



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

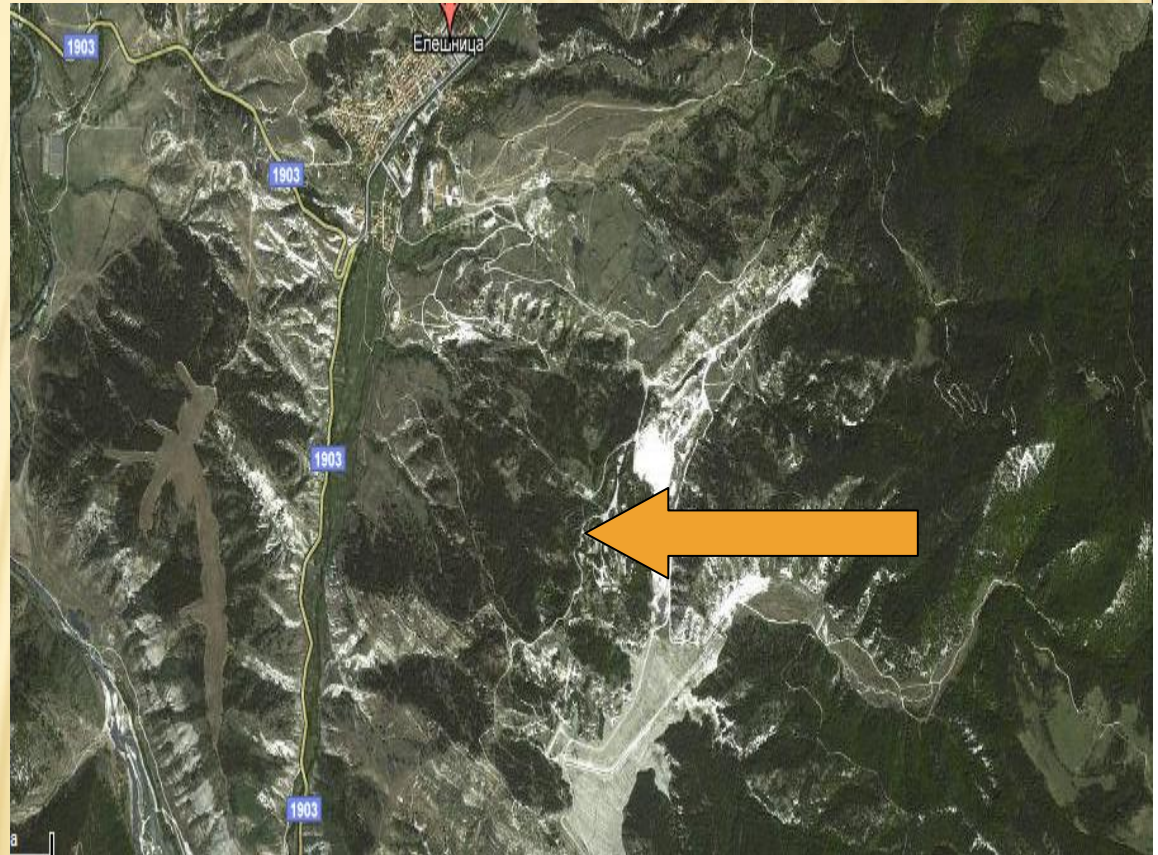
---

***AREA OF FORMER URANIUM  
MILLING PLANT “ZVEZDA”  
ELESHNIVA – BEFORE AND NOW***

Kremena Ivanova  
Radostina Georgieva

# SATE DESCRIPTION

- ✘ Uranium Milling plant “Zvezda” is located in Rodopi mountain close to village Eleshnica





# OPERATION HISTORY

---

- ✘ 1965 – begin production as Milling plant for sulfuric-acid extraction of uranium from uranium ores and regeneration of ion-exchange resins from in situ leaching technology.
- ✘ 1992 – was shut down

# HISTORICAL DATA

---

- ✘ 2004 - Technical liquidation was completed:
  - + Dismantling of machinery, equipment and installations.
  - + Removal of metal building structures.
  - + Demolition by blasting the 4 Building, which can not be used for other activities because of radioactive contamination.
  - + Deposit of radioactive waste in tailing pond.
  - + Decontamination (cleaning) of radioactivity less contaminated equipment.
  - + Renovation of not contaminated buildings.

