



**CRCPD WORKSHOP: CONTINUING EFFORTS FOR NORM  
REGULATORY FRAMEWORK DEVELOPMENT AND  
RISK-INFORMED DECISION MAKING**

**E-46 TASK FORCE TO DEVELOP A WORKSHOP AND  
GUIDANCE ON RADIATION PROTECTION ISSUES RELATED  
TO TENORM**

**MEMBERS**

Gary Forsee (IL), Chairperson  
Chuck McCracken (OH)  
Jared Thompson (AR)  
Jeff Semancik (CT)

**Conference of Radiation Control Program Directors (CRCPD)  
112 E. Main Street, Suite 1  
Frankfort, KY 40601  
[www.crcpd.org](http://www.crcpd.org)**

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Gary Forsee (IL), Chairperson  
Chuck McCracken (OH)  
Jared Thompson (AR)  
Jeff Semancik (CT)

**H-39 ADVISORS**

William Kennedy (NCRP)  
Andy Lombardo (HPS)

**RESOURCE INDIVIDUALS**

Adela Salame-Alfie (USCDC)  
Armin Ansari (USCDC)  
Phil Egidi (USEPA)

**CONTACT PERSON**

E-46 Chairperson, Gary Forsee (IL) [gary.forsee@illinois.gov](mailto:gary.forsee@illinois.gov)

**MARCH 2022**

## FORWARD

The E-46 Task Force was charged with the organization of a workshop, to be held in conjunction with the September 2019 Ninth International Conference on Naturally Occurring Radioactive Material, NORM IX, in Denver, Colorado. Panel members included professionals with naturally occurring radioactive material (NORM) regulatory experience from industry, academia, and regulating agencies. The forum was intended to present the latest domestic and international efforts in the regulation of NORM from these varied perspectives and then solicit input and exchange among the attendees on two key topics:

- Identification of Priority Issues in Regulation of NORM
- Identification of Barriers to a Regulatory Framework

This document, “Continuing Efforts for NORM Regulatory Framework Development and Risk-Informed Decision Making,” summarizes the workshop and presents the collective findings, conclusions and recommendations identified by audience members and panelists. Note that the detailed discussions are best covered in the documents referenced and this document serves to cover only the key elements of the discussions and conclusions that took place.



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Angela Leek  
CRCPD Chairperson

## PREFACE

The NORM IX International Symposium, held in Denver, Colorado in September 2019, included an afternoon session on “Continuing Efforts for NORM Regulatory Development and Risk-Informed Decision Making.” The workshop was brought about by collaboration between the U.S. Centers for Disease Control and Prevention (USCDC) and the Conference of Radiation Control Program Directors (CRCPD). The workshop was designed to present speakers and topics which traced the history of NORM, ongoing scientific efforts, barriers to NORM regulation, and regulatory development efforts both domestic and internationally, and to conclude with a presentation on conducting dose assessments and how the information obtained can guide appropriate risk-informed decisions on NORM residue management and NORM industry regulation.

Workshop goals were to:

- Identify Priority Issues in Regulation of NORM
- Identify Barriers to Regulatory Framework

Panel members included professionals with experience and involvement in both past and present NORM issues. CRCPD thanks and acknowledges the contributions of the guest speakers on their respective topics:

Dr. L. Max Scott – “NORM Awareness Evolution”

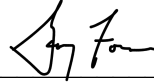
William E. Kennedy, Jr. – “Status Report on the NCRP Commentary on NORM and TENORM from the Oil and Gas Industry in the United States - Abstract #125”

Andrew Lombardo – “NORM Regulatory Development and Risk-Informed Decision Making”

Stephane Pepin, “IAEA –Establishment of a Regulatory Framework for NORM Activities: The Need for a Graded Approach”

This report summarizes the discussions and findings from the workshop. The report identifies priority issues and barriers to implementation of an effective, uniform regulatory system. The report identifies useful tools and information that can provide assistance and guidance for developing the regulatory system.

Detailed discussion and explanation of the concepts presented are best derived from the documents referenced.



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Gary Forsee  
E-46 Task Force Chairperson

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## **ABSTRACT**

E-46 Task Force, Gary Forsee, Chairperson, “CRCPD Workshop: Continuing Efforts for NORM Regulatory Development and Risk-Informed Decision Making,” Publication Number 22-2, March 2022, 25 pages.

