Annex 3

Session Summaries of
FNCA 2025 Workshop on
Radiation Safety and Radioactive Waste Management Project

Session 2 : Introduction

1) Recent Developments of FNCA Projects (Mr. WADA Tomoaki, FNCA Advisor of Japan)

At present, eight FNCA projects are being actively implemented across four key research areas. Over the past 25 years, the FNCA has made substantial contributions to the advancement of nuclear and radiation applications, yielding notable outcomes through close collaboration among the participating countries in Asia. At the Ministerial Level Meeting held last year, the Philippine Mutation Breeding Project team was awarded the Best Research Team Award under the FNCA Award 2024.

2) Environmental radiation and radioactivity from the nuclear facilities（Prof. KOSAKO Toshiso, Japan)

This phase of the project is titled "Environmental Radiation and Radioactivity from Nuclear-Related Facilities." The following points will be discussed: (1) radiation sources (natural origins, artificial origins), (2) measurement methods (external radiation, internal radiation), (3) transfer in the environment (air, ground, water), (4) effects on humans (assessment methods, reference levels), and (5) public understanding. An overview of these points will be provided.

Session 3 : Country report

1) Australia

Australia will speak about the radiological measurement of liquid from the waste facilities at ANSTO. This will include the basis for the decisions of what is to be analysed, how we set the values we have to meet and the ways that we capture and measure all waste waters which come onto the site, including stormwaters. The calculations are described from the World Health Organisation drinking water guidelines for radiation through regulations and then in practice to the quantity that can be poured down the drain in a laboratory at ANSTO. ANSTO has never had a radiological result above the limits in the waters discharged from site.

2) Bangladesh

Environmental radiation and radioactivity are critical concerns in radiation-related facilities due to the potential risks to human health and the environment. Activities such as the cleaning of Cs-137 contaminated land and the segregation of Cs-137 contaminated dust bags from large containers demand meticulous planning, precise

monitoring, and stringent safety measures. These tasks involve challenges including accurate detection, safe handling, proper waste categorization, and long-term disposal. Additionally, Naturally Occurring Radioactive Materials (NORM) monitoring in high-risk industrial sectors—such as ship-breaking yards, the fertilizer industry etc.—presents further complexities. These environments often involve unregulated material flows, insufficient worker awareness, and limited infrastructure for routine radiation surveillance. Conversely, environmental radioactivity monitoring within the 32 km radius of the Rooppur Nuclear Power Plant (being built) is essential to establish baseline data and ensure early detection of any radiological impact during and after plant operation. Addressing these challenges requires a comprehensive approach encompassing regulatory enforcement, technical capacity building, and public safety awareness to ensure safe operations and effective environmental protection.

3) China

This report focuses on the effluent discharge of operating nuclear power plants in China. China has established a four-tier system covering dose limits, constraint values, total quantity and concentration control, with standards consistent with and stricter than international ones. Data of recent 10 years show that emissions of gaseous and liquid effluents are far below limits, surrounding environment shows no abnormality except slightly increased tritium concentration, public exposure dose is far below the constraint value, and monitoring and information disclosure are strict.

4) Indonesia

This report summarizes the environmental radiation monitoring conducted in 2024 and related research activities on the remediation of Cs-137 contaminated soil. The monitoring included both continuous measurements and periodic sampling. Routine environmental radiation measurements were carried out and reported to the nuclear regulatory body (BAPETEN) every semester. The results indicated no significant exposure rates or airborne contamination. All contamination and dose rate parameters remained well below regulatory limits, confirming that research and operational activities at the nuclear facilities in the Serpong area were conducted safely and securely. Radiation protection systems in all installations functioned effectively, and all personnel adhered strictly to operational procedures. The soil remediation activities involved several stages, including mapping and segregation of contaminated soil, which were conducted on four drums containing a total of 150 liters of soil. Mapping results showed that Cs-137 contamination was unevenly distributed, with higher concentrations found in fine soil fractions, while lower concentrations were observed in coarser soil and gravel. Gamma spectrometry measurements revealed that the radioactive activity in the contaminated soil exceeded the clearance level, which is set at 100 Bq/cm². For soil exceeding this limit, further treatment using the soil washing method is planned, aiming to reduce contamination levels, particularly in fine soil particles. We need to develop a soil segregation machine to accelerate the processing of contaminated soil. This equipment will enable more efficient separation of soil fractions based on particle size and contamination

levels, significantly improving the speed and effectiveness of the remediation process. By enhancing this capability, large volumes of contaminated soil can be managed more systematically and safely.

