

# **Summary of guides and recommendations for decision making in the post release and transition phase taking into account uncertain information – Slovak Republic case study**

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**Introduction on approaches to deal with uncertainty information within the decision-making process in nuclear emergency**

Training seminar, 16 April 2019  
University of Milan, Italy

# Slovak stakeholder discussion panel

- Set up in Slovakia in the framework of the project CONFIDENCE – WP4 (Transition to long-term recovery, involving stakeholders in decision-making processes) and WP6 (Decision making under uncertainties)

## Topics:

- Evacuation/relocation of population
- Urban area recovery

## Objectives:

- To determine which criteria are important for which stakeholder groups
- How certain criteria impact the return of evacuated/relocated population or opposite – impact further extended evacuation/relocation
- How these criteria and their uncertainties could be taken into account in post accident decision making on decontamination and recovery management

# Topics for discussion

- What do we understand by “the transition phase”
- Main concerns during the transition phase
- Issues to be addressed during the transition phase:
  - Relocation of people and restoration of living conditions
  - Application of countermeasures (e.g. food and agricultural protective actions, closing of the area)
  - Decontamination
  - Radiological characterization of the contaminated areas
  - Radioactivity surveillance/monitoring programs
  - Waste management
  - Information and risk communication to the population
  - Public acceptance
  - Public trust in experts and authorities
- Objectives and criteria of the restoration plan
- Alternative restoration actions
- Stakeholders engagement

# Organization and panel composition

The Slovak stakeholder panel took place in **December 10-11, 2018** in VUJE premises in Modra-Harmonia.

The panel was composed of usual decision-makers involved at different levels of the emergency preparedness, response and recovery management activities – 19 members represented following organizations:

- Nuclear Regulatory Authority
- Public Health Authority
- Civil Protection and Crisis Management Offices at national (Ministry of Interior – Civil Protection and Crisis Management Division) and regional level (Trnava region - Bohunice NPP, Nitra Region - Mochovce NPP)
- Slovak Medical University in Bratislava (monitoring network and education)
- Police Academy (Public Administration and Crisis Management)
- Slovak Hydrometeorological Institute (monitoring network)
- Mayor and Chief of self-government (Prefect) of village Kalna nad Hronom (member of GMF – Group of European Municipalities with Nuclear Facilities and national Association of Municipalities and local/regional Civic Information Commissions, Mochovce NPP area)

# Scenario

- Scenario was situated during the transition phase after a fictitious accident in the Bohunice NPP with external release of radioactivity to environment.
- The release has ceased, and the control over the source has been taken.
- The radioactive contamination has spread in the surroundings of the damaged NPP and transported and dispersed through the borders of the country affecting the neighboring regions.
- The contamination level, range of contamination and affected areas have been identified.
- Early emergency actions have been taken to avoid the exposure to population, including evacuation, access restrictions and food restrictions.
- It has to be decided how to proceed in such a situation and prepare recovery of contaminated areas.

# Municipality Piestany

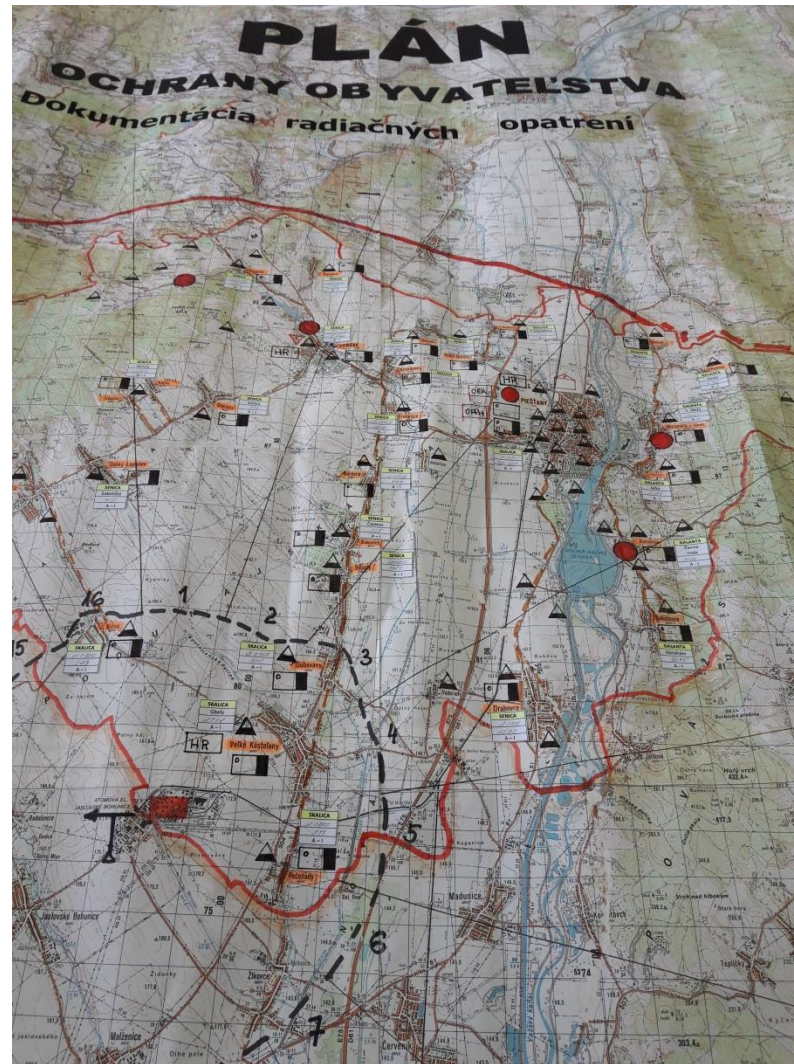
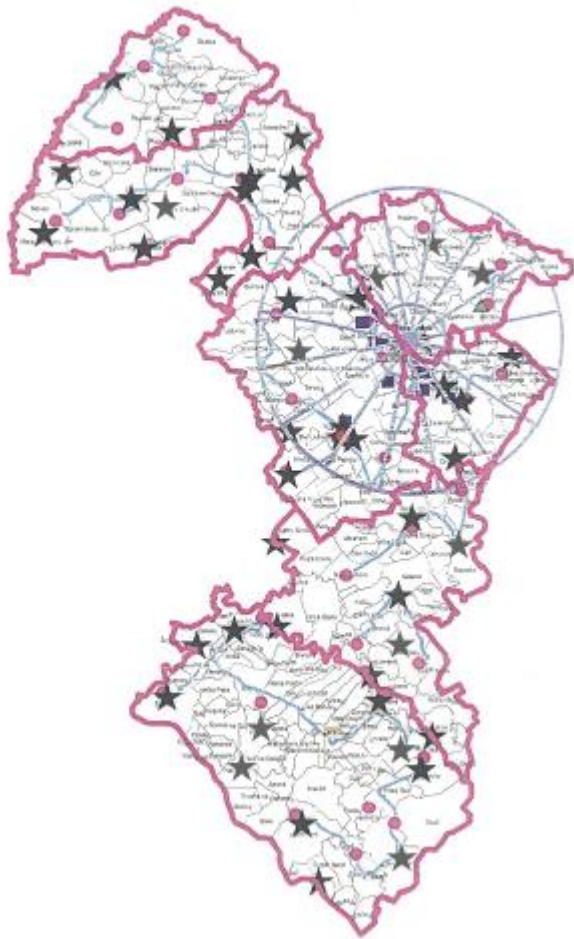


- **Spa town**
- Region/Canton: Trnava
- District: Piestany
- **Population:** 27 666 + 6 000 spa guests
- **Area of municipality:** 44.2 km<sup>2</sup> with 24% of build-up area ~ 10.7 km<sup>2</sup> including buildings with different walls and roofs, interiors, streets and pavements, areas of grass, trees, plants, soil, playing grounds, sport fields, water areas and others.
- **Geography:**
  - on the right bank of the river Vah
  - south of the town is the Sĺňava water reservoir created by a dam on the Vah river





