Ministry of Health
National Centre of Radiobiology and Radiation Protection
Sofia - Bulgaria

Assess of the need for waste water treatment plant of the uranium mining site "Iskra", Katina

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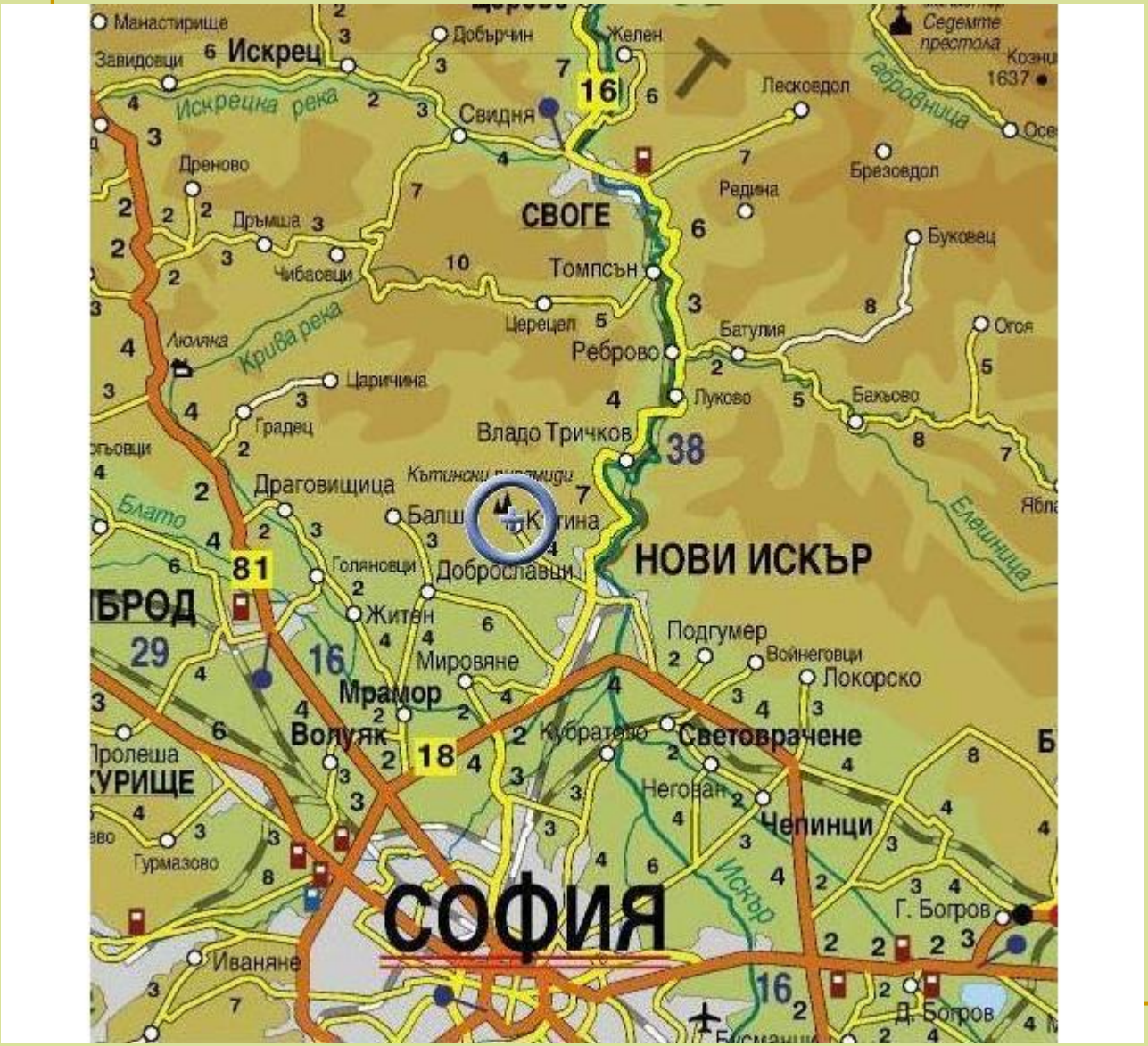
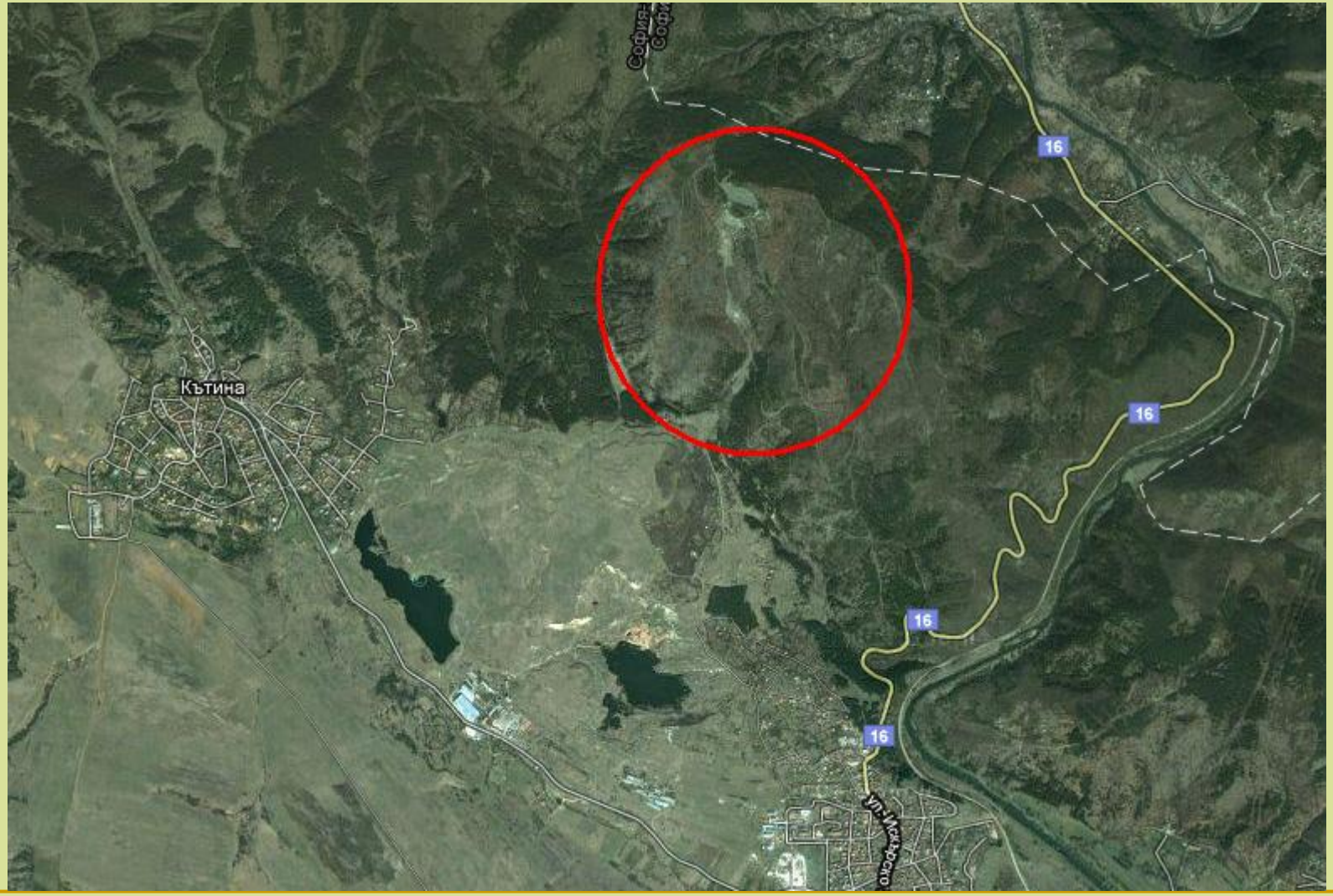
SITE DESCRIPTION



