

**Terms of Reference (ToR) for a New ENVIRONET NORM Project:
“Promoting Good Practices and Providing Knowledge Transfer Applicable to the Management of
Naturally Occurring Radioactive Materials (NORM) Residues and Wastes”**

1 Background

Radionuclides occur naturally in the environment and are present in most materials. These materials are referred to as naturally occurring radioactive material (NORM). Certain industrial activities can increase the potential for human exposure to the NORM radionuclides, sometimes generating residues or wastes with radionuclide concentrations above natural background levels. The number of industries that generate NORM is large, including mining and mineral processing, other resource extraction activities, coal combustion, and water treatment. The primary radionuclides of concern are associated with the U-238 and Th-232 decay series, and K-40. NORM can be associated with current industrial projects (i.e., active facilities), as well as with former projects and activities (i.e., legacy sites). If NORM is not properly managed, it can present unacceptable radiation risks to workers, the general public, and the environment. While many countries have developed management frameworks to ensure proper management of NORM, not all countries have done so. Even in Member States with well-developed NORM policies, strategies, and regulatory structures, there are still challenging issues associated with the management of NORM residues/wastes.

An extensive body of literature relevant to NORM management is available, including documents prepared by the IAEA and by other organizations. This includes publications providing general information about NORM and NORM-generating industries, guidance documents on multiple aspects of NORM residue/waste management, risk analyses, case studies, and so forth. In addition, there already exists in many Member States considerable expertise with respect to good practices for NORM residue/waste management. Despite this wealth of accessible information and expertise, Member States still articulate a need for practical guidance in dealing with the challenges related to management of NORM residues/wastes and legacy sites (i.e., sites where past NORM-generating activities resulted in environmental contamination).

During the IAEA ENVIRONET Plenary Meeting and joint RER 9121 Meeting in December 2014, efforts were made to identify key issues facing the environmental remediation community. Several discussion groups were formed; one group focused on the challenges facing IAEA Member States with respect to NORM residue/waste regulation and management. Subsequently, in July 2015, the IAEA convened a consultants meeting to discuss the need for and structure of an ENVIRONET initiative to support the needs of the Member States. Through the course of that meeting, the consultants formulated a proposal for a project on NORM (hereafter referred to as the NORM Project) and generated a draft Terms of Reference (ToR) for the new NORM Project. The draft ToR was subsequently presented at the ENVIRONET Plenary Meeting held in November 2015 and reviewed in depth at a joint consultants meeting and technical meeting in December 2016 in Stockholm, Sweden. This version of the NORM Project ToR represents the outcome of the December 2016 meeting.

The challenging issues associated with the management of NORM residues/wastes identified and compiled by the consultants of the 2015 and 2016 consultancy meetings and the 2016 technical meeting are given in Table 1.

Table 1 Identified Issues Related to Management of NORM Residues/Wastes and Legacy Sites

(Note: the issues listed in this table are inter-related, with many of them cutting across topical areas.)

1. **Terminology**
 - a. Definition of NORM
 - b. Definition of terms related to NORM management

2. **NORM Policy and Stakeholder Involvement**
 - a. NORM policy, strategy, and regulation
 - i. Determination of regulatory authority and scheme
 - ii. Coordination with national radioactive waste management policy and regulation
 - iii. Coordination with other national policy and regulation (e.g., environmental regulation)
 - b. Exemption levels
 - i. Dose-based
 - ii. Risk-based
 - iii. Activity concentrations
 - iv. Surface concentrations
 - c. Conditional clearance
 - d. Cost, funding, and human resource requirements
 - e. Raising Member State NORM awareness, including technical training and education
 - f. Stakeholder engagement/public awareness
 - g. Import, export, and international trade

3. **NORM Characterization and Risk Assessment**
 - a. Inventory of past, ongoing, and future activities
 - i. Identify NORM-generating industries and processes
 - ii. Residue/waste volumes
 - iii. Radioactivity concentrations or exposure rates
 - iv. Other constituents of concern
 - v. Current management
 - b. NORM Characterization
 - i. Residue/waste characterization
 - ii. Legacy site characterization
 - c. NORM Measurements
 - i. Appropriate sampling and monitoring methodologies
 - ii. Analytical methodologies
 1. Laboratory
 2. On site measurements (e.g., in situ measurements, mobile lab)
 - iii. Infrastructure and equipment requirements
 - iv. Quality assurance and quality control (QA/QC)
 - v. Recordkeeping
 - d. Risk assessment
 - i. Radiological dose assessment
 - ii. Environmental impacts and risk
 - iii. Physical risk (e.g., accidental release of contaminated material)

4. **Management Framework**
 - a. Life-cycle management to help prevent environmental contamination
 - b. Integrated safety management, including radiological and non-radiological hazards
 - c. Cost assessment across all aspects of residue/waste management
 - d. National management approach
 - i. Private vs. state-owned waste management organization