# Region Trnava



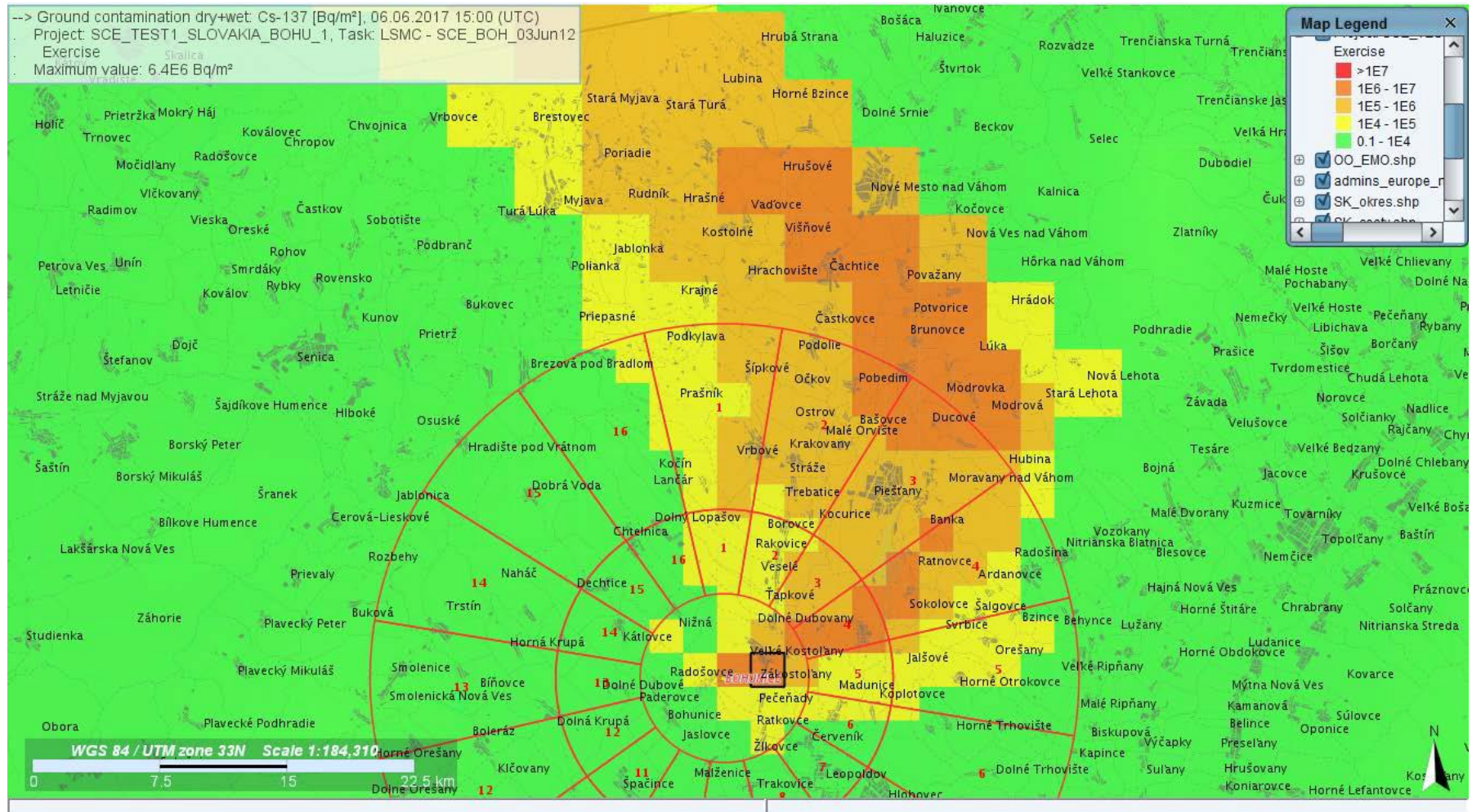
# Traditional events in Piestany during summer: period in 3 month after an accident

- 1.– 3.6.2018 Opening on the **spa season**
- 1.– 3.6.2018 **International Canoe Regatta** Piešťany - International event for the young canoeists
- 15.–16.6.2018 **Car at tuning party** – party motorisms, sport, music, dance, fashion and entertainment
- 6.–8.7.2018 **Motorcycle race with side rock concerts**, paragliding and other site events
- 10.–11.8.2018 **Grape Festival** is a summer music open-air festival
- 30.8.–1.9.2018 **Country Lodenica** – a festival dedicated to country and folk music
- 17.–23.9.2018 **Victoria Regia** is the major **florist event** in Slovakia – an international competition in flower arranging. The annual Slovak championship in flower arrangements and traditional flower promenade are enriched by Unusual Flowers Festival



# Scenario Bohunice (release: June 3 at 12:00)

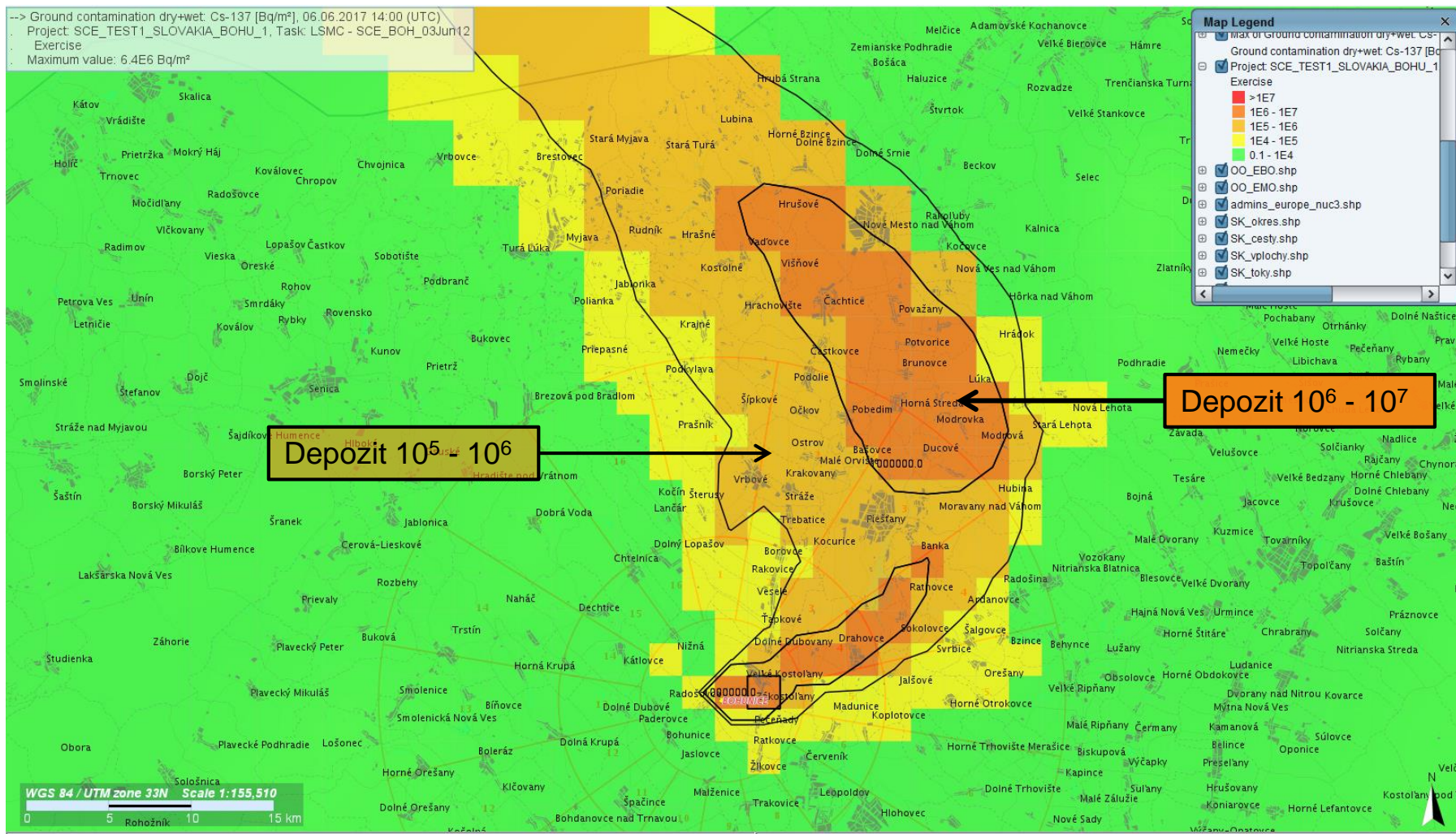
## ground contamination (dry+wet) for Cs137 at ~3 days after start of release





