

# **Japan's Policies and Activities for Deep Geological Disposal of HLW & TRU Waste and the Stakeholder Engagement Activities Related<sup>1</sup>**

Shunsuke Kondo

President

Nuclear Waste Management Organization of Japan (NUMO)

Thank you Mr. Chairman.

Good afternoon Ladies and Gentlemen. It is my great pleasure to present you this afternoon Japan's Policies and Activities for Deep Geological Disposal of high-level radioactive waste (HLW) and Transuranic Waste (TRU waste) and the stakeholder engagement activities related.

(Slide 3) In Japan the Government initiated in 1976 research and development (R&D) programs on deep geological disposal (DGD) of HLW separated from used nuclear fuel by reprocessing when it decided to construct reprocessing facilities in Japan for recycling nuclear fuel in its nuclear power program.

In 1999 the Japan Atomic Energy Agency (JAEA) reported that there are geological areas widely in Japan where we can locate a safe deep geological repository (DGR). After evaluating the validity of the report, the Atomic Energy Commission (AEC) recommended the Government to establish a system for implementing DGD of HLW, taking into consideration of the results of a year-long nation-wide public consultation activity. Upon receipt of the AEC's recommendation, the Government enacted in 2000 the Act on Specified Radioactive Waste Final Disposal that specified that DGD should be implemented by corporations authorized by the Government at the site selected through a consent-based multi-stage process.

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<sup>1</sup> Presented at [STIG Risk Governance International Symposium: Risk Governance in High Level Waste – Challenge and experience in Germany and Japan – held by STIG \(Science, Technology, and Innovation Governance\), University of Tokyo at Daiwa Ubiquitous Computing Research Bldg., September 6, 2016.](#)

Slide 3 shows the timeline of program for DGD of HLW in Japan. In accordance with the Act, the Ministry of Economy, Trade and Industry (METI) authorized Nuclear Waste Management Organization of Japan (NUMO) established by the HLW producers in the same year as an organization to implement the DGD of HLW and transuranic (TRU) wastes.

As summarized in Slid 4, the NUMO is currently authorized to pursue;

- ◆ Selection of a site for DGD of HLW and TRU wastes through a consent-based stepwise process that consists of literature survey, preliminary investigation and detailed investigation;
- ◆ Promotion of public information activities and public relation activities as the public is at the center of decision-making involved in the process;
- ◆ Promotion of the research and development for safe and efficient implementation of DGD in cooperation with R&D institutions at home and abroad, preparing a Safety Case report of DGR at each step;
- ◆ Collection of fee for final disposal, which is administered by Radioactive Waste Management Funding and Research Center (RWMC).

Slide 5 depicts the organizational structure for the promotion of DGD in Japan I have just mentioned briefly, and Slide 6 summarizes the current organization of NUMO. Considering the fact that the NUMO's mission is, unlike that of the counterparts in abroad, limited only to the geological disposal of HLW and TRU waste, we can say that the current size and budget of NUMO are comparable to those of GD implementers in other countries.

Slide 7 depicts the idea of three stage consent-based site selection process. In this process, NUMO can move survey and investigations forward only after it obtains the approval of the mayor of the municipality the survey or investigation area is located.

As mentioned in Slide 8, NUMO informed in 2002 all municipalities in Japan the open solicitation for the acceptance of a literature survey, the first stage of the process, and held seminars and symposia on a nationwide scale since then,

to communicate with the public on the importance and the safety of dDGD of HLW in cooperation with the METI. The METI established a system to provide a subsidy for community development to both a municipality that applies for the survey & investigations and the prefecture where the municipality is located, as an incentive for them to help society solve the problem of managing HLW.

As mentioned in Slide 9, Toyo Town in Kochi prefecture officially submitted its intention to accept the literature survey in 2007. A strong opposition campaign spread in the municipality of which population was about 3400, however, and an ensuing mayoral election resulted in the defeat of the incumbent who promoted the project. The town subsequently withdrew its submission.

After this event, METI started to explore the way to induce municipalities to accept a literature survey. Japan Atomic Energy Commission (JAEC) also deliberated the issue and, as a result, sent a letter to the Science Council of Japan (SCJ) requesting opinion on the effective approaches of public outreach with a view to promoting the final disposal of HLW in September 2010. But both could not come to concrete conclusions before the occurrence of Great East Japan Earthquake and the major nuclear accident at Fukushima Daiichi triggered by huge tsunami induced by it in March 2011.

The accident at Fukushima Daiichi Nuclear Power Station caused public distrust in the Government and amplified public concerns about anything nuclear including the safety of DGD of HLW. The Science Council of Japan (SCJ) published in September 2012 in such social environment their opinion in response to the JAEC's request for opinion sent two years before.

(<http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-22-k159-1.pdf#search='2012%E5%B9%B49%E6%9C%8811%E6%97%A5+%E5%AD%A6%E8%A1%93%E4%BC%9A%E8%AD%B0+%E6%8F%90%E8%A8%80'>)

In the opinion, which is summarized in Slide 10, SCJ advised the Government that

- A) Social consensus on the nuclear energy policy should be pursued before talking about GD of HLW;

- B) The limitation of scientific and technological capability should be recognized and scientific autonomy for scientific deliberation should be secured;
- C) A policy framework should be rebuilt centered on temporary storage and the control of total volume of the waste;
- D) Socially acceptable procedures should be pursued, formulating policies based on the principle of fair burden-sharing among people;
- E) Multi-step procedures should be pursued to build consensus among the public by establishing proper venues for discussion and
- F) Need for long-term tenacious efforts to solve the problems should be recognized.

At that time, the JAEC had been publishing a series of statement that included policy recommendations to the Government in 2012, reviewing the reason why we had promoted the nuclear energy utilization in Japan and the approach taken for the assurance of its safety Slide 11 shows the title page of one of such statement. ([http://www.aec.go.jp/jicst/NC/about/kettei/121218\\_e.pdf](http://www.aec.go.jp/jicst/NC/about/kettei/121218_e.pdf))

In the statement on the waste management summarized in Slide 12, AEC stressed the importance of pursuing the realization of DGD of HLW as a responsibility of current generation that generate the waste, and advised the Government the following four actions, taking into consideration of the aforementioned opinion of SCJ:

- A) To review the scientific feasibility of DGD of HLW in Japan taking into consideration the latest knowledge of geo-science obtained after 2000, and share the result with the public as well as learned societies;
- B) To make it clear that the efforts to realize DGD of HLW should be promoted based on a consent-based stepwise site selection process, assuring the reversibility of policy and the retrievability of waste mined so that the course of action can be modified based on the result of reviews of technology and policy in the future;
- C) To share with the public through regular meeting with citizens and municipalities the process to decide the site for DGR with a view to developing social trust, acting in a competent, predictable and caring

manner.

- D) To cultivate national understanding of the importance of fair and equitable sharing of the benefit arising from areas with geological environment suitable for DGD between the owners and the public.

In April 2014, the Government published a revised Strategic Energy Plan, after turns and twists in policy deliberation. It specified, among others, summarized in Slide 13, that nuclear power should be utilized as an important base-load power source based on a safety-first policy, maintaining the existing nuclear fuel cycle program, though the nuclear dependence should be reduced as low as practicable.

It also stressed that the action to implement the DGD of HLW should not be postponed by an extended storage of it, while ensuring the reversibility and retrievability mentioned by the JAEC so that the future generation can select a different solution if it decides so.

A background to this decision was a report from an advisory group on the DGD technology METI established in October 2013 that included experts nominated by learned societies concerned. As depicted in Slide 14, the group reviewed the current status of the scientific feasibility of DGD of HLW based on the latest scientific knowledge, in accordance with the JAEC's advice, and released in May 2014 a report that pointed out that

- A) Natural events that could severely disturb the safety functions of DGD system (containment and isolation) should be avoided in the site selection process.
- B) Areas having the geological characteristics that are required for the assurance of long-term safety of DGD of radioactive waste in such a way are widely distributed in Japan;

Slide 15 depicts the change of annual outdoor ambient dose equivalent rate around the Fukushima Daiichi Nuclear Power Station (FDNPS) from Nov. 2011 to Nov. 2015. I am showing you this slide as I think it proper at this juncture to quickly summarize the current on-site and off-site situation at Fukushima and

the situation of nuclear power in Japan to give you some idea of social environment in which NUMO is struggling to face with the public.

First Fukushima off-site: as summarized in Slide 16, in the area where lands were highly contaminated by the large scale releases of radioactivity from the tsunami-hit Fukushima Daiichi nuclear power station, about 47,000 people are still requested to evacuate from their home, and about 30,000 people, many of whom are families with children, have left their home, having made up their own mind to do so, due to anxiety about health and health of children in particular, due to radiation exposure to be continued if they remain there. It is our great regret that the accident has caused about 2,000 deaths due to the worsening of diseases owing to careless emergency evacuation from hospitals and/or physical and psychological stress in the life in a shelter after dislocation.

I would like to add hesitantly, as a person once advised the Government to request nuclear operators to introduce severe accident management features and therefore responsible for the occurrence of the severe accident at Fukushima Daiichi Nuclear Power Station, that we and risk governance community, in particular, should not forget the fact that our society has experienced about 40,000 accidental loss of life and about 30, 000 suicide every year, at the same time.

As summarized in Slide 17, at Fukushima, comprehensive decontaminations in the high dose area except highly contaminated area are to be completed within a year and evacuation orders to Tamura City and Kawauchi Village were uplifted in 2014, and that to Naraha Town was done so in 2015. However, decontamination of highly contaminated forests that are major elements of highly contaminated area remained at present is difficult, and it is recognized that it will take many years to complete the decontamination of the areas. The preparation of interim storage facilities for decontamination waste composed of soil and plants removed is discouragingly slow, on the other hand, due to difficulties in obtaining the consent of landowners, who are evacuee and sufferer of the accident. This is the reason why we can see a temporarily stored pile of packed waste in many place in Fukushima prefecture.

