# FNCA

Forum for Nuclear Cooperation in Asia

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Radiation Safety & Radioactive Waste Management Project


# RS&RWM Newsletter No.17


March 2022
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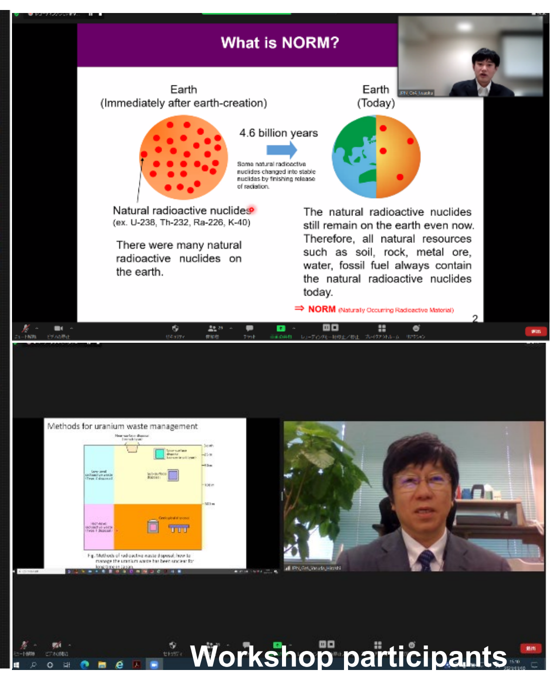
## Radiation Safety & Radioactive Waste Management Workshop 9-10 November 2021, Japan, Online

FNCA 2021 Workshop on Radiation Safety and Radioactive Waste Management (RS&RWM) was held on November 9 - 10, 2021. The workshop in this fiscal year was held online again as in 2020 due to the COVID-19 pandemic. At this workshop, there were 23 representatives involved in the radiation safety and radioactive waste management from 10 member countries, namely Australia, Bangladesh, Indonesia, Japan, Kazakhstan, Malaysia, Mongolia, The Philippines, Thailand and Vietnam. In the opening session, the welcome remarks were delivered by Mr.Takahisa Funabiki, MEXT, and Mr. Tomoaki Wada, FNCA Coordinator of Japan. Mr. Funabiki mentioned FNCA activities and importance of the nuclear waste management in the member countries. Mr. Wada introduced the suggestions of Coordinators Meeting, which was held in June 2021, related to the RS&RWM Project via video message. Following the opening session, Professor Toshiso Kosako, Project Leader of Japan, explained the problems with Naturally Occurring Radioactive Materials (NORM) and Technologically Enhanced Naturally Occurring Radioactive Material (TENORM), which are expected to become a serious social problem in many Asian countries. The goal of 7th phase of this project from 2021 to 2023 is to compile a consolidated report on NORM and TENORM. He also described the workflow to compile the consolidated report. After his presentation, participants presented their current situations, problems, and future plans on NORM and TENORM in their own countries.




Workshop participants

On the second day, there were 2 topical presentations on NORM and TENORM from Japan. Dr. Kazuki Iwaoka, National Institutes for Quantum Science and Technology (QST), introduced the NORM data base in QST while explaining the current status of NORM survey in Japan. Professor Hiroshi Yasuda, Hiroshima University, presented on the management of uranium wastes from the perspective of humanities and social sciences.
After their presentations, the participants were divided into 3 groups and discussed about contents for the consolidated report. Later the leader of each group presented the summary of their ideas.


Professor Kosako mentioned that NORM and TENORM are radioactive materials more complex and harder to manage than previously handled radioactive wastes, and the situations and issues involved are completely different depending on the country. He also said that it will be vital to share a broad spectrum of knowledge among the member countries, carry out fact-finding surveys based on an international consensus, and consider what sort of response will be necessary.
Summary of each presentation and comments can be found on the FNCA website.

