HIROSAKI UNIVERSITY

Radiation Environment and Medicine 2022 Vol.11, No.2 56–60

REM
Radiat Environ Med

Report

Discussion Points of Radiation Protection for NORM Based on the IAEA Webinar "Holistic Approach to NORM Management"

Md. Mahamudul Hasan[1]* and Qinyou Zhuang[1]

[1]*Department of Environment Systems, Graduate School of Frontier Sciences, The University of Tokyo, Kashiwa campus, Chiba 277-8561, Japan*

Received 12 October, 2021; revised 25 January, 2022; accepted 9 February, 2022

International Atomic Energy Agency (IAEA) organized an online meeting on July 15, 2021, entitled 'Holistic Approach to NORM Management Webinar,' which shared the perspectives based on a workshop held on May 2021 in Brazil assessing the member state's infrastructures in managing Naturally Occurring Radioactive Materials (NORM), devised valuable perspectives by providing a roadmap on the integrated system. The panelists, and/or international experts who supported the workshop summarized new NORM perspectives in the webinar. As the young participants to the webinar under the invitation of Nuclear Regulation Authority (NRA, Japan) and IAEA; the authors, in this report summarized the webinar contents on eight presentations, discussions, important/unique points (strong suggestions, new proposals, potential solutions involving IAEA critical role, countrywide strategic examples, Sustainable Development Goals (SDGs) adoption, new international standards following political feasibility, and waste handlings on NORM management) along with sharing opinions on the webinar. 'How holistic approach is applicable in countries with inappropriate infrastructure,' 'harmonization,' and 'future decommissioning perspectives in regions which lacked disposal option' etc. were mainly discussed in the webinar, also showed in this report based on the author's opinion exchanges from the viewpoint of young researchers in the field of radiation protection.

Key words: IAEA, NORM, management, webinar, holistic approach, radiation protection

1. Introduction

Naturally occurring radioactive materials (NORM), includes radioactive elements found in the environment. It comprises radionuclides from the so-called long-lived primordial decay chains, resulting from the decay of uranium and thorium, and further long-lived radionuclides, like potassium[1, 2]. Although the activity concentrations of radionuclides found in natural rocks and soil are usually low, certain minerals, including commercially exploited minerals, hold these elements at higher concentrations. NORM represents no real potential of a radiological emergency concerning the tissue reactions or the immediate risk to life; actions protecting the workers and public should consider long-term external exposure, consumption of radioactive material, and inhalation of radon or thoron. As for NORM management against the exposures, an integrated system is recommended to protect the public, workers, and environment, including characterization of the exposure situation and optimization of radiological protective actions[3]. International Conference on the Management

*Md. Mahamudul Hasan: Department of Environment Systems, Graduate School of Frontier Sciences, The University of Tokyo, Kashiwa campus, Chiba 277-8561, Japan.
E-mail: mahamudullpe.du@yahoo.com
https://doi.org/10.51083/radiatenvironmed.11.2_56

Table 1. The list of presentations of Holistic Approach to NORM Management Webinar

Serial	Presentation title/topic	Speaker
(1)	Main conclusions of the workshop on holistic approach to NORM management	Eliana Amaral
(2)	The international radiation protection paradigm overlooked NORMs: searching for a holistic solution	Abel Gonzalez
(3)	Policies and strategies on NORM residues management	Marta Tallavera Garcia
(4)	Holistic management of NORM resources in the circular green economy transition	Julian Hilton
(5)	Extracting metals from tailings-technological challenges and regulatory constraints. Is it a real prospect?	Frank Winde
(6)	Holistic approach to NORM management disposal considerations	Roman Bilak
(7)	Decommissioning	Janelle Lewis
(8)	Towards effective radiation protection based on improved scientific evidence and social considerations-focus on radon and NORM	Laura Urso

Table 2. Panelist's info

Eliana Amaral
Former Director of Institute of Radiation Protection and Dosimetry and former Director of NSRW/IAEA Brazil

