Annex 3

Session Summaries of
FNCA 2021 Onilne Workshop on
Radiation Safety and Radioactive Waste Management Project

Session 3 : Country Report

1) Australia (Mr. Duncan Kemp, Australian Nuclear Science and Technology Organisation (ANSTO))

This discussion looks at the requirements to manage NORM within Australia. There is a strong regulatory framework in Australia to manage NORM, provided by National Guidance in Radiation Protection Series 15 - Safety Guide - Management of Naturally Occurring Radioactive Material (NORM). As part of this there is a need for the organisation to provide a Safety Case to operate the facility to the regulator. The Safety Case to Construct and Operate the facility includes all the safety, security, quality, operational plans and for NORM in particular it contains a NORM Management Plan and a Rehabilitation Plan at the end of life of the facility. The Sandy Ridge Facility for the disposal of hazardous waste will be used as an example. This facility is a clay mine which will also be used for the disposal of hazardous waste when the mine is complete. The NORM Management Plan for Sandy Ridge had to describe the waste, including nature of material (chemical, physical and radiological), contaminants, and quantities and rate of production. They also had to describe the environment into which the waste will be disposed, including the social and cultural heritage; and present and potential land use. The system for waste management including the facilities and procedures involved in the handling, treatment, storage and disposal of radioactive waste and the resultant predictions of environmental concentrations of radionuclides and radiation doses to the public.

The NORM management plan had to include a program for monitoring the concentration of radionuclides in the environment and assessment of radiation doses to members of the public. Contingency plans were developed for dealing with accidental releases of radioactive waste in the environment, or early shutdown of operations. There had to be regular reporting on the waste disposal operation and results of monitoring and assessments. It also has to include a plan for the decommissioning of the operation and associated waste management facilities, and for the rehabilitation of the site.

During the operational stage, the appropriate authority must be notified of any changes to the operation which may alter the nature or quantity of waste generated; any proposal to change the waste containment system; and any unanticipated circumstances that may lead to a variation in performance of the approved Radioactive Waste Management Plan.

By following all the requirements Sandy Ridge was given an approval to operate and dispose of NORM.

2) Bangladesh (Dr. M. Moinul Islam, Bangladesh Atomic Energy Commission (BAEC))

Materials containing no significant amounts of radionuclides other than naturally occurring radionuclides are defined as NORM. The significant amounts of radionuclides depend on the national regulatory decision.

Materials that contain natural radionuclides, whose levels are concentrated due to technological operations termed as TENORM. TENORM are in many cases large-volume, low-activity waste streams produced by industries such as mineral mining, phosphate fertilizer production, water treatment and purification, oil and gas production, coal combustion, scrap metal recycling and incineration etc. The level of individual exposure from NORM is usually minor. However, TENORM in some cases can be dangerous and classified as radioactive waste.

In the presentation possible origin of NORM and TENORM are highlighted. The existing policy and regulatory clearance of NORM radionuclides has been mentioned. Combination of alpha/beta contamination monitor, dose rate monitor, radioisotope identification device, Gamma-spectroscopy system cover health protection and regulatory compliances for NORM/TENROM characterization. Analysis of NORM residues performed by applying these approaches. Current NORM management and some challenges are also briefly discussed in the presentation.

3) Indonesia (Mr. Adi Wijayanto, The National Research and Innovation Agency (BRIN))

