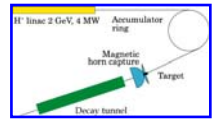
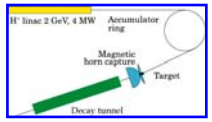


Safety issues for WP2

E. Baussan

Safety Issues for WP2



Outlines:

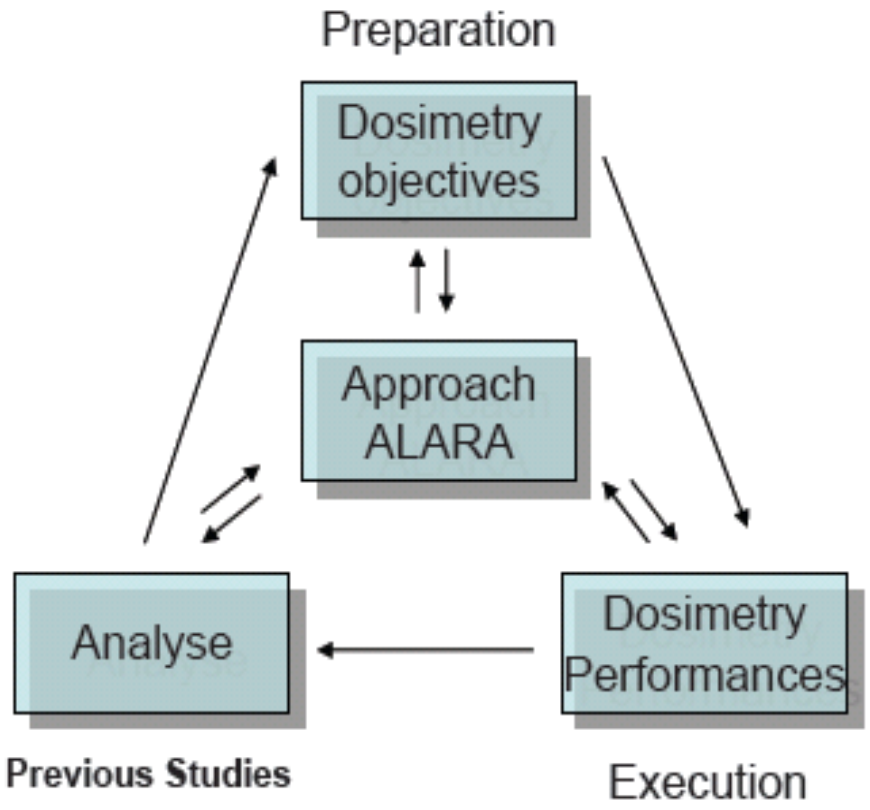
- Introduction
- SB layout facility simulation
- One horn simulation
- Next steps

Toward a safety WP2 roadmap

- **ALARA approach :**

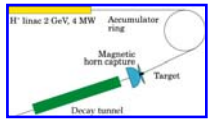
⇒ **Anticipate and reduce individual and collective exposition to radiation**

- **Iterative processes :**
  - Préparation
    - Building Structure lists of materials
    - Dose Equivalent Rate Estimation
    - Optimize procedure during operation and maintenance phases
    - Evaluate residual activity of wastes ….
  - Execution
  - Safety Analyse from previous facilities (WANF, CNGS, NuMi, J-PARC…)



As Low As Reasonably Achievable

Safety Issues for WP2



- **Safety : preparation phase**
  - Radiological risks
    - Determine the radiological risks (external or internal contamination) for each part of the facility.
    - Investigate biological protections with respect to the prompt dose and residual dose
    - Environmental impact studies
  - Non-radiological risks
    - Electrical risks, cooling system, maintenance operation….

Zoning area classification

Valeurs fixées pour les installations fixes

Dose équivalente aux extrémités (mains, avant bras, pied, cheville) : H_T

0,2 mSv (1h)	0,65 mSv (1h)	50 mSv (1h)	2,5 Sv (1h)
	ZSR	ZSR	ZSR

Zone non réglementée: Contrôle de l'état de propreté radiologique si risque de contamination dans les ZR attenantes

ZS Zone surveillée	ZC Zone contrôlée	Zone contrôlée jaune	Zone contrôlée orange	Zone interdite rouge
80 µSv (mois)	7,5 µSv (1h)	25 µSv (1h)	2 mSv (1h)	100 mSv (1h)

Dose efficace E_T

2 mSv/h	100 mSv/h

Débit d'équivalent de dose

Au niveau de l'organisme entier (exposition externe seule)

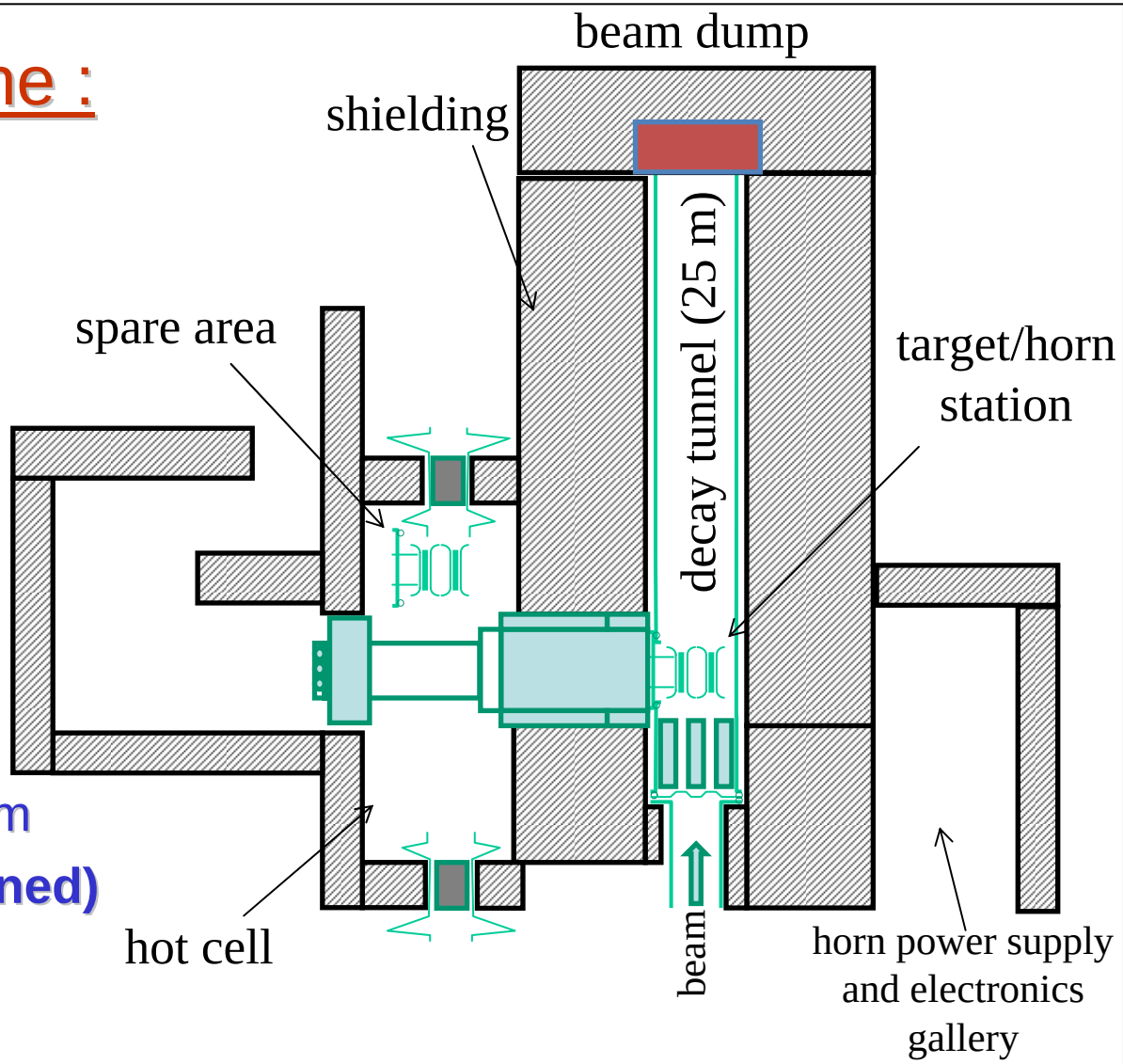
! Les valeurs de doses (E_T et H_T) correspondent à des doses intégrées sur la période considérée (le mois ou l'heure)

