Applus RTD

Together beyond standards

Decommissioning of non-nuclear facilities

Insight into the process of decommissioning

André Bloot

Radiation Protection Department

Applus RTD, The Netherlands

June 2018

1. Introduction

André Bloot, Radiation Protection Expert

Applus RTD

Radiation Protection Services

Work areas

- Industrial Radiation Protection
- Natural Occurring Radioactive Materials
- License applications
- Risk analysis & environmental impact assessments

Learning Objective:

An overview will be presented of non-nuclear facilities, where decommissioning can play a role.

Participants will be able:

- To have more insight into the process of decommissioning.
- Insight into the role of the radiation protection expert in the project organization.
- Ideas will be given into possibilities of a variety of techniques.

Decommissioning of non-nuclear facilities (NNF)

1 Introduction

2 Scope

3 IAEA & decommissioning

4 Why decommissioning at non-nuclear facilities?

5 Planning of the decommissioning

6 Decommissioning process

7 Decommissioning projects in The Netherlands

8 Summary Q&A

Decommissioning NNF

2. Scope of non-nuclear facilities

- Buildings, installations and premises:
  - NORM contaminated (Natural Occurring Radioactive Materials)
  - Activated material induced by ionizing radiation
  - Contaminated materials due to applications with artificial radionuclides

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
  - Geothermic installations
  - Energy production with coal
  - Slag wool used as insulation

3. IAEA & decommissioning

Literature

- General Safety Requirements No. GSR Part 6; Decommissioning of Facilities, IAEA 2014.
- Technical Report No. NW-T-2.3; Decommissioning of small medical, industrial, and research facilities: a simplified stepwise approach, IAEA 2011.
- Safety Guide No. WS-G-2.2; Decommissioning of medical, industrial en research facilities, IAEA 1999.
- Safety Reports Series No. 67; Monitoring for compliance with Exemption and Clearance Levels, IAEA 2012.

IAEA & Decommissioning

- **GSR Part 6: Requirements**
  1. Protection of people & the environment (limits)
  2. Responsibilities associated with decommissioning
     1. Government
     2. Regulatory body
     3. Licensee
  3. Management of decommissioning
  4. Decommissioning strategy
  5. Financing of decommissioning

General Safety Requirements No. GSR Part 6; Decommissioning of Facilities, IAEA 2014.

IAEA & Decommissioning

- GSR Part 6: Requirements

1. **Protection of people & the environment**
    1. Optimization
        1. Dose limits for workers & members of public
        2. Protection against exposure of an incident
        3. Reduction of exposure due to an incident
    2. Graded approach
        1. Detail level of decommissioning plans and hazards with decommissioning
        2. Decommissioning actions and hazards with decommissioning

General Safety Requirements No. GSR Part 6; Decommissioning of Facilities, IAEA 2014.

IAEA & Decommissioning

- **GSR Part 6: Requirements**

2. **Responsibilities associated with decommissioning**
    1. Government
    2. Regulatory body
    3. Licensee
        1. Strategy
        2. Initial and final decommissioning plan
        3. Estimating costs of decommissioning and providing financial assurances and resources
        4. Managing decommissioning project
        5. Managing operational waste
        6. Safety and environmental assessments
        7. Radiological surveys

IAEA & Decommissioning

- **GSR Part 6: Requirements**
  1. **Decommissioning strategy**
     - *The selection strategy will form the basis for the planning*
       - Abandoned site or a site with adjacent buildings
       - Other contaminants
     - *The selection strategy is consistent with management of waste*
       - Clearance levels
       - How to deal with inhomogeneous contamination
     - *The selection must be justified.*
       - Costs
       - Exposure workers
       - Environmental impact

Decommissioning NNF

Implementation decommissioning plans in The Netherlands

- **Decree**
  - In cases belonging to a **category designated** by Our Minister's regulations, the entrepreneur shall draw up a **termination plan**
- **Regulation**
  - **Accelerator** energy >20 MeV or a cyclotron >8 MeV
  - **Oil and gas** exploration or oil- and gas production
  - **Coa**l energy production
  - **Thermical phosphorus** production

  - ***No slag wool***

Implementation in The Netherlands

Dutch Decree on radiation protection (2018)

- Termination plan = decommissioning plan = part of the license application
  - Facility inventory
  - Decommissioning strategy
  - Project management
  - Radiation protection program
  - Environmental impact
  - Clearance criteria
    - General clearance
    - Specific clearance
  - Costs estimation

Decommissioning of non-nuclear facilities

4. Why decommissioning at NNF?

What if NOT?

- Uncontrolled radioactive contamination in soil
- Uncontrolled radioactive contamination of other premises
- Radioactive material in consumer products

Facilities

- Abandoned sites with radioactive materials and contamination
- Radioactive materials at scrapyards
- Radioactive materials in buildings during demolition

5. Planning of decommissioning

Historical research of the facilities

i. Licenses

ii. Documents

iii. Interviews

Inventory of the facilities

i. During working life

ii. Inventory prior to the decommissioning

Inventory of decommissioning techniques

i. Reports

License application for decommissioning

Planning

- **Historical research of the facilities**

- *Licenses*
  - Radionuclides
  - Particle energy

- *Documents*
  - Year reports, log books, routine & incident records
  - Purchase of products
  - Mass balance

