

# **ERPAN Meeting**

## **7<sup>th</sup> June 2010, CEPN Paris**

**New UK guidance for NORM (for occupational doses in excess of 1 mSv/yr)**

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# New UK NORM guidance

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## OVERVIEW

### **New UK guidance for NORM (for occupational doses in excess of 1 mSv/yr)**

- Aimed at NORM employers who have not considered radiation
  - Does BSS/ national legislation apply?
  - Provide a simple way to initially assess the risks.
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## What's the problem in workplaces ?

Found in all rocks and soils around the world .

Uranium-238 and Thorium-232: Secular Equilibrium.

High concentrations in shales and mineral sands.

Equilibrium disturbed during production & processing.

### External Hazard

Radiation field usually v. small (0 - 1 $\mu$ Sv/h)

Some exceptions (few 100  $\mu$ Sv/h)

### Internal Hazard

Main hazard: Inhalation / ingestion, & radon !

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## Where's the problem in workplaces ?

- Oil and gas industry: scales build up in pipes and vessels.
- Mineral extraction industries: Eg china clay, coal mining, scales build up in water extraction systems.
- Metal ore processing industries: Refractory materials or feed ores may contain NORM.
- Use & processing of zircon sands or “flours”. Eg. in foundries.
- Titanium dioxide production: processing of mineral sands containing NORM (typically Ilmenite and Rutile).
- Thorium metal alloy manufacture and use: Eg. aircraft parts, welding electrodes.

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## UK regulations requirements



### Apply to:

- A. NORM being processed for radioactive, fissile or fertile properties;  
or
- B. Work where persons may exceed 1 mSv/year

### Control measures:

1. Hazard identification, elimination/reduction, and risk assessment
2. Process control to prevent dusts arising
3. Worker controls to prevent inhalation

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## Hazard identification

### Information from suppliers of raw materials

#### Monitoring and analysis of:

Dose rates at concentration points and storage locations.

Scale formation in pipework & equipment - Ra-226, Ra-228 and daughters

Precipitation with sand / sludge in settling tanks and separation vessels - Ra-226, Ra-228 and daughters

‘Plating-out’ in gas systems - Pb-210 and Po-210

**Airborne activity concentrations** where inhalation possible.

**Radon** measurements

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## Measurements in workplaces ?

### Mineral sand processing

Photograph 1

Photograph 2



Dose rates around  
exterior of bulk storage

Airborne monitoring

Radon  
monitoring

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## Measurements in workplaces ?

Oil, gas, mineral extraction

Photograph 1

Inside vessels

Equipment storage areas



Exterior of  
pipes

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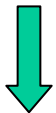


## Risk assessment

Employee dose estimation:

**$\Sigma$  External + Internal doses**

Dose rates x  
occupancies



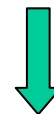
Usually < 1 mSv

Ingestion



Usually insignificant

Airborne conc. X  
inhalation rate x  
dose coeffs X  
occupancies



Can exceed 20 mSv

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## Example concentrations where doses may be exceeded

| Industry              | Material            | Nuclide | < 1<br>mSv/y | < 6<br>mSv/y | < 20<br>mSv/y | Typical values* |
|-----------------------|---------------------|---------|--------------|--------------|---------------|-----------------|
|                       |                     |         | Bq/g         |              |               |                 |
| Phosphate industry    | Phosphate ore       | U-238   | 0.08         | 0.2          | 1             | Up to 1000      |
| Zircon                | Refractory products | U-238   | 0.1          | 0.3          | 2             | Up to 1000      |
| Rare earth extraction | Monazite sand       | Th-232  | 0.6          | 2            | 10            | 40 - 600        |
| Thorium products      | Gas mantles         | Th-232  | 200          | 300          | 2000          | Up to 2000      |
| Oil & gas extraction  | Radium scales       | Ra-226  | 3            | 10           | 50            | 0.1 - 15000     |

NRPB/CEPN EC report, Penfold, J, *et al*, Reference level for regulatory control of workplaces where minerals are processed which contain enhanced levels of NORM.

\* IAEA Safety report series  
No. 49, 2006

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## Practical control measures required

HSE notification & RPA consultation

Management arrangements, supervision, Local Rules

Dust elimination in processes and cleaning-up

Dose rate and air monitoring

Designation of areas

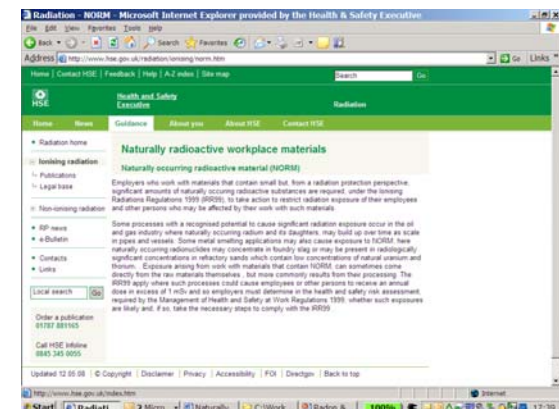
Record keeping

Training

Dosimetry & Classification of workers

Respiratory protective equipment

Accident potential?



