Annex 3

Session Summaries of
FNCA 2024 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)

Since 1st FNCA meeting was held in 2000, there are currently ongoing eight (8) projects under the FNCA framework and 12 countries are participating in the project activities.

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

The activities of the FNCA RS&RWM project are summarized as follows: 1. Workshop papers, 2. Newsletter and 3. Consolidated report. Detailed information is shown on the FNCA Website. The past activities are listed and the former project of NORM/TENORM text contents are shown.

This term's theme from 2024 is "Environmental radiation and radioactivity from the nuclear facilities". The phase plan is scheduled in 2024 is a starting year, after three years discussions, the products are summarized in 2026 as a consolidated report. The purpose of this project is based on "Radiation related facilities ultimately release radioactive materials into the natural world, what is the current situation and how is it detected.

There are some discussion points in the project of Environmental radiation & radioactivity.
Those are ① Radiation sources from natural or artificial origin. ② Radiation Measurement and Monitoring method： External radiation or Internal radiation. Normal or Accidental situation.
③ Radionuclide Migration in the Environment：Through Air, Land, Water systems.
Transfer modeling is effective. ④ Finally, effects on the human body：Intake estimation of the human body requires some parameters like life custom: Dose conversion factors are used for evaluation. Those are summarized as reference levels for practical use.
⑤ Public understanding: Easy and understandable explanation is inevitable accompanied with international estimation and agreement.

As an example of radiological marine environment around Fukushima-1 NPP after treated water release is shown.

Session 3 : Country report

1) Australia

This presentation will discuss the way that Australia is a federation of states, with each jurisdiction having its own laws and regulators. It will discuss the two main regulators for environmental radiation at the Federal level, how they interact and what the focus of each of these are. One is the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) which regulates the use of radiation and emissions. The other is the Department of Climate Change, Energy, the Environment and Water which regulates the environmental impact of all significant projects or facilities.

2) Bangladesh

Environmental radiation and radioactivity in radiation-related facilities present significant challenges that impact public health, safety, and ecological integrity. This report explores the sources of radiation within these facilities, emphasizing the potential health risks associated with both occupational exposure and environmental contamination. National organization and legal & regulatory framework for radiation protection will be outlined in the presentation. The existing policy and regulatory clearance of natural and fallout radionuclides has been highlighted. Dose limit for occupational and public exposure has been discussed. Lastly, present environmental radiation and radioactivity in some radiation-related facilities and challenges are also briefly discussed in the presentation.

3) China

China has made progress in improving laws and regulations, regulatory ability, and radioactive waste disposal capacity building, China will take measures for challenges on LILW disposal site selection, GD of HLW and disposal of DSS. The new technologies and applications for radioactive waste treatment including mobile low level waste incineration technology, waste filter cartridge reduction technology, wet oxidation technology, microwave drum drying technology and waste oil and waste solvent treatment technology. Radioactive decontamination detergent and devices have been used in NPPS successfully.

4) Indonesia

In 2021, the National Nuclear Energi Agency (BATAN) and other National Research Agencies merged into the National Research and Innovation Agency (BRIN). In BRIN, nuclear-related institutions are mostly in the Research Organization for Nuclear Energy (ORTN) and the Directorate of Nuclear Facility Management (DPFK). Environmental radiation monitoring around the nuclear facilities is carried out by the Directorate of Nuclear Facility Management (DPFK).

Indonesia has 3 nuclear facility establishments. The first, Serpong Nuclear Establishment with 6 (six) nuclear facilities 30 MW RSG-GAS research reactor, Installation of Connection Channels for Spent Fuel Facilities

(KH-IPSB3), Radioactive waste treatment plant (IPLR). Radiometallurgical Installation (IRM), Experimental Fuel Element Installation (IEBE), Radioisotope and Radiopharmaceutical Installation (IRR). The second is Bandung Nuclear Establishment with a 2000 kW research reactor, and the third is Yogyakarta Nuclear Establishment with a 100 kW research reactor.

Environmental Radiation Monitoring in Serpong Nuclear Establishment is carried out in 2 ways: continuous radiation measurement and grab measurement in periodic sampling. In Serpong, there are 6 continuous radiation stations with 1 meteorological station. For grab monitoring, the samples are air, rainwater, soil, surface water, drinking water, sediment, and grass with different frequencies and numbers of sampling points. The measurement report is sent to BRIN's headquarters every three months and to the National Nuclear Regulatory Body BAPETEN and the Ministry of Environment per semester. Until now, there have been no anomalous results from routine monitoring of nuclear facilities in Indonesia.

The issue of environmental radiation is the decontamination of contaminated materials from the environment, both from the decommissioning activity or other causes.

5) Japan

ALPS treated water discharge has been started on August 2023, and the Japanese government has been conducting marine environmental radioactivity monitoring since one year prior to the discharge. To ensure the transparency and reliability of the monitoring, the monitoring is being carried out with the cooperation of the IAEA and specialist agencies of various countries, and the monitoring results are published on the following website. https://shorisui-monitoring.env.go.jp/en/map/01/

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.