This report presents the discussions and findings of the CRCPD and USCDC September 2019 workshop. Concerns identified as a priority in the regulation of NORM included: the utility of historical concentration-based limits, the application of dose-based limits, regulation by industry of origin, the need for guidance on effective monitoring (including for Pb-210 and Po-210), and harmonizing regulations domestically and internationally. The following issues were identified as barriers to an effective and consistent regulatory framework: inadvertent regulation of background; the need for guidance on terminating NORM activities and financial assurance; cleanup and institutional controls associated with legacy sites; regulatory address of the entire life cycle of NORM sites; and ineffective risk communication to the public about NORM. Relevant to the expressed issues and concerns, useful tools and publications were presented to attendees.



## INTRODUCTION

The Conference of Radiation Control Program Directors, E-46 Task Force was charged with the following:

- Collaborate with state, local, national and international organizations, including the National Council on Radiation Protection (NCRP), the International Atomic Energy Agency (IAEA), the Health Physics Society (HPS), and the International Commission on Radiation Protection (ICRP), in convening a meeting to identify priority issues related to the handling and disposal of NORM generated during some industrial processes and measures that can be taken to improve protection of workers and members of the public.
- Hold a workshop in conjunction with the Ninth International Symposium on NORM (NORM IX) being held in the United States during the week of September 23- 27, 2019, in order to attract more international and national participation. Experts in the fields of radiation safety; industrial processes that produce NORM to include oil and gas production; waste management; as well as state radiation control staff working on this issue, will be invited to participate and share their expertise.
- Provide proceedings and outcomes from the workshop by March 31, 2020.
- Report on the results of the workshop at the 2020 CRCPD Annual Meeting.

In fulfillment of this task, the NORM IX International Symposium, held in Denver, Colorado in September 2019, included an afternoon session on “Continuing Efforts for NORM Regulatory Development and Risk-Informed Decision Making” provided by CRPCD and USCDC.

The workshop was designed to provide a historical overview of NORM regulations, discuss a pending NCRP commentary which catalogues emerging issues and longstanding concerns in the oil and gas industry relative to NORM, solicit input from attendees on the handling and disposal of NORM, present concepts for regulatory frameworks, and discuss the application of risk assessment and risk communication in drafting NORM regulations.

Workshop goals were to:

- Identify Priority Issues in Regulation of NORM
- Identify Barriers to a Consistent Regulatory Framework

The Workshop topics included, among others:

- History of NORM regulation (or lack of regulation)
- Ongoing scientific issues related to NORM
- Dose assessment for risk-informed regulation
- Barriers to effective regulation of NORM

Panel members included professionals with experience and involvement in both past and present NORM issues.

- Dr. L. Max Scott, retired Louisiana State University (LSU) professor and current Radiation Safety Officer, based on more than 40 years of experience with NORM issues, spoke on “Historical Overview and the Need for Consistent Regulation.”
- William E. Kennedy, Jr., spoke about the “Status Report on the NCRP Commentary on NORM and TENORM from the Oil and Gas Industry in the United States - Abstract #125.”
- Stephane Pepin, with the Federal Agency for Nuclear Control, Belgium, spoke about “IAEA Establishment of a Regulatory Framework for NORM Activities: The Need for a Graded Approach.”
- Andrew Lombardo, spoke about “Risk Assessment and Effective Risk Communications, Dose Assessment Training, and NORM Regulatory Development and Risk-Informed Decision Making.”
- Gary Forsee discussed the “Domestic Suggested State Regulations for Regulation and Licensing of TENORM (SR-N).”
- Ruth McBurney presented a “Summary of the Workshop” at the Closing Session of NORM IX.

The workshop solicited salient comments from industry, academia, state and international governments and stakeholder organizations. In the context of developing a consistent national regulatory framework, attendees provided input on the priority issues that should be addressed while also communicating what have been long-standing barriers to such a framework. Attendees identified the following priority issues that should be addressed in any NORM regulatory framework:

- Establishment of defensible criteria for a regulatory threshold (either concentration or dose based)
- Consistent application of a regulatory framework regardless of industry of origin

- Establishment of standards and guidance for effective monitoring of all NORM nuclides
- Disposal of NORM residues and assessment of environmental impact
- Risk communication to workers and the public

The workshop then catalogued the barriers that have historically prevented address of the priority issues, as well as the establishment of a consistent national regulatory framework. Relevant information and tools were communicated to attendees and the conclusions of the workshop were delivered to the E-45 Committee on TENORM and the SR-N Working Groups. This information may be used in future development of appropriate rules for the regulation of NORM. Due to the impacts of the COVID-19 public health emergency, the E-46 Task Force was not convened at the 2020 CRCPD annual meeting and the resulting summary document was delayed. Nonetheless, input from panelists and attendees has been aggregated and incorporation into the development of a regulatory framework ongoing.

