




Does GAMP make the Belgian regulators happy ?




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## General remarks



GAMP  $\Rightarrow$  general methodology for  
**radiological impact** assessment  
process



Not to be confused with **decision-**  
**making** process !

Impact assessment as (fundamental)  
INPUT to decision-making process

## General remarks

Mutual interaction between decision-making process and impact assessment process

*Objectives and scope* of impact assessment determined a.o. by:

- 1) Which stage in the decision-making process ?  
Screening, detailed assessment, choice of remediation option
- 2) What is the objective of the decision-making process ?

# General remarks

Objectives and scope of the decision-making process ?

- 1) Generic: remediation necessary or not ? Choice of remediation option
  - 2) Answer to (very) specific questions:
    - Gela example: landfilling of dismantling waste?
    - Belgium: project of building a jail on a former PG stack ?
- ⇒ decision-making process not always linear + time constraint
- ⇒ Need for *flexible / modular* models

## General remarks

Distinction between « nuclear or NORM **legacy** sites » and NORM sites in **operation**

- « Legacy » (existing exposure situation) ⇒ **remediation** of contamination
- NORM site in operation (« planned » exposure situation) ⇒ **prevention** of contamination
- + different regulatory framework for legacy or operational

## Comparison Belgian approach

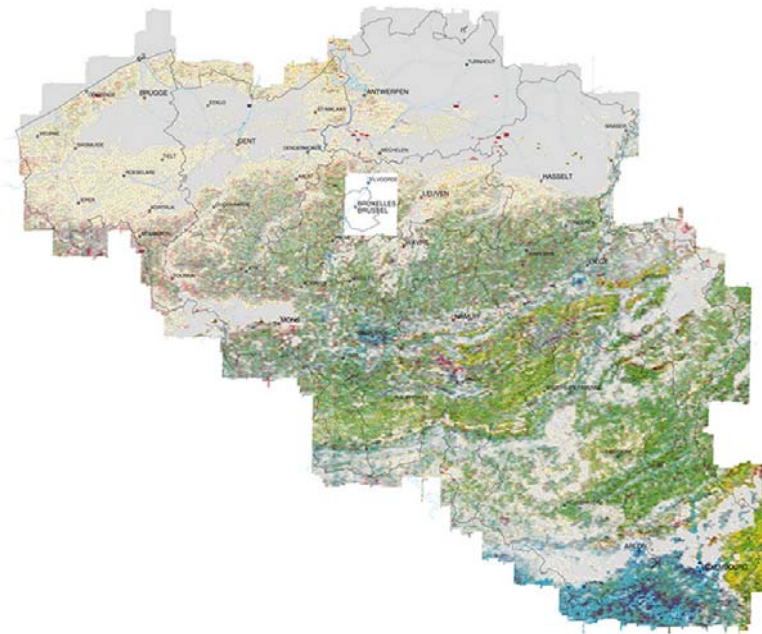
Phase/modules of Belgian approach		GAMP
Risk-assessment	Identification	Identification
	Orientation study	Site (preliminary) characterisation + screening assessment
	Descriptive study	Intermediate and/or detailed assessment
Assessment of intervention options	Listing of remediation options + concertation between stakeholders	Identify and evaluate alternative approaches
	Clean-up or risk management project	~ Select feasible approach / Implementation
Implementation	Implementation	Implementation
	Control and follow up	Control of cleanup criteria

## Examples in Belgium

### Identification:

- In the 90s, **aerial gamma spectrometry** survey of Belgium (Geological Service of Belgium)
- + historical records

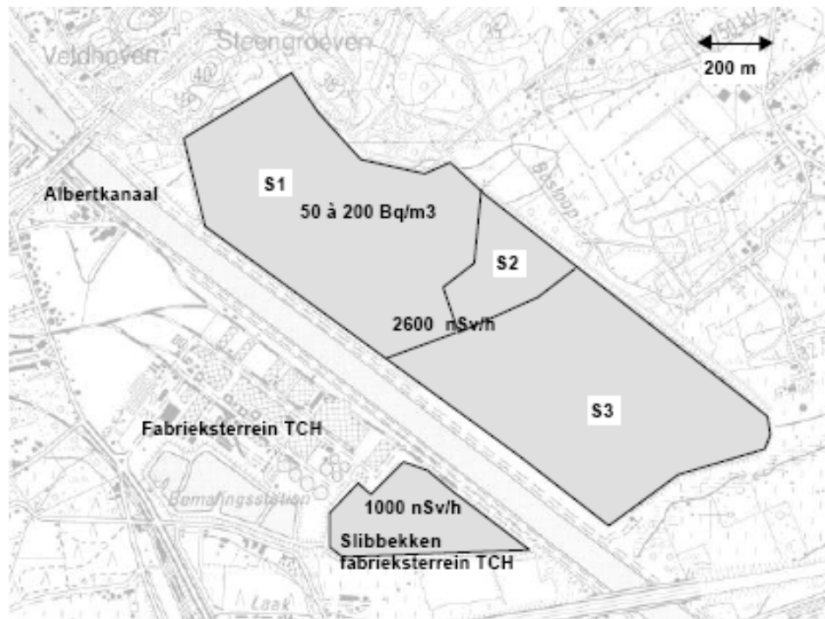
Not yet any statement about risk: increase of the radiation level may be due to purely natural factors