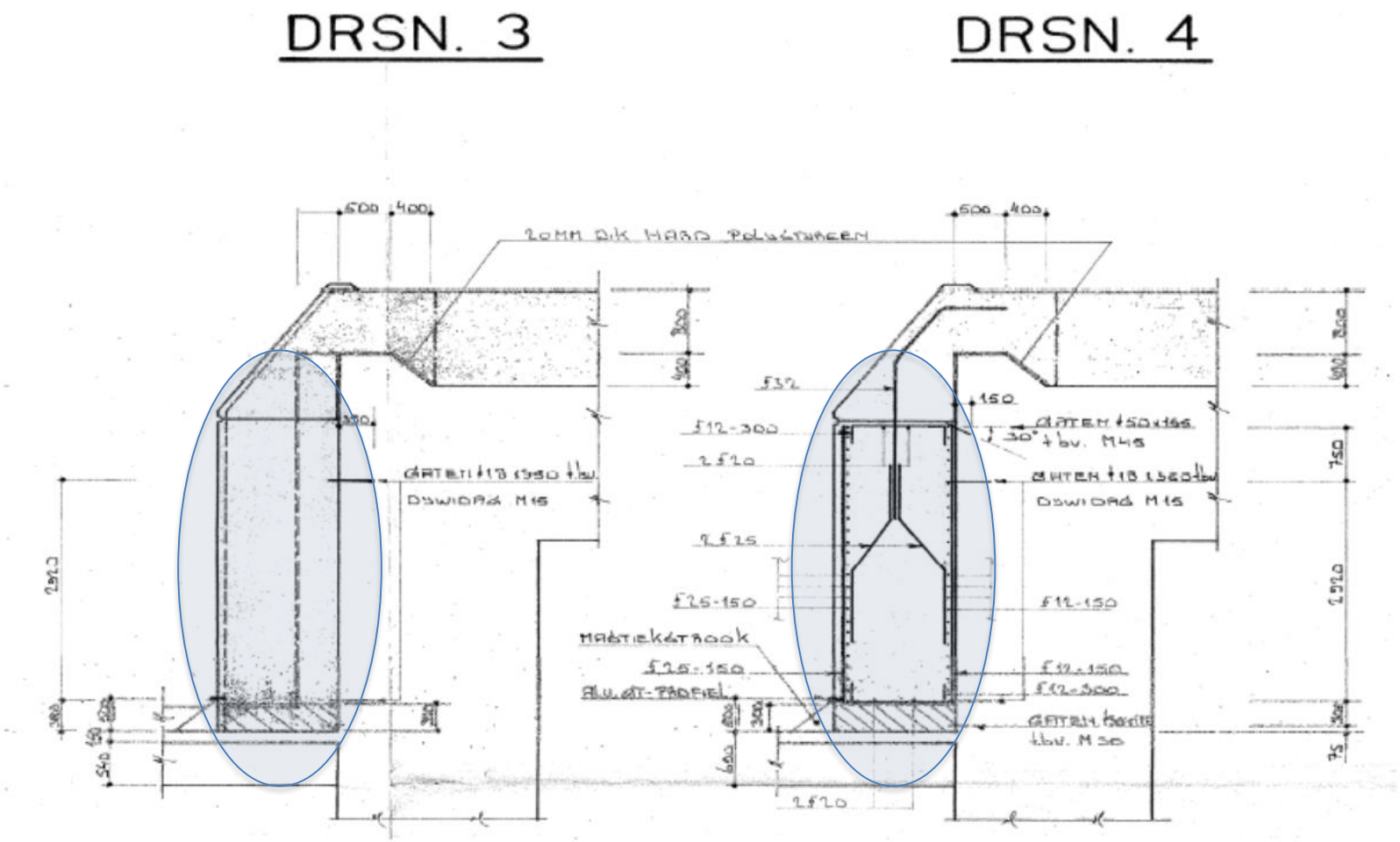
- *Interviews*
  - Knowledge of installation
  - Pollutants
  - Rumours

Planning

- **Inventory of the facilities**
  - *During working life*
    - Log files during production; amounts
    - Internal audits
    - Incidents
    - Spills
  - *Inventory prior to the decommissioning*
    - Process &Installation Drawings; calculations of amount of materials for waste
    - Product process; amounts of material
    - 3-D inventory of installation parts; decommissioning strategy
  - *Reports of inventory*
    - Drawings
    - Pictures, video, 3-D