Note that the term NORM is used throughout this report as it represents an internationally and nationally recognized topic subject to ongoing regulatory review. Whereas, domestically, the term NORM may represent background materials only and the term technologically enhanced naturally occurring radioactive material (TENORM) represents those materials subject to additional regulatory scrutiny. Use of the two terms varies domestically. Unless the two terms are specifically contrasted, readers should not interpret the use of the term “NORM” to be exclusive or limiting in scope.

## HISTORICAL OVERVIEW AND THE NEED FOR CONSISTENT REGULATION

The historical overview traced the genesis of NORM awareness, but also emphasized the need for consistent regulation by highlighting issues that have both recently emerged and those that have persisted in excess of four decades.

NORM awareness began as early as 1940 and legal and scientific interest in NORM grew until the 1980s when it became common knowledge that NORM was associated with petroleum production, coinciding with the time when gamma radiation detectors became more sensitive and had growing widespread use. Around 1981, marked attention was given to production tubulars in the North Sea exploration and measurement of production equipment in the United States began to identify the presence of NORM.

Domestically, the question emerged of what an acceptable exposure level for NORM was. In 1988, in Louisiana, a multi-stakeholder committee determined that 1.0 mSv/h (100 microR/hr) signaled the need to be investigated further, but ultimately settled on a 0.50 uSv/h (50 microR/hr) limit. The limit was not risk-based. Later that year, Louisiana adopted interim regulations for oil and gas NORM. Dr. Scott posited other questions to attendees about the concentration limit of 185 mBq/g (5 pCi/g) for Ra-226 and why Ra-228 was included, despite its short half-life of five years. The 185 mBq/g (5 pCi/g) Ra-226 concentration limit was adapted from cleanup standards for inactive uranium mill tailing sites promulgated by both the U.S. Environmental Protection (USEPA) on January 5, 1983 (40 CFR Part 192) and the U.S. Nuclear Regulatory Commission (USNRC) on October 16, 1985 (10 CFR Part 40) - Uranium Mill Tailings Control Act (UMTRCA) rules. The concentration criterion for soil was 185 mBq/g (5 pCi/g) at the surface and 555 mBq/g (15 pCi/g) in the subsurface. Shortly after 1983, the USEPA determined these standards were also suitable for remediation of Ra-228 at Title II sites. However, over the years this surface remediation standard not only has been employed as an exemption level but also as a de facto waste acceptance criterion.

The extent to which regulations for NORM were developed or applied also varied based on the origin of the radioactivity (water treatment, uranium mill tailings, petroleum production, rare earth). The presence of NORM was recognized in other industries and consumer products, contributing to the difficulty of developing regulations with a one-size-fits-all approach. Concerns still exist regarding the handling of radon and the accumulation of radon decay products in the petroleum industry. As detection and monitoring of NORM

residues increased, the need for consistent guidance on portal monitors and rejecting loads of scrap and waste emerged. Finally, the needs for a consistent framework are underscored when NORM residues are being exported or imported to jurisdictions with varying exemption limits, classifications of low-level radioactive waste, or no NORM regulations at all.

As the awareness of NORM and TENORM grew and presented legal and scientific questions, the need for uniform regulation of NORM across all industries and across all states and countries became recognized. The basis on which NORM would be regulated and afforded deposition into the environment must be tied to a defensible standard. Increasingly, this is trending towards the use of dose assessments which drive the development of risk-informed regulation.

# **ONGOING AND EMERGING ISSUES WITH OIL AND GAS NORM**

## **INTRODUCTION**

An overview of generation and management of NORM residues within the oil and gas industry is being developed through a NCRP scientific committee. The “Commentary on NORM and TENORM from the Oil and Gas Industry in the United States - Abstract #125” (published post-workshop in 2020) will then be used to evaluate the need for a full NCRP report on radiation protection recommendations for states, workers, the public, and the environment.

