

EAN STEERING GROUP MEETINGS
June 14, 2022



European Norm Association:
Role and impact on NORM X Conference

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Presence of ENA in NORM X

- **In Steering Committee:** Christian Kunze (*chair of ENA*)
- **In Scientific Programme Committee:** Rafael Garcia Tenorio (ENA Board)
Cristina Nuccetelli (ENA Board)
Ivana Zenata (ENA Board).

The annual ENA meeting was organized as associated events of NORM X.

About 25% of the sessions (9 out of 40) were dedicated to ENA

Totally 29 presentation + 1 panel on RadoNORM survey

List of ENA sessions in NORM X.

In brackets number of presentation/session

Area 3: Current and future challenges: NORM tailings and residues in a Circular Economy

- Sessions 21 (4), 23 (3), 30 (4), 33 (3)

Area 4: Environmental aspects of NORM

- Sessions 16 (4), 19 (4)

Area 5: Industry

- sessions 10 (4), 13 (3), 25 (1+panel on [RadoNORM](#) survey)

+ 3 Panel sessions and *Annual ENA associative meeting* (session 27)

Main topics addressed in ENA sessions

Regulation: **4** talks (Belgium, Ghana, The Netherlands, IAEA for oil and gas)

Network: **7** talks (ENA, HERCA NORM WG, OSPAR, MEENAS, IRPA NORM WG, ISIMIR-N IAEA, REGSUN IAEA)

Recycling: **4** talks (phosphogypsum in BM, oil shale ash in BM, TiO₂ in mortar, extraction of fluorite and REEs from fluorite sludges)

Dose modelling: **3** talks ([NORM in landfill](#), [NORM sludge from waterworks in farmland](#), screening levels for reuse of U contaminated sites for recreation and residence)

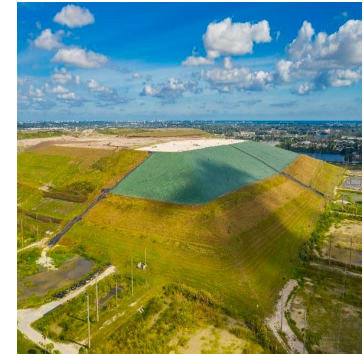
Social science: **1** talk

Technical aspects: **5** talks ([Use of drones for monitoring](#), special materials to reduce scales, problems with Th-232 series determination)

RadoNORM: 1 presentations (Survey on NORM involving industries)

Dose modelling

Development of a methodology at European level for dose assessment and estimate of amount of NORM waste disposable at landfills for conventional waste
(**Laura Urso et al.** – Session 19)



Development of a methodology at European level for dose-assessment to the members of public following use of NORM sludge in agriculture
(**Nuccetelli et al.** – Session 21)

Dose modelling - NORM in conventional landfill

(Urso et al.)

Goal: to estimate disposable mass of NORM residues with dose criteria of 1 mSv per year.

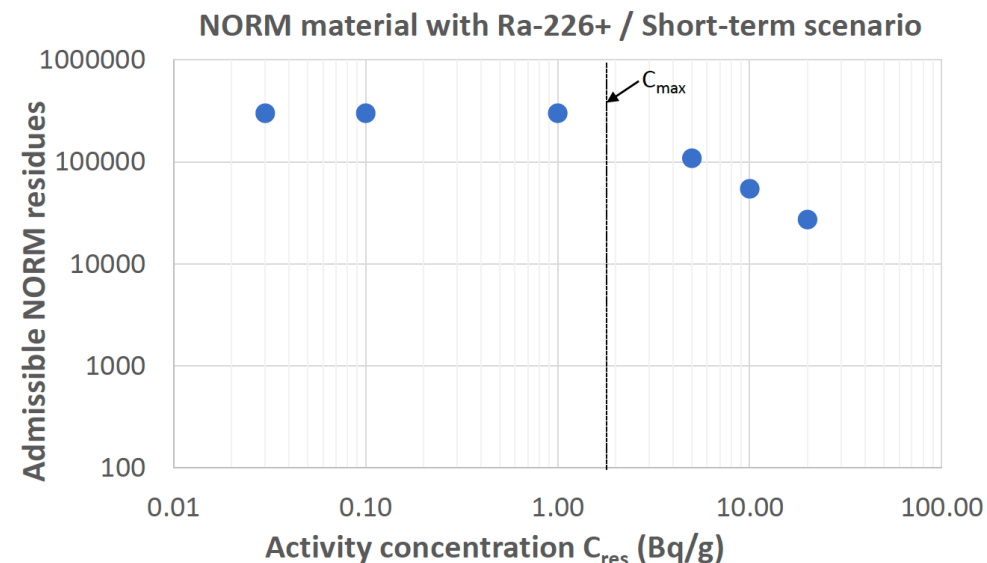
Methods: RESRAD-ONSITE to carry out dose-assessment starting from unit of RN conc.