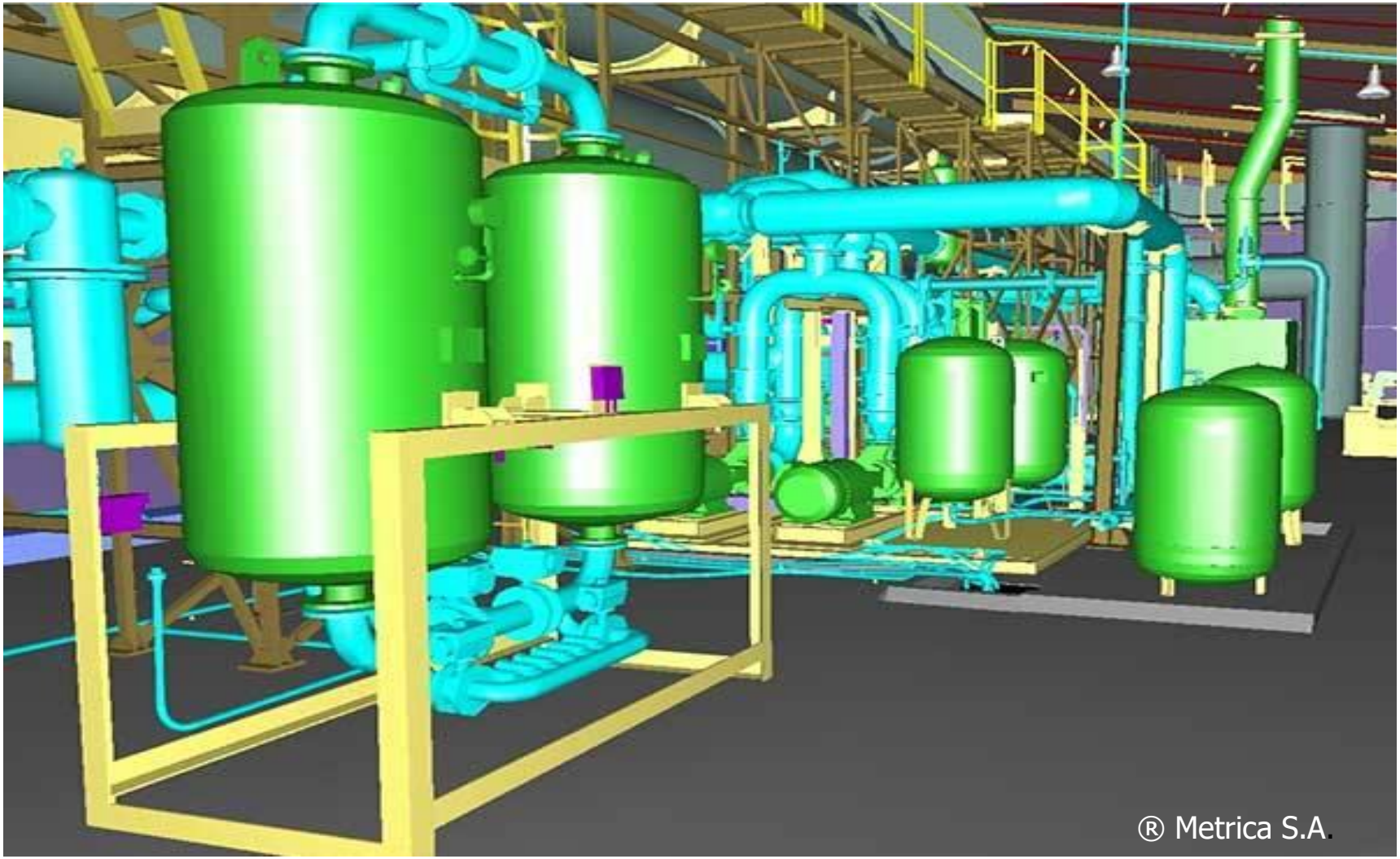
Planning

- **Inventory of the facilities ; concrete/reinforcement drawings**



Planning

- **Inventory of the facilities ; 3-D**



Planning

- **Process from ending work to start of the decommissioning**

- Inventory report of the facility
- Decommissioning plan with the choice of dismantling techniques
- License application of decommissioning
- Invitation for tenders to the contractors
- Application for license

End of working life	Inventory	Plan	Tender	License
T = 0	T = + x year			T = +2 year

Planning

- **License application for decommissioning**

- Decommissioning a Particle Accelerator Building

Start consultation talks with Authorities **T = 0**	**Start license application** **T = +1 year**	**Start decomm work** **T = +2 year**

Decommissioning NNF

6. Decommissioning process

i. License for decommissioning

- Input inventory
  - Surface contamination
  - Activation of materials
  - Large amounts of NORM

ii. Decommissioning techniques

- Approach
  - Dose rate levels (activation of steel)
  - Radioactive contamination (low levels, mass)
  - Monitoring and clearing of materials

iii. Project organization at site

- Role
  - Facility owner
  - Contractor
  - Radiation Protection Officer

Decommissioning

ii. Decommissioning techniques

- Techniques & Radioactive waste
  - **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; filter air*
  - **Chemical removal techniques**
    - *Personal Protection Equipment, aggressive liquids*
    - *Solid parts and neutralize*
  - **Other techniques**
    - *Saw, drilling, milling*