ZSR : zone spécialement réglementée

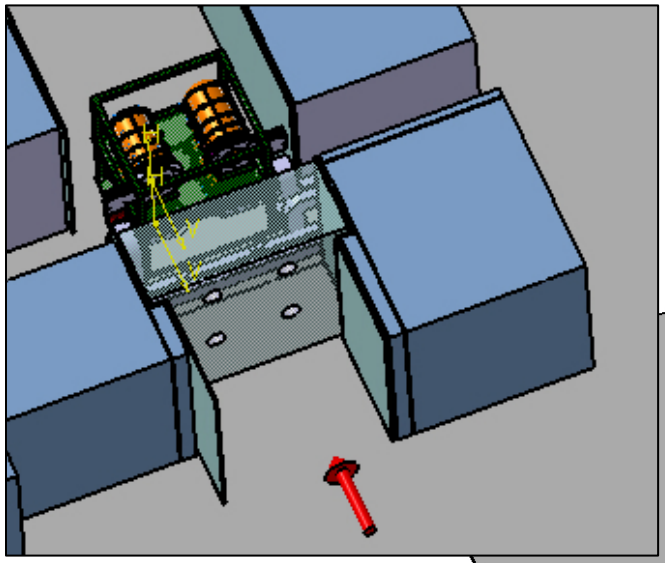
Rencontres Nucléaire & santé -17 janvier 2007-

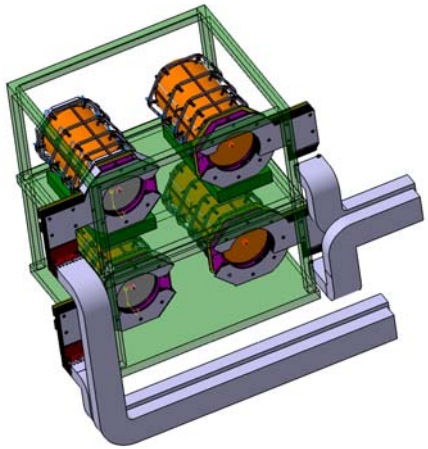
Design of the SB line :

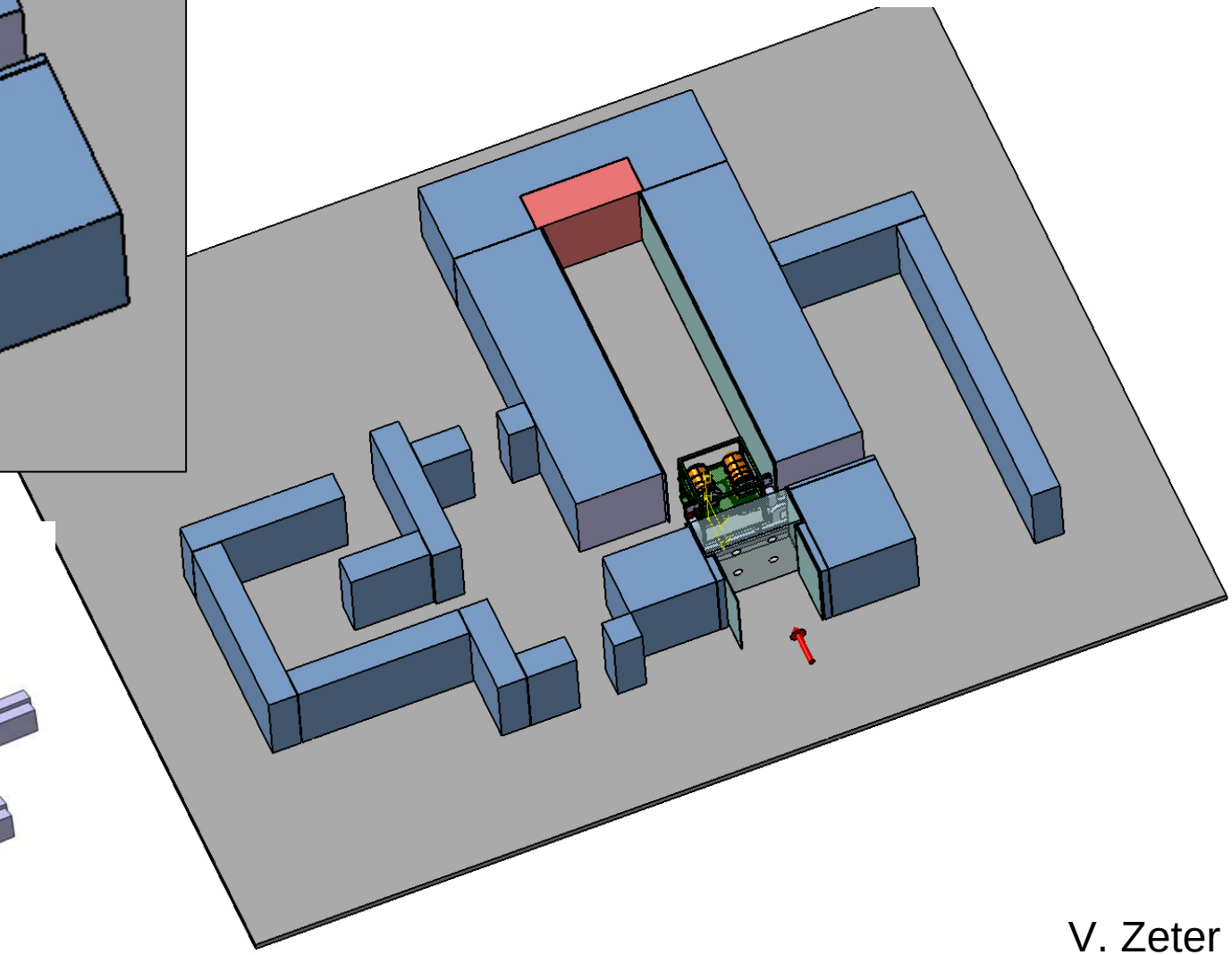
- **Proton Driver line**
- **Experimental Hall**
  - MW Target Station
  - Decay Tunnel
  - Beam Dump
- **Hot Cell / Spare area**
- **Service Gallery**
  - Power supply
  - Cooling system
  - Air-Ventilation system
- **Waste Area (to be defined)**



