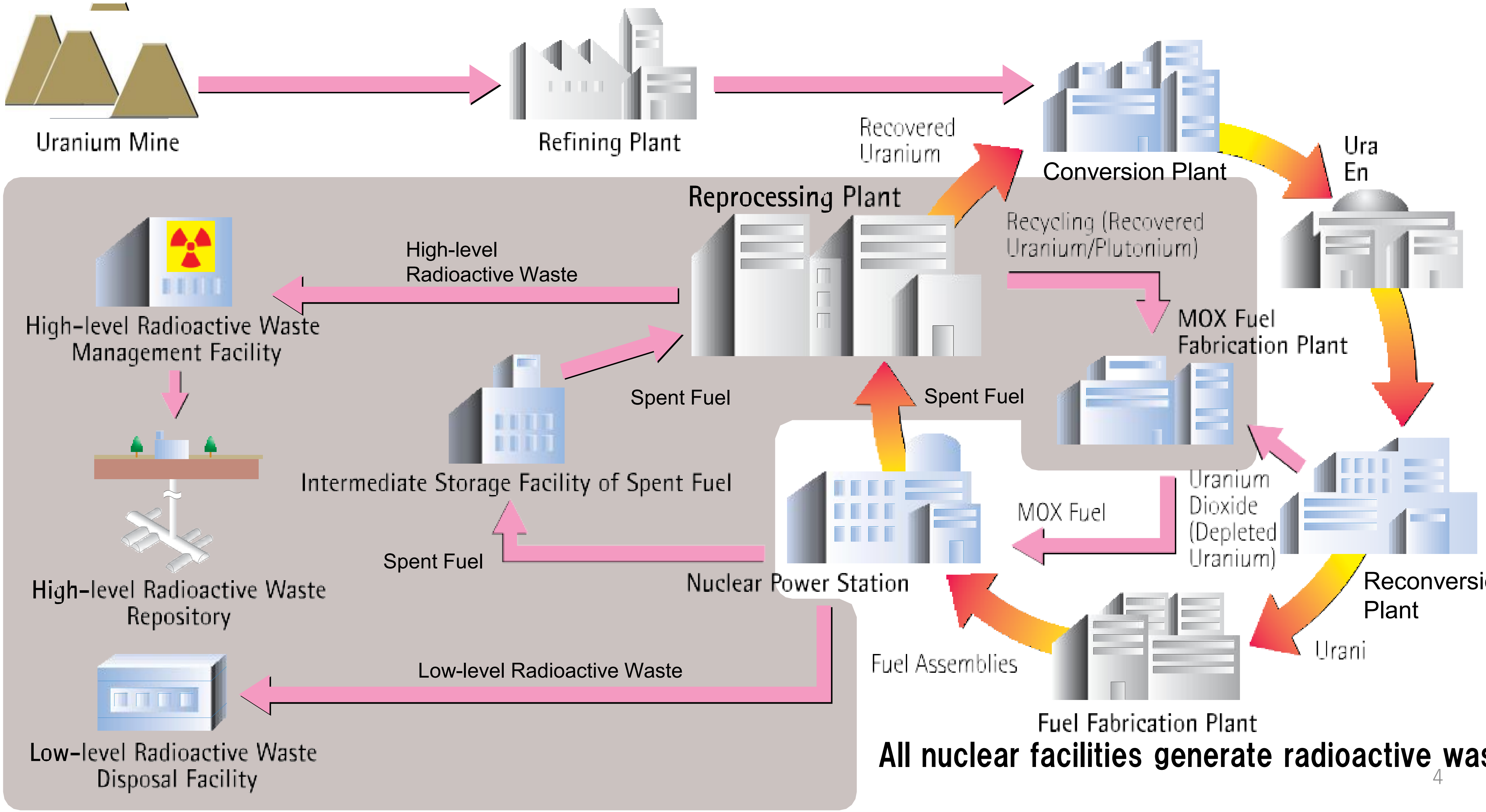
Background Information on Radioactive Waste

The Principle of Radioactive Waste Management

1. Protection of human health
2. Protection of the environment
3. Protection beyond national borders
4. Protection of future generation
5. Burdens on future generation
6. National legal framework
7. Control of radioactive waste generation
8. Radioactive waste generation and management of interdependencies
9. Safety of facilities

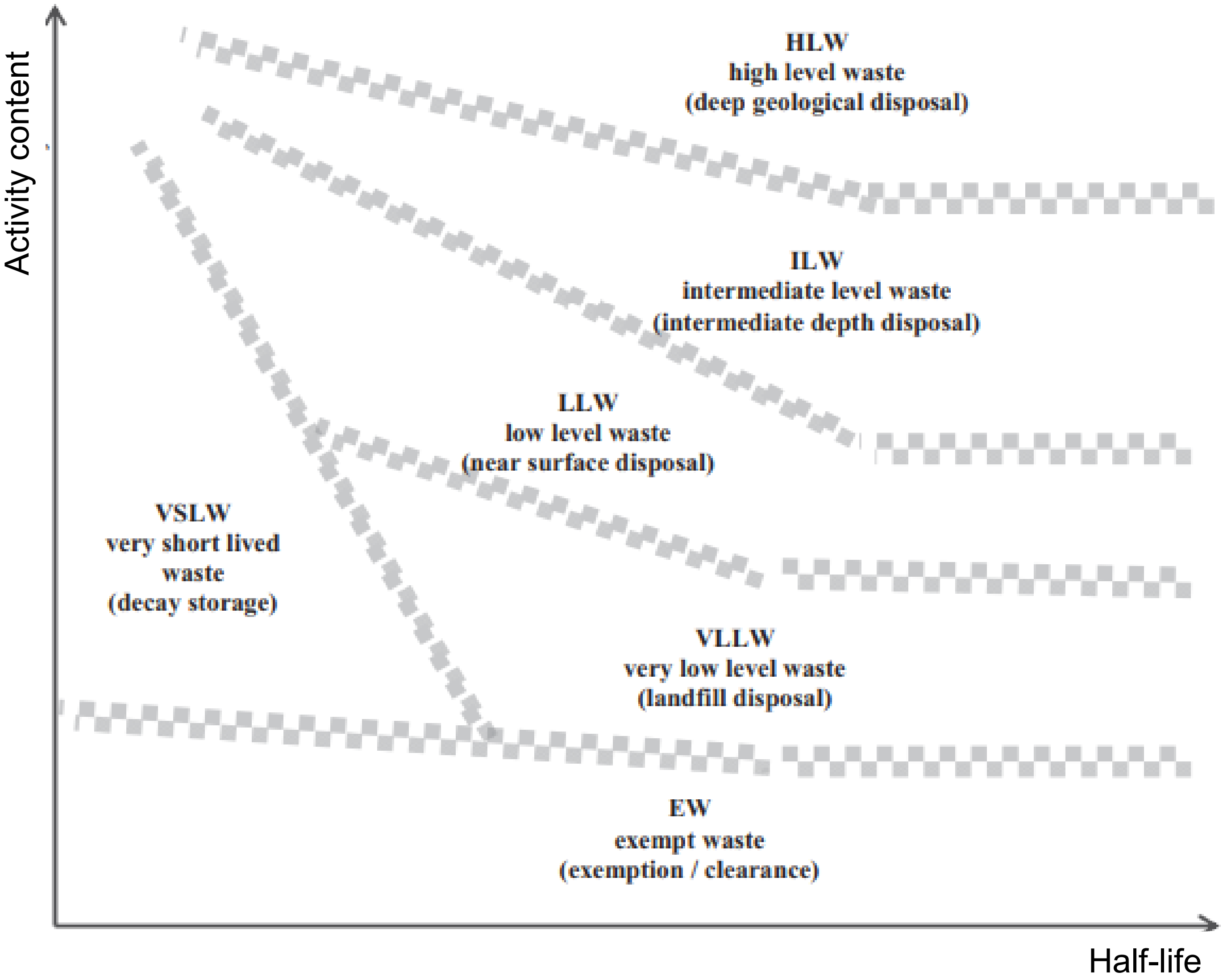
IAEA safety Series No. 111-F

Nuclear fuel cycle and radioactive waste



All nuclear facilities generate radioactive waste

Waste classification and management and disposal option



Conceptual illustration of the waste classification scheme

- In general, the higher the radioactive content, the greater the need for radioactive containment and isolation from the living environment.
  - Active institutional control contributes to ensuring the safety of near-surface disposal facilities for waste that mainly contains short-lived radionuclides.
  - Waste containing a large amount of long-lived radionuclides, in particular, requires higher levels of containment and isolation, and disposal at greater depths.
  - The limit value (acceptance criteria) for the amount of radioactive material that can be tolerated for each radionuclide is specified based on the safety evaluation of each disposal site.
  - Waste containing extremely short-lived radionuclides can be reduced to below the clearance level by decay storage.
- Management of waste containing amounts of radioactive material below exemption/clearance levels in the lower range on the vertical axis can released without radiological restrictions.

INTERNATIONAL ATOMIC ENERGY AGENCY, Classification of Radioactive Waste, Safety Standard Series No.GSG-1, 2009.