## Open seminar

In usual years, FNCA holds open seminars at the sites of its workshops, in which it attempts to disseminate what the activities of its projects are and their results to local people. In FY2021, due to the COVID-19 pandemic, RS&RWM workshop was held online. To continue our past efforts on open seminar, a project member of Japan, Mr. Tatsuo Saito, video-recorded his presentation about low level radioactive waste disposal project and NORM Guidelines in Japan.
The recording is available on the following websites:
https://www.fnca.mext.go.jp/english/rwm/e_ws_2021.html

## FNCA Activities in JFY 2021

| Activity | Date | Host Country |
|---|---|---|
| **The 21st Coordinators Meeting** | June 30, 2021 | Japan（online） |
| **Workshop on Radiation Safety and Radioactive Waste Management** | November 9 - 10, 2021 | Japan（online） |
| **The 22nd Ministerial Level Meeting** | December 9, 2021 | Japan（online） |
| **FNCA 2022 Study Panel** | March 9, 2022 | Japan（online） |

For more details, please refer to the following FNCA website.
https://www.fnca.mext.go.jp/english/index.html

# Immobilisation of contaminated materials

Bangladesh
**Dr. M. Moinul Islam** (Project Leader)
Chief Scientific Officer and Head
Health Physics and Radioactive Waste Management Unit
Bangladesh Atomic Energy Commission (BAEC)

## Introduction

In order to limit the potential dispersion of the waste conversion of a waste into a waste form by solidification method is widely used for radioactive waste conditioning. Solidification reduces the void within the container and provides integrity and stability of the waste package during handling, transportation, storage and disposal of the radioactive wastes.

Cement matrix has been used for many years for immobilisation of low- and intermediate level waste. The advantages of immobilisation of radioactive waste by cementation are that it is readily available, low cost, good thermal, chemical and physical stability, good compressive strength and provides good self-shielding [1].

The main objective of the present work to converts raw waste containing mobile contaminants into a solid and stable form physically surround waste component with set cement matrix enable it to be stored safely and conveniently, significantly reducing the potential for release of radionuclides into the environment. The Portland composite cement used for immobilisation of the contaminated Zinc Oxides (ZnO) ashes which were stored in two different containers.

## System of work:

Segregation of the contaminated material was performed carefully for the measurement of radiation dose rate and surface activity and stored in different containers. From the measurement the radiation dose rate and surface activity prior to immobilisation and safe storage of the contaminated material in different packages B7, B14, B17 and B19 were found to be varied as 13.8 - 19.7 µSv/h and 12.2 - 22.8 Bq/cm$^2$ respectively. At 1 m distance from the contaminated material the dose rate and surface activity recorded which are in the ranging from 4.16 - 5.78 µSv/h and 4.05 - 6.05 Bq/cm$^2$. Presence of $^{137}$Cs radionuclide in the packages containing ZnO was detected by using a radio isotope identification device. Furthermore, from the gamma spectral analysis by using a HPGe detector a distinct photo peak at the energy of 661.7 keV indicates the presence of $^{137}$ Cs in the analysed samples. The specific activity of the $^{137}$Cs in the contaminated materials was determined by using HPGe detector having 20% efficiency. Measured activity of the contaminated material in different packages shown in Table 1. Fig 2 shows the calculated activity concentration due to $^{137}$Cs in the contaminated materials and how the activity concentration would change overtime. This indicates required time frame for regulatory control of the materials contained in the packages B7, B14 and B17, B19.

On the basis of the activity concentration of $^{137}$ Cs containing contaminated ZnO were carefully segregated and converted to a stable solid form through the cementation process in order to prevent the dispersion of the contaminated materials in the surroundings environment by maintaining an appropriate water cement ratio. The Portland composite cement, sand and water were used to immobilise the contaminated ZnO ashes inside a 250L Galvanized Iron (GI) cylindrical drum of height 36 inch and diameter of 24 inch. A rotary mixing method applied for the mixing of the various components thoroughly and allowed to set uniformly.

Reduction in the surface activity and radiation dose rate of waste packages after immobilisation of the contaminated materials are shown in Fig 3 and Fig 4.


Fig.1. Radionuclide detection in contaminated material using radio isotope identification device