- ii. Centralized vs. multiple dispersed facilities
 - iii. NORM-dedicated facilities vs. facilities accepting multiple types of wastes
- e. Management options for residues/wastes not exempted or conditionally cleared (application of the waste management hierarchy)
 - i. Prevention
 - ii. Minimization
 - iii. Reuse (i.e., using the NORM in its current form)
 - iv. Recycle (i.e., reprocessing of the NORM into a new form), including NORM contaminated scrap metal
 - v. Disposal
- f. Selection of management options, including reuse, recycle, storage, and disposal
 - i. Justification and optimization
 - 1. Cost/benefit analysis
 - 2. Multi-criteria decision analysis
 - ii. Safety assessment
 - 1. Risk assessment, including human and environmental risk
 - 2. Site selection criteria and site evaluation
 - 3. Design criteria
 - 4. Residue/waste acceptance criteria
 - 5. Pre-treatment requirements
 - iii. Stakeholder involvement
 - iv. Financial guarantees
 - v. Monitoring requirements
 - vi. Other considerations (e.g., economic impacts)
- g. Transportation requirements and controls
- h. Emergency preparedness and response
- i. Closure or decommissioning of NORM facilities (e.g., of buildings and infrastructure)
 - i. Risk assessment, including human and environmental risk
 - ii. Decommissioning and waste management plan
 - iii. Characterization
 - iv. Decontamination technologies
 - v. Dismantling technologies
 - vi. Environmental remediation
 - vii. Stakeholder involvement
 - viii. Decommissioning fund
- j. Long-term stewardship of closed or decommissioned NORM management facilities/sites
 - i. Monitoring
 - ii. Institutional controls

5. Legacy Sites

- a. Identification
- b. Conceptual site model
- c. Characterization
- d. Risk assessment
- e. Remedial action evaluation and selection, if needed
- f. Management options for contaminated materials, including infrastructure needs
- g. Costing and funding

2 Objectives and Outcomes of the Project

The two primary objectives of the NORM Project are to:

1. Compile and share good practices and technologies to support Member States in (1) acquiring knowledge, (2) obtaining practical experience, and (3) implementing best practices related to both sustainable NORM residue/waste management and legacy site management; and
2. Collect and consolidate information to (1) support ongoing IAEA initiatives related to development of reports on NORM residue/waste and legacy site management and (2) refine and enhance the assistance provided to Member States on the basis of an improved understanding of their issues and needs.

The desired outcomes or results of the NORM Project are to:

- Increase knowledge and technical capacity in the Member States specific to
 - Management of NORM residues/wastes in order to prevent the creation of new legacy sites requiring remediation, and
 - Management of existing legacy sites;
- Enhance national capabilities to develop policies and strategies for NORM residue/waste management and remediation of legacy sites, and establish required infrastructure; and
- Improve the understanding of NORM institutional infrastructures (i.e., policy, strategy, regulation, laboratories, reuse options, storage and/or disposal facilities) and NORM inventories (i.e., NORM-generating industries and processes, residue/waste streams, volumes, exposure rates or radioactivity concentrations, other constituents of concern, current management) across Member States.

3 Scope of the Project

The scope of the NORM Project could include all industrial activities involving NORM; however, priorities should be established to serve the primary needs of the Member States. Per the IAEA and other sources, industries that generate NORM include, but are not limited to:

- Mining and processing of uranium and other natural resources;
- Extraction of rare earth elements;
- Production and use of thorium and its compounds;
- Production of niobium, ferroniobium, and tantalum;
- Production of oil and gas;
- The zircon and zirconia industries;
- Manufacture of titanium dioxide pigment;
- The phosphate industry;
- Production of iron and steel, tin, copper, aluminium, zinc and lead;
- Combustion of fossil fuel and biomass;
- Water treatment; and
- Geothermal energy production.

The focus of the project should be on radiological aspects of NORM residues/wastes and legacy sites. However, when appropriate, other associated hazards (e.g., flammability, reactivity, leachability, toxicity) should be acknowledged as they may require more stringent management or control than the radiological nature of residue, waste, or environmental contamination.

The target audience for the project includes regulators, industrial operators, and researchers in Member States where:

- NORM-generating industries and/or sites are present, or
- NORM contamination otherwise exists (i.e., without presence of any NORM-generating industry/activity).

Specific activities undertaken as part of the NORM Project may focus on specific audiences, as needed to appropriately address issues and needs. Other stakeholders (such as local government staff, contractors, non-governmental organizations, and the general public) will benefit from the deliverables produced by some activities under this project.

4 Activities and Deliverables

The NORM Project will undertake activities in three different areas described below and summarized in Table 2. The project is expected to last for multiple years. Specific schedules and indicators of success should be developed for each activity to evaluate progress towards the desired outcomes of the project identified in Section 2.

