



## NORM training: increasing awareness, reducing exposure

Richard van Sonsbeek  
RTD Radiation Protection Services  
ETRAP 2005 Brussels, November 23rd, 2005



## CONTENT

1. Introduction: NORM in the O&G Industry
2. NORM in an African E&P company
  - Radiation Protection Organisation
  - Role of Radiation Experts
  - Training of Radiation Experts
3. Objective and Main elements of the training
4. Discussion

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## NORM in the Oil and Gas Industry

- E&P companies are faced with Naturally Occurring Radioactive Materials;
- Reservoir rock contains the primordial radionuclides U-238, U-235, and Th-232;
- Production streams contain radionuclides of the U-238 series and the Th-232 series.



R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## Three main sources of NORM in Oil and Gas production

1. Radium isotopes **Ra-226, Ra-228, and Ra-224** are dissolved in the formation water that is co-produced with the oil and gas;
2. Radon (**Rn-222**) travels from the reservoir rock with the water and gas;
3. Unsupported **Pb-210** is directly mobilised from the reservoir rock.



The parent nuclides **U-238** and **Th-232** are not mobilised from the reservoir rock.

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## The three sources result in a NORM problem in three ways

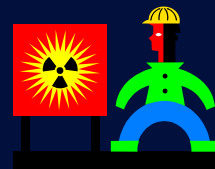
1. Due to temperature and pressure drops radioactive (**radium**) sulphate and carbonate **scales** are formed on the inner walls of production facilities, and in sludges;
2. **Thin films of Pb-210** appear on the inner walls as Rn-222 decays;
3. The unsupported **Pb-210** is found in the **sludges**.

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## Reported activity concentrations

Radium isotopes:  
from 0.1 Bq/g up till 15,000 Bq/g

Pb-210:  
up till 1,000 Bq/g



Care should be taken when working on **opened** installation parts, especially when you consider the **large volumes** of radioactive materials.

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## External radiation

Location	Dose rate ( $\mu\text{Sv/h}$ )
Down hole tubing, safety valves (internal)	up to 300
Wellheads, production manifold	0.1 – 22.5
Production lines	0.3 – 4
Separator (scale, measured internally)	up to 200
Separator (scale, measured externally)	up to 15
Water outlets	0.2 – 0.5

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## Radiation protection measures

- Workers should be protected against the harmful effects of the radioactive material
  - **External exposure**
    - time, distance, shielding
  - **Internal exposure**
    - **protective clothing, respiratory protective equipment, appropriate work methods, industrial hygiene**
- Work should be performed in such a way that uncontrolled release and dissemination of radioactive material is prevented (good housekeeping practices)
  - **Clean-up of contaminated land is very costly**

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## Radioactive Waste

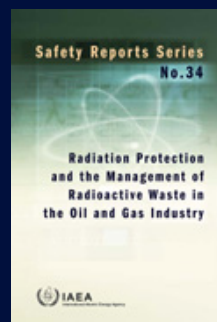
- Work should be performed in such a way that the **volume of radioactive waste** that is produced is kept **as low as possible**;
- Provided that there are allowed disposal options, the disposal of radioactive waste is usually very expensive.



R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## More information

IAEA Safety Report Series No 34  
Radiation Protection and the Management of  
Radioactive Waste in the Oil and Gas Industry



R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## NORM in an African E&P company

- Anecdote: NDT operator observed an enhanced gamma dose rate at pipeline
- RTD Radiation Protection Services performed a radiation survey
- NORM was encountered in various installation parts either
  - still in operation or
  - supposed to be disposed off as scrap metal

**The company has a NORM problem**



R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## Company's response

- No regulations on ionising radiation, and radioactive materials in the African country where the Company was operating, let alone on NORM
- Company is part of international group of companies of Dutch origin: Company has to comply with group regulations
- The Radiation Advisory Committee re-acted by developing NORM procedures

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Company's policy

It is the Company's policy to protect personnel, the environment and the general public against the hazards of exposure to ionising radiation due to its activities. In following this policy the Company will apply the three basic principles for radiation protection:  
**justification, optimisation and dose limitation.**