# Radioactive inventory of the area

- ✘ 2005 – Measurement of gamma dose rate with portable detector of whole milling plant area approximately 50 000 m<sup>2</sup>

The total contained area was 8 300 m<sup>2</sup>

## Contaminated area of Milling plant “Zvezda”

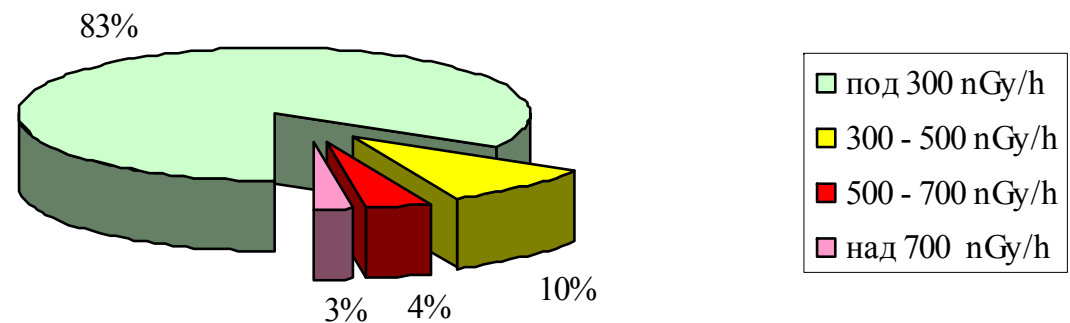


Схема 2





Схема 1 - Мрежа на измерване на мощността на дозата гама-лъчение на терена на завод "Звезда", с. Елешница

Storage of ore  
649- 2105 nGy/h.

Main Corpus and  
waste rock pile – up  
to 1842 nGy/h.

Map of the site with  
contamination

# CRITERIA FOR REMEDIATION ACTIVITIES

---

- ✘ Regulation on limits for purpose of radiation protection and safety during liquidation of consequences from uranium industry in Bulgaria (St.G. No 1 of 1999)

This limits of radiation protection and safety ensure observation of the limit on effective dose for any member of the public – 1 mSv/y



# THE LIMITS FOR RE-USE OF AREA

---

<b>Way of using</b>	<b>dose rate nGy/h</b>	<b>Ra-226 Bg/kg</b>
<b>Without restriction</b>	<b>to 300</b>	<b>to 200</b>
<b>For green area without an open-air kindergarten</b>	<b>to 300</b>	<b>to 200</b>
<b>For woodland</b>	<b>to 700</b>	<b>to 1000</b>
<b>For agricultural purposes</b>	<b>to 500</b>	<b>to 600</b>
<b>Competent authorities decision for each case</b>	<b>above 700</b>	<b>above 1000</b>



# THE LIMITS FOR RE-USE OF BUILDING

---

<b>Way of using</b>	<b>dose rate nGy/h</b>	<b>Ra-226 in soil Bq/kg</b>	<b>Rn-222 inside Bq/m<sup>3</sup></b>
<b>New building</b>	<b>to 300</b>	<b>to 200</b>	<b>to 200</b>
<b>Re-use without restriction</b>	<b>to 300</b>	<b>to 200</b>	<b>to 400</b>
<b>For store</b>	<b>to 500</b>	<b>to 600</b>	<b>to 600</b>
<b>Competent authorities decision for each case</b>	<b>above 500</b>	<b>above 600</b>	<b>above 600</b>

# THE LIMITS FOR RE-USE OF METAL AND PLASTIC WASTE

Way of using	Surface contamination Bq/cm <sup>2</sup>	
	Alpha	Beta
Without restriction#	0.05	0.50
For smelting	0.50	5.00
Storage in control aria	0.50 - 2.50	5.00 - 25.00
Competent authorities decision for each case	above 2.50	above 25.00

#with the exception of food industry and drinking water supplies



# THE LIMITS OF BUILDING MATERIAL

---

<b>Way of deposit</b>	<b>Ra-226 [Bq/kg]</b>
<b>Using or deposit in storage without restriction</b>	<b>200</b>
<b>Storage in control aria</b>	<b>200 - 1000</b>
<b>Competent authorities decision for each case</b>	<b>above 1000</b>