Uranium mining area "Iskra" is located in west “Stara Planina”mountain , next to the village of Katina and city Novi Iskar about 15 km north of Sofia.

SITE DESCRIPTION



SITE DESCRIPTION

- Area "Iskra" is located in the catchment of the river “Taina”, which is left affluent of the River Iskar.
- Total area is approximately 4 km^2 and long 1.2 kilometers.
- Moderate continental climate, bordering the mountain area. (There are cold winters with average January temperatures below 0 ° C and a long and hot summers with average July temperatures around 20 °C typically).

SITE DESCRIPTION

- Precipitation in the area have a clearly expressed maximum principal in spring - summer season (May - June) and the main minimum in winter (February)
- Average annual rainfall is in the range 640 - 700 mm
- The prevailing wind direction during the year is from the west.
- Area of Katina village is approximately 20.527km^2 with a population of about 931 citizens

OPERATION HISTORY

- 1956 - The development of the deposit began through open-pit mining of peak “Brezy brah” Simultaneously trace the horizontal facilities in lower horizons.
- 1962 – Classic mining shut down due to depletion of stocks
- 1982 – Reassessment of stocks was made
- 1985 - In situ leaching technology was organized

ACTUAL SITUATION

- 1992 – Closing of the Uranium mining
- 2000 – Technical liquidation was completed. It consisting of:

  Above-ground facilities

  - Dismantling the equipments
  - Demolishing the buildings
  - Decontamination
  - Depositing the radioactive waste