Decommissioning slag wool (NORM) insulation

Decommissioning of a NORM facility

- **High pressure water cleaning**

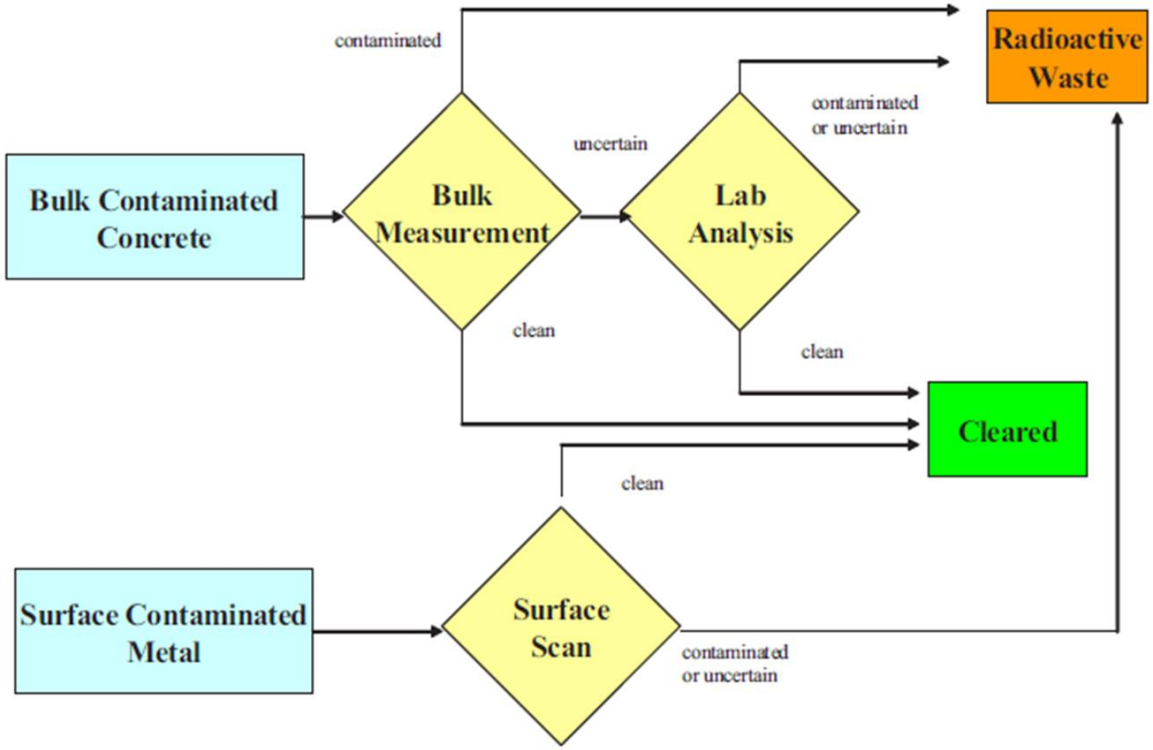
Decommissioning of a NORM facility

- **High pressure water cleaning**

ii. Decommissioning techniques

- Monitoring techniques and clearing of materials

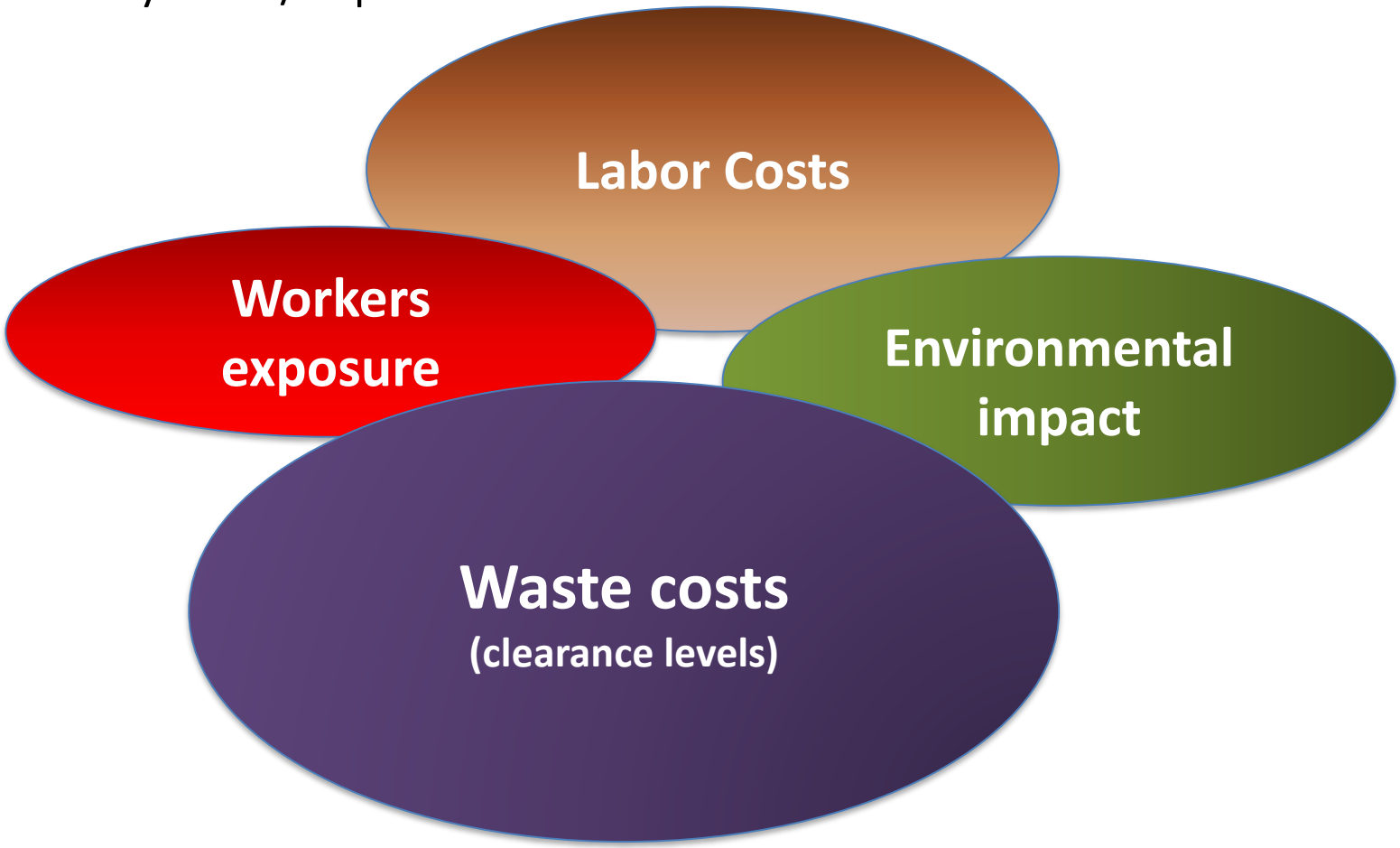
- **Bulk materials**
- Direct measurements
- A select sampling technique
- Combination of techniques
- Samples & costs



- **Surface contamination**
- 100 % measurements
- Direct measurements
- Wipe tests

Decommissioning

- **Waste reduction; exposure workers & impact environment**
  - Consequences of waste costs
  - Consistency costs / exposure



