



Experiences of dealing with NORM

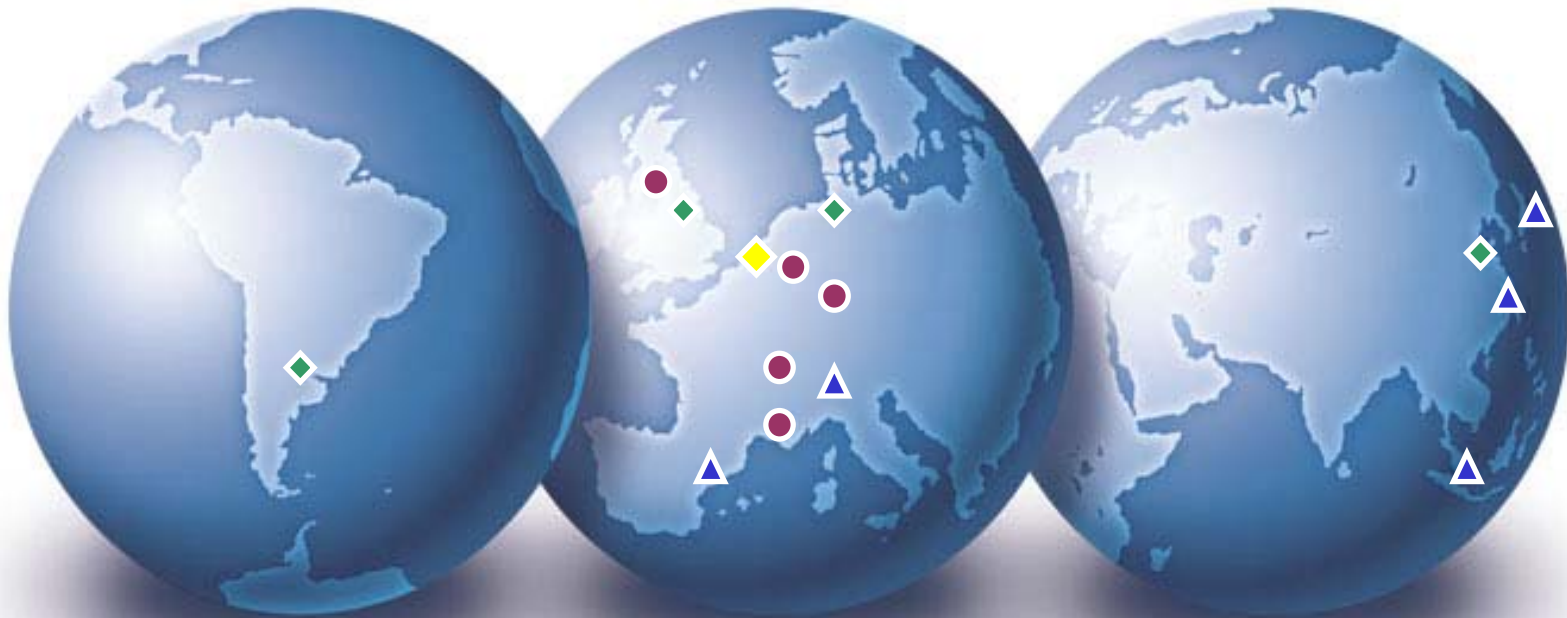
Phosphate industry in the Netherlands

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PRODUCTION	SALES	PRODUCTION SALES & MARKETING