  Underground facilities

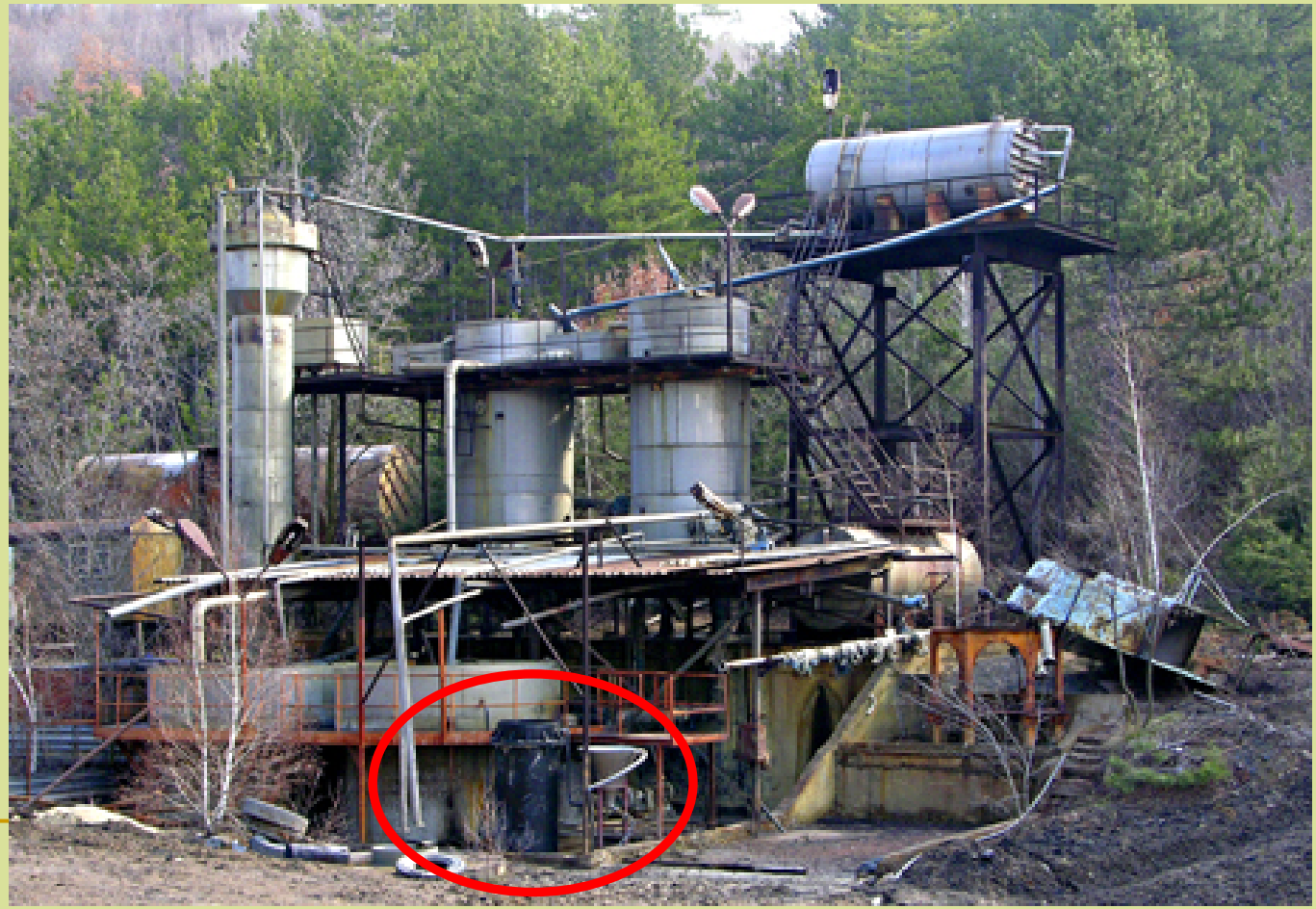
  - Closing with two concrete walls

ACTUAL SITUATION

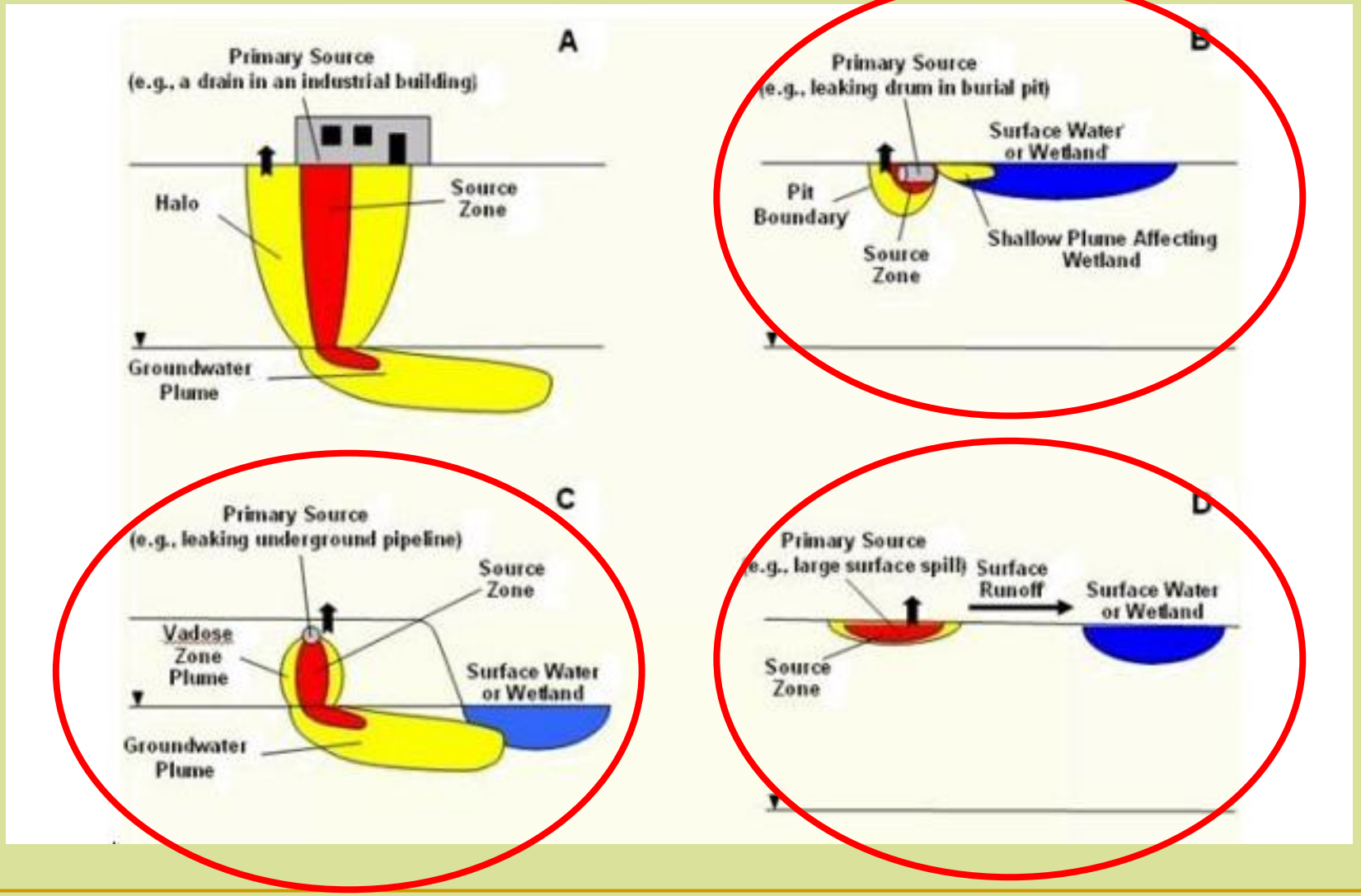
- 2005 - The technical remediation was completed. It consist of:
  - Stabilization and reshaping of the surface
  - Removing of the surface water
  - Covering in no radioactive soil layer
    - Measuring of the gamma dose rate
    - Calculating the thickness of the layer
    - Covering in the soil layer
- 2008 - The biological remediation was completed. It consist of:
  - Revegetation
  - Growing a plants or a bushes