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## Probable future international legislation

### **International Atomic Energy Agency (IAEA)**

International Basic Safety Standards for Protection of ...

### **European Commission EURATOM**

Basic Safety Standards for Protection of ...

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## European Commission

### Basic Safety Standards Directive 2010/11 ?

Classifies NORM exposure as 'planned exposure'. Registration or licensing required for worker doses  $> 1$  mSv/y and public  $> 0.3$  mSv/y.

The following list of industrial sectors involving NORM, including relevant secondary processes, shall be taken into account:

- Extraction of rare earths from monazite
- Production of thorium compounds and manufacture of thorium-containing products
- Processing of niobium/tantalum ore
- Oil and gas production
- Geothermal energy production
- TiO<sub>2</sub> pigment production
- Thermal phosphorus production
- Zircon and zirconium industry
- Production of phosphate fertilisers
- Cement production, maintenance of clinker ovens
- Coal-fired power plants, maintenance of boilers
- Phosphoric acid production,
- Primary iron production,
- Tin/lead/copper smelting,
- Ground water filtration facilities,
- Mining of ores other than U ore.

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## **HSE proposed NORM Guidance**

There is very little data available relating to foundries using zircon material. These industries employ about 250,000 people across 7000 companies in the UK. Further study in this area would be of benefit these industries.

Hazards associated with the use of thoriated metals should be considered further as there appears to be little data available.

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## HSE proposed NORM Guidance

Aimed at ensuring industries carry out initial assessment of likely exposures.

If  $> 1$  mSv/yr then more detailed assessment required, with advice from suitable RPA.

If  $< 1$  mSv then periodic reviews, avoid storing bulk materials near occupied areas, general dust reduction & RPE, COSHH may still apply.

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## HSE proposed NORM Guidance

Typical examples of industrial processes:

1. The **oil and gas industry** where LSA scales can build up inside pipes and vessels.
2. **Mineral extraction** industries such as china clay or coal mining where LSA scales can build up in water extraction systems forming part of the mining or mineral processing activities.
3. Industries that **process metal ores where refractory materials** or feed ores may contain NORM and where some radionuclides can volatilise and condense or concentrate.
4. The use or processing of **zircon sands or "flours"**. Zircon is a mineral sand containing NORM and is often used in foundries.
5. The **production of titanium dioxide** involving the processing of mineral sands containing NORM (typically Ilmenite and Rutile).
6. The manufacture and use of **thorium metal alloys** in aircraft parts and special types of welding electrodes. [\[](#)

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## HSE proposed NORM Guidance

**Initial assessment:** [Assuming Th-232 and U-238 decay chains in equilibrium and U-235 chain is negligible.]

- Calculate external doses.
- Ignore ingestion doses (unless  $> 100$  Bg/g).
- Inhalation doses – representative dust sampling (as COSHH), radionuclide analysis, ICRP dose coeffs (S values, 5  $\mu\text{m}$ ), 1.2  $\text{m}^3/\text{hr}$  breathing rate. Examples included.
- Radon

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If sum of the internal and external  $< 1$  mSv per year; it is unlikely, even considering the uncertainties in the assessment of dose that IRR99 will apply to the work activity.

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## HSE proposed NORM Guidance

### Worked examples of internal radiation doses from Th-232 decay chain\*

|                                                          |      |      |      |      |     |     |
|----------------------------------------------------------|------|------|------|------|-----|-----|
| Th-232 concentration (Bq/g)<br>in dust samples           | 1    | 5    | 10   | 1    | 5   | 10  |
| Total inhalable dust conc. (mg/m <sup>3</sup> ) measured | 10   | 10   | 10   | 10   | 10  | 10  |
| Time of exposure<br>(h/year)                             | 2000 | 2000 | 2000 | 1750 | 350 | 175 |
| Calculated annual internal radiation dose (mSv)          | 1.2  | 5.8  | 11.6 | 1    | 1   | 1   |

### Worked examples of internal radiation doses from U-238 decay chain\*

|                                                             |      |      |      |      |     |     |
|-------------------------------------------------------------|------|------|------|------|-----|-----|
| U-238 concentration (Bq/g)<br>in dust samples               | 1    | 5    | 10   | 1    | 5   | 10  |
| Total inhalable dust conc.<br>(mg/m <sup>3</sup> ) measured | 10   | 10   | 10   | 10   | 10  | 10  |
| Time of exposure<br>(h/year)                                | 2000 | 2000 | 2000 | 2400 | 460 | 235 |
| Calculated annual internal radiation dose (mSv)             | 0.8  | 4.2  | 8.4  | 1    | 1   | 1   |

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