Types of radioactive waste disposal facilities in Japan

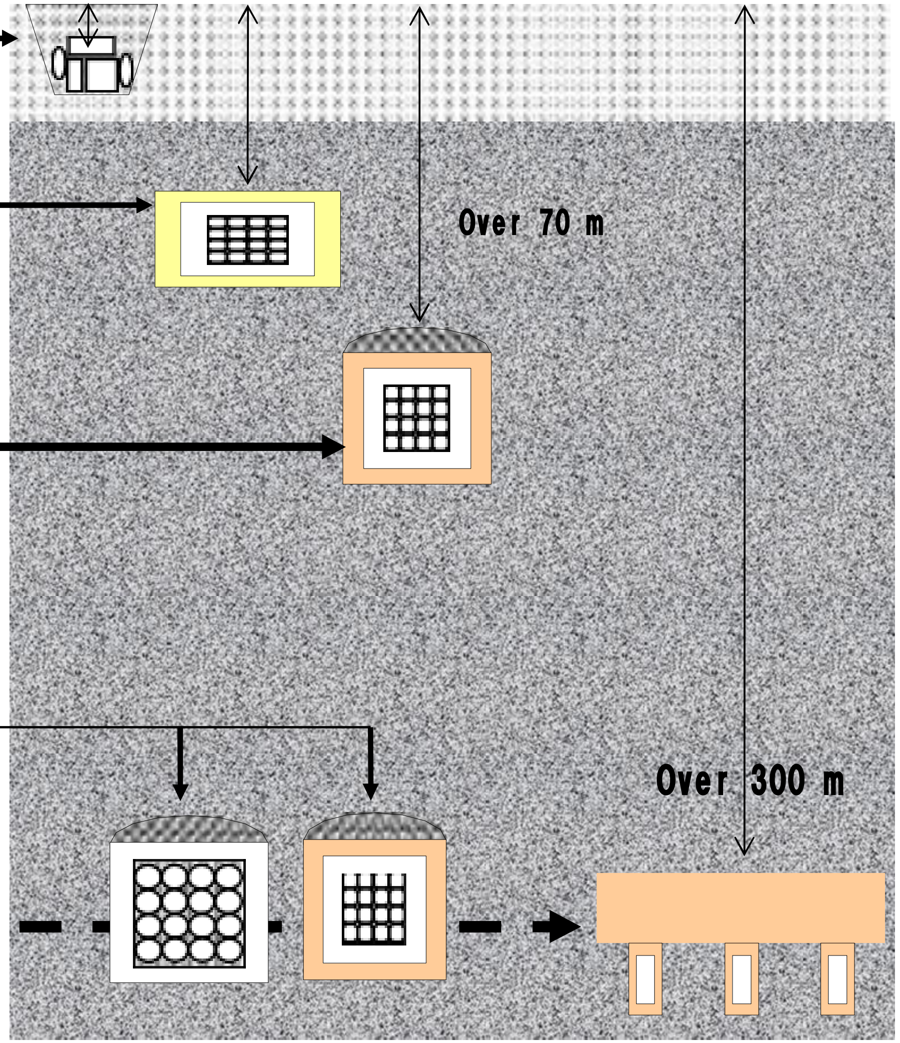
Near-surface disposal without engineered barrier (trench disposal) (Very Low Level Waste: VLLW) (L3)

Near-surface disposal with engineered barrier (L2) (Relatively Low-Level LLW)(Pit disposal)

Intermediate depth disposal with engineered barrier (L1) (Relatively high-level LLW)

Geological disposal
(LLW highly contaminated TRU)

Geological disposal
(High-level radioactive waste)



Nuclear Fuel Cycle Options

A) Once through (direct disposal)

B) Light Water Reactor Cycle + MOX fuel use
(Reprocessing)

C) Fast Reactor Cycle
(Reprocessing + Pu recycle)

D) Reprocessing + Partitioning and Transmutation

Comparison of Nuclear Fuel Cycle Options

From the perspective of efficient resource utilization and reducing the volume and harmfulness of high-level radioactive waste, Japan 's basic policy is to promote the nuclear fuel cycle, which involves reprocessing spent fuel and making effective use of the recovered plutonium and other materials.

Basic Energy Plan (Cabinet decision, July 2018)

	Once-through (direct disposal)	Light Water Reactor Cycle (Reprocessing)	Fast Reactor Cycle (Reprocessing) (*4)
a. Efficient use of resources	×	10-20% of new fuel can be produced	Greater savings than the light water reactor cycle
b. Volume of HLW	1. Spent fuel	1/4 <Vitrified waste>	1/4 to 1/7 (*5) <Vitrified waste>
c. Reducing the toxicity of high-level radioactive waste (*1)	Approximately 100,000 years <Spent fuel>	Approximately 8,000 years <Vitrified waste>	Approximately 300 years <Vitrified waste>
d. Cost	1.0 (*2) (yen/kWh) ~	1.5 (*3) (yen/kWh) ~	No estimates available as this is still in the research and development stage

*1 The period required for the toxicity of waste to decrease to the same level as the total amount of natural uranium used to generate electricity
*2 Calculation by the Atomic Energy Commission (November 2011) (Case of 3% discount rate)
*3 Verification results by the General Energy Survey Power Generation Cost Verification Working Group (May 2015)
*4 Assumes the use of both light water reactors and fast reactors. Fast reactors utilize plutonium extracted from spent fuel from light water reactors.
*5 Improvements will occur depending on the proportion of fast reactors in the total.

Source: Agency for Natural Resources and Energy, Answers to Frequently Asked Questions

Reprocessing vs direct disposal

Regarding the nuclear fuel cycle (light water reactor cycle), there are merits such as

① the amount (volume) of high-level radioactive waste is reduced to about one-fourth,

② the period until the degree of toxicity of a material becomes equivalent to that of natural uranium is shortened from about 100,000 years to about 8,000 years, and

③ effective use of resources.

On the other hand, it has the following disadvantages

① Higher cost than direct disposal,

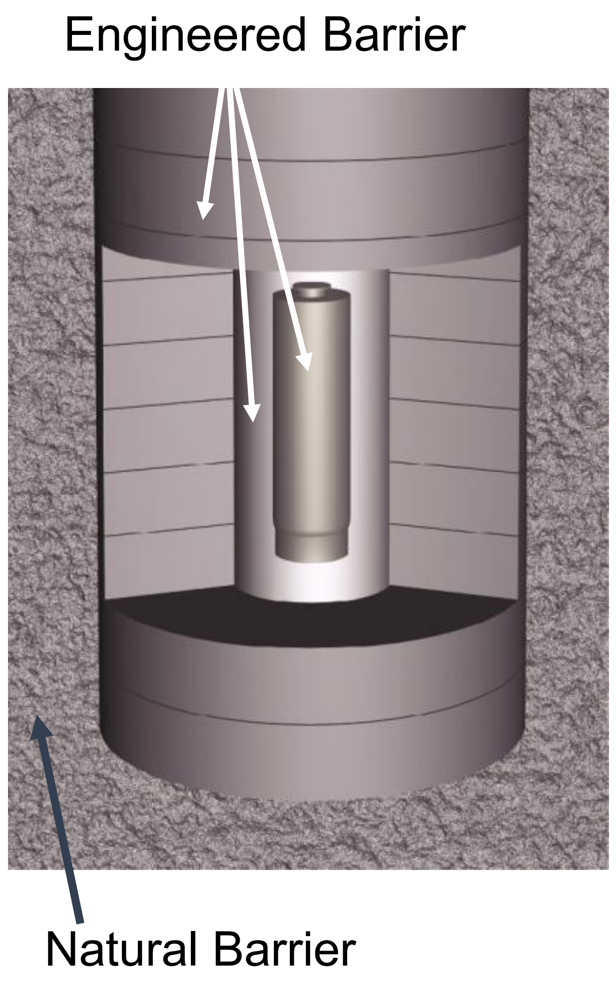
② More risky than direct disposal with respect to nuclear nonproliferation

In addition, the realization of the fast reactor cycle will have great effects.

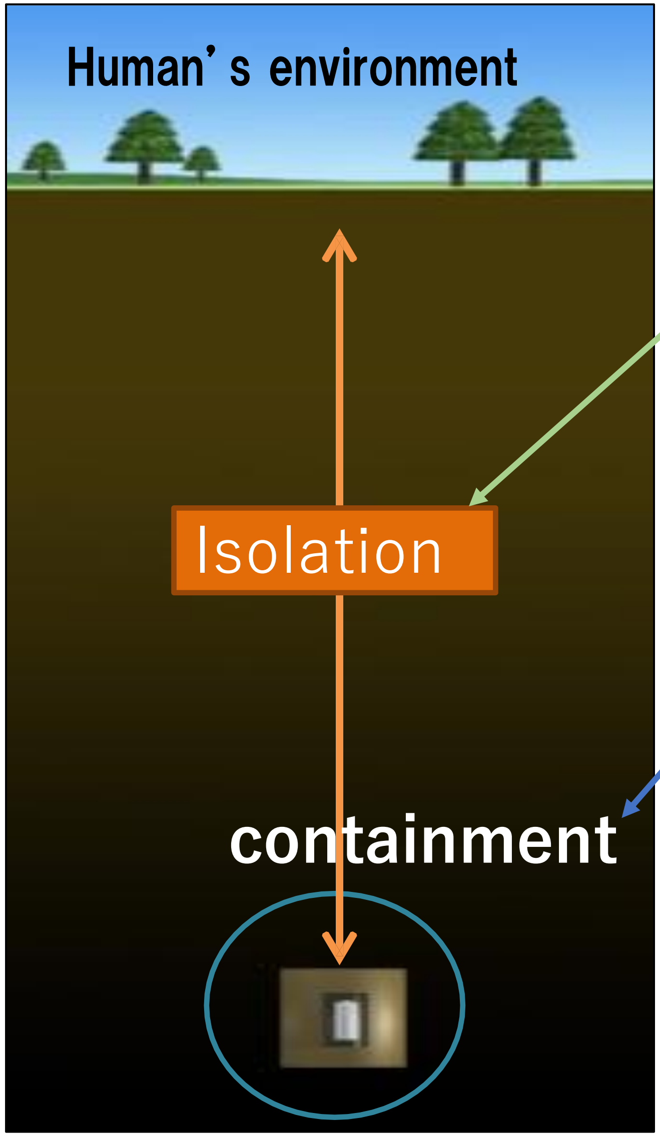
Multiple safety functions by combining engineered barriers and geological formation

-Although the safety principles and strategies for disposal are the same, the existence of geological formation differs from country to country, the types and characteristics of geological formation to be disposed of differ, and development has been based on the development policies of each country. Because of these reasons, the disposal concepts that have been developed are partly different.