Abel Gonzales
Former Director NSRW/IAEA and Member of the ICRP Argentina

Marta Tallavera Garcia
CSN/Spain

Roman Bilak
Terralog Canada

Julian Hilton
Alef Group UK

Frank Winde
Wismut GmbH Germany

Janelle Lewis
Chevron/USA

Pedro Lemos
Autoridade Reguladora de Energia Atómica/Angola – (TBC)

Amir Bagheri
Iran Radioactive Waste Management Co.TBC

of Naturally Occurring Radioactive Materials, NORM in Industry (NORM2020) introduced a holistic framework for managing NORM sustainably and effectively in member states; later on, the IAEA Technical Cooperation (TC) program supported a workshop in Brazil reviewing the member states' infrastructure to deal NORM with different perspectives (policy, strategy, regulations, inventory, valorization of residues, disposal of NORM waste, characterization of residues, decommissioning of facilities and site remediation and communication in an integrated way) in addition to providing a road map to them; raised valuable perspectives[4] which were shared to the international community in a webinar entitled 'Holistic Approach to NORM Management Webinar' held on Thursday, July 15, 2021, 9:00 pm Japan Time (Tokyo, GMT+09:00). This report summarizes the eight presentations (Table 1), important Q&As, and provides the authors' impressions and opinions on the webinar from the viewpoint of young researchers in the field of radiation protection, who joined the webinar under the invitation of NRA, Japan and IAEA. Table 2 presents the panelists' information.

2. Presentation contents and key points

2.1. Main conclusions of the workshop on holistic approach to NORM management

As the first webinar presenter, Eliana Amaral summarized discussions involving various stakeholders, service providers, operators, academia, and experts following the Brazil workshop's conclusion. First, as a strong suggestion under the theme of radiation protection and regulation, the presenter clarified an additional improvement and sufficiently specific regulatory control against the lack of inevitable NORM regulation. Although the regulators, enterprises, and academia were ready to deal with NORM, the absence of particular rules formulated a significant hindrance. In addition, as per the safety issue, NORM should be separated from the framework of the nuclear facility. Dose criteria was described in this presentation as the best approach to regulate NORM facilities; thus, the arbitrary number of 1 Bq/g of uranium and thorium, derived from natural radioactivity distribution, should not be active in use as a platform for controlling facilities/activities. On the contrary, following the theme of NORM inventory, residues, and wastes, considering possible future economic importance is necessary (as a resource) before deciding NORM wastes. This presentation emphasized functional ability as criteria for determining

NORM residues or hazardous wastes, for which recycling or re-use would ascertain a better choice for residual valorization. The speaker claimed at 'exportation,' aggravated with decommissioning offshore platforms, as the unique solution for Brazil, county without any disposal option. Finally, following the infrastructure theme, it is strongly suggested to adopt new international standards and protocols for sampling, characterization, and equipment cleaning. The accredited laboratories and certified service providers are demanded in these regards. As a conclusion of the Brazil workshop, this lecture regarded 'holistic approach' as applicable to NORM regulation and control, categorizing the entire aspects into a completed unit of circular economy achieving future milestones.

2.2. The international radiation protection paradigm overlooked NORMs: searching for a holistic solution

Abel Gonzales, second speaker in the webinar, explained the histories and chronological generation background of International Commission on Radiological Protection (ICRP) publications, recommendations, radiological meetings, and IAEA safety standards. The lecture dispelled the confusion on exposure limits. It defined 'holistic' approaches as 'the belief that the parts of something are intimately interconnected and explicable only by reference to the whole'. As the potential solutions, two suggestions are given on the holistic approach in this lecture: accelerating significant changes on standards with the help of the IAEA safety standards focusing on the political feasibility, and dealing with the scope of ICRP 104 to formulate a suitable paradigm. Additionally, the speaker highlighted the four suggested approaches/ proposals (on legislation for NORM industries, on the regulation of NORM industries, on legacy sites with NORMs, and consumer goods with NORMs) derived in international conference on the management of NORM in industry held in October 2020, as effective the NORM management on the industries.

