

# Decommissioning of non-nuclear facilities

## Insight into the process

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# Decommissioning of non-nuclear facilities

- 1 ALARA principle**
- 2 Scope non-nuclear facilities**
- 3 Process of decommissioning non-nuclear facilities**
- 4 Decommissioning; execution process**
- 5 Decommissioning project; a former phosphorus production plant**

# Decommissioning of non-nuclear facilities

## 1. ALARA principle.

ALARA

'As Low As **Reasonably** Achievable'  
taking economic and social factors  
into account



## 2. Scope of non-nuclear facilities

- **Induced or applied radioactive materials (artificial)**
  - Accelerator facilities; radionuclide production
  - Research laboratories; radionuclides as markers
- **Natural occurring radioactive materials (NORM)**
  - Oil & gas production installations (NL)
  - Geothermal installations (NL)
  - Coal fired power stations (NL)
  - Slag wool application as insulation (NL)





- **Natural Occurring Radioactive Materials (NORM)**

- Large amounts of material (>10,000 tons)
- Relative low activity concentration (1-100 Bq/g)
- Clearance levels 1 Bq/g.
- Relative low external exposure
- Inhalation of dust by the workers
- Emission of dust (environment)



## 3. Process of decommissioning

- **Inventory**
  - Historical research of the facilities
  - Licenses, documents, interviews, rumors
- **Inventory in advance of decommissioning**
  - During working life
  - Inventory prior to the decommissioning
- **Inventory during decommissioning**
  - Items never opened during operations

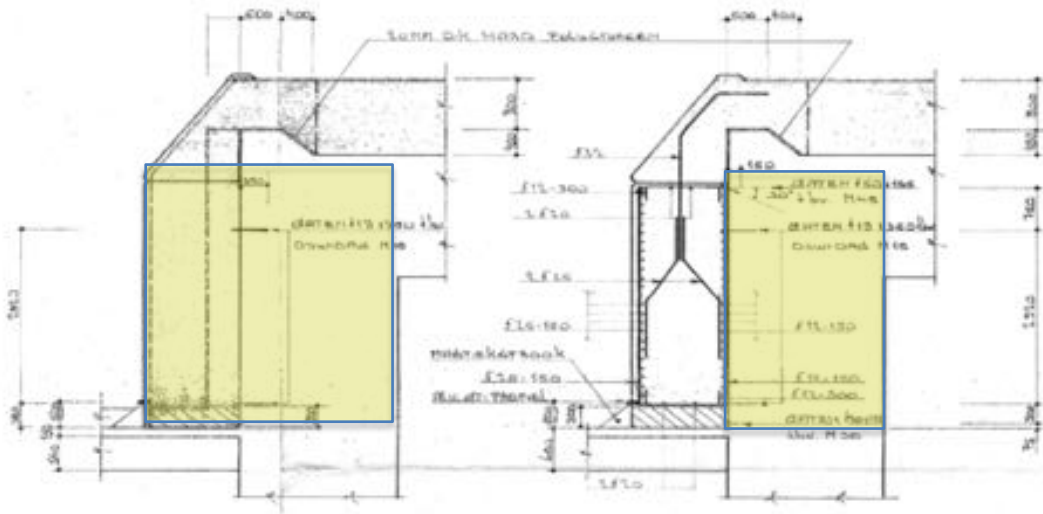


# Decommissioning of non-nuclear facilities

- Inventory of a accelerator facility ; concrete/reinforcement

DRSN. 3

DRSN. 4



## 4. Decommissioning; execution process

- Stakeholders

- Facility Owner
- License authority
- Inspectorate
- Residents



Inspectie SZW  
Ministerie van Sociale Zaken en  
Werkgelegenheid



- Project organization

- Project management
- Contractors
- Radiation Protection Expert



<https://sanerendoejesamen.nl/>



Autoriteit Nucleaire Veiligheid en  
Stralingsbescherming



DE OMGEVINGSDIENST  
VOOR EEN SCHOON  
EN VEILIG ZEELAND



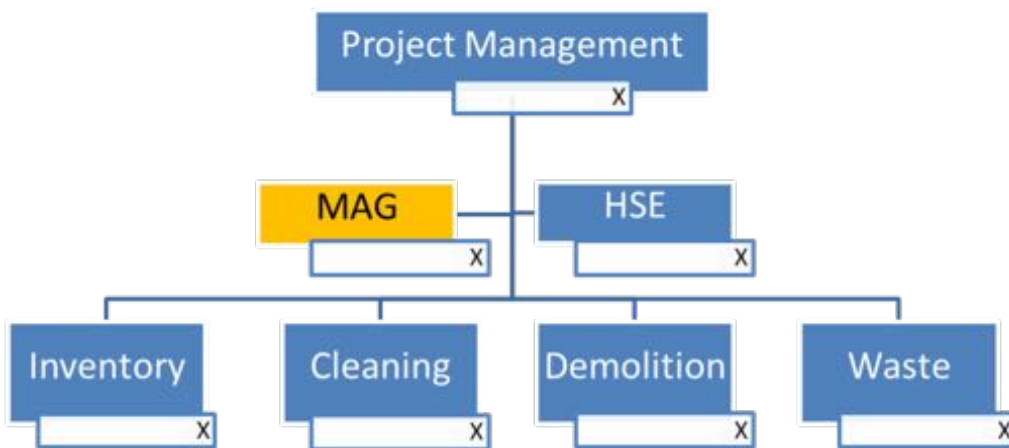


# Decommissioning execution process

## Project organization at site

- **Management Advisory Group on decommissioning**

- Facility owner
- Project management
- Cleaning contractors
- Waste manager
- Radiation protection expert