At Fukushima on-site, on the other hand, the decommissioning of damaged FDNPS has been promoted in accordance with a roadmap developed by TEPCO and the Government, as summarized in Slide 18 and 19. The first component of the roadmap is the activities to stop the leakage of contaminated water to the outside, establishing walls along the harbor, pumping up groundwater via wells and discharging it to the sea after decontamination. This has been almost completed. The second is the activities to reduce the accumulation of contaminated water at the site. Although significant progress was made in this endeavor, we foresee the necessity of further increase in the number of water storage tank.

The third is to remove the spent fuel from the spent fuel pool in the damaged reactor buildings. The work was completed at unit 4 and now preparatory civil works are being promoted at unit 1 & 3. The fourth is to start the removal of fuel debris from the damaged units. This activity is still in exploration phase: we are making efforts to determine the location and the chemical composition of fuel debris as well as to find ways to remove the debris under extremely high radiation environment. The fifth is to promote stabilization, conditioning and safe long-term management of radioactive wastes generated in these activities and the sixth is to promote public communication about the progress and difficulty of these activities including the risk involved steadily.

As for nuclear power generation, many actions and initiatives aimed at strengthening nuclear safety have been taken by NPP operators and regulators. Based on the results of comprehensive safety reassessments that evaluate the design and safety aspects of NPP and the robustness against extreme events, in particular, necessary improvements have been identified and implemented steadily, as shown in Slide 20, which summarized the measures taken against Tsunami.

The Nuclear Regulation Authority (NRA) established a new regulation rule for nuclear reactors and facilities based on these assessments and has applied it to the review of application to restart the NPP after refueling. As summarized in

Slide 21, twenty-six NPPs in the country have applied for the review and currently only five resumed operations. In the meantime, the district court imposed a provisional disposition late March this year to hold operation of Takahama Unit 3&4, both of which had restarted shortly before the action taken by the court.

Furthermore, it should be pointed out that the results of public opinion poll on nuclear power in recent months indicated as summarized in Slide 22 that a large share of people supports the gradual reduction of nuclear dependence in the energy supply for this country and does not support the restart of idling NPPs. The Government and nuclear industry therefore should make full explanations about safety and risk management measures strengthened based on the lessons learned from the accident both for the Japanese public and the arena of the Japanese judicial system, as the Government recognizes in the Strategic Energy Plan I mentioned before that the operation of NPPs is one of the key conditions for Japan to achieve the goal set in accordance with the framework of the COP21 Agreement established in Paris last December.

Now, back to the waste management issue.

In May last year, the Government amended the Basic Policy on the Final Disposal of the Specified Radioactive Waste in order to reflect the new policy elements mentioned in aforementioned Strategic Energy Plan published in 2014. The Government emphasized in the revised basic policy the five points summarized in Slide 23 and 24;

1. Steadily promote the policy, recognizing it as the responsibility of the current generation that has produced the waste to realize the DGR, while securing the reversibility and the retrievability, promoting the research and development of alternative technologies.
2. Communicate with the public as well as diverse communities in municipalities on the importance of both realizing a DGR and showing the public's respect and gratitude to the communities that volunteer to participate in the process for the siting of a DGR.
3. Provide communities in municipalities with information about the



geological and social suitability of their area for siting a DGR.

4. Support the initiative of communities in municipalities to learn the issue, providing them for information, opportunities and financial support to study the importance and the safety of a DGR, clarifying measures to appreciate the community participating in the process of selecting the site for DGR for the benefit of society.
5. Strengthen the organizations related to implementing a DGR including NUMO as well as the NRA and the AEC that should independently review the activities of the Government and NUMO.

In accordance with this revision, the Government decided, as summarized in Slide25, to add a process of distinguishing all areas in Japan into three categories, i.e., potentially more suitable, potentially suitable and potentially unsuitable areas for siting a DGR.

At present, an advisory committee on DGR technology for METI is discussing the factors for distinguishing these areas. The METI requested the OECD Nuclear Energy Agency (NEA) to conduct an independent technical peer review on the suitability of this process and the criteria under preparation. Recently the NEA review team published its conclusion that the process was generally in accordance with international practices.

The scientific and technological factors to categorize areas established in the latest session of the committee are as summarized in Slide 26:

- A) From the viewpoint of long-term stability of geological environment, the vicinity of volcanoes or active faults should be avoided, and areas where are susceptible to significant uplift or erosion, or high geo-temperature, or volcanic thermal water or deep-seated fluid should be avoided: presence of economically valuable resources is also a factor of unsuitability:
- B) From the viewpoint of safety of surface and underground facilities, areas where there is a danger that surface facilities are damaged by the pyroclastic flow and where unconsolidated bedrock is too thick to assure the integrity of underground facility should be preferably avoided:

C) From the viewpoint of minimizing social inconvenience due to surface transportation of HLW, areas within sufficiently short distance, such as 20km, from coast are favorable. Coastal sub-seabed areas and islands should be considered as favorable from this viewpoint.

Needless to say, the identification of areas is, as depicted in Slide 27, the first step of a long way to go, as potentially more suitable areas to be identified by such factors should cover a significant part of Japan. The identification is just to inform communities across the country on their potential to host a DGR.

The Government expects, however, that it will spark national and community debates on the issue, and the Government and NUMO will support the activity of groups of residents in communities in those areas to deliberate the merit and the demerit of accepting the survey by NUMO as a service to the nation.

As a preparation for the publication of the distinction of all areas in Japan in three categories planned within this year, the Government and NUMO jointly held three series of symposia in nine cities of the country from last year to this year. As summarized in Slide 28, the Government and NUMO communicated to and discussed with the public in each meeting about

- The revision of the basic policy
- International recognition of DGD as the preferred approach
- Approach to assure the safety of DGD of HLW
- Responsibility of the current generation to pursue DGD of HLW
- Development of scientific criteria for identifying potentially suitable areas for siting a DGR
- Consent-based stepwise process for selecting a site for DGR,
- The importance of showing the public's respect and gratitude to the municipalities that volunteer to participate in the process for the siting of a DGR, and
- NUMO's determination to contribute to the sustainable development of the municipality that entertains the siting of DGR.

In every occasion, we had 100-300 audiences in the hall and the meeting was covered by local newspapers and TV. We posted video of the meetings to

NUMO's website.

We had various questions and comments or expression of outrages from the audience at these symposia, including those listed in Slide29:

- The Government's sudden and active initiative to the issue of DGR siting at this moment is based on the intention to persuade the public to accept the restart of idling NPPs, isn't it?
- The Government should pursue alternative ways of managing used fuel and waste, including a long-term storage of used fuel, in accordance with the SCJ's suggestion, and abandon the nuclear fuel recycling policy.
- It is doubtful that geological environment in Japan is stable and predictable and it is arrogant to claim the safety of DGD of HLW for hundred thousand years: don't repeat "nuclear safety myth".
- DGR should be located in the underground of city areas from the viewpoint of burden sharing / inequality reduction, considering the fact that low-population areas have been forced to accept the siting of risky nuclear power plants. Incentives for community to help society to solve a problem should not be regarded as a compensation for risk.

As shown in Slide30 and 31, NUMO has also been promoting the understandings of geological disposal by information dissemination activities through website and social media, email magazine and contribution of articles and talks to magazines on the one hand and the utilization of communication Vehicle "Geo Mirai" at the bustling places in cities, premises of scientific museums etc. on the other.

NUMO has been conducting public opinion survey to measure the effect of these activities. The result of the most recent survey summarized in Slide 32 indicates that the recognition of the importance of DGD of HLW is still limited among the public and that NUMO has to work harder for improving the nationwide awareness of and interest in DGD of HLW, as well as the existence and activities of NUMO as an implementer of DGD.

Slide 33 summarizes the approach NUMO will pursue after the announcement of more suitable areas by the Government. NUMO presented this slide also at symposia I mentioned before with a view to demonstrating our openness and transparency. We are also presenting our intention to promote communication activities in municipalities in the potentially more suitable area, holding dialogue seminars, expecting the emergence and the development of voluntary learning activities of communities in the municipalities, which NUMO will financially support.

Last but not least, as it is essential for NUMO to be recognized by the public as a group of trustworthy experts for implementing a DGR, NUMO has been carrying out research and development (R&D) to extend the knowledge base for the safety of the DGRs and for the optimization of design and operation of DGR facilities, in collaboration with implementers/R&D organizations at home and abroad, as summarized in Slide 35, 36, 37 and 38.

To confirm that the R&D made progress and technological capabilities are built steadily, NUMO assembled its knowledge on major geological environments in Japan into three geological site models, Pre-Quaternary plutonic bedrock, Neogene sedimentary bedrock and Pre-Neogene sedimentary bedrock site models, designed a DGR for each model site and demonstrated its technological feasibility and safety based on scientific and technological evidence. As mentioned in Slide 22, we have been developing a generic safety case report since 2014 combining such activities. Entering this year, we compiled its final draft to be reviewed by domestic and international experts. It is expected that the report will be completed by the end of this year.

Before closing I would like to introduce two more information that may be helpful for farther understanding the current social environment for the promotion of DGD of HLW. First, as shown in Slide 39, the SCJ that had published a report to recommend the Government to basically change the policy of managing HLW after the Fukushima accident published last April a follow-up report, in which SCJ proposed interim storage for buying time for the formulation of national consensus on the HLW disposal for 50 years, 30 years

for DGR consensus making & siting and 20 years for construction of DGR. We felt the converging trend of policy between the SCJ and the Government, at least in appearance.