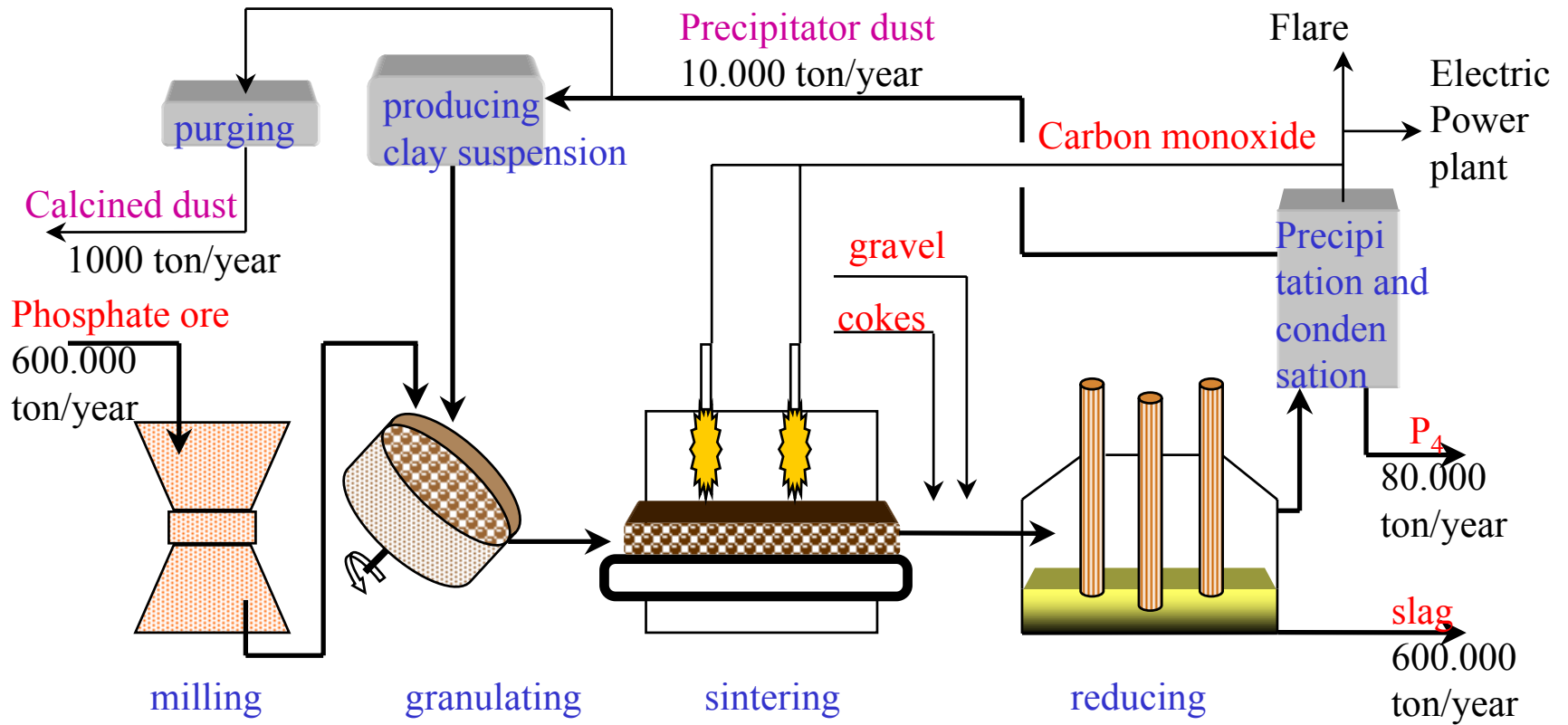


Production at Thermphos Vlissingen

- Phosphorus chlorides
- Phosphorus oxides
- Phosphorus sulphates
- Phosphoric acid
- Phosphorus



