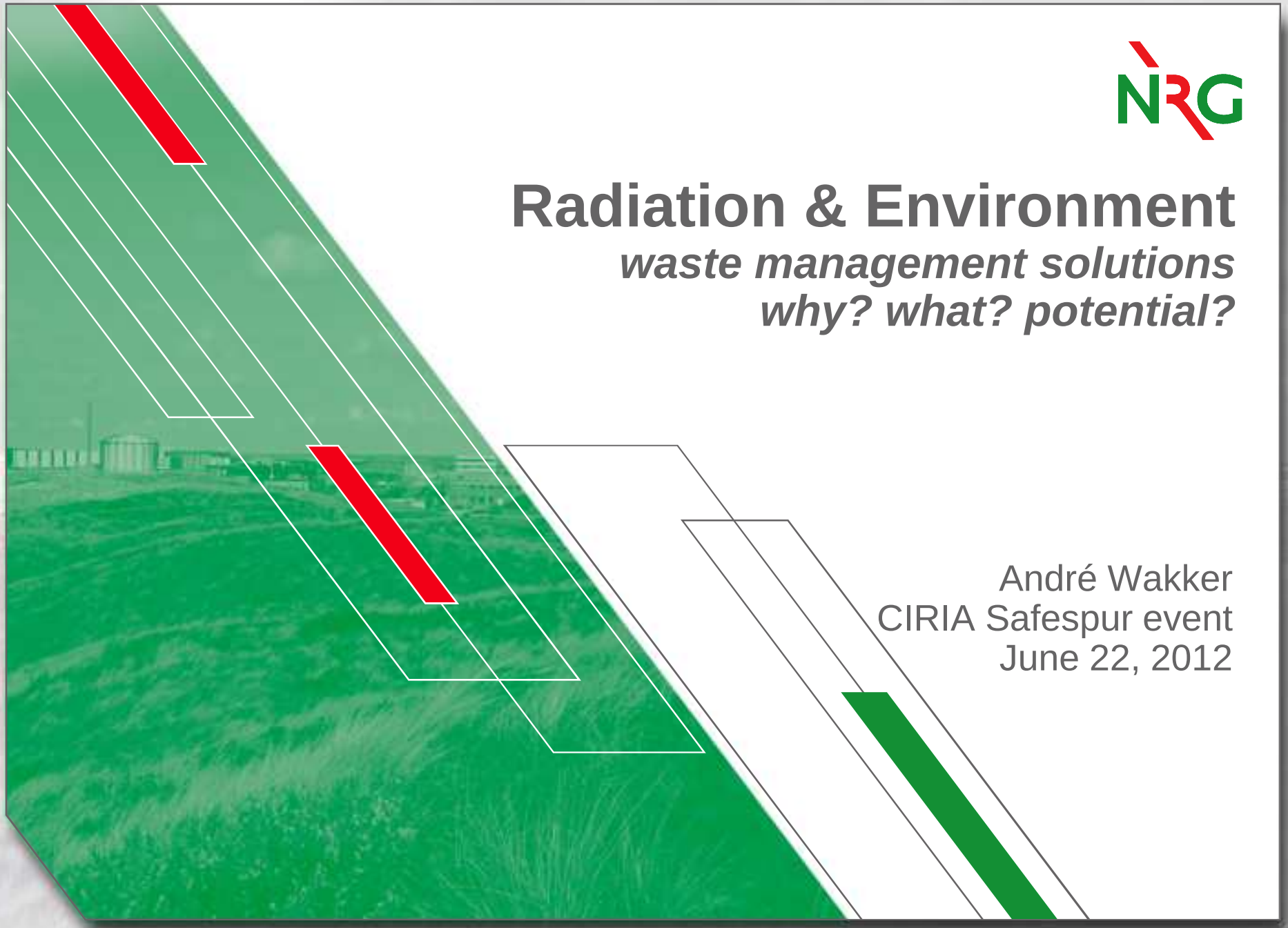


Radiation & Environment

waste management solutions
why? what? potential?

André Wakker

CIRIA Safespur event

June 22, 2012

Outline

- Who we are
- What we do
- Waste management solutions
  - Characterization of historical waste
  - Treatment of radioactive wastewater

  Why? What? Potential?

Nuclear Research & Consultancy Group

NRG (Nuclear Research and Consultancy Group) provides nuclear related services to both governments and industries around the globe.

