Introducing NORM

Three is glad to present some basic hints about NORM that should be taken onto consideration whilst dealing with these matters

The acronym **NORM** means all Naturally **O**ccurring **R**adioactive **M**aterials or **T**echnologically **E**nhanced NORM, where human activities have increased potential of exposure. Usually originated from natural radioactive material particularly by mobilization of Uranium (U-238) and/or Thorium (Th -232) decay series, which known as a primordial radio-nuclides that produce several decay series of radioactive daughters. Among those **Radium isotopes**, and **Radon isotopes** which usually originated as a result of radioactive decay of Radium isotopes. Radon considered as a dangerous radioactive gas, it is decayed by alpha particles which characterized by high ionizing power.

GUIDELINES & PRINCIPLES

Basic objectives of NORM surveying

- Investigate and monitor the occurrence of NORM in fields or industrial sites
- Predict possible remedial measure for workers and environmental safety.
- Reduce occupational exposure to workers.
- Assure implementation and enforcement of basic safety code of practice compatible with regulations in Algeria.
- Draw the attention of competent authority to the expected future danger of NORM.

NORM background

- First recognition of NORM on 1930.
- NORM received a global attention during last 4 decades
- Two forms of hard scales, Black grayish and white soft.
- NORM discovery associated with deep wells dog within reservoirs having a granite or shale bed rocks and high percentage of water cut to crude oil production (70-94%).

NORM scale deposition & accumulation

•Scales formed during production stages of oil – gas- water mixture and separation , due to changes of underground well pressure and temperature of produced water , which in presence of Ca, Sr, and Ba Cations lead to formation of solid radioactive Radium carbonates or sulphates which will be mobilized upward and deposited inside above ground facilities of oil production such as; separator, skimmer-tank, Christmas tree, and platform.

Radiation effects on human body

- From 0 to 200 rem vomiting, nausea, other radiation sickness, and no death anticipated.
- From 201 to 500 rem vomiting, nausea, other radiation sickness, up to 50% of deaths within 1 month, and survivors convalescent for about 6 months.
- From 501 to > 1000 rem all personnel involved will show vomiting, nausea within two to four hours time after exposure, death to all within one to two weeks.

Ionizing radiation

- Ionizing radiation recognized as a potential danger since 1895, due to the fact that it cannot be detected initially and directly by any five senses of human body.
- To day and after about 109 years humans were able to utilize ionizing radiation in many fields, such as medicine, advanced technology, and industry. Thanks to researchers and scientists all over the world particularly those contribute to its better understanding and reduce the risk of its danger.

Radiation control principles

- The basic principle of external radiation protection (i.e. time, distance, and shielding) should be considered in all safe working procedures.
- All safe working procedures must be clear, concise and easy to follow by the users.
- Training on the use of procedures must be given.
- Areas and personal dose exposure monitoring shall be conducted as prescribed according to the classification of the working areas.
- Records of area and personal dose monitoring should be kept and maintained as required by the relevant authorities.

GUIDELINES & PRINCIPLES

Operating principles

- Knowledge of the basic principle of external radiation protection (i.e. time, distance, and shielding)
- Implementation of suitable PPE
- Implementation of Safe Working Practices
- Implementation of Standard Operating Procedures
- Safe working procedures must be reviewed periodically to ensure its intended effectiveness and efficiencies
- Prevent spread of radioactive substances in the environment
- Treat, store and dispose of contaminated equipment and radioactive waste in a controlled manner

Implementation of suitable PPE

Personal Protective Equipment (PPE) is last choice in radiation protection methods.

- PPE is used to reduce radiological risk, i.e. the probability of exposure and/or the impact of any accidental radiation exposure.
- PPE must be used in conjunction with other hazards and risks controls.
- Examples of PPE that should be considered when working with NORM/TENORM include:
  - Respirators: to reduce the inhalation of dust containing radionuclide.
  - Gloves and apron: to reduce contamination of the body.
  - Goggles: to reduce contamination of the eyes.