5) Japan

Japan has a history of almost 70 years of environmental radiation monitoring of nuclear facilities. In this presentation, we will review important events in this history and highlight the lessons from adverse incidents. Following the criticality accident in 1999, the focus was on implementing nuclear accident countermeasures in terms of environmental radiation dose. The experience of Fukushima Daiichi accident has led to improvements in environmental radiation monitoring in Japan, Monitoring around the designated waste interim storage facilities is the one of the latest actions taken in Japan.

6) Kazakhstan

One of the main tasks facing the world community was the problem of handling of ionizing radiation sources, radioactive waste and spent nuclear fuel resulting from human use of nuclear energy. This issue is also relevant for Kazakhstan. Firstly, because of the large amount of accumulated on the former grounds of nuclear tests and is continuously generated at the enterprises of the uranium industry and in medical institutions of radioactive waste. Secondly, due to the presence on the territory of Kazakhstan of five nuclear reactors, which are the main sources of spent nuclear fuel.

A large amount of NORM/TENORM radioactive waste has been accumulated in Kazakhstan and there is a tendency to an increase in its volume, which requires ensuring safe management of its, including disposal. NORM/TENORM materials are represented by wastes of uranium mining, oil and gas production, metallurgical industries in the form of dumps, tailings, contaminated soils, pipes, equipment, and so on.

To regulate the handling of radioactive waste, ionizing radiation sources and spent nuclear fuel management in Kazakhstan, a number of documents in the form of Laws, Regulations and other normative legal acts are being developed and revised on an ongoing basis. But despite the fact that Kazakhstan has a lot of experience in this area, nevertheless, there are tasks in the regulatory legal framework and infrastructure of nuclear energy facilities that require compulsory solutions in the near future.

In particular, to date, the Law on the Semipalatinsk Nuclear Safety Zone has been developed and approved, which defines: the operator organization, the main criteria for zoning, and the status of the former Semipalatinsk test site. Also, a Law on Radioactive Waste is under development; it will define the basic procedure for managing radioactive waste.

One of the important and serious issues in terms of radioactive waste management is the decommissioning of the Kazakhstan BN-350 reactor.

7) Malaysia

Environmental monitoring is a regulatory requirement for certain licensed facilities, including nuclear reactors, mineral processing plants, wastewater treatment facilities, and radioactive waste disposal sites. Monitoring environmental radiation and radioactivity plays a critical role in assessing the levels of radiation in the surrounding environment, detecting unplanned releases or contamination, and ensuring that radiation exposure to the public and the environment remains within permissible regulatory limits. The Atomic Energy Act and its subsidiary regulations identify specific nuclear installations and activities that are compulsory to carry out such monitoring as part of their licensing obligations.

8) Mongolia

The legal framework for radiation safety in Mongolia, the current status of radioactive waste management, and the key challenges in this area are examined. Mongolia has acceded to several international treaties and conventions and is taking steps to develop and implement national policies and regulations in line with its international obligations. National laws and regulations have been updated, enabling the implementation of regulatory oversight for Naturally Occurring Radioactive Materials (NORM). In addition to improving radioactive waste management facilities and enhancing safety, Mongolia has been working in cooperation with the International Atomic Energy Agency (IAEA) and other member states to strengthen its radioactive waste management practices.

9) The Philippines

The report of Philippines discusses the most recent activities for radioactive waste management and environmental radioactivity monitoring in the country, with focus on developments on its legislation. The legislation for the creation of an independent regulatory body has been ratified, and it is hoped that these development will pave to a stronger program for environmental monitoring. The ratified bill also has provisions for the establishment of a radioactive waste management office. Detailed presentations on the results of monitoring was presented in other sessions.

