Screening assessment of Gela site with ReCLAIM

Kremena Ivanova

1. Identify the problem (1)

Phosphogypsum disposal site (Gela)

Site consists of one large phosphogypsum stack approximately 1-2 km from the sea and the radium activity concentration is about 500 Bq/kg.

1. Site investigation and characterization (1)

Historical data:

- *Between 1967 and 1981, phosphogypsum residues were directly discharged into the sea*
- *Between 1981 and 1992, residues were cumulated in the landfill*
- *In 2002 an external wall, made with bentonite cement was constructed; this wall penetrates 3 m into the slab of underground clay. Measurements of ratio 234U:238U in downstream can indicate if the retaining wall is functioning as required.*
- *Future plans for the site include decommissioning of the phosphoric acid plant.*

1. Site investigation and characterization (2)

Information about industral process:

(1) phosphorite consumption: ***350 – 400 10^3 t a^{-1}***

(2) type of process: ***mainly Prayon – wet process***

(3) production of phosphoric acid: ***60 - 100 10^3 t a^{-1}***

(4) production of slurry: ***300 10^3 t a^{-1}***

(5) the concentration of phosphogypsum in the slurry was 10 – 20 %;

(6) until 2000 there was no regulatory requirements applicable to this site from a radiological point of view;

1. Site investigation and characterization (3)

A retaining wall surrounds the stack to restrict the flow of leachate is 60 cm thick, 3,550 m long, at a distance of about 5 m from the heap of residues

Leachate extracted from these wells is pumped back to the top of the stack.
A drainage trench between the wall and the heap was construted, with a series of wells to collect rainfall percolate. The whole trench was lined with waterproof materials.

1. Site investigation and characterization (4)

Landfill, composed of 4 basins (one is empty), is about 55 ha wide; the mean height of phosphogypsum residues is 14.5 m.

1. Site investigation and characterization (5)

The groundwater flow is towards the sea. Groundwater completely depends on rainfalls, which is very rare but intense; for long periods in a year piezometers and wells, outside the N-NW side of the stack are dry .

Measured concentrations of radionuclides in phosphogypsum and phosphorites.

Nuclide	Concentration in phosphogypsum [Bq.kg^{-1}]	Concentration in phosphorites [Bq.kg^{-1}]
^{226}Ra	418±27	1249
^{214}Pb	313±15	1261
^{214}Bi	272±12	1170
^{212}Pb	19±1	40
^{212}Bi	19±2	41
^{234m}Pa	25±4	1415
^{235}U		65

2. Screening criteria

Screening criteria will depend on a number of factors.:

- *Government policy,*
- *The location and major features of the site,*
- *The anticipated future use of the site and surrounding areas,*
- *The objective(s) of the screening assessment ect.*

0.3 mSv/a *or* ***1 mSv/a*** *or* ***? mSv/a***

Screening assessment is very conservative assessment

3. ReCLAIM (1)

ReCLAIM ('Review of Contaminant Levels for the Assessment calculation of de minimis Inventory Model') has been developed by Nexia Solutions Ltd for the Nuclear Decommissioning Authority (NDA).

ReCLAIM is available to be used in assessing doses to site operators and future exposed groups related to the risks from radioactive contamination in soil and water, and calculating soil and water screening levels for radioactive contamination on nuclear licensed sites.

ReCLAIM v3.0 was developed in Microsoft Excel 2002 under Windows XP SP1 32 bit.

3. ReCLAIM (2)

VERIFICATION STATEMENT

This document has been verified and is fit for purpose. An auditable record has been made of the verification process. The scope of the verification was to confirm that: -

- The document meets the requirements as defined in the task specification/scope statement
- The constraints are valid
- The assumptions are reasonable
- The document demonstrates that the project is using the latest company approved data
- The document is internally self consistent

HISTORY SHEET

Issue Number	Date	Comments
Draft 1	27/02/08	Draft for comment
Issue 1	29/02/08	Issued after approval (see document checking history sheet for details)
Issue 2	16/04/08	Issued after addressing comments from Peer Review by the Health Protection Agency

3. ReCLAIM (3)

ReCLAIM v3.0 works the following three modes of operation:

- *Default Models. - contains two default exposure scenario models. The first, default model 1, is based on Oatway and Mobbs (2003) and the second, default model 2, is based on the RCLEA methodology (DEFRA, 2007)*
- *User-defined Parameter. – This mode of operation takes the calculations a step forward towards a more site specific assessment, by allowing changes to default parameter*
- *User-defined Scenario. – This mode allows the user to perform an entirely bespoke or site specific contaminated land assessment by enabling them to define and parameterise their own exposure pathway calculations for their desired scenario.*

4. Screening assessment with ReCLAIM

SUMMARY PAGE

Assessment Details

User ID	002	Reference	0	Company Name	0
Date of Assessment	00.01.1900	Site Name	Gela site	Checked by	

Description of Site for assessment	Phosphogypsum disposal site Gela

Input Summary

Dose Target (mSv y^{-1})	1.00E+00	Model Parameters	default models
Patchiness	80%		
Assessment Type	DOSE		

<<< Return to MAIN

Radionuclide Measured Values

Radionuclide	Soil (Bq g^{-1})	Surface water (Bq L^{-1})	Aquifer water (Bq L^{-1})	Surface contamination (Bq cm^{-2})
Ra+226	5.00E-01			

Output Summary

Model Selected	default models
Dose Target (mSv y^{-1})	1.00E+00
Total Dose from Assessment (mSv y^{-1})	3.80E-01
Selected Nuclide	
Most limiting Scenario	Construction_Adult
Assessment Type	DOSE