While NORM is recognized in numerous industries, the scope of the commentary is focused on oil and gas since wastes from this industry pose public health challenges across the United States. Horizontal drilling and high-volume hydraulic fracturing are explained with regard to their impact on NORM generation and waste management options are detailed for both liquids and solids. An analysis of radiation protection, environmental issues and potential residue management strategies within this industry likely will be applicable to all facets of NORM management (Kennedy 2019).

In addition to providing a comprehensive historical and regulatory primer on NORM, the commentary will examine the generation of NORM in both conventional and unconventional production methods. Common residue management strategies are examined, and their impacts discussed in terms of dose consequence, public perception and potential legal implications. Of particular importance is the variety of ways in which individual states may or may not regulate NORM and the lack of a nationwide, consistent framework. The consequence is that monitoring workers or the workplace for exposures is inconsistent, rare, or altogether non-existent (Kennedy 2019).

## **SCIENTIFIC QUESTIONS**

The discussion on NORM regulatory frameworks elicited several questions from attendees. These included concerns that revisions to dose conversion factors and permissible risk ranges could unintentionally place the contribution from

background levels of NORM under any regulatory oversight. This could make the line between potentially regulated NORM and the concentrations of NORM in background increasingly difficult to differentiate. This leads to the question of what are the permissible concentration and exposure limits that should be utilized. The workshop panelists attempted to catalogue these issues and gather input from attendees on potential science-based solutions.

## CONCENTRATION LIMITS

Concentration limits are pragmatic and familiar as in the adaption of the UMTRCA remediation limits (5 pCi/g for radium) and the IAEA's use of 1 Bq/g (27 pCi/g) as an exemption level. Limits of 185 mBq to 1.85 Bq/g (5 to 50 pCi/g) vary from state to state and range in application from an exemption limit to a waste disposal criterion. The cleanup criteria for surface soils have been adopted as landfill disposal limits or exempt quantities; although the question arises if it is appropriate that cleanup levels also would serve as disposal limits without justification (Kennedy 2019).

Workshop attendees contributed valuable input on the discussion of how to segregate background NORM from potentially regulated materials. While this has been parsed before on the distinction between NORM and TENORM, differences in definitions nationally could greatly impact the scope of NORM being regulated (and potentially encompass the routine activities of man). Consensus among stakeholders and regulators was that consistent with other regulatory frameworks for radioactive materials, NORM should be regulated when it presents an unacceptable exposure to the public. While considerable time was spent discussing the application of dose modeling and identifying NORM that could give rise to these exposures, many industries are ill-equipped to perform these calculations alone. Moreover, the assumptions in these models require some standardization to give rise to meaningful results. In order for the regulated community to effectively implement these protective exposure limits, the use of concentration limits and assumptions about potential exposure pathways may be utilized.

In this context, it is then preferable to marry the use of concentration-based limits to the specific disposal options – with their own exposure pathways. If there were no assessment of potential exposure pathways, then the most limiting scenarios might be utilized to conceptualize the absence of any controls – and the concentrations of NORM beneath which one could be exempt. To further complicate the matter, the total *volume* of NORM at any particular concentration also should be known in order to quantify any dose consequence. Finally, should the use of concentration limits be pursued, it will be necessary to establish values for not only radium – but all NORM nuclides –

as both liquid and solids. The establishment of these concentration limits should be connected to a single protective exposure limit – which requires conservative assumptions about current and future exposure pathways.

## **DOSE ASSESSMENT**

The concept of dose assessment was presented in the context of evaluating exposures from NORM-contaminated materials and groundwater. The considerable technical factors that go into developing a source term were discussed in terms of both realistic and bounding scenarios. NORM presents particular challenges in terms of the multiple decay series, variable status of equilibrium, technological enhancement of one or more radionuclides, radon, and the presence of background radiation.