Indonesia has regulatory framework for NORM/TENORM consist of Act No. 10 Year 1997 on Nuclear Energy, Government Regulation (GR) No. 33 Year 2007 on the Safety of Ionizing Radiation and Security of Radioactive Sources, GR No.29 Year 2008 on the Licensing of Ionizing Radiation Sources and Nuclear Material, GR No. 101 Year 2014 on the Management of Dangerous Waste and GR No. 58 Year 2015 on the Radiation Safety and Security in Transport of Radioactive Material and also BAPETEN Chairman Regulation (BCR) No. 9 Year 2009 on Intervention of TENORM BCR No. 16 Year 2013 on the Radiation Safety in Storage of TENORM. The existence of disposal route for NORM Waste with selected NORM Disposal method based on technology, environment, economy, suitable and potential in Indonesia like Industrial landfill, licensed NORM Disposal Facility and low-level waste facility. The Inventory NORM in Indonesia, Highest K-40 with range 3-1545 Bq/kg, average 142±3 Bq/kg in Mamuju, Th-232 with range 5-3457 Bq/kg, average 45±4 Bq in Mamuju and Ra-226 with range 5-7586 Bq/kg, average 33±3 Bq in Biak Island. The result of mapping NORM generated Industries in Oil and Gas Company: Ra-226 in Petrochemical, Inc. Solid Waste, Gresik 522.30 ± 49.41 Bq/kg, Th-232 in Oil sludge, ALS Ind, Inc. 42.22 ± 4.38 Bq/kg, U-238 in Petrochemical, Inc. Solid Waste, Gresik 31.91 ± 6.78 Bq/kg. NORM recycled and used as building materials in State Electricity Company (PLN), North Sumatera Concentration in fly ash (Ra-226) 88.25 ± 8.95 Bq/kg, (Th-232) 88.39 ± 8.95 Bq/kg, (U-238)30.56 ± 3.55 Bq/kg and Kaltim Prima Coal, Inc. (KPC), East Kalimantan in bottom ash(Ra-226) 65.79 ± 6.82 Bq/kg, (Th-232) 55.53 ± 5.79 Bq/kg, and (U-238) 45.50 ± 4.55 Bq/kg. Based on the Radiological Assessment at Total E&P Indonesia, East Kalimantan, several sites at the surveyed areas are contaminated by NORM waste. (max. Ra-226=2432 Bq/kg; Ra-228=5667 Bq/kg; Th-228=7651 Bq/kg). There were found some sacks containing tin slag in some location. The tin slag sand used when sandblasting processes was done some years ago for cleaning the tank. Inventory lists of TENORM effluent volumes and radiation levels in Bangka and Belitung Islands have been estimated and measured. Technology recommendations for optimizing radiation safety for tin mining workers in the work area, especially in tin separation service companies, have been prepared taking into account the economy and safety of workers.

4) Japan (Mr. Tatsuo Saito, Japan Atomic Energy Agency (JAEA))

- The regulatory standard for near surface disposal in Japan is to confine the radioactivity of radioactive waste in the waste disposal site until the reduction of the impact on the public falls below the standard, in accordance with the Act on the Regulation of Nuclear Reactors.
- Uranium waste disposal in Japan has been excluded from the application of the basic concept of safety for the Category-2 waste disposal project formulated by the Nuclear Safety Commission in 2010.
- In order to establish the clearance of uranium waste of materials and the regulatory standards for disposal of uranium waste, the concept of regulation on clearance and uranium waste was developed by Nuclear Regulation Authority in 2021.
- Requirements for uranium waste regulatory standards;
  ① The average activity concentration of uranium in the waste cleared should be below about 1 Bq / g.
  ② The average activity concentration of uranium in a near surface disposal site should be below about 1 Bq / g at the time of burial.

5) Kazakhstan (Mr.Vycheslav Gnyrya, Institute of Atomic Energy of the National Nuclear Center of the Republic of Kazakhstan (IAE NNC RK))

A large amount of 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.

A special state program was realized for restoration of the contaminated territories of former uranium mines and open pits. There are also a large number of operating facilities for the management of waste from the uranium mining and uranium processing industry.

A number of deposits of polymetals, rare earths, and phosphorites in Kazakhstan contain uranium mineralization, which is extracted together with the main one during ore mining. Part of the radioactive mineralization goes to dumps and tailings, part remains in the main product.

At the coal deposits, permanent radiation monitoring are carried out both during the mining and during the shipment of coal. To improve the ecological situation in the oil-producing regions of the country and return pipes and oil and gas equipment to the production cycle, a project to create a chemical-technological mobile complex is being successfully implemented.

Most important aspects of the problem of NORM/TENORM management are:

- shortcoming of the radioactive waste management system;
- incompleteness of the process of implementation of organizational measures for radioactive waste management;
- absence of any effective funding mechanism that would satisfy with internationally recognized principles for the safe management of radioactive waste.

On January 2, 2021, a new Environmental Code of the Republic of Kazakhstan was adopted, which entered into force on July 1, 2021. The adoption of the new code is due to the low efficiency of environmental impact

assessment, the irrelevance of legislative regulation in the field of waste, limited public participation in environmental control, inappropriate procedure for the economic assessment of environmental damage by the current code. It should be noted that the new environmental code was developed on the basis of the best international experience.