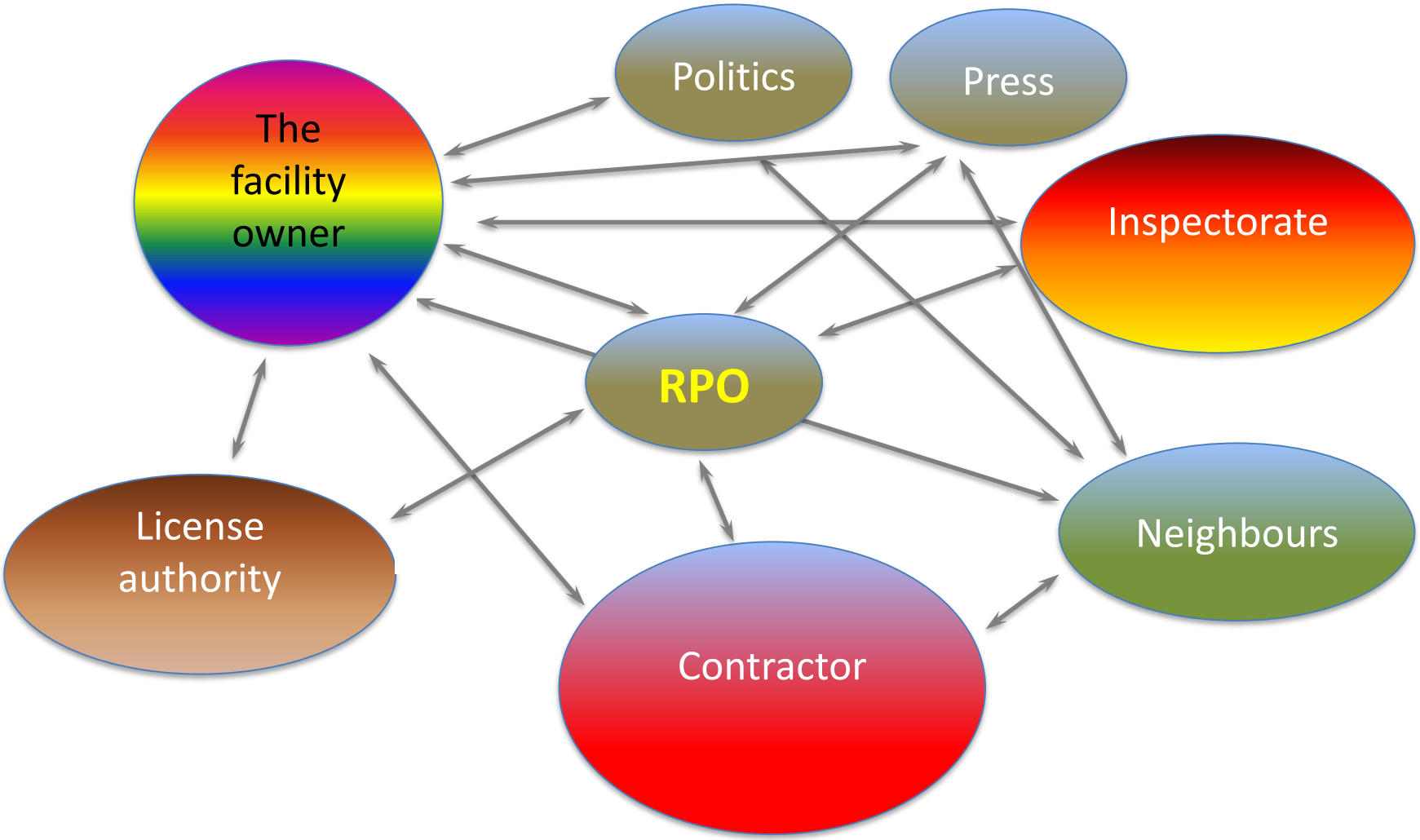
Decommissioning NNF

iii Project organization at site

- *Role of the facility owner*
    - Costs control
    - Time control
    - Impact on regular work and other facilities
- *Role of the contractor*
    - Safety first
    - Time control
    - Costs control
- *Role of the Radiation Protection Officer*
    - Key person for the authorities on radiation protection
    - Supervision of radiation protection
        - Workers
        - Release of materials
    - Advisory tasks

Process

- **Radiation Protection Officer & Stakeholders**



Decommissioning NNF

7. Decommissioning projects in The Netherlands

Specific approach/Graded approach for each project

- Gas mantle factory Amsterdam (NORM)
  - Decontamination
  - Waste reduction
- Accelerator building; Nikhef (Co-60 activation)
  - Activation products in steel and concrete
  - Concrete wall thickness; 2 m
- Phosphorous production plant; ThermPhos (NORM)
  - Large scale of the project
  - Combined risk of phosphorus, asbestos and NORM