2.3. Policies and strategies on NORM residues management

Marta Tallavera Garcia interpreted the European safety standard (Euratom directive) strategy where NORM industries are regulated under planned exposure situation. Moreover, the directive proposed 1 Bq/g as the general exemption and clearance activity concentration level for NORM in solid materials. However, countries are also allowed to apply lower/higher values based on the specifications of the materials. It is noted that about half of countries have specific provisions on their regulation to grant the exemption and conditional clearance of 1 millisievert (mSv) per year or lower dose criterion above the background. Based on the consideration criteria of 'NORM wastes are radioactive wastes or not,' this presentation classified the associated European countries, emphasizing the discussing of 'NORM waste as radioactive waste' internationally. Finally, the elements which should be incorporated into national policy dealing with NORM residue management are suggested as follows: financing, horizontal policy coordination, policy instruments, assigning responsibilities, NORM waste inventory, infrastructure, regulatory framework and, consultation and participation.

2.4. Holistic management of NORM resources in the circular green economy transition

Julian Hilton highlighted circular economy following the transition approach, particularly in the energy sector, replacing the word 'residue' into 'waste'. Emphasized at NORM2020 conference, where the circular economy issue was started, the presenter proposed adopting a circular economy in place of a linear economy depending on raw materials, production, use, and recycling as elements. The government, industry, and academia are encouraged to invent better solutions following SDGs 7, 9, 12, 13 & 17. To ascertain the long-term achievement, proposals those were encouraged to obtain as the principles are described as resetting broken linear model, material value preservation-Zero Waste-whole life cycle management, accessing primary resources on necessary while secondary resources are not sufficiently available, introducing new molecules where hydro-carbon industries failed to produce, staying existing resources within the system boundary, reconsidering risk/benefit model including investment algorithms. Moreover, as NORM prospects, several additional needs were strongly suggested: attention on SDGs adoption, IAEA critical role in leadership's constructive regulation, integrating NORM materials with water-energy-food nexus, accompanying entire NORM resource life cycle with people/planet prosperity, investigating innovative tools/instruments by NORM regulators, and lastly formulating partnership of GIA-Government, Industry, Academia leading to zero waste.

2.5. Extracting metals from tailings-technological challenges and regulatory constraints. Is it a real prospect?

Under the discussion of current NORM waste management approaches, Frank Winde incorporated the case studies of phosphate industries in Belgium, Brazil, and India, where 100% re-using policy is adopted in producing fertilizer & cement. Thus, this management option is considered under the category of complete revalorization/zero-waste. As a similar concept, 'carbon neutrality' is often used in the topic of greenhouse gases, aiming for 'no waste'. A complete re-usage in a circular economy is the ultimate characteristic of this option, where all wastes are indicated as resources. An extensive

discussion on the evolution of mine waste management, partial revalorization following tailing reclamation, uranium recovery from South African gold tailing have been made from the viewpoint of environment, regulation, economics, public health, and social acceptance. In this lecture, fifteen key points as mine wastes revalorization outputs were ascertained under economic category (significant uranium resource by gold tailings, profitability, lower uranium price at the end of the cold war, revival during the nuclear renaissance, affecting profitability by uranium price & low extraction efficiency) environmental (cleaning up inner-city, averting future remedial costs, lowering residual uranium levels, reduction of contamination potential, future possibility on complete revalorization, the further necessity of improving environmental performance, demanding a viable commercial uranium extraction market, compliances, and interventions).

2.6. Holistic approach to NORM management disposal considerations

Roman Bilak conferred regulatory and environmental considerations in waste streams' disposal function with NORM to achieve zero discharge operations and greater ecological security. As the crucial elements, zero surface discharge theme, future land usage, public acceptability, safety & security, efficient waste management, and long-term liability & cost were pointed out in this lecture.

2.7. Decommissioning

Janelle Lewis concentrated offshore decommissioning approach by describing its features, potentiality in producing waste streams; proposing the initiation of decommissioning plan as early as 30+years before the end of the concession date contemplating NORM as a potentially influential factor in decommissioning options. Later, emphasizing decommissioning life cycle materials evaluation, this presentation suggested four capacity-building opportunities (laboratory capabilities, surveying tools, expertise, waste management, and alternative management options) as part of successful decommissioning planning and execution.