-However, the understanding of the functions that natural and engineered barriers contribute to safety (safety functions) is basically the same, and radionuclides are confined and attenuated by the combination of those barriers and at the point of reaching the biosphere. To date, it has been shown that radiological effect on human may fall below protection targets.



"Containment" and" Isolation" are preferred strategy in waste disposal



- Separate from human living environment
- Less susceptible to the human living environment and the natural environment on the ground
- Waste is separated from people on the ground by thick bedrock.

- Ensuring that radioactive materials remain confined to a limited area over a long period
- Less oxygen, slow ground water flow, less soluble in ground water and less mobile

Does not affect the human living environment for a long period of time

Routes of radioactive materials reaching humans from disposal sites and countermeasures to protect humans from radiation exposure

Routes of radioactive materials reaching humans from disposal sites

- River water use scenario
- Human intrusion scenario

Radioactivity of radioactive material reduces with time

Countermeasures

Make the arrival time to humans as long as possible.

↓

Make the time to leave the disposal site and the transportation time through groundwater as long as possible.

「Containment」

Prevent human intrusion

- Human control of disposal site（Hundreds of years at most)
- Dispose deep underground to reduce the possibility of human intrusion

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Passive institutional controls（excavation limits, record keeping, marking, etc.)

「Isolation」

↓

Select a disposal option according to the type and amount of radioactive material contained in the radioactive waste.

Historical Background of Geological Disposal

1st Period (1950s – mid 1970s)

- Recommendation of the US National Academy of Science (NAS)
  Disposal to rock salt beds is promising (1955) →Disposition concept relying solely on natural barriers
- Disposal tests at the rock salt mine in Kansas, USA
  US AEC's decision on a disposal site at the test site
  Plan cancelled due to local and state government opposition

2nd Period (mid 1970s – 1980s)

- Clarification of the framework of the concept of geological disposal through study by international organizations
- Any type of geological formation that meets certain conditions can be considered for a repository
- Ensure that disposal safety is not solely dependent on the natural geological environment, but on the system as a whole, including engineering measures (multiple barrier system) (OECD/NEA, 1977)

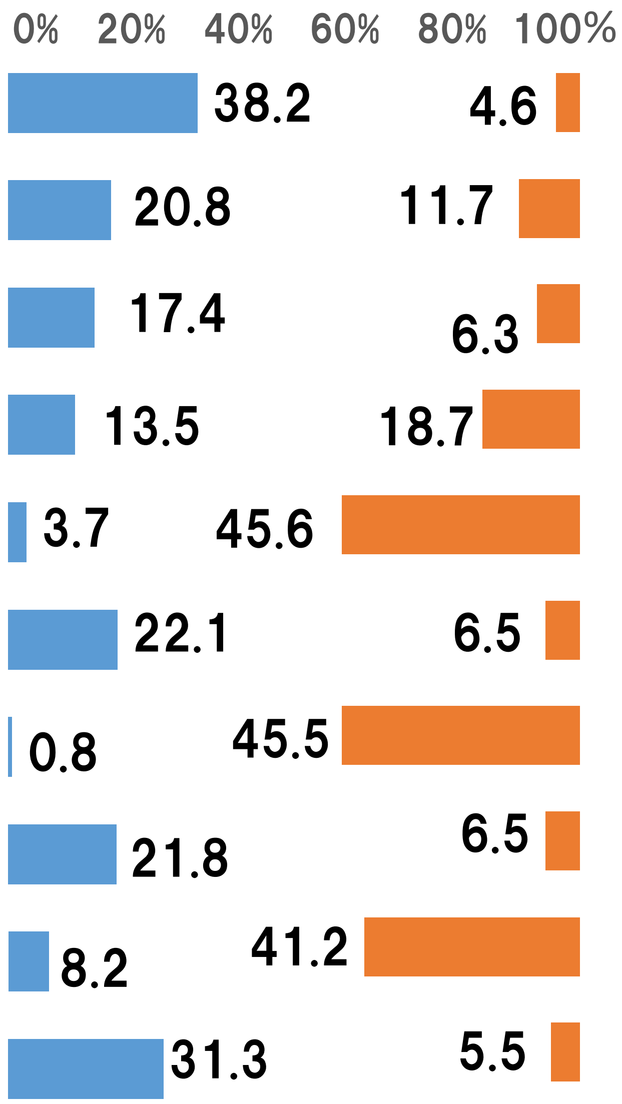
3rd Period (late 1980s – around 2000)

- Transition from R&D phase to implementation phase

4th period (after 2000)

- Discussion of the concept of geological disposal with attention to social issues as it progresses to the project stage, such as site selection for geological disposal

Result of public opinion survey pertaining to HLW disposal



High-level radioactive waste must be disposed of by our generation	38.2	4.6	HLW disposal does not have to be considered in our generation
In favor of burying HLW deep underground as a disposal method	20.8	11.7	Oppose burying HLW deep underground as a disposal method
I' m interested in the nationwide scientific screening (mapping)	17.4	6.3	I' m not interested in the nationwide scientific screening (mapping)
I think it is possible to ensure the safety geological disposal of HLW	13.5	18.7	I don' t think it is possible to ensure the safety geological disposal of HLW
I don' t think there will be any major accidents at the final disposal site	3.7	45.6	I' m worried about a major accident at the final disposal site
A final disposal site for HLW must be determined as soon as possible	22.1	6.5	No need to rush to decide on a final disposal site for HLW
I think a finel disposal site for HLW will be quickly determined	0.8	45.5	I don' t think a final disposal for HLW will be decided for a while
I think the disposal project will benefit the employment and economy for the site	21.8	6.5	I don' t think the disposal project will benefit the employment and economy for the site
I don' t I would object if a final disposal site was planned for my neighboring area	8.2	41.2	I think I would oppose a final disposal site if it were planned in neighboring community
Regardless of whether nuclear power is utilized, we must address waste disposal.	31.3	5.5	We should decide to phase out nuclear power generation before considering waste disposal.

Concept of High-level Radioactive Waste Disposal

Radioactive waste disposal methods considered

Ideas	Examples
Long-term above ground storage	Not currently planned to be implemented anywhere
Disposal in outer space	Investigation now abandoned due to cost and potential risks of launch failure
Rock melting (proposed for wastes that are heat generating)	Laboratory studies performed in the UK
Disposal at subduction zones	Not permitted by international agreements
Sea disposal	Not permitted by international agreements
Sub seabed disposal	Not permitted by international agreements
Disposal in ice sheets	Rejected by countries that have signed the Antarctic Treaty or committed to providing solutions within national boundaries
Deep borehole disposal	Investigations are underway in the USA
Partitioning and transmutation	Laboratory studies performed

Institutional control after closure of repository

- Memory keeping
- Marker
- Monitoring (before and after closure)
- Prohibition of unauthorized excavation at disposal site, etc.

- Issues common to all countries that have been discussed by experts from various countries at international organizations such as the IAEA, OECD/NEA, and the EU.

- For example, OECD/NEA, Preservation of Records, Knowledge and Memory (RK&M) Across Generations: Final Report of the RK&M Initiative, 2019.

-Some of these issues have been discussed or incorporated into Acts in Japan, but further consideration is necessary.

IAEA SSR-5; 5.12. Geological disposal facilities have not to be dependent on long term institutional control after closure as a safety measure (see Requirement 5).
Nevertheless, institutional controls may contribute to safety by preventing or reducing the likelihood of human actions that could inadvertently interfere with the waste or degrade the safety features of the geological disposal system. Institutional controls may also contribute to increasing public acceptance of geological disposal.

Reversibility and retrievability（R&R） 1/5

- What is reversibility and retrievability?
- Reason for incorporating reversibility and retrievability
- In Japan, the basic policy for final disposal of HLW revised in 2015 guarantees reversibility from the perspective of securing a wide range of options in the future.

Ref. OECD/NEA, Reversibility and Retrievability (R&R) for the Deep Disposal of High-level Radioactive Waste and Spent Fuel　Final Report of the NEA R&R Project (2007-2011) , December 2011.

Journal of AESJ, Vol.55, No.9 (2013). Vol.55, No.11 (2013). Vol.56, No.1 (2014). Vol.56, No.2 (2014).