Phosphorus production process



Phosphate-ore + gravel + cokes \Rightarrow slag + carbon monoxide + phosphorus

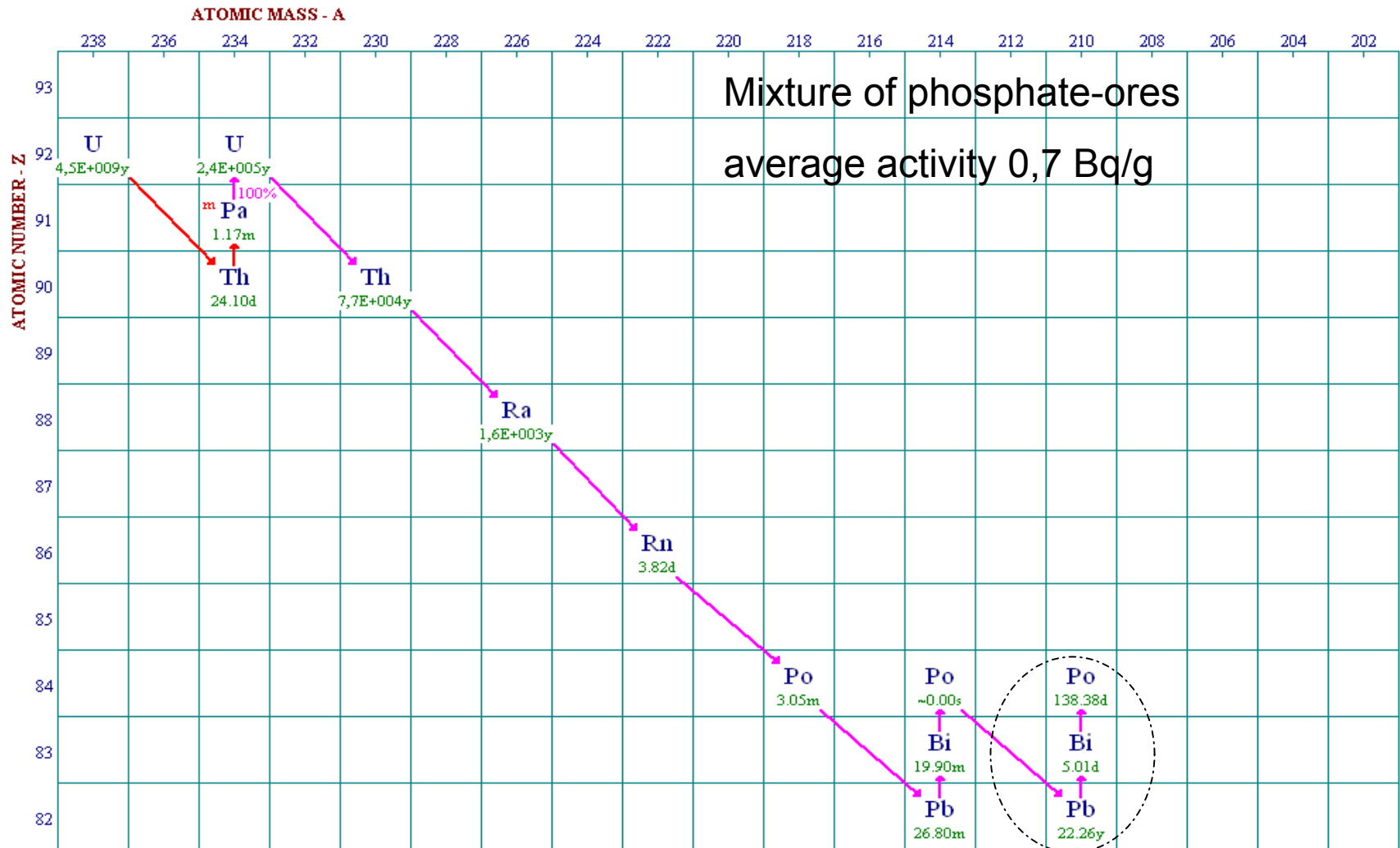


Radioactivity aspects

- *RA origin*
- *NORM material*
- *Surface contamination*
- *Exposed workers*



Natural radionuclides in phosphate-ore



Disposal of calcined dust

- Predominantly ^{210}Pb + series
- Activity concentration
 - 500-800 Bq/g
- At present calcined dust is stored at COVRA for 150 years before it can be permanently disposed of



Risks of workers exposure

- Natural radionuclides alpha en beta emitters
- Inhalation of dust-particles results in possible exposure
- Handling of NORM material; surface contamination



Determination of risks

- Surface activity measurements to determine contamination
- Personal Air Sample-measurements program



RA-contaminated surfaces

- Possible presence of phosphorus on our installation parts.
- Decontamination practice

