Annex 3

Session Summaries of

FNCA 2023 Workshop on

Radiation Safety and Radioactive Waste Management Project

Session 2 : Introduction

1) FNCA Activities (Mr. Tomoaki Wada, FNCA Advisor of Japan)

There are currently ongoing eight (8) projects under the FNCA framework. A new Climate Change Science Project - Research on evaluating the CO_2 emission from forest soils in Asia - was launched this year. Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT), which is a sponsor for the FNCA, has Training Programs on Nuclear Energy and Radiation Utilization.

2) Malaysia's Achievements in FNCA Projects (Dr. Muhammad Rawi Mohamed Zin, Deputy Director General of Nuklear Malaysia)

Malaysia became a member of the FNCA in 1990 with the aim of exchanging information and views on the peaceful use of nuclear technology with neighbouring Asian countries. Malaysia has actively participated in FNCA meetings, workshops, and project activities. Currently, Malaysia is participating in eight (8) FNCA projects. Malaysia way forwards is on 20th September 2023, the Minister of Science, Technology, and Innovation (MOSTI) launched National Nuclear Technology Policy 2030 to optimize the peaceful use of nuclear technology for the country's socioeconomic development.

3) Project Overview and Goal（Prof. KOSAKO Toshiso, Japan)

This project focuses on Naturally Occurring Radioactive Materials (NORM) and Technologically Enhanced NORM (TENORM), where radiation exposure is sometimes a problem, and investigated and considered the current situation in each FNCA country. In recent years, international standards regarding the regulation of naturally occurring radioactive substances are being considered. Related information was also collected. This report collects NORM/TENORM data and presents the discussed results based on task group work in the Radioactive Waste Management (RWM) project within the framework of FNCA.

Session 3 : Country report

1) Australia

Mr. Duncan Kemp, Technical Director, Radioactive Waste, Australian Nuclear Science and Technology Organisation (ANSTO) delivered a presentation on Australian NORM management plans and rehabilitation plans. He stated that a graded approach is important for defining the levels of the NORM control. Australia's approach to managing NORM was discussed. He also discussed the engineering and administrative controls that can be put in place to decrease the risks from NORM materials in the workplace.

2) Bangladesh

Dr. Khandoker Asaduzzaman, Chief Scientific Officer and Unit Head, Health Physics and Radioactive Waste Management unit, Institute of Nuclear Science and Technology, Bangladesh Atomic Energy Commission (BAEC) presented the structure of national organization for Radwaste management, regal and regulatory framework, NORM/TENORM sources, and issues and challenges related to NORM/TENORM. He mentioned that the NORM industry has still not been defined in Bangladesh. Currently, Bangladesh has not comprehensive nation-wide investigation/survey data on NORM/TENORM inventory. The NORM/TENORM management strategies and technologies need to be developed for radiation protection and safety. He also added the case studies on NORM/TENORM management and characterization. Dr. Asaduzzaman explain the NORM management procedure of an imported scrap oil tanker ship (the end-of-life ship) contain large amounts of residues (sludges) that are contaminated with hazardous materials and NORMs in its oil pipes and tanks with high activity concentrations higher than the NORM exemption levels. The NORM contaminated scraps (stainless steel pipes) in a shipping container at the sea port were detected before being exported. Some of them had significant surface contamination levels and dose rates, they were then transferred to the Central Radioactive Waste Processing and Storage Facility (CRWPSF) for interim storage and further processing.

3) Indonesia

Dr. Syaiful Bakhri, Head of Research Centre for Nuclear Fuel Cycle and Radioactive Waste Technology, National Research and Innovation Agency (Badan Riset dan Inovasi Nasional, BRIN) delivered a talk on present status of TENORM management in Indonesia. TENORM in Indonesia are from various industries. He stated that the companies producing TENORM should conduct a radiological study and store the generated TENORM residues/wastes at their own interim storage. He also added the issues related to TENORM. The coordination among authorities is desired to establish the national system of TENORM management and resolve the conflict and inconsistence on NORM regulations.

4) Japan

Dr. Tatsuo SAITO, Principal Researcher, Radioactive Wastes Disposal Center, Decommissioning and Radioactive Waste Management Head Office, Japan Atomic Energy Agency (JAEA) outlined the NORM guidelines of Japan. He mentioned that two guidelines (1. Exemption of Natural Radioactive Substances from Regulation." and 2. Guidelines for Ensuring the Safety of Raw Materials and Products Containing U or Th") regarding NORMs (U, Th) have been established in Japan. He pointed out that raw materials and general