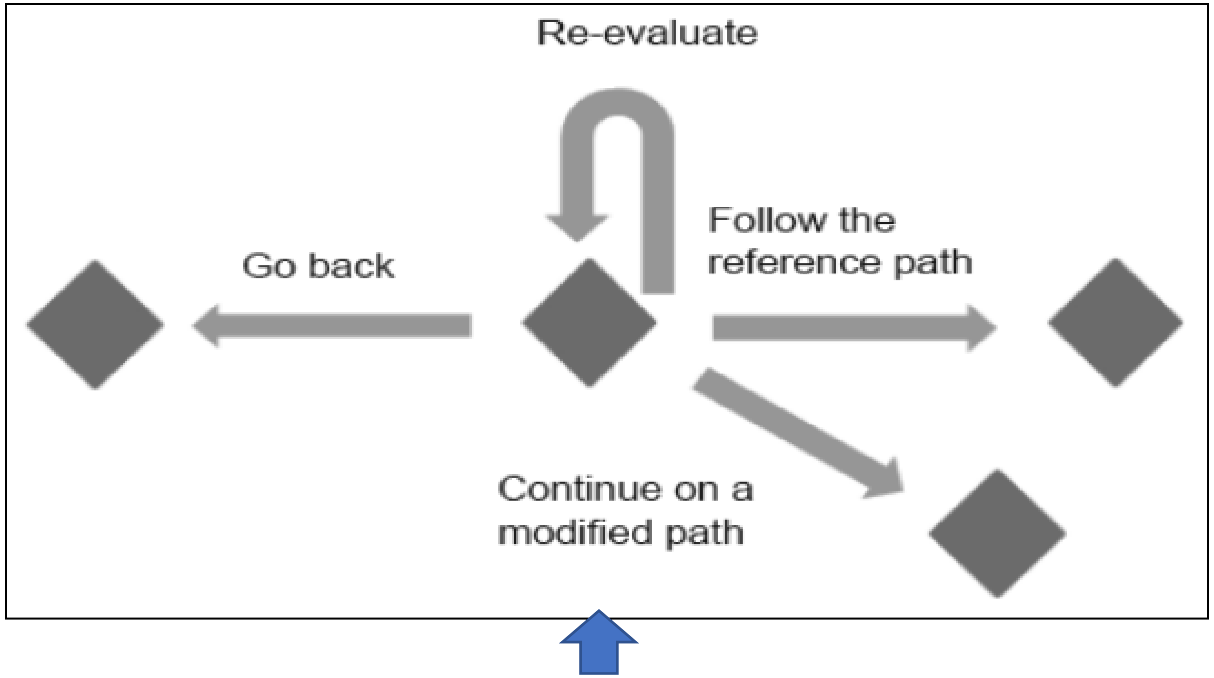
Definition of R&R 2/5

Terminology matters a great deal when discussing R&R and geological repository concepts. For the sake of clarity, the project produced its own definitions of key terms:

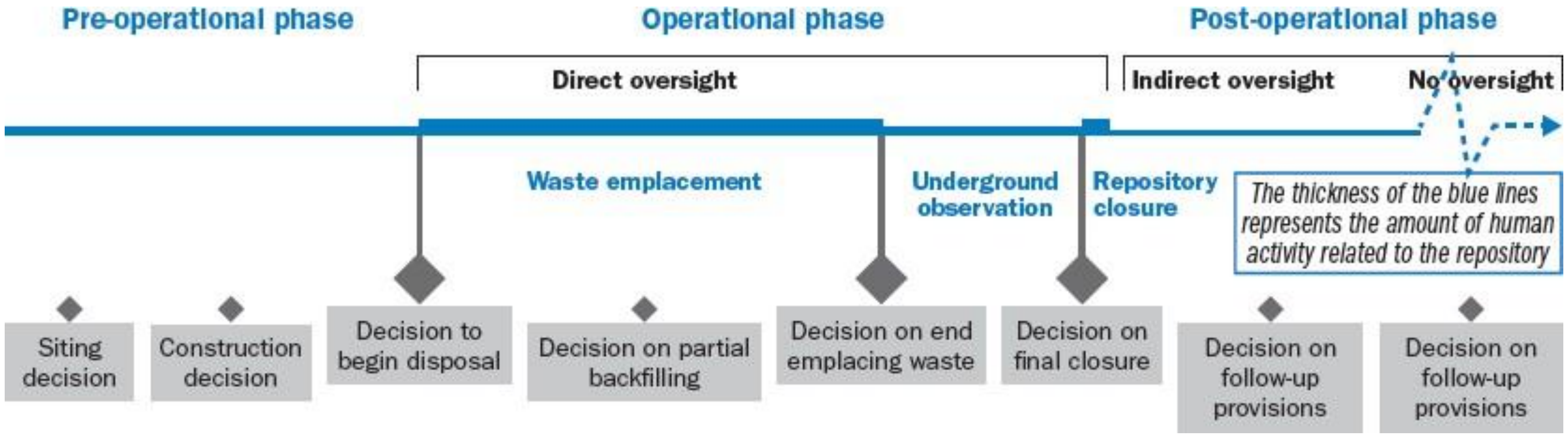
Reversibility describes the ability in principle to reverse or reconsider decisions taken during the progressive implementation of a disposal system; reversal is the concrete action of overturning a decision and moving back to a previous situation.

Retrievability is the ability in principle to recover waste or entire waste packages once they have been emplaced in a repository; retrieval is the concrete action of removal of the waste. Retrievability implies making provisions in order to allow retrieval should it be required.

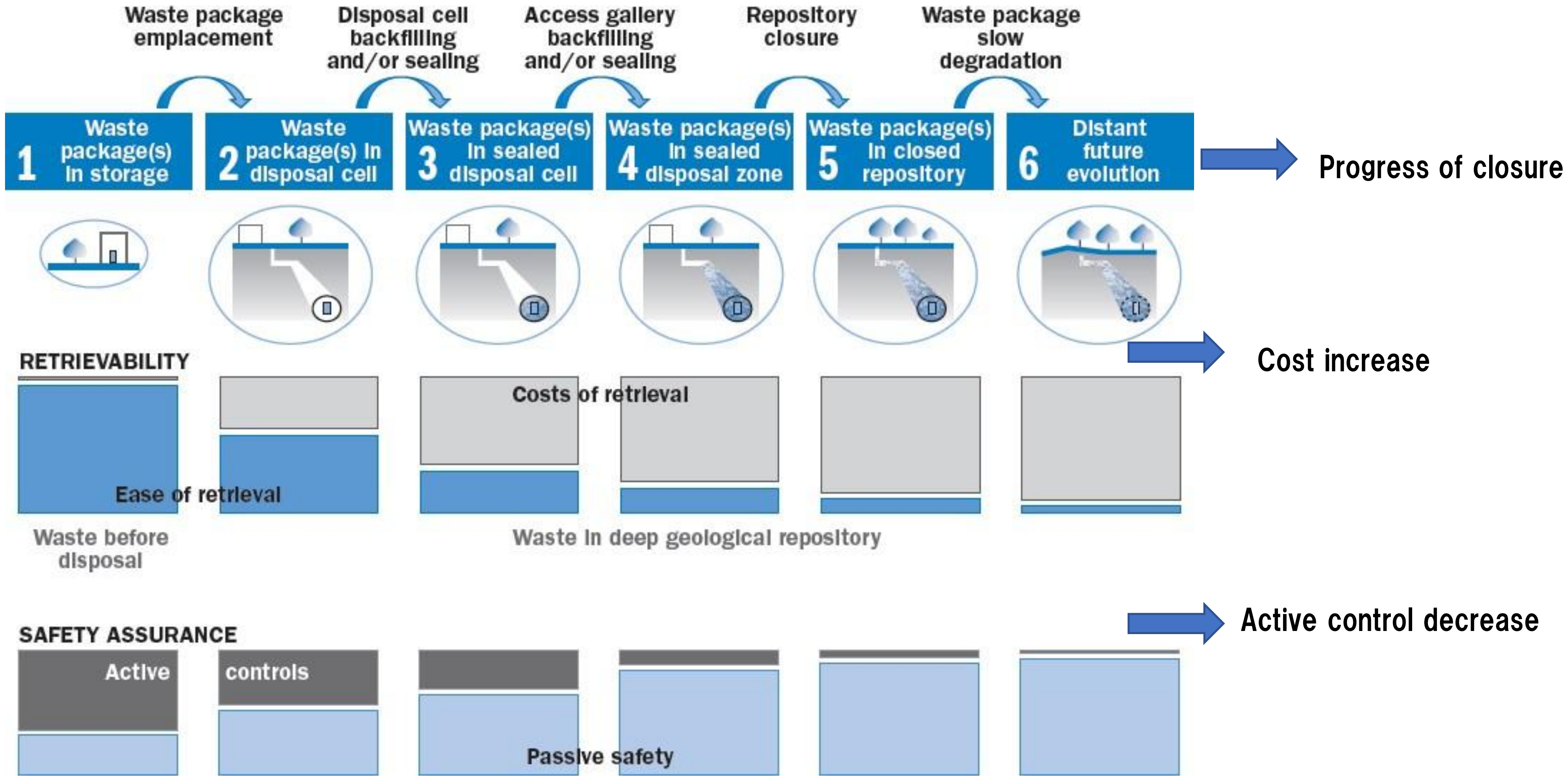
Reversibility of decisions – potential outcomes of options assessment, including reversal 3/5



Repository life phases and examples of associated decisions



Retrievability 4/5



"R-scale" - Lifecycle stages of the waste, illustrating changing degree of retrievability, passive vs. active controls and costs of retrieval in a deep geological repository. During the operational phase, not all waste packages present in the facility will be at the same lifecycle stage.
Note: exact proportions of illustrated rectangles may vary depending on the repository design.