10) Thailand

Environmental radiation monitoring associated with the operations of the Thailand Institute of Nuclear Technology (TINT) was conducted during Thailand's fiscal year 2024 across three sites: Chatuchak, Khlong Ha, and Headquarters. Monitoring activities included the assessment of surface water, groundwater, rainwater, surface soil, sediment, and aerosols, along with ambient dose equivalent rate measurements. Major sources of potential radioactivity include research reactor operations, radioisotope production, radioactive waste management, and irradiation services. All monitoring results confirmed compliance with national and international safety standards. Gross alpha and beta activity levels in water samples were below the limits set by the National Environment Board and the World Health Organization. Artificial radionuclides (I-131, Cs-

137, and Co-60) were not detected in any samples. Activity concentrations of natural radionuclides (Th-232, U-238, and K-40) in surface soil and sediment were within expected background ranges. Ambient dose equivalent rates in areas surrounding the TINT sites were measured using field survey meters, while on-site measurements were conducted using automated 24/7 Environmental and Facility Radiation Detector (EFRD) systems. Results from both field surveys and EFRD monitoring confirmed that dose equivalent rates remained below the public exposure limit of 1 mSv/y, indicating that TINT's operations posed no radiological risk to the public.

11) Vietnam

Vietnam is advancing a dual strategic focus: restarting its national nuclear power program and elevating uranium and rare earths to strategic national industries. This ambitious new direction makes the development of a comprehensive national radioactive waste management strategy an immediate and critical priority.
The primary challenges are managing future spent nuclear fuel from Nuclear Power Plants (NPPs) and the large volumes of NORM waste from the industrial-scale mining of strategic minerals. As a proactive first step, Vietnam has successfully upgraded its key radioactive waste storage facility at the Institute for Technology of Radioactive and Rare Elements (ITRRE), demonstrating our commitment to addressing future challenges.
To realize our long-term goals, we seek to enhance international cooperation through FNCA. We specifically request support in three key areas: expertise for national repository development, advanced workforce training for the nuclear power sector, and technology transfer for the industrial-scale treatment of NORM waste from uranium and rare earth processing.

12) Singapore

This presentation outlines Singapore's ambient radiation monitoring capabilities, which are supported by the Ambient Radiation Monitoring Network (ARMNet), and the National Radiochemistry Laboratory (NRL), which conducts environmental baseline radioactivity monitoring. The ARMNet, commissioned in 2020 consists of 40 fixed monitoring stations and 5 Quick Deployment Units strategically placed across Singapore to provide continuous monitoring of radioactivity in the atmosphere radiation. The NRL, which commenced operation in April 2018, aims to establish Singapore's baseline radiation levels and to detect presence of any radioactive contaminants in the environment.

Session 4： Presentation on environmental radiation and radioactivity

1) Environmental Radiation at the PNRI Radioactive Waste Management Facility (Eng. Ronald Piquero, Philippines)

This presentation shows the results of environmental radiation monitoring conducted at the Philippine Nuclear Research Institute's Radioactive Waste Management Facility (PNRI-RWMF). Key monitoring activities included ambient gamma radiation, airborne particulate sampling, gamma-ray spectrometry, and radon/thoron

measurements. Results showed ambient dose rates ranging from 0.12 to 0.21 μSv/h and airborne radioactivity levels between 0.018–0.022 Bq/L, all well below IAEA screening thresholds. These findings confirm effective radiological control and compliance with safety standards. Future directions include expanding monitoring to soil and water, upgrading equipment, and strengthening interagency collaboration.

2) Environmental Radiation Monitoring/Radiation Protection at Central Radioactive Waste Process and Storage Facility of Bangladesh Atomic Energy Commission (Dr. Khandoker Asaduzzaman, Bangladesh)

The Central Radioactive Waste Processing and Storage Facility (CWPSF) of the Bangladesh Atomic Energy Commission (BAEC) plays a vital role in managing radioactive waste generated from medical, industrial, and research activities across the country. To ensure environmental and occupational safety, a comprehensive radiation protection and environmental monitoring program has been implemented at the facility. This program includes regular monitoring of ambient gamma dose rates, surface contamination, and radioactivity levels in environmental media such as soil, water, and air. Zoning and controlled access are enforced to limit radiation exposure, while protective measures are taken to prevent the spread of contamination. Periodic assessment ensures that radiation levels remain within regulatory limits, minimizing risks to workers, the public, and the environment. The data collected supports regulatory compliance and guides continual improvement in safety protocols. Through these systematic efforts, CWPSF upholds national and international standards for radiation safety and environmental protection.