# THE LIMITS FOR RE-USE OF VEHICLES AND EQUIPMENTS

---

<b>Way of using</b>	<b>Surface contamination</b>	
	<b>Bq/cm<sup>2</sup></b>	
	<b>Alpha</b>	<b>Beta</b>
<b>Without restriction</b>	<b>0.50</b>	<b>5.00</b>

The National Center of Radiobiology and Radiation Protection issues certificates (statement of conformity) for way of use of above mentioned items.



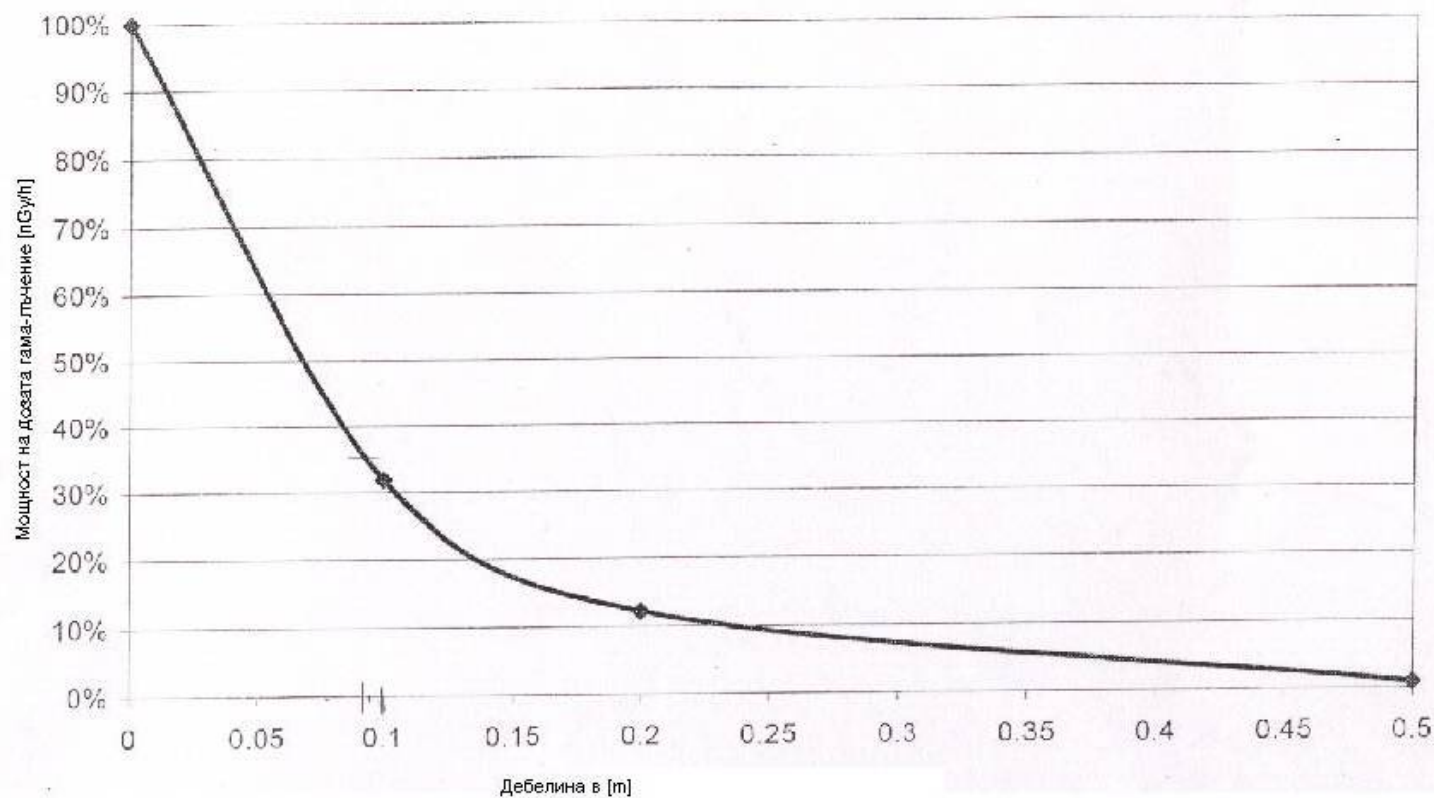
# DECOMMISSIONING ACTIVITIES

- ✘ Covering with non radioactive soil layer (clay) - measuring of the gamma dose rate and calculating the thickness of the layer, using the equation