# Scenario Bohunice (release: June 3 at 12:00)

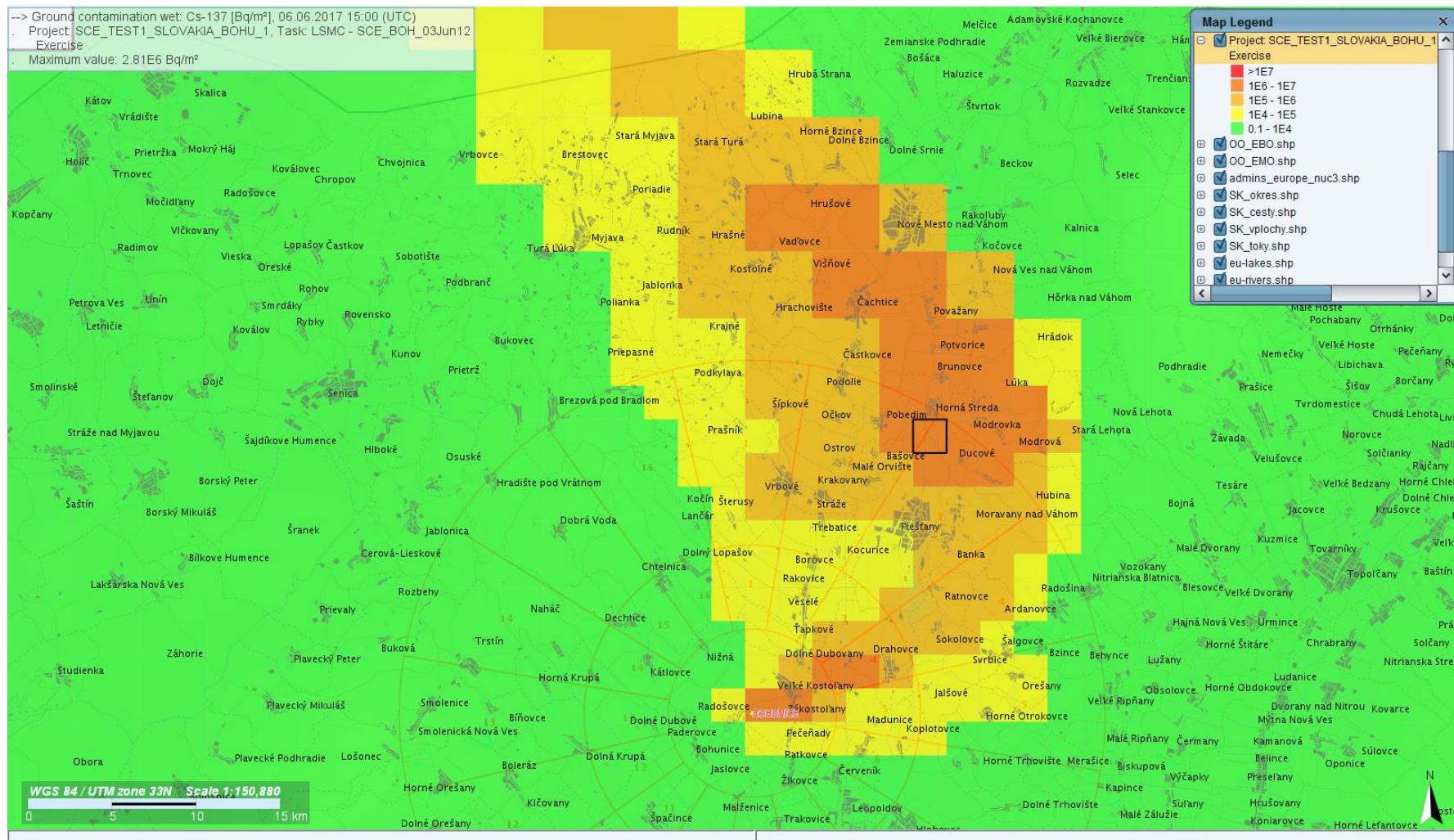
## ground contamination (dry+wet) for Cs137 at ~3 days after start of release





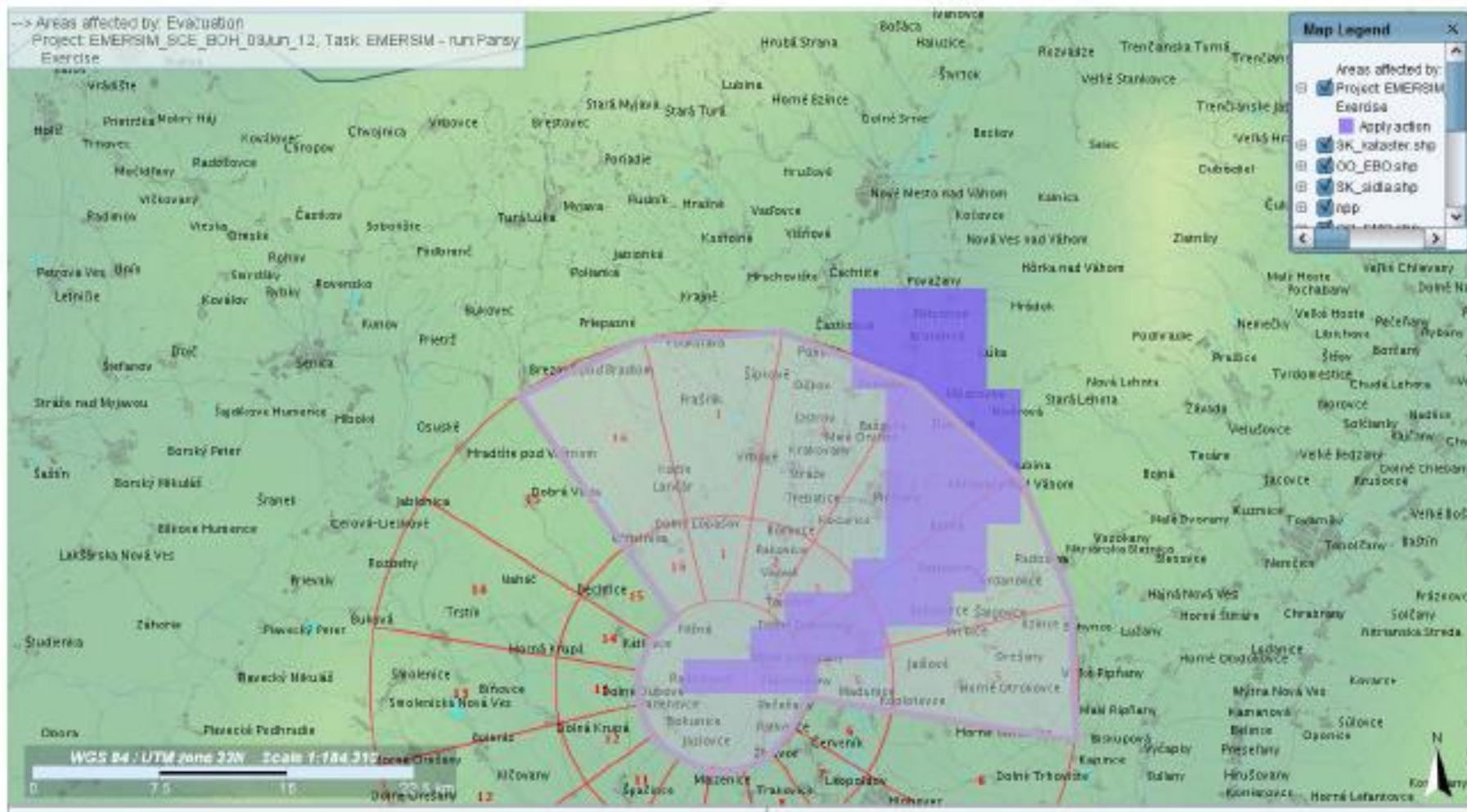
# Scenario Bohunice (release: June 3 at 12:00)