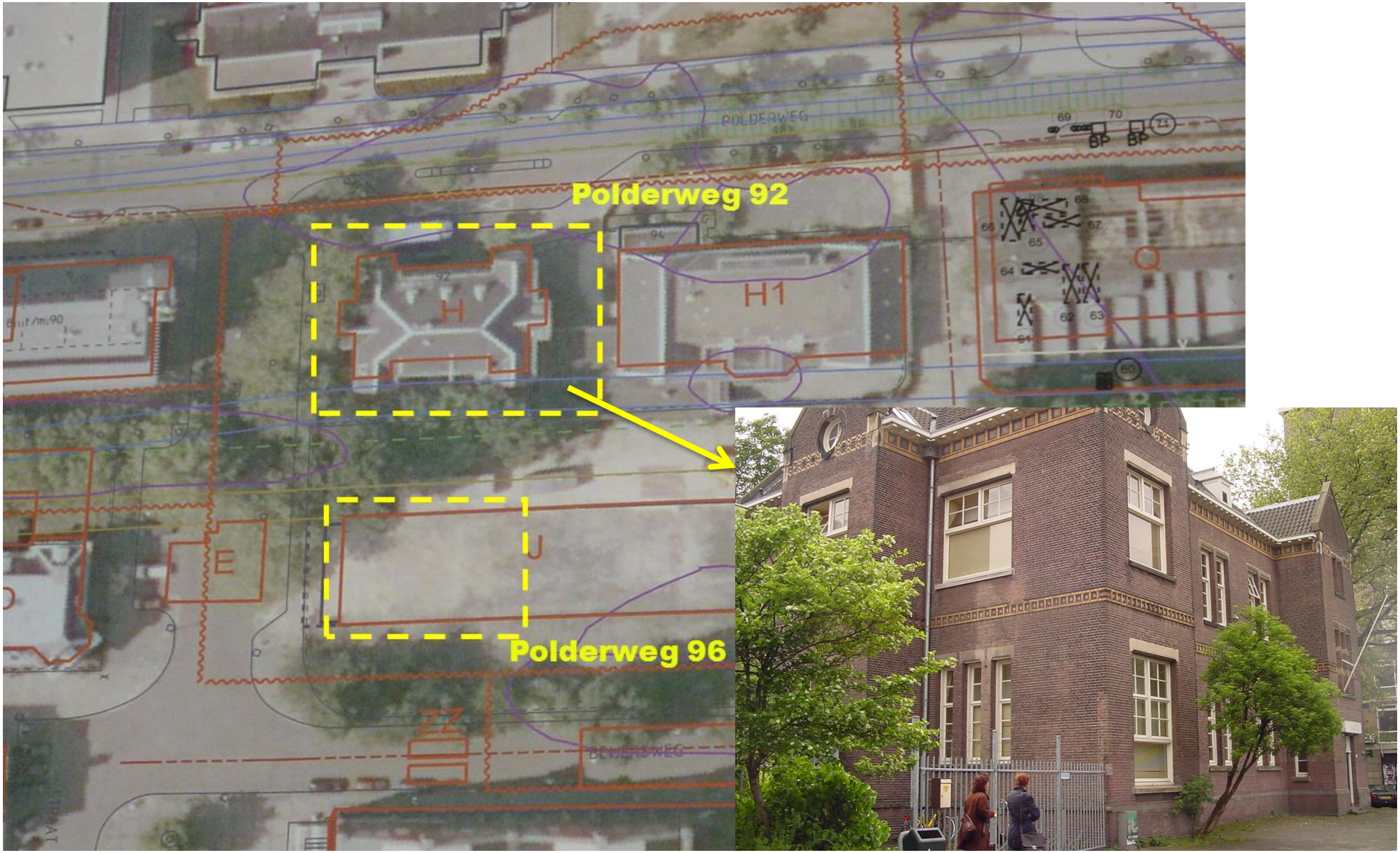
NNF decommissioning projects in NL

- **Specific approach: Former gas mantle factory Amsterdam**

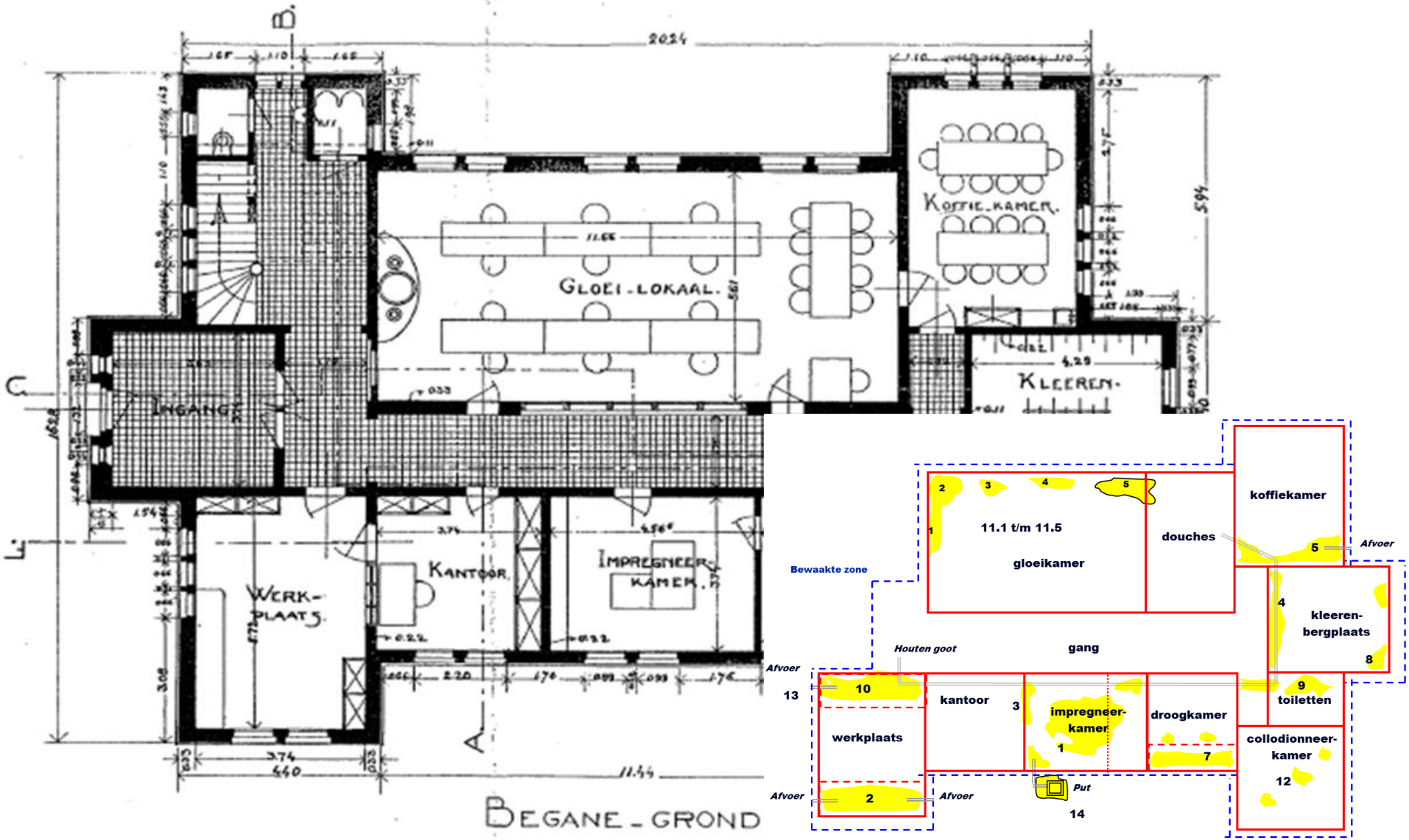
  - Historical building must be preserved
  - Removal of all radioactive material (Th-nat)
  - Soil clean up below clearance levels (< 1 Bq/g)
  - During clean up waste separation
  - **Involve the stakeholders; level of information**

    - City Counsel Oosterpark/Watergraafsmeer
    - Project bureau Polderweggebied
    - Department Soil Amsterdam
    - Engineering Department Amsterdam
    - Environmental Inspectorate
    - Labour Inspectorate
    - Residents of the Polderweg
    - Environmental group LAKA
    - RTD Radiation Protection

Decommissioning project gas mantle factory



Inventory


GLOEI-LOKAAL.
KOFFIE-KAMER.
KLEEREN-
INGANG
WERK-PLAATS.
KANTOOR.
IMPREGNEER-KAMER.
BEGANE-GROND
Bewaakte zone
11.1 t/m 11.5
gloeikamer
douches
koffiekamer
Afvoer
kleeren-bergplaats
Houten goot
gang
werkplaats
kantoor
impregneer-kamer
droogkamer
toiletten
collodionneer-kamer
Put

NNF decommissioning projects in NL

- **Specific approach: Former gas mantle factory Amsterdam**

  - Clean up manually; large equipment could mix the radioactive contamination
  - Construction of the building must be preserved
  - Create a containment within the actual building and the rooms

NNF decommissioning projects in NL

- Clearance during the sanitation:
- Comparison of a calibrated geometry with a known activity concentration of the soil samples

- Advantage
  - Accurate estimation of waste streams
  - No time consuming analyses
  - Costs of analyses can be reduced