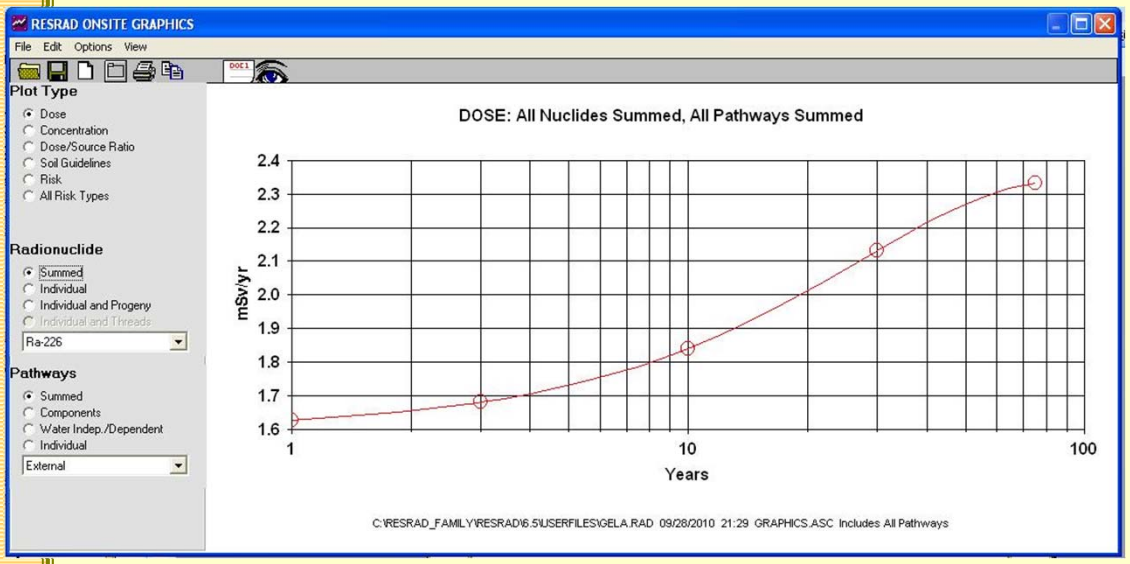
Select model to report: d-Mod1

Total Dose : Dose Target
0.38
PASS

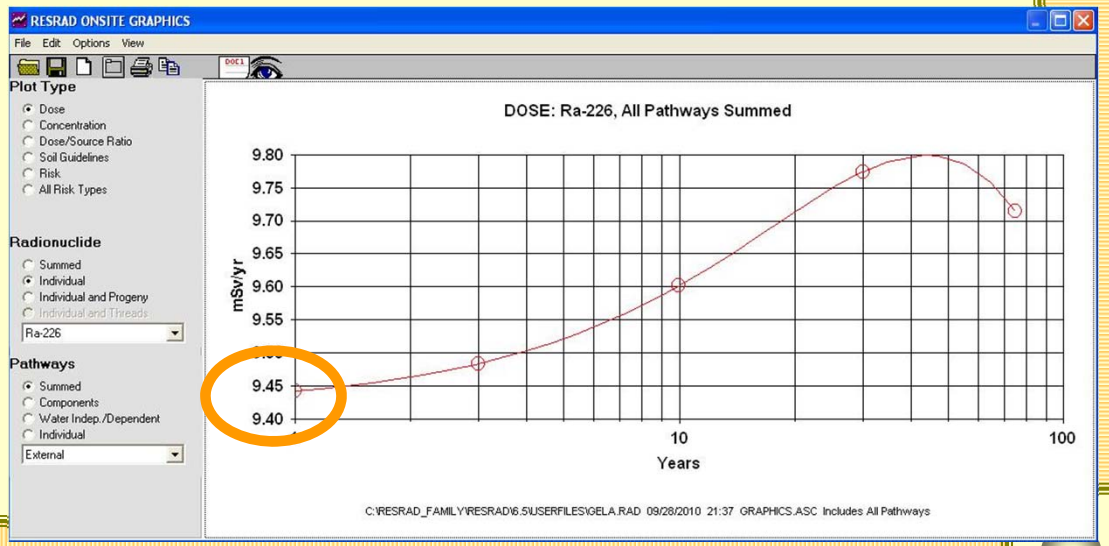
Calculate depth at which model = PASS

VIEW MOST LIMITING SCENARIO OVERVIEW >>>

4. Screening assessment with RESRAD 6.5



With exposure of ^{222}Rn



5. Consideration

- *The results of ReCLAIM satisfy the screening criteria but the results of RESRAD 6.5 do not satisfy the screening criteria*
- *Do more realistic assumptions and exposure scenarios - strike off some exposure pathways*
- *Reduce screening criteria to 0.3 mSv/a*

6. Assessment with ReCLAIM

Exposure Pathway	Parameter	Default Scenario	Default	Parameters Changed	Basis
Inh Dust	Time spent indoors (h y-1)	0	7100	7100	
Inh Dust	Time spent manually digging (h y-1)	0	20	20	
Inh Dust	Time spent mechanically digging (h y-1)	0	79	79	
Inh Dust	Time spent outdoors when the ground is not	0	689	689	
Inh Dust	Time spent outdoors with soil on skin (h y-1)	0	79	79	
Inh Dust	Nonambient Inhalation Rate (m3 h-1)	0	1.69	1.69	
Inh Dust	Ambient Inhalation Rate (m3 h-1)	0	0.92	0.92	
Inh Dust	Enhanced Dust Loading in air (g m-3)	0	0.0005	0.0005	
Inh Dust	Ambient Dust Loading in air (g m-3)	0	0.00005	0.00005	
Inh Dust	Enrichment Factor	0	1	1	
Ing Green Veg	Green Veg Ingestion Rate (kg y-1)	0	17.5	35	
Ing Fish	Fish Ingestion Rate (kg y-1)	0		10	
Ing Aquifer Water	Water Ingestion Rate (L y-1)	0	600	600	
Ing Surface Water	Water Ingestion Rate (L y-1)	0	600	600	
Ext dose water	Time spent swimming (h y-1)	0	7.5	7.5	
Ext dose surface	Time spent at Surface Geometry 1 (h y-1)	0		300	
Ext dose surface	Surface Geometry 1	0		1 m above - infinite uniform	
Ext dose surface	Time spent at Surface Geometry 2 (h y-1)	0		500	
Ext dose surface	Surface Geometry 2	0		1 m above - 10 m diam patch	
Ext dose surface	Time spent at Surface Geometry 3 (h y-1)	0		700	
Ext dose surface	Surface Geometry 3	0		5 m from edge - infinite uniform	
Ext dose surface	Time spent at Surface Geometry 4 (h y-1)	0		1000	
Ext dose surface	Surface Geometry 4	0		50 m from edge - infinite uniform	

Output Summary

Model Selected	USER-defined scenario
Dose Target (mSv y $^{-1}$)	3.00E-01
Total Dose from Assessment (mSv y $^{-1}$)	3.99E-02
Selected Nuclide	
Most limiting Scenario	USER Specified
Assessment Type	DOSE