The second is the Opinion Seeking Not to Operate Nuclear Power Plants Published by Sendai Bar Association this July, summarized in Slide 40. Though the Association is by no means a part of community of geo-science, it advocates that it is extremely difficult to reliably select the site for DGR in Japan that can assure safe management of the waste away from human living environment over a period of several tens of thousand years in the current scientific level. It claims that, as an earthquake that may occur, even that in a remote location, could change the state of the bedrock around the repository and vary the flow characteristics of the groundwater around the repository, and that such changes may shorten the time for the radioactive material disposed in the repository to reach human environment. My quick comments are in Slide 41 for your information.

In summary, though our move is slow, the announcement of areas of more suitable for siting a DGR at the end of this year will surely be a step to start new process of engaging with the public and municipalities on the need for and the safety of deep geological disposal. In the process, we would like to cultivate a social environment in which the public will support and show respect/gratitude to municipalities that are interested in hosting the repository for helping society solve a problem, in the first place.

As mentioned in Slide 40, the public still expresses strong distrust of nuclear enterprise, mentioning severe consequences caused by the accident at Fukushima, we must strengthen our efforts for communicating with the public sincerely, believing that the continuation of an active exchange of opinions with diverse group of people as a competent, caring and faithful organization will change the situation.

# Japan's Policies and Activities for Deep Geological Disposal of HLW and the Stakeholder Engagement Activities Related

September 6, 2016

Shunsuke Kondo  
President

Nuclear Waste Management Organization of Japan (NUMO)

## Table of Abbreviations

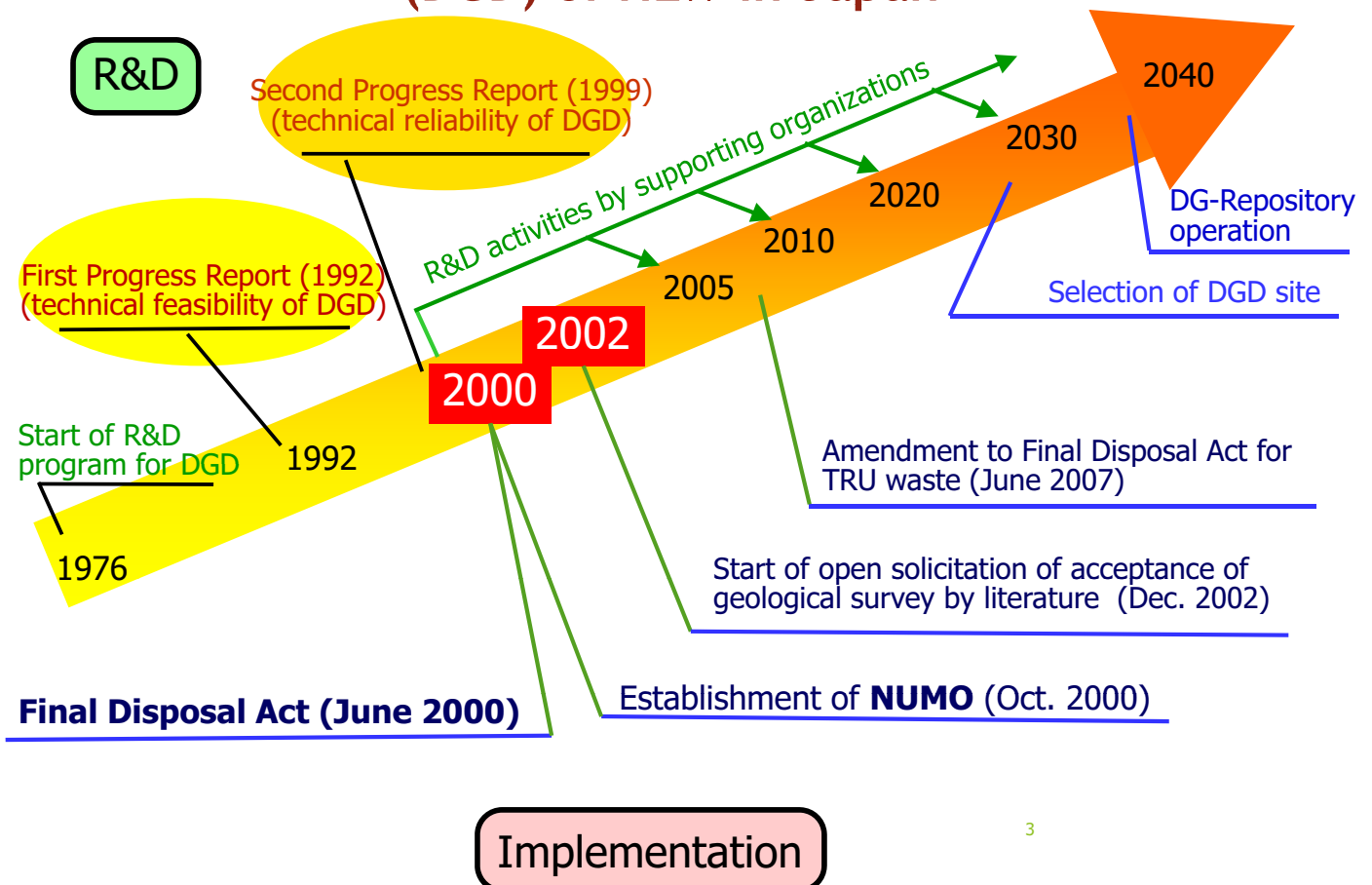
DGD	Deep Geological Disposal
DGR	Deep Geological Repository
FDNPS	Fukushima Daiichi Nuclear Power Station
HLW	High-Level radioactive Waste
JAEA	Japan Atomic Energy Agency
JAEC	Japan Atomic Energy Commission
METI	Ministry of Economy, Trade and Industry
NPP	Nuclear Power Plant
NRA	Nuclear Regulation Authority
NUMO	Nuclear Waste Management Organization of Japan
RWMC	Radioactive Waste Management Funding and Research Center
SCJ	Science Council of Japan
TRU waste	Low-Level waste containing transuranic nuclides which are long-life alpha emitters as well as long life radioactive nuclides

# History of Policies and Activities for Deep Geological Disposal of HLW and LLW in Japan

- ◆ The Government initiated in 1976 research and development (R&D) programs on deep geological disposal (DGD) of high-level radioactive waste (HLW) separated from used nuclear fuel by reprocessing.
- ◆ As the Japan Atomic Energy Agency (JAEA) concluded in 1999 that there are potential areas where a safe deep geological repository (DGR) can be located in Japan, the Japan Atomic Energy Commission (JAEC) recommended the Government to establish a system for implementing DGD of HLW, after nation-wide public consultation activities.
- ◆ Upon receipt of the recommendation, the Government enacted in 2000 the **Act on Specified Radioactive Waste Final Disposal** that specified that DGD should be implemented by corporations authorized by the Government at the site selected through a consent-based multi-stage process.

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## Timeline of Program for Deep Geological Disposal (DGD) of HLW in Japan



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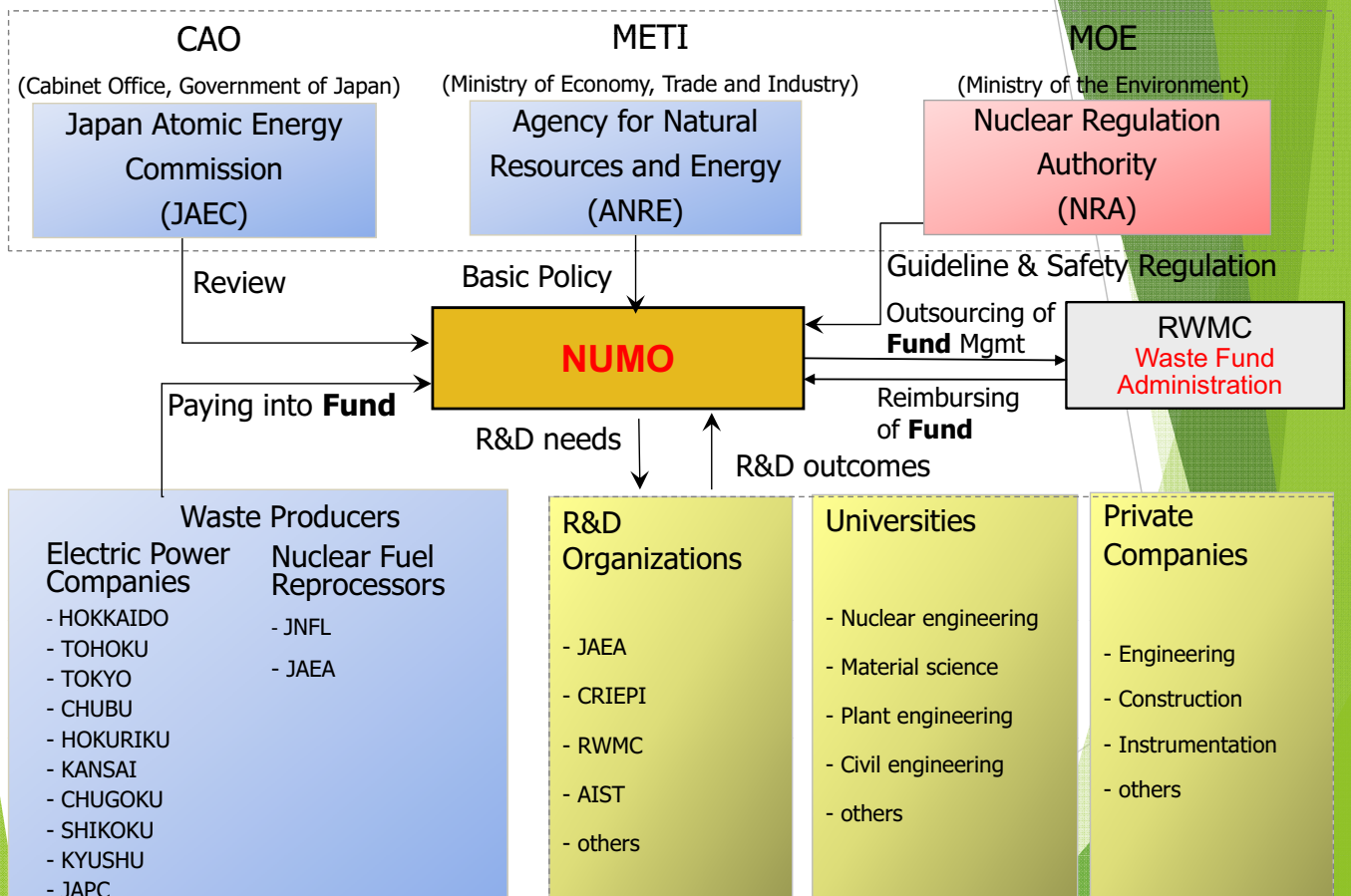


