

Management of NORM waste in the Netherlands

Jeroen Welbergen COVRA, Rob Wiegers IBR,
Leo van Velzen NRG and Jan Kops KOAD

COVRA_{NV}

NORM6

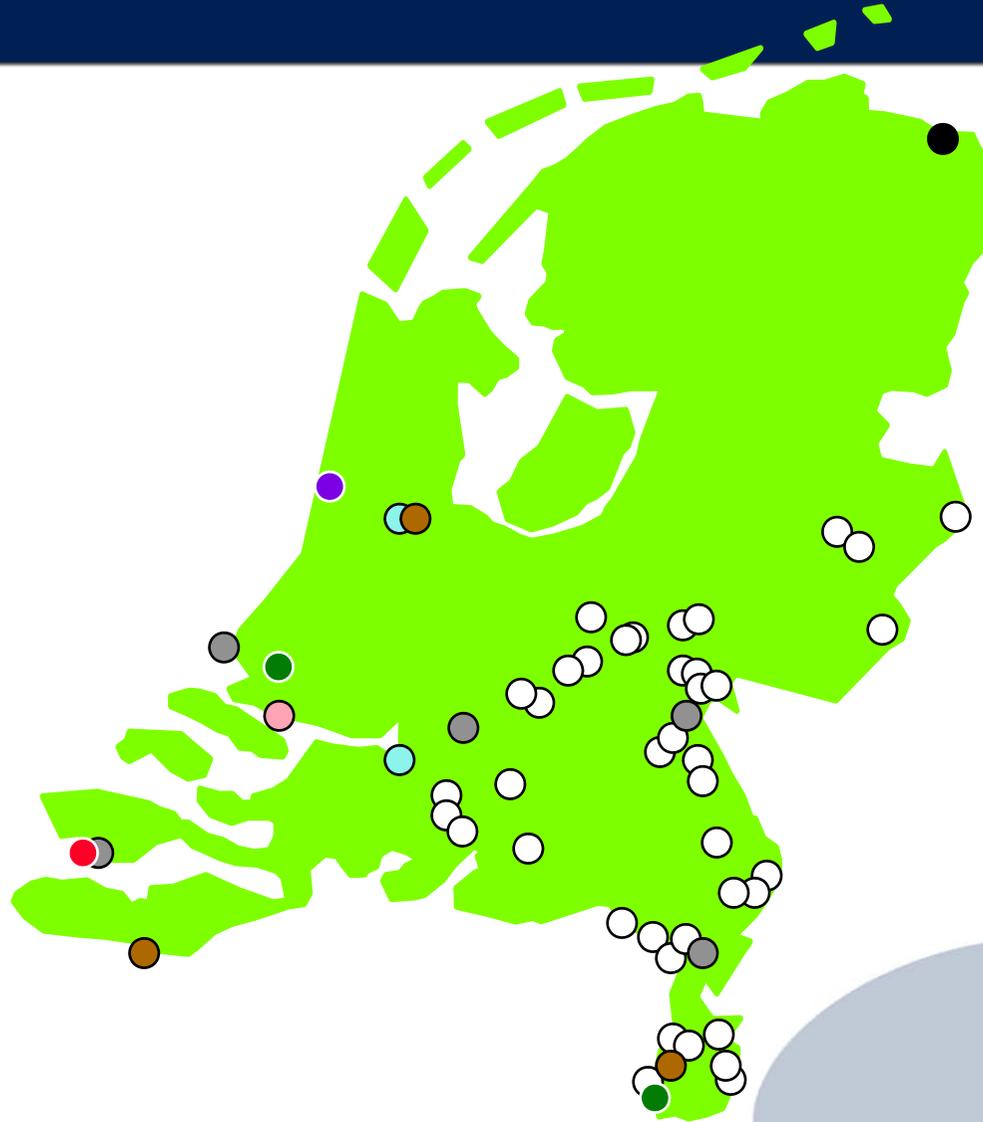
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2010

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NORM industry



- elementary P
- Titanium
- steel
- cement
- fertilizer
- Mineral sand
- Coal fired plant
- Ceramics
- Oil/gas