ACTUAL SITUATION

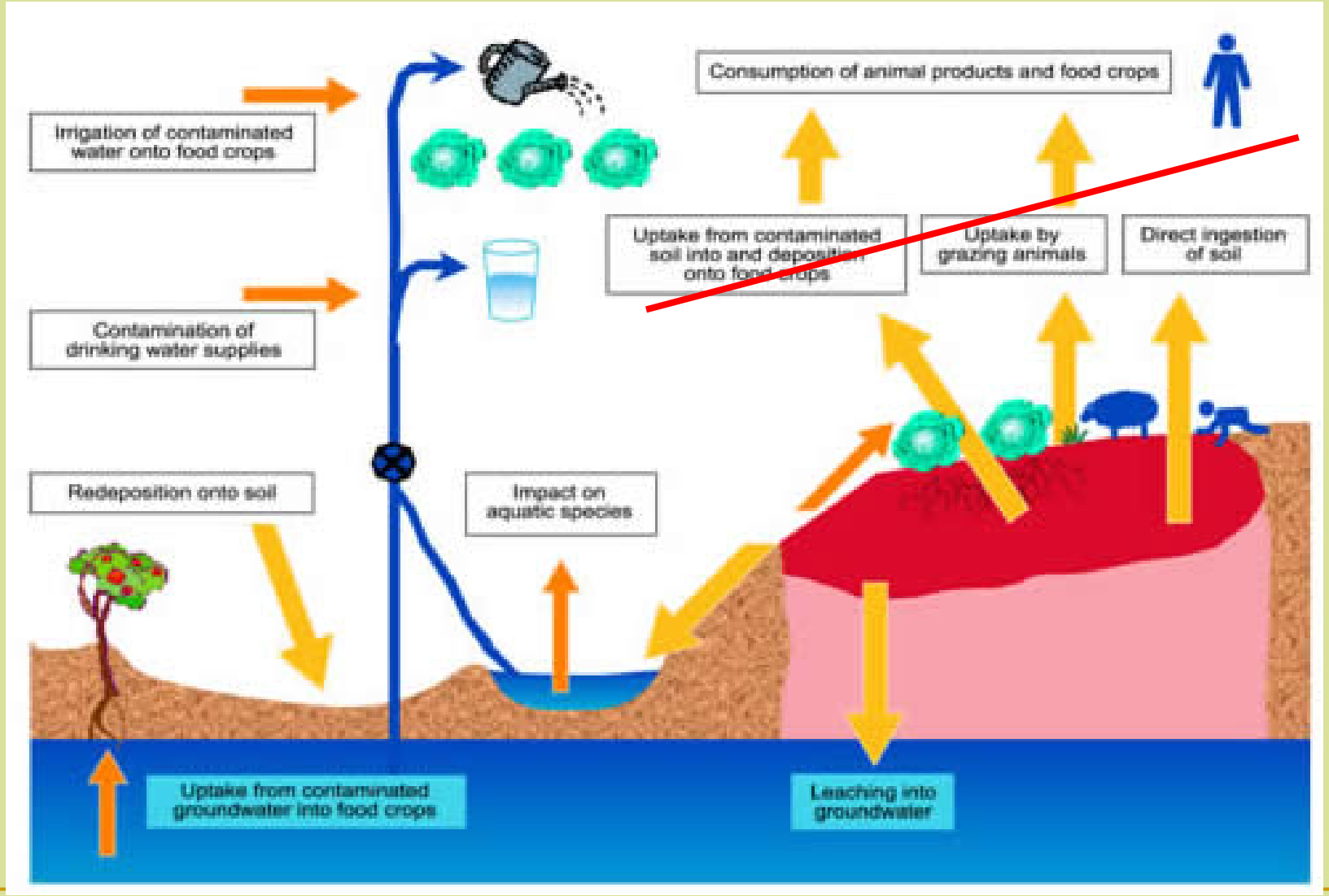
- *2005* – The polluted water is purified with sorption column