Superbeam Facility







V. Zeter

Chemical composition of Material:

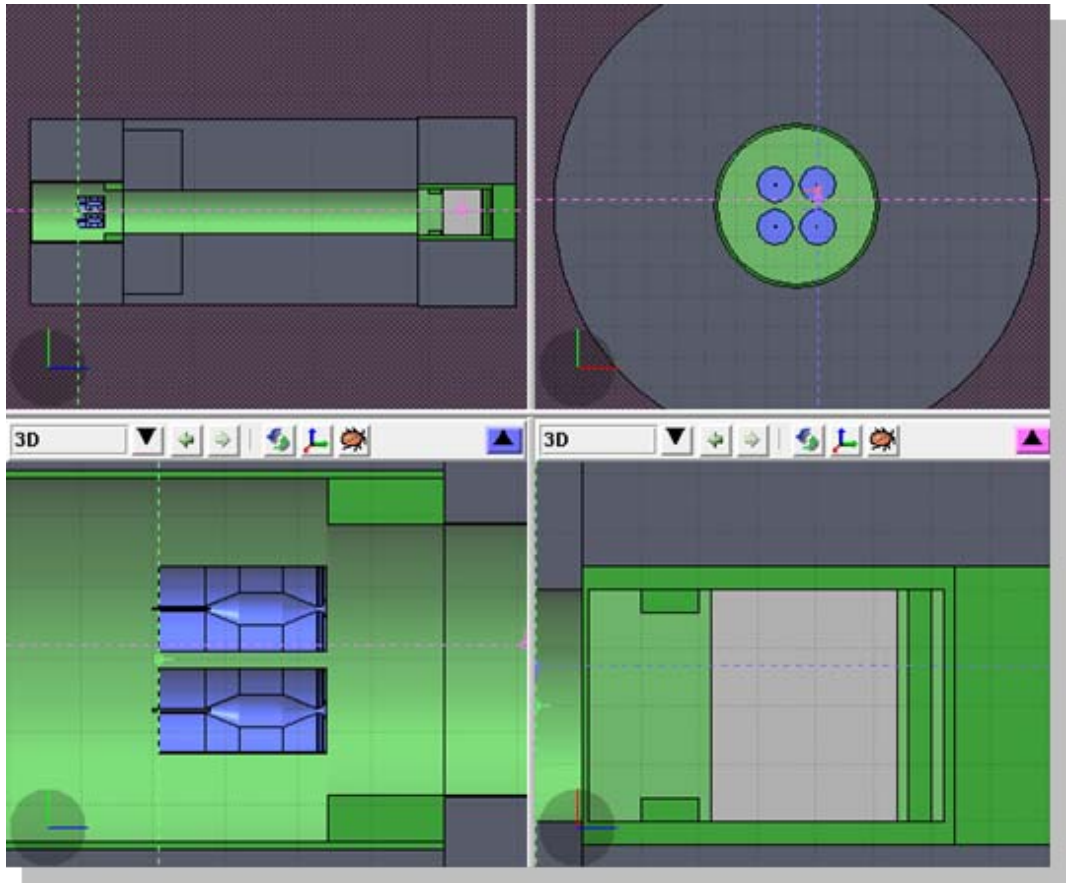
Target => Titanium

Horn => Anticorodal 110 alloy
Al (95.5%), Si(1,3%), Mg(1,2%), Cr(0.2%), Mn(1%), Fe (0.5%), Zn(0.2%), Cu(0.1%)

Decay Pipe => Steel P355NH
Fe(96.8%), Mn(1.65%), Si(0.5%), Cr(0.3%), Ni(0.3%), C(0.2%)

Tunnel => Concrete
O(52.9%), Si(33.7%), Ca(4.4%), Al(3,49%), Na(1,6%), Fe(1.4%), K(1,3%), H(1%), Mn(0.2%), C(0.01%)

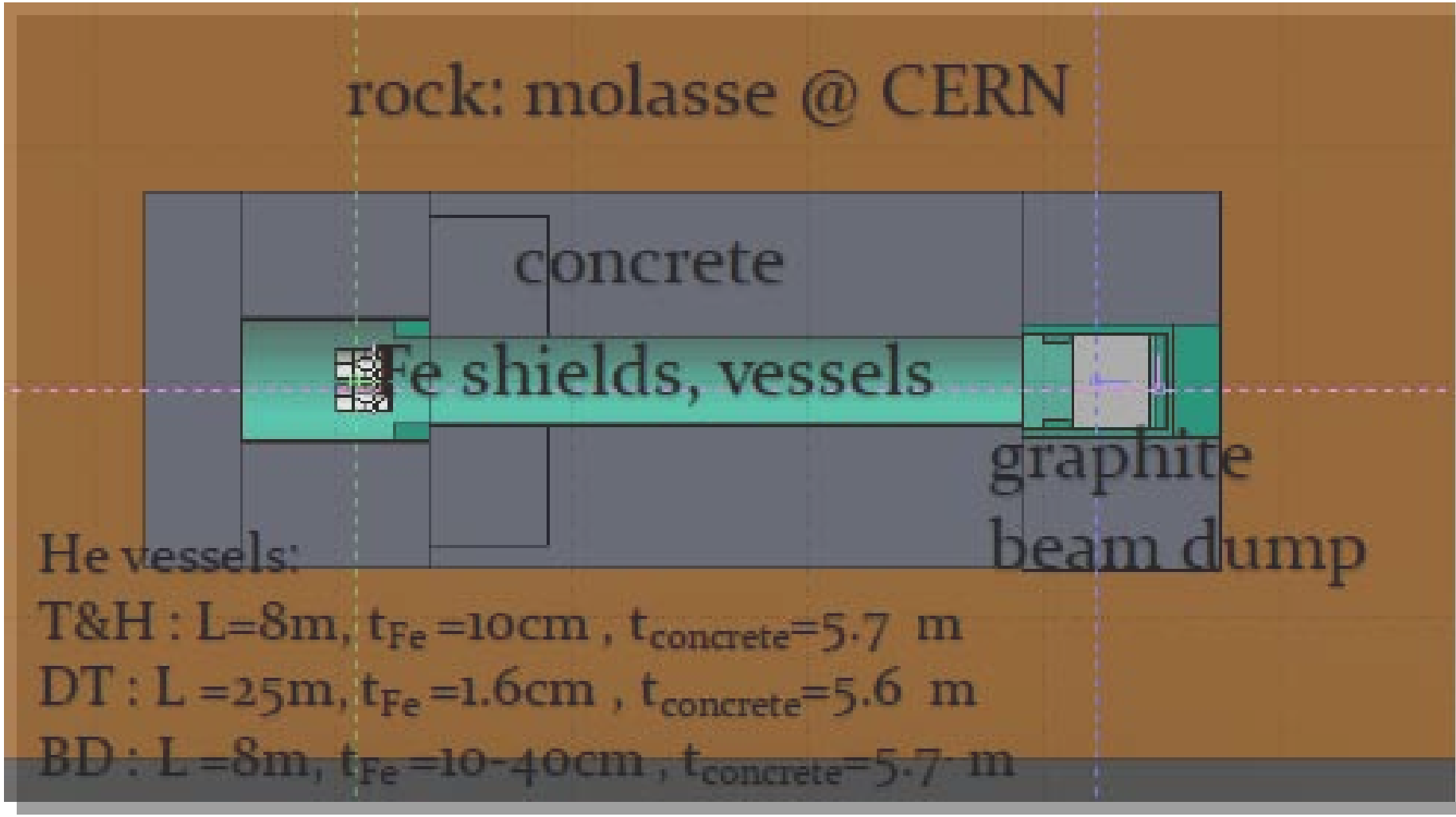
Surrounding Environment => Molasse
O(49%), Si(20%), Ca,(9.7%), Al(6.4%), C(5%), Fe(3.9%), Mg(3.2%), K(1%), Na(0.5%), Mn(0.1%)



