Project Proposal for Decommissioning of NORM Facilities
With Emphasis to Oil and Gas Industries: a Typical Example of NORM Affected Industry in Egypt

Prof. Dr. Nadia Helal
Head of Radiation Safety Department, Egyptian Nuclear& Radiological Regulatory Authority, ENRRA
Email: Nadiahelal1969@Gmail.com
Overview

- NORM in the oil and gas industry
- The Egyptian approach
- Current situation
- Challenges
- Project proposal
NORM in the Oil and Gas Industry

The oil and gas industry is a global industry that operates in many Member States of the IAEA. There are several facets to the industry including:

The construction sector responsible for manufacturing and fabricating facilities and equipment;

The production sector responsible for developing and exploiting commercially viable oil and gas fields;

‘Downstream’ sectors dealing with transport of the raw materials and their processing into saleable products;

Marketing sectors responsible for the transport and distribution of the finished products.
Radioactive materials, sealed sources and radiation generators are used extensively by the oil and gas industry, and various solid and liquid wastes containing naturally occurring radioactive material (NORM) are produced.

The presence of these radioactive materials and radiation generators results in the need to control occupational and public exposures to ionizing radiation.
Various radioactive wastes are produced in the oil and gas industry, including the following:

* Discrete sealed sources, e.g. spent and disused sealed sources;
* Unsealed sources, e.g. tracers;
* Contaminated items;
* Wastes arising from decontamination activities, e.g. scales and sludges.

These wastes are generated predominantly in solid and liquid forms and may contain radionuclides of artificial or natural origin with a wide range of half-lives.
NORM in Scale
Sludge

Sludge stored in pits

Sludge mixed with sand and land farmed
Evaporation Pond
Deposition of NORM can occur at the following locations:

- Production tubulars (T)
- Wellheads (W)
- Valves (V)
- Pumps (P)
- Separators (S)
- Water treatment vessels (H)
- Gas treatment tanks (G)
- Oil storage tanks (O)
Occupational exposures occur:

- During maintenance activities inside the process:
- During collection, handling and treatment of solid wastes and contaminated items.
- During disposal of wastes e.g. to repository.
- During decommissioning activities.
- During remediation activities e.g. produced water disposal ponds.
Summary

• Variety of NORM residues are produced.

• Wide range of activity levels.

• Significant quantities can be produced.

• Worker doses occur primarily during maintenance.

• Requires regulation of the workplace and the authorized disposal of NORM and decommissioning of the facilities.
The Egyptian Approach

Oil and Gas Industries, a Typical Example of NORM Affected Industry in Egypt
Introduction

- Egypt is dependent on oil and gas as the main sources of energy with the development engines utilizing more than 90% of its energy needs from oil and gas.

- Due to major recent discoveries, natural gas is likely to be the primary growth engine of Egypt's energy sector for the foreseeable future.

- Foreign oil companies began more active exploration for natural gas in Egypt beginning in the early 1990s, and very quickly found a series of significant natural gas deposits in the Nile Delta, offshore from the Nile Delta, and in the Western Desert.
Introduction

• Egypt's natural gas sector is expanding rapidly with production having more than doubled between 1999 and 2003 and tripled by 2007, giving a good chance for export.

• From this point came the importance of controlling offshore health and safety aspects in Egypt.
Production sites

- Sinai.
- Eastern Desert.
- Western Desert.
- Gulf of Suez, the northern part of the Red Sea, where 90% of the Egyptian oil exploration and production activities.
- This area may consider a significant source of environmental contamination with TE-NORM.
Sources of oil and gas in Egypt....cont.
Management of NORM in Egypt
Egyptian Nuclear & Radiation Law

• The Egyptian Nuclear and radiation Law no. 7 of 2010 was promulgated on March 29th, 2010.

• The Law no. 7 of 2010 established an independent body known as “Egyptian Nuclear & Radiological Regulatory Authority (ENRRA)”.

• Article (2) of the law states that:

  “The RB shall carry out all regulatory and control works related to treatment of natural radioactive materials naturally occurring from oil extraction or ores production”.
• **Legal 3**
  The law regulate the decommissioning of nuclear facilities.

  The law has legal arrangement for a financing mechanism covering decommissioning.

• **Legal 4**
  • The legal system in Egypt covers all aspects for non-radioactive materials parts of decommissioning.

  • The legal framework for implementing safeguards cover nuclear activities including decommissioning
ENRRA Structure

Supreme Committee for Nuclear & Radiological Emergency

ENRRA (Chairman of the Board)

ENRRA (Vice Chairman)

Central Nuclear and Radiological Emergency Chamber

Central Laboratories

National Network for Radiological Monitoring

Radiation Sources & Facilities Safety Sector

Nuclear Facilities Safety Sector

Nuclear Safeguards & Nuclear Security Sector

Research & Development Activities (Internal TSO)
National NORM Guidance

• Egyptian Atomic Energy Authority has asked the radiation protection advisory committee to provide advice on NORM

• **In 1999:**
  Pet (1) was issued to meet Atomic Energy Authority’ requirements for site categorizations.