Segments of decay chains in secular equilibrium (e.g. Ra226+, Pb210+) similar to RP 122-II

Scenario: landfill worker in active landfill for 35 years

Results:

Tabulated values		
Segment of decay chain	$D_{\max}$ (mSv/year) per unit concentration	$C_{\max}$ (Bq/g) based on dose limit 1 mSv/year
U-238sec	0.60	1.7
Unat	0.03	35.0
Th-230	0.01	77.5
Ra-226+	0.55	1.8
Pb-210+	0.02	51.5
Po-210	0.004	245.2



Dose modelling – use of NORM sludges in agriculture

(Nuccetelli et al.)

Goal: to determine clearance level (CLs) for sludges used as fertilizers with dose criterion of 1 mSv per year

Methods: RESRAD-ONSITE to carry out dose-assessment starting from unit of RN conc.

Segments of decay chains in secular equilibrium (e.g. Ra226+, Pb210+) similar to RP 122-II

Scenarios: 1) farmer working for 35 years; 2) farmer working and living for 75 years

Results:

U-238 series		
Segment of chains	Max dose per Bq g ⁻¹ of dry sludge (mSv y ⁻¹ per Bq g ⁻¹)	CL (Bq g ⁻¹)
U _{nat}	2.2E-03	4.58E+02
Th-230	6.1E-03	1.64E+02
Ra-226+	1.4E-01	6.99E+00
Pb-210+	1.5E-02	6.61E+01
Po-210	1.5E-04	6.48E+03

Th-232 series		
Segment of chains	Max dose per Bq g ⁻¹ of dry sludge (mSv y ⁻¹ per Bq g ⁻¹)	CL (Bq g ⁻¹)
²³² Th& ²²⁸ Th	3.33E-01	3.0
²²⁸ Ra+	3.06E-02	33
²²⁸ Th+	6.01E-03	166

Dose modelling – Impact and perspectives

Impact

- developed methods can be used by authority/operator, even non-experts in field of radiation protection, as screening tools.
- to increase the acceptance of NORM residues among owners of conventional landfill
- to increase awareness of radiation protection standards in society
- to help recycle and reuse of NORM residues for implementing Circular Economy

Perspectives

- to assess the level of conservatism of the dose assessment (also) taking into account the uncertainties evaluated by ranges of input parameters
- possible update of the CLs in RP 122-II and RP 135

Technical aspects

Drone based gamma spectrometry of NORM affected areas and uranium legacy sites: results and outlook of the DUB GEM research & development project
(**Kunze et al.** – Session 23)



Miniaturized High Resolution CZT Modules for Drone Based Waste Characterization
(**Streicher et al.** – Session 23)

Technical aspects – Drone based gamma spectrometry

(Kunze et al.)

Gamma radiation hotspots are good indicators of gradually developing failure of cover systems, or a developing landslide.

	CeBr ₃ (Medusa)
Crystal dimensions (inches)	3 x 6
Crystal volume (cm ³)	700
FWHM at 662 keV (%)	< 3.9
Number of spectral channels	2048



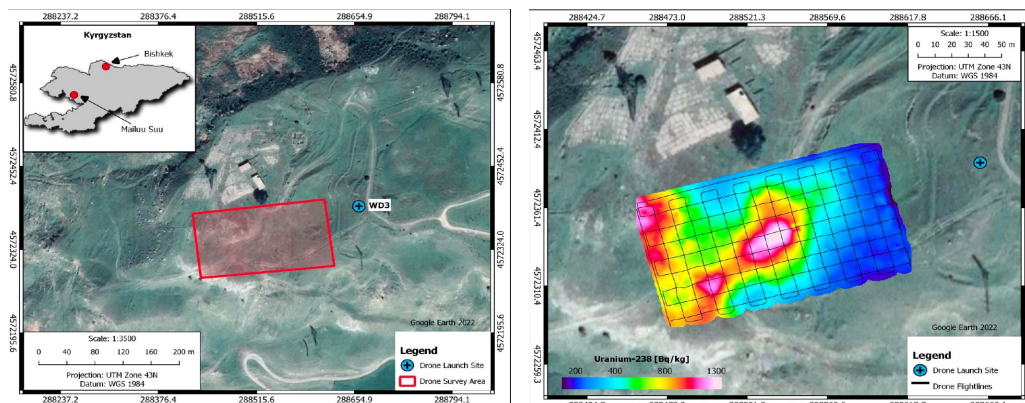
Some (known) problems:

Depth distribution of specific activity cannot be resolved
No spectral resolution of individual nuclides of the U and Th series

Assumptions:

Homogeneous extension of the specific activity to infinite depth
Equilibrium within the U 238 and Th 232 decay chains

Flight area in Kyrgyzstan, waste rock dump no. 3



The main area of application of drones at Uranium Legacy Sites (ULS) is to support long-term monitoring and maintenance, where limited lateral resolution and limited spectral resolution of individual nuclides are not critical.