# Nuclear Waste Management Organization of Japan (NUMO)

- ◆ NUMO is a corporation established by HLW producers and authorized by the Ministry of Economy, Trade and Industry (METI) in 2000, of which mission is to implement the deep geological disposal (DGD) of HLW and TRU waste, i.e., wastes from the reprocessing of used nuclear fuel.
- ◆ It is currently pursuing;
  - ✦ Selection of a site for DGD through a consent-based stepwise process that consists of literature survey, preliminary investigation and detailed investigation;
  - ✦ Promotion of public information activities and public relation activities as the public is at the center of decision-making involved in the process;
  - ✦ Promotion of the research and development for safe and efficient implementation of DGD, preparing a Safety Case report of DGR at each step;
  - ✦ Collection of fee for final disposal, which is managed by RWMC.

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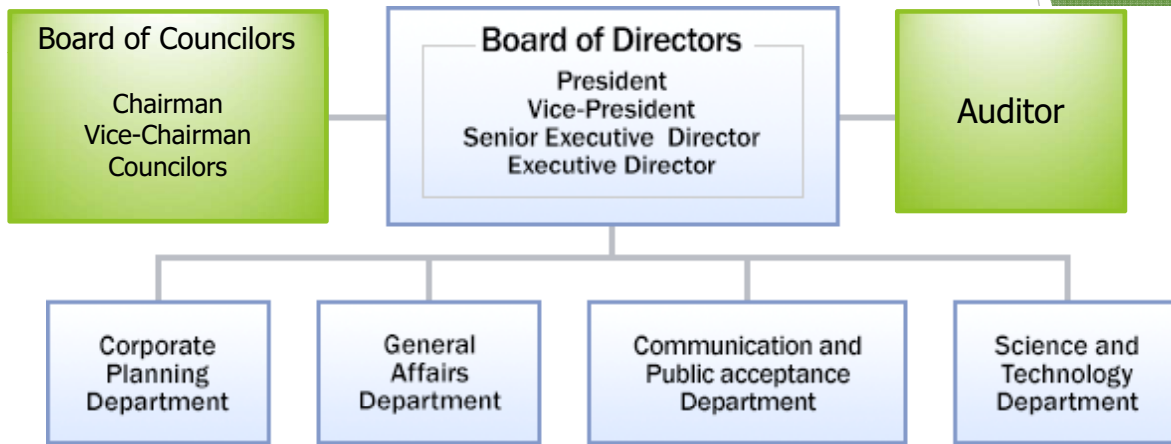
## Organizational Structure for DGD Program



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# Organization of NUMO



## Board of Councilors

Chairman **Kyohei Takahashi** Chairman of the Board, Showa Denko K.K.  
 Vice-chairman **Kenji Yamaji** Director, Research Institute of Innovative Technology for the Earth

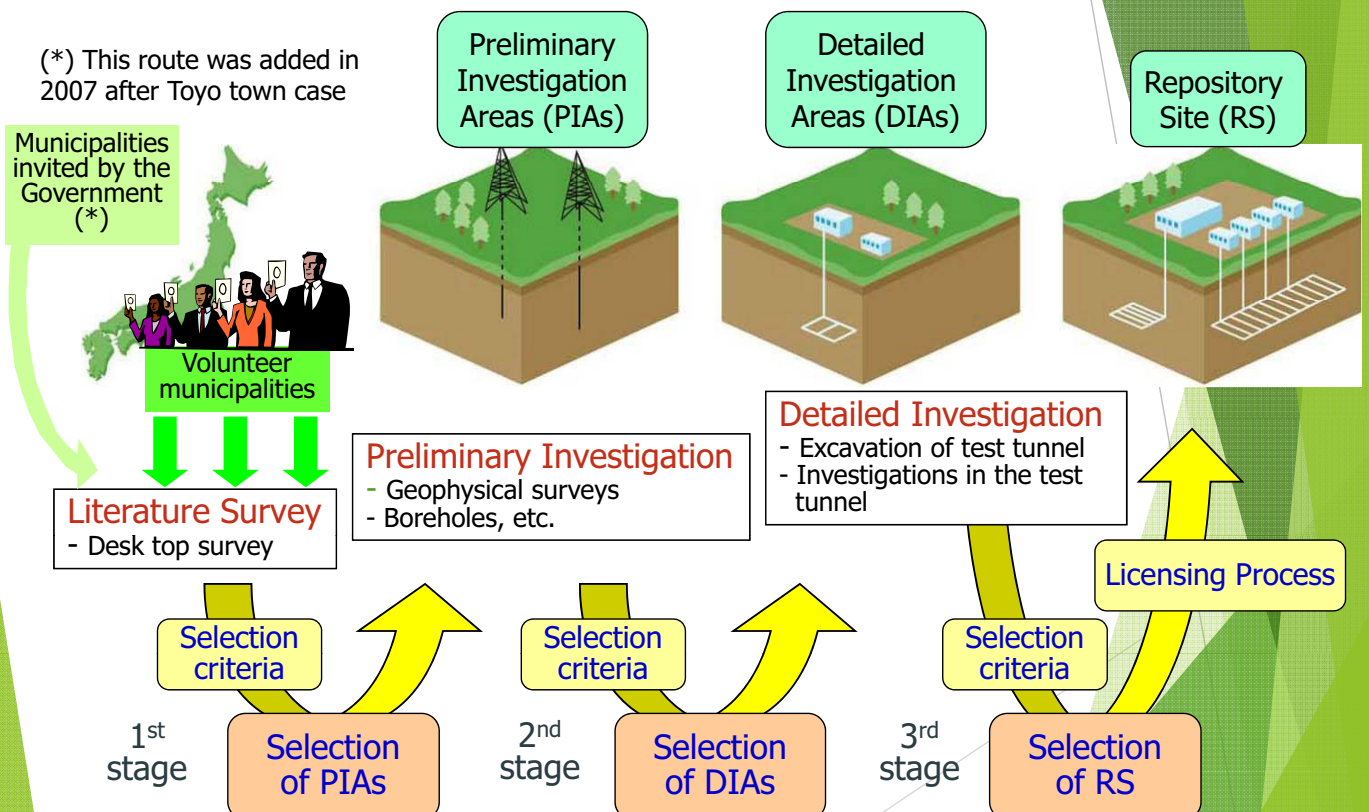
## Board of Directors

President **Shunsuke Kondo**  
 Vice-president **Yosaku Fuji**  
 Senior Executive Director **Minoru Nakamura**

No. of Employees: 116 (as of Sep. 1, 2016) Annual expenditure: JPY 3,910M (FY2015)

# Three Stage Consent-Based Site Selection Process

NUMO can move forward survey and investigations only when it obtains the approval of the mayor of the municipality the survey or investigation area is located.



## Activity of NUMO in Its First Ten Years (1/2)

- ◆ The Final Disposal Act provides that NUMO should get a prior consent of the mayor of the municipality where a site survey area is located and the governor of the prefecture to which the municipality belongs in the promotion of the stepwise process for selecting a site for deep geological repository (DGR).
- ◆ NUMO announced in 2002 to all municipalities in Japan the open solicitation for accepting the literature survey.
- ◆ NUMO has been holding seminars and symposia on a nationwide scale since then to communicate with the public on the importance and the safety of DGD of HLW in cooperation with the METI.
- ◆ The Government established a system to provide a grant for community development to both a municipality that applies for the survey and the prefecture where the municipality is located with a view to appreciating the willingness to participate in the process for the benefit of the society.

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## NUMO's Activity in the First Ten Years (2/2)

- ◆ In 2007 Toyo-town in Kochi prefecture officially submitted its acceptance of a literature study to NUMO. However, a strong opposition campaign spread in the municipality of which population was about 3400 and an ensuing mayoral election resulted in the defeat of the incumbent who accepted the literature survey. The town subsequently withdrew its submission.
- ◆ Recognizing the difficulty for municipalities to submit the acceptance of a literature survey, the METI started to explore the way to reduce the difficulty. JAEC also deliberated the issue and sent a letter to the Science Council of Japan (SCJ) requesting opinion on the effective approaches of public outreach.
- ◆ But both could not come to concrete conclusions before the occurrence of Great East Japan Earthquake and the major nuclear accident at Fukushima Daiichi Nuclear Power Station triggered by it in March 2011.

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## Six Advices in the Science Council of Japan (SCJ)'s Response in Sept. 2012 to the JAEC's Request for Opinion on the Effective Communication with the public for Advancing DGD of HLW in Sept. 2010

- a. Pursue social consensus on nuclear energy policy before deliberating policies related to DGD of HLW;
- b. Recognize the limitation of scientific and technological capability and secure scientific autonomy for scientific deliberation;
- c. Rebuild a framework of policy on the premise of temporary storage of HLW and the control of total amount thereof;
- d. Explore socially acceptable procedures such as those in which fair burden-sharing among people is ensured;
- e. Pursue multi-step procedures to build consensus among the public by establishing venues for discussion among them;
- f. Recognize the need for long-term tenacious efforts to solve the problems.