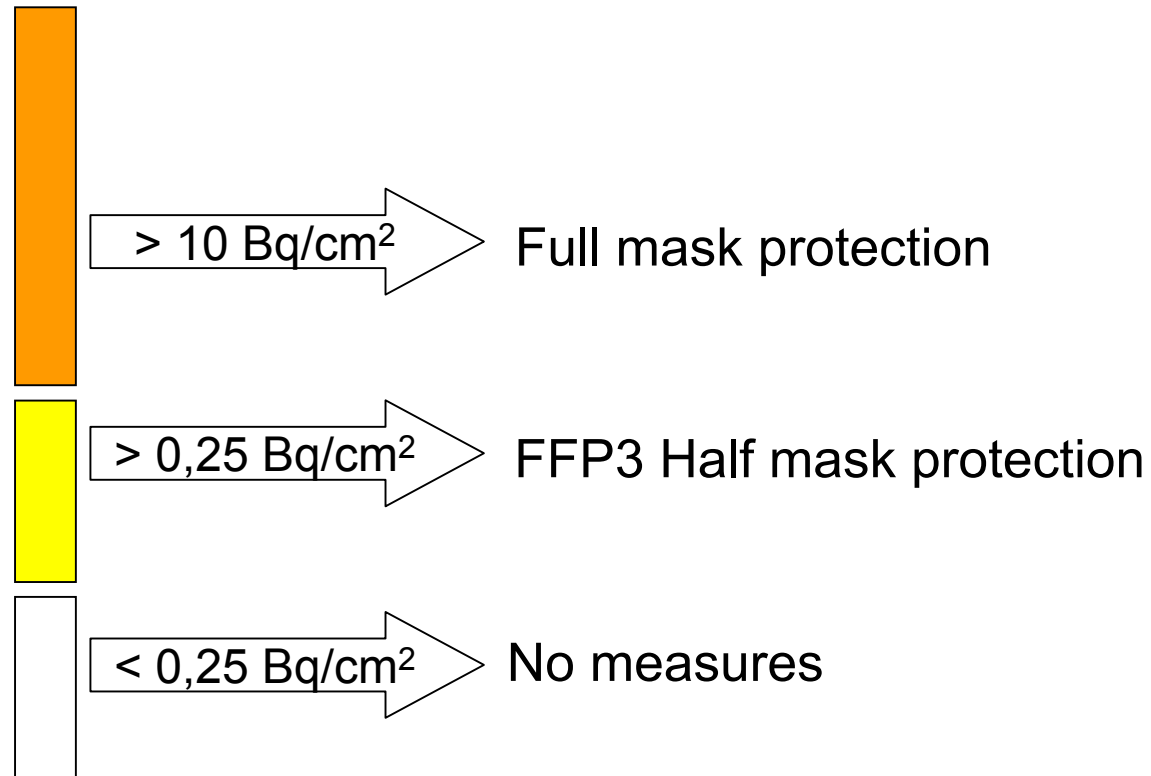


RA-contaminated surfaces

- Procedure to measure surface contamination before a work permit is written for maintenance work
- Procedure to measure surface contamination before being able to dispose scrap metal



Protective measures when working with surface contamination



Limits RA-surface contamination

- Thermphos permit
 - Dispose scrap material with a surface contamination $< 0,4 \text{ Bq/cm}^2$
- Legislation in the Netherlands
 - NABIS limit of 4 Bq/cm^2



Determine exposure of workers during “normal” working conditions

- Personal air sample program is run every year in which 60-70 measurements are carried out spread out over the different functions
- The average dose is determined, which is reported to the exposed workers



Personal Air Sample (PAS)-measurement



Results

- Some results of 2006
 - » Thermphos average 0,43 mSv/a
 - » P4 process 0,34 mSv/a
 - » Sintering process 0,55 mSv/a
 - » Cleaner 0,73 mSv/a
- There is some relation between function of the worker and the received dose
- On average dose 0,6 mSv (2006)
- Cleaners dose of 0,75 mSv (2006)



Legislation in the Netherlands

- Radiation protection legislation
 - Exposed workers class B, dose 1 - 6 mSv/a
 - Exposed workers class A, dose 6 - 20 mSv/a
- Dose for a Thermphos worker is below 1 mSv
 - Thermphos worker designated as class B exposed worker
 - Measurement program
 - Information and instruction program



Dose control measures

- Information and instruction
- Good housekeeping
- Additional protection during work with high chance of exposure (half mask or full mask)
- Process changes where possible to reduce activity of dust particles



Conclusions and summary

- Presence of natural radionuclides results in exposed workers
- Procedures to deal with surface contamination
- Dose is below 1 mSv
- Workers at Thermphos are designated as exposed workers class B.