# GAMP and Tessenderlo site

Tessenderlo: treatment of phosphate ores to produce cattle food  
(in operation ⇒ obligation to notify the RP authority as NORM industry)

HCl process ⇒  $\text{CaF}_2$  sludges as residues  
⇒ Disposal on landfills ("Veldhoven")







## GAMP and Tessenderlo site



**Identification** of the problem: via aerial gamma spectrometry + data from the notification

### Site investigation and characterisation ?

Yes, via notification from the operator

- Till 1995, **Ra-226** concentration in  $\text{CaF}_2$  sludges  
~ **3.5 Bq/g** (but significant concentration of radium in waste water)
- Since 1995, changes in the process (co-precipitation of Ra with Ba):  
increase of Ra-226 concentration in sludges ~ **11 Bq/g**
- External dose rate on dumpsite: **up to 2.5  $\mu\text{Sv/h}$**
- Radon monitoring since 1993: **up to ~ 500 Bq/m<sup>3</sup>**





## GAMP and Tessenderlo site



### Screening criteria ?

Landfill in operation:

If average activity on the whole volume of landfill > **0.2 Bq/g**  
⇒ need for risk-assessment (see also German NORM regulations)

Other possible screening criteria: radon concentration (max. 100 Bq/m<sup>3</sup> indoors according to recent WHO recommendations)

Screening criteria's clearly exceeded in this case (no specific modelling necessary)



## GAMP and Tessenderlo site



### More realistic assessment ?

⇒ See for example CARE report (EC Radiation Protection 115)

Two exposure scenarios:

i) **Normal evolution** (farmers residing and working close to the site) ⇒ dose of ~ **0.5mSv/y**

ii) **Intrusion scenario** (living in houses built on site)

⇒ **357 mSv/y** (radon biggest contributor)

**More realistic assessment** still to be done

Operator plans to stop phosphate activities and **clean up** site between 2010 and 2020



## GAMP and Tessenderlo site



At this stage (“more realistic assessment”)

Decision criteria (intervention criteria – not anymore a screening criteria) is a **dosis** criteria:

Guidelines in Belgium:

- *dose < 0.3 mSv: never intervention*
- *0.3 < Dose < 1 mSv: intervention rarely justified*
- *1 < dose < 3 mSv: intervention generally justified*
- *Dose > 3 mSv: intervention always justified*



## Exposure scenario's



### *Guidelines in Belgium:*

At least three scenario's to be considered:

- i)* a scenario which corresponds to the current use of the site;
- *ii)* a worst-case scenario; it is the (realistic) scenario which leads to the highest exposure (typically an intrusion scenario such as the construction of dwellings on the site);
- iii)* a "likely" scenario which doesn't necessarily correspond to the current use of the site but corresponds to a likely evolution in the use of the site.



## Screening criteria ↔ intervention criteria



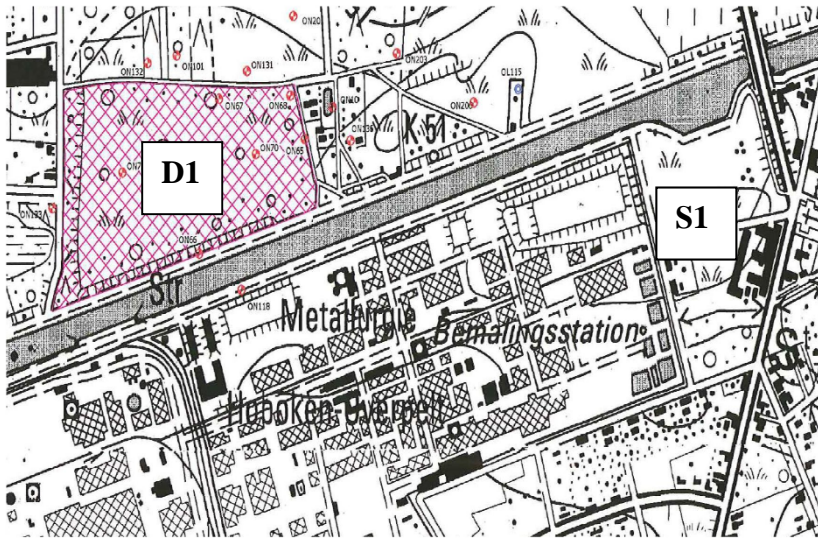
*GAMP: one screening criteria to be compared to the results of screening assessment and more realistic assessment*