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### **Renewing Approaches to Deep Geological Disposal of High-Level Radioactive Waste (Statement)**

December 18, 2012

Japan Atomic Energy Commission

#### 1. Approaches to the disposal of HLW in Japan

In Japan, the Special Committee on Disposal of High-Level Radioactive Waste (Special Committee) of the Japan Atomic Energy Commission (JAEC) made recommendations a

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## Recommendation of the AEC to the METI on Dec. 2012

- a. Review the scientific feasibility of DGD of HLW in Japan taking into consideration the latest knowledge of geo-science obtained after 2000, and share the result with the public as well as learned societies.
- b. Make it clear that the efforts to realize DGD of HLW should be promoted based on a consent-based stepwise site selection process, assuring the reversibility of policy and the retrievability of waste mined so that the course of action can be modified based on the result of reviews of technology and policy in the future;
- c. Share with the public the process to decide the site for DGR with a view to developing social trust: the Government and NUMO should act as a competent, predictable and caring organization, introducing systems for independently reviewing such activities and recommending necessary improvement to relevant parties.
- d. Cultivate the understanding of the importance of fair and equitable sharing of the benefit arising from areas with geological environment suitable for DGD between the owners and the public.

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## Strategic Energy Plan Published by the Government in April 2014

- ◆ Promote the utilization of nuclear power as an important base-load power source that should be operated based on a safety-first policy under NRA's risk-informed regulation, maintaining the existing nuclear fuel cycle program, though the nuclear dependence should be reduced as low as practicable.
- ◆ Should not postpone the action to implement the deep geological disposal of HLW as an extended storage of HLW might put the future generation in a situation difficult to promote DGD of HLW, while ensuring the reversibility and the retrievability so that the future generation can select a better solution.

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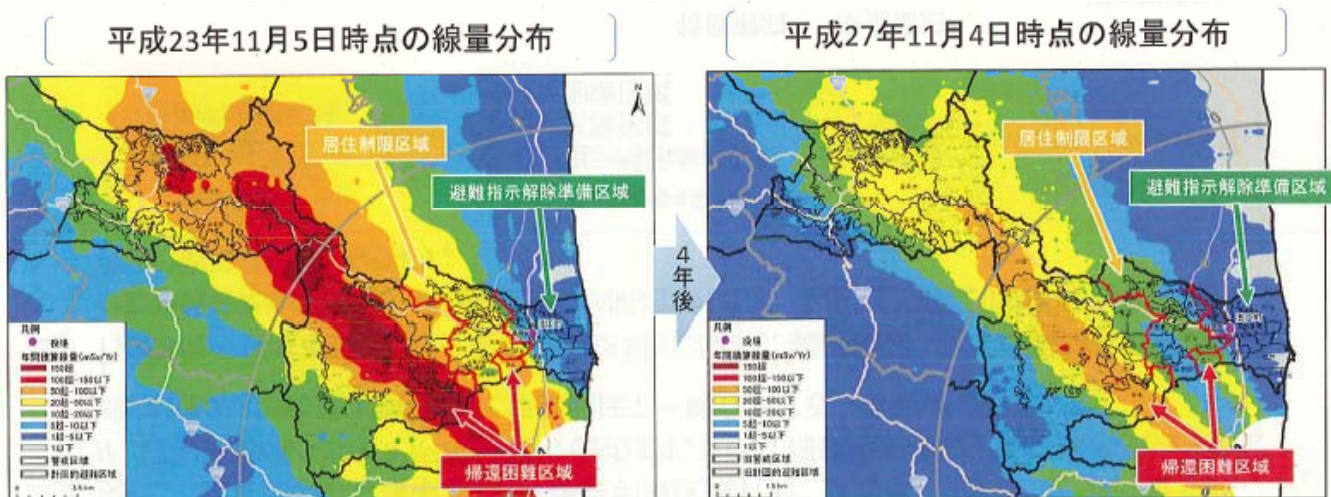


# Scientific Reviews by the Government

- ◆ The METI established in October 2013 an advisory group on DGD technology that included experts nominated by learned societies concerned and asked it to review the current status of the scientific feasibility of DGD of HLW based on the latest scientific knowledge.
- ◆ The group released a summary report in May 2014 that pointed out that
  - Areas where natural processes such as igneous activity, uplift, increased fracturing may severely disturb the safety functions of DGD system (containment and isolation) in the future should be avoided in the site selection process.
  - Areas having the geological characteristics required for long-term safety of DGD of HLW are widely distributed in Japan.

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## Change of Annual Outdoor Ambient Dose Equivalent Rate around the FDNPS\* from Nov. 2011 to Nov. 2015



※第4次航空機モニタリング(平成23年12月16日公表)及び第10次航空機モニタリング(平成28年2月2日公表)の結果を基に内閣府原子力被災者生活支援チームが作成。

Resource; 「浪江町の復興に向けた取組について」(H28年6-7月)

This document was made by Support Team for Residents Affected by Nuclear Incidents in Cabinet Office based on 4<sup>th</sup> airborne monitoring data (5<sup>th</sup> November 2011) and 10<sup>th</sup> airborne monitoring data (4<sup>th</sup> November 2015) .

\* FDNPS; Fukushima Daiichi Nuclear Power Station

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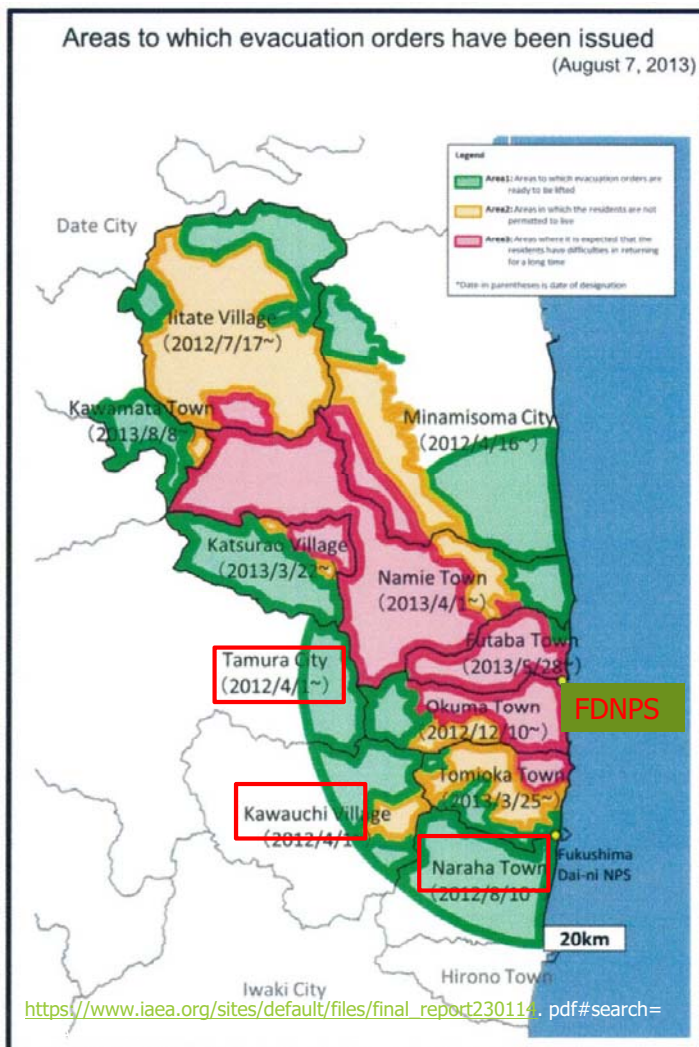
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# Fukushima Off-site Situation

## Situation Around Fukushima Daiichi Nuclear Power Station (FDNPS)

- About 47,000 people are still requested to evacuate from their home.
- About 30,000 people, whom are families with children in many cases, have left their home, having made up their own mind to do so, due to anxiety about health and health of children due to radiation exposure, in particular.
- About 2,000 persons have died from worsening of diseases owing to careless emergency evacuation from hospitals and/or physical and psychological stress in the life in a shelter after dislocation.

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## Decontamination of Contaminated Areas

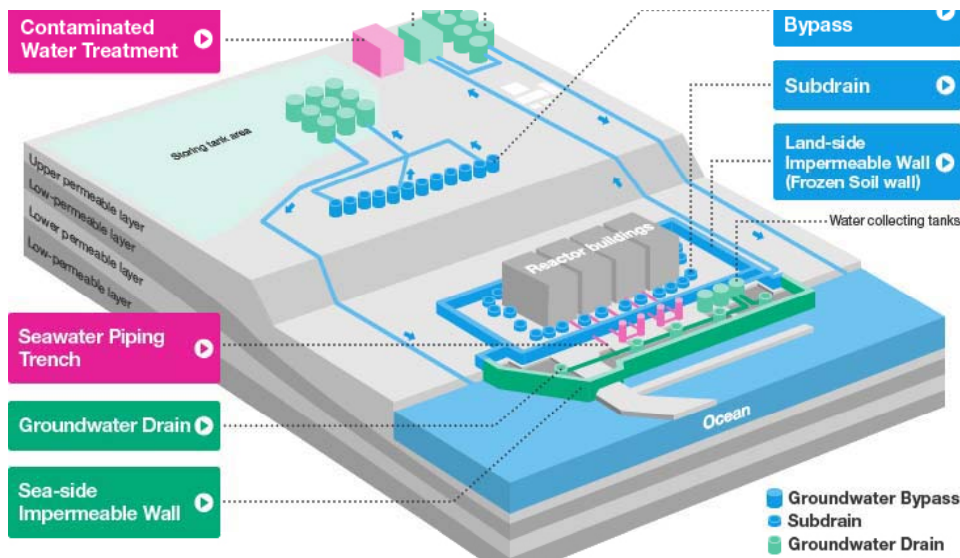
- Comprehensive decontaminations are to be completed in these areas except forest within this year.
- Evacuation orders to Tamura City and Kawauchi Village were uplifted in 2014, and that to Naraha Town was done so in 2015.
- Decontamination of red areas has not been done yet, due to the difficulty in the decontamination of forest. Only fallen leaves, lower twigs, pruning etc. in forests are removed from the border area of forest (within 20m from the border) at present.
- The preparation of interim storage facilities for decontamination waste is discouragingly slow due to difficulty in obtaining the consent of landowners, who are evacuees and sufferers of the accident.