4.1 Activity 1: Best Practices Guidance

- Description: development of documents providing practical guidance on NORM residue/waste and legacy site management; to incorporate relevant information already available in existing literature; to be developed in modular fashion
- Potential topical areas are as listed in Table 1:
 1. Terminology
 2. NORM Policy and Stakeholder Involvement
 3. NORM Characterization and Risk Assessment
 4. Management Framework
 5. Legacy Sites
- Mechanisms
 - Consultants meetings
 - Working groups
- Deliverable
 - Series of documents that can be published in multiple formats (e.g., printed document, downloadable electronic file(s), modular materials on CONNECT)
- As of January 2017, two initial tasks have been identified under this activity, as described below.

4.1.1 Task 1: Report on Considerations for Developing Policies and Strategies for NORM Management

- Description: prepare a report discussing aspects to be considered in developing country-specific NORM policies and strategies, including discussion of terminology, policy/strategy options, and the implications of different policy decisions.
- Mechanism

- Establish working group of Member State representatives
- Draft report produced by working group
- Technical meeting to review and revise draft report
- Deliverable
 - IAEA report

4.1.2 Task 2: Document Providing Guidance on the Assembly of Relevant NORM Information by Member State (NORM Inventories)

- Description: develop a document providing Member States guidance on the need and the process for assembling information regarding NORM management infrastructures and NORM inventories
- Mechanism
 - Establish working group of Member State representatives
 - Draft guidance document produced by working group
 - Technical meeting to review and revise draft guidance document
- Deliverables
 - IAEA guidance document

4.2 Activity 2: Transfer of Knowledge and Best Practices

- Description: workshops and training events providing practical experience on best practices for management of NORM residues/wastes, specific topics to be determined but to be drawn from topics listed in Table 1.
- Mechanism
 - Regional or interregional events; could incorporate a “train-the-trainer” approach for disseminating knowledge within a country or region
 - IAEA to fund technical experts
 - Participants funded by individual companies (e.g., NORM-generating companies, service companies)
 - Consider importance of bringing together stakeholders (e.g., regulators, operators, workers, general public)
 - Could also include secondments, exchange visits, or internships through which participants would gain hands-on experience working with expert practitioners in a host organization; participants to be funded by their own company
- Deliverables
 - Training materials produced for workshops and training events

4.3 Activity 3: Direct Assistance to Member States

- Description: provision of direct technical assistance to Member States
- Mechanism
 - Expert missions, including site visits
- Deliverables
 - Technical documents, such as strategy plans, cost estimates, and residue/waste management plans
 - Case studies detailing project-specific projects, outcomes, and lessons learned; these practical experiences can provide instructional material for incorporation into the best practice guidance documents (Activity 1) and workshops and training events (Activity 2).

Table 2 Summary of Main Activities and Deliverables Proposed Under the NORM Project

Activity	Description	Mechanism	Deliverables
1 Best Practices Guidance	Practical guidance on NORM residue/waste and legacy site management	<ul style="list-style-type: none"> • Consultants meetings and working groups 	<ul style="list-style-type: none"> • Series of guidance documents released in multiple formats
2 Transfer of Knowledge and Best Practices	Workshops and training events providing practical experience on best practices associated with all topics in Table 1	<ul style="list-style-type: none"> • Regional or interregional events • Technical experts funded by IAEA • Participants funded by individual companies 	<ul style="list-style-type: none"> • Training materials
3 Direct Assistance to Member States	Provision of direct technical assistance	<ul style="list-style-type: none"> • Expert missions, including site visits 	<ul style="list-style-type: none"> • Technical documents (e.g., mission reports) • Case studies

5 Project Organization and Information Dissemination

The NORM Project will be directed by a Chair and Co-chair representing Member States, and will be supported by a steering committee including the chair, co-chair, and at least three other members. Working groups may be formed to accomplish specific activities and the working group leads may be asked to serve on the steering committee or, at least, participate in steering committee meetings. Additional Member State participants will be integrated into NORM Project activities, including participation in technical meetings and working groups.

Information and document exchange will use the CONNECT platform to maximize efficiency and effectiveness of the project. Specific deliverables (e.g., technical reports, Best Practices Handbook) and relevant materials (e.g., this ToR, meeting summary reports) will be made available on the CONNECT platform. Potentially, an access-controlled workspace can be created within the CONNECT platform to facilitate collaboration in the development of materials (e.g., handbook chapters).

6 Participation

The project is open to experts and organizations (e.g. operating organizations, regulatory bodies, and supporting organizations) within IAEA Member States that are or will be involved in the regulation, operation, and/or closure of NORM-generating activities or sites. Prior to formal project meetings official letters with invitation to all Member States are envisaged to be sent through the Permanent Missions in Vienna.

Requests for additional information about the project will need to be sent to the IAEA Scientific Secretaries – Horst Monken Fernandes (H.Monken-Fernandes@iaea.org), Zhiwen Fan (z.fan@iaea.org).