The Residual Radioactivity in the Environment (RESRAD) family of codes, intended for site remediation, also is employed commonly to support regulatory decision making. Due to its availability and recent use in NORM disposal evaluations by state and federal agencies, panel experts walked through the use of RESRAD for the evaluation of NORM disposals and the development of dose-based, site-specific disposal criteria. Considerations within such an analysis should include, among other items:

- Contribution from external shine, inhalation, and ingestion
- Analysis of environmental transport
- Reasonable assurance of the assumed exposure pathways over 1,000 or 10,000 years
- Assessment of groundwater impacts and the future site resident
- Landfill intrusion, if applicable, treated as an accident
- Dose limits as performance objectives

In addition to accurately representing the source term and site characteristics, care must be taken when assuming future land use and occupancy. The most common scenario patterns are resident farmer, suburban resident, industrial worker and recreationist. Is it reasonable to assume the future land inhabitant will derive the entirety of their food and water from the land? The land may not support a resident farmer in arid west. Is it reasonable the recreationist will obtain food and water where camping? If the site is a landfill, what are the effectiveness of long-term controls towards preventing landfill intrusion? What factors are being selected for resuspension of NORM and what breathing rate is being utilized? The workshop provided an overview of the complex decision-making process, the required defensibility in such decisions and the prudence of engaging stakeholders during such a process. The review of dose assessment modeling, its sensitivities, the need to be pragmatic, and



the need for effective communication were all charted as critical issues with respect to NORM and TENORM regulation. Regulators and stakeholders should note that unanticipated results of actual operations still do emerge when compared against model predictions and that planned future use remains both a point of interest and legal debate (Lombardo 2019).

The need to select sensible scenarios that will determine the operable pathways becomes even more apparent during the evaluation of focused disposal options. For instance, if employing deep well disposal of sludge, the disposal may be nowhere near an aquifer and may be contained completely. Multiple exposure pathways may be reduced or eliminated. Finally, multiple software solutions or modeling methods may be necessary to accurately characterize complex scenarios. To elaborate on the scenario of deep well disposal of sludge, the impacts on lateral dispersion of NORM through an aquifer may not be adequately covered. The difficulty of accurately representing radon exposures for future receptors has resulted in both CRCPD and the USNRC recommending excluding the contribution of radon in dose assessments of residual radioactivity. However, a separate standard is then warranted to protect the public.

The disposal or repurposing of NORM residues may not be limited by NORM contaminants. Other hazardous or environmentally significant components may impact disposal options, as is often the case in land application. An analysis of these factors also is important as the factors can further shape the scenarios to be modeled.

The presentation concluded by developing a conceptual model, examining the RESRAD input and output and following through by performing an iterative process and sensitivity analysis of the factors used.

## **ADDITIONAL CONCERNS**

Workshop attendees and panelists appeared in agreement that more effective risk communication to workers and the public alike could improve safety and avoid overly conservative decision making. This may be implemented through worker training and stakeholder outreach to properly frame hazards. Increased training also may facilitate better measurements, characterization of NORM and risk communication skills among workers.

## LEGAL CONCERNS

The application of differing standards by various regulatory entities and the various limits established have given rise to increasing litigation regarding oil and gas NORM. These include:

- Assertions of negligence, creating a private or public nuisance or both
- Breach of contract (including trespassing)
- Merger and acquisitions
- NORM identified as a hazardous substance or activity
- Issues regarding worker and community right to know (Kennedy 2019)

The bulk of concerns discussed stressed the need for uniform, defensible and science-based regulation. Consistent with the role of NCRP, its commentary seeks to better protect workers the public and the environment by putting forth recommendations that could support the development of a national NORM framework and provide the scientific basis for promulgating regulations.

## REGULATORY UNIFORMITY AND LIMITATIONS

Template regulations for the licensing of NORM have been available from the CRCPD for decades with the latest version published in 2004. However, a relatively low number of states have adopted the template regulations, and fewer still apply them to the entirety of NORM-generating industries. The workshop panel discussed the existing facets of the Suggested State Regulation for the Regulation and Licensing of TENORM (SR-N). Among others, these include:

- A 185mBq (5 pCi/g) radium exemption limit
- Industry-specific exemptions
- 1 mSv (100 mrem/year) TEDE exemption
- Land application for residuals beneath 370 mBq/g (10pCi/g)
- 50 microR/hour release limit for contaminated scrap
- 5000 dpm/100cm<sup>2</sup> beta/gamma and 1000 dpm/100cm<sup>2</sup> alpha release limits
- Licensing under the traditional USNRC Agreement State format

Despite the longstanding availability of SR-N, there is relatively little consistent adoption and implementation amongst states. The status of NORM regulation at the federal level was discussed and was characterized as generally regulated by industry of origin. States that have elected to promulgate regulations for NORM, likewise, may do so only for certain industries. Some may regulate only distinct portions of the industry – such as waste management. Complicating the situation further, licensing requirements, disposal activities, and even the definition of NORM (or TENORM) varies by state. “Regulation” may not be in the form of a license, and the jurisdictional authority of several states may limit the scope of which they could potentially regulate (e.g., limited to waste disposal only or not able to promulgate on worker protection issues).

