



TYPES OF SAFETY ASSESSMENTS OF NEAR SURFACE REPOSITORIES FOR RADIOACTIVE WASTE

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CONTENT



- WHAT IS SAFETY ASSESSMENT OF NEAR SURFACE REPOSITORIES FOR RADIOACTIVE WASTE?

- CLASSIFICATION OF DIFFERENT TYPES SAFETY ASSESSMENT IN BULGARIA;
- APPROACHES USED FOR SAFETY ASSESSMENTS
- EXAMPLES FROM SAFETY ASSESSMENTS GENERATED IN BULGARIA.

CLASSIFICATION OF TYPES OF SAFETY ASSESSMENT



TECHNICAL SUBSTATION OF SAFETY (TSS)

SAFETY ASSESSMENT (SA)

- PRELIMINARY SA (PSA);
- SA CASE (SAC);
- POST CLOSURE SA (PCSA)

ASSESSMENT OF INFLUENCE ON ENVIRONMENT (AIE)

HOW?

PROBABILISTIC APPROACH

DETERMINISTIC APPROACH

ANALITICAL APPROACH

WHEN?

Requirement from Regulatory - As additional evaluation of technical substation of safety including risk assessment of all facilities and supply systems – electricity, fire-precaution, transport vehicles and facilities, etc.

1. PSA – is applicable for repositories and site selection when there are numerous of uncertain parameters used as input data for evaluation;
 2. SAC – is applicable in cases when there are changes of input parameter values, monitoring results indicating that there is change in radio ecological situation, there exists need to take repository design decisions;
 3. PCSA – when the repository closure plan is developed and there is a regulatory approval of the post closure strategy.

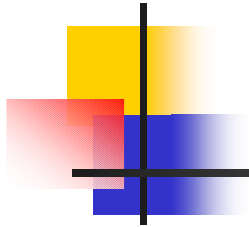
Requirement from Regulatory - As additional independent evaluation of repository influence on environment on the base of technical substation of safety, safety assessment.

WHY?

Licence procedure

Licence procedure
 Regulatory requirement for:
 - Site selection procedure;
 - Repository exploitation;
 - Repository closure

Licence procedure
 Must be approved by
 Ministry of Environment
 and Waters





APPROACH APPLIED FOR TECHNICAL SUBSTATION OF REPOSITORY SAFETY

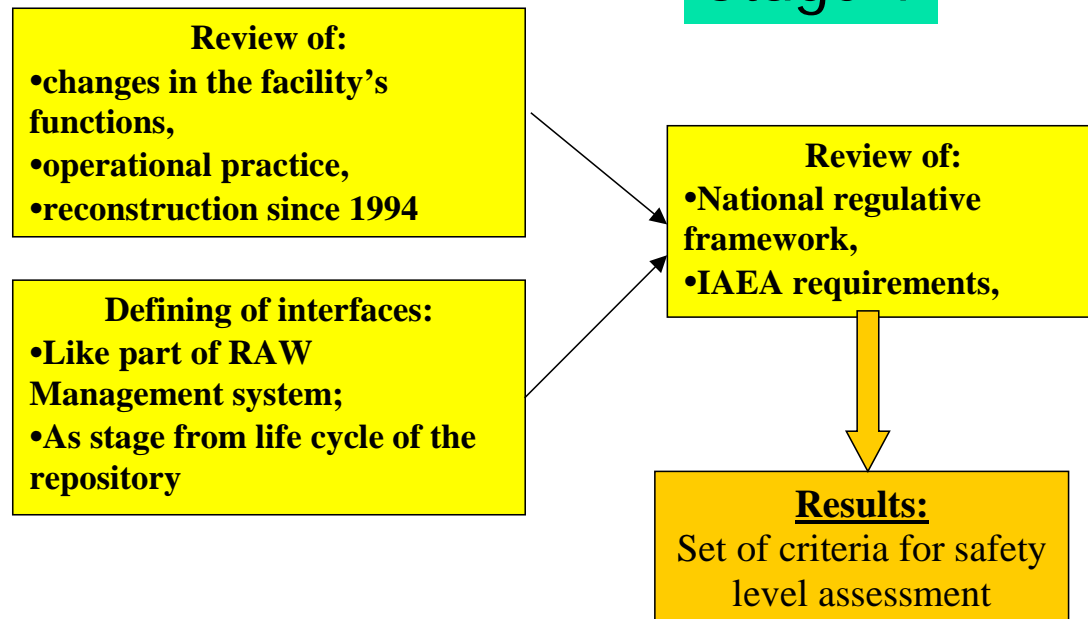
Stage 1- Criteria selection

Stage 2 - Information collection

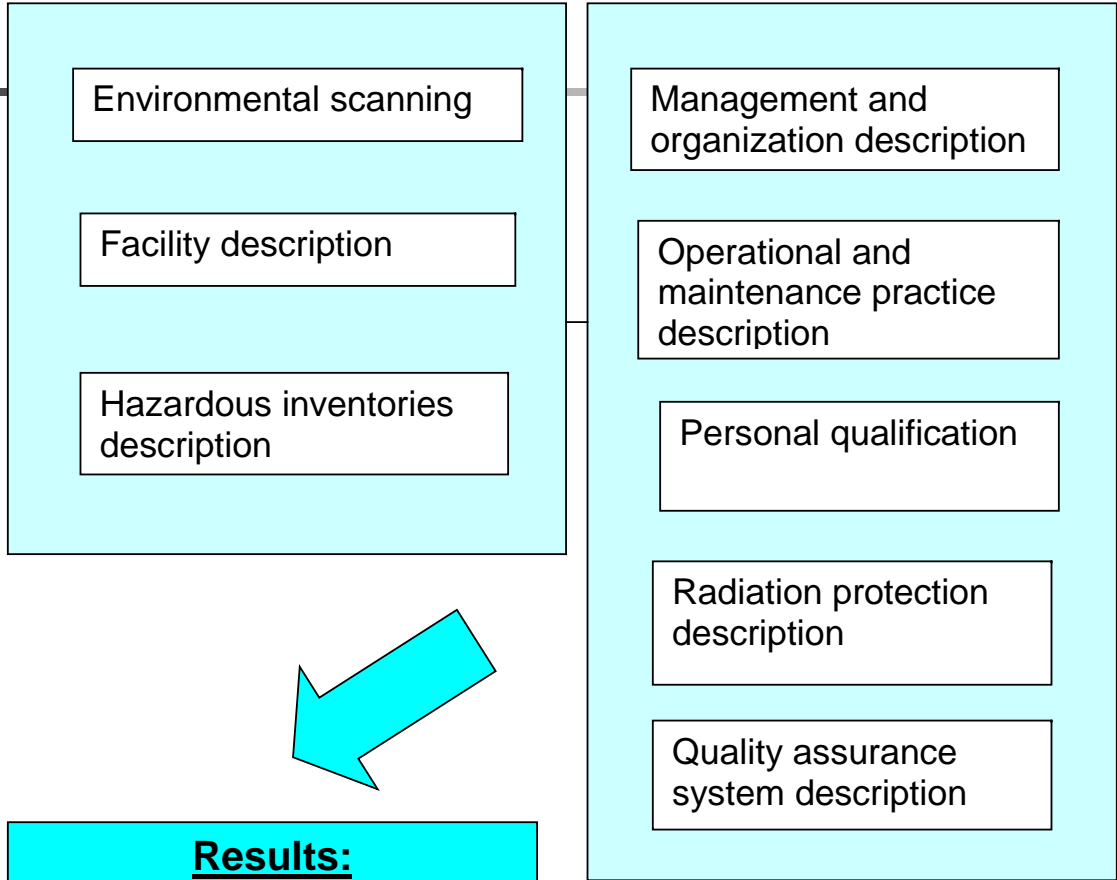
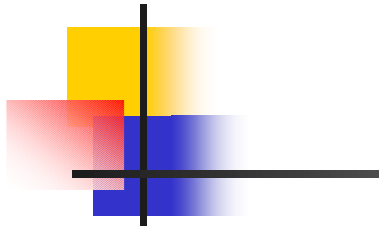
Stage 3 - Safety analysis conduction