Observations of R&R project　5/5

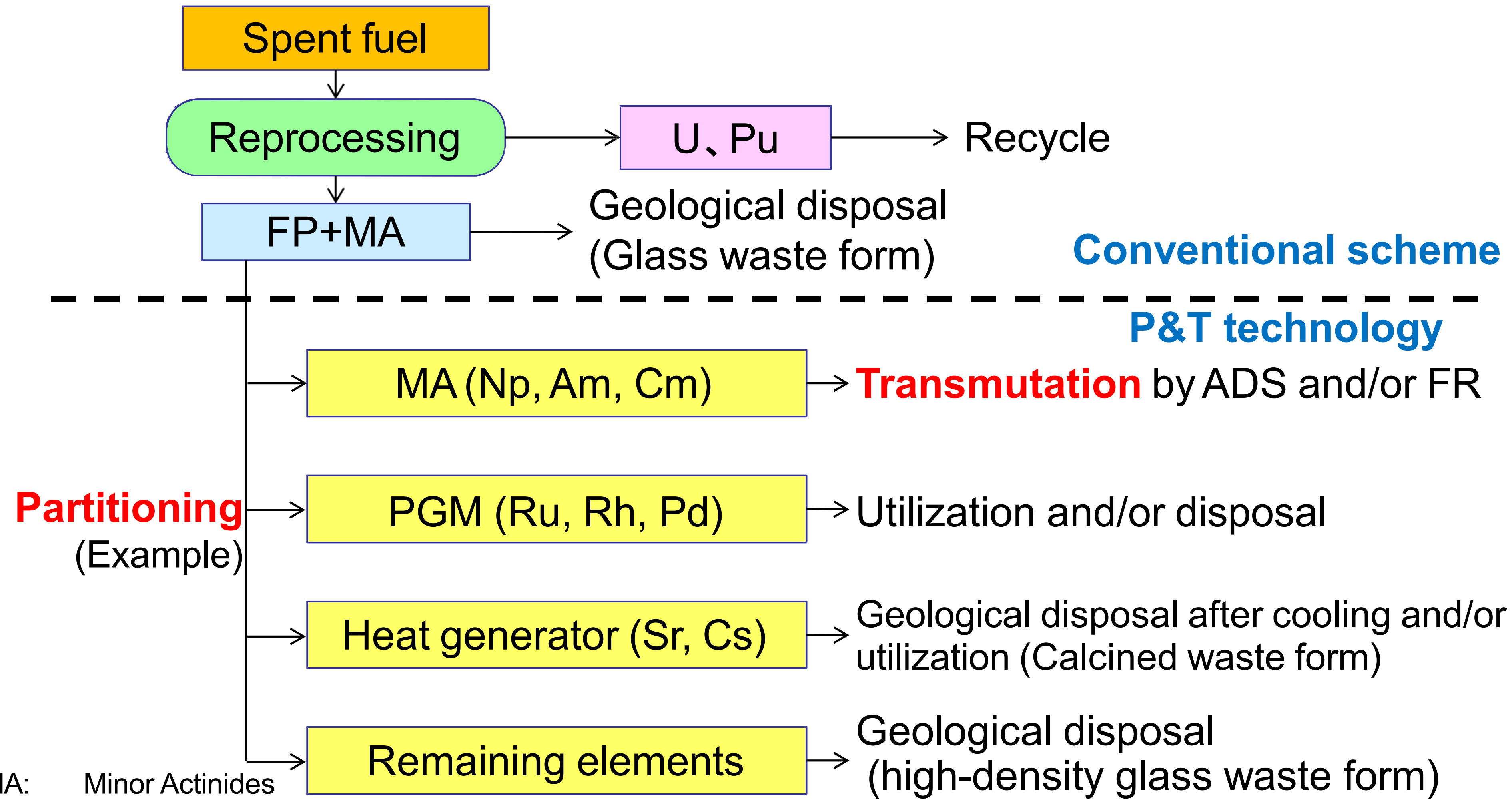
- There are various approaches to R&R in the policies and laws of each country (some countries require reversibility and retrievability by law, while others do not formally state them).
- It is recognized that even in countries where R&R is not formally enshrined in law or policy, these can be important issues.
- There are technical differences between countries, such as differences in host rocks and differences in the design of reference disposal sites (for example, it is possible to keep tunnels open for a long time after emplacement in some countries).
- Importantly, each country has its own distinct history of repository development, as well as its unique social, cultural and legal environment.
- Given the existence of these fundamental differences, it is to be expected that there will be diversity in R&R efforts.

Partitioning and transmutation（P&T’s）and its effect on disposal of HLW

- Effect of reducing potential radiological impact, radiation exposure dose, heat generation, and HLW volume.
- Need to consider based on "The NUMO Pre-siting SDM(site descriptive model)-based Safety Case".
- Additional cost for P&T and reduction of disposal cost should be evaluated.
- Atomic Energy Society of Japan, "Treatment/Disposal and Partitioning/Transmutation Technology of Radioactive Waste" Research Special Committee Final Report “ was submitted in 2022.

- https://www.aesj.net/sp_committee/com_rwmpt

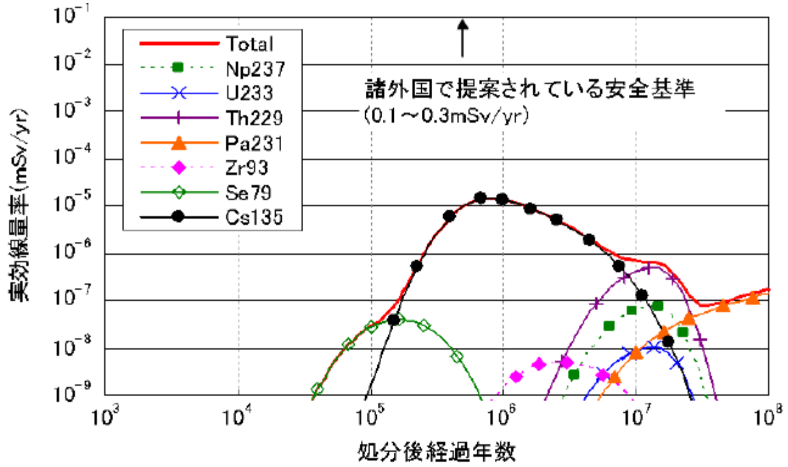
Flow of Partitioning and Transmutation



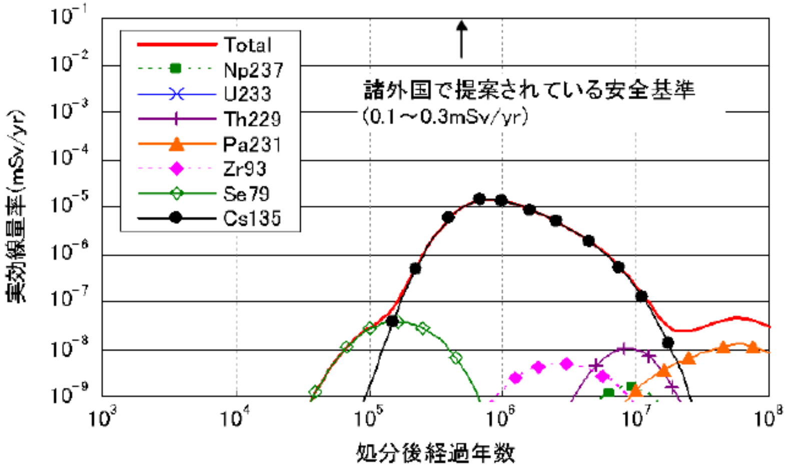
MA: Minor Actinides
FP: Fission Products
PGM: Platinum Group Metal
FR: Fast Reactor
ADS: Accelerator Driven System

Example of P&T's effect on disposal of HLW

In the groundwater migration scenario, the presence of reprocessing and P&T have no effect on the max. effective dose.