7) Malaysia

Malaysian Nuclear Agency (Nuklear Malaysia) was mandated by Malaysia government in 1984 to function as national radioactive waste management center. While Waste Technology Development Center (WasTeC) is the center who carries out this function on behalf of Nuklear Malaysia. Under this function, Nuklear Malaysia is responsible for planning and development technology, facilities and human resources for the management of radioactive waste in Malaysia. Currently Nuklear Malaysia has transport, treatment and storage facilities for radioactive waste. Nuklear Malaysia decided to develop a borehole disposal facility for disposal of disused sealed radioactive source (DSRS) Category 3 to 5. At the same time, Nuklear Malaysia proposed to the Malaysia government to gazette a site for development of National Repository to ensure management of radioactive waste in Malaysia now and in the future are safe, secure and not burden next generations.

8) Mongolia

This presentation covers the key aspects of radioactive waste management in Mongolia, focusing on relevant international and national legal frameworks. It provides data on radiation applications, including radiation sources, DSRS, uranium deposits, and NORM facilities. Reference levels of radioactivity for coal and building materials are discussed, along with the roles of responsible organizations. The presentation also highlights the technical capacity of the Radioactive Waste Management Facility and recent efforts to characterize and condition Ra-226, concluding with future directions for waste management.

9) The Philippines

The report of Philippines discusses the different arrangements for environmental radioactivity monitoring in the country. It presented the relevant policies and regulations on monitoring of the environment. Current measurement systems are ambient gamma radiation measurements, soil and terrestrial materials concentrations analysis, radionuclide air particulate monitoring and radon measurements in dwellings and water which are mostly done by research groups. The radioactivity and radiation levels were also reported. Lastly, activities on public awareness and the present status of radioactive waste management were reported.

10) Thailand (Dr. Klitsadee Yubonmhat, Thailand Institute of Nuclear Technology (TINT))

Thailand's background radiation comes primarily from natural sources such as cosmic radiation, terrestrial radiation, and radon gas. The ambient dose equivalent rates ranged from 0.01 to 0.3 μSv/h. The Princess Sirindhorn Neutron Monitor is an important facility for detecting cosmic radiation. Terrestrial radiation in Thailand varies by region due to geological formations and human activities. In certain areas, the terrestrial gamma dose rate ranged from 590 to 206,080 nGy/h, giving an annual effective dose of 0.7-250 mSv. Radon gas is a major issue in Thailand, as it is the second largest cause of lung cancer after smoking. Indoor radon concentrations in eight regions in upper northern Thailand ranged from 11 to 405 Bq/m^3, yielding a yearly effective dose of 0.44 -12.18 mSv. Radon concentrations in hot spring areas ranged between 10-17 and 11-147 Bq/m^3 for outdoor and indoor environments, respectively. While natural sources are the primary contributors, human activities and installations (medical applications, research and education, industrial uses, consumer products, nuclear facilities, accidents, and incidents) also contribute to environmental radiation. However, Thailand has implemented regulations to protect the public and the environment from radiation risks associated with these activities and installations.

11) Vietnam

Radioactive waste in Vietnam originates from a variety of sources, including disused sealed radioactive sources (DSRS) used in medical, industrial, research, and educational fields, nuclear research reactor, mining, and mineral processing activities. While Vietnam does not have nuclear power plants, it operates a 500 kW research reactor for producing medical radioisotopes and conducting scientific research. The country lacks a centralized national storage facility for radioactive waste, so it is stored at multiple locations.

- DSRS are mainly stored at several research facilities, with the Dalat Nuclear Research Institute (NRI) and the Institute for Nuclear Science and Technology (INST) – both under the Vietnam Atomic Energy Institute (VINATOM) – holding the largest quantities. In addition to disused sources, NRI also stores radioactive waste generated from its production of radioisotopes using the research reactor, kept in a temporary storage facility on-site.
- NORM (Naturally Occurring Radioactive Material) waste, generated from research into radioactive mineral processing, is stored in a temporary facility at the Institute for Technology of Radioactive and Rare Elements, also under VINATOM.
- On an industrial scale, NORM waste comes from the mining and processing of rare earths and placers such as titanium, zircon, and ilmenite. Tailings and very low-activity radioactive waste are primarily stored in tailings ponds at mining or processing sites. Additionally, a shallow burial site with concrete tanks for solid waste from zircon processing is in operation to support ZOC (Zirconium Oxychloride) production.

Overall, these storage facilities are regulated by the Vietnam Agency for Radiation and Nuclear Safety (VARANS, MOST). While environmental radiation at these sites is generally well-monitored in line with legal requirements, managing other very low-activity radioactive waste, such as NORM tailings and solid waste from mineral processing and oil and gas extraction, presents ongoing challenges.

Session 5： Presentation on environmental radiation and radioactivity

1) Environment radiation (Dr. Mohd Zaidi Bin Ibrahim, Malaysia)

All radiation related facilities in Malaysia need to be licensed under the Act 304 (Atomic Energy Licensing Act 1984). According to Radiation Protection (Licensing) Regulations 1986, license for facilities or activities related to radiation is classified into Class A to Class G license. The need to carry out radiation and radioactivity monitoring for the facilities is stated in guidelines and license conditions. Area and environmental radiation monitoring are compulsory for all radiation related facilities, while environmental radiation and radioactivity monitoring are compulsory for facilities which release emission or effluent into the environment. Current area monitoring results show a few stations at radioactive waste management facilities have dose rate higher than the limit. These are due to the dismantled DSRS for borehole project. Results for environmental radiation and radioactivity monitoring show there is no significant increase in radiation and radioactivity detected.