## ground contamination (wet) for Cs137 at ~3 days after start of release



# Scenario Bohunice (release: June 3 at 12:00)

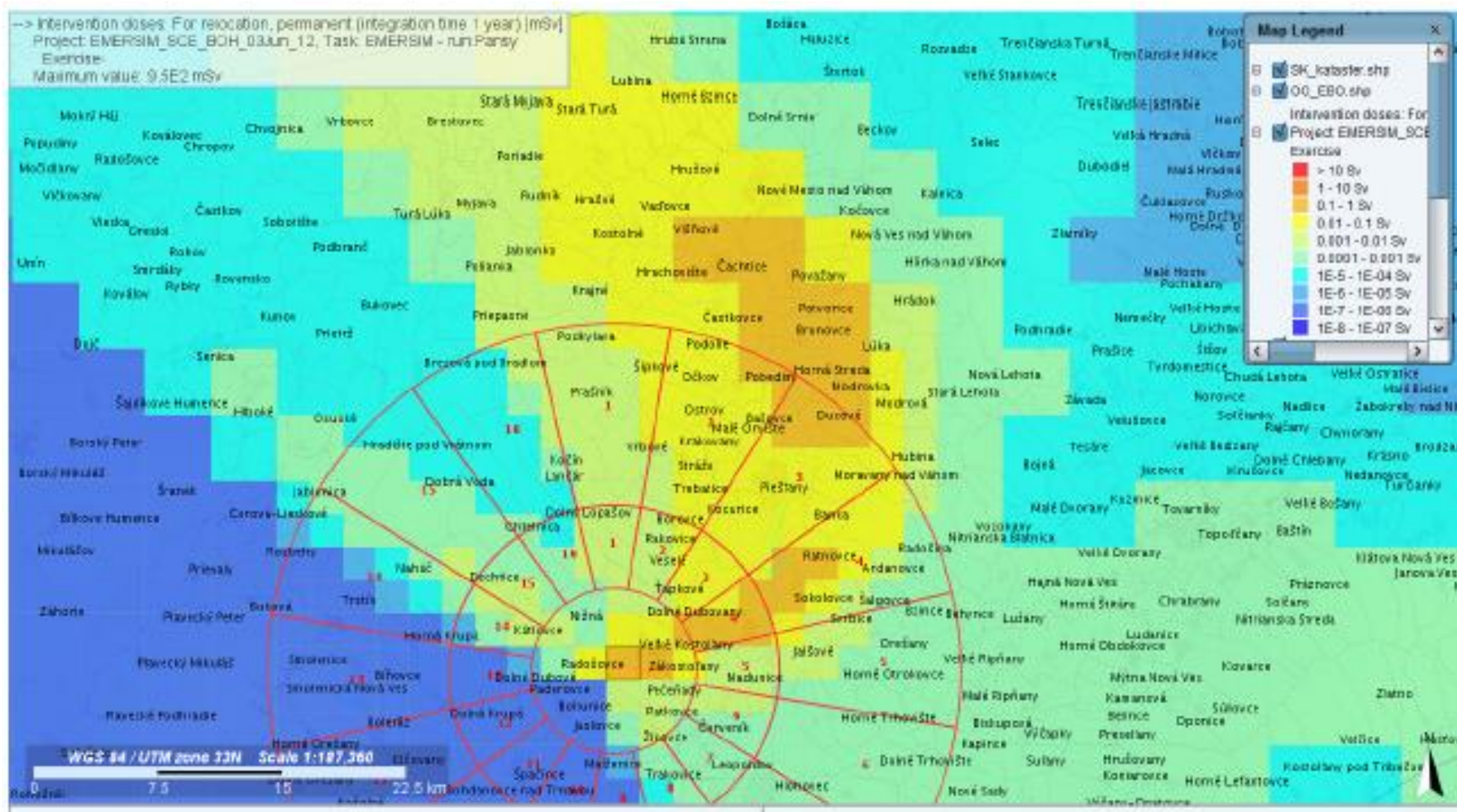
Areas affected by evacuation (effective dose, integration time 7 days, 100 mSv)





# Scenario Bohunice (release: June 3 at 12:00)

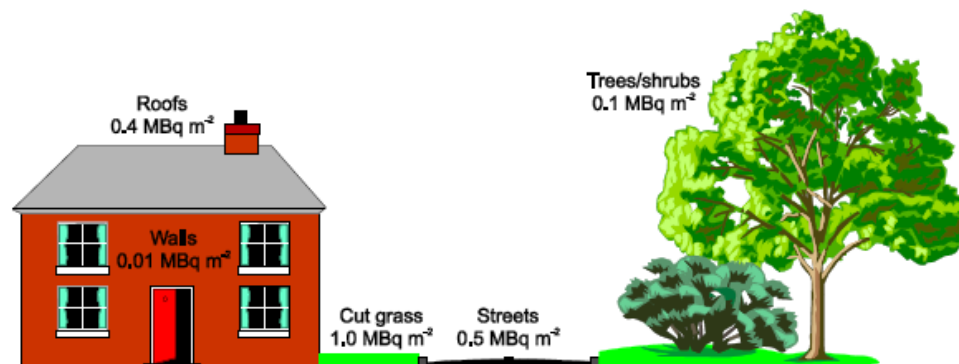
Areas affected by temporary relocation (effective dose, integration time 1 year, 100 mSv - GSR Part 7)



# Consequences for Piestany

## ■ Contaminated surfaces in urban areas

- Roofs, walls
- Streets, pavements
- Areas of grass, garden(s)
- Playing grounds
- Sports fields
- Interiors
- ...