Inventory and clean up

Inventory and clean up

NNF decommissioning projects in NL

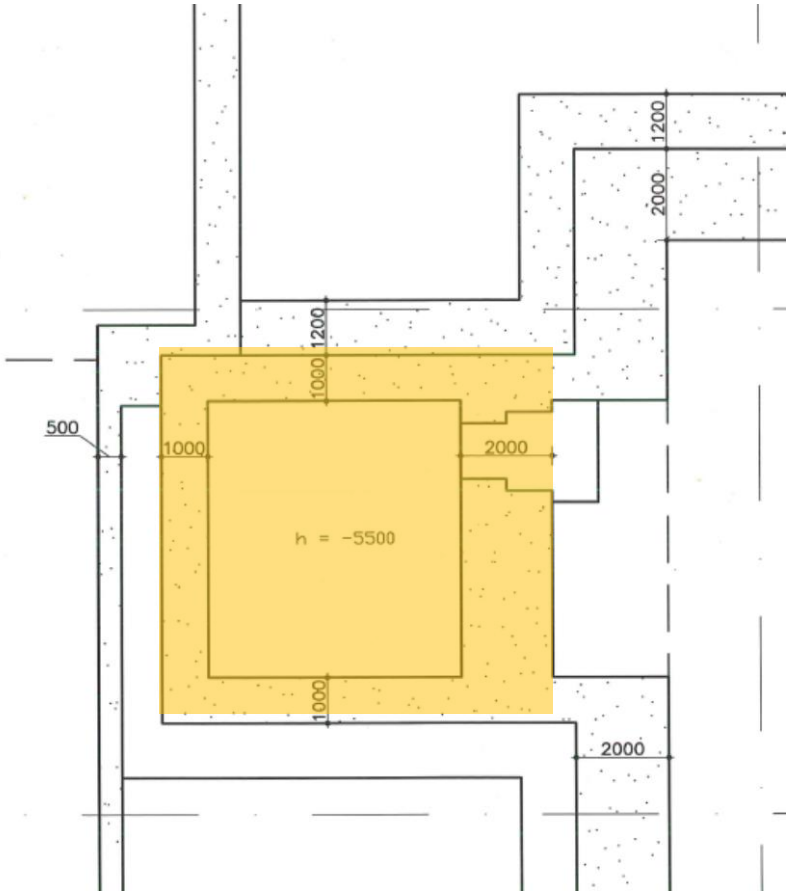
- **Specific approach: Nikhef site Amsterdam**
  - Existing buildings and neighbours
  - AMOLF Institute; science 24/7 at sub atomic level
    - decommissioning strategy
    - risk of vibrations; choice of decommissioning technique.
  - Building and part of cellars had to be removed
  - Concrete and reinforcement steel separation and clearance at site
  - **Involving stakeholders; level of information**
    - NWO Nikhef
    - AMOLF
    - City Counsel Amsterdam Oost
    - Environmental Inspectorate ANVS
    - Labour Inspectorate I-SZW
    - Residents
    - Environmental group LAKA
    - RTD Radiation Protection