Stage 4 - Safety assessment documentation

Stage 5 - Draw up the requirements

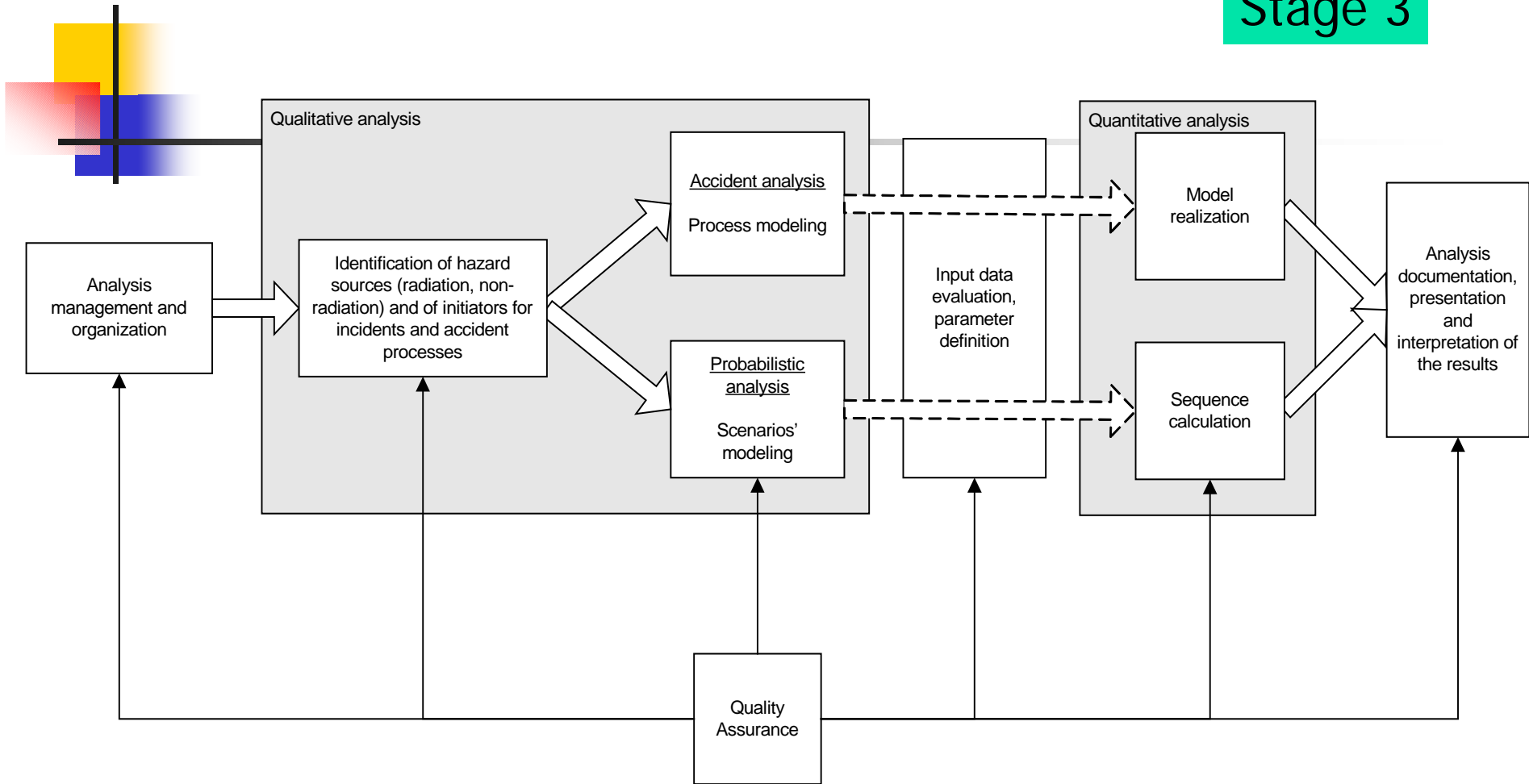


Stage 2



Results:
Actual conditional parameters of the facility, necessary for safety analysis