Select model to report

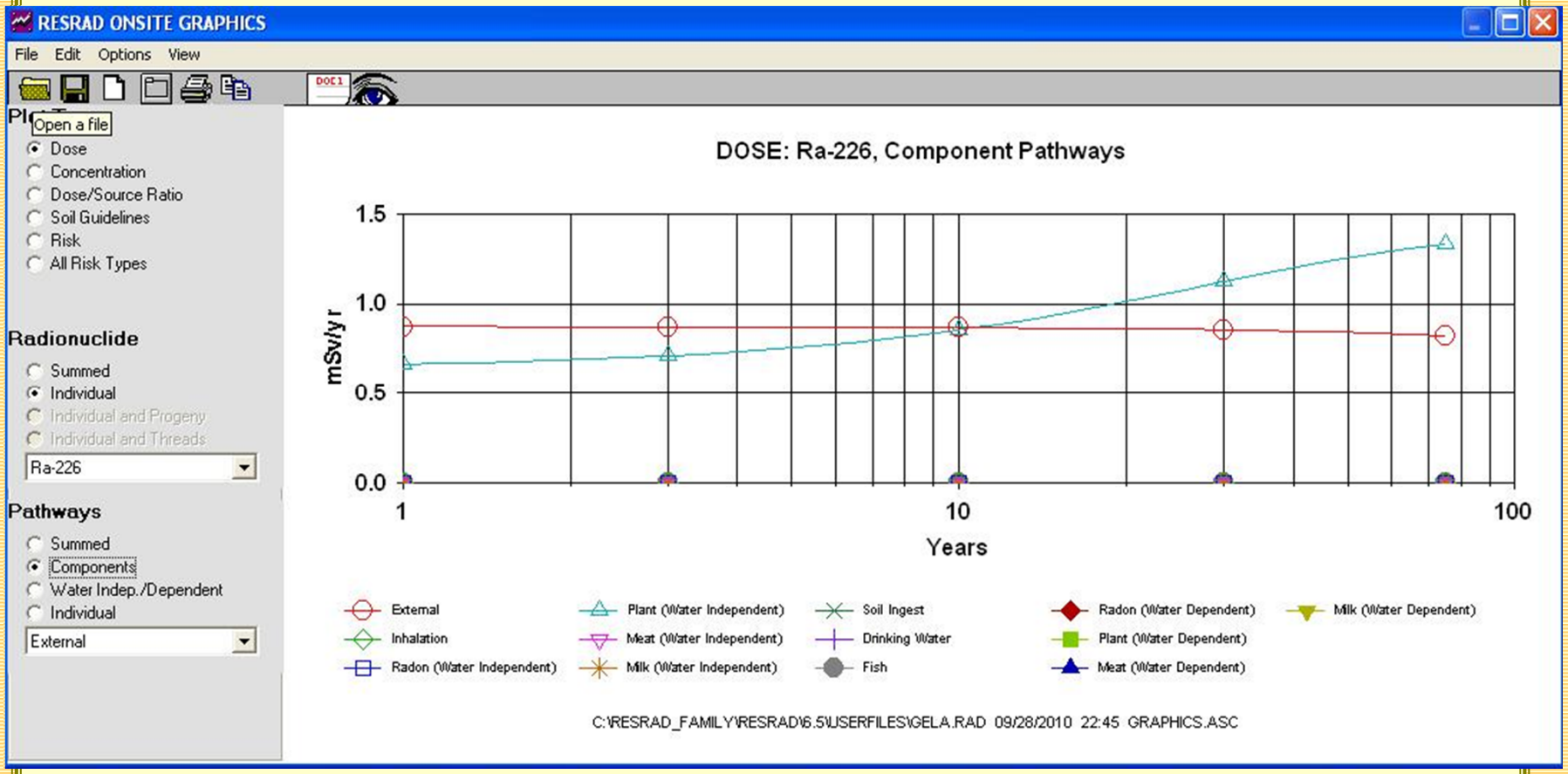
d-Mod1

Total Dose : Dose Target
0.13
PASS

Calculate depth at which model = PASS

VIEW MOST LIMITING SCENARIO OVERVIEW >>>

7. Assessment with RESRAD 6.5



8. Consideration

- *More investigation and characterisation of the site*
- *More hydrological data*
- *Collecting of groundwater and soil sampling around the landfill*
- *Make the detail assessment*