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## At Fukushima: Decommissioning of FDNPS (1/2)

1. Stop the leakage of contaminated water to the outside as soon as possible: **completed**
2. Reduce the volume of contaminated water generated as soon as possible: **significant progress was made.**



<http://www.tepco.co.jp/en/decommision/planaction/waterprocessing-e.html>

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## At Fukushima: Decommissioning of FDNPS (2/2)

3. Remove the spent fuel from the spent fuel pool in the damaged reactor buildings in three years: **completed at unit 4; preparatory civil works are in progress at unit 1 & 3.**
4. Start the removal of fuel debris (fuel containing material: FCM) from the damaged units in ten years: **still in exploration phase.**
  - Explore the location and characteristics of FCMs as well as methods for FCM removal.
5. Promote stabilization, conditioning and safe long term management of radioactive wastes.
6. Promote public communication about the progress and difficulty of these activities including risk communication.

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# Defense-in-Depth: Tsunami

## Prevent - Protect - Diversify

- Seawall designed based on revised design-basis tsunami
- Water-tightness of safety-significant buildings
- Bunkered system for essential safety function

### Example)

#### Further Tsunami Countermeasures at the Kashiwazaki-Kariwa NPS

(Source; TEPCO website, [http://www.tepco.co.jp/en/nu/fukushima-np/f1/images/f12np-gaiyou\\_e\\_5.pdf](http://www.tepco.co.jp/en/nu/fukushima-np/f1/images/f12np-gaiyou_e_5.pdf))



Alternative Water Injection (8 fire engines)



14 Power Supply Vehicles (500-750kVA) and 2 On-board Gas Turbine Generators (4500kVA)



現状 Present status



完成後 After construction

長さ: 約1.5km



Construction of 10-meter (ASL:15-meter) Seawalls



Water-tight Doors

20

## Current Status of Nuclear Power in Japan

### ● NPPs (as of August 2016)

- The following 5 plants resumed operation among 26 plants whose restart applications submitted to NRA.
    - Takahama 3/4 of Kansai Electric Power Co.; however, stopped operation soon after the restart, due to temporary injunction against their operation imposed by a district court on March 9.
    - Ikata 3 of Shikoku Electric Power Co.; people filed a temporary injunction to a district court.
    - Sendai 1/2 of Kyushu Electric Power Co.; started operation last year, but recently the newly-elected governor requested the company to temporarily suspend operation.
  - The restart applications of Takahama 1/2, Kansai Electric Power Co., are completed with two-decade life extension approved.
  - The restart applications of 17 NPPs are under consideration.
  - 15 NPPs are in the decommissioning phase including 6 plants decided after the new regulation.
- JNFL postponed the completion of construction of the Rokkasho Reprocessing Plant to 2018.
  - JNFL postponed the completion of construction of MOX fuel fabrication plant to 2019.
  - TEPCO postponed the start of operation of used fuel storage facility at Mutsu to 2016.
  - The NRA advised the change of operator of Monju.

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# Result of Recent Opinion Survey about the Nuclear Power

- Should Japan use nuclear power in the future? (Mainichi Shinbun, March 2016)
  - Stop at once: 19%
  - Take time on the reduction of nuclear dependence: 62%
  - No need for the reduction of nuclear dependence: 9%
  
- Are you in favor of restarting idling NPPs?
  - Mainichi Shinbun, March 2016
    - Yes: 30%
    - No: 53%
  - NHK (Japan Broadcasting A.)

	March 2016	May 2016
• Yes :	15%	15%
• No :	44%	47%
• That is a tough decision :	34%	30%

**Note:** On April 14, a series of **earthquakes** started to occur at Kumamoto area in Kyushu region, including a magnitude 7.3 main shock that struck at 01:25 JST on April 16. A few aftershocks have been felt daily until now.

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## Revision of the Government's Basic Policy for DGD (1/2)

In May 2015, the Government revised the Basic Policy on the Final Disposal of the Specified Radioactive Waste established in 2007, emphasizing the following five points:

1. Steadily promote the policy as the DGD of HLW is a responsibility of the current generation that has produced the waste, while securing the reversibility and the retrievability and promoting the research and development of alternative technologies.
2. Communicate with the public as well as diverse communities in municipalities on the safety of DGD and the importance of
  - a. Implementing DGD of HLW, and
  - b. Showing the public's respect and gratitude to the municipalities that volunteer to participate in the process for the siting of a DGR in order to help society solve the problem.

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## Revision of the Government's Basic Policy for DGD (2/2)

3. Provide the public with information about potentially suitable areas for siting a DGR.
4. Support the initiative of various groups in municipalities to learn about DGD of HLW and to enter into dialogue among them, providing information and financial support to do so, clarifying measures to appreciate the municipalities participating in the process of selecting the site for DGR for the benefit of society.
5. Strengthen the organizations related to implementing a DGR including NUMO as well as the NRA and the AEC that should independently review the activities of the Government and NUMO.

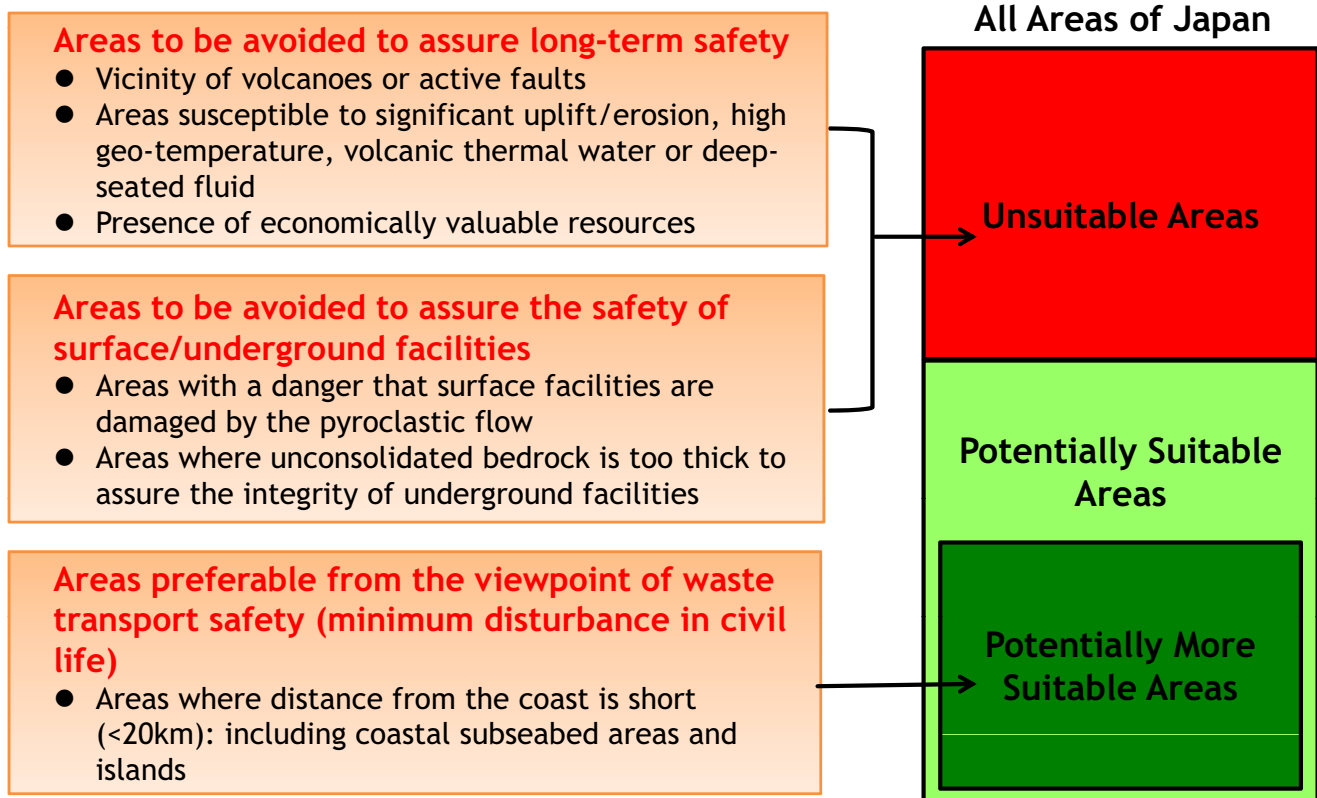
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## Addition of a New Process to the Legal Site Selection Process for DGD

- In accordance with the revised basic policy, the Government decided to add a new process for selecting a site for DGR in which it would publish the result of nationwide scientific screening that categorizes all areas in Japan into three categories, potentially more suitable, potentially suitable, and unsuitable areas for siting a DGR.
- The criteria for the categorization have been under deliberation. The METI requested the OECD Nuclear Energy Agency (NEA) to conduct an independent technical peer review on the suitability of this process and the criteria under preparation. Recently the NEA review team published its conclusion that the process was generally in accordance with international practices.
- The criteria compiled as a summary report of the Government's advisory group are now subjected to public comment.
- The Government plans to publish the result of the categorization within this year.