NORM waste

- **Steel works (slags)**
- **Coal fired plants (fly ashes)**
- **Phosphorus industry (calcinate)**
- **Oil/gas industry (installations)**
- **Pigment industry (residues)**
- **Fertilizer industry (installations)**

Problems

- **Natural resources**
 - U and Th bearing minerals, ores
- **Concentration of radionuclides**
 - thermal process
 - extractions
- **Discharges**
 - to air
 - to water
 - external radiation

Solutions

- **prevention**
 - Purchase of natural resources, adjustments in process
- **reuse**
 - Mixing with concrete, road constructions, dykes
- **cleaning**
 - Contaminated scrap to melters
- **treatment**
 - By Central Organisation for Radioactive Waste
- **deposit**
 - Land fills for NORM

Waste policy

- **Prevention ->->-> (ladder of Lansink)**
- **Exemption level (EL = CL)**
- **notification (1-10 EL)**
- **licensing (> 10 EL)**
- **Isolation, Control and Monitoring**
- **Radioactivity decay (hazards disappear!)**
- **NORM (< 10 EL) waste to deposits**
 - (near Rotterdam/near Amsterdam)
- **(TE)NORM waste (> 10 EL) to Radwaste org.**
 - (near Vlissingen)

legislation

- **International Committee of Radiation Protection (ICRP)**
 - recommendations
- **EURATOM**
 - Regulations and directives
- **Basic Safety Standard**
 - Exemption / clearance per radionuclide in Bq, Bq/g
- **Nuclear Energy act**
- **Radiation Protection Decree**
- **NORM Ordinance**

Radiation Protection Decree

- **List of justifiable applications**
- **licensing**
- **Risks analyses**
- **Radiation Protection Expert**
 - (RPE, RPO)
- **Dose registration**
- **Radwaste to certified WMO**

NORM Ordinance

- **Positive list**
- **Notification and licensing**
- **Chain control**
- **Summation of radionuclides**
- **RPE, RPM**
- **Method of measurements**
- **Waste**