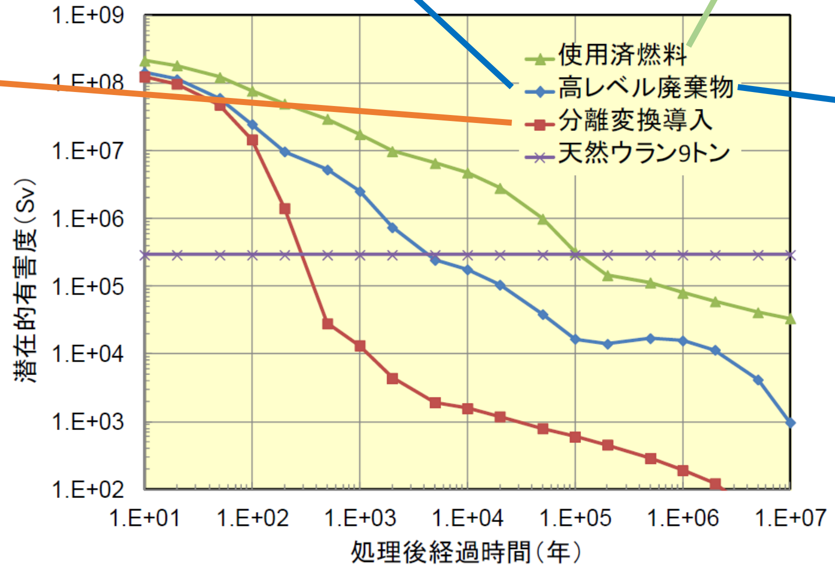


Groundwater migration scenario without MA recycle

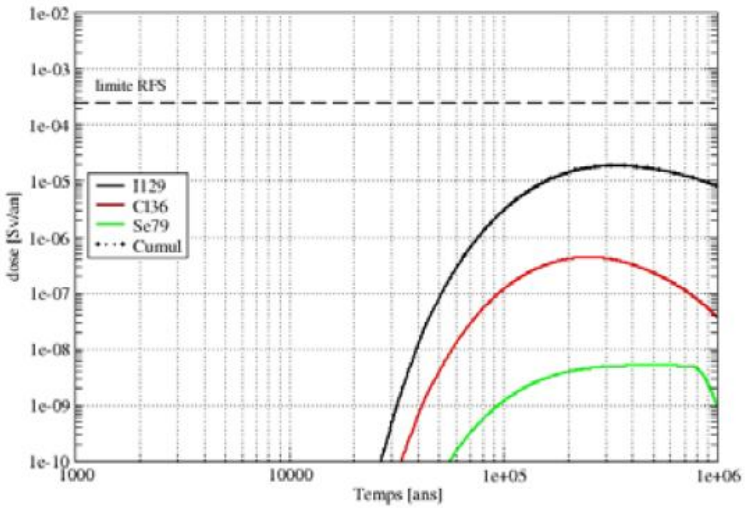


Groundwater migration scenario with MA recycle

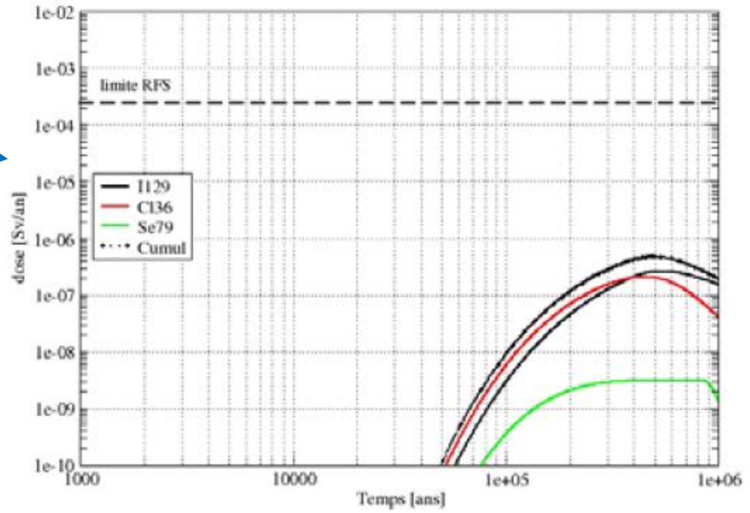
(Standardized to 29,000 vitrified wastes generated when FBR is operated at 40 GWe for 40 years)



(Hiroyuki Oigawa, Current Status and Prospects of Separation and Conversion Technology, Lecture Materials for Meeting on Energy Issues, December 20, 2012)



Effective dose rate from repository under normal evolution scenario (UOX/URE fuel (27,000tHM) → direct disposal)



Effective dose rate from repository under normal evolution scenario (UOX/URE fuel (42,300tHM) → reprocessing → vitrified waste)

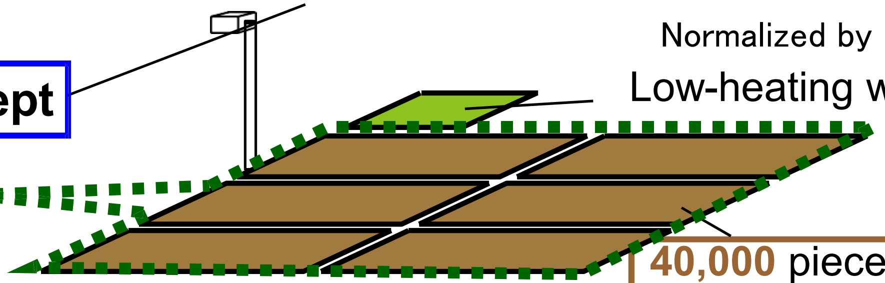
(ANDRA, Dossier 2005 Tome - Safety evaluation of a geological repository, 2005.)

Effects of Introducing Partitioning and Transmutation

Normalized by 32,000tHM of 45GWd/t spent fuel

Conventional Concept

1.8 km²



Low-heating wastes (0.13km²)

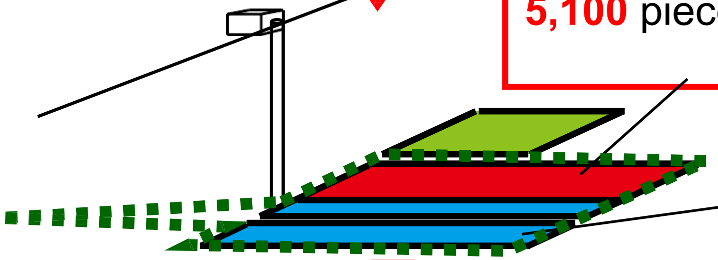
CT: Cooling time before disposal

40,000 pieces of **glass waste forms** (1.8km²)
(CT: **50** y)

(Vertical emplacement in crystalline rock)

MA transmutation
+
FP Partitioning

0.41 km²

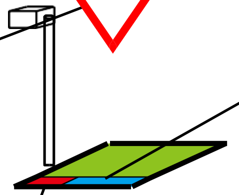


5,100 pieces of **Sr-Cs** calcined forms (0.23km²)
(CT: **130** y)

8,300 pieces of **highly-loaded glass** waste forms (0.18km²)
(CT: **5** y)

MA transmutation
+
FP Partitioning
+
Long-term storage of Sr+Cs

0.015 km²



8,300 pieces of **highly-loaded glass** waste forms (0.01km²)
(CT: **45** y)

5,100 pieces of **Sr-Cs** calcined forms (0.005km²)
(CT: **320** y)

Ref. : K. Nishihara, et al., “Impact of Partitioning and Transmutation on LWR High-level Waste Disposal”, J. Nucl. Sci. Technol., 45(1), 84-97 (2008).

Geologcal Disposal　　Site selection in Japan

- From technical point of views, site investigation to select a site will be done by 3 steps, i.e. consists of an initial literature survey phase and three subsequent stages: selection of Preliminary Investigation Areas (PIAs), selection of Detailed Investigation Areas (DIAs) and selection of the repository site.
- Adopting consent-based processes is common in most countries and needs community engagement.
- Each country determine site selection systems, methods, decision-making processes, etc., reflecting differences in national character, socio-politics, and historical circumstances.

Site selection process of Japan

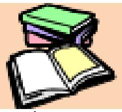
Ref. Radioactive waste WG (April, 2022) Document 3

Do not bring in any radioactive waste during the 20-year investigation period

Apply from municipalities (example of Suttsu Town)
・Hearing the opinion of residents briefings and town councils by the town.
・The final decision is made by the mayor.

or

Municipal government accepts proposal from national government (example of Kamoenai Village)
・Petition to invite from the Chamber of Commerce to the village assembly.
・The invitation was voted on by the village assembly.
・In response to this, the government made an offer and the mayor accepted it.

Literature survey
About two years

(Desk survey)

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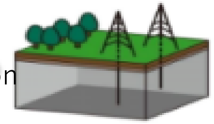
Preliminary investigation
About four years
Site selection

(Boring investigation)

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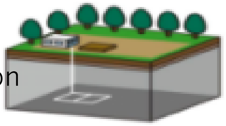
Detailed investigation
About fourteen years
Site selection

(Investigation and tests at underground facilities)

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Selection of disposal site

＊1 Listen to local opinions (Contrary to the opinion, do not proceed)

Literature survey stage
Maximum total
2 billion yen
(up to 1 billion yen in a single fiscal year)

Preliminary investigation stage
Maximum total
7 billion yen
(up to 2 billion yen in a single fiscal year)

Institutionalization will be considered from the detailed investigation stage

Socio-economic issues and countermeasures (how to respond to literature surveys, etc.)

History of Final Disposal and Nationwide Dialogue Activities

-Confidence and trust building

-Information dissemination, dialogue activities (government, NUMO)

a. Transmission of information

-Dissemination to various social strata - cross-media public relations, information dissemination via websites, SNS, and information dissemination via e-mail magazines

-Efforts for the mass media and media, support for geological disposal model exhibition vehicles, workshops and debate classes for educators, etc.

b. Dialogue

-Interactive nationwide information meeting

-Nationwide expansion of interest groups that want to know more deeply through dialogue activities (approximately 160 interest groups)

-Activities to promote understanding of geological disposal by next-generations

-Dialogue activities in the community (METI representatives visit local governments)

-Regional development

-Countermeasures against reputational damage caused by harmful rumors

Ref. Radioactive waste WG（April, 2022）Document 3

Community Dialogue Meeting in Literature Survey Areas

- In order to expand the area of the literature survey, to visit individual local government leaders across the country began in 2023. With the cooperation of local electric power companies, 250 local governments have been visited as of the end of September this year.
- Additionally, the Agency for Natural Resources and Energy and the Nuclear Waste Management Organization of Japan (NUMO) are jointly conducting nationwide dialogue activities. Interactive seminar were launched in 2017, and 214 seminars have been held as of the end of September 2025.
- In addition, the government and NUMO held symposiums and conducted mass media public relations activities, including television commercials and newspaper advertisements.