## ■ Under the scenario the situation in Piestany 3 days after an accident was supposed to be as follows:

- contamination 3 - 4 MBq/m<sup>2</sup> <sup>137</sup>Cs
- doses ≈ 20 mSv/year



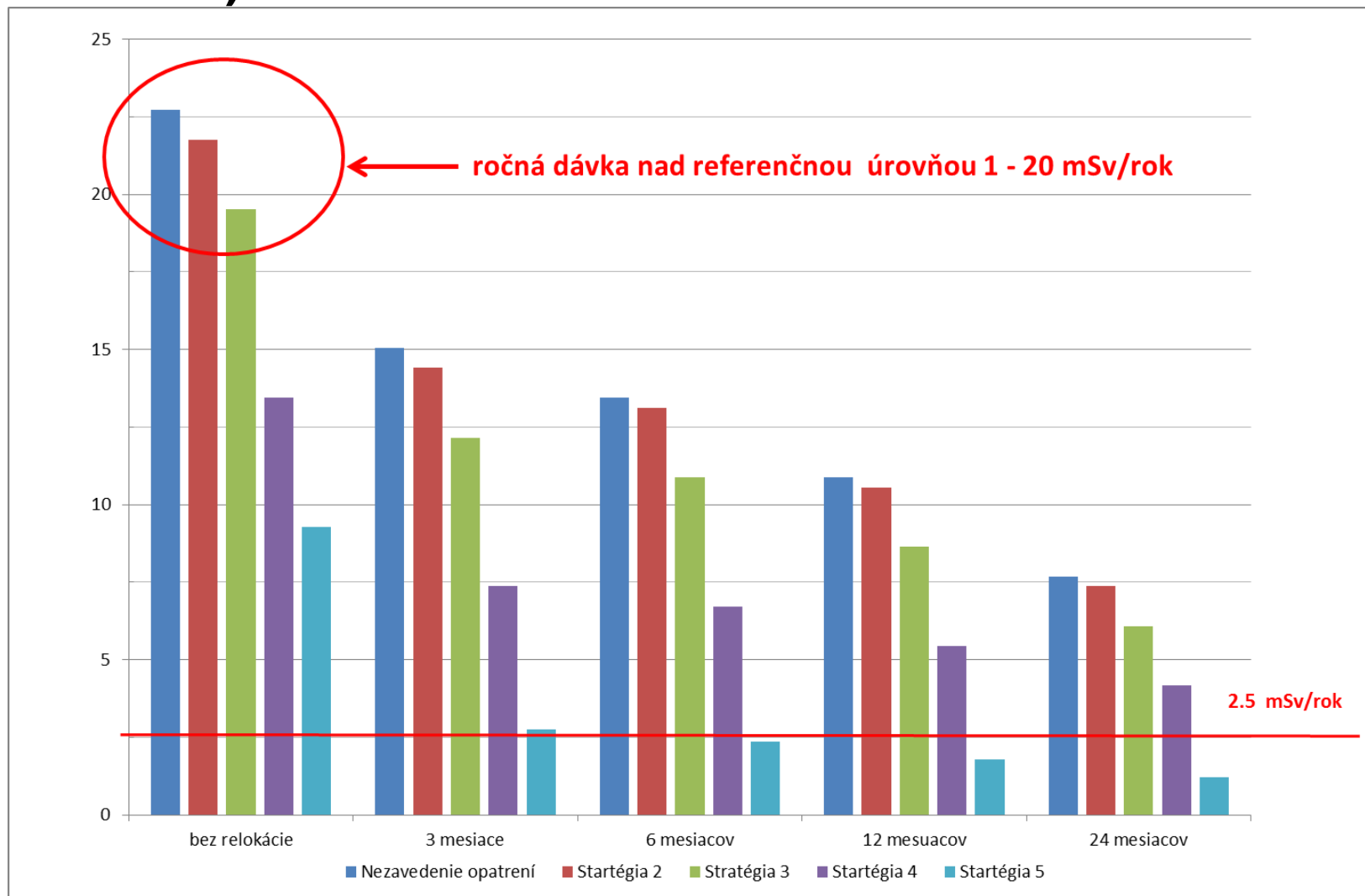
# Recovery strategies

- 8 strategies have been defined based on the EU project HARMONE:
  - 5 strategies with different recovery options aimed at the cleanup of areas of grass, greens, gardens and plants, the interior and roofs,
  - 3 of the five cleanup strategies were combined with a three month relocation period.

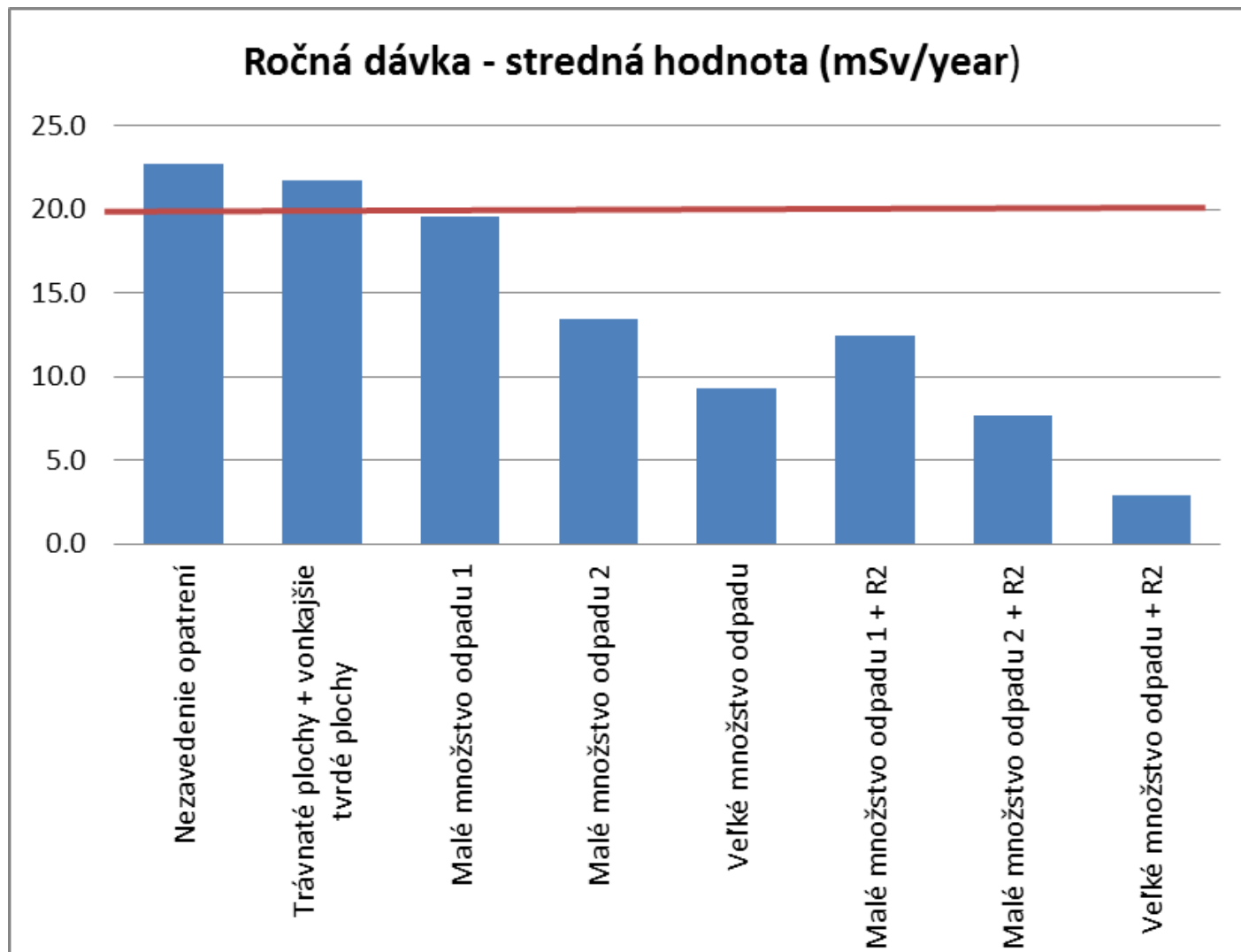
# Recovery strategies

1. Do nothing (introducing of monitoring strategy)
2. Grass cutting, vacuum cleaning (roads)
3. Roof brushing (roofs), vacuum cleaning (internal building), tree/shrub removal (trees and shrubs), grass cutting (small and large areas of grass), plant and shrub removal (small area of plants) (*low waste 1*)
4. Roof brushing (roofs), vacuum cleaning (internal building), tree/shrub removal (trees and shrubs), grass cutting (small and large areas of grass), plant and shrub removal (small area of plants), rotovating carried out after plant, grass and shrub removal (*low waste 2*)
5. Roof replacement (roofs), vacuum cleaning (internal building), tree/shrub removal (trees and shrubs), grass cutting (small and large areas of grass), plant and shrub removal (small area of plants), topsoil removal carried out after plant, grass and shrub removal (*high waste*)
6. Strategy 3 + relocation for three months
7. Strategy 4 + relocation for three months
8. Strategy 5 + relocation for three months.