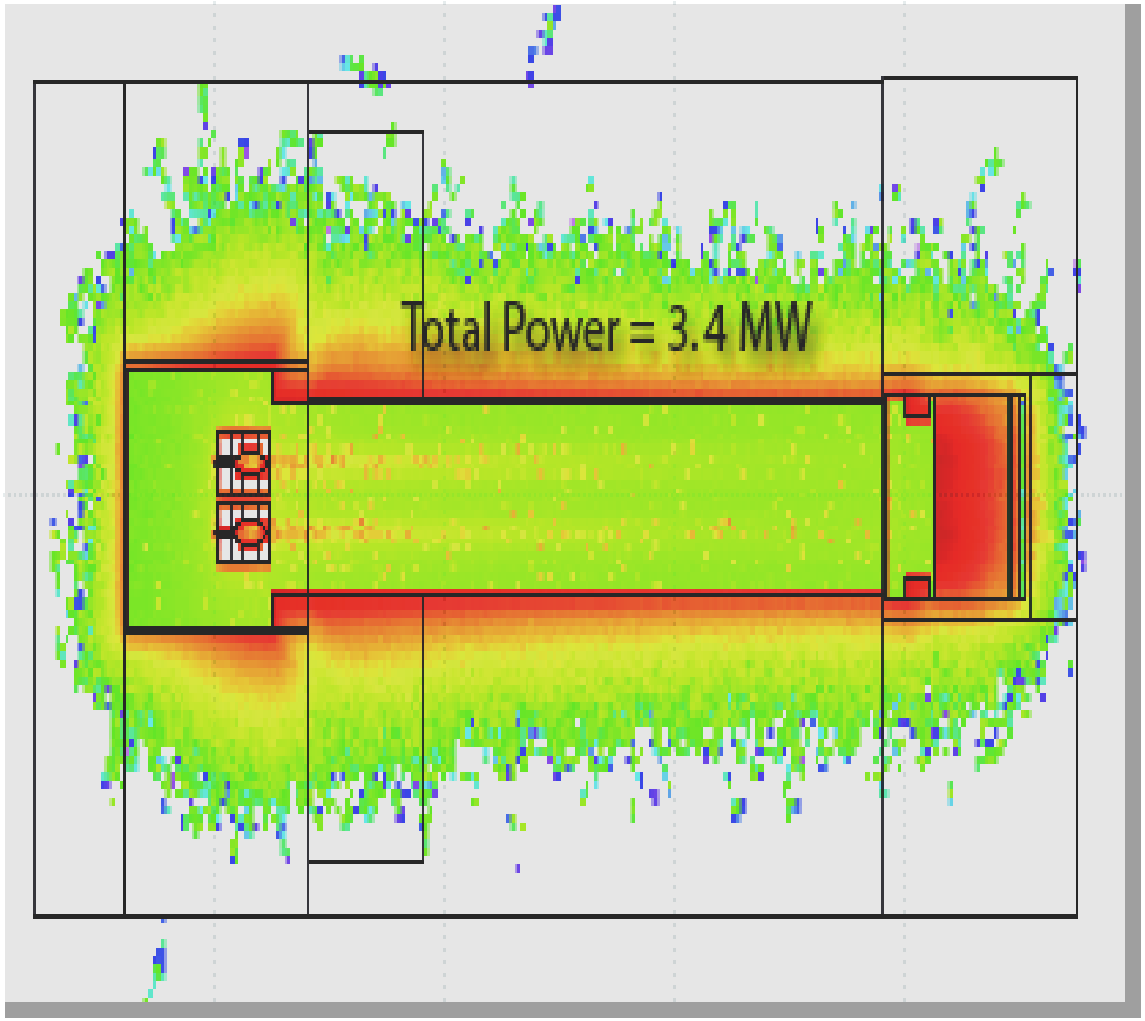
Four horn station layout

Energy deposition in the SB Layout

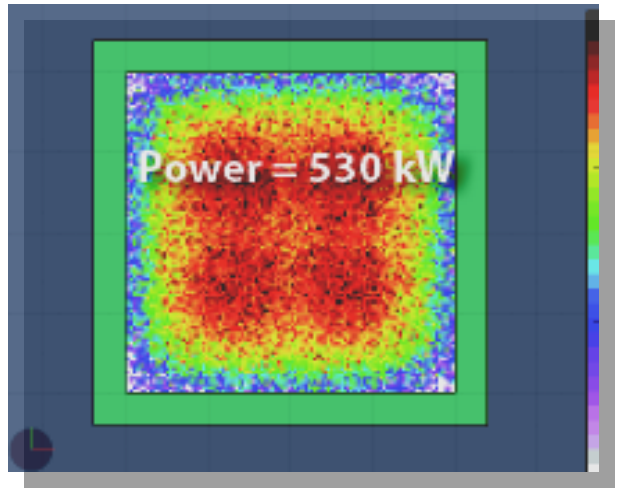
Geometrical Dimension ot the SB Layout:



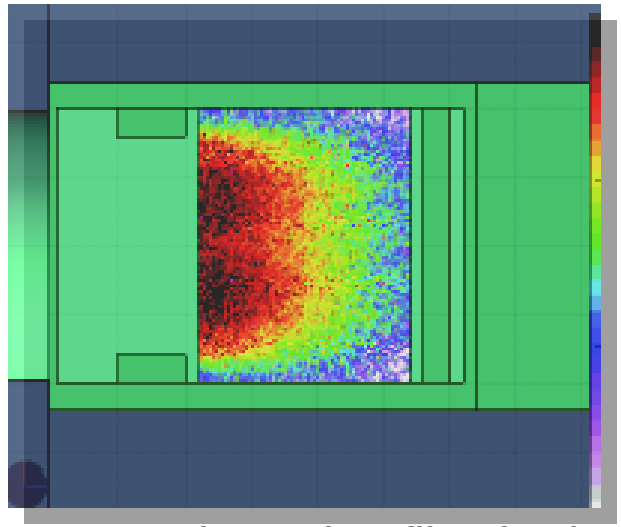
Energy deposition in the SB Layout



Energy confined in the SB facility

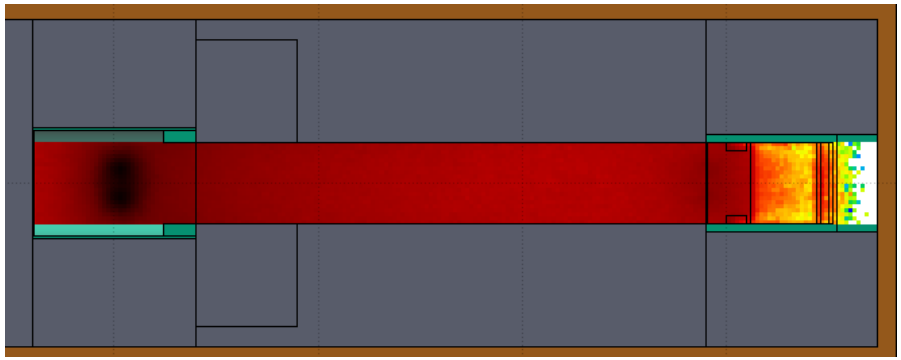


Beam dump (front view)

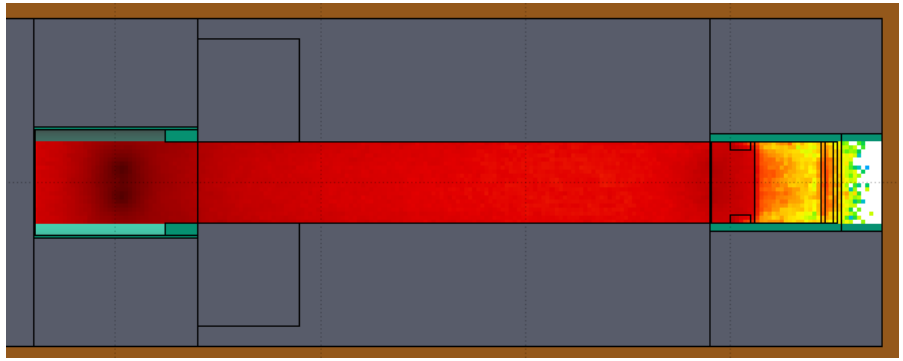


Beam dump (profile view)

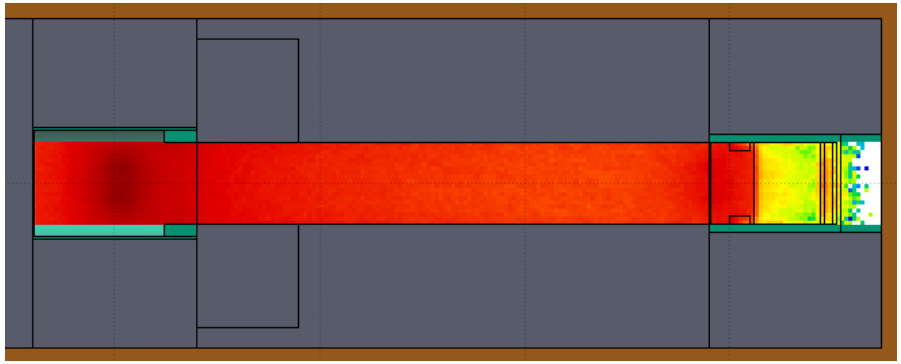
Time Evolution of the Dose Equivalent Rate