Pathways of migration



Exposure pathways



MATERIALA AND METHODS

Sampling

Sampling point	Description of the area	Environmental components
P1	Before SC	water
P2	After SC	water, sediment
P3	Gully after SC	soil
P4	Waste rock pile	air
P5	Lake “Kiselo”	water, sediment
P6	100 m. after lake	water, sediment
P7	River “Taina”	water, sediment
P8	River “Iskar”	water, sediment

Sampling map

MATERIALA AND METHODS

Environmental components	Radiation parameter	Methods
air	Rn concentration Gamma dose rate	Direct measurement
water	U_{nat} Ra-226, gross alpha activity	Radiochemistry
Soil, sediment	Natural radionuclides	Gamma spectrometry

RESULTS – direct measurement

Sampling point	Gamma dose rate [nSv/h]	Rn concentration [Bq/m^3]
P1	230 ± 30	
P2	250 ± 30	
P3	230 ± 30	
P4	350 ± 40	16 ± 7
P5	200 ± 20	
P6	180 ± 20	
P7	160 ± 20	
P8	160 ± 20	

RESULTS – soil and sediment samples

Sampling point	Activity concentration		
	$U_{nat.}$ [mg/kg]	^{226}Ra [Bq/kg]	^{232}Th [Bq/kg]
P2	116 ± 8	122 ± 6	15.8 ± 3.4
P3	10.3 ± 2.0	235 ± 11	40.3 ± 3.8
P5	14.5 ± 1.8	165 ± 7	33.9 ± 2.0
P6	16.0 ± 2.8	38.0 ± 2.2	47.3 ± 3.7
P7	9.9 ± 1.6	35.4 ± 1.7	54.4 ± 4.1
P8	5.5 ± 0.8	35.0 ± 1.7	36.2 ± 2.1

RESULTS – water samples

Sampling point	PH	Activity concentration		
		$U_{nat.}$ [mg/l]	^{226}Ra [Bq/l]	Gross α [Bq/l]
P1	2.63	0.80 ± 0.08	0.019	10.44 ± 0.13
P2	2.64	0.54 ± 0.07	0.018	7.02 ± 0.13
P5	2.91	0.14 ± 0.02	0.006	1.74 ± 0.15
P6	6.80	0.09 ± 0.02	0.004	≤ 0.2
P7	8.16	0.08 ± 0.02	0.004	≤ 0.2
P8	7.62	≤ 0.02	0.004	≤ 0.2

Dose assessment – type of assessment (ICRP- Publication 101)

SITUATION	TYPE OF ASSESSMENT	
	Prospective	**Retrospective**
Practice	Design of new facility or compliance with the dose constraint for an upcoming year	Dose to the public from past operations or compliance with dose the dose constraint for past year
Existing	Future prolonged exposures (e.g., after remediation)	Earlier exposures
Emergency	Emergency planning	Actual impacts after emergency

Dose assessment – type of assessment (ICRP- Publication 101)

Existing situations may require prospective assessments or retrospective assessments to determine the implications of proposed actions. The assessment provides the basis for understanding the future consequences if no actions are taken, or for understanding the dose averted if certain actions are implemented.

Dose assessment – type of assessment (ICRP- Publication 101)

Deterministic methods which involve the direct multiplication of selected point values of parameters and environmental concentrations:

- screening method - very conservative assumptions are made to estimate dose using concentrations of radionuclides at the point of discharge to the environment.
- general assessment - involves populations, pathways.