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Policy implementation

In implementing the policy the Company will:

- apply and handle ionising radiation sources or radiation devices in a responsible way, and
- minimise exposure of personnel and public to far below the dose limits set (ALARP)

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Policy implementation with regard to NORM

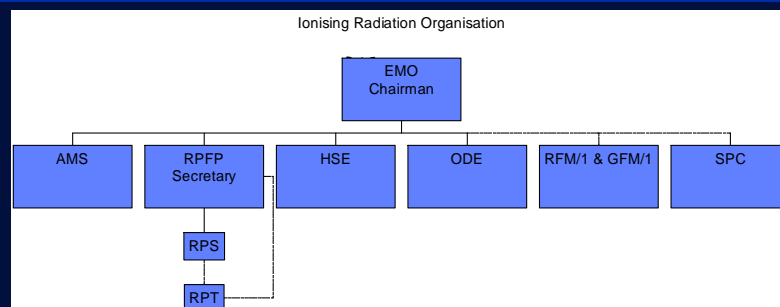
Specific objectives in respect of NORM are to:

- identify all sites where NORM is encountered in order to issue appropriate HSE rules of conduct ('operations') and to provide suitable Personal Protective Equipment ('maintenance');
- prevent the release of NORM into the environment;
- identify proper treatment, storage and disposal routes for NORM waste and NORM-contaminated equipment, and
- plan NORM clean up efforts using a cost/benefit approach.

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Radiation Protection Organisation African Company



- RAC: Radiation Advisory Committee
- RFPF: Radiation Protection Focal Point
- RPS: Radiation Protection Supervisor
- RPT: Radiation Protection Technician

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229





## Radiation Advisory Committee (RAC), members

- General manager of Company
- Operational managers
- Managers of staff departments
- Radiation Protection Focal Point

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Radiation Protection Focal Point (RPFP)

- The RPFP is the **in-house radiation expert** and the **liaison** to the external (expert) consultants on ionising radiation
- The Company uses radiation experts of RTD Radiation Protection Services to perform the tasks of a Radiation Protection Advisor
- Further experts of other companies of the group are consulted

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Responsibilities / Tasks of RFPF (on NORM)

- act as secretary for the RAC meetings
- monitors/proposes the company's radiation protection policy implementation
- communicates with competent regulatory authority on Company matters concerning the protection against the hazards of ionising radiation
- is current on all potential and actual NORM-related activities within the company at all times
- data base owner for registers containing records on
  - NORM data
  - radiation monitoring/doses:
- identify the need for radiological workers and the number of RPS's and RPT's required

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Training of RFPF

- The RFPF shall be trained in all aspects concerning the use and handling of radiation sources and radiation devices, and handling of NORM-waste and NORM-contaminated objects.
- The RFPF shall have knowledge of all local regulations on ionising radiation as well as the recommendations laid down in the Ionising Radiation Safety Guide and international regulations and developments.
- The RFPF shall at least have 3 years experience in the petroleum Exploration and Production industry (with respect to NORM).

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Radiation Protection Supervisor Responsibilities

The Radiation Protection Supervisors (RPS) will carry out measurements and supervision of work involving potential exposure to ionising radiation.

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Radiation Protection Supervisor Tasks

- inspect and supervise work involving radiation sources and non-routine NORM jobs
- ensure quality assurance of radiation protection
- organize the required monitoring and sampling
- qualify waste with respect to the Company's clearance/exempt concentration c.q. surface contamination limits
- ensure that NORM waste and NORM-contaminated equipment is stored, packaged and disposed off in compliance with regulations and procedures
- communicate with and report to the RFPF

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Training of RPS

The RPS shall

- be trained in Basic Radiation Safety, with emphasis on the handling of NORM
- have knowledge of the company's procedures on NORM

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Radiation Protection Technician Support the RPS

To support the RPS's a number of personnel are trained as Radiation Protection Technicians (RPT). The RPT's only need to measure the external radiation ( $\mu\text{Sv/h}$ ) and contamination levels ( $\text{c/s}$ ) when a specific part of the installation is opened and report the measurement results to the RPS. They are instructed by the RPSs.