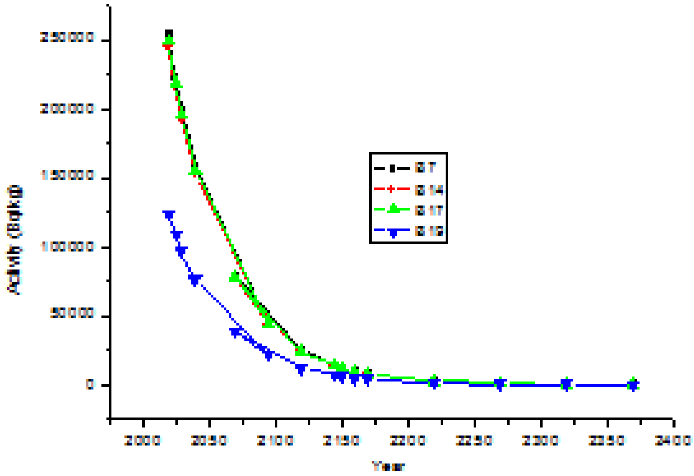
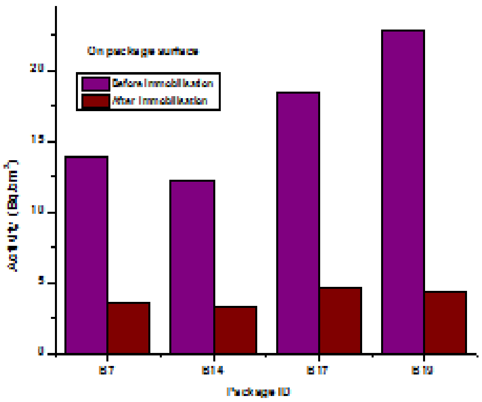



Fig.2. Calculated specific activity of the contaminated materials



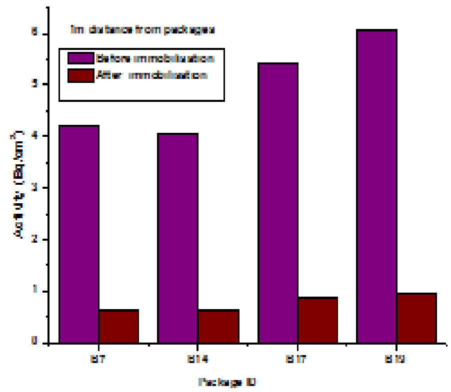
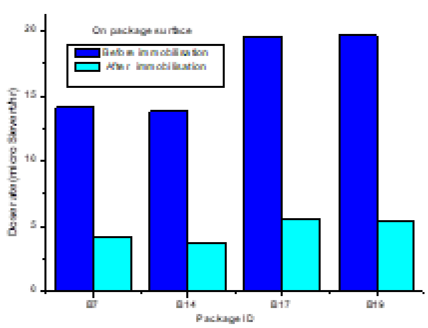




Fig.3. Surface activity of the contaminated material before and after immobilisation



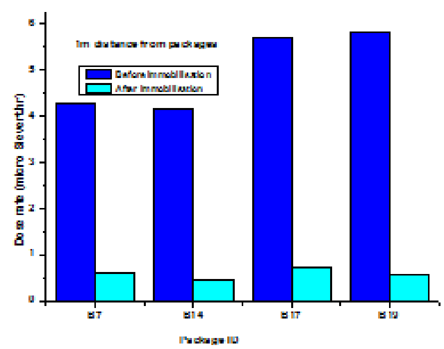




Fig 4. Dose rate measurement of the contaminated material before and after immobilisation

| Package ID | Dose rate (µSv/h) | Dose rate at 1 m distance (µSv/h) | Surface activity (Bq/cm$^2$) | Surface activity at 1 m distance (Bq/cm$^2$) | Activity ( $^{137}$Cs ) concentration (Bq/kg) |
|---|---|---|---|---|---|
| **B7** | 14.1 | 4.3 | 13.4 | 4.2 | 2,53,647 |
| **B14** | 13.8 | 4.2 | 12.2 | 4.05 | 2,45,060 |
| **B17** | 19.6 | 5.7 | 18.4 | 5.4 | 2,49,516 |
| **B19** | 19.7 | 5.8 | 22.8 | 6.05 | 1,23,643 |

Table 1. Dose rate and surface activity on the surface of the packages

| Package ID | Dose rate (µSv/h) After Immobilisation | Surface activity (Bq/cm$^2$) After Immobilisation |
|---|---|---|
| B7 | 4.2 | 3.6 |
| B14 | 3.8 | 3.3 |
| B17 | 5.6 | 4.6 |
| B19 | 5.4 | 4.3 |

Table 2. Dose rate and surface activity on the surface of the immobilised waste packages

**Conclusion:**

Results show the reduction in the radiation dose rate and surface activity level of the immobilised packages. Dose rate reduction of the immobilised packages are approximately 70 to 72% and at lm distance 85 to 90%.Whilst, the reduction in the surface activity are ranging from 72 to 82% and at lm distance which was found 83 to 84%. On the basis of the calculated activity contaminated with $^{137}$Cs contained in the packages B7, B14, B17, and B19, exempt activities of radionuclide from regulatory regime will occur approximately after 4.7 and 4.2 half life respectively [2].
Leach resistance and compressive strength study of the waste form are required to verify the integrity of the waste form and it is an important consideration for safe handling and transport of radioactive waste prior to disposal.