Model for dose assessment

ReCLAIM

Version 3.01 April 2008

environment@nexiasolutions.com

www.nexiasolutions.com/environment

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Dose assessment – without sorption column

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		1.90E-02		
U+238		2.02E+01		

USER Specified	d-Mod1

Exposure Pathway	Parameter	Default Scenario	Default	Parameters Changed	Basis
Ing Beef	Beef Ingestion Rate (kg y-1)	0	30	30	
Ing Beef	Cattle Grass Ingestion Rate (kg d-1)	0	65	30	
Ing Beef	Cattle Soil Ingestion Rate (kg d-1)	0	0	0	
Ing Beef	Cattle Water Ingestion Rate (L d-1)	0	0	0	
Ing Milk	Milk Ingestion Rate (kg y-1)	0	240	240	
Ing Milk	Cattle Grass Ingestion Rate (kg d-1)	0	65	65	
Ing Milk	Cattle Soil Ingestion Rate (kg d-1)	0	0	0	
Ing Milk	Cattle Water Ingestion Rate (L d-1)	0	0	0	
Ing Green Veg	Green Veg Ingestion Rate (kg y-1)	0	35	35	
Ing Root Veg	Root Veg Ingestion Rate (kg y-1)	0	95	35	
Ing Fish	Fish Ingestion Rate (kg y-1)	0		5	
Ing Aquifer Water	Water Ingestion Rate (L y-1)	0	350	300	
Ing Surface Water	Water Ingestion Rate (L y-1)	0	350	300	

Output Summary

Model Selected	USER-defined scenario
Dose Target (mSv y^{-1})	3.00E-01
Total Dose from Assessment (mSv y^{-1})	5.46E-01
Selected Nuclide	
Most limiting Scenario	USER Specified
Assessment Type	DOSE
Most limiting nuclide	U+238

Select model to report
d-Mod1

Total Dose : Dose Target
1.82
FAIL

Calculate depth at which model = PASS

VIEW MOST LIMITING SCENARIO OVERVIEW >>>

HIDE ACTIVE PATHWAYS FOR MOST LIMITING SCENARIO

Dose assessment – with sorption column

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		1.80E-02		
U+238		1.37E+01		

USER Specified	d-Mod1

Exposure Pathway	Parameter	Default Scenario	Default	Parameters Changed	Basis
Ing Beef	Beef Ingestion Rate (kg y-1)	0	30	30	
Ing Beef	Cattle Grass Ingestion Rate (kg d-1)	0	65	30	
Ing Beef	Cattle Soil Ingestion Rate (kg d-1)	0	0	0	
Ing Beef	Cattle Water Ingestion Rate (L d-1)	0	0	0	
Ing Milk	Milk Ingestion Rate (kg y-1)	0	240	240	
Ing Milk	Cattle Grass Ingestion Rate (kg d-1)	0	65	65	
Ing Milk	Cattle Soil Ingestion Rate (kg d-1)	0	0	0	
Ing Milk	Cattle Water Ingestion Rate (L d-1)	0	0	0	
Ing Green Veg	Green Veg Ingestion Rate (kg y-1)	0	35	35	
Ing Root Veg	Root Veg Ingestion Rate (kg y-1)	0	95	35	
Ing Fish	Fish Ingestion Rate (kg y-1)	0		5	
Ing Aquifer Water	Water Ingestion Rate (L y-1)	0	350	300	
Ing Surface Water	Water Ingestion Rate (L y-1)	0	350	300	

Output Summary

Model Selected	USER-defined scenario
Dose Target (mSv y^{-1})	3.00E-01
Total Dose from Assessment (mSv y^{-1})	3.71E-01
Selected Nuclide	
Most limiting Scenario	USER Specified
Assessment Type	DOSE
Most limiting nuclide	U+238

Select model to report
d-Mod1

Total Dose : Dose Target
1.24
FAIL

Calculate depth at which model = PASS

VIEW MOST LIMITING SCENARIO OVERVIEW >>>

HIDE ACTIVE PATHWAYS FOR MOST LIMITING SCENARIO

Treatment of uncertainties in dose assessment

Conclusion

- It is difficult to take a decision using only dose assessment when the doses is low
- Need of additional cost assessment on purpose to apply ALARA
- Alternative options have to be assessed