The myriad of issues legitimately preventing a consistent, nationwide framework were presented and solutions solicited from attendees. The patchwork of regulatory approaches nationwide has impacted interstate commerce, left gaps in worker protection, and created both liabilities and environmental impacts. General consensus was that proposed revisions should continue to address all NORM nuclides but regulate on the basis of dose consequence – not necessarily industry of origin. Some degree of harmonization should be sought on exemption levels, clearance limits and acceptable disposal limits for NORM residuals. Limits should be developed for liquids as well and address exposures from radon. At the same time, the

development of regulations and the resulting burden placed on both the regulators and industry should be risk-informed. This led to the discussion on a graded approach of developing a regulatory framework and the ongoing work at the IAEA.

Before transitioning to the discussion on a graded regulatory approach, the draft proposals from the revised SR-N were presented. These concepts included draft exemption levels for all NORM nuclides, both solid and liquid. The use of modeling to make regulatory decisions was discussed, as well as default assumptions (and concentration limits) a regulatory or industry could use should they wish not to perform dose assessment modeling. Despite the work on these issues, scientific questions remain and the implementation can be overly complex. The input received from the audience was substantial and will be incorporated into ongoing peer review.

## **A GRADED APPROACH AS A CONCEPT FOR NORM REGULATION**

NORM is not equal to nuclear. Moreover, NORM represents a large diversity of activities and materials which may involve multiple regulators, and non-radiological hazards (that sometimes dominate) and do not represent an acute exposure. However, in the absence of regulatory control, chronic exposures are likely. NORM regulations are but one piece in a jigsaw puzzle of an integrated approach to health, safety and environmental management. The degree of regulatory oversight should be commensurate with the risk present. The concept of a graded approach for regulations was discussed, why it is relevant to NORM, and the basic elements of developing a regulatory framework appropriate to NORM (Pepin 2019).

## **WHY IS A GRADED APPROACH IN NORM NEEDED?**

NORM occurs in diverse situations and raises diverse questions such as:

- Is the worker safe enough?
- Is the environmental impact from this NORM waste disposal acceptable?
- Which degree of remediation is appropriate, and for what type of area?
- What commercial products are safe for consumers?

While worker and consumer protections, remediation, and disposal are all important considerations, the degree to which they present themselves in various NORM industries varies. This makes a graded approach necessary.

The approach should be commensurate with likelihood and possible consequences and level of risk associated with loss of control.

Definition - IAEA Safety Glossary:

“For a system of control, such as a regulatory system or a safety system, a process or method in which the stringency of the control measures and conditions to be applied is commensurate, to the extent practicable, with the likelihood and possible consequences of, and the level of risk associated with, a loss of control. To develop a graded approach requires (i) control measures that can be applied at various levels of stringency, and (ii) a means for assessing the risks associated with the loss of control.”

With a graded approach, regulations increase in limitations with level of risk. This is relevant to NORM due to the diversity of activities and contamination pattern, and lack of acute exposure but potential for chronic long-term exposure.

## PROCESS FOR DEVELOPING A REGULATORY FRAMEWORK

The IAEA has worked to convene several technical working groups which apply the development of a regulatory framework NORM. This is the subject of an ongoing technical document which identifies the development of a regulatory framework for NORM involving several stages (Pepin 2019). These include:

- Gaining an understanding of the NORM activities in the country [state], (i.e., build an inventory of uses and residuals amongst present NORM operations)
- A review of the existing regulatory infrastructure
- Engaging stakeholders
- Implementing regulations with periodic review
- Reviewing NORM exposures as new uses and processes emerge
- Refining risk assessment
- Planning for inspections and enforcement

Special considerations include:

- While building an inventory of NORM, the presence of industries and hazards associated with the management of residuals will vary geographically. As a result, the need and extents of NORM regulations will vary by state.
- Revised dose assessments, authorizations and regulatory oversight may occur throughout the life cycle of facility.
- Import and export of NORM residuals are issues to consider.
- The importance of cooperation and coordination amongst regulators, industry and stakeholders can not be overstated.
- The degree of regulatory oversight exerted should be in a state of constant review due to the emergence of new industries, process changes, regulator experience, gap identification, stakeholder feedback and the evolution of domestic and international standards.