• **In 2006:**
  PET(1) has been updated to PET(2).
ON ARRIVAL, THE CONTAMINATED ITEM IS OFFLOADED AND DIRECTED TO RADIATION CONTROLLED AREA.
Basic Decontamination Process of NORM Contaminated Equipment….cont.,

THE EQUIPMENT IS MONITORED AND TAGGED

THE EQUIPMENT IS DISMANTLED
Basic Decontamination Process of NORM Contaminated Equipment....cont..

EACH PART IS GIVEN AN INDIVIDUAL IDENTIFICATION NUMBER, MONITORED AND TAGGED.

THE BREAKDOWN AREA IS ECONTAMINATED, FLUSHING ALL CONTAMINENTS INTO THE CLOSED LOOP DRAINAGE AND FILTRATION SYSTEM.
Basic Decontamination Process of NORM Contaminated Equipment….cont.,

EACH PART IS INDIVIDUALLY DECONTAMINATED

FOLLOWING DECONTAMINATION, EQUIPMENT IS MONITORED IF ACCEPTED, TAPE IS ATTACHED TO THE EQUIPMENT.
Which NORM Industries are of Regulatory Significance?

- The mining and processing of **uranium** ores
- Extraction of **rare earth** elements;
- Production and use of **thorium** and its compounds;
- Production of **niobium and ferro-niobium**;
- **Mining** of ores other than uranium ore;
- Production of **oil and gas**;
- Manufacture of **titanium dioxide** pigments;
- The **phosphate** industry;
- The **zircon** and zirconia industries;
- Production of **tin, copper, aluminium, zinc, lead, and iron and steel**;
- Combustion of **coal**;
- **Water** treatment.
We regulate NORM in:

- Oil and gas industry
- Zircon and zirconium silicate
- Iron scraps

*Regulations and Regular Inspection are Implemented*
Current Situation

• There is an established system of regulations specified for NORM operations, residue and wastes.

• There is a national waste management facility.

• The facility is operated by EAEA
Current Situation........

• The national regulations on NORM is based upon IAEA safety standards.

• There are decontamination facilities specifically for items contaminated with NORM.
Current Situation......

• In the interim NORM wastes stored at the operator’s site in accordance with requirements defined by the regulator.

• Wastes requiring clearance from the site are monitored, analyzed and comply with release criteria defined by the regulator prior to release.
Challenges

• Lacking of a facility authorized to accept NORM waste for treatment and disposal.

• No inventory for NORM legacy sites.

• Legacy sites require to be identifying and investigating during the radiological hazard assessments of each NORM industry.
Challenge

• No information about the existing amounts of NORM residues/waste and/or rates of wastes/residues and effluents accumulated and/or released by these industry.

• No decommissioning strategy (plan) for oil and gas NORM facilities.
Project Proposal for:
Decommissioning of Oil and Gas NORM Facilities

1. Introduction
2. Scope
3. Decommissioning in Oil and Gas facilities
4. Objectives of the Project Proposal
5. The Desired outcomes of the NORM Project
6. Suggested strategy
7. Key issues and activities
8. Recommendation
9. References
1. Introduction

- Oil production facilities can become significantly contaminated by NORM materials which also contain hydrocarbon and other hazardous materials.

- If it is no longer economically beneficial to continue production at a specific well site, the physical structures may be removed and the well plugged and abandoned.
Furthermore, when an oil or gas reservoir has been depleted to the extent that further economic exploitation is no longer viable then:

(a) The wells will be abandoned and the production and transport systems has to be decommissioned and dismantled;

(b) The ancillary offshore and onshore structures (e.g. waste management, storage and treatment facilities) may become redundant and may need to be dismantled and/or returned to the public domain for unrestricted use;

(c) The owner or operator will request that the regulatory body terminate the license for possession, use and processing of radioactive materials.
2. Scope

- This proposal is intended to cover the practical aspects of decommissioning of NORM facilities.

- The focus of the work is principally aimed at facility decommissioning, focusing on operators with little or no previous experience in decommissioning.
3. Decommissioning in Oil and Gas facilities

- The term ‘decommissioning’ refers to the administrative and technical actions taken to allow the removal of some or all of the regulatory requirements from a facility.

- Decommissioning is increasingly becoming a major issue, since hundreds of facilities will end their operational lifetimes over the next decades.
3. Decommissioning in Oil and Gas facilities.....cont´d

• The decommissioning of oil and gas production facilities and their associated structures such as waste management and storage facilities gives rise to a variety of waste materials and items, some of which may be radioactive (e.g. sealed and unsealed sources, NORM scales, contaminated equipment, and concrete and soil).

• The decommissioning of these facilities can have to take place in countries which do not have a developed infrastructure for dealing with radioactive materials.
3. Decommissioning in Oil and Gas facilities.....cont´d

• Also in many of these countries the standards of general safety and safety culture are not yet well developed.