consumer goods containing NORM such as U and Th exceed the exemption levels set by the IAEA are necessary to examine whose radioactivity concentration or radioactivity level exceeds the exemption level to elucidate to need to be regulated in the same way as artificial radiation sources. Dr. SAITO also discussed with 8 categories of materials containing NORM and their action levels. He emphasized on the measurement radiation levels in NORM to reduce health risks due to unnecessary radiation exposure when handling them. He also summarized a picture of measured radioactivity concentration of several general consumer goods containing NORMS (U, Th series nuclides) and were reported 0.00084 Bq/g (Yu-no-hana (bath additives using hot-spring minerals resembling flowers)) – 34 Bq/g (Radon hot spring bath element) for 238U and 0.00081 Bq/g (Yu-no-hana) – 270 Bq/g (Radon hot spring bath element). Mr. SAITO stated that a survey of living environmental radiation was conducted (published in November 2020) to calculate the national dose (annual average dose per person); consumer exposure due to NORM and occupational exposure of radiation workers of different sectors including NORM workers were also measured and were 0.00005 mSv/a and 0.022 mSv/a, respectively.

5) Malaysia

Dr. Mohd Zaidi Bin Ibrahim, Manager, Waste Technology Development Centre, Malaysian Nuclear Agency delivered a presentation on the present status of NORM/TENORM in Malaysia. He mentioned that in Malaysia, any activities involving NORM are regulated under the provisions of the Atomic Energy Licensing Act 1984 [Act 304]. Dr. Zaidi pointed out that mineral processing, oil and gas, and tin mining are the main industries involved with activities related to NORM. He stated that management of TENORM waste is the main issue for activities related to NORM in Malaysia. TENORM waste from the mineral processing industry remains the most problematic issue for the government to solve because of its huge amount and the resistance of the public. Dr. Zaidi emphasized that clearance levels are used to determine whether the control of activities involving NORM are subjected to Act 304 and must comply with all aspects of licensing, regulation, and safety to ensure the safety of workers, public, and environment. Guides, codes, and standards are provided by the regulator to ensure all licenses comply with requirements and the goals imposed in regulations are achieved. Residues containing NORM less than clearance limits are regulated under the provision of the Environmental Quality Act 1974 (Act 127).

6) Mongolia

Ms. Ganbaatar Dolgormaa, Nuclear and radiation security state inspector, Department of Nuclear and Radiation Inspection, Mongolia stated the current status of NORM management in Mongolia. He discusses the origins/sources of NORMs in Mongolia in her country report. Coal-fired power plants and maintenance of boilers, Cement production, maintenance of clinker ovens, Oil and gas production, Mining of ores other than uranium ore, Ground water filtration facilities, Uranium mining waste, Processing of rare earth minerals,

Production of phosphate fertilizers, Processing of niobium/tantalum ore, Phosphoric acid production, Tin/lead/copper smelting are the main sources of NORMs in Mongolia, she mentioned. Ms. Dolgormaa also delivered some data of measured radioactivity concentration of U in lignite deposits, food products, building materials, mining sectors and soils from different locations of Mongolia and Rn concentration in wells, springs, building and potable water of several locations. She mentioned that Mongolia hasn`t got specific laws for NORM, however, the legislative basis for NORM in Mongolia is the relevant articles 111.1.8 of Nuclear Energy Law. Regulatory framework regarding radioactive materials also described. Monitoring of occupational exposure (year-wise) also highlighted and mentioned that the dose limits for occupational exposure is 20 mSv/year and for public exposure is 1mSv/year in Mongolia. Ms. Dolgormaa pointed out several issues related to NORN/TENORM.

7) The Philippines

Mr. Angelo Absalon Panlaqui, Philippine Nuclear Research Institute (PNRI) presented status of NORM and TENORM in the Philippines. Legislation/policies, sources, and status of management of NORM and TENORM are reported. Besides, status of radioactive waste management upcoming and ongoing projects was also reported. One question was asked about no existing policy and legislation on the control and management of NORM/TENORM in the Philippines.

8) Thailand

Dr. Klitsadee Yubonmhat, Thailand Institute of Nuclear Technology (TINT) delivered a presentation on present status of NORM/TENORM in Thailand. The governmental organizations, sources, management, and issues related to NORM/TENORM are reported. The NORM/TENORM contaminated metal is often received from companies buying scrap metals. It is mostly from abroad. The question is how it was brought into the country while the importation gates probably have radiation surveillance systems. Two questions were asked about how to detect imported metals contamination and drafting legislation of customs checkpoint for imported wastes.

9) Vietnam

Mr. Nguyen Thanh Thuy, Institute for Technology of Radioactive and Rare Elements (VINATOM) presented Consolidated report on NORM in Viet Nam. Sources and management for NORM, mining and processing, general management for rad-waste from research activities, issues related to NORM were reported. According to reported issues, to manage safety and effectively NORM, it should be built a regulatory framework for this radioactive waste in the near future.