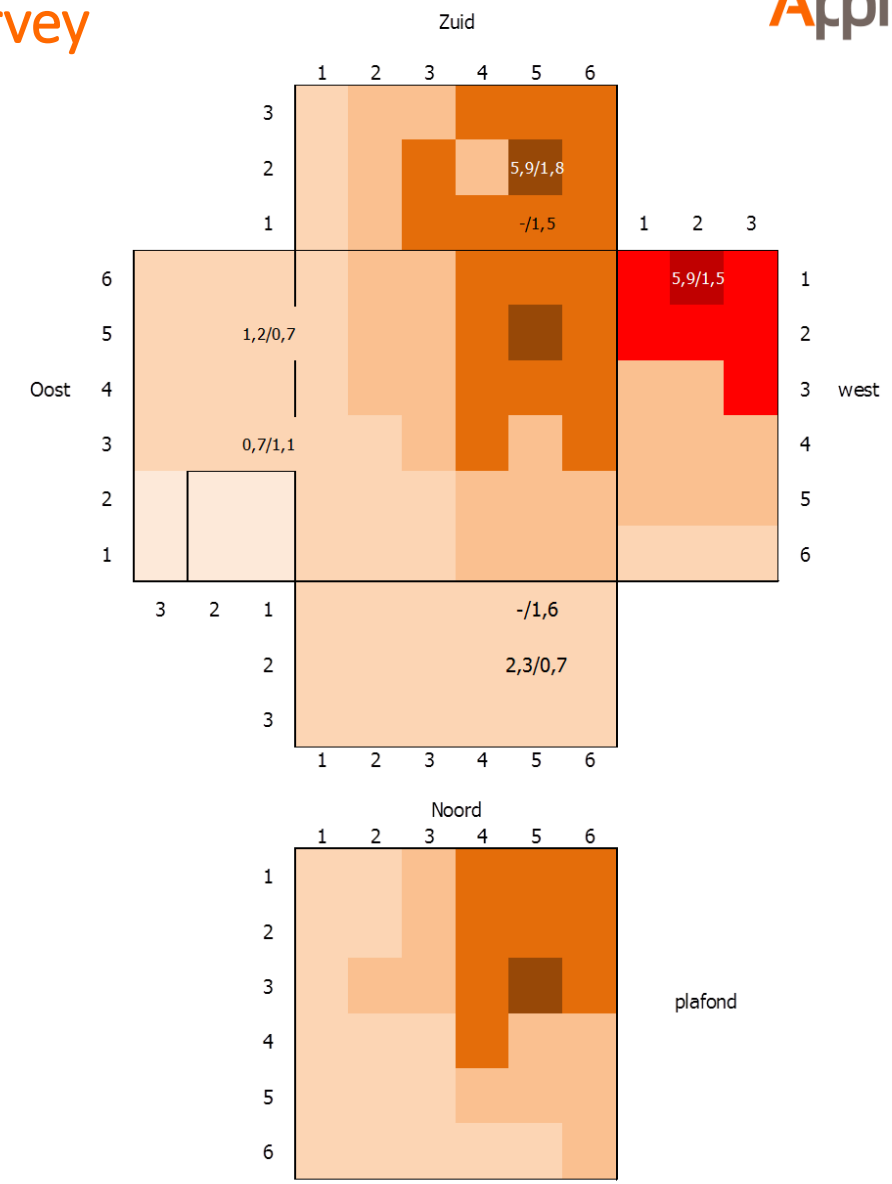
Decommissioning project Nikhef

- Specific approach: Nikhef

Particle dumping room; Co-60 activation of steel reinforcement

Decommissioning project Nikhef; survey





Co-60
Eur-152

- = geen wapening in monster

- Specific approach: Nikhef

- Specific approach: Nikhef

- Specific approach: Nikhef

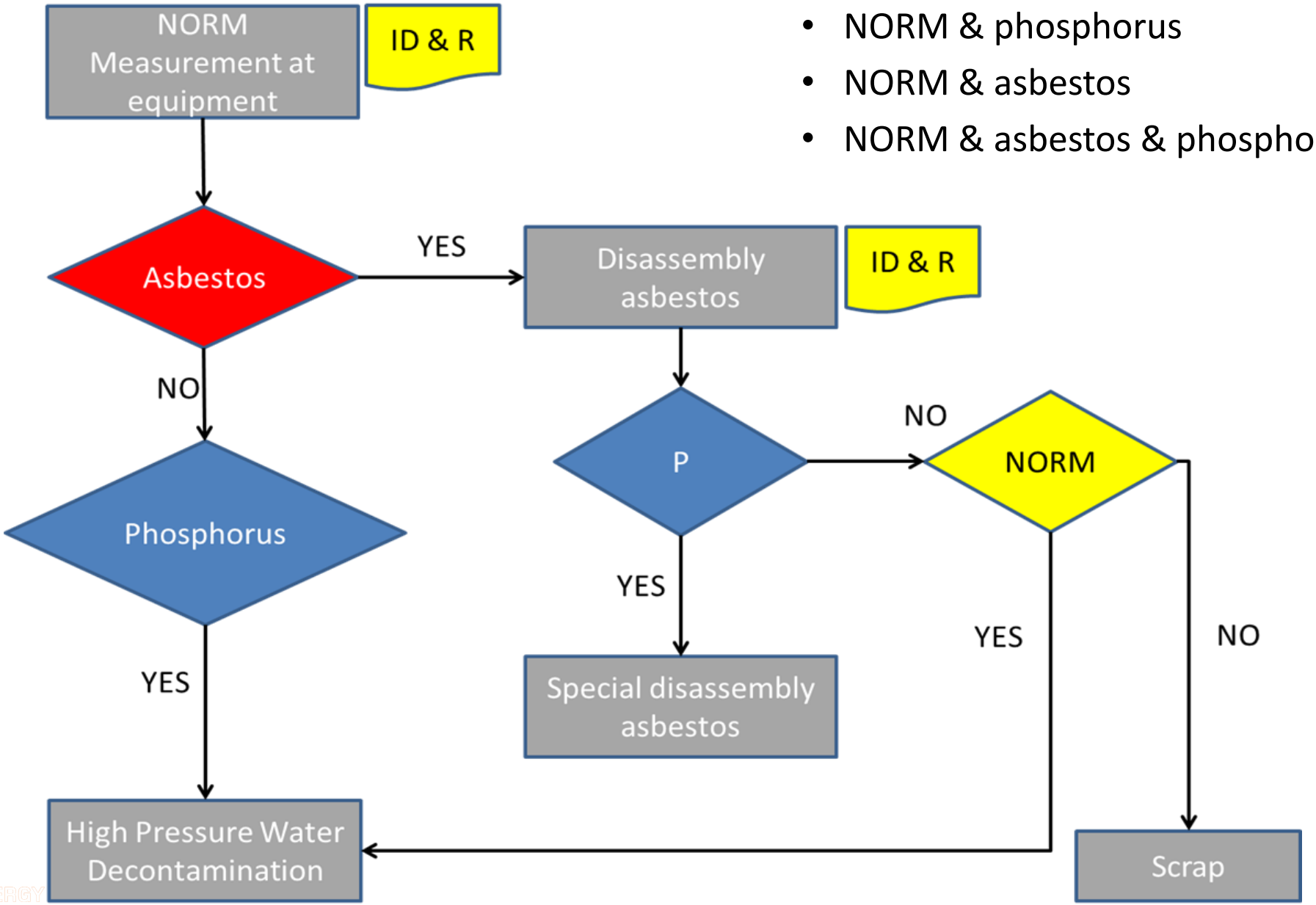
Decommissioning project former ThermPhos site

- **Specific approach: Former ThermPhos site at Vlissingen**
  - Risk of phosphorus, asbestos and NORM
  - "Neutralize" phosphorus risk at site by incineration; NORM waste
  - Several decontamination techniques were investigated
    - High Pressure water; 1000 – 2500 bar
    - Sand blasting
    - Chemical decontamination
  - **Involve the stakeholders; level of information**
    - Zeeland Seaports
    - Province Zeeland
    - Inhabitants of villages
    - Regional Environmental Inspectorate
    - ANVS; license applications
    - Environmental Inspectorate ANVS
    - Labour Inspectorate I-SZW

Decommissioning project former ThermPhos site

Decommissioning project former ThermPhos site

- NORM & phosphorus
- NORM & asbestos
- NORM & asbestos & phosphorus



Decommissioning project former ThermPhos site

- **Investigation of decommissioning techniques; specific approach**

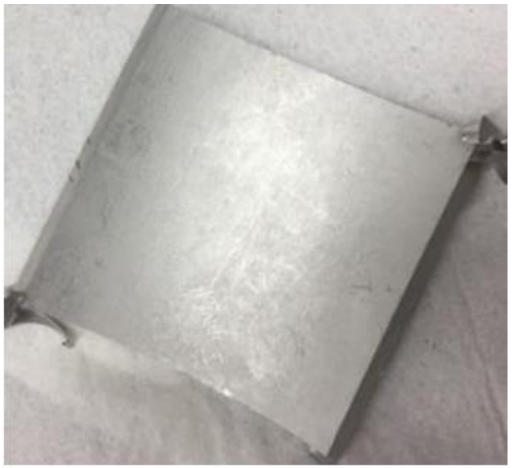
- **The chemical composition of the contamination**
  - Radioactive contamination is always a chemical composition

- **The temperature of the production process**
  - “Room temperature”
  - >1000 ˚C

- **Type of contaminated material**
  - Carbon steel
  - Carbon stones
  - Plastics

Before Deco

After Deco



Decommissioning project former ThermPhos site

- **Specific approach: “Neutralize” phosphorus risk at site by incineration**

- **Emission and discharge of radioactivity**
  - Pb-210, Po-210.
  - Monitoring and license clearance (emission)

- **Solid waste**
  - Chemical compounds (heavy metals) and leaching

- **Liquid waste**
  - Phosphorous acid and clearance levels

8 Summary & Q&A

- Make an inventory and make plans
- Talk to people who have the specific knowledge of the installation
- Inform stakeholders as much as possible
- Graded approach; also in decommissioning

Applus+ RTD

Together beyond standards