Stage 3





Results of TSS (1997) and future work

TSS

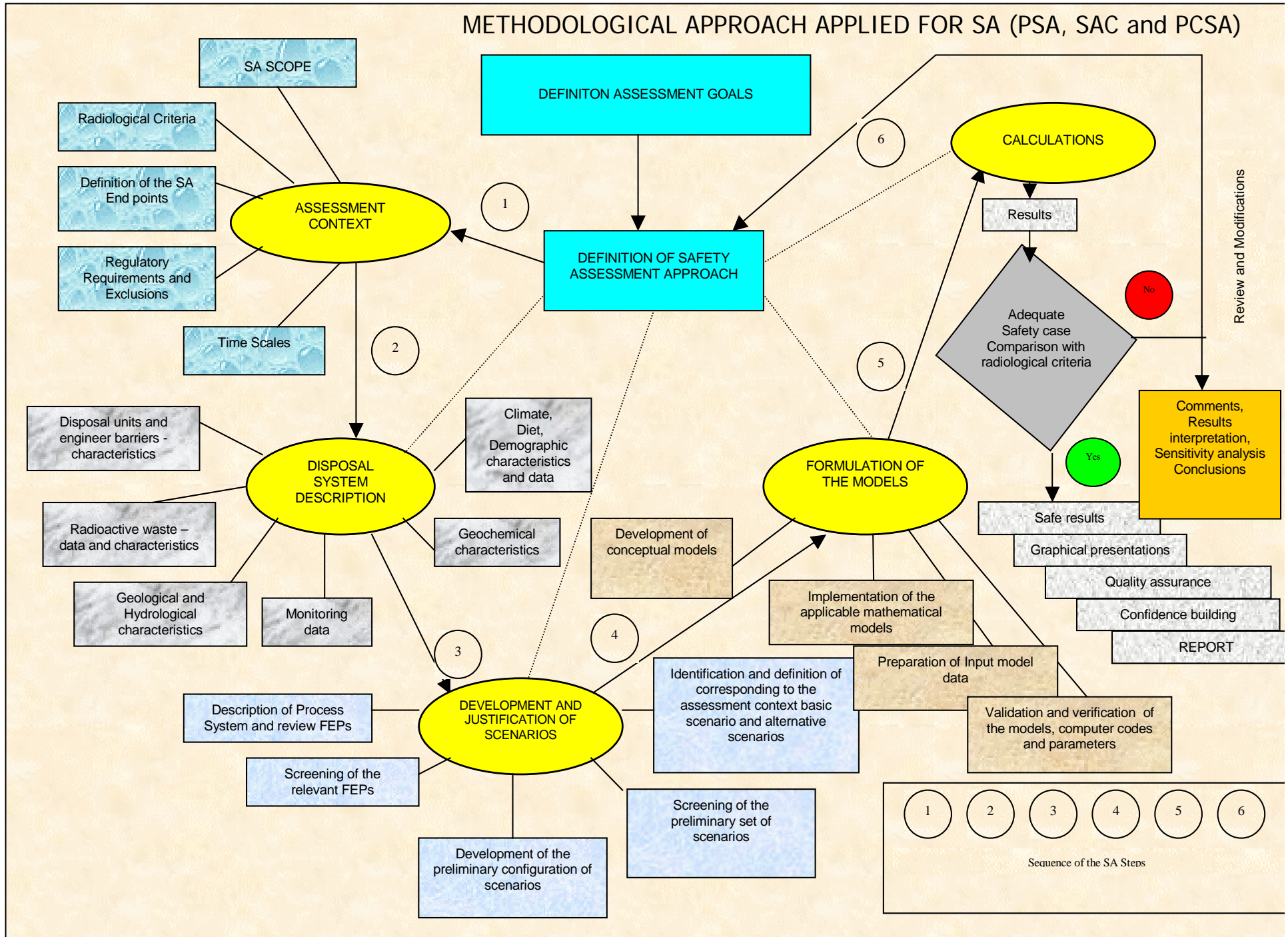
Repository is operated until 2025

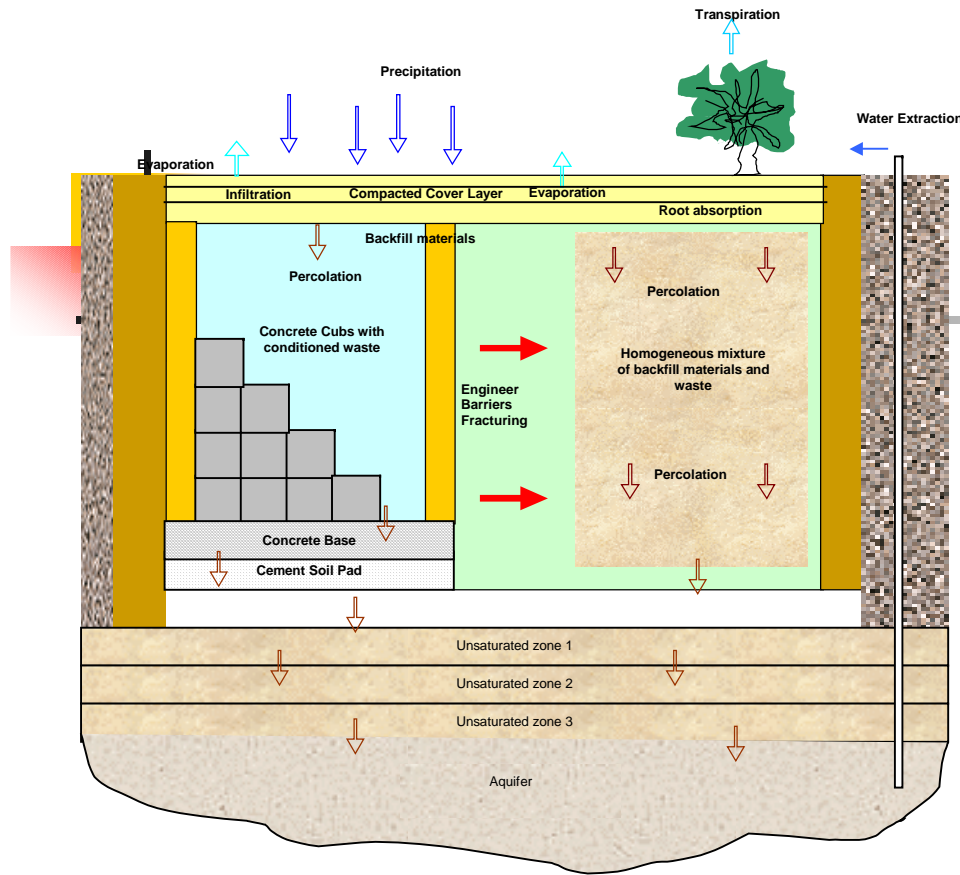
Operational safety for disposal of waste in existing disposal facilities only for disposed RW

- Spilling of waste package during unloading and disposition into disposal vaults – annual risk $7.58 \cdot 10^{-9}$
- Spilling of waste package as result of transport accident on the site – annual risk $2.90 \cdot 10^{-9}$
- Fire scenario on the site due to transport accident or surrounding forest fire – annual risk $3.50 \cdot 10^{-13}$
- Release of radionuclides to the environment due to flooding or earthquake – annual risk $5.05 \cdot 10^{-4}$

The new version of TSS is under development.

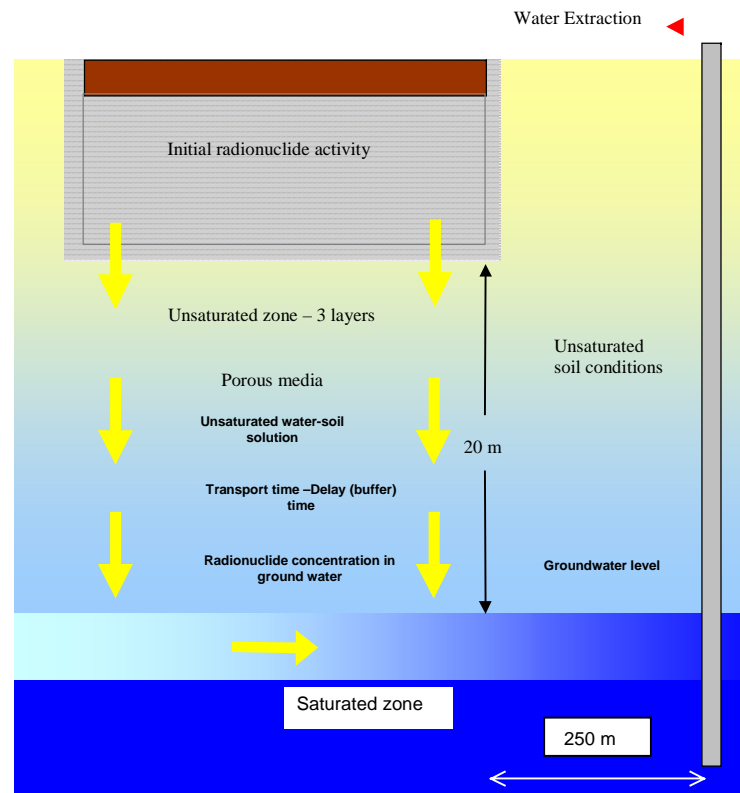
METHODOLOGICAL APPROACH APPLIED FOR SA (PSA, SAC and PCSA)