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Radiation Protection Technician Tasks

- measure both the external radiation ( $\mu\text{Sv/h}$ ) and contamination level (c/s) whenever an installation part is to be opened;
- report the measurement results in compliance with the relevant NORM Procedure;
- notify the RPS if either one or both levels exceed the agreed standards;
- supervise routine NORM jobs.

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Training of RPT

The RPT shall

- be trained in using the available radiation monitors to measure NORM
- have knowledge of the Company's NORM Procedures concerning the registration and reporting of measuring results
- at least have assisted a RPS at 3 routine jobs with respect to NORM

Refresher training should be carried out annually

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Objectives of the training provided by RTD

- to create a general awareness of the presence of NORM, and the hazards thereof.
- to reduce directly the risk for the workers
- to inform the workers about good housekeeping
- reassurance of the (often non-educated) workers

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Students

- The population of students is a mixed population with regard to culture, education, and work experience;
- Most students have no background in physics, and therefore some of the physical background of radioactivity, and ionising radiation must be treated;
- Especially the RPTs do not speak English, therefore training has to be provided in French, or with French interpreter.

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## Main elements of the course

- Theoretical and practical part
- Course is given “in house” on the production locations
- Practical exercises at the work location of the students are possible (reassurance)

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## Theory and practice



R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## Training course contents

The course consists of the following elements:

- basic atomic and nuclear physics: atoms, molecules, isotopes, radioactive decay;
- ionising radiation: the distinct properties of alpha-, beta- and gamma radiation;
- interaction of ionising radiation with matter;
- dose and dose rate, annual limits;
- external, and internal radiation exposure, contamination;
- origin of NORM in the oil and gas production;
- detection of NORM (portable monitors)
- interpretation of measurements;
- the specific hazards of NORM;
- protective measures to be taken during work on NORM contaminated installations
- implementation of the Company's NORM procedures

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229

## "Test your knowledge"

- At the beginning of the training course every student is provided with a list of questions
- Usually these questions cannot be answered correctly by students that have no prior knowledge on radiation protection
- At the end of the training course they will notice that they can answer the questions

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229





## Course duration and examination

- RPT course: 1.5 days
- RPS course: 3 days
- Only when the students pass an exam they are provided with a course certificate

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Trainers

- The trainers are radiation experts of RTD, and
- have broad experience themselves as supervising radiation expert;
  - are used to communicate with people “on the shop floor”;
  - also perform the radiation surveys on the Company’s installations and therefore know about the extent and magnitude of the NORM contamination.

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Discussion Norm is a worldwide problem

- NORM contaminated objects may be transported from one side of the world to another (e.g. scrap metal)
- Awareness of the hazards of NORM at the location where it first occurs is of great importance
- Experience with NORM contaminated objects at scrap metal yards in the Port of Rotterdam

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Discussion Risks for Company

- Unawareness of NORM or not responding to it may lead to a E&P company to be held liable for the consequences and incidents may lead to bad publicity
- Increasing the awareness through training such a provided by RTD can prevent unwanted incidents from happening
- Training is relatively inexpensive compared to the potential financial risk

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## Discussion Motivated students

- The students are usually very motivated because it concerns their own workplace
- Students that work longer at the Company sometimes can provide valuable historic information
- The training creates awareness among the local workers: They have longer contracts with the Company than ex-patriots and do most of the communication with the local population

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229



## The End

**Thank you for your attention!**

Further information  
**RTD Radiation Protection Services**  
Delftweg 144, P.O. Box 10065  
3004 AB ROTTERDAM  
THE NETHERLANDS  
+31 (0)10 2088229  
rps@rtd.nl

R. van Sonsbeek : RTD Radiation Protection Services : rps@rtd.nl : +31 (0)10 2088229