**Reference:**

[1] M.I. Ojovan, and W.E Lee, An Introduction to Nuclear Waste Immobilisation, 2nd edition, Elsevier, (2014), 206.
[2] Bangladesh Gaette, Nuclear safety and radiation control rules, Exempt activity concentrations and exempt activities of radionuclides, September (1997), 49.

# Short Summary of LLW disposal project and NORM Guidelines in Japan

Japan
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Assistant Principal Engineer
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Decommissioning and Radioactive Waste Management Head Office
Japan Atomic Energy Agency (JAEA)

The FNCA 2020 Workshop on RS&RWM Project was held online on December 14-15, and 11 FNCA member countries participated in this workshop.

As this country report of Japan, 2 topics were introduced:

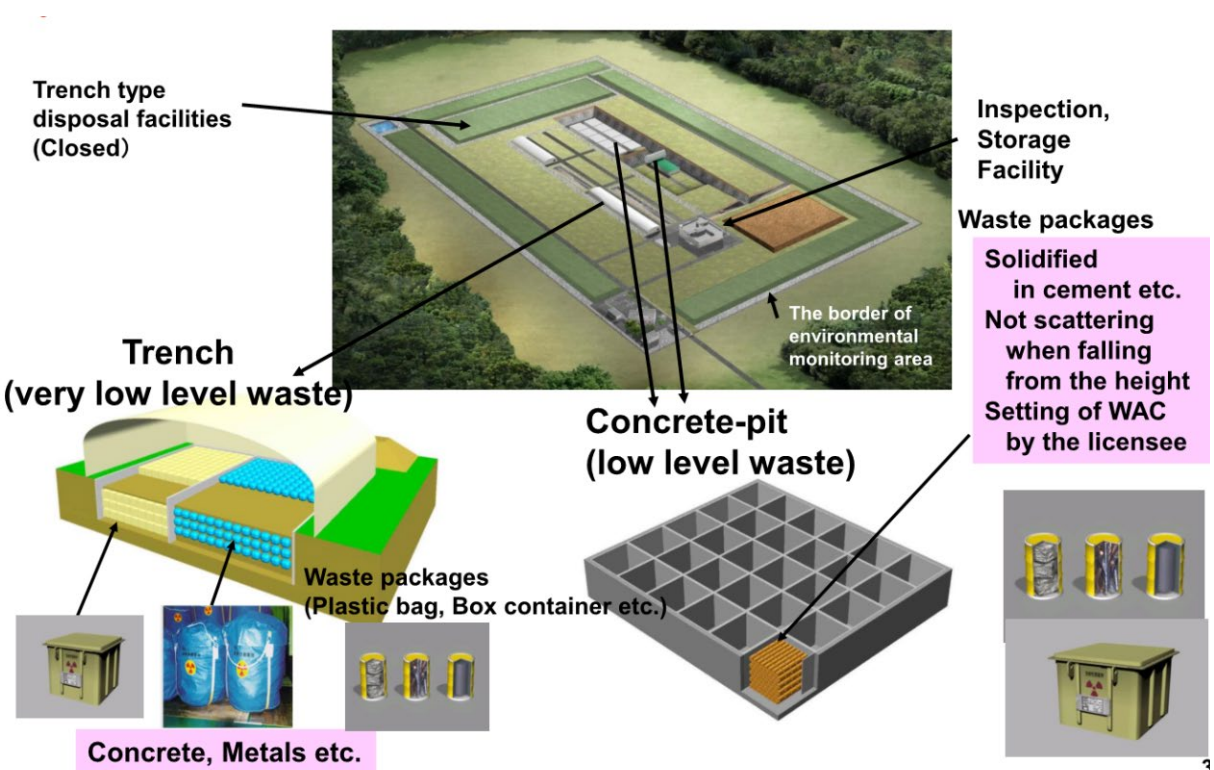
1. Disposal Concept of Radioactive Waste in Japan and Japan Atomic Energy Agency (JAEA)'s mission

2. Introduction of the outline of guideline for measures in handling Naturally Occurring Radioactive Materials (NORM) in Japan

## 1. Disposal Concept of Radioactive Waste in Japan and Japan Atomic Energy Agency (JAEA)'s mission

JAEA's mission is promoting the disposal project of low level radioactive waste (LLW) generated from the nuclear energy research / medical and industrial use of radio isotopes in Japan.