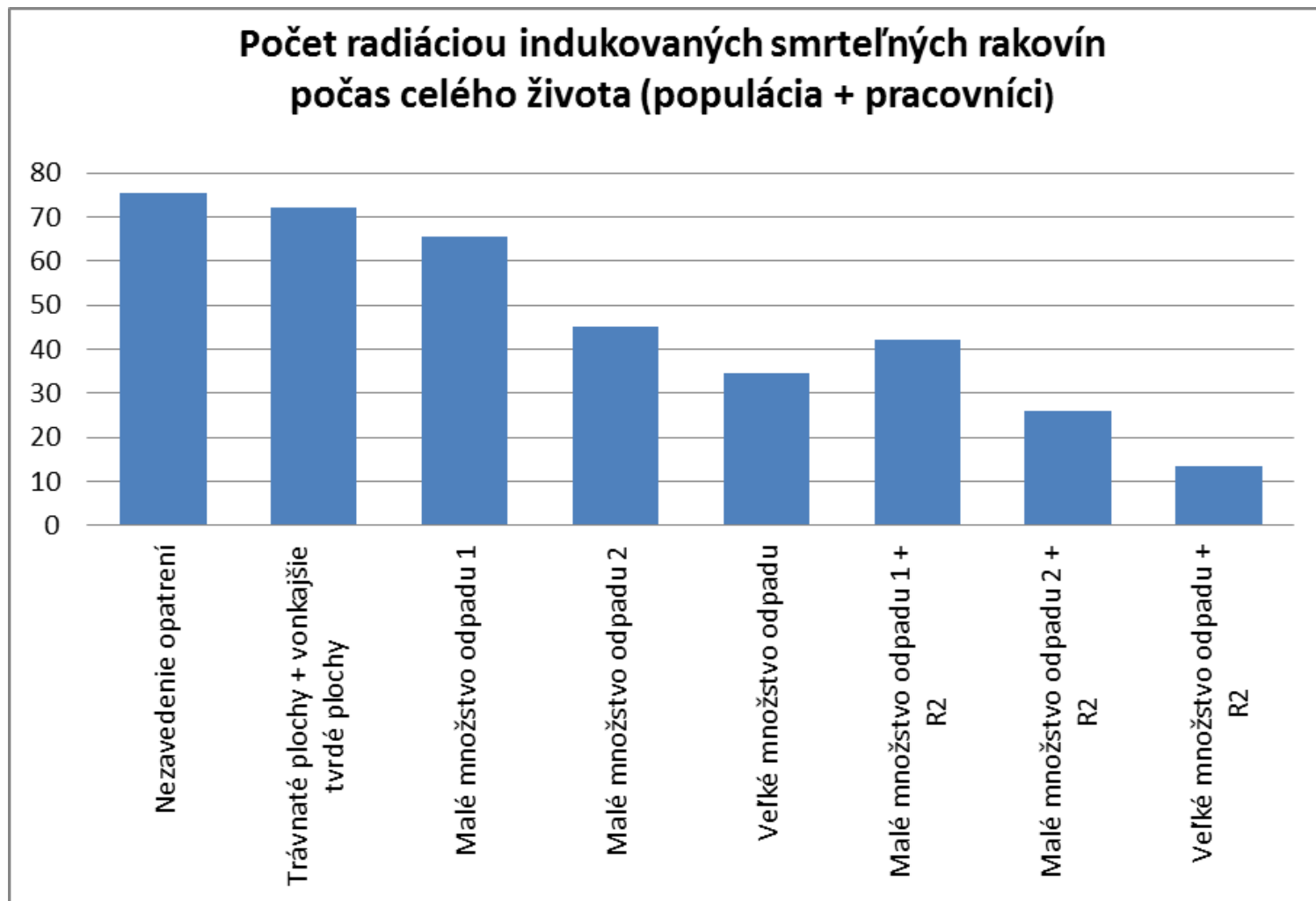
# First year dose above EURATOM reference level: 1 – 20 mSv/year (compared to average dose in Slovakia) – results of ERMIN module of JRODOS