Session 4： Presentation on Environmental radiation

1) Environment radiation

Professor Toshiso Kosako, Professor Emeritus at the University of Tokyo, has delivered an instructive lecture on environmental radioactivity. He initiated the session by proposing to include this subject matter in the forthcoming phase of the FNCA Project. This addition aims to facilitate a thorough assessment of the current environmental radioactivity status across participating member countries and the methodologies employed for its detection. Moreover, he systematically elucidated the various intricate modes of radionuclide release into the environment, considering diverse sources, including nuclear facilities and potential contingencies. Subsequently, the lecture explored a diverse range of techniques utilized in environmental radiation monitoring, encompassing car-borne surveys, the establishment of radiation monitoring stations, and the collection of soil and water samples. The presentation underscored the importance of comprehending the migration and accumulation of radionuclides in the environment and the food chain. Additionally, he drew upon the example of the Fukushima Daiichi ALPS (Advanced Liquid Processing System) treated water discharge in Japan to illustrate the real-world implications of these concepts. The lecture culminated by emphasizing the pivotal role of dose estimation for the general public. This holistic approach advocated within the FNCA Project, serves as a cornerstone for both ensuring environmental safety and safeguarding the well-being of the public.

Session 9: Poster Session

1) Malaysia

① Borehole Disposal Facility for Disused Sealed Radioactive Sources (DSRS)

The borehole disposal technology for DSRS is relatively new and Malaysia will proudly be the first country to own such facility once it is completed. The facility, developed by the Malaysian Nuclear Agency with technical and financial assistances by the IAEA will be a safe and secure disposal option. The disposal principle is simple and low cost but most importantly it ensures the safety of the people and the environment far into the future in-line with the national regulations, the Atomic Energy Licensing Act (Act 304) .

② Waste Technology Development center (WasTeC)

WasTeC is the National Radioactive Waste Management Center that has been entrusted by the government for the management of radioactive waste in Malaysia. It was established in 1984 as one of the units in the Malaysian Nuclear Agency known as the Waste Management Unit (before being rebranded as WasTeC and placed under the Waste Technology and Environment Division (BAS)

2) The Philippines

Radon is the second leading cause of lung cancer, next to smoking, according to the World Health Organization. Radon exposure may come from the soil, rocks, groundwater, or indoor environments such as homes and workplaces.

In the Philippines, the average radon concentration in homes was 21.4 Bq/m^3, translating to an annual effective dose of 0.4 mSv. The data ranges from 19.4 to 57.6 Bq/m^3, with the maximum observed from concrete houses. On the other hand, the average radon concentration in underground metallurgical and coal mines in the country ranged from 30 to 347 Bq/m^3, corresponding to an annual effective dose of 0.15 to 0.5 mSv. In the fertilizer manufacturing industry, the highest radon in the facility was 77 Bq/m^3, which is attributed to the storage of phosphate rocks. These endeavors contributed to the radon profile of the country. However, no investigation into tourist caves has been conducted yet.

This study determined the radon concentrations inside tourist caves in the Philippines for the first time. The selected caves, namely the Hinagdanan Cave, Batungay Cave, and Princess Manan-aw Cave, are located in the island province of Bohol in the Central Visayas region of the country. The concentration of radon was determined using a passive air monitoring device called the Raduet (Radosys, Ltd., Hungary). These detectors were deployed inside the caves for three months, covering the tourist pathway.

The radon concentration inside these caves was above the safety limit (300 Bq/m^3) recommended by the World Health Organization. The dose assessment and evaluation show that the annual dose limit prescribed by the Philippine Nuclear Research Institute is generally not exceeded. However, the radiation exposure of Batungay cave workers should be further optimized to avoid possible exceedance. Lastly, based on the risk assessment, it was found that Batungay Cave and Princess Manan-aw Cave are at higher risk than Hinagdanan Cave workers. It may be attributed to the overall length of the cave, which directly translates to the workers' exposure time during tours. Generally, the tourists are at low risk. Therefore, the current practice for tours effectively controls the exposure of tourists. However, it is important to note that the workers or tour guides in the said caves are limited, and mitigation measures may still be needed to reduce their risk of radon exposure.

3) Thailand

Cs-137 contaminated electric arc furnace dust (EAFD), hazardous waste from the steel production factory in Thailand, has been solidified with Ordinary Portland Cement (OPC). In this research, the EAFD-OPC specimens were prepared by various formulations with constant water to EAFD-OPC ratio of 0.45. The EAFD content was set to be 20, 25, 30, 35, and 40 wt.% of the binders' total weight. The qualification test (i.e., ANSI/ANS-16.1) was performed to judge whether the specimens meet the requirement for leaching (i.e., leachability index > 6.0). The Cs-137 leachability indices have been determined from the test data. The controlling leaching mechanism was also analyzed using the slope of the linear relationship between the logarithm of cumulative fraction leached and the logarithm of cumulative leaching time. The results show that the indices range from 5.9 ± 0.3 to 6.3 ± 0.1, depending on the EAFD content. It was clearly demonstrated that

the addition of EAFD content decreases the index. The results of the linear relationship indicate that the mechanism for the Cs-137 leaching could be surface wash-off and diffusion, depending on the formulation.