3) Environmental Radiation Monitoring Program related to Nuclear Facility in Japan (Mr. OHKURA Takehisa, Japan)

Environmental radiation monitoring for nuclear facilities is primarily conducted to monitor and assess the potential impacts of radioactive waste released from the facilities into the environment on nearby residents. When conducting routine environmental radiation monitoring, a monitoring program is established in advance based on an assessment of the potential impact of a nuclear facility on the surrounding environment. Various monitoring subjects are measured according to the program, and the results are used to assess the potential impacts on the local population. Since the primary objective of routine monitoring is to ensure the safety of local residents, it is conducted through cooperation between the local governments and the nuclear facility operators. As a result of collaboration between local government and each operator to conduct joint monitoring, thereby enabling the assessment of the cumulative impact of multiple facilities and ensuring that the total dose to local residents remains within dose limit for the public 1 mSv/year.

4) Environmental Radiation at Radioactive Waste Facilities in Nakhon Nayok (Dr. Klitsadee Yubonmhat, Thailand)

The Thailand Institute of Nuclear Technology, a nuclear energy user and radioactive waste management operator, operates two waste management facilities in Nakhon Nayok: a waste incinerator and a disused sealed radioactive source (DSRS) storage building. The incinerator was formerly used to treat solid waste and organic liquid waste but is now inoperative. It is likely to be decommissioned. Although liquid waste remains stored in its tanks, radiation dose rates at the incinerator site are at background level. The DSRS storage building includes a mobile tool kit for handling category 3, 4, and 5 DSRSs and also serves as a storage facility for DSRSs. Radiation dose rates at all wall-contact points outside the building are at background level. Environmental radiation monitoring of surface water, rainwater, surface soil, sediment, and airborne dust confirms that radiation levels in the surrounding environment meet safety standards.

Session 7: Poster Session

1) China

This paper explores the influence of anions in the environment during the disposal of radioactive waste on the mineral phase composition of cemented waste form. Based on the principle of minimization of Gibbs free energy, the changes in the content of each mineral phase component in the cemented waste form under different concentrations of anions were calculated by thermodynamics, and the evolution process of the cemented waste form with the change in anion concentration was analyses. The calculation results show that SO_4^{2-} and Cl^- have a relatively large impact on the mineral phase composition of the cemented waste form, which will lead to the complete degradation of the cemented waste form and the loss of retardation effect on radionuclides. The impact of NO_3^- on the mineral phase composition of the cemented waste form is relatively tiny, and a stable equilibrium state will be reached after the reaction between NO_3^- and the mineral phase composition of cemented waste form. The results of this study reveal the evolution law and mechanism of the degradation of cemented waste form caused by anions in the disposal environment, and can provide data support for the safety evaluation of the disposal of cemented waste form.

2) Japan

① "Integrated Consulting for Energy, Safety, and the Environment: JANUS's Contributions to Nuclear Disaster Preparedness and Waste Management in Asia"（Dr. SHIMADA Kazumasa, JANUS）

JANUS delivers integrated consulting services in energy, safety and disaster prevention, and environmental sectors across the Asia region. This poster highlights: (1) our emergency response system for real-time prediction of radiation exposure—covering effective dose, thyroid equivalent dose, and more—during nuclear incidents; (2) our support for safety assessments and management in radioactive waste disposal and decommissioning projects both domestically and abroad; and (3) our environmental initiatives in Asia aimed at fostering sustainable, circular societies and tackling waste challenges. Through these efforts, JANUS

contributes to resolving regional energy, safety, and environmental issues and to the realization of a sustainable society.