$$H=H_0 \cdot \exp(-\mu d)$$

- ✘ For validation of calculated results has been used theoretically derived dependence and used in practice to calculate the thickness of the covering layer over similar sites in Germany.
- ✘ Accept to be an insulating layer of clay with  $2.2 \text{ g/cm}^3$  density and thickness of 30 cm.

# Relation between percent of decrease of gamma dose rate and thickness of the lear



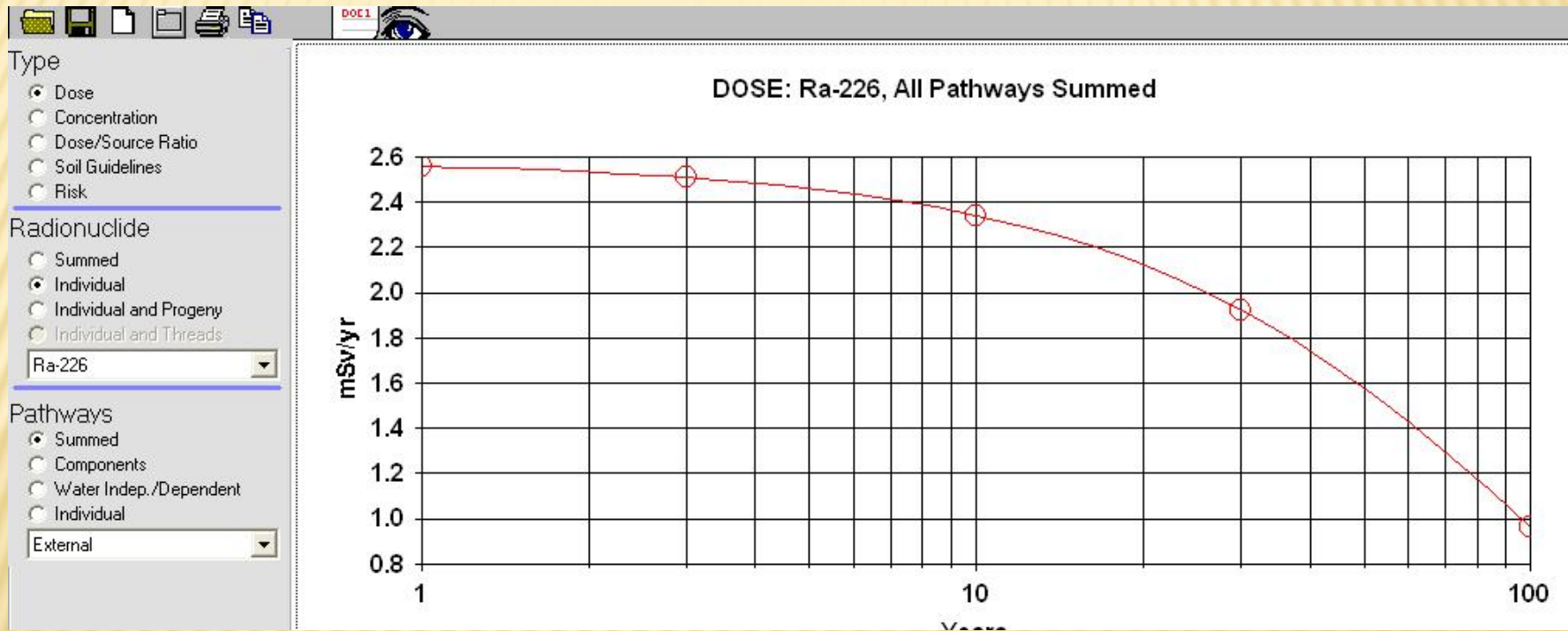
Фиг.1  
(x1 в радиационната програма)