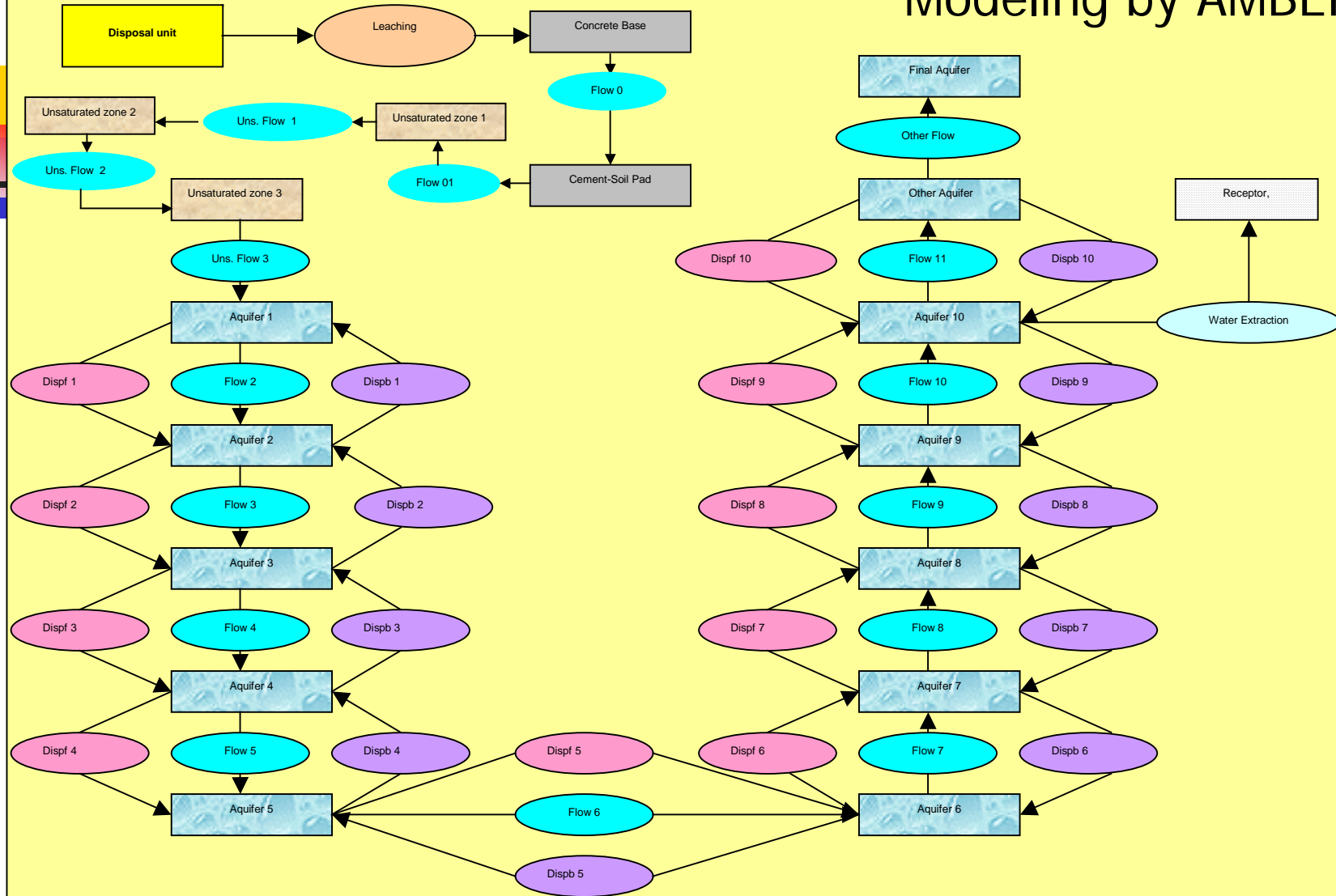


EXAMPLE1 - PSA

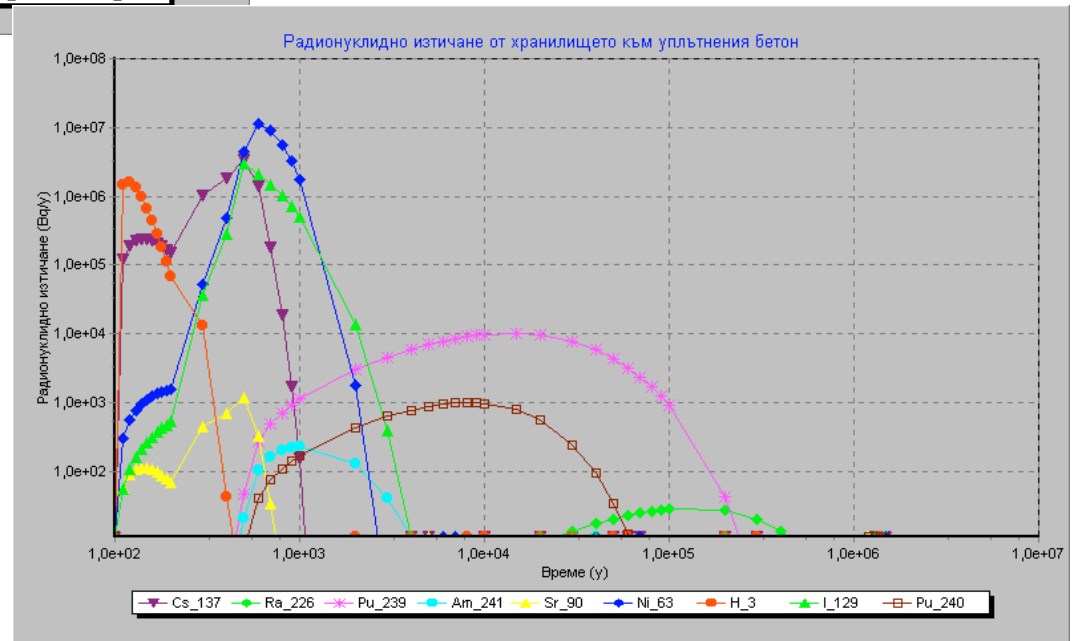
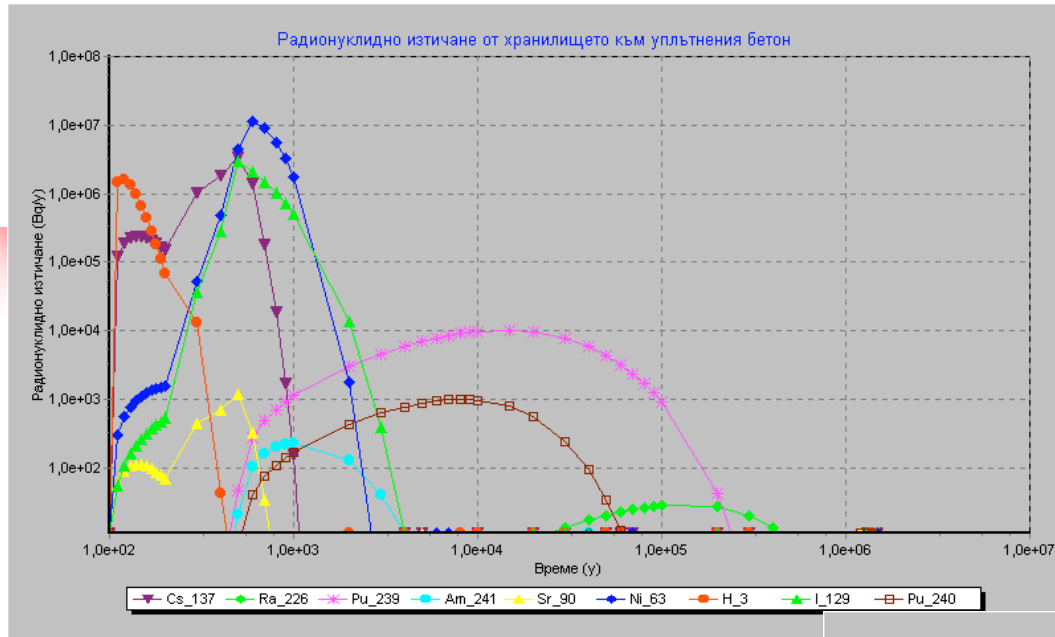
Future Repository for LLRW from NPP Kozloduy-Site Selection

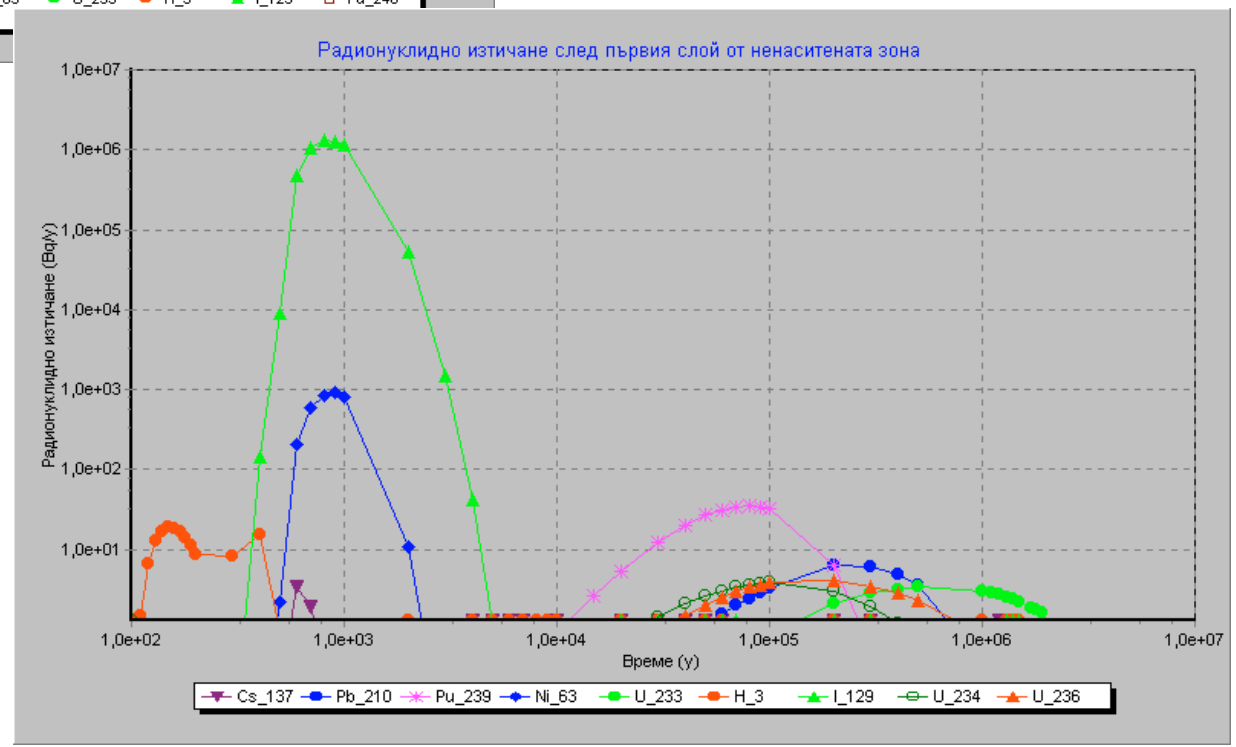
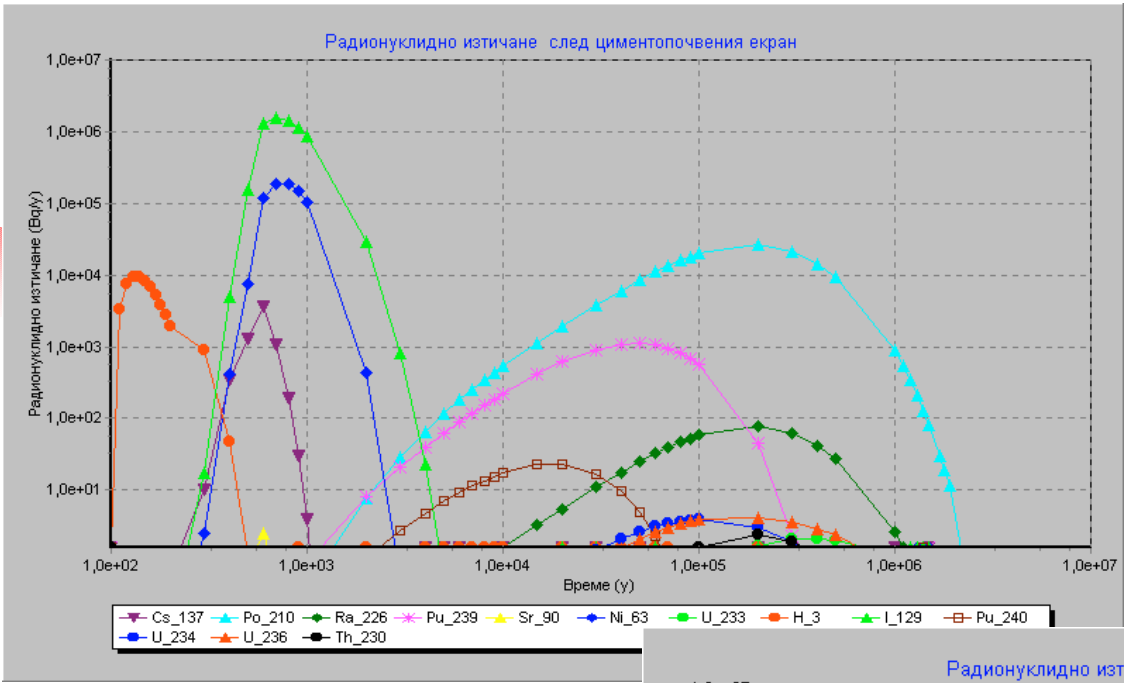