〈Large-scale symposium in Tokyo〉
(February, 2025)

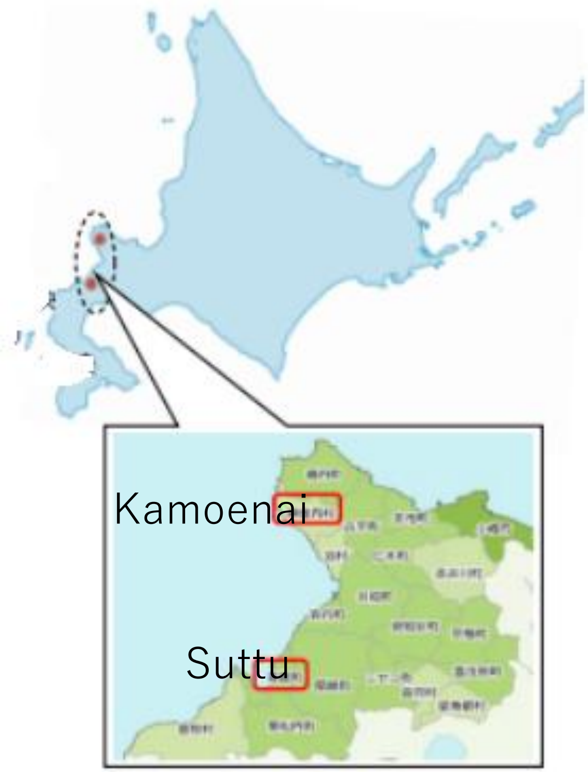
〈newspaper advertisements〉

〈TV commercials〉

History of Japanese site selection process from 2000 to 2024

The basic policy was revised in 2015, the “Nationwide Map of Scientific features for Geological Disposal” was published in 2017, and as a result of the accumulation of steady understanding activities since then, a literature survey was started in two municipalities in Hokkaido (Suttsu Town, Kamoenai Village) in 2020. A literature survey was started in Saga (Genkai Town) in 2024.

2000: Enactment of the Final Disposal Act
⇒ Established NUMO (Nuclear Waste Management Organization of Japan) as the implementer of GD
⇒ Nationwide call for public application of local governments accepting disposal site selection surveys (since 2002)
2007: Toyo Town, Kochi Prefecture (Applied → Withdrawn) ⇒ No host municipality appeared
2013: Establishment of final disposal-related ministerial conference ⇒ Start of drastic review of initiatives
2015: Cabinet decision on new basic policy
• Promote initiatives for geological disposal as a responsibility of the current generation
• Share respect and appreciation for the host community with the people
• Secure reversibility from the perspective of securing a wide range of options in the future
• The national government takes the initiative, such as presenting areas that are scientifically considered to be more suitable.
2017: Published the Scientific Characteristics Map
• Started dialogue activities nationwide
2018: Commencement of detailed dialogue activities centered on dark green areas on the map
2019: Strengthening information provision based on the needs of interested groups who want to know more, etc.
Formulation of the “immediate action policy toward the start of literature surveys in multiple regions”
2020: Literature survey started in two municipalities in Hokkaido (Suttsu Town, Kamoenai Village)
2024: Literature survey started in one municipality in Saga (Genkai Town)
2024: Submit the literature survey report in two municipalities in Hokkaido to the village chief, town mayor, and Governor of Hokkaido



Ref. Radioactive waste WG（April, 2022）Document 3

Recent movement of literature survey at three municipalities

(1) Suttsu Town, Hokkaido
(2) Kamoenai Village, Hokkaido

April 18,2025 :End of public comment period for literature survey report (Over 2,000 questions received)
November 30,2024~ :Literature survey report briefing session begins
November 22,2024 :Submit the literature survey report to the town and village mayors
August 1, 2024: The national council concludes its deliberations on the draft literature survey report
February 13, 2024: The national council begins deliberations on the draft literature survey report (submitting the draft literature survey report as a reference material)
December 27, 2023: The national government amends the "Enforcement Regulations for the Act on Final Disposal of Specified Radioactive Waste" (revising the public inspection period from "one month" to "a period of 30 days or more")
November 2, 2023: The national government publishes the "Concepts for evaluation at the literature survey stage“
April 14,2021~ :Launch of "Forum for Dialogue" (Suttu town 16 times, Kamoenai village 21 times)
November 17, 2020 : Literature survey begins in two municipalities in Hokkaido

(3) Genkai Town, Kyushu

April 17,2025~: Launch of "Forum for Dialogue"
June 10, 2024: Literature survey begins (NUMO business plan change approved)
May 10, 2024: The Genkai Town Mayor expresses his intention to accept the national request for a literature survey
May 1, 2024: The national request to conduct a literature survey
April 26, 2024: The Genkai Town Council adopts a petition requesting the acceptance of the literature survey at its general meeting
April 17, 2024: The Genkai Town Council begins deliberations on the petition at its Special Committee on Nuclear Power Measures
April 4, 2024: The Genkai Town Council formally accepts the petition requesting the acceptance of a literature survey

Dialogue activities

Role of community dialogue forums in Suttu and Kamoenai

- It is important to have continuous dialogue and deepen discussions among residents based on the provision of appropriate information.
- For this reason, a "forum for dialogue" was established when conducting a literature survey. In response to the opinions of the committee members at the "forum for dialogue," various initiatives are implemented to support the region.

<Operation of "Forum for Dialogue">

- Assign a third-party facilitation to conduct unbiased discussions
- Ensuring free discussion and transparency beyond the position of each participant
- Provide opportunities for the general public to participate in a variety of ways othrt than as committee members

<Study theme>

Disposal business related

- Outline of disposal project
- Approach to safety assurance
- Progress report on the literature survey
- Visits to related facilities etc

Regional development vision

- Discussion on future town planning
- Economic and social impact studies

etc

Re. Atomic Energy Sub-committee（May 10, 2022）Document 6.

Regional development

Image of regional development vision

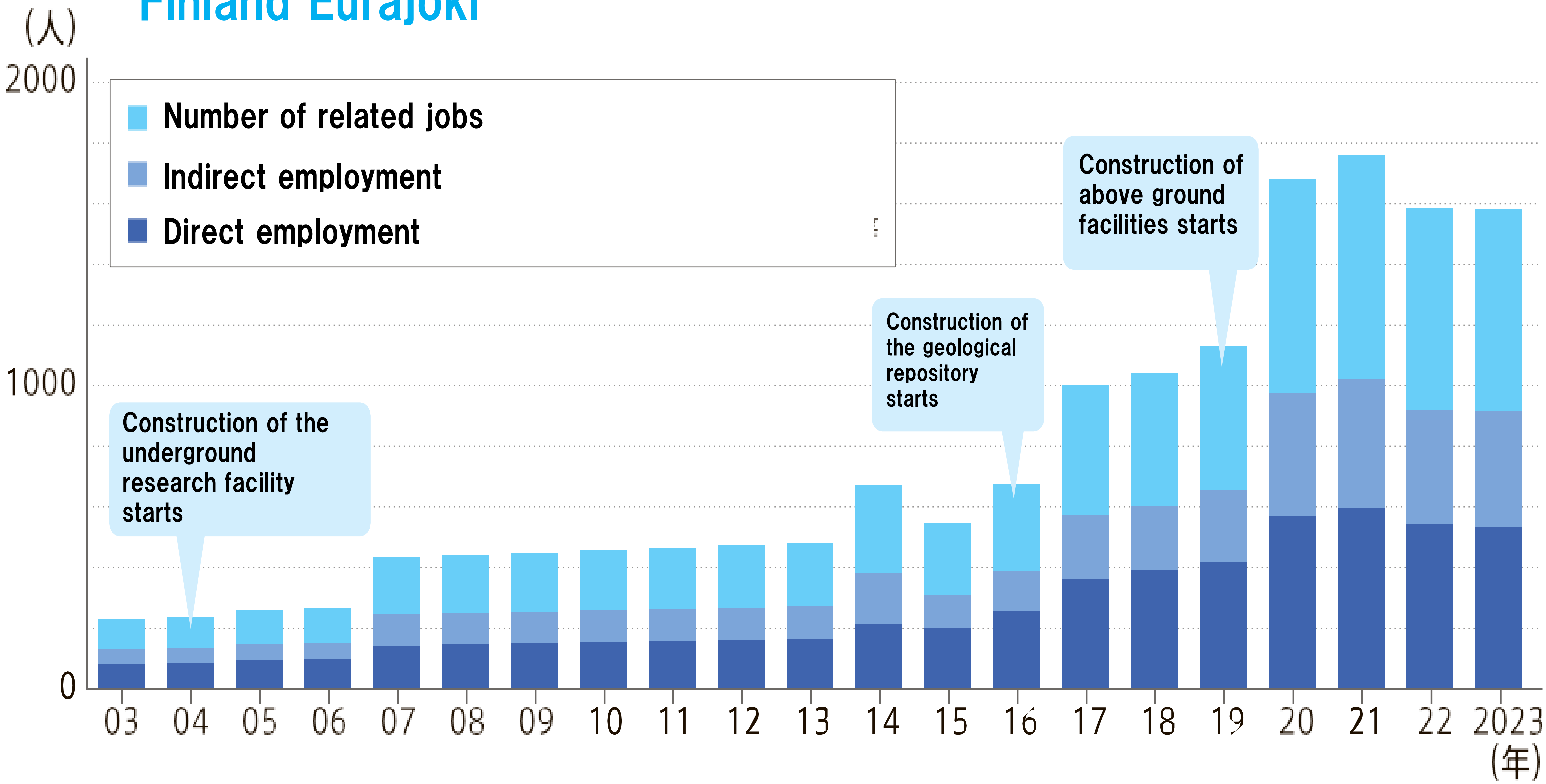
Since the disposal project will last for more than 100 years, efforts toward regional development will be implemented.