## FINDINGS OF THE WORKSHOP

Priority issues and barriers to a consistent (one-size-fits-all) regulatory framework were identified. Key elements of concern in NORM regulation were identified as follows:

- Addressing and effective implementation of license termination and financial assurance on NORM industry licenses
- The inadvertent regulation of background materials when using a dose-based standard (Natural concentrations of NORM can give rise to exposures exceeding those proposed.)
- Need to address disposal and environmental deposition in framework, including recognition of physical, administrative and engineered controls that may negate the need for regulatory oversight
- Cleanup of legacy sights
- Addressing industry liability
- Addressing public and worker exposures
- Incorporating elements for education of workers
- Build or refine regulator tools for effective risk communication to the public

## PRIORITY ISSUES IN REGULATION OF NORM

Chief among the priority issues are determining concentration and dose limits upon which regulations may be designed. Other issues include what radionuclides to include, standards for monitoring, provisions for financial assurance and decommissioning. Questions that arise relative to the priority issues are:

- Is it NORM or TENORM?
- Should the 185 mBq/g (5 pCi/g) exemption limit for radium be retained? What limit should be used for other NORM nuclides? What about liquids?
- Should regulations move to a dose-based limit?
- Why do we regulate by industry of origin (or type of production) and not by a dose-based limit?
- Po-210 and Pb-210 are issues as well; is there a need for effective monitoring?
- What standards and guidance are there for portal monitors?

- To what extent can we harmonize NORM regulations (nationally and internationally)?
- How can regulations address long-term institutional controls and financial assurance?
- How can regulators best communicate risk with members of the public?
- What standards should regulators consider in cleanup of legacy sites?
- NORM industry sites will have varied life cycles, which may require discretely different amounts of regulatory oversight. How would regulations address operations and close out phases?
- With regard to a revised regulatory NORM framework which seeks harmonization and consistent implementation:
  - The draft SR-N is less prescriptive and activity specific.
  - It is less industry-specific, and more focused on limiting exposures – regardless of their origin.
  - SR-N would prescribe the methodology and consistent point at which activities and industries should be assessed for increased regulatory oversight.
  - This would be based on a dose – 1 mSv (100 millirem/year)?
  - The implementation of regulatory oversight would be graded – commensurate with the risk present.
  - Ideally, NORM residue management practices and industrial uses of NORM would be examined by regulators via dose assessment models. However, this is not always feasible.
  - Therefore, default concentration limits for each NORM nuclide (solid or liquid) are provided which may act as “triggers” for regulatory oversight.
  - The framework remains flexible – allowing dose assessments by either the regulator or the industry to recognize site-specific characteristics or operational and engineering controls to be recognized.
  - In this fashion, the scope and extent of NORM regulations will necessarily vary by state. However, a consistent framework for the evaluation of NORM practices and residues is established.

## **BARRIERS TO A REGULATORY FRAMEWORK**

Overarching barriers to a consistent and uniform regulatory framework exist with authorities of various regulatory entities. Within each entity, issues that must be addressed include some of the following concepts and concerns:

- The definition of NORM vs. TENORM cannot be easily reconciled due to statutory restrictions and definitions among states.