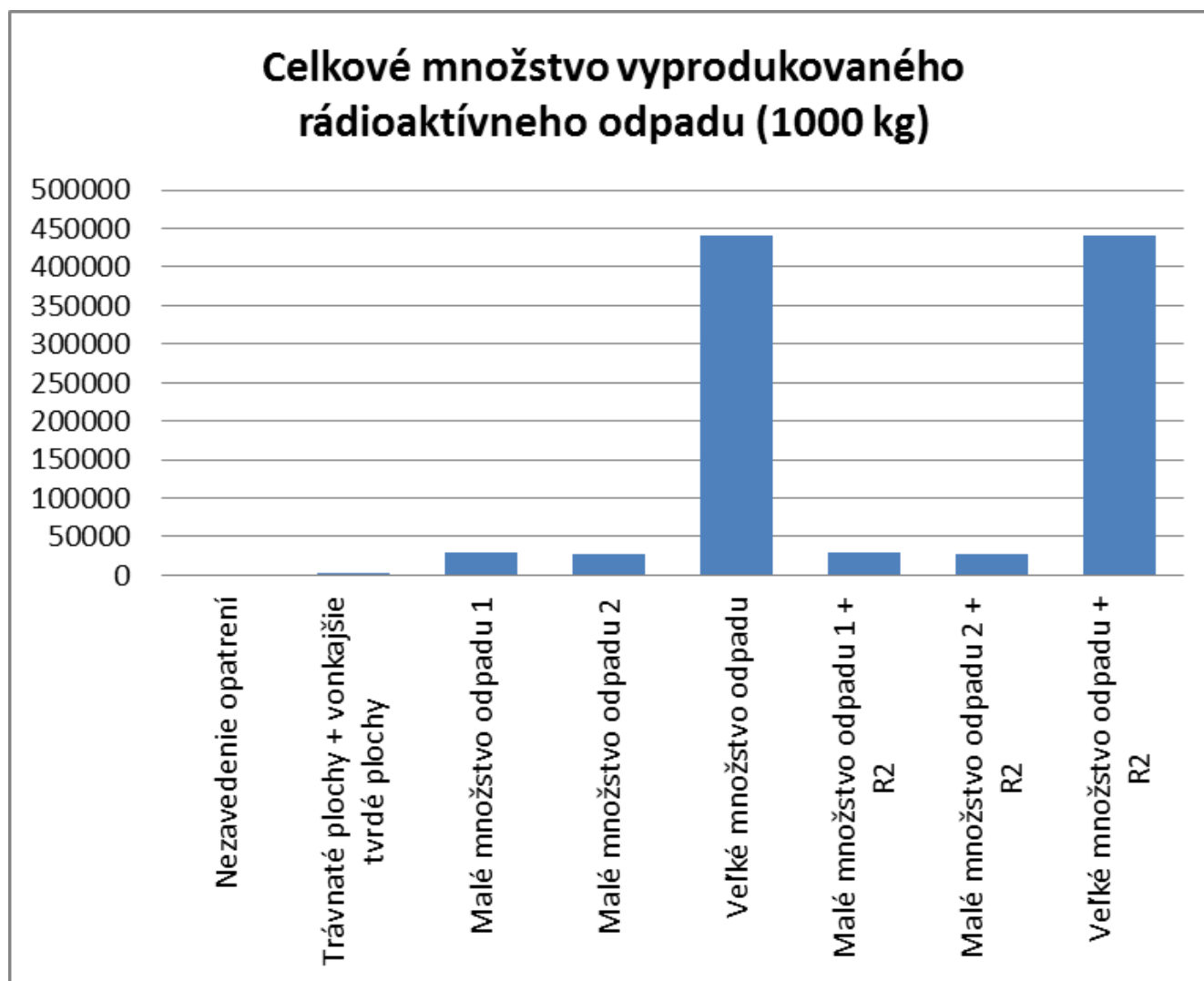
# Annual dose, mean value, mSv/year



# Number of cancer incidences during 50 years, attributed to the exposure (popul. and workers)



# Radioactive waste amount, kg



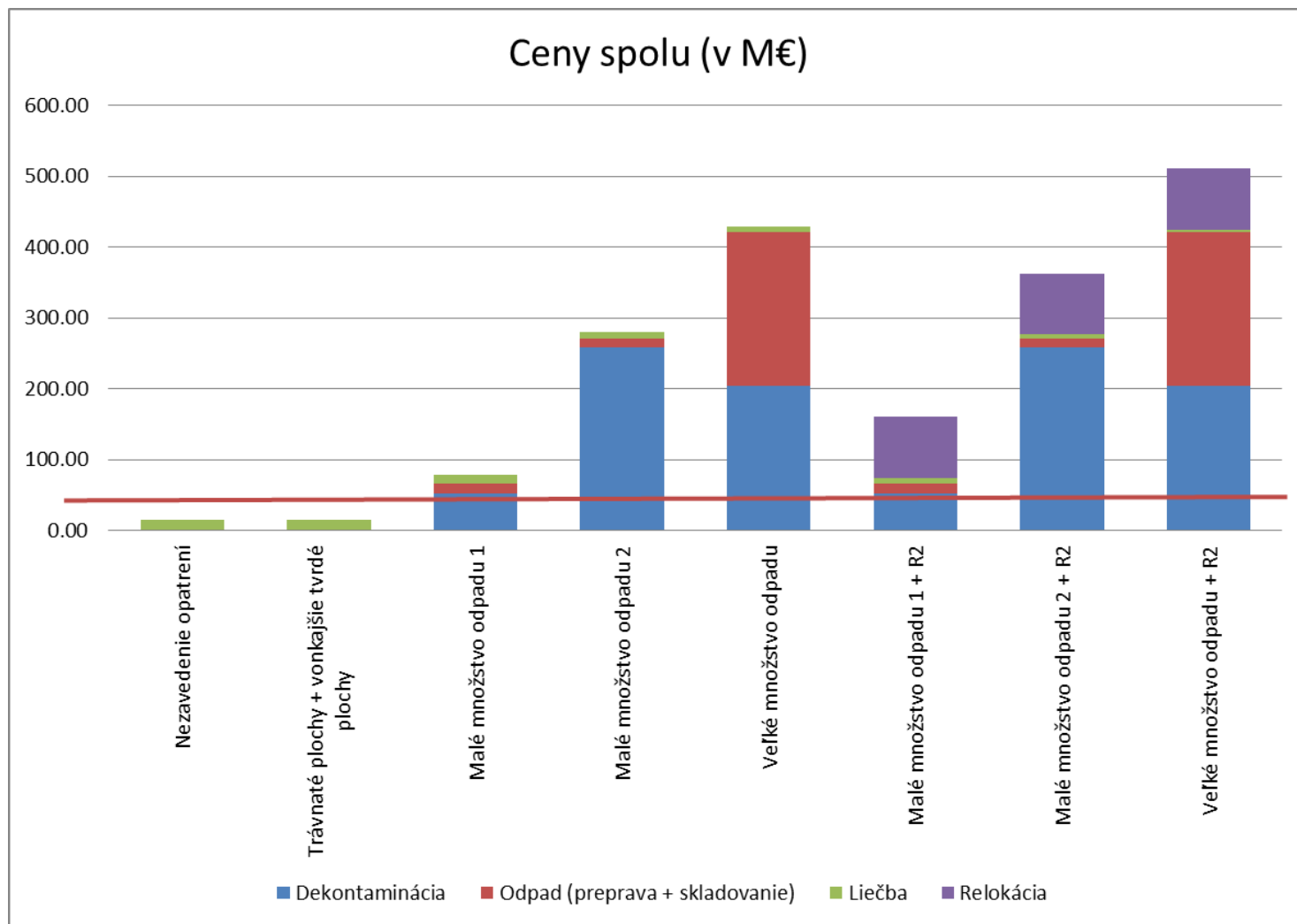


# Costs

Costs of countermeasures taken into account during the discussions included following items:

- accommodation during relocation
- compensation of loss of productivity during relocation
- clean-up strategy implementation
- waste transport and storage and
- cancer treatments

# Overall costs for particular strategy



# Uncertainties included in generated ERMIN outputs

The following uncertainties have been included in generating the ERMIN outputs:

- occupancy variability,
- deposition amount and composition to reference surface variability,
- shielding/environment variability,
- soil migration variability and
- countermeasure uncertainty (simply treated; time of application and whether or not effective)

# Main areas of concern and uncertainties

Participants identified main areas of **concern and uncertainties** related to:

- availability of adequate personal resources of trained and prepared professionals at all levels (national, regional and local),
- sufficient technical resources especially related to the radiological monitoring,
- availability of National emergency plan with specified competences and responsibilities of stakeholders as well as
- reference levels and other criteria for preparation of advice, implementation and withdrawal of countermeasures.

The influence of **successful and sustainable preparedness process** was stressed as well as advice and implementation of urgent protective measures which influence development and implementation of later countermeasures during the transition phase.

The **information provided to population also during the exchange of KI tablets campaign** is essential.

# Criteria for selection of reconstruction strategy

The criteria for selection of reconstruction strategy under the contamination scenario presented have been identified as follows:

- **public health (health effects);**
- **costs (economical effects);**
- personal and technical resources subdivided into the number of workers needed for the realization of countermeasures, personal resources expressed by **“How difficult is to allocate the workers”** for particular restoration strategy implementation and technical resources needed for particular restoration strategy implementation;
- **wastes** expressed by availability of storage places which is conditioned by the **amount of waste;**
- population acceptance and **willingness to cooperate on realisation of options** of particular restoration strategies (self-help);
- attitude to property and home;
- relation to receiving society during the relocation and to certain degree indifference of people in peace time and during the emergency preparedness process;
- political decisions, the role of state, education and professionalism;
- infrastructure

# Use of MCDA

The formal decision aiding tool such as multi-criteria decision making (MCDA) have been presented and tested during the stakeholder panel to see how it can be adapted and used for uncertainty handling and “robust” decision making for radiological emergency.

The tool was helpful in identifying of weights of particular criteria influencing selection of restoration strategies and giving the preferences by different stakeholders.

The participating stakeholders effectively used the decision aiding tool MCDA which was helpful in thorough discussions and supportive in making decisions