- Infrastructure development
  Ex.road maintenance
- Local small business support
- Tourism promotion and community development
- Economic ripple effect
  Ex. Tax revenue
  - Local order amount
  - Employment inducement effect
  - Production inducement effect
- Medical institution development
- Education support
- Disaster prevention

Re. About the immediate policy for conducting literature surveys in multiple regions（2019 Local government briefing materials）

Economic Effects in Final Disposal Site Host Municipalities

Finland Eurajoki



Principle of waste minimization

-Waste minimization is a requirement of the IAEA. Both radioactivity and volume shall be reduced.

(Reference) IAEA Safety Document "Predisposal Management of Radioactive Waste, Safety Standard Series No. GSR Part5, (2009): Requirement 8 Radioactive waste generation and control

All radioactive waste shall be identified and controlled. Radioactive waste arisings shall be kept to the minimum practicable.

-Japan Atomic Energy Commission, Policy on Processing and Disposal of Low Level Radioactive Waste (Views) (December 28, 2021)

Principle of waste minimization

In the management, treatment, and disposal of waste, it is important to give top priority to ensuring safety. In order to control the environmental impact, the first step is to prevent the generation of waste during decommissioning, etc. as much as possible. , it is necessary to minimize the amount of radioactive materials generated in terms of both quantity and volume. In doing so, we will measure and evaluate the radioactivity of waste such as metals and classify it appropriately based on the results, thereby promoting the reuse of materials that are not contaminated with radioactive substances. It is desirable to promote the reuse of waste that falls below safety standards and does not need to be treated as radioactive waste legally by utilizing the clearance system, as has already been done in Europe. It is appropriate to minimize waste through these efforts and to dispose of the remaining radioactive waste at a landfill site.

The principle of waste minimization is also consistent with the direction of aiming for a sustainable recycling-oriented society.

Long-term storage vs geological disposal

Basic concept of geological disposal

● When stored on the ground for a long period of time, the risk of natural disasters and wars increases, and future generations will continue to bear the burden of maintaining the technology and human resources necessary for management.

● By properly burying deep underground, the risk of future high-level radioactive waste can be kept sufficiently small without human control until the radioactivity decays.

Present → Decades → Hundred of years → Thousand of years → Tens of thousands of years

When storing on the ground for a long period of time

Increased security risks in management
- Ground is more susceptible to earthquakes, volcanic eruptions, typhoons, tsunamis, wars, terrorism, etc. than underground
- Things are more likely to corrode above ground than underground

→ <By properly burying deep underground>
Safety risks can be reduced.

Continuing need for human control and growing uncertainty about control feasibility
- Can human society continue to manage for tens of thousands of years?
- Can we continue to maintain the skills and human resources necessary for management?
- Who will bear the costs necessary for future generations to manage?

→ <By properly burying them deep underground>
The burden on future generations can be reduced without the need for human management.

Ref. “Interactive national briefing session Explanati

Situation in other countries

-Finland, Sweden, and France are leading the way.

-It is important to learn from other countries' experience.

-Even if a successful example is introduced as it is, it does not necessarily lead to success.

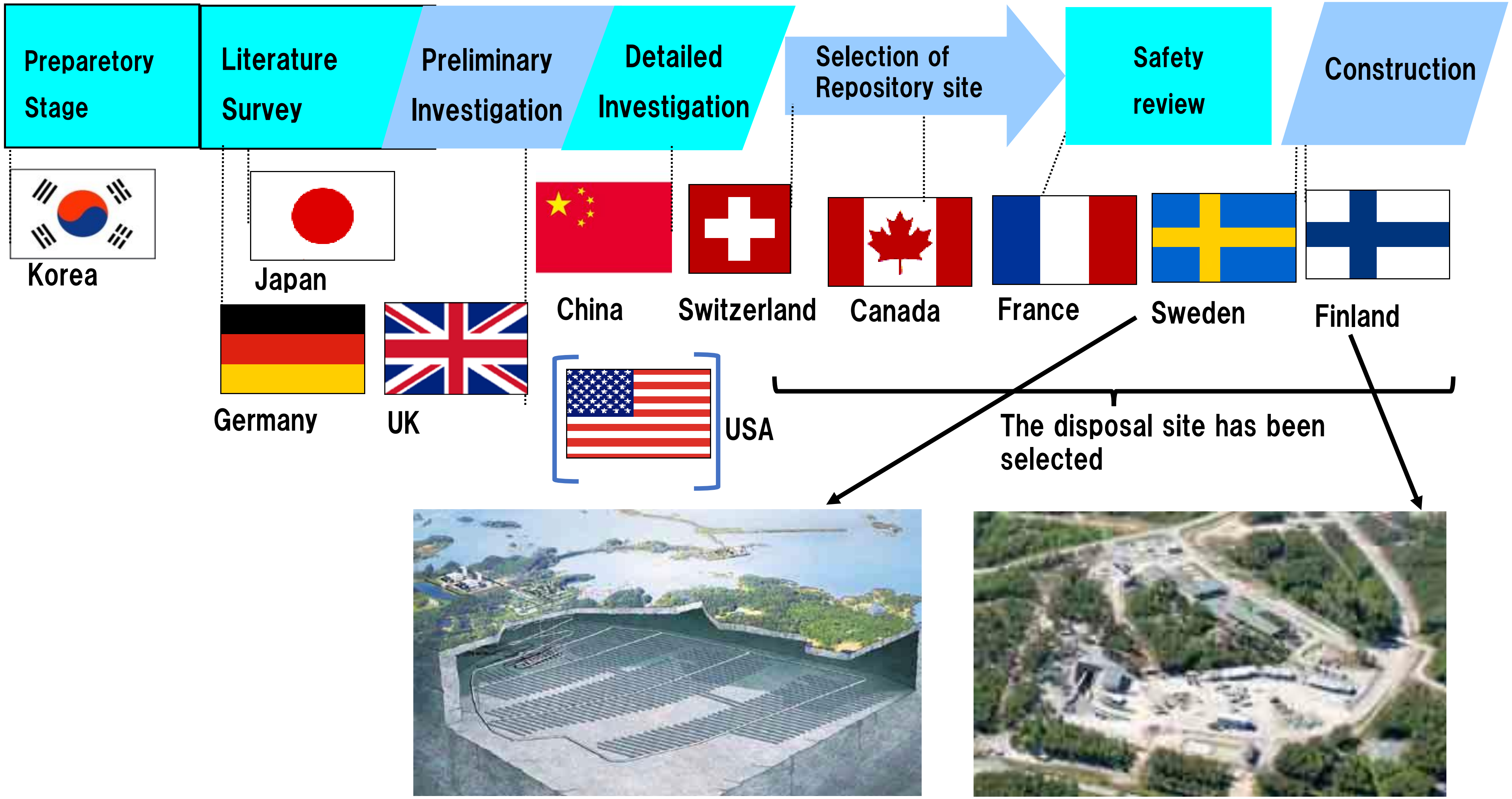
-In EU member countries, conditions for adding nuclear power plants to the EU taxonomy;

  - -Compliance with EU laws, radioactive waste management fund, decommissioning fund

  - -Operation of very-low/low/intermediate level radioactive waste repository

  - -Plan to operate a geological repository for high-level radioactive waste by 2050

Situation of Nuclear Powered Countries toward Realization of Final Disposal



EU Taxonomy

Criteria for determining whether an economic activity is environmentally sustainable

Objectives of EU Taxonomy

1) Climate change mitigation
2) Climate change adaptation
3) Sustainable use and production of water and marine resources
4) Transition to circular economy
5) Pollution prevention and control
6) Protection and restoration of biodiversity and ecosystem

Nuclear power is recognized as confirming to the EU taxonomy as long as the following strict conditions

1) Member countries using nuclear power must operate final disposal sites for very low and low level as well as intermediate level waste
2) Countries using nuclear power must develop a plan for the construction of a final disposal site for high level waste
3) Countries with existing nuclear power plants and plans to build new nuclear power plants as of 2025 must use accident tolerant fuel that has been certified by the regulatory authority

Conclusion

In the keynote speech, technical and social issues of final disposal were introduced.

A major issue for final disposal is safety. Based on this premise, various issues have been also discussed. If the goal of these issues is to get people to understand and accept final disposal and final disposal sites can be managed and closed, I think most of the issues have not yet been answered.

These issues have been discussed for many years in international organizations or through international projects from the 1990s to today. Relevant information can be collected through the Internet.

Deep geological repository is considered the most preferred disposal method, but many items continue to be considered (e.g. R&R, high-performance container etc.)

I hope that you will first gather relevant information, read and understand the contents, exchange opinions with your colleagues if possible, and be able to make and express your own opinions. By doing so, I think the information becomes your own living knowledge.

As final disposal is a project that spans more than 100 years, I hope that you and succeeded next generations will continue to do so.