Technical aspects – Miniaturized High Resolution CZT Modules

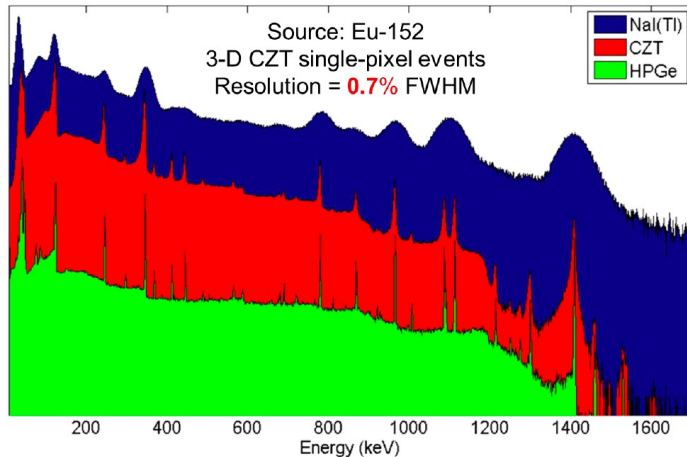
(Streicher et al.)

Cadmium Zinc Telluride (CZT) detector characteristics

NaI: 7% @ 662 keV, room temperature operation

HPGe: 0.2% @ 662 keV, -200C operation temperature

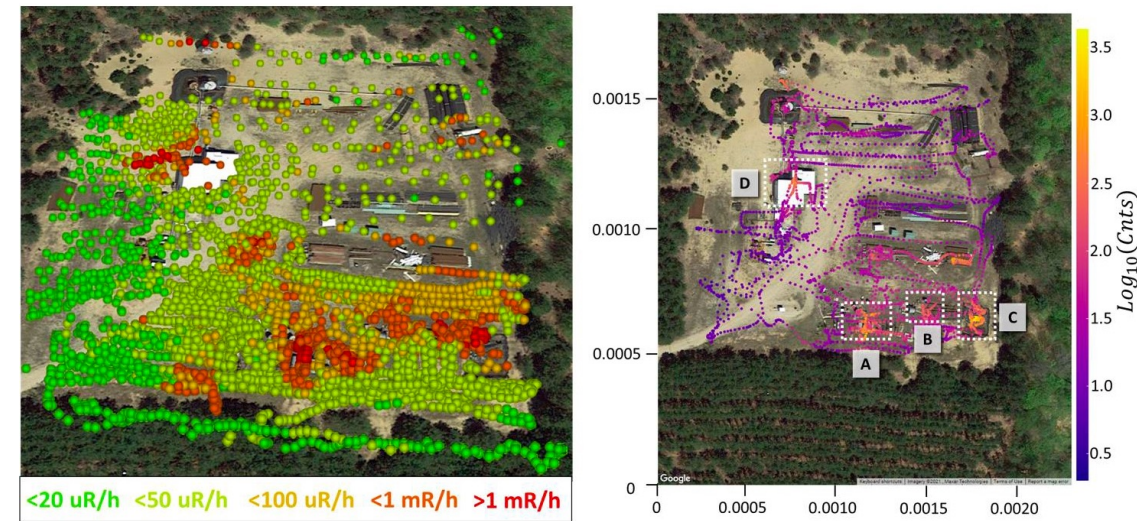
CZT: <1% @ 662 keV, room temperature operation, up to 24 cm³



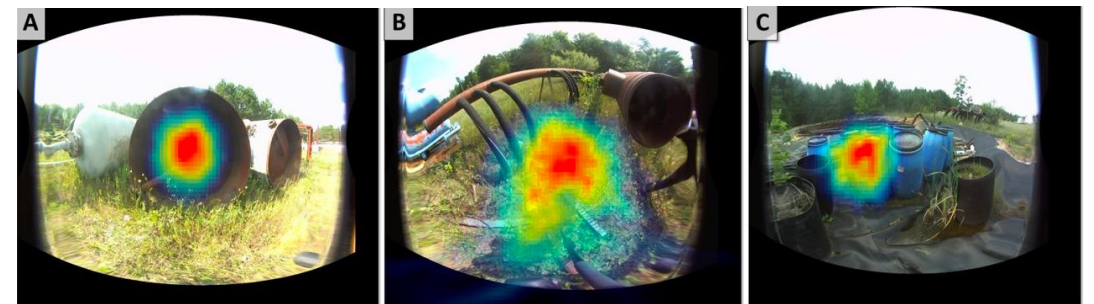
CZT has:

- HPGe-like resolution
- rugged
- low power operation
- high efficiency

Comparison with early drone measurements using a NaI



Additional **spatial information**
using **gamma-ray imaging**



Panel: *Protection of workers, public and environment in a circular economy* (Session 36)