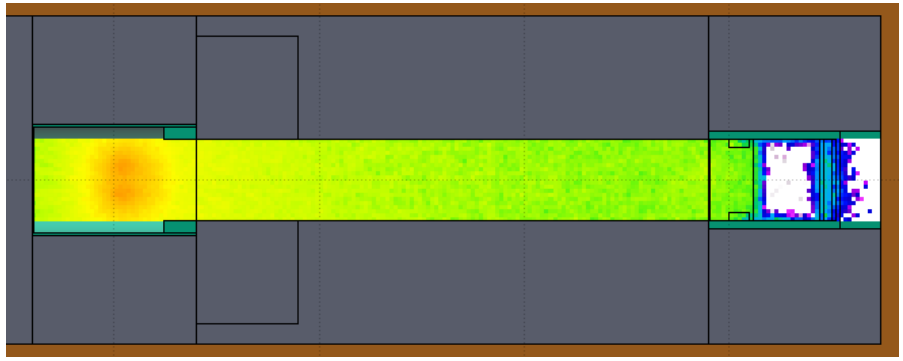
After one day



After one month



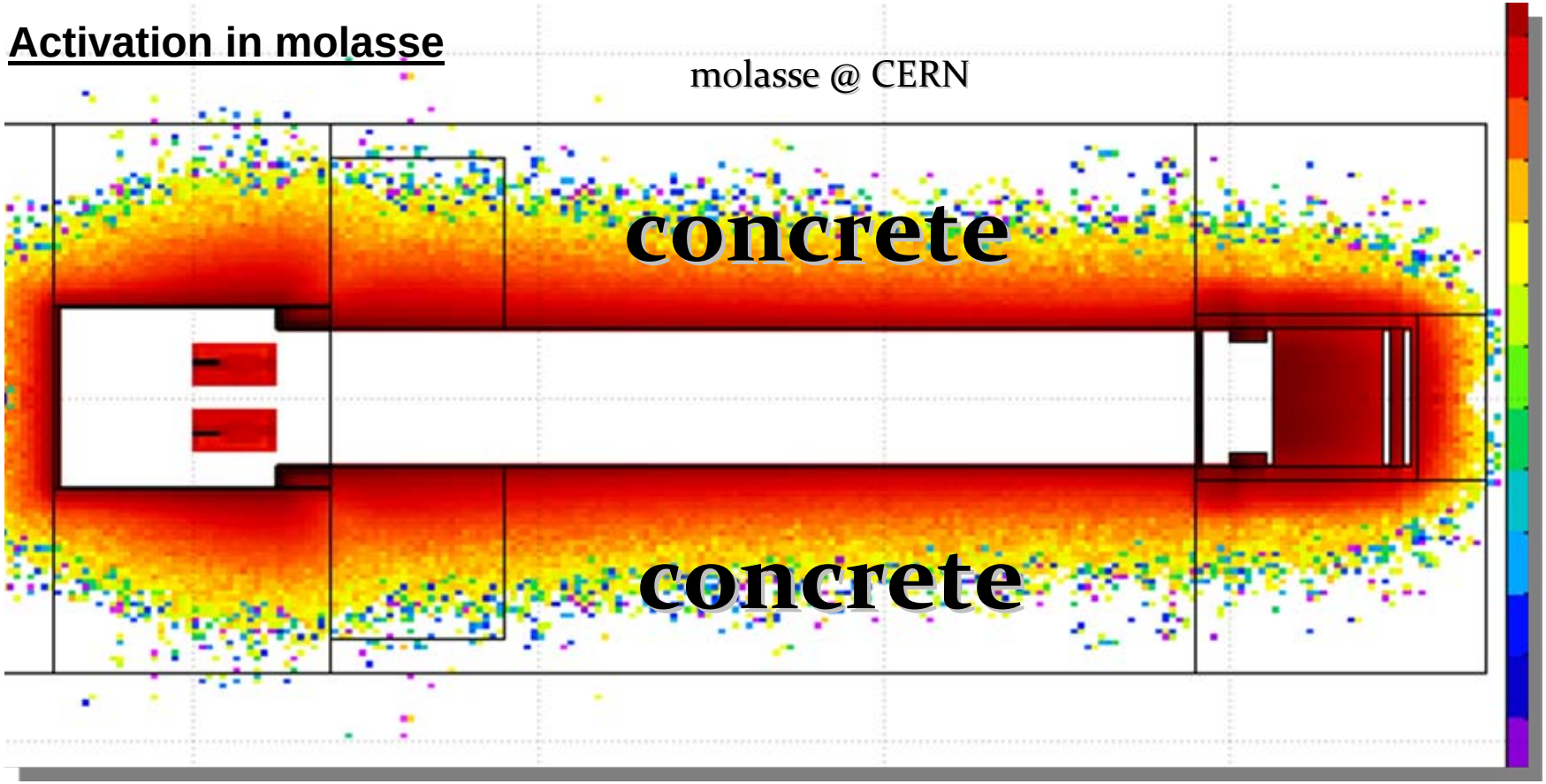
After half year



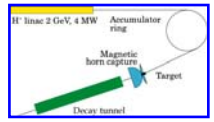
After a 10 year

Environmental impact

Activation in molasse



A 6m thichness concrete wall surrounding all the layout limit the production of radionucleides in the molasse. Especially, the production of ^{22}Na and tritium could represent a negative impact by contaminating the ground water.


H⁻ linac 2 GeV, 4 MW
Accumulator ring
Magnetic horn capture
Target
Decay tunnel

Target + Horn

Safety Issues for WP2

Working strategy :

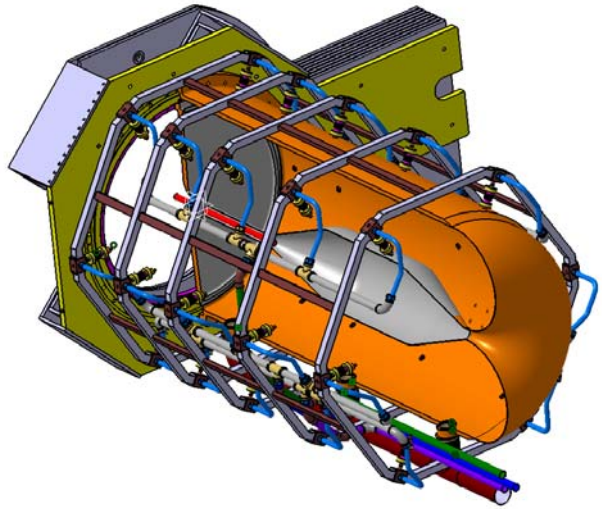
- **Normal intensity operation : 4 horns at 1.0 MW beam power**
- **High inensity operation : 3 horns at 1.3 MW beam power**

Optimisation of the horn design:

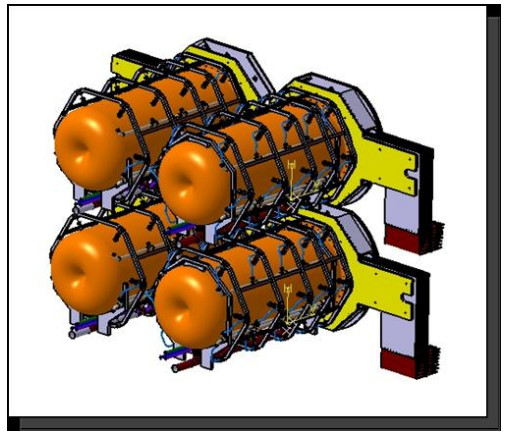
reduce maintenance operation on the four horn system:

- Identify points reducing the lifetime of horns (mechanical instability during beam operation,)
- Complex network of water pipes, difficulty to repair in case of leaks
- Fast electrical connector
- …