GUIDELINES & PRINCIPLES

Radiation detection

- Geiger-counter; NORM survey Instrument
  - Scintillation probe- Sodium Iodide crystal
  - Geiger-Mueller probe- mylar plastic
- Scintillation probe- (µR/hr) Measures Gamma
- Geiger-Mueller probe- (cpm) Measures Alpha and Beta particles
- Alpha scintillation detectors such as ZnS(Ag) activated detector.
- Alpha track-etch detectors (ATDs), or SSNTDs detectors.
- Alpha radiation detector (Sili).

Radiation surveying types

1 Screening or Confirmatory Survey (General)

2. Open Equipment or Recovered Downhole Equipment Survey

3. Loose Contamination or Land Survey

4. Surplus Equipment Survey

5. Third Party Equipment or Facility Survey

6. Employee Frisking Survey

Radiation surveying principles

Conducting NORM Surveys basic principle should be bear in mind considering that Meters are not explosion proof or water proof:

- Check the atmosphere and do not use the meter in combustive gases
- Check continuously the meter response
- Be aware of multiple sources
- Record adequately the information

GUIDELINES & PRINCIPLES

Remediation requirements

Upon NORM Surveying results the case study situation will present:

- Justification for remediation.
- Site characterization.
- Legal requirements & exposure pathways.
- Other factors;
  - Criteria followed (Radiological criteria).
  - Decision making process.
  - Costs against the benefit & liabilities analyses.

GUIDELINES & PRINCIPLES

Radioactive waste requirements

Upon verification of the existence of NORM waste the following provision shall be taken to assure:

- Regulatory bodies and Industry entity involved require full knowledge of where NORM occurred and what is the activity level, types of radio-nuclides.
- Knowledge of the level that caused a potential hazard to both environment and humans.
- NORM management within the country policy, (high Authorities).

Two general themes needed for NORM handling should be:

- Reduction of the amount of NORM waste generated.
- Good management of NORM waste to protect human health and environment.

Radioactive waste requirements

Upon verification of the existence of NORM waste the following provision shall be taken to assure:

- Well known acceptable level of protection of the environment.
- Radioactive waste should not impose undue burdens on future generations.
- Interdependencies among the steps of waste generation and management shall be appropriately taken into account.
- Safety assurance of facilities during their life time.

GUIDELINES & PRINCIPLES

Radioactive site rehabilitation

Rehabilitation of NORM contaminated plants or land is a delicate issue requiring legal coverage and social acceptance and steps i.e.

- Determine acceptable levels of radioactive and toxic contaminants
- Propose methods for safe disposal or confinements of contaminants
- Evaluation of cost against benefit in conjunction to risk
- Review of previous experience in rehabilitation of similar sites
- Selection of multi-attribute analysis
- Follow key factors success to guarantee health and safety
- Selected approach shall involve the reduction of major risks at optimum social cost

GUIDELINES & PRINCIPLES

NORM related activities

- Routine and non-routine jobs on NORM contaminated installations
- Protection of personnel against NORM risks
- NORM surveys / Sampling for NORM
- Supervised and Controlled Areas
- Packing, temporary storage and transport
- Decontamination of personnel
- NORM measuring program
- Radiological safety precautions for the workshop
- Clean up of NORM contaminated areas
- Control, issue and care of Radiation Protection Instrumentation
- Dose assessment
- Decontamination of equipment
- Control of contaminated equipment
- NORM training

NORM pictures typical examples

Drilling Cuttings Sumps

Flanges(Flow restrictions)

GUIDELINES & PRINCIPLES

NORM pictures typical examples

Pressure Vessels

Production Tubings

NORM pictures typical examples

Pipe Scale

Polluted Soil

Three-E energy engineering environment

NORM MANAGEMENT

GUIDELINES & PRINCIPLES

Prepared with the contribution of:

B. H: Fawaris

G. Gemma

L. Micheli