COVRA site



1. Office
2. treatment
3. Storage LLW
4. Storage HLW
5. Scrap yard
6. Storage NORM
7. Storage TENORM

NORM waste from pigment industry

-TiO₂ process



- Solid waste filters with Ra, U and Th + daughters
- 5 m³/y
- 1000 Bq/g



NORM sludges from Oil/gasindustry



-dewatering

-removal of
HM

-solidify by
distillation

DVRA^{NV}



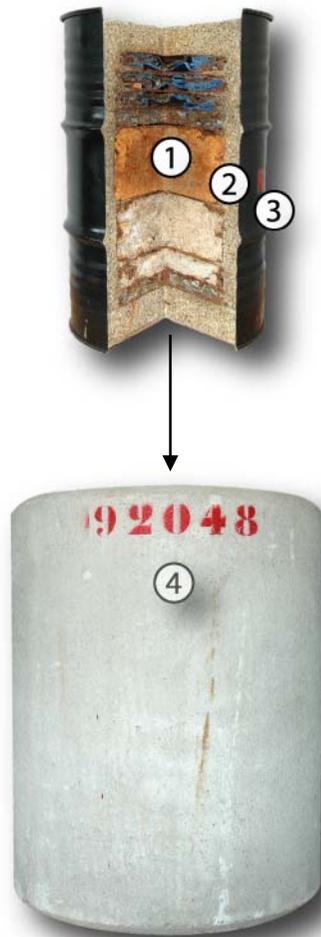
Collection in 100 l drums



Volume reduction by supercompaction

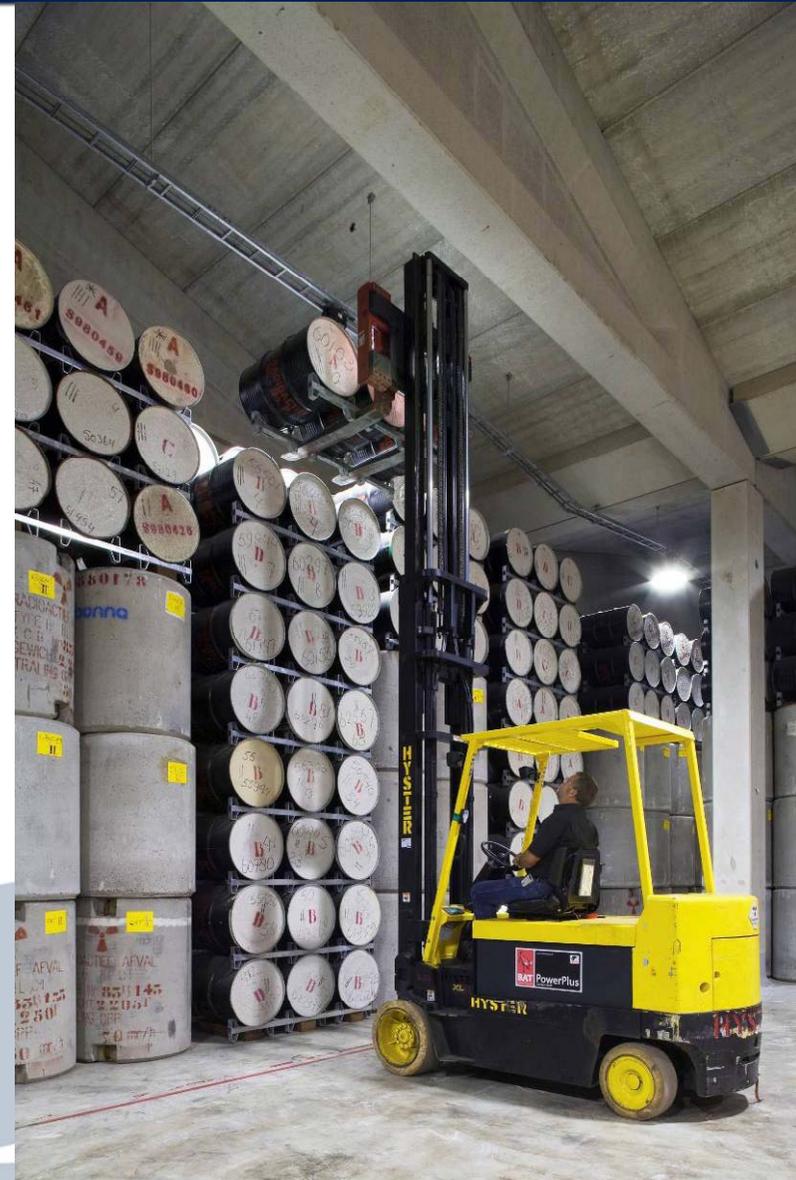
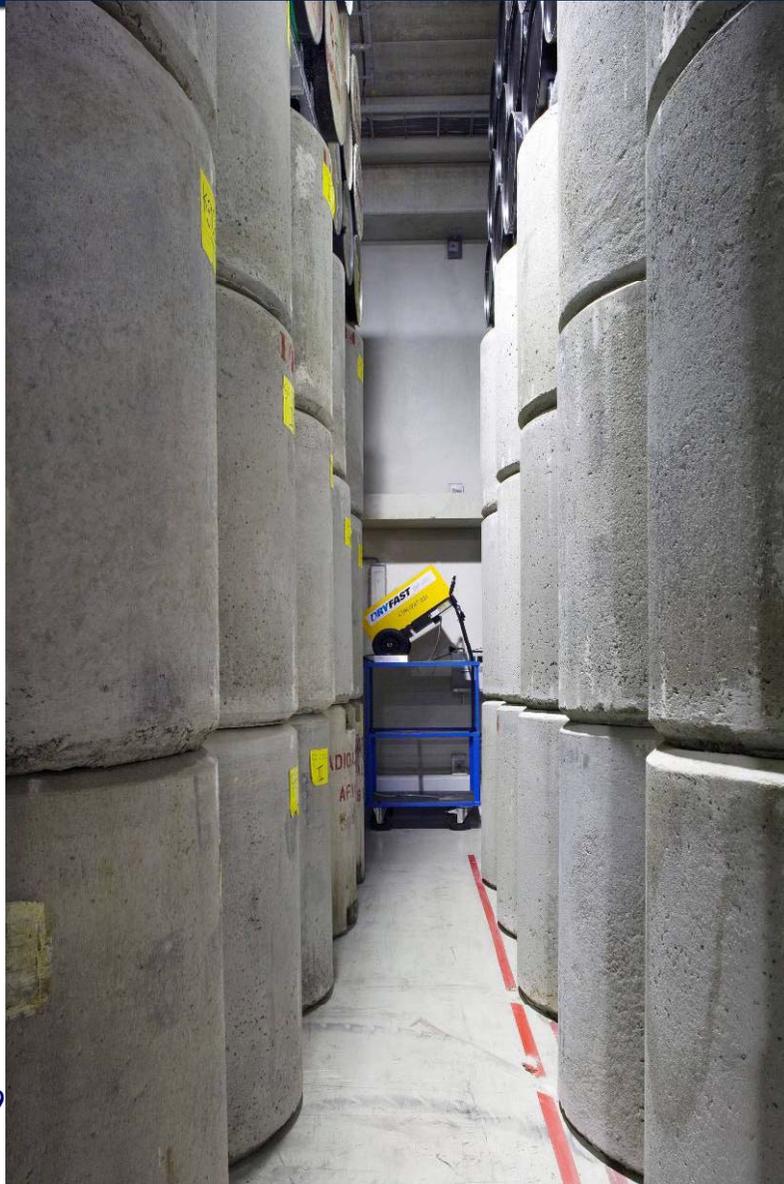