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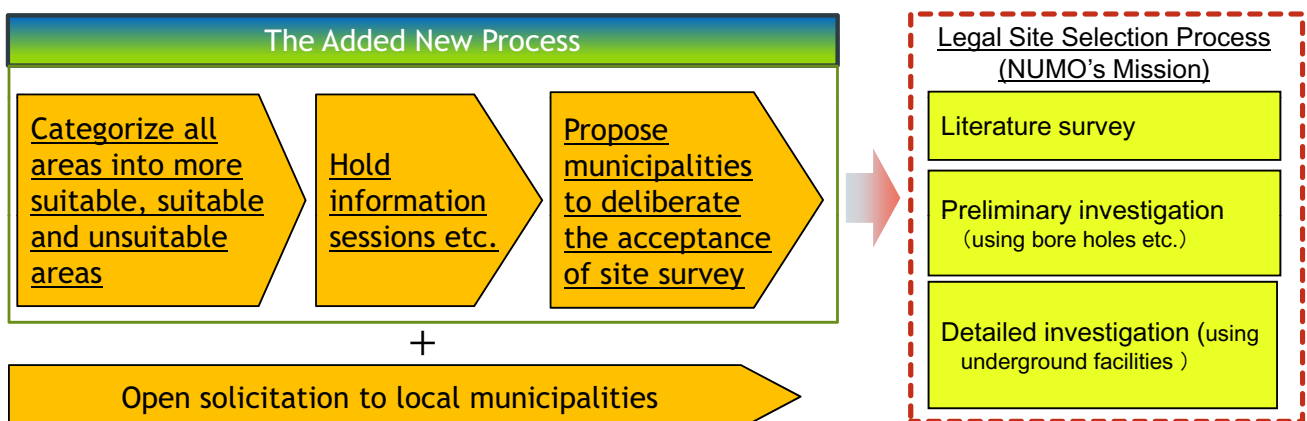
# Criteria to Categorize Areas in Japan into Three Categories, i.e. Potentially More Suitable, Potentially Suitable and Unsuitable Areas for Siting a DGR



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## Categorization of All Areas in Japan

- ▶ The categorization is the first step of a long way to go, as a significant part of Japan should be in the category of potentially more suitable areas. It is just to inform municipalities across the country on their potential to host a DGR.
- ▶ The publication will be expected to spark debates on the issue in municipalities located in potentially more suitable areas. NUMO will support the activity of groups of residents in such municipalities to deliberate the merit and the demerit of accepting the NUMO's survey as an important service to the nation.



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## Nation-wide Symposia Co-hosted with NUMO and the Government from 2015 to 2016

- Three campaigns of symposia in 9 cities
- Purpose: to communicate to the public about
  - Revised basic policy,
  - International recognition of DGD as the preferred approach,
  - Safety of DGD of HLW,
  - Responsibility of the current generation to pursue the DGD of HLW
  - Development of scientific criteria for identifying potentially suitable areas for siting a DGR
  - Consent-based stepwise process for selecting a site for DGR, and
  - Willingness of NUMO to contribute to the sustainable development of the municipality that entertains the siting of DGR
- Program:
  - Panel discussion among invited panelists and METI & NUMO
  - Discussion involving audiences on the floor
- Audiences and media attention
  - 100-300 in the hall. Video posted to NUMO website.
  - Covered by local newspapers and TV.

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## Questions from the Audience at the Symposia

- **Nuclear energy policy:**
  - Relation between the initiative to communicate the issue of DGR siting and the initiative to restart idling NPPs.
  - Considering the difficulty in waste management, stop the restart of NPP operation so as to stop waste generation.
- **Why DGD:**
  - Alternative ways of spent fuel and waste management, long-term storage of spent fuel as suggested by Science Council of Japan.
- **Safety of DGD:**
  - Unpredictability of the future of and doubt on the stability of geological environment in Japan: feel arrogance in the explanation of long-term safety of DGD of HLW: do not repeat “nuclear safety myth”.
- **Siting process:**
  - Locate DGR in the underground of city areas (burden sharing / inequality reduction).
  - Incentives for community to help society solve a problem should not be regarded as a compensation for risk.

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# NUMO's Communication Activities in 2016

## ■ Voluntary group meetings

- Venue: many places in Japan
- Types of meeting
  - ✓ Lecture and dialogue sessions, visit of Underground Research Lab. etc.
- Purpose
  - ✓ Encourage stakeholders to deliberate the siting of GDF

## ■ Information dissemination

- Improve NUMO website, including the creation of a flexible knowledge environment to the request of potentially large number of website visitors
- Biweekly email magazine
- Promotion of social media utilization
- Contribution of articles and talks to magazines

## ■ Use of communication vehicle “Geo Mirai”

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## Activity Using Communication Vehicle “Geo Mirai”

- Purpose  
Organize exhibitions in local cities, scientific museums etc. to promote understandings of the deep geological disposal.
- Contents  
Presentation of 3D animation, exhibitions of a model of multi-barrier disposal system/an experiment using bentonite
- Participants  
General public (families): 7,727 visitors and 3,072 participants to activities in “Geo Mirai” at 25 venues (as of 9 March, 2015)



Communication vehicle “Geo Mirai”



3D animation



Experiment using bentonite

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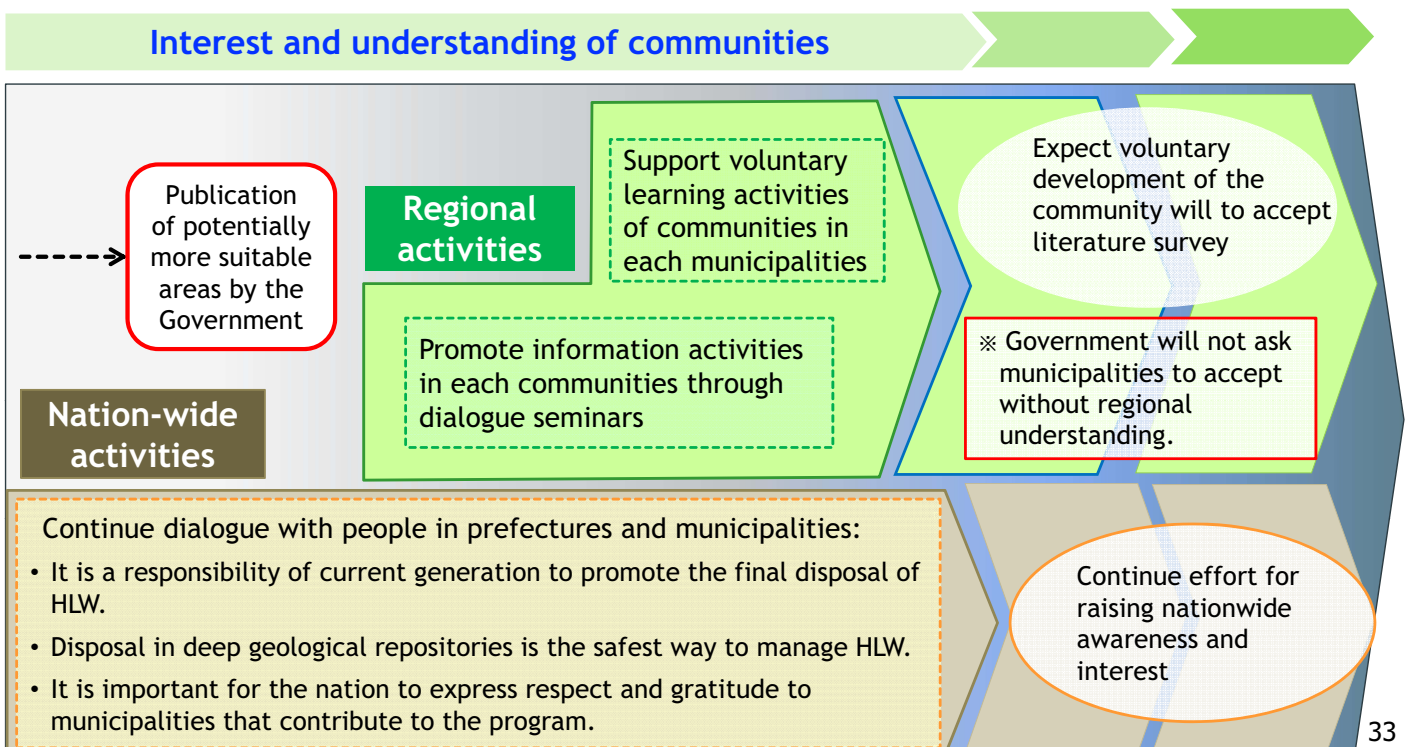
# Public Opinion About DGD : Feb. 2016

- ▶ I know what is HLW: 28.5%, I have heard about HLW: 56.3%.
- ▶ I know the difference between HLW and the decontamination waste in Fukushima: 35.1%.
- ▶ I am interested in disposal of HLW: 15.8%, rather 37.3 %.
- ▶ I think it necessary to dispose HLW: 51.4%, rather 27.5 %.
- ▶ I think geological disposal of HLW is safe: 2.7%, rather safe 13.5%, difficult to say, 48.8%, rather unsafe 19.8%, unsafe 17.3% .
- ▶ I agree geological disposal of HLW: 5.6%, rather 19.5%, difficult to say 54.6%, rather against 12.1%, against 8.2%.
- ▶ I agree the siting of GD in my neighborhood: 2.7%, rather 6.3%, difficult to say 32.6%, rather against 23.4%, against 35.0%.
- ▶ I agree to appreciate/pay respect to the area that accepts the siting of DGR: 28.8%, rather 31.8%, difficult to say 32.1%.
- ▶ I think it proper to economically support the area that accepts the siting of DGR: 30.8%, rather 31.4%, difficult to say, 30.5%.
- ▶ Do you know NUMO: yes in detail, 2%, yes roughly 11.9% yes name only 28.1%.

