# Good and bad practices of decommissioning in the phosphate industry

S. Pepin, G. Biermans, B. Dehandschutter, A. Poffijn, M. Sonck (Federal Agency for Nuclear Control, Belgium)

EU NORM 2 Symposium, June 17 – 19, 2014 - Prague

FANC AFCN

# Overview

- Contaminations in phosphate processing facilities;
- NORM regulations in Belgium;
- Decommissioning: “the good, the bad and the ugly”

⇒“wild” versus planned decommissioning;

- Liabilities;
- Conclusions;

# NORM in phosphate industry

Comprehensive review in IAEA **Safety Report 78** "*Radiation Protection and Management of NORM residues in the phosphate industry*"

Sedimentary phosphate rocks: typical activity concentration
1 – 4 Bq/g U-238sec

Processing:

**Sulfuric acid process**

$Ca_3(PO_4)_2 + 3H_2SO_4 \rightarrow 3CaSO_4 + 2H_3PO_4$

Phosphogypsum phosphoric acid

**Hydrochloric acid process**

$CaF_2.3[Ca_3(PO_4)_2] + 12\ HCl \rightarrow 3\ Ca(H_2PO_4)_2 + 6\ CaCl_2 + CaF_2$

water discharge Sludge (solid waste)

+ **scalings** in facilities

# Contaminations in phosphate processing facilities

## First example: HCl process

Various patterns of contamination – various dose-rate: 0,6 up to ~40 µSv/h

| | U-238 | Ra-226 | Pb-210 | Po-210 |
|---|---|---|---|---|
| | (Bq/g) | | | |
| **Scales on external side of reactor vessel** | 5.6 | 1.12 | 2.6 | 2.5 |
| **Scale in decanter** | 10.7 | 136 | 70 | 94 |
| **Scale in washing decanter** | 3.4 | 780 | 240 | 159 |
| **Incrustation in gutter** | 240 | 1.12 | 18 | 21 |
| **Scale precipitation cones** | 1.26 | 0.25 | 3.6 | 11 |

FANC AFCN

# Contaminations in phosphate processing facilities

Second example: former ammonium phosphate production

$H_3PO_4 + NH_3 \rightarrow NH_4 H_2PO_4$ (MAP)

Sulfuric acid process: uranium follows $H_3PO_4$

⇒ Uranium scales

| Nuclide | Activity concentration (Bq/g) |
|---|---|
| U-238 | 228 |
| Th-230 | 23 |
| Ra-226 | 0.14 |
| Th-232 | 0.81 |

One tank ~5 kg scales
=> ~50 g U

⇒ low gamma dose-rate !

⇒ Use the right measuring instrument

## NORM regulations in Belgium

NORM work activities (e.g. phosphate industry) submitted to declaration

⇒ Impact workers + population must be < 1 mSv/a
– if not, **corrective measures** or **licensing**

⇒ New assessment if “significant changes” in production processes
⇒ Specific assessment for decommissioning

# Decommissioning: the good, the bad and the ugly

HCl process:

⇒ end of phosphate production in december 2013

**Planned** decommissioning
(managed as a project within the company)

**Declaration** submitted to FANC including:

- Descriptions of the installations to be cleaned-up /dismantled;
- Radiological measurements (dose-rate + activity concentration of representative samples);
- Work protocol incl. protection measures for workers;
- Proposal for disposal of residues;
- Planning of operations;

# Decommissioning: the good, the bad and the ugly

**Regular meetings** between FANC and operator

FANC **authorised** decommissioning activities:

- follow-up external doses of workers (time-registration during work operations + dose-badge) + protection against inhalation/ingestion;
- Phasing of activities (1st : removal of sludge – 2nd : removal of scales);
- Waste register;
- Monitoring releases (waste water);

⇒ **Sludge** from decommissioning to be disposed on sludge basin used for production sludge (condition: similar radiological characteristics as production sludge);

⇒ **Scales**: to be decided based on evaluation of waste outlets;

⇒ **Other materials**: to be decided case by case keeping in mind Lansink principle

## Decommissioning: the good, the bad and the ugly

Former *ammonium phosphate building* (part of a larger complex)
Intricate juridical context (*bankruptcy* of successive operators)

Decommissioning undertaken without declaration to FANC
No prior characterization

Various subcontractors – not informed about radiological aspects

One phosphoric acid tank exported to a scrap yard in the Nederland
⇒ alarm of portal monitor
⇒ U contaminated scales

⇒ FANC inspection on site

# Decommissioning: the good, the bad and the ugly

Installations in devastated state:

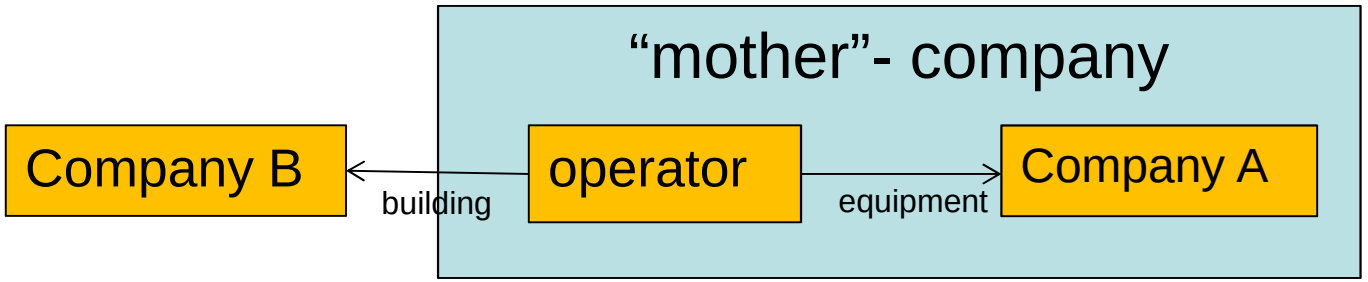



Parts of equipements transfered to another location: spills of scalings on the ground;

# Decommissioning: the good, the bad and the ugly

Issue of **liabilities**
Operator of facility = “licensee”

Operator ammonium phosphate:
⇒Never submitted a declaration
⇒Went bankrupt during decommissioning
Operator ≠ owner of equipment (rented from company A)
≠ owner of building / ground (rented from company B)




Bankrupt operator without asset => *who is liable ?*

## Conclusions

- *Significant contaminations* in phosphate facilities with various nuclide vectors

⇒ Prior characterization (use the right instrument ! + knowledge of the processes)

- *Planned* versus *unplanned* decommissioning
- *Dialogue* needed between operator and authorities (but also enforcement policy)
- Identify responsibilities / liabilities – financial aspects

⇒ Think about decommissioning *already during the production phase*