Hot Cell is mandatory to repair/replace the target+horn system



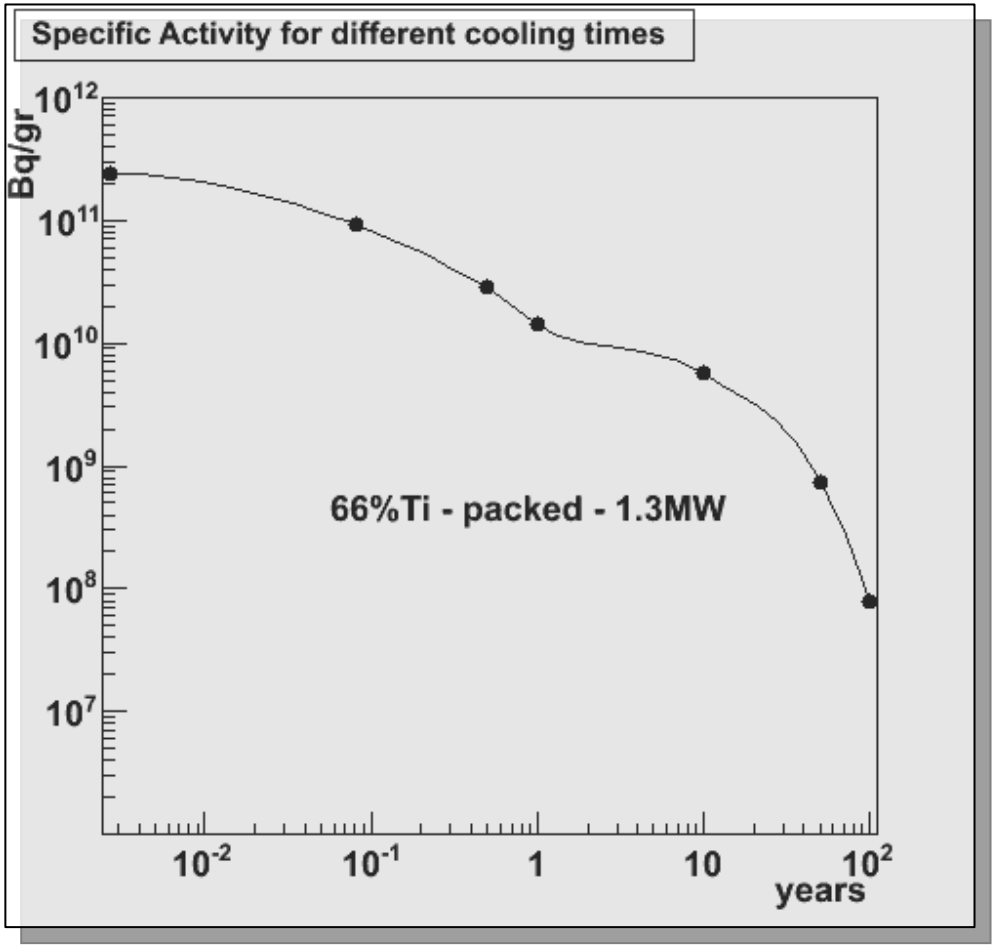
View of the horn

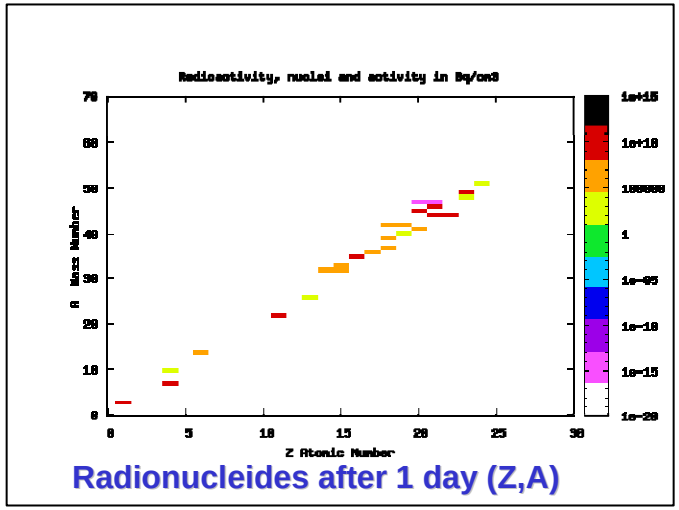


View of the four horns

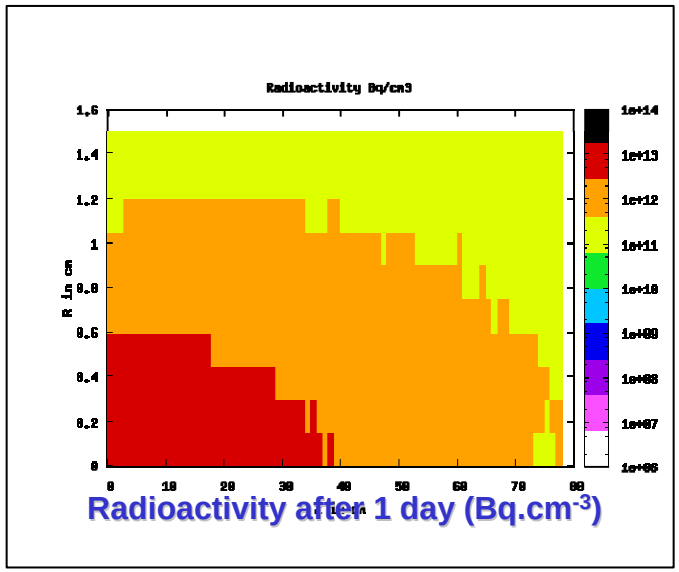
Radiation simulations : Target Activation

Evolution of the target activity with cooling time:





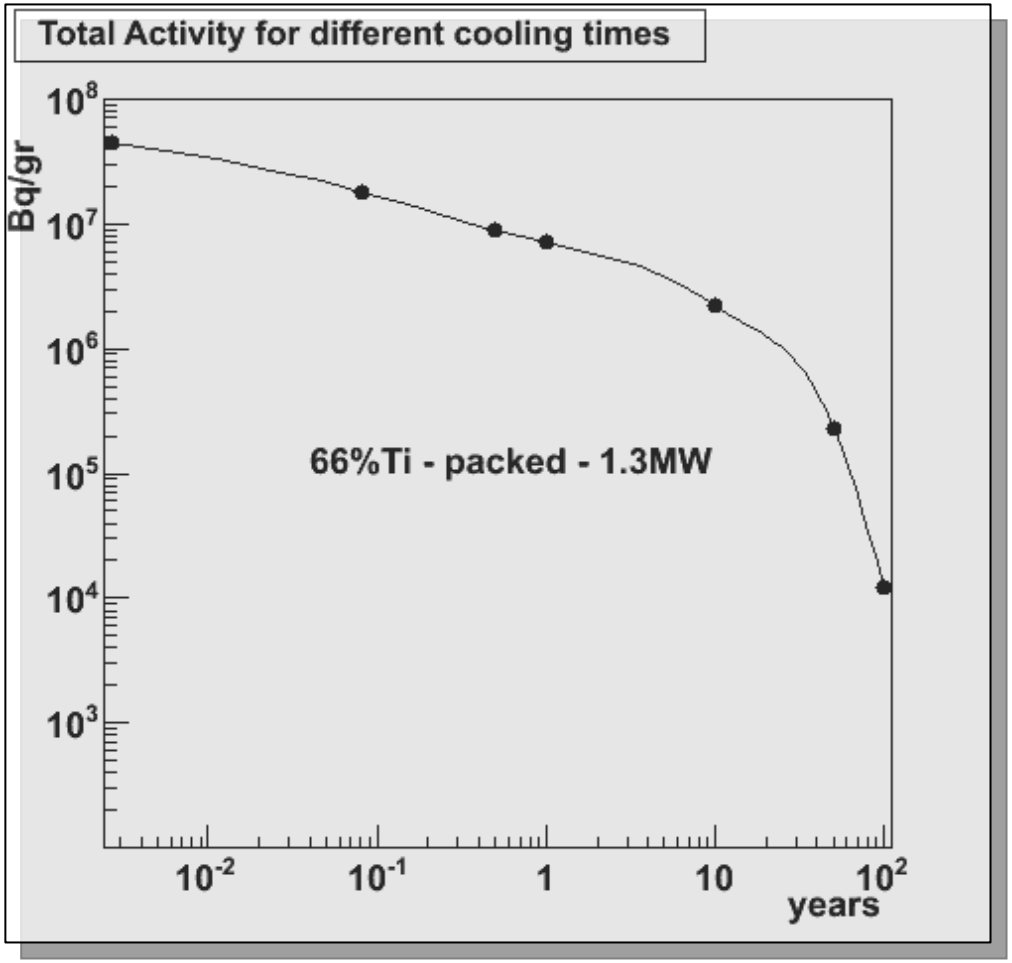
Radionucleides after 1 day (Z,A)