- *Subjects for discussion & decisions*
- License applications
  - When, what, how long.
- Project logistics
  - Sequence, routing
- Decommissioning techniques
  - Inventory, methods
  - Tests, pilots projects
- Release of materials
  - Methods, procedures
  - Measuring techniques

- **High pressure water cleaning**

- *Personal Protection Equipment, inhalation; contamination*
- *Water treatment; solids and solvable materials*
- *Sampling of water*



- **Grinding/sand/metal parts blasting**

- *Personal Protection Equipment, inhalation*
- *Dust; air filter, emission*



- **Chemical removal techniques**

- *Aggressive liquids, Personal Protection Equipment*
- *Solid parts and neutralizing of chemicals*

- **Other techniques**

- *Saw, drilling, milling, laser*



# Decommissioning and waste

- **Specific approach/Graded approach for each project**
- Decommission techniques; costs versus risks (ALARA)
  - Costs of workers
  - Exposure of workers
  - Environmental impact
  - Generating or reduction of waste
- Other issues;
  - Other buildings on the site
  - Citizens nearby the site



# Decommissioning project former Phosphorus Production Plant





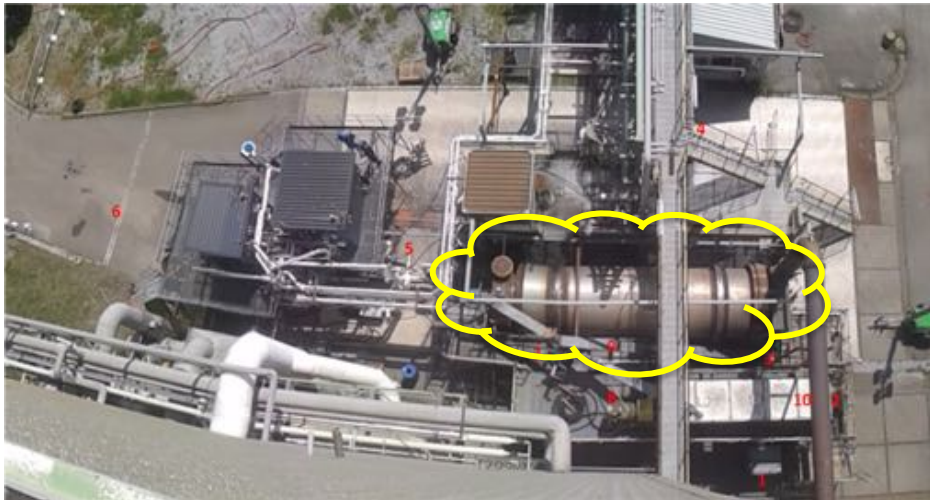
# Decommissioning project former Phosphorus Production Plant

- NORM & asbestos; PPE
- NORM & phosphorus; PPE



## 5. Decommissioning project example

- *Specific approach: Former phosphorus production plant*
- **Combined risks of phosphorus and NORM**
  - “Neutralize” phosphorus risk at site by incineration
    - NORM waste (calcinate)
    - Production of phosphorus acid
    - Emission monitoring



# Specific decommissioning of the former sintering furnaces



- NORM surface contamination Pb-210+; 100 - 2500 Bq/g.
- Walls and ceiling; surface contamination > 100 Bq/cm<sup>2</sup>
- Total surface 340 m<sup>2</sup>, total mass 100,000 kg
- Enclosed space.



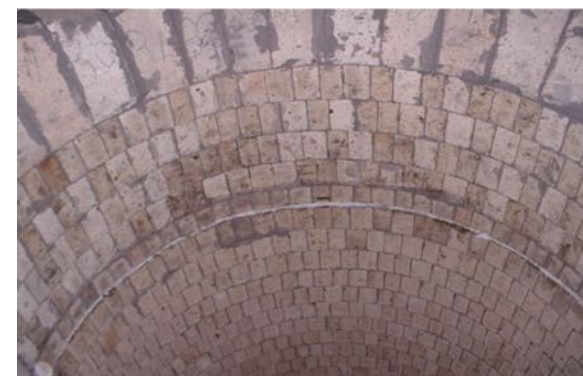
# Specific decommissioning of the sintering furnaces

- Options for dismantling of the sinter furnaces
  - Re-use of materials; steel; heat resistant materials (500 tons)
  - Waste reduction; costs of demolition versus cleaning
  - Dust environment & emissions due to dust ( $< 5 \text{ mg/m}^3$  and below clearance level)

## *Step by step approach*

- *Removal of the radioactive scaling by sand blasting*

1. Removal of dust by vacuum cleaning; 30 tons
  - NORM landfill site (notification duty;  $< 10 \text{ Bq/g}$ )
2. Removal of Pb-210 scaling from walls by sand blasting; 3 tons
  - NORM landfill site (specific clearance license duty)
3. Demolition of walls and ceiling; approx. 300 tons
  - Re-use of material below clearance levels ( $1 \text{ Bq/g}$ )
4. Cleaning of steel by high pressure water jetting and sand blasting; 200 tons
  - NORM scaling; radioactive waste (license duty)
  - Re-use of metal to scrap metal s below clearance levels for surface contamination





## Summary

- NORM installations: large amounts of waste with low activity concentration
- NORM decommissioning: dust is the major risk during decommissioning
- NNF: also other hazards involved with decommissioning
- Decommissioning projects: specific role of a management advisory group