Storing pucks in drums and containers



1. pucks
2. concrete
3. galvanised drum
4. concrete liner

Stacking of drums and containers





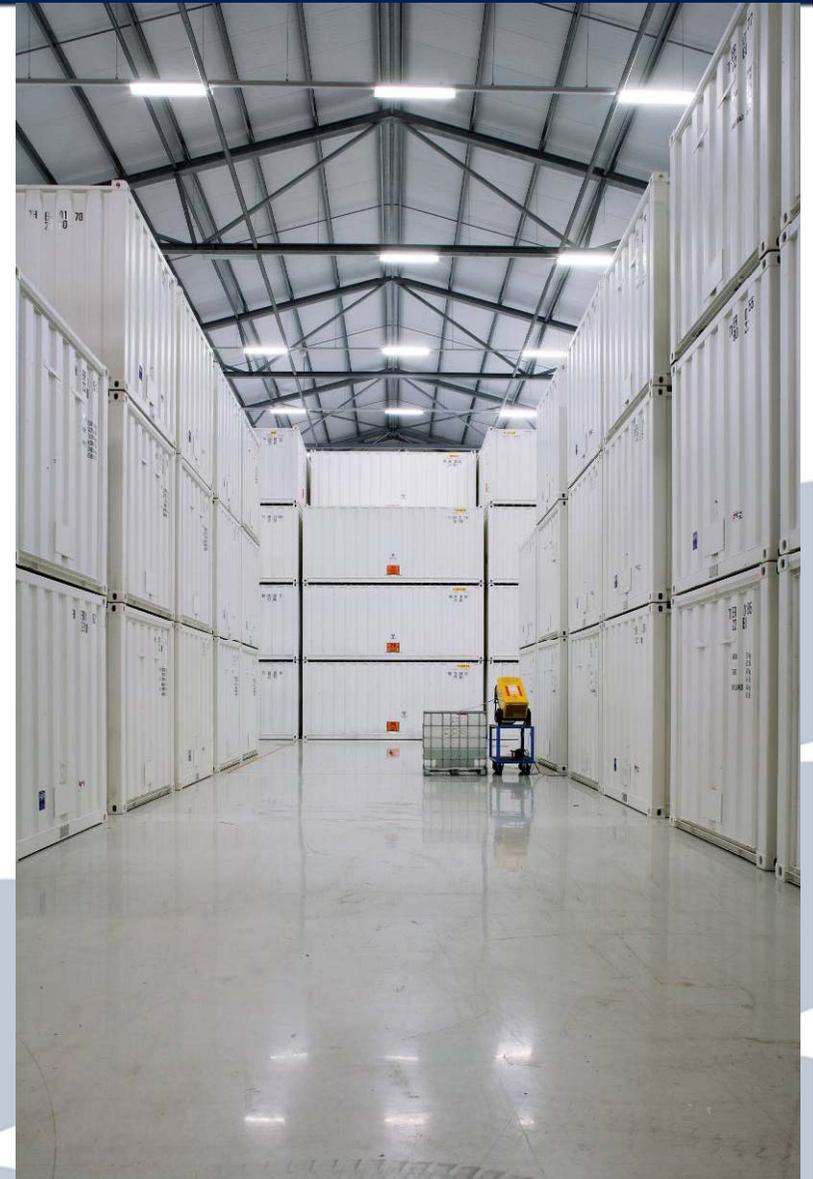
phosphorus industry

- **Thermal process with Phosphate ore**
- **Filters catch dust**
- **Dust contains airborne radionuclides**
 - **Po-210, Bi-210 and Pb-210**
- **500 tonnes/y**
- **0.5-40 kBq/g**



Storage of NORM waste

- **Solid waste of Ore industry**
- **Storage in 20ft containers**
- **Calciate will decay within 150 yrs**
- **Reuse of NORM**





Uranium industry

- **Uranium enrichment by ultra-centrifugation of UF_6 → enriched and depleted uranium**
- **Conversion of depleted UF_6 in U_3O_8**
- **Radionuclides:**
 - **$\text{U}238$, $\text{U}235$, $\text{U}234$ and $\text{U}232$**
- **5000 tonnes U/y**
- **10 kBq/gram**