# DECOMMISSIONING ACTIVITIES

- ✘ Placing topsoil
- ✘ Removing surface water drainage measures
- ✘ Assessment of the condition of buildings and equipment
- ✘ Certification of remediation area

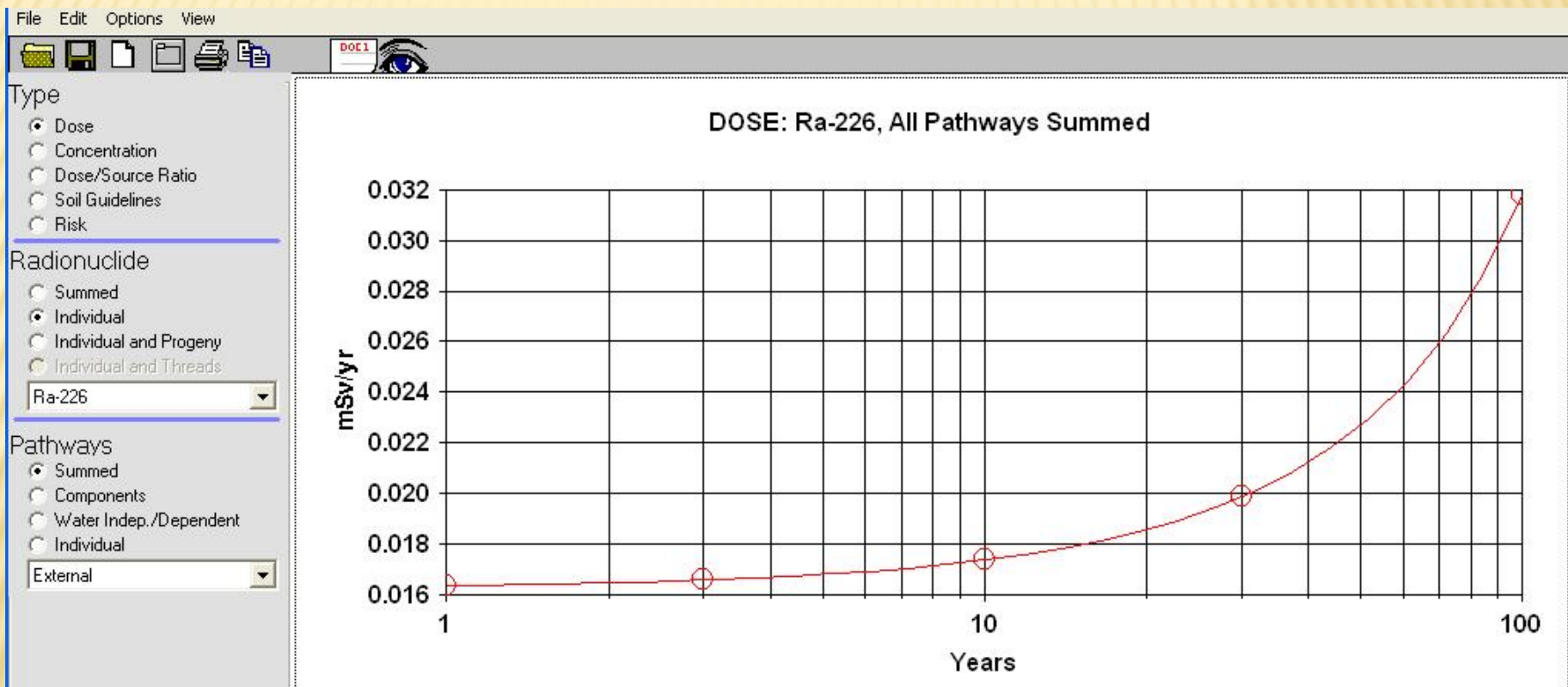
# RESRAD 6.3 without remediation



Maximum concentration of Ra-226 in soil 1560 Bq/kg



# RESRAD 6.3 with remediation





in 2008 after remediation activities



in 2003





# **THANK YOU FOR ATTENTION**

---

**In 2010 the land of “Zvezda” Eleshnitsa will be measured and certified for the purpose of reclamation the remediation activities.**