J.F Lecomte (ICRP)

- Challenges with NORM in circular economy : 1) reuse and recycling of residues, 2) management of waste
- Integrated and graded approach needed: often multi-hazards and radiological risk rarely dominant
- Involvement of stakeholders in the decision making processes

L. Urso (Bfs)

- The circular economy and sustainability goals have to be in line with the goals of the RP system, not vice versa.
- When necessary, level of conservatism in dose assessments needs to be reduced
- Guidance and tools on how to carry out dose assessments should be made available to non RP experts

Panel: *Protection of workers, public and environment in a circular economy (2)* (Session 36)

K. Karfopoulos (Greek Atomic Energy Commission, EEAE)

- The implementation of a **robust** radiation protection system in industries involving NORM effectively promotes the objectives of a Circular Economy
- Characterization of materials and processes and **realistic** dose assessments are safety keys for both an efficient and effective regulatory control as well as the further optimization of protection.

B. Okyar (IAEA)

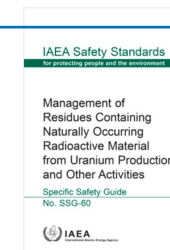
- Development of international safety standards and supporting documents with priority on topics to address challenges
- Integration of RP into Occupational Safety and Health-OSH (holistic approach): Industrial hygiene, industrial safety, fire safety, etc
- Challenges regarding the limited experience in radiation protection for many industry sectors concerned

New reports, guidelines (published or upcoming)

IAEA documents

Recently published

Management of Residues Containing **Naturally Occurring Radioactive Material** from Uranium Production and Other Activities ([SSG 60](#)) **2021**



Under preparation

Updated guidance on RP and the management of radioactive waste in the **oil and gas industry** ([SR-34 revision](#)) – described by B. Okyar ([Session 10](#))

Safety Report on **Occupational Radiation Protection in the Water Supply and Treatment Industry**
Described by B. Okyar ([Session 5](#))

Under development

[Guidance on Existing Exposure Situations \(EES\) to meet GSR Part 3 requirement](#)

Safety Guide on Application of the Concept of Exemption (DS 499)

(Miroslav Piňák, Session 2)

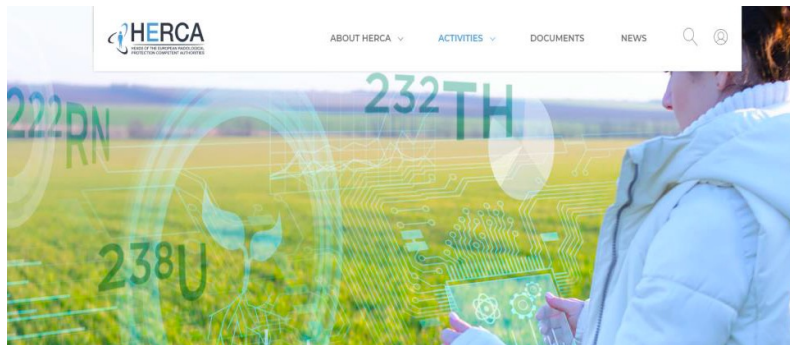
Safety Guide on Application of the Concept of **Clearance** (DS 500)

New reports, guidelines (published or upcoming)

HERCA (*Heads of European Radiological Protection Competent Authorities*)

HERCA Guide on 'Application of the concepts of Exemption and Clearance to the regulation of the naturally occurring radioactive materials (NORM) across HERCA countries' (**2021**)

(J. Popic, Session 13)



IRPA (*NORM WG*)

Book on good Radiation Protection practice in industries affected by NORM
(under preparation)

(S. Pepin, Session 30)



Link to download all the NORM X presentations



The screenshot shows the NORMX website interface. At the top, there is a navigation bar with links: ORPNET, What is ORPNET?, Worldwide Networks, Regional Networks, Additional Resources (highlighted), and Training. A search bar is located on the right. Below the navigation bar, the NORMX logo is displayed. On the left side, there is a sidebar menu with links: IAEA publications, Scientific papers, Posters and Factsheets, Outreach material, Events and meetings, Frequently asked questions on ALARA, NORM VIII, NORM IX, and NORM X (highlighted). Below the sidebar, there are links for ORPAS Technical Meeting - 2021, Recent, and Site contents. The main content area features a banner with the text "25 YEARS OF NORM SYMPOSIA" and "FUTURE: RESIDUES APPLIED IN A CIRCULAR ECONOMY". To the right of the banner is a circular logo with the word "NORM" and two green arrows forming a circle. Below the banner is a wide, curved image of a city street at night, illuminated by streetlights, with buildings and trees visible.

<https://nucleus.iaea.org/sites/orpnet/resources/SitePages/NORMX.aspx>