The report outlined JAEA's conceptual design of near surface radioactive waste disposal site. The conceptual image of the disposal site is as follows.



## 2. Introduction of the outline of guideline for measures in handling Naturally Occurring Radioactive Materials (NORM) in Japan

In a new phase, which starts in FY2021 (FY2021-FY2023), our RS&RWM Project decided new theme of activities that are aimed at making a report on NORM and Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM).

In Japan, raw materials (Monazite, titanium ore, phosphate ore, etc.) and products (Titan oxide, Phosphate fertilizer, refractory bricks), each containing U or Th, are prevailing and used in large amount. In addition, products manufactured based on natural ores containing radioactive substances are used by many people as general consumer goods.

As a result, public are exposed to radiation from sources other than natural radiation in their daily lives.

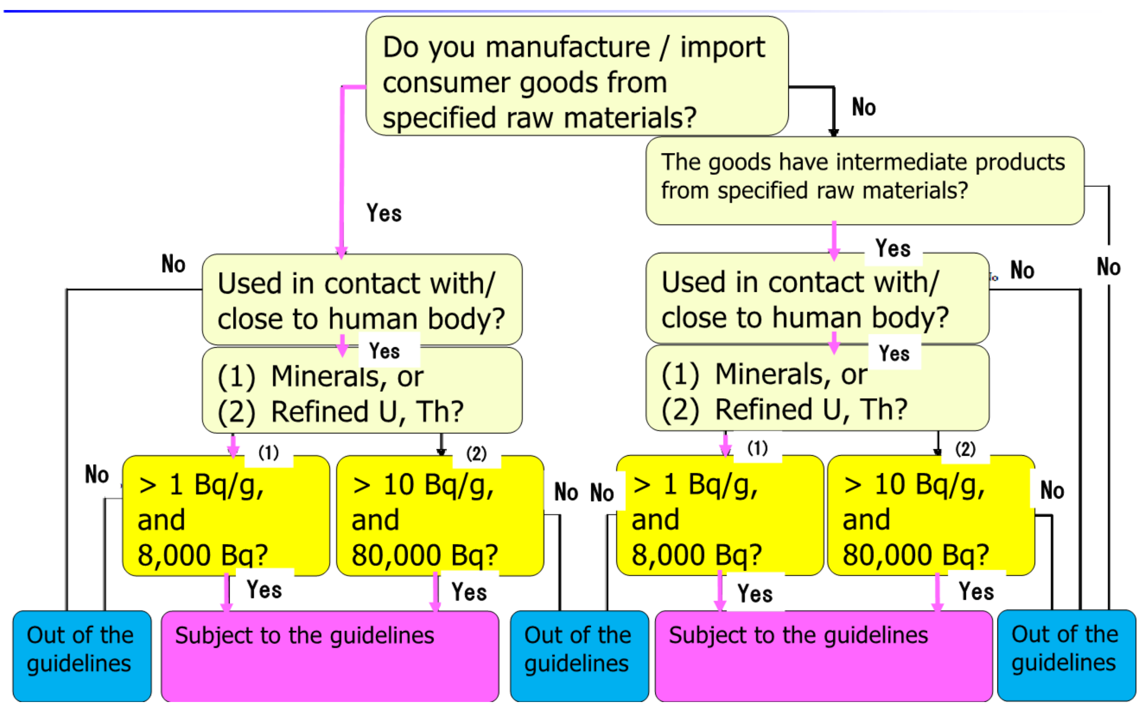
Measures are needed to reduce health risks due to unnecessary radiation exposure when handling natural ores, etc.

For the purpose of "reducing unnecessary exposure of workers at manufacturing sites" and "reducing unnecessary exposure of public, Japan has two guidelines for NORM.

The first is for NORM categorization with its containing minerals or generic streams, into 8 groups to lead to each guideline dose (1mSv/y or 10μSv/y) for action/exemption.