2.8. Towards effective radiation protection based on improved scientific evidence and social considerations-focus on radon and NORM

Laura Urso introduced the RadoNorm project for more than twenty member states formulating new scientific knowledge to assess and reduce prolonged dose risk, mainly focusing on radon and NORM. The project is undertaken through work packages, regarded as dosimetry, effects & risks, societal aspects, mitigation, and exposure assessment. However, as per the critical tasks following NORM, exploring European NORM sites & exposure scenarios, long-term prediction model, mitigation strategy on NORM industries, fundamental research on NORM synthesis, NORM model validation, and methodological tools development are strongly identified.

3. Feelings and opinions as the participants of the webinar

The webinar reformed the authors' outlook regarding NORM's generations, its scientific & social management strategies and associated international radiation protection aspects. The presentations describing NORM from multivariate viewpoints (environment, health, policy making, sustainable economy, mining, waste management, and social sciences) enlightened the authors' considerations as the early learners of radiation protection strategies. The various regulatory functions/control case studies on NORM described in the presentations for Brazil-by Eliana Amaral and HERCA European countries-by Marta Tallavera Garcia were found to be very influential in categorizing international scenarios for waste management and developing associated NORM residues policies & strategies. The lecture from Abel Gonzales about 'when and how'-radiological recommendations, publications, dose limits, and standards designed for ICRP/IAEA were influential for learning NORM's history and avoiding confusion/contradiction on human radiological exposure units. Definition on 'holistic approach' and its potential solutions and NORM management proposals were given in this presentation and were caught the authors' great attention.

Furthermore, the RadoNorm project, described by Laura Urso leading to adequate future radiation protection of radon and NORM focusing on improved scientific and social considerations, was also noteworthy. The authors believe that the experience and the scope of more than twenty member states covered by this project might be a praiseworthy example for learning the organized project work packages and implementing suitable recommendations. As for the long-term implications of developed models & mitigation strategies, the scope should be extended to countries from other regions, especially where complex exposure scenarios and insufficient practices of radon & NORM are available. The circular economy, revalorization strategies claimed in the webinar. The provided examples, including the possible future solutions on the newest form of hazardous waste due to future mining activities, reviewed during the free discussion was also attractive. The discussion of utilizing the word 'waste' between risk communication and daily lives caught authors' attention emerging to highlight clear indication of confused wording/language usage in radiation protection field. Finally, as of the

forthcoming debate over-optimization of NORM radiation protection, 'clear definition of wastes/residues for NORM,' 'sound decommissioning strategy for no disposal option zones,' 'settlement on reference level for newly discovered hazardous wastes in NORM industries' and 'harmonize national strategies with international regulatory organizations' might be necessary for future social, economic, and public health considerations for NORM.

Acknowledgments

The authors would like to thank Nuclear Regulation Authority (NRA, Japan), and International Atomic Energy Agency (IAEA) for allowing to join in the webinar.

Conflict of Interest

The authors declare that they have no conflict of interest.

Reference

1. The Canadian NORM Working Group of the Federal Provincial Territorial Radiation Pretection Committee. Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) [Internet]. 2011. 70 p. Available from: https://www.canada.ca/en/health-canada/services/publications/health-risks-safety/canadian-guidelines-management-naturally-occurring-radioactive-materials.html
2. Chambers DB. Radiological protection in North American naturally occurring radioactive material industries. Ann ICRP. 2015;44:202–13.
3. Lecomte JF, Shaw P, Liland A, Markkanen M, Egidi P, Andresz S, *et al*. ICRP Publication 142: Radiological Protection from Naturally Occurring Radioactive Material (NORM) in Industrial Processes. Ann. ICRP. 2019;48(4):5–67.
4. IAEA. Holistic Approach to NORM Management Webinar [Internet]. Available from: https://www.iaea.org/about/organizational-structure/department-of-nuclear-energy/division-of-nuclear-power/environet-webinars/holistic-approach-to-norm-management