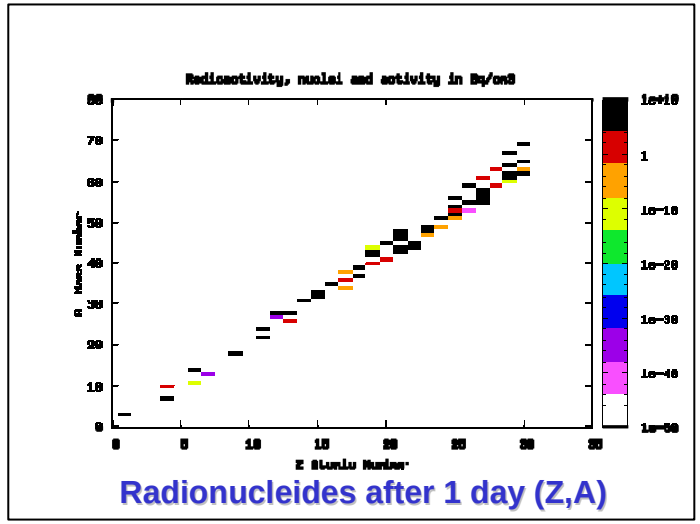


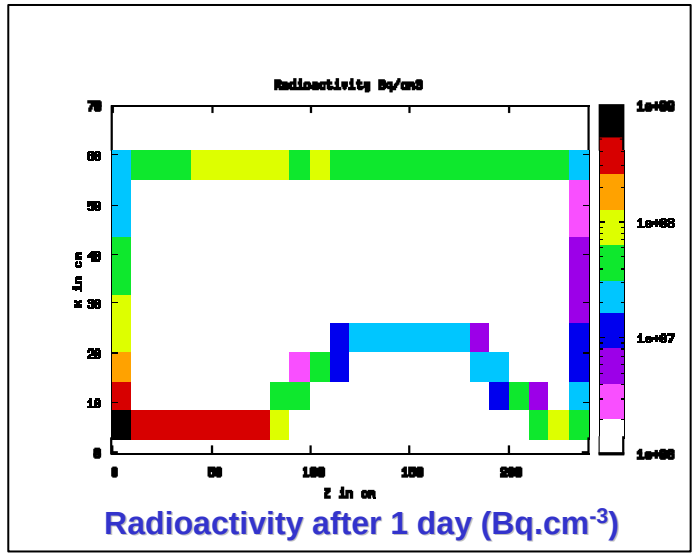
Radioactivity after 1 day (Bq.cm^{-3})

Radiation simulations : Horn Activation

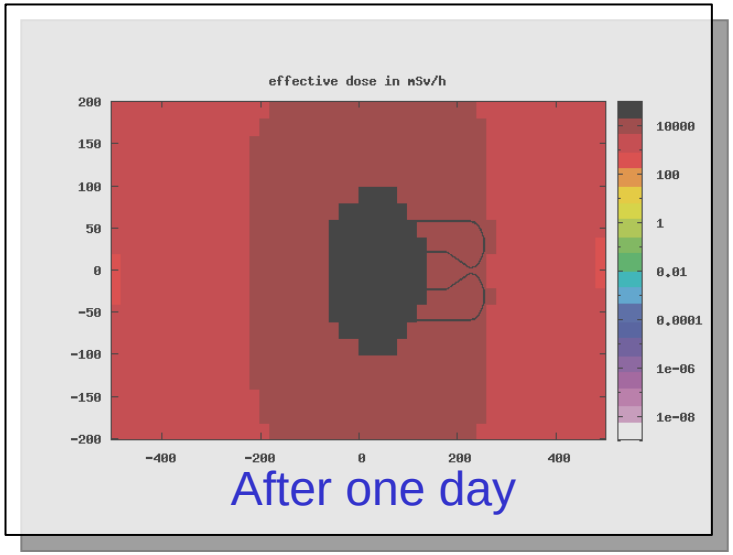
Evolution of the horn activity with cooling time:



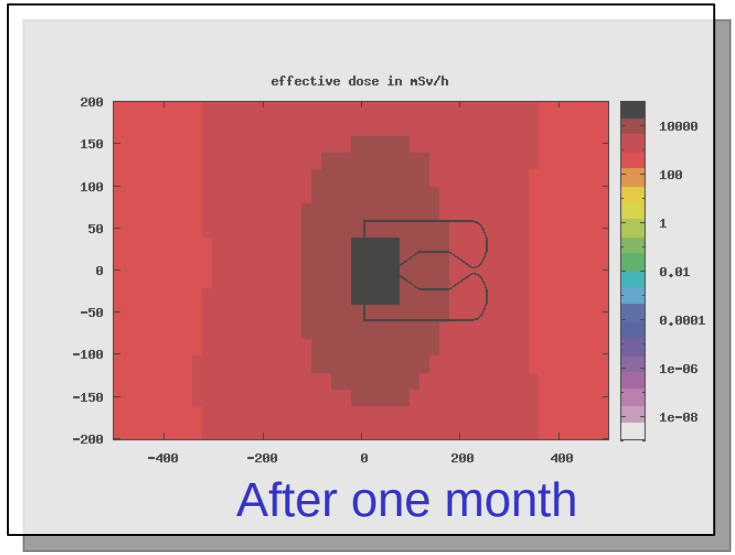




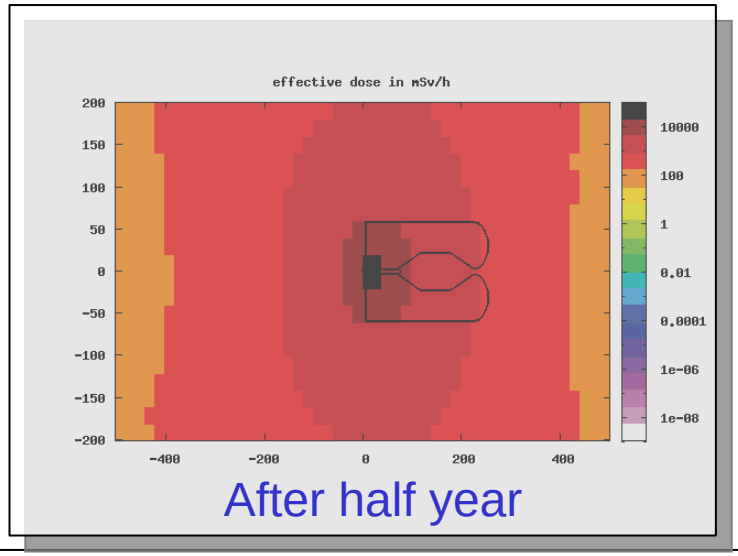
Time evolution of the DER : Target+Horn



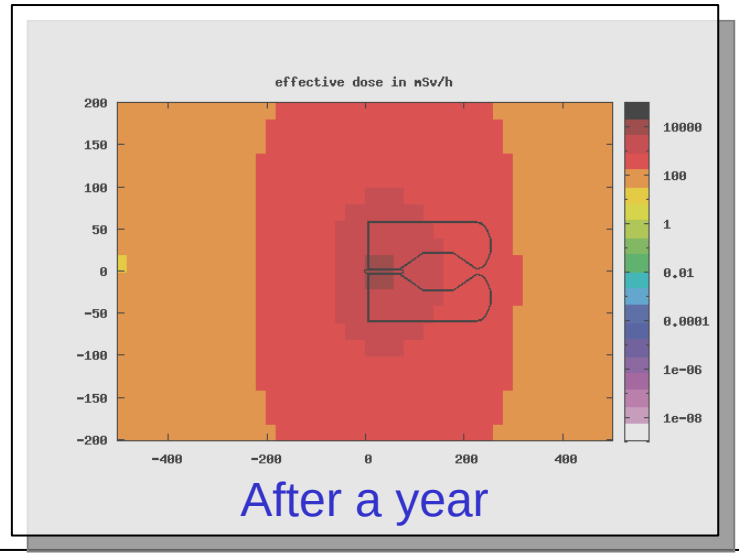
After one day



After one month



After half year