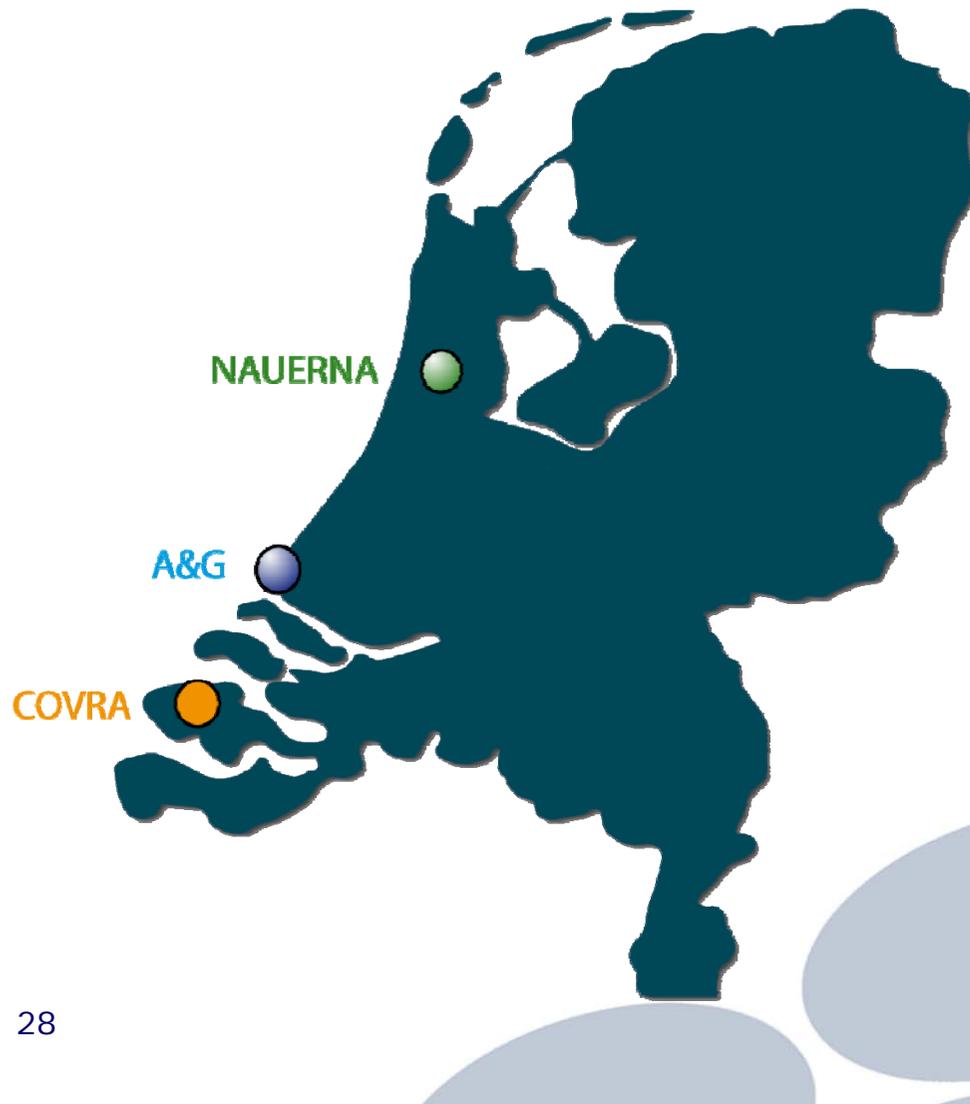


Storage of DUO

- **UF_6 not suitable for storage because of chemical hazards**
- **U_3O_8 is stable oxide**
- **reuse?**



Deposits for NORM



**Nauerna near
Amsterdam**

**A&G near
Rotterdam**

**COVRA near
Flushing**

A&G (Rotterdam)



- **Mega tonnes of NORM waste**
- **Chemical characteristics are required**
- **Leachability has to be analysed above 15 Tonnes**

Nauerna (Amsterdam)



- **Compliance with acceptance criteria is required**
- **Leachability has to be analyse above 15 Tonnes**

Long term solution

- Reuse of decayed Calcinate
- Recycling of depleted U_3O_8
- Reuse of decayed Radwaste after dismantling
- Radwaste to final repository
 - International (regional) solution ?