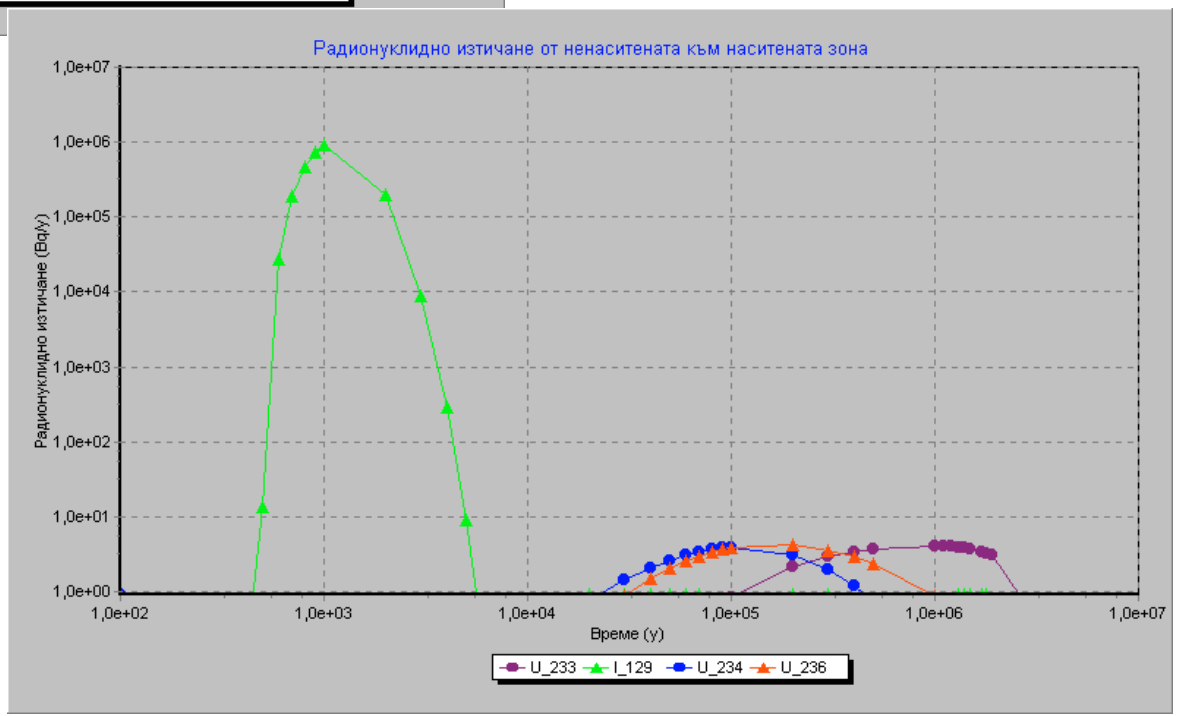
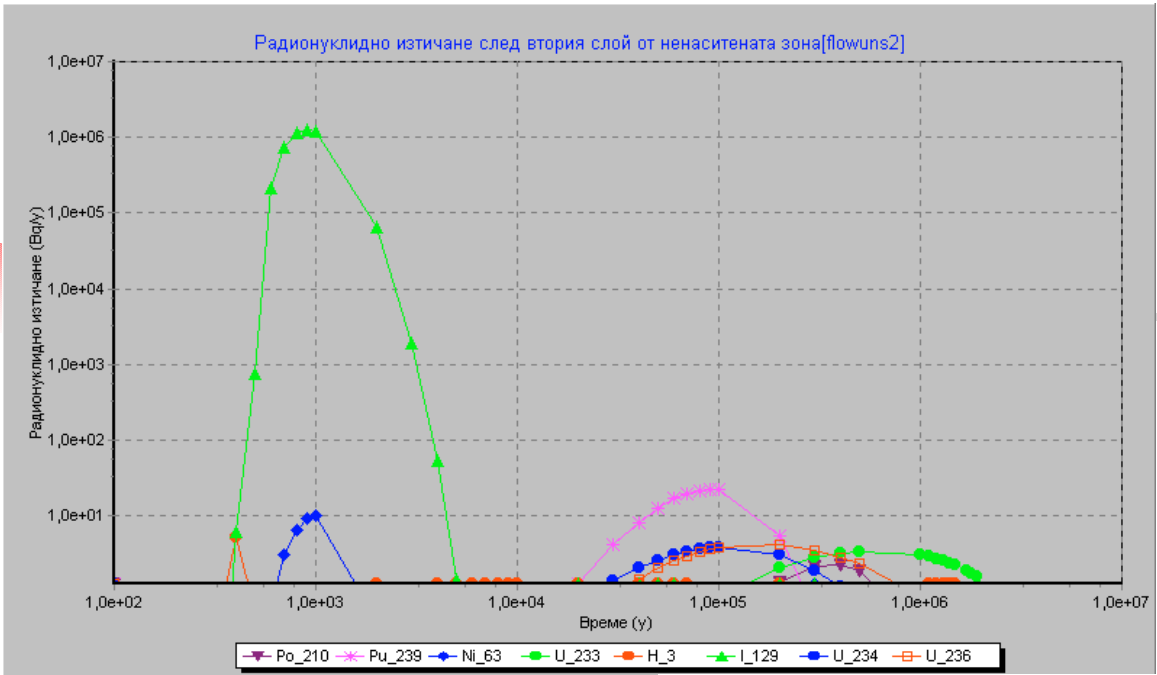
Modeling by AMBER