② Marine Monitoring in Japan（Dr. Nitta Wataru, Japan Chemical Analysis Center）

The discharge of ALPS-treated water into the ocean has been carried out since August 2023. The Marine Monitoring has been conducted since before the discharge of ALPS-treated water into the ocean in Japan. And the monitoring results are available on the websites of each organization. To ensure the transparency and reliability of Marine Monitoring in Japan, Inter-Laboratory Comparisons between analytical laboratories are continuously conducted under the IAEA framework. The IAEA reports summarized in past reports that analytical laboratories in Japan have high analytical capabilities.

3) Malaysia

The production of contaminated zinc oxide (ZnO) has been traced to the processing of fly ash from steel smelting operations, which was unknowingly contaminated with radioactive material. Investigations suggest that the source of Cesium-137 (Cs-137) contamination is a disused sealed radioactive source (DSRS), containing millicurie-level Cs-137, that was inadvertently disposed of as scrap metal. The incident involves an unlicensed industry operating outside the regulatory framework of the Atomic Energy Licensing Act. This situation presents a significant challenge to the national radioactive waste management system, particularly in assigning legal responsibility and in establishing both interim and long-term waste management facilities, which require substantial financial resources.

4) Mongolia

On January 17, 2025, Mongolia signed an investment agreement to develop the Zuuvch-Ovoo and Dulaan Uul uranium deposits, with production planned from 2028 using in-situ leaching. Environmental radiation monitoring is regularly conducted across soil, water, and air. National regulations on NORM have been approved, with phased implementation of oversight. A new radioactive waste management facility is under construction. These efforts aim to enhance safety and align with international best practices.

5) The Philippines

① Baseline radon monitoring at the PNRI radioactive waste management facility and Philippine research reactor-1 SATER (Mr. Angelo A. Panlaqui, PNRI)

This study measured baseline radon levels at PNRI's RWMF and PRR-1 SATER using passive detectors over three months. Radon levels at the RWMF averaged 435 Bq/m³, exceeding the safety limit of 300 Bq/m³, with a peak of 903 Bq/m³ in a storage area. PRR-1 SATER showed significantly lower concentrations, averaging 61 Bq/m³. The findings highlight the need to include radon in routine environmental monitoring, with recommendations for improved ventilation and internal dose assessments to enhance radiation protection.

② Uranium geochemical maps of the Philippines (ver. 3) (Ms. Americus Perez, PNRI)

Under the auspices of the then Philippine Atomic Energy Commission, extensive uranium exploration datasets from various provinces were generated. An attempt to synthesize radiometric, stream sediment, heavy mineral, and stream water uranium data is currently underway. This work describes the release of the PNRI-NMRS Uranium Geochemical Map of the Philippines. The current database includes 2109 stream sediment and 1053 heavy mineral samples, 111 stream water samples from selected localities, and 1007 ground and carborne radiometric readings. The drainage geochemical database is combined with a rock geochemical database from published datasets and GEOROC. The spatial distribution of geochemical data is visualized in geochemical maps with exploratory data analysis (EDA) classes. The combination of drainage and rock geochemistry enables the characterization of primary and secondary, hydrothermal fluid-assisted uranium enrichments in Philippine geoscapes. Anomalies identified here associated with Fe and/or Cu prospects/mineralization are potential targets for renewed uranium exploration.

6) Thailand

Electric arc furnace dust (EAFD) contaminated with Cs-137 (gamma radiation emitting radionuclide) accidentally generated during steelmaking process could be classified as Radwaste. Cementation is a potential method for conditioning this type of waste. The standard leaching test (ANSI/ANS-16.1) was previously performed on different specimens of the 28-day-old cemented EAFD to examine the Cs-137 release from the specimens. In the present work, 15 different leaching models based on the four processes (loosely bound radionuclide release, surface wash-off, diffusion, and dissolution) were used to describe the Cs-137 release data obtained from the test and to determine the processes controlling the Cs-137 leaching. It was found that the Cs-137 leaching from all specimens studied was caused by the loosely bound Cs-137 release, surface wash-off, and diffusion. The contribution of diffusion to the Cs-137 leaching is significantly lower than that of the rest processes. The contribution proportion of each process varied according to the cementation recipes used to prepare the specimens.