### *Belgium:*

- *screening criteria (expressed in measurable quantities: activity concentration, radon concentration/flux,...) to be compared with screening assessment*
- *Intervention criteria: expressed in dose to be compared with more realistic assessment*
- *Clean-up criteria: objective of the intervention (to be defined in the process of selection of remediation option – expressed in operational quantities in the clean-up project)*

## GAMP and Olen site

- Metallurgical company: radium extraction and production of radium sources from 1922 till 1969
- ⇒ Dumpsites D1 and S1 (to be remediated)
  - ⇒ Contamination of banks of nearby river (« Bankloop ») (remediation project almost over ⇒ licensed disposal site for remediation waste)



## GAMP and Olen site

**Identification:** obvious for depositories, not obvious for patchy contamination in the nearby villages (some production waste used in road construction)

**Screening assessment:** average Ra-226 concentration ~ 20 Bq/g (up to 930 Bq/g), Rn-222 outdoors (D1 site) up to 1000 Bq/m<sup>3</sup>

**More realistic assessment:** See BIOMASS study + more specific study SCK-CEN (Belgian Nuclear Study Centre) about D1 landfill

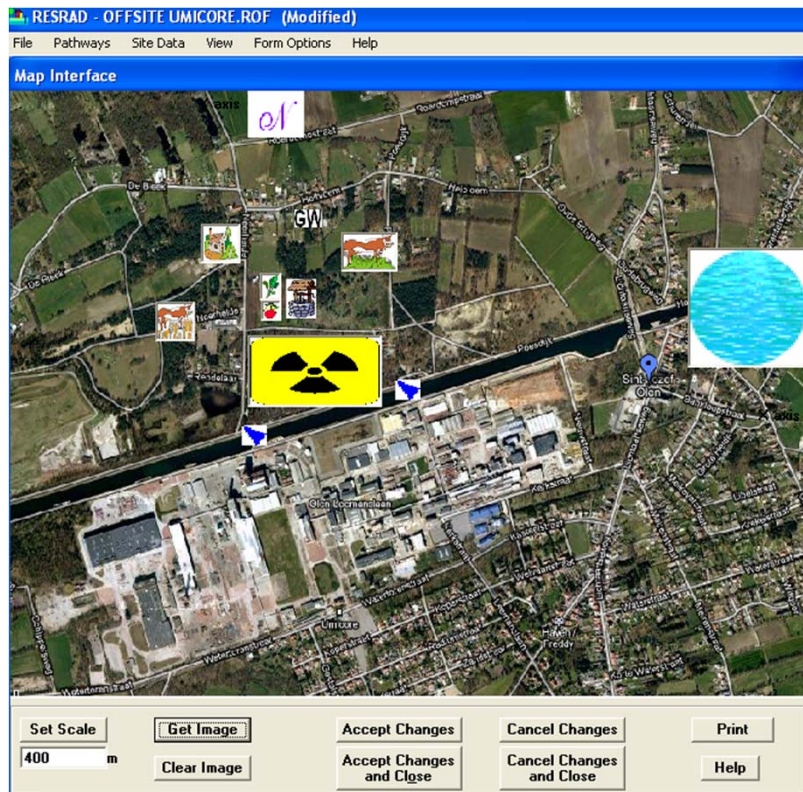
- Normal evolution: ~ 2 mSv/y
- Intrusion: ~ 56 mSv/y

**Detailed assessment and clean-up** for D1 and S1 still to be done



## GAMP and Olen site

Some (very) preliminary assessment of radiological D1 site using RESRAD + RESRAD OFF SITE



Dwelling on site:

- Main contribution from radon (~100 mSv/y)
- external ~ 20 mSv/y

Groundwater pathway:

Not significant for Ra-226  
Shows up for Th-230

## GAMP and Olen site: clean-up

« Bankloop » river

⇒ **Clean-up operations** have been performed

Cleanup criteria

*Excavation works:*

1. dose rate measurement

< 0.2  $\mu\text{Sv/h}$  ⇒ STOP

> 0.2  $\mu\text{Sv/h}$  ⇒ go to step 2

2. measure activity concentration Ra-226

< 0.5 Bq/g (depth < 1m) or 1 Bq/g (depth > 1m) ⇒ STOP

> 0.5 or 1 Bq/g ⇒ dig out – waste on disposal site

!! Cleanup criteria was not everywhere achievable (volume of licensed disposal site full !) – some residual contamination left over

## Conclusions (1)

- *Decision-making* and *risk-assessment* are two different process ... but *dialogue* between them
- Questions from decision-makers can be *generic*, as well as very *specific*  
⇒ flexibility and modularity of models
- Decision-makers don't only ask about the *risk*  
⇒ definition of cleanup criteria, engineering of cleanup (properties of cover, volume of waste to be excavated, ...), most appropriate monitoring program ?

## Conclusions (2)

- Clear statement about **uncertainties** necessary (sensitivity analysis,...)
- Importance of **record-keeping**: a risk may be acceptable today, not anymore tomorrow
  - ⇒ decisions may be reconsidered
  - ⇒ Models and its assumptions must be well documented