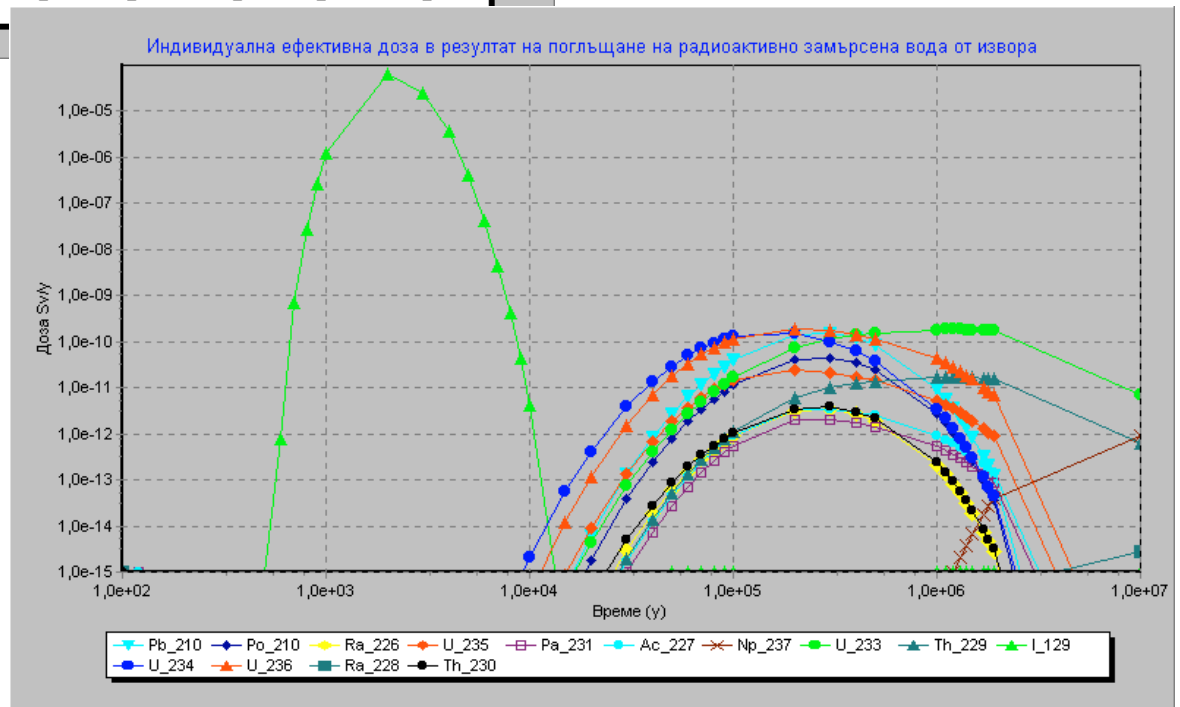
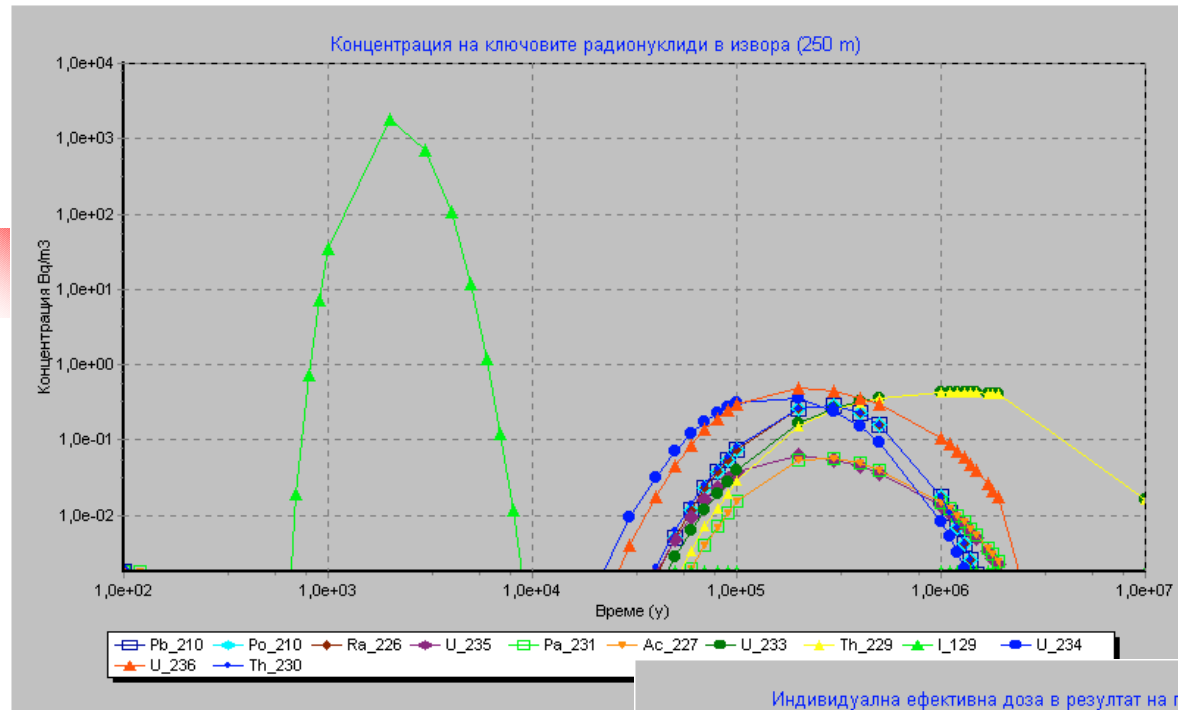