• A direct consequence of this is that there is not an indigenous work force that is familiar with the practices that have to be adopted.
4. Objectives of the Project Proposal

• The key objective of this project is to provide: practical information, experience and assistance aimed at a broad spectrum of practitioners who are faced with decommissioning of NORM facilities, including those who have limited or no previous experience.

• Support the decommissioning organization that may be faced with limited financial and scientific resources, for making efficient and effective decommissioning planning essential.
4. Objectives of the Proposed Project....cont’d

• Furthermore, it is also possible that the organization may need more guidance in starting the process of obtaining financial and other resources required for decommissioning.

• Establishment of decommissioning strategy for NORM contaminated industries, (disposal options, land remediation process and its cost estimation, and remediation of NORM legacy sites).
4. Objectives of the Proposed Project....cont’d

• Provide operators of NORM industries and staff of regulatory organizations with a comprehensive overview of topics related to NORM waste management, including:
  
  contamination detection,
  equipment decontamination,
  waste minimization strategies,
  waste characterization and storage.

• Removal of the radiological and non-radiological hazards associated with the operation of the NORM facility or system that will allow the facility to be released from regulatory control; and protect the worker, general public and the environment during the process.
5. The Desired outcomes of the NORM Project are to:

Increase knowledge and technical capacity of 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;
5. The Desired outcomes of the NORM Project are to:

• Improve the understanding of NORM institutional infrastructures (i.e., policy, strategy, regulation, laboratories, reuse options, storage and/or disposal facilities).

• NORM physical inventories (i.e., NORM generating industries and processes, residue/waste streams, volumes, exposure rates or radioactivity concentrations, other constituents of concern, current management) across the country.
6. Suggested Strategy

• The preferred strategy for the decommissioning process will include the following steps:

• Decontamination of contaminated items to levels defined by the regulatory body as suitable for unrestricted release;

• Release of all decontaminated facilities and areas for unrestricted public use (clearance from regulatory control);
6. Suggested Strategy....con`d

• Final disposal of radioactive wastes and remaining contaminated items in a facility authorized by the regulatory body.

• Start planning to deal with any NORM as soon as the project is first conceived.

• Communicate with the local regulators to ensure that all actions are understood by them and they, as a consequence, will support.
6. Suggested Strategy.....cont’d

- Try to identify magnitude of problem by looking at past disposal records and external monitoring.

- Identify routes of disposal for any NORM contaminated materials.

- Establish what working regulations are going to be used.

- Establish what defining criteria must be adopted for identifying radioactive NORM material, paying particular attention to where final refurbishment or demolition will take place.
6. Suggested Strategy.....cont’d

• Ensure that properly trained local supervisors are available.

• Establish clear working procedures which the supervisors can and must enforce.

• Ensure all managers understand that completion times cannot be used to try to reduce standards.
7. Key Issues and Activities

- The decommissioning process involves numerous issues and activities including:
  - Development of the decommissioning strategy and plan and associated QA programmes;
  - Development of dismantling and decontamination strategies;
  - Assessment of risks to workers, the public and the environment during and after the decommissioning activities;
  - Submissions to the regulator, e.g. plans, strategies, records, reports and survey results;
  - Approval by the regulatory body;
7. Key Issues and Activities....con’d

• Identification of potentially contaminated structures and areas;
• Identification, quantification and characterization of hazardous waste materials;
• Identification and characterization of radioactive wastes (this would include surveys to locate and identify contaminated areas, items and materials);
• Development of strategies to minimize the generation of radioactive wastes during decommissioning;
7. Key Issues and Activities....con’d

• Surveys to assess the levels of gamma dose rate, and alpha and beta surface contamination;

• Implementation of appropriate radiological protection programmes for workers, the public and the environment;

• A wide range of decontamination activities, e.g. components, buildings and land areas;

• Disposal of all radioactive wastes at authorized facilities;
7. Key Issues and Activities....con’d

- Land remediation activities;
- Transport of radioactive materials in accordance with applicable regulations;
- A final radiation survey after dismantling, removal and remediation activities have been completed.
8. Recommendations

- It is of great necessity that the agency develop a guideline identifying the obligation and responsibility for decommissioning of NORM facilities in a secure and safe methodology.
9. References


2. INTERNATIONAL ATOMIC ENERGY AGENCY, "Radiation protection and the management of radioactive waste in the oil and gas industry", Training course series No. 40, IAEA, Vienna, 2010.

3. INTERNATIONAL ATOMIC ENERGY AGENCY, "Radiation protection and the management of radioactive waste in the oil and gas industry". SAFETY REPORTS SERIES No. 34, IAEA, Vienna, 2003.


5. INTERNATIONAL ATOMIC ENERGY AGENCY, "decommissioning of facilities". IAEA SAFETY STANDARDS SERIES No. GSR Part 6, IAEA, Vienna, 2014.
Questions?