- A uniform licensing approach, as known under the USNRC Agreement State framework, may not be feasible. The regulatory jurisdiction for NORM varies among states and may lie with the department or agency responsible for the environment, waste management, public health, natural resources, radiation protection, or the railroad authority. The ability to issue licenses – especially with regard to radioactivity – may not necessarily reside within every regulating jurisdiction.
- Multiple stakeholders have expressed the need to retain concentration-based exemption limits. The use of concentration limits (e.g., 185 mBq/g [5 pCi/g]) rather than a dose limit, is more easily implemented and requires no specialized expertise in dose modeling. However, even at very low concentration limits, the failure to properly manage NORM residues can still result in unacceptable exposures to the public. Efforts to further lower the concentration limits and mitigate these exposures may inadvertently result in the regulation of materials present at background levels. Somehow, a consistent dose-based standard must be implemented which does not result in the regulation of materials at background levels.
- The use of concentration-based exemption limits which are “above background” results in a limit that varies from state to state. Since background changes from state to state, materials exempted in one jurisdiction could be regulated in another. This gives rise to issues with interstate movement of NORM residues and wastes.
- Radon resulting from background NORM can and does result in exposures to the public in excess of 100 millirem per year. If regulators include the contribution of radon in dose assessments of NORM being deposited into the environment, SR-N would effectively prohibit any deposition of NORM back into the environment. Moreover, the variability associated with radon concentrations in residential structures makes it very difficult to claim that any authorized level of NORM in the environment is “protective.” Therefore, a separate standard for public exposures from radon is likely necessary.
- Ownership, financial assurance, termination requirements and decommissioning must be addressed.
- Regardless of a concentration-based or dose-based framework, industry-specific and disposal-specific guidance is likely needed.
- Physical characteristics, administration, and engineered controls may negate need for regulatory oversight. This must be recognized.
- Institutional controls should be considered and incorporated into a regulatory framework.
- Consistent guidance needs to be established for monitoring, portal monitors and release of contaminated scrap metal so as not to impede interstate commerce.

## USEFUL TOOLS AND INFORMATION

While there are innumerable guidance documents for the regulation of NORM in various industries, those discussed within the scope of this workshop are indicated below:

- [Association of State and Territorial Solid Waste Management Officials \(ASTSWMO\).](#)
- [CRCPD and Institute Scrap Recycling Industries \(ISRI\) Video. “Radiation Safety in Scrap Recycling.”](#)
- IAEA, [Management of NORM Residues from Uranium Production and Other Activities, SSG-60, 2021.](#)
- NCRP. [Commentary No. 29 – Naturally Occurring Radioactive Material \(NORM\) and Technologically Enhanced NORM \(TENORM\) from the Oil and Gas Industry \(2020\).](#)
- USCDC Website – [Radiation Awareness Training in Layman Terms and Other Resources.](#)

## **THE NEED FOR TRAINED COMMUNICATORS**

Words and jargon that are used as regulatory terms may have connotations to the public that convey levels of risk inaccurately. For instance, talking about “contaminated” lands or properties may cause alarm. A successful path forward in regulating NORM requires being understanding of the audience and finding ways to communicate without inflaming.

Note that USCDC has radiation training for communication. CRCPD will work to update USCDC website regarding NORM.

## CONCLUSIONS

“CRCPD Workshop: Continuing Efforts for NORM Regulatory Framework Development and Risk-Informed Decision Making,” examined the current state of the NORM regulatory framework, as it exists fragmented and varying in consistency. Ideally, a uniform framework should exist for the proper protection of public health and the environment. However, this would require considerable work and cooperation nationwide and worldwide. In the absence of a uniform network, various entities may originate and refine regulations to address the priority issues in this report while working around existing barriers identified.

## RECOMMENDATIONS

Broad recommendations from the workshop include:

- Develop a uniform regulatory framework for NORM.
- Harmonize regulations, both nationally and internationally.
- Move to limits based on dose and on appropriate analyses.
- Consider exemptions for certain operations and circumstances.
- Resolve scientific and legal issues, where possible.
- Establish standard reasonable scenarios for modeling NORM exposures.
- Develop standards for appropriate monitoring and measurements.
- Collect information on new and emerging technology in order to review and revise regulations in a timely manner.
- Address financial assurance.
- Develop programs and an effective means for risk communication with the public.

## ABBREVIATIONS

ASTSWMO	Association of State and Territorial Solid Waste Management Officials
HPS	Health Physics Society
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiation Protection
NCRP	National Council on Radiation Protection and Measurements
NORM	Naturally Occurring Radioactive Material
RESRAD	Residual Radioactivity in the Environment
TECDOC	IAEA Technical Documents
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material
UMTRCA	Uranium Mill Tailings Control Act
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
USCDC	United States Centers for Disease Control and Prevention
USEPA	United States Environmental Protection Agency
USNRC	United States Nuclear Regulatory Commission

## REFERENCES

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