Results from Example 1



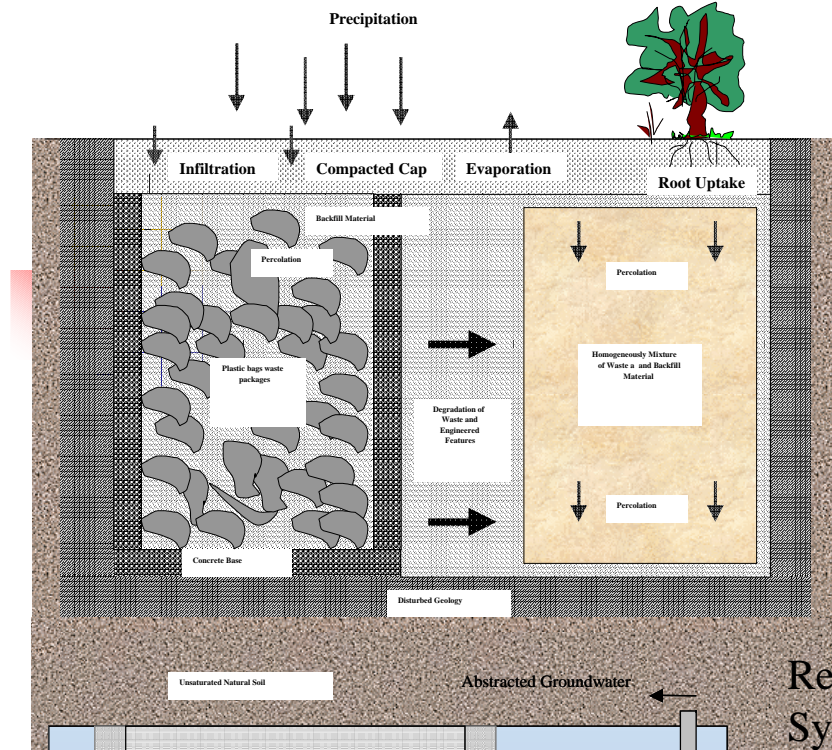




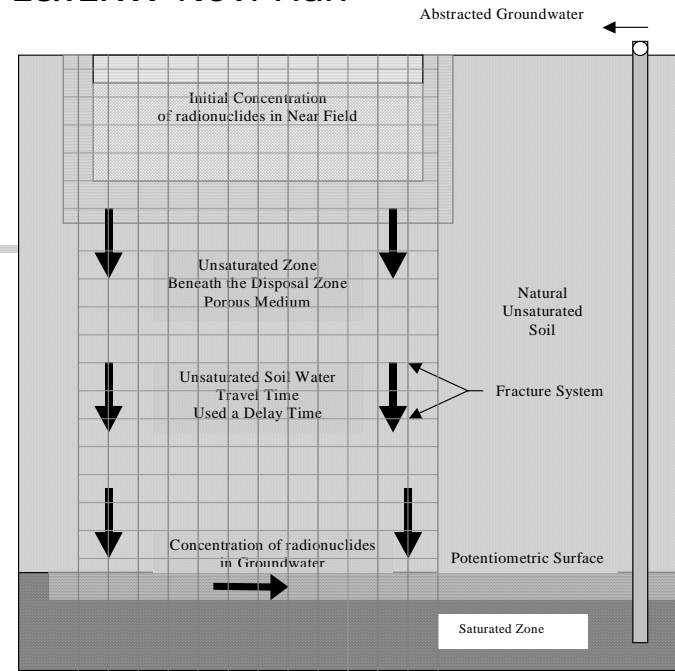


EXAMPLE2 - PCSA

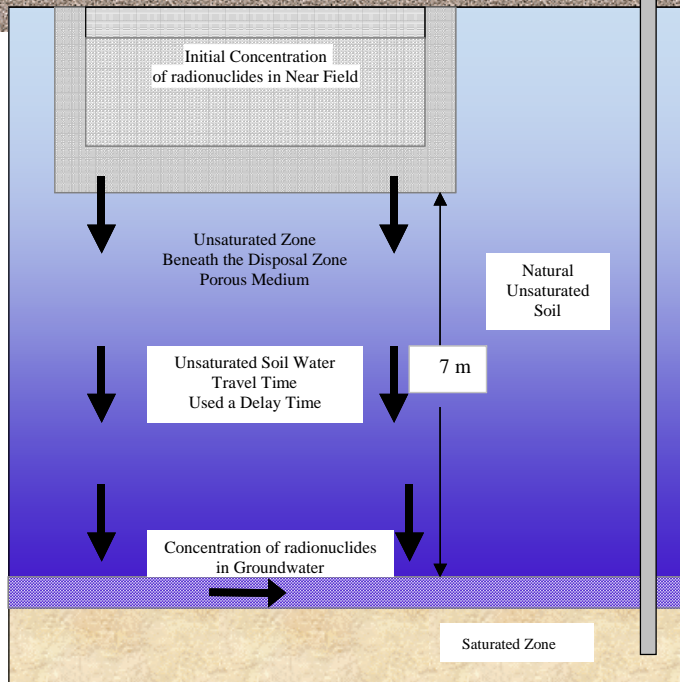
Repository for L&ILRW Novi Han



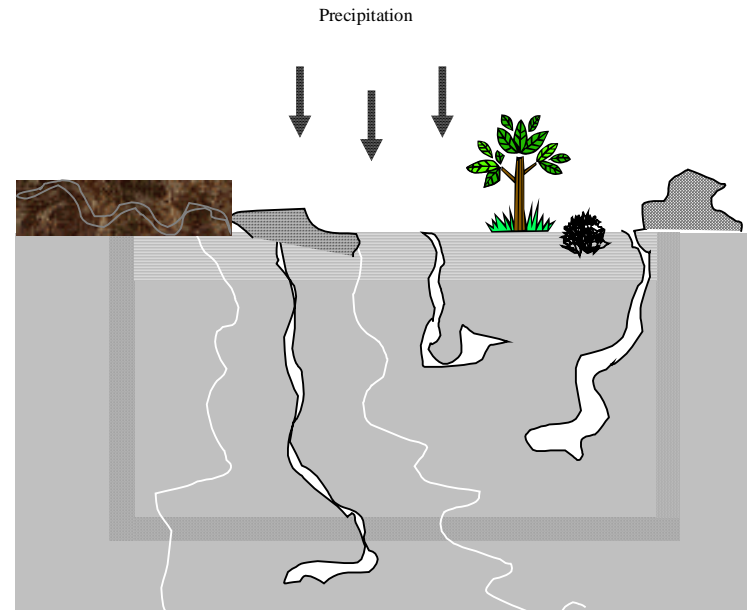
Fracture Matrix

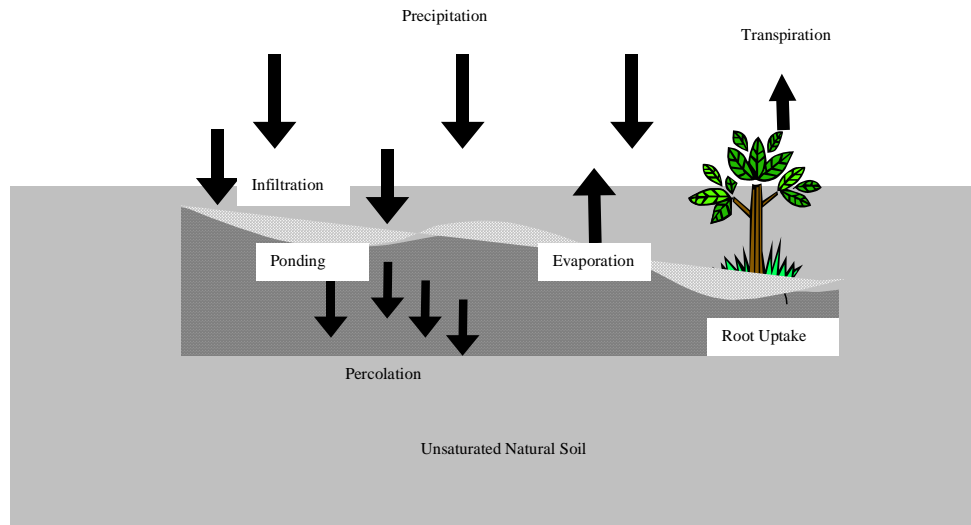


Reference System



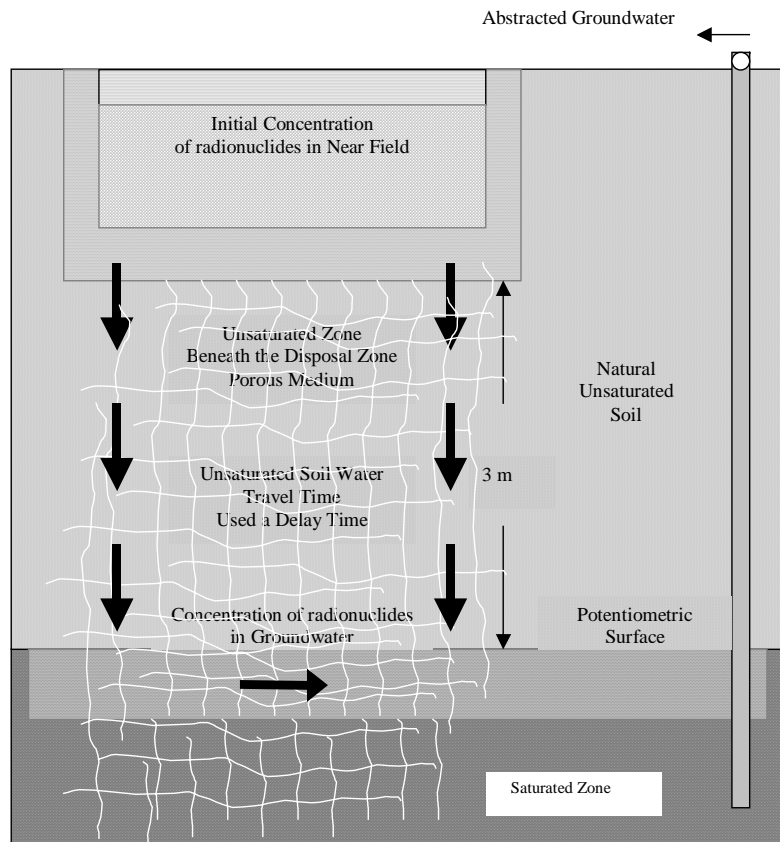
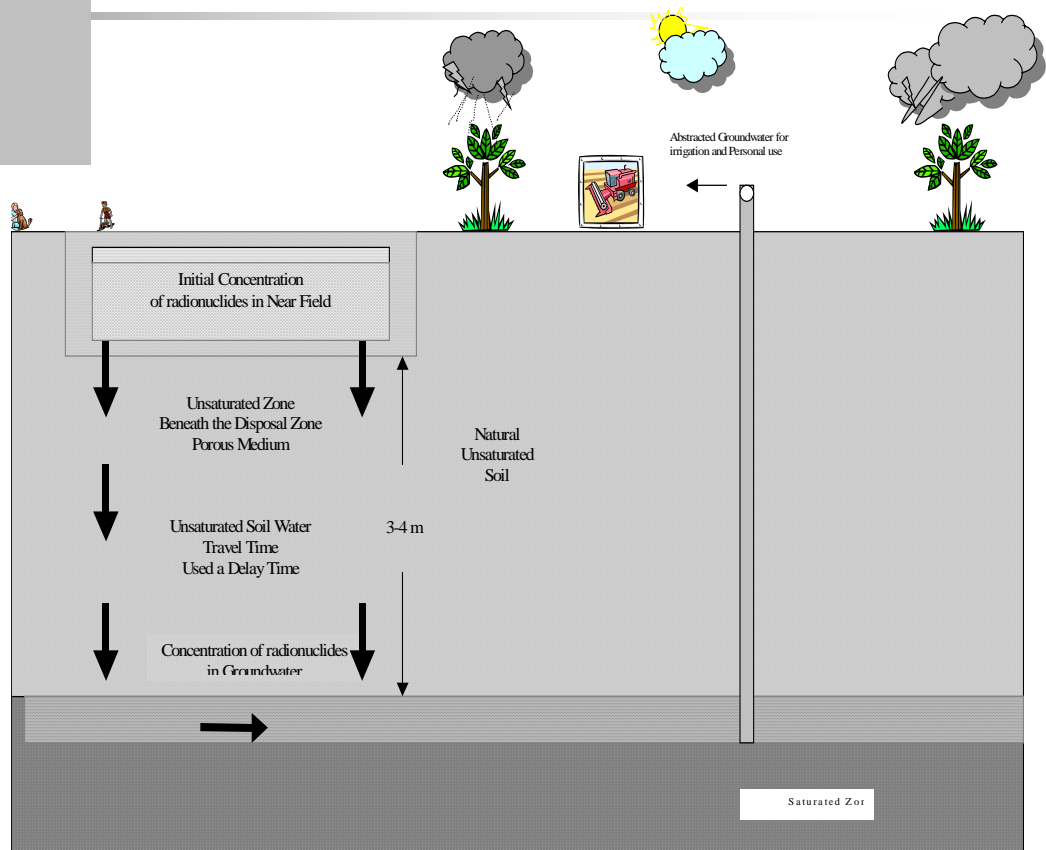
Animal Intrusion