# Key criteria used by MCDA

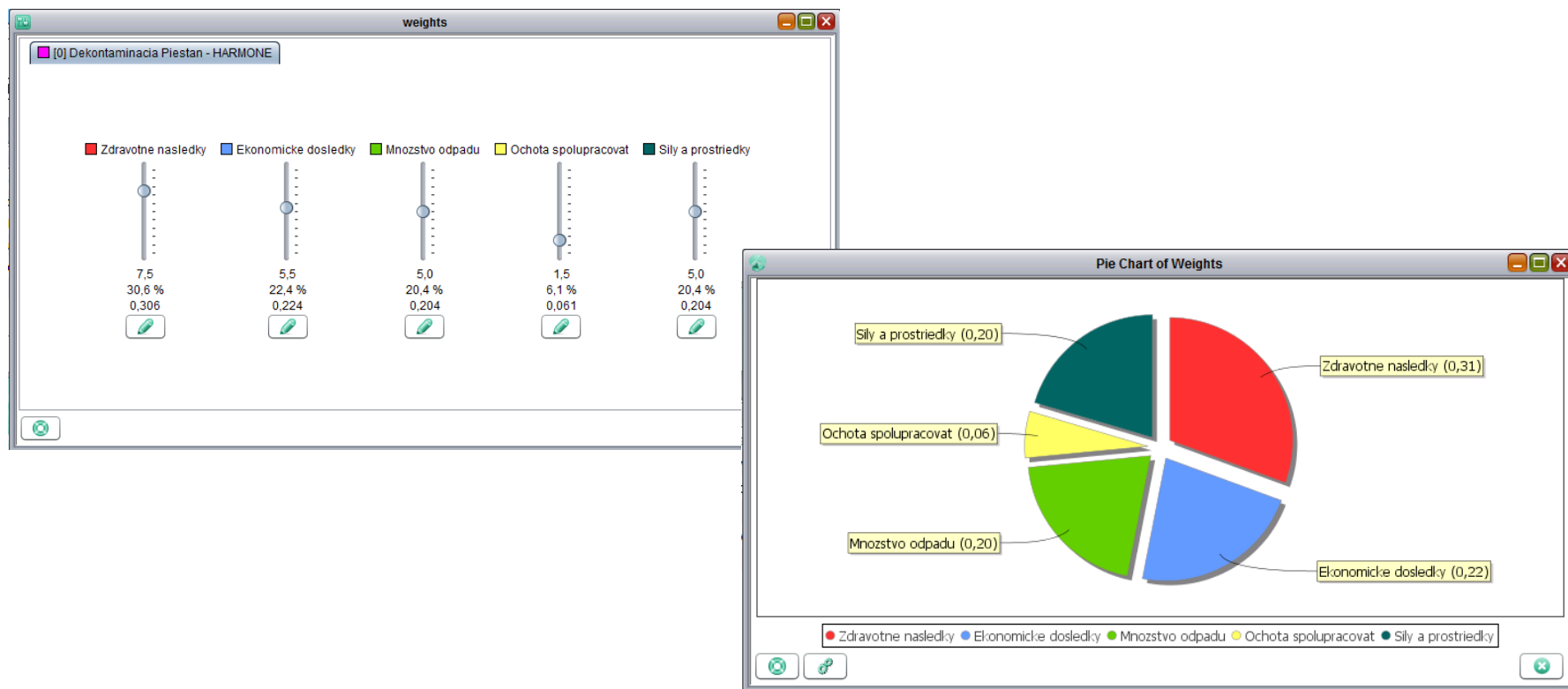
Such criteria as **health effects**, **costs** and **amount of waste** have been used from the JRODOS results as an output of ERMIN calculations.

Soft criteria - expressed as “**How difficult is to allocate the workers**” and “**Is population willing to cooperate in implementation**” were widely discussed, precisely specified and expressed by empirical functions under the MCDA requirements.

Values									
Criteria	Weights	Bez opatre	Travalcest	Malo odpa	Malo odpa	Vela odpa	Malo1 +R	Malo2+R	Vela+R
▼ Dekontaminacia Piestan - HARMONE									
■ Zdravotne nasledky	0,306	0,000	3,000	10,000	30,000	41,000	33,000	49,000	62,000
■ Ekonomicke dosledky	0,224	15,000	16,000	79,000	281,000	429,000	161,000	363,000	511,000
■ Mnozstvo odpadu	0,204	0,000	818,000	29059,0...	26907,0...	441271,...	29059,0...	26907,0...	441271,...
■ Ochota spolupracovat	0,061	0,500	1,000	0,800	0,700	0,500	0,300	0,300	0,100
■ Sily a prostriedky	0,204	10,000	25,000	50,000	113,000	300,000	600,000	700,000	1000,000

# Criteria and their weights in MCDA

The weights of particular criteria have been discussed and it was agreed that it is very subjective and responsible attitude is needed in their assessment. MCDA tool provide interface suitable to follow influence of the weights on the overall ranking of particular strategies and their preferences



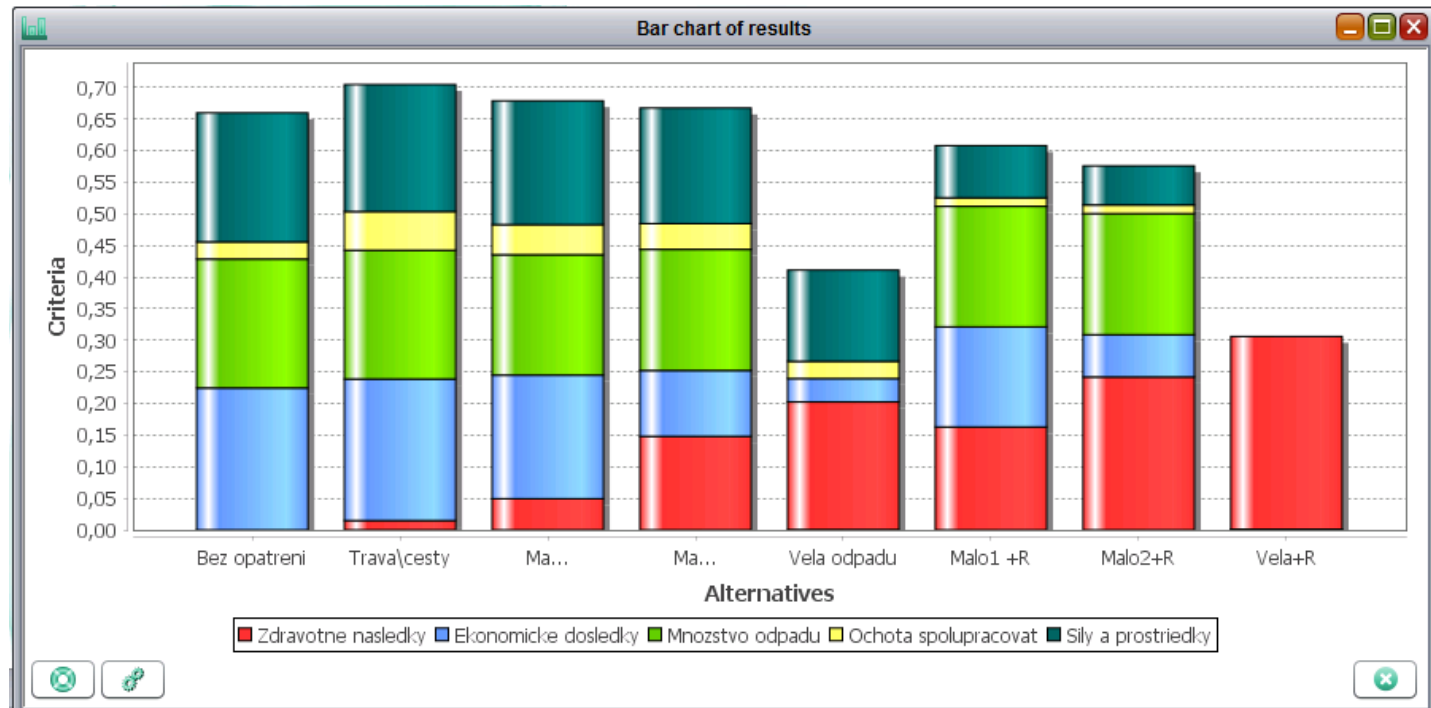
# Preferences of particular restoration strategies

## MCDA output

Based on the discussion which identified particular factors and uncertainties influencing strategy preferences participants ranked strategies as follows:

- 1.Strategy 2
- 2.Strategy 4
- 3.Strategy 3
- 4.Strategy 1
- 5.Strategy 6 + 7
- 6.Strategy 5 + 8

MCDA output



# Uncertainties visualization

Visualization of uncertainties taken into account by the ERMIN module of the JRODOS DSS have been incorporated within the MCDA tool and one of the possible outputs accepted and appreciated by panel members is given here



# Conclusions and perspectives

Stakeholder discussion panel in Slovakia has been focused on **what to do and how to proceed in presented contamination scenario** and **how to evaluate the potential impacts of decisions on achieving acceptable living conditions**.

These discussions were mindful of the inherent **uncertainties associated with the real consequences** of the contamination scenario, the strategies to be implemented and the potential socio-economic impacts on the affected population.

**Preferences** collected within WP4 panel discussion **served the inputs to the MCDA** by WP6.

The appropriate means of **visualisation** in terms of information for decision making when based on an MCDA tool have been discussed and evaluated. The MCDA tool was helpful in identifying of weights of particular criteria influencing selection of restoration strategies and giving the preferences by different stakeholders.