- Located in Petten (NL) and Arnhem (NL)
- Employs ca 450 fte
- Turnover > € 70 mio

Irradiation & Development	Safety & Power	Radiation & Environment
Nuclear research and production of medical isotopes	Technological services for nuclear power plants	Integrated radiation protection services

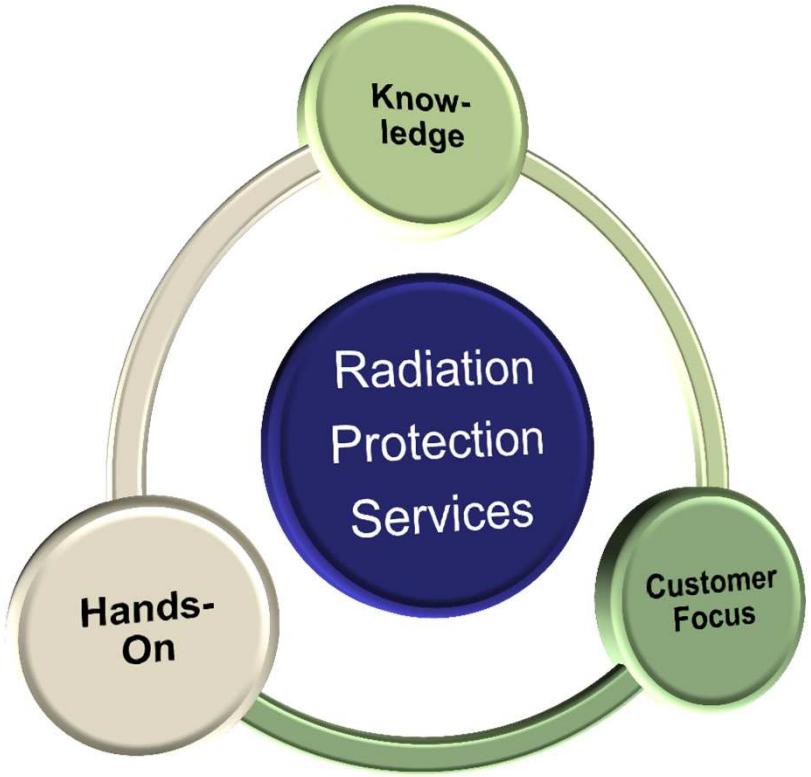
NRG operates the HFR (High Flux Reactor) for research and production of nuclear medicine, making NRG Europe's largest producer of molybdenum – treating over 24.000 patients per day.

Radiation & Environment

Who we are: a unique mix of skills

We support organizations to manage radiation safely and responsibly

R&E holds over 90 motivated and experienced employees, with an unique mix of skills that combines in-depth knowledge with practical solutions.



Knowledge
Originates from Dutch research institute
> 50 years experience
> 20 Ph.D. employees
> 90 scientific publications

Hands-On
Performing measurements in all locations
- Hazardous situations
- On- and off-shore
- Handling RA waste

Customer Focus
Understand your operational requirements
- Operate own nuclear facility
- Performs all radiation protection services for on-site HF Reactor

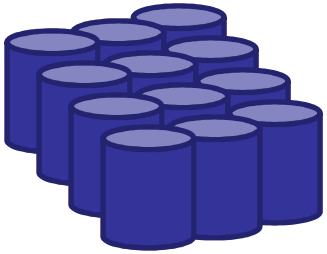
Waste management solution (1)

complete characterization of Petten historical waste

- Since 1958, Petten accumulated 1600 drums of RAW (irradiated fuel rigs, activated materials, isotope waste).
- Mixed (HLW, ILW, LLW) waste, complex inventory, not too well documented.
- Not sustainable, not acceptable to COVRA and regulator.
- Finally, an in-house solution was developed based on stringent COVRA waste acceptance criteria.
- Full characterisation with proven technology.
- Proof of principle in 2008-2010. Proof of production in 2012.
- 2013: Start of campaign.

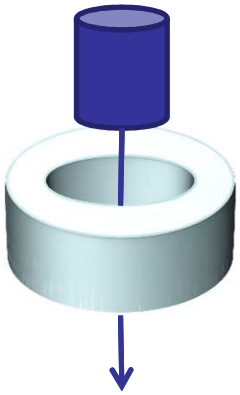
Waste management solution (1)

complete characterization of Petten historical waste



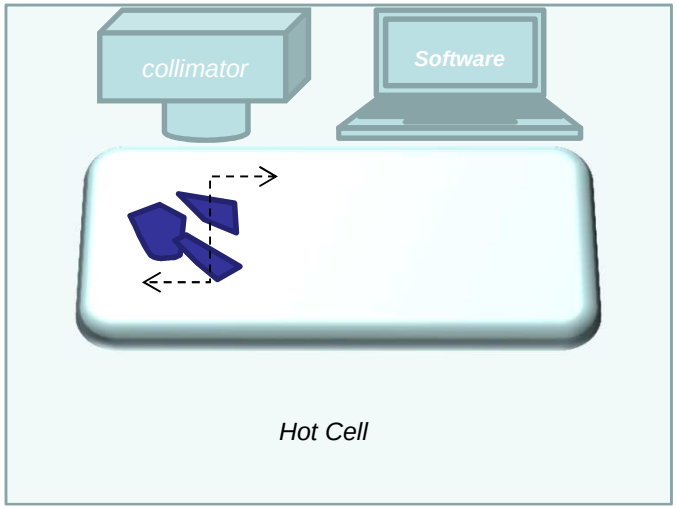
unsorted nuclear waste:

LIMH



VINISH
First classification of activity in drum

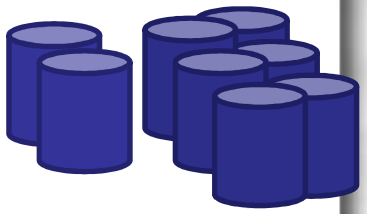
gamma-scans, neutron activity



HIRARCHI
detailed classification of nuclides & activity per waste item

rapid 3D multi-point y-measurement with moving collimator & statistical analysis of data to reconstruct surface image

Innovations:
- *collimator: no distortion of y rays*
- *software: data reconstruction*



sorted nuclear waste:
HLW
MLW
ILW
LLW

Minimize Cost

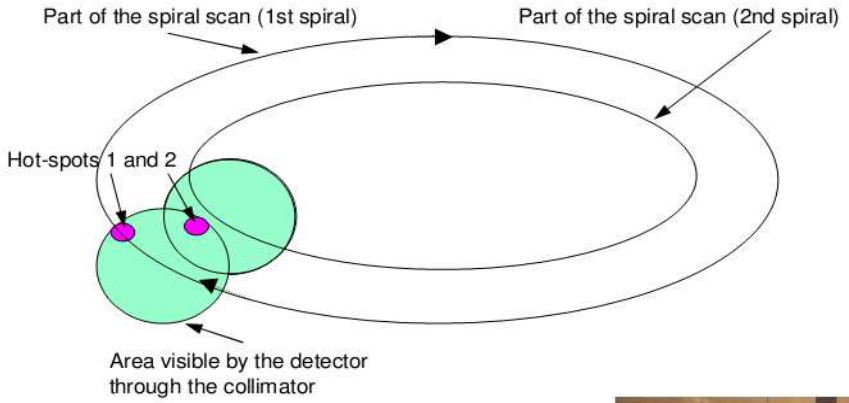
Minimize Footprint

COVRA

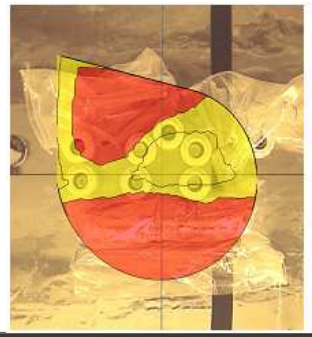
Waste management solution (1)

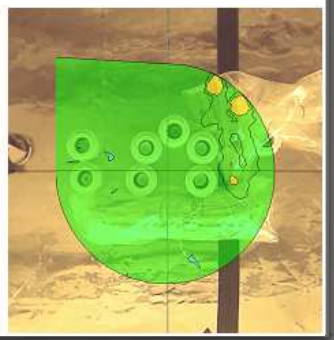
Complete characterization of Petten historical waste

- Scans are optimized according to predefined waste acceptance criteria (WAC).
- Classification of RAW: intensity, energy, nuclide identification.



Scan	Duration	HLW	ILW	LLW	Below LLW
HLW	16 sec.				
ILW	3 min.				
LLW	5 min.				





Waste management solution (1)

Complete characterization of Petten historical waste

- *Vinish/Hirarchi* fully operational in 2013.
- Solution can be applied elsewhere, tailor-made to customer needs, specific radiation conditions and waste acceptance citeria.
- Potential?

Waste management solution (2)

treatment of radioactive wastewater

- Cleaning of nuclear systems for maintenance or decommissioning generates large volumes of radioactive waste water.
- Lifetime extension and upgrading of nuclear power plants needs maintenance and replacement and will generate more waste water.
- Usually organic acids such as EDTA* are added to the water to enhance the cleaning of contaminated surfaces.
- Waste water contains therefore radio nuclides (^{58}Co, ^{60}Co and ^{54}Mn) bound to dissolved organic (EDTA) material which is not easily to be removed.

* Abbreviation of EthyleneDiamineTetraAcetic acid (a soluble material) .

Waste management solution (2)

destructive treatment of organics

- Oxidizing by degradable agents such as H_2O_2
- UV-light in combination with a catalyst such as TiO2.
- Oxidizing by micro organism.
- Electrochemical treatment with coagulation.
- Underwater Plasma Technology

UPT has been applied at 1 NPP to solve a historical waste problem.

Waste management solution (2)

UPT: perspective?

- Cobalt isotopes bound to EDTA can be removed from waste water using UPT.
- After removal of the deposited Co hydroxide, the activity has been reduced from more than 20 000 Bq/l to less than 100 Bq/l.
- The volume of the radioactive residue is about 1% of the volume of original waste.
- Energy consumption is frequency dependent.
- **BUT: Wastewater specific? Cost? Justification? Alternatives?**
- **Potential?**

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