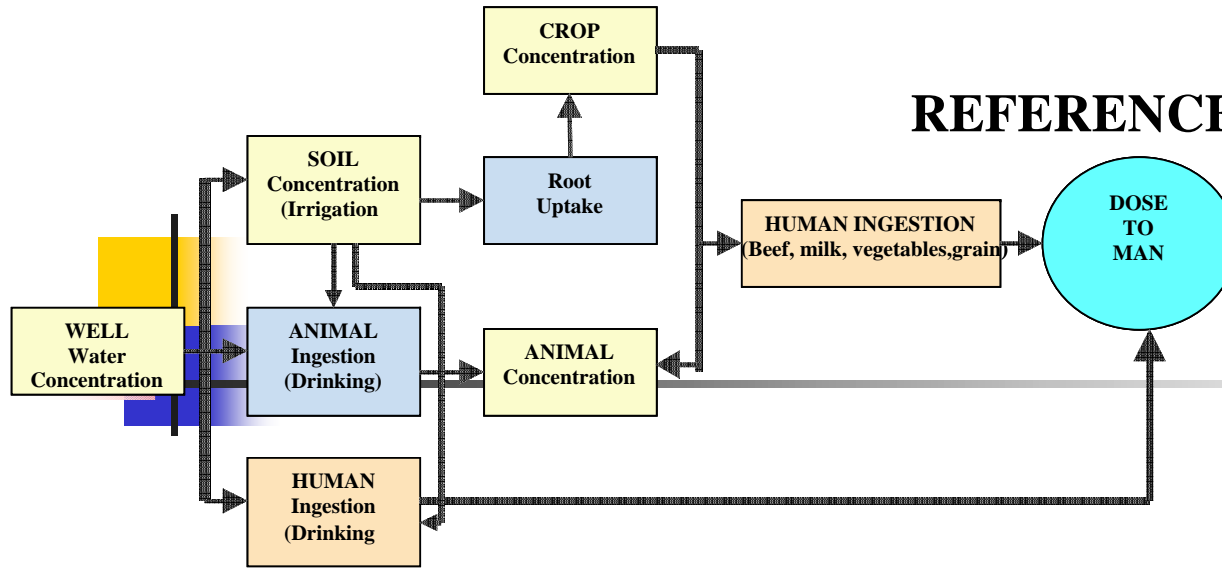
Cap Subsidence

Climate Change



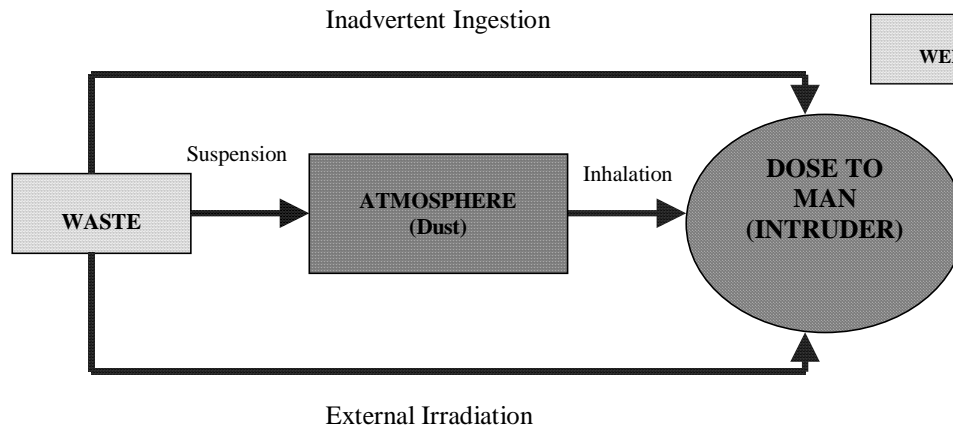
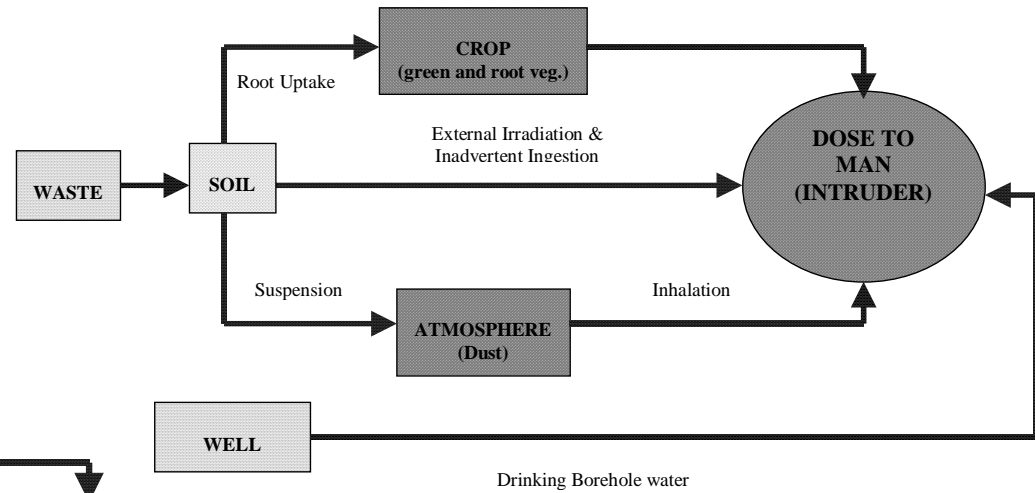
Geological Change

REFERENCE SYSTEM

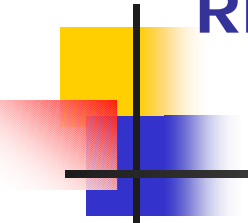


HOUSE CONSTRUCTION AND RESIDENCE

INTRUSION SCENARIOS



ROAD CONSTRUCTION



RESULTS FROM CALCULATIONS –TOTAL DOSES - REFERENCE SYSTEM- WHOLE REPOSITORY

TOTAL DOSE – $3,70E-08$ Sv/a

MAIN CONTRIBUTOR – DISPOSAL UNIT FOR SOLID
WASTE

KEY RADIONUCLIDE – ^{14}C

MAIN PATHWAY – INGESTION

THE TOTAL DOSE IS WELL BELOW THE
RADIOLOGICAL CRITERIA – $3E-04\text{Sv/a}$



RESULTS FROM CALCULATIONS –TOTAL DOSES – CONCEPTUAL SCENARIOS - WHOLE REPOSITORY

- **FRACTURE MATRIX – 2,50E-07 Sv/a**
- **CAP SUBSIDENCE – 5,67E-08Sv/a**
- **ANIMAL INTRUSION – 5,56E-06Sv/a**
- **MAIN DISPOSAL UNIT - SOLID WASTE**
- **MAIN PATHWAY – INGESTION**
- **THE TOTAL DOSES ARE HIGHER THAN THE RESULTS FOR REFERENCE SYSTEM BUT IS WELL BELOW THE RADIOLOGICAL CRITERIA – 3E-04Sv/a**



RESULTS FROM CALCULATIONS –TOTAL DOSES – ALTERNATIVE EVOLUTION SCENARIOS - WHOLE REPOSITORY

- GEOLOGICAL CHANGE – 1,87E-07 Sv/a
- CLIMATE CHANGE – 1,24E-07Sv/a
- HUMAN INTRUSION – KEY DISPOSAL UNIT – SSS,
KEY RADIONUCLIDES – ^{137}Cs , ^{239}Pu , ^{226}Ra
 - ROAD CONSTRUCTION - 4,6E-03Sv/a
 - HOUSE BASE CONSTRUCTION – 1,42E-02Sv/a
 - HOUSE CONSTRUCTION - 2,59E-02Sv/a
- THE TOTAL DOSES OF INTRUSION SCENARIOS ARE
BELOW THE RADIOLOGICAL CRITERIA FOR
INTRUSION SCENARIOS - 10-100 mSv



DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

- GENERAL
- ABOUT CLASSIFICATION
- ABOUT POSSIBILITIES FOR APPLICATION OF
DIFFERENT TYPES SA
- ABOUT NEW REGULATION REQUIREMENTS
- CONCLUSIONS AND RECOMMENDATIONS