The second guideline is for ensuring safety of NORM with preparing measures by screening with flow chart of guideline radioactivity (1 or 10 Bq/g) to the targeted manufactures and consumer goods for exposure reduction.

The figure below is a screening flowchart of NORM containing products according to the guidelines. The management of public exposure by NORM in Japan is currently carried out using these guidelines.



# FNCA Consolidated Report on Low Level Radioactive Waste Repository

Japan
**Toshiso Kosako** (Project Leader)
Professor Emeritus, The University of Tokyo

Project team of RS&RWM in FNCA has been prepared the project summary reports. We would like to introduce the newest report. The title is;

"FNCA Consolidated Report on Low Level Radioactive Waste Repository"

The full text can be obtained from the following website;
https://www.fnca.mext.go.jp/english/rwm/e_projectreview.html

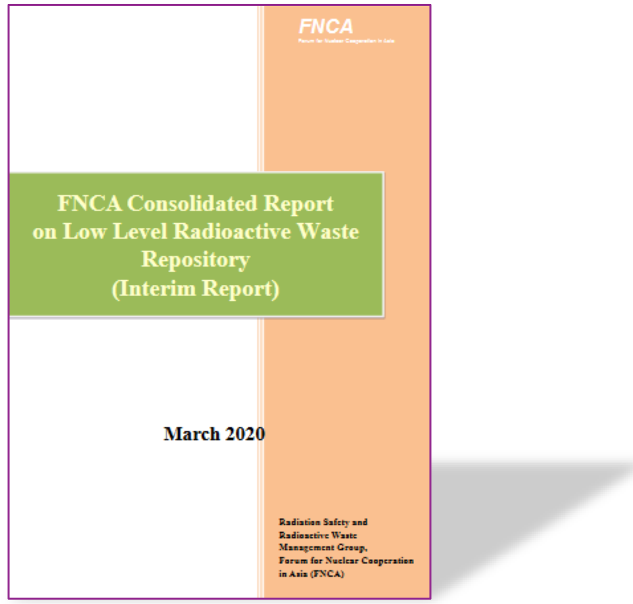
Here, we would like to show the overview of this report.

-----Outline-----

The FNCA Radioactive Waste Management Project started in 1995 with the aim of improving the safety of radioactive waste management in the Asian region. Since then, the FNCA member countries have been conducting the activities to exchange and share information/experience gained from radioactive waste management among FNCA member countries. It goes without saying that enhancing radioactive waste management activity ensures and improves the nuclear safety in Asia. With the considerations of growing-up use of radiation and nuclear science/technology in Asian countries, the promoting exchange of knowledge and experience related to radioactive waste management will lead to more effective international cooperation.
The workshop activities on radioactive waste management, which has long been implemented between FNCA member countries, has been promoted a favorable development of nuclear safety culture between the participating countries. As a pioneering project, the results of these activities were compiled in March 2003 in the FNCA RWM Consolidated Report (FNCA RWM-R001): "The Consolidated Report on Radioactive Waste Management in FNCA Countries".
Then, in March 2007, the revised version was published as FNCA RWM-R004. Since then, nearly 20 years have passed, and the progress has been made in the actual site of low-level radioactive waste (LLW) disposal repositories in FNCA countries. In consideration of this, the additional following-up investigations on the LLW disposal repositories were necessary.
A comprehensive study was conducted on the current situation of FNCA countries regarding the siting, public acceptance, planning, safety analysis and construction of LLW disposal repositories, in taking into account of actual surrounding situations of each participating country. The study results are summarized in this integrated report.


Prof. Toshiso Kosako explaining the contents of the Consolidated Report on LLRWR (2019 RS&RWM workshop, Vietnam)

The structure of this report is divided into two parts, one for general matters and for specific matters according to each country report. We are expecting a useful application of this report among the people concerned. Regarding the formulation of the report, we received various assistance from the persons. We appreciate much these related persons.


FNCA
FNCA Consolidated Report on Low Level Radioactive Waste Repository (Interim Report)
March 2020
Radiation Safety and Radioactive Waste Management Group, Forum for Nuclear Cooperation in Asia (FNCA)

## ✧✧FNCA Consolidated Report on Low Level Radioactive Waste Repository✧✧

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Forum for Nuclear Cooperation in Asia

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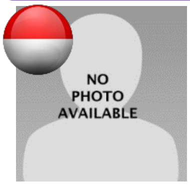

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