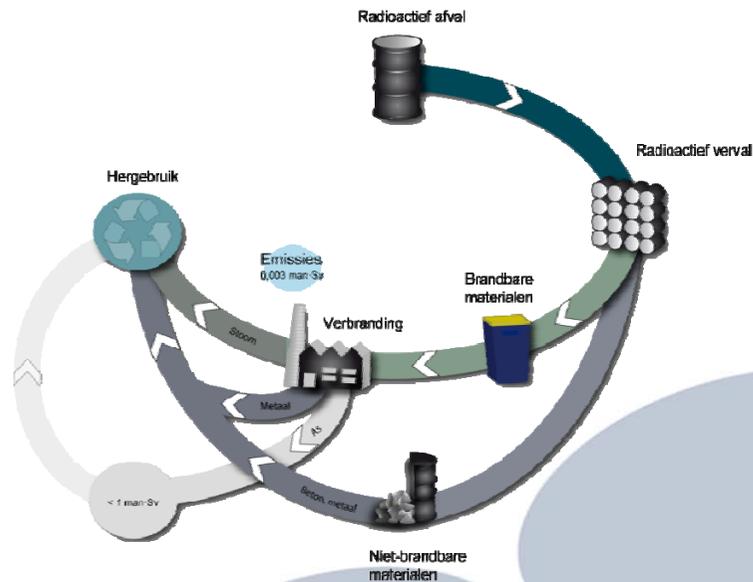
Depleted sinters in road construction



In dykes



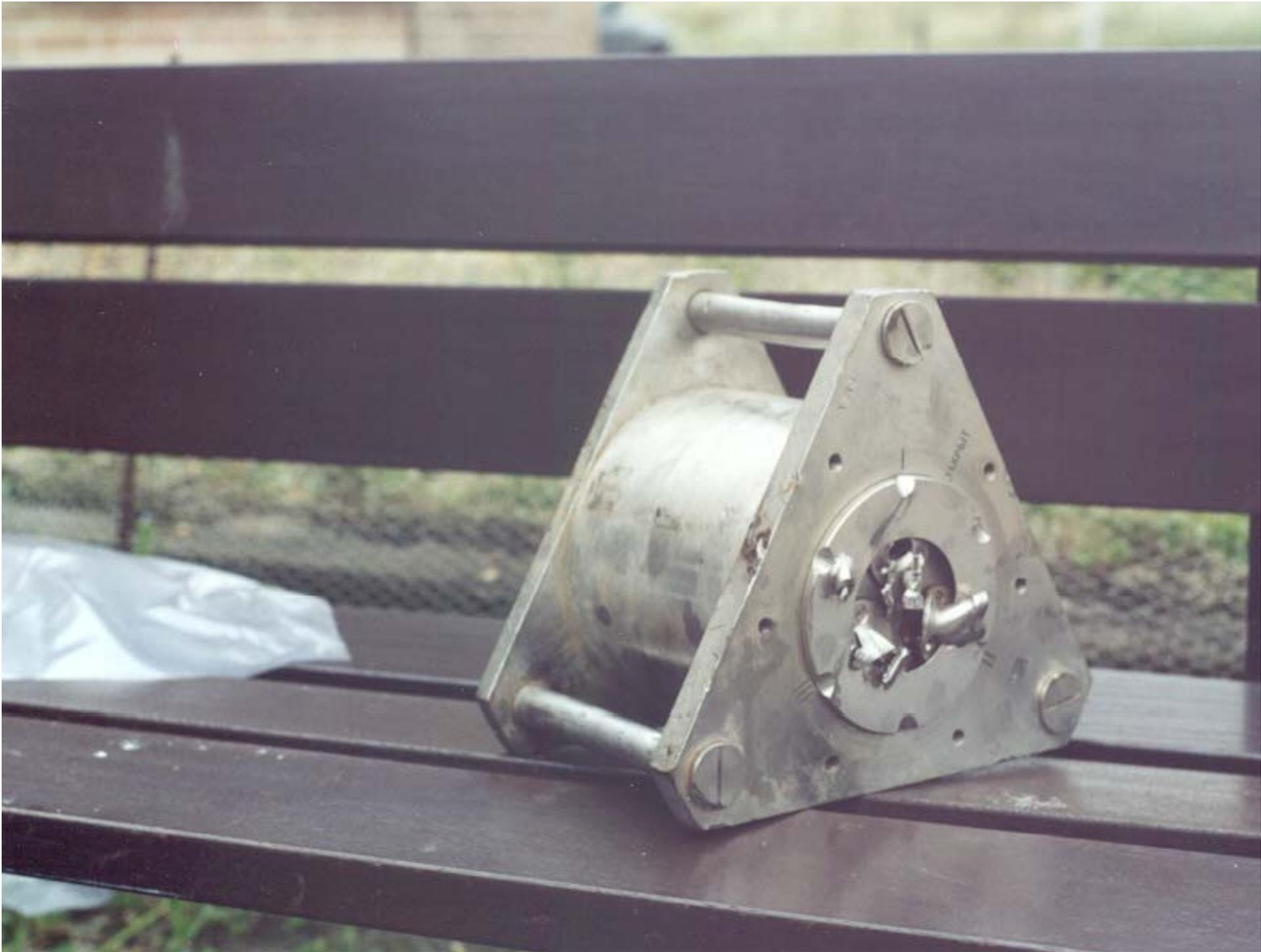
Recycling of decayed radwaste



RADIOACTIVE SCRAP

- **metal casings with insulation wool (Th)**
- **pipes from the oil & gas industry (Ra)**
- **lost or orphan sources**
- **activated metals**





MANAGING RADIOACTIVE SCRAP

Obligation to:

- **measure all incoming scrap**
- **register measurements**
- **appoint a responsible person**
- **secure financial assurance**



EXPLORANIUM
RADIATION DETECTION SYSTEMS

WEGBRUG

MELDEN BIJ RECEPTIE
REPORT TO RECEPTION
BEIM EMPFANG MELDEN

HER

MANAGING RADIOACTIVE SCRAP

Positive measurement:

- inform inspectorate**
- organise work to separate within 15 days radioactive from non-radioactive material**
- ship radioactive parts to COVRA, NRG or Siempelkamp**

>> resulting radioactivity shipped to COVRA

Conclusion

- **Reuse of NORM is strongly promoted**
- **Legislation is practicable**
 - **< 1 Mg of NORM waste is exempted of RPE**
- **RPE for instructions, procedures and risk analysis, RPM for daily surveillance**
- **NORM waste (1-10 EL) to deposits**
 - **< 15 Mg no leachability analysis**
- **(TE)NORM waste (>10 EL) to COVRA**
- **NORM waste to final repository????**