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## Planned Approach to Communicate with Nation and Communities after the Publication of potentially more suitable areas by the Government

- ◆ Deepen nationwide dialogue, expecting the development of voluntary learning activities of communities in each area.



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# Considerations from the Viewpoint of Social Sciences

- ▶ There was a discussion about the appropriateness of taking social-scientific viewpoints such as restrictions on land access by the related laws and regulations and number of landowners and population density (ease of land access) into consideration of categorization criteria. It was concluded, however, that these factors should be taken into consideration when a municipality will designate the district for literature survey.
- ▶ When assessing the district proposed by a municipality volunteered, NUMO will carefully determine the area for preliminary geological investigation, reviewing the potential impacts of siting a DGR there on the natural environment of the district and on the economics/life/culture of the local community, jointly with the municipality volunteered.

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## Framework for Promoting R&D for DGD

- **R&D Organizations**
  - ❖ JAEA, AIST: Funded by the Government
  - ❖ CRIEPI: Funded by EPCs
  - ❖ RWMC: Funded by the Government
  - ❖ NUMO: Funded by Final Disposal Fund
- **R&D Coordination Conference organized by the Government**
  - ❖ Establish an overall R&D Plan
  - ❖ Coordinate R&D co-operation among organizations
  - ❖ Coordinate the integrated evaluation of R&D results
- **Principles for Coordination of R&D tasks**
  - ❖ Pursue the assurance of reliability and confidence in S&T of DGD
  - ❖ Develop site characterization techniques, engineering for designing repositories at selected sites
  - ❖ Task sharing: those to attain TRL level 1-4 should be promoted by R&D organizations other than NUMO. Those to attain TRL level 5 and 6 should be promoted in consultation with NUMO. NUMO should demonstrate TRL 7-9, taking into consideration of the characteristics of site.

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# Major R&D infrastructures operated by JAEA

## ■ Horonobe Underground Research Center

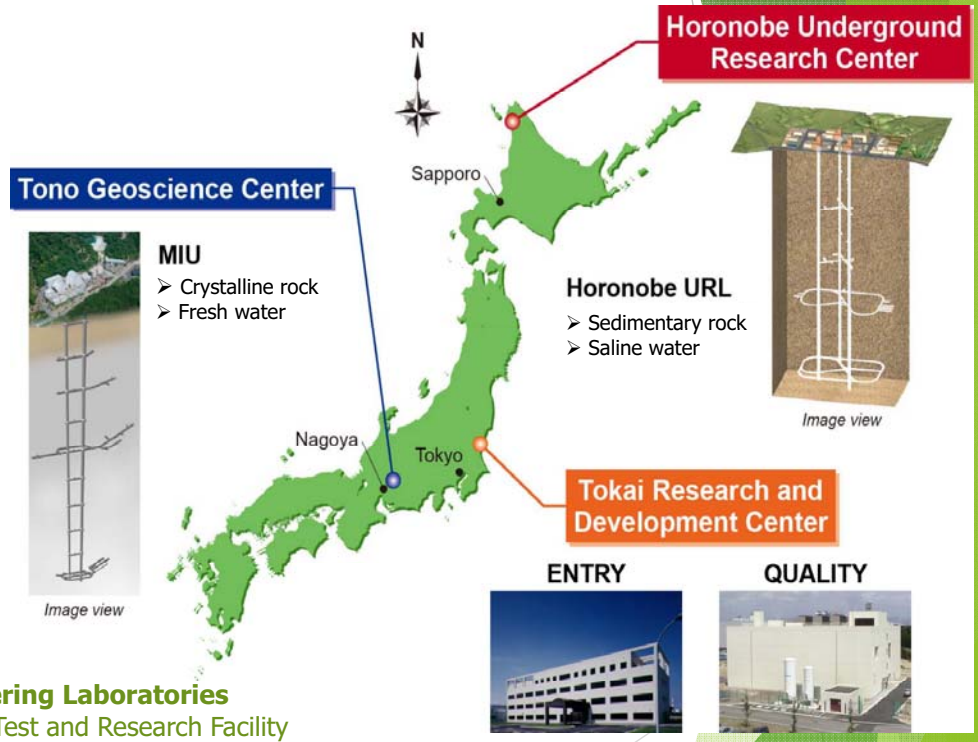
- Research on the deep geological environment in sedimentary rock
- Improvement of the reliability of disposal technologies
- Development of advanced safety assessment methods

## ■ Tono Geoscience Center

- ◆ MIU: Mizunami Underground Research Laboratory
- Research on the deep geological environment in crystalline rock

## ■ Nuclear Fuel Cycle Engineering Laboratories

- ◆ **ENTRY**: Engineering Scale Test and Research Facility
- ◆ **QUALITY**: Quantitative Assessment Radionuclide Migration Experimental Facility
- Improvement of the reliability of disposal technologies
- Development of advanced safety assessment methods



Source from; JAEA's web-site, [http://www.jaea.go.jp/04/tisou/english/research\\_facilities/research\\_facilities.html](http://www.jaea.go.jp/04/tisou/english/research_facilities/research_facilities.html)

# R&D Activities of NUMO (1/2)

- Systematically promote R&D, in cooperation with relevant R&D organizations under the initiative of "Coordination Conference".
- Actively promote international collaborations with IAEA and NEA, and those with foreign implementers and research institutes.
- In particular, participate in URL projects operated by foreign implementers positively, in order to tackle key R&D issues, cultivate necessary human resources with technical capability, accumulate technical experience and knowledge and thus obtain organizational trust.



## R&D Activities of NUMO (2/2)

- Prepare a Generic Safety Case Report to reconfirm in a generic sense the feasibility and safety of the deep geological disposal in Japan, reflecting the latest R&D achievements and the flexibility in adapting the design of DGR to three bedrock conditions; Pre-Quaternary plutonic rock, Neogene sedimentary rock and Pre-Neogene sedimentary rock to be encountered in the siting process, of which focus is put on:
  - ◆ Development of more realistic geological models on the basis of key characteristics, e.g. distribution of faults, fractures and their hydraulic conductivities, in particular from studies in JAEA's URLs at Horonobe and Mizunami, and
  - ◆ Application of radionuclide transport models, realistically representing the geometry of the ESB components and geosphere, which can allow comparison of different sites and possible repository concepts by the safety assessment.
- The documentation is underway. The final draft report for external peer review is planned to be published in autumn 2016.

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## The SCJ's Proposal to Carry out Interim Storage of HLW Before the Establishment of National Consensus on the Geological Disposal of HLW, April 28, 2015

1. Classified HLW and used fuel should be stored at interim storage facilities (ISFs) for 50 years (30 years for making consensus on DGD and selecting a site for DGR and 20 years for the construction of DGR).
2. Recognizing the responsibility of producing the waste, each EPC should find a site for an ISF in its customer area, except the area that accepts NPP. The restart of idling NPPs should be conditioned with a plan for interim storage of HLW.
3. A list of candidate areas for DGR, in addition to the risk assessment of DGD should be prepared by a third party committee, assuring its autonomy, fairness and impartiality, from which nuclear energy promoters should be excluded.
4. Pursue the establishment of a socially acceptable organization that proposes nuclear energy policy: the organization should be operated based on the principle of citizen participation, so as to recover the social trust in the policy.

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# Opinion Seeking Not to Operate NPPs Sendai Bar Association (July, 2016)

- ▶ In view of the present situation that the operation of deep geological repository for HLW is very difficult in Japanese geological environment, nuclear power plant should not be operated in Japan.
- ▶ Even if a site suitable for deep geological repository is found in Japan, an earthquake that may occur, even that in a remote location, could change the state of the bedrock around the repository and vary the flow characteristics of the groundwater around the repository. It is undeniable that such changes may shorten the time for the radioactive material disposed in the repository to reach human environment.
- ▶ This means that it is extremely difficult to reliably select the site for DGR in Japan that can assure safe management of the waste away from human living environment over a period of several tens of thousand years in the current scientific level.

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## Comment on the Opinion

- ▶ The “opinion” mentions the possible impact of earthquake on the mobility of radionuclides in the rock. Key issues here are predictability of earthquake and whether earthquake wave propagation through rock will cause change in the groundwater flow or not.
- ▶ It ignores the fact that:
  - ▶ Scientists can make reasonably accurate long-term predictions when it comes to earthquake location and the predictions have been used by municipalities to make a hazard map as a part of planning disaster prevention measures.
  - ▶ The DGR will be located at more than three hundred meter below ground in the rock which contains groundwater of which age is more than hundred thousand years though the rock should have experienced number of earthquake in these years as a part of Japanese island. This characteristics of groundwater in the rock at more than hundreds meter below ground is not uncommon in Japan.

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# Summary

- ◆ The policy of implementing DGD of HLW is maintained by the government even after the Great Earthquake.
- ◆ The Government started to be proactive, preparing to identify potentially highly suitable areas for siting a DGR in order to promote municipalities in these areas to deliberate volunteering to accept the Literature Survey, the first stage of the siting process, for the benefit of society.
- ◆ As the public expresses strong distrust of nuclear enterprise, mentioning severe consequences caused by the accident at Fukushima, it is not easy at present to communicate with the public on this issue: the nuclear element alters the perception of the issues in the mind of the public.
- ◆ NUMO, however, will continue efforts for communicating with the public about the safety and the importance of DGR sincerely, in parallel with the efforts to be a competent, caring and faithful organization.

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***Thank you for your kind attention!***

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