2) Environmental Radioactivity Monitoring in JCAC (Prof. KOSAKO Toshiso, Japan

In JAPAN, to improve the reliability of environmental radioactivity monitoring, we have been continued the following efforts: (1) standardizing analysis and measurement methods, (2) maintaining and improving the analysis and measurement skills of personnel through training, and (3) objectively evaluating the capabilities of analytical laboratories through proficiency tests.

3) Environmental Monitoring at ANSTO (Mr. Duncan Kemp, Australia)

This session will describe the environmental monitoring approach in detail for ANSTO, along with the general principles of source, pathway and receptor. It will discuss how the environmental data is collected and the areas where it is taken from. The focus will be on the airborne emissions and the liquid emissions from the site.

Session 8: Poster Session

1) Australia

The poster will describe the data collection and software used by ANSTO to determine the Airbourne emissions from ANSTO and the minimal environmental radiation emitted by the ANSTO site.

2) Indonesia

Irregularity radiation exposure at BATAN Indah Residential Area about 3.5 km north from the nuclear facility was found during the routine inspection on 30-31 January 2020, with Cs-137 activity concentration in the soil about 93.600 – 524.000 Bq/kg. 137Cs-contaminated soils and plants have been successfully cleaned up that resulted 862 drums (487 drums 100 L & 375 HDPE 150 L) contaminated soils and vegetations. The contaminated soil and vegetation are stored at interim storage facility of radioactive waste treatment facility (IPLR) of BRIN (formerly BATAN). The soil volume reduction will be conducted including soil separation based on Cs-137 activity concentration, soil separation based on soil particle size, and soil decontamination by soil washing and electro kinetic method.

3) Japan

As this document of poster session of Japan, I'll introduce here:

Outline of Public Exposure and NORM Management in Japan.

In summary, I'll report as follows:

- According to the latest exposure studies in Japan, exposure from artificial sources is comparable to that from natural sources.
- Exposures from artificial sources are mostly medical exposures,
- Japanese guidelines recommend that exposures exceeding official NORM limits be measured and controlled.

4) Mongolia

This poster presents information on environmental radioactivity in Mongolia, with a focus on safety regulations based on International Atomic Energy Agency (IAEA) standards and guidance. It examines the impact of coal consumption and the use of coal ash in building materials, both of which can contribute to elevated radiation levels, assessing their implications for environmental safety and public health. Additionally, the poster provides a comprehensive overview of Mongolia's radioactive waste management facilities' technical capabilities and offers general information on facilities handling Naturally Occurring Radioactive Material (NORM).

5) The Philippines

Background: Storage is a critical aspect of managing radioactive waste. During this stage, waste materials containing certain radionuclides may produce decay products in gaseous form, namely, radon. Radon can accumulate inside the facility over time and can be inhaled, posing an internal radiation risk to the workers. This work determined the baseline radon levels inside the PNRI – Radioactive Waste Management Facility.

Methods: Radon in the ambient air was measured using a solid-state nuclear track detector, commercially known as Raduet, from March to June 2023. The detectors were placed in key areas inside the facility, such as the office, waste processing, and storage building. After this, the detectors were analyzed, and the alpha radiation tracks left on each detector were counted automatically by an optical imaging technique.

Results: The radon concentration in the facility ranges from 38 – 903 Bq m^{-3}. The highest radon concentration was found inside one of the facility's storage buildings, wherein a mix of solid and disused sealed radioactive sources are stored. Specifically, it may have been connected to waste packages containing radium sources and thorium mantles that decay to produce radon. Additionally, inadequate ventilation within the storage building could have contributed to the elevated radon levels.

Conclusions: In conclusion, elevated radon levels inside the radioactive waste management facility, particularly in its storage building, present serious health risks to workers due to increased internal radiation exposure. Effective monitoring and mitigation strategies are essential to mitigate potential health hazards associated with radon gas accumulation in the facility's environment.

6) Thailand

Cementation was used to solidify the Cs-137-contaminated electric arc furnace dust (EAFD). The EAFD and ordinary Portland cement (OPC) were used as cementation binders. Bentonite was added to resist the Cs-137 leaching from the EAFD-OPC-bentonite specimens. Various cementation recipes were used to prepare the specimens. The 28-day-old specimens were subjected to the standard leaching test to assess the Cs-137 release. The amount of Cs-137 leached decreased as the bentonite content increased. The specimens without bentonite had Cs-137 leachability index (LI) values ranging from 6.2 to 6.8, and the LI reduced as the EAFD content rose. The specimens containing bentonite had better LI values ranging from 6.6 to 9.3. The LI increased as the bentonite content increased. This proves that bentonite can be an effective cementation additive for retarding the Cs-137 leaching.