6) Malaysia (Mr. Ahmad Khairulikram bin ZAHARI , Malaysian Nuclear Agency)

Main industries related to NORM in Malaysia includes tin mining, iron smelting, oil and gas, and rare earth extraction. These industries produces Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) at different radioactivity levels. NORM management strategy depends on the nature of the waste itself and the economic viability of the method to be used. One of the NORM waste currently being managed in the Malaysian Nuclear Agency is the diethylhexyl phosphoric acid (DEHPA) which is the solvent used to remove the element of thorium and uranium in the rare earth extraction process. Since it was received in the year 1997, multiple research work to treat and condition the DEHPA waste had been conducted with various outcomes. Learning from those outcomes, the current study was designed with the aim to first reduce the waste volume by distillation to separate the kerosene part of the DEHPA waste then immobilize the concentrated DEHPA using geopolymer. Geopolymer has many economic advantages to be used as a wasteform such as ability to synthesize at room temperature and abundance of starting materials which is derived from a processing by-product.

7) Mongolia (Mr. Oyunbolor Galnemekh, Nuclear energy commission of Mongolia)

The huge volume of naturally occurring radioactive materials (NORM) wastes produced annually by extracting industries in Mongolia and it deserves to come to the attention of national environmental protection agencies and regulatory bodies. NORM wastes constitute, by and large, unwanted byproducts of industrial activities as diverse as coal, copper, zinc, lead and REE mines, oil and gas wells. In many of these branches of industry, the problem of naturally occurring radioactive materials is present. The main source of risk for workers and public is the short-lived radon daughter products present in air. This source of risk is present in all over Mongolia, due to its geological condition. Whole territory of the country is presented by granite with enhanced concentration of uranium. These granites are the main source of the uranium in radioactive mineral deposits and NORM in other non-uranium mining sites and lakes.

Although a great deal of work has been done in the fields of radiation protection and remedial actions concerning uranium and other mines recent years, the need to dispose of NORM wastes will have environmental and regulatory implications that thus far are not fully adopted. NORM regulation now is on final stage of approving by the Government of Mongolia. Most concepts (graded approach, exemption, notification, authorisation etc.) are already included in the Mongolian regulatory framework.

Radon issue is not yet explicitly mentioned in the Mongolian regulatory framework apart from some articles in different documents. Radon Action Plan is not approved and Radon Survey was not carried out in Mongolia. General agency for sepcialized inspection and and its branch Metropolitan inspection agency are carry out measurement campaigns in public buildings such as schools, kindergartens etc. Regulatory limits for workplaces, old and new buildings, mining sites (1110 Bq/m^3 in workplaces, 200 and 100 Bq/m^3 in

existing and new buildings, respectively). Based on the survey results, GASI and its branch MIA inform the owners/users of public buildings if the radon concentration exceeds the reference levels and provide informal advice.

Lack of laboratory capacity, human resources and absence of National radon action plan are the main challenges for NORM regulation in Mongolia.

8) The Philippines (Ms. Kristine Marie Romallosa, Philippine Nuclear Research Institute (PNRI))

The overview of potential sources of naturally occurring radioactive materials in the country are discussed in the report. These potential sources are from coal mining and industry, mineral mining of copper, gold, iron among others, oil and gas exploration and fertilizer industry. The results of measurements and analysis from various R&D works are also presented. This includes the radioactivity concentrations in soil, some building materials, NORM industries such as coal and minerals processing, and radon levels. The goals of these studies are for policy recommendations on NORM management.

In terms of national framework on NORM/TENORM, there was not much progress since 2020. That is, there is still no existing policy and legislation on the management of NORM in the Philippines. Although there are some regulations with regards to radioactive waste management which covers the requirements for the management of wastes arising from NORM processing, these industries are currently not regulated.

Lastly, the report will also present the updates on the radioactive waste management in the Philippines. The current inventory of wastes and the ongoing activities of the PNRI-RWMF is discussed.

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

This paper describes the management of NORM residues from the disused rare-earth processing facility and also reveals the results of element investigation of the sampled NORM residues. In the early management stage, the residues formerly kept in HDPE drums were again enclosed using conventional metal drums, and then temporarily stored in the other building. The ICP-OES technique clearly confirmed that there are different elements existing in the liquid residue samples. The concentration of Thorium ranged from 0.20 to 14211.3 mg/L, while that of Uranium ranged from 1.625 to 22065.0 mg/L. The XRF technique also showed that the solid residue samples consist of several elements. The content of Thorium dioxide (ThO_2) found in the samples was up to 59.42%, and the highest content of Uranium dioxide (UO_2) was 3.45%. The calculation-based results show that the activity concentrations of Thorium and Uranium in the residues could be up to 2,141 Bq/g and 422 Bq/g, respectively.

10) Vietnam (Prof. Le Thi Mai Huong, Nuclear Training Center - Vietnam Atomic Energy Institute)

The management of radioactive wastes NORM/TENORM is currently being interested by countries around the world, especially IAEA. Nearly, Vietnam has just started facilities related to NORM / TENORM, their management is still relatively new. The state management Agencies do not have specific policies related to this issue. In this paper, the current situation of waste management in this form is mentioned at mining and processing facilities containing radioactive elements in Vietnam. Specifically, the issue of managing tailings wastes in uranium processing experiments, in mining and processing beach sand minerals, in exploiting and

processing rare earth ores and in ZOC production. The report also reports on the possibility of developing this type of waste in Vietnam in the near future and proposes some recommendations for the Ministry of Natural Resources and Environment, the Ministry of Science and Technology on the need to develop a substance management policy on NORM/TENORM in Vietnam to ensure safety for the environment and facilitate businesses to participate in the field of exploration, exploitation and processing of mineral resources containing radioactive elements.

Currently, we do not have general regulations on NORM waste management, nor do we have specific regulations on radiation safety management for NORM in related industries, except for mining. minerals, titanium and uranium. The guidelines outlined above are largely based on an activity concentration assessment. While the world trend is increasingly moving towards the application of the annual dose criterion (1 mSv/year), a number of solutions was proposed.

Session 5: Presentation on Consolidated Report on NORM/TENORM

1) **Current status of NORM survey in Japan (Dr. Kazuki Iwaoka, National Institutes for Quantum Science and Technology (QST), Japan)**

Many types of natural resources are imported and used as industrial raw materials in Japan. However, activity concentrations of natural radioactive nuclides in natural resources have not yet been well identified. If some natural resources have natural radioactive nuclides at high concentration, its workers can be exposed to high radiation levels by industrial use. It is important to specify natural resources containing natural radioactive nuclides at high concentration.

In this presentation, we will report the current status about a survey of the concentrations of natural radioactive nuclides in natural resources (e.g., QST NORM database) (Figs1 and 2).

QST NORM database: (http://www.nirs.qst.go.jp/db/anzendb/NORMDB/ENG/index.php)

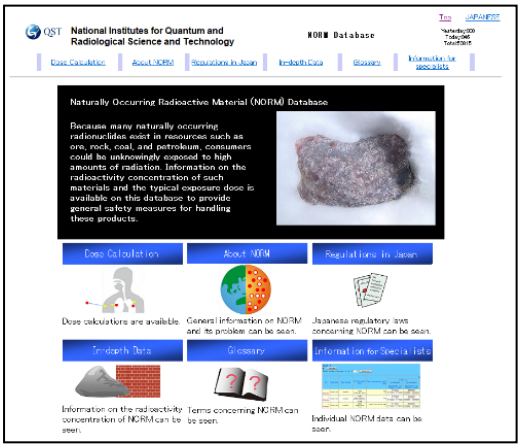

Fig1. Website of QST NORM database

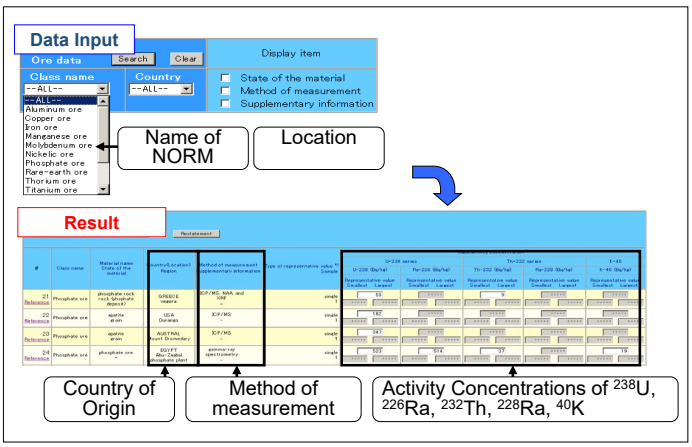

Fig2. Search system of concentration of NORM in QST NORM database

2) Perspective on management of uranium wastes from the viewpoints of humanities and social sciences (Prof. Hiroshi Yasuda, Hiroshima University, Japan)

The radioactivity of the waste contaminated with natural uranium and its progeny nuclides, so-called "uranium waste", cannot be expected to reduce over hundreds of thousands of years; rather, potential exposures of future generations could be more significant than ours. While, it is characterized by being a nuclide that exists in the natural environment from the immemorial time. Considering this peculiar feature, the authors have thought that we need more investigations from the viewpoint of not only natural science/engineering but also humanities/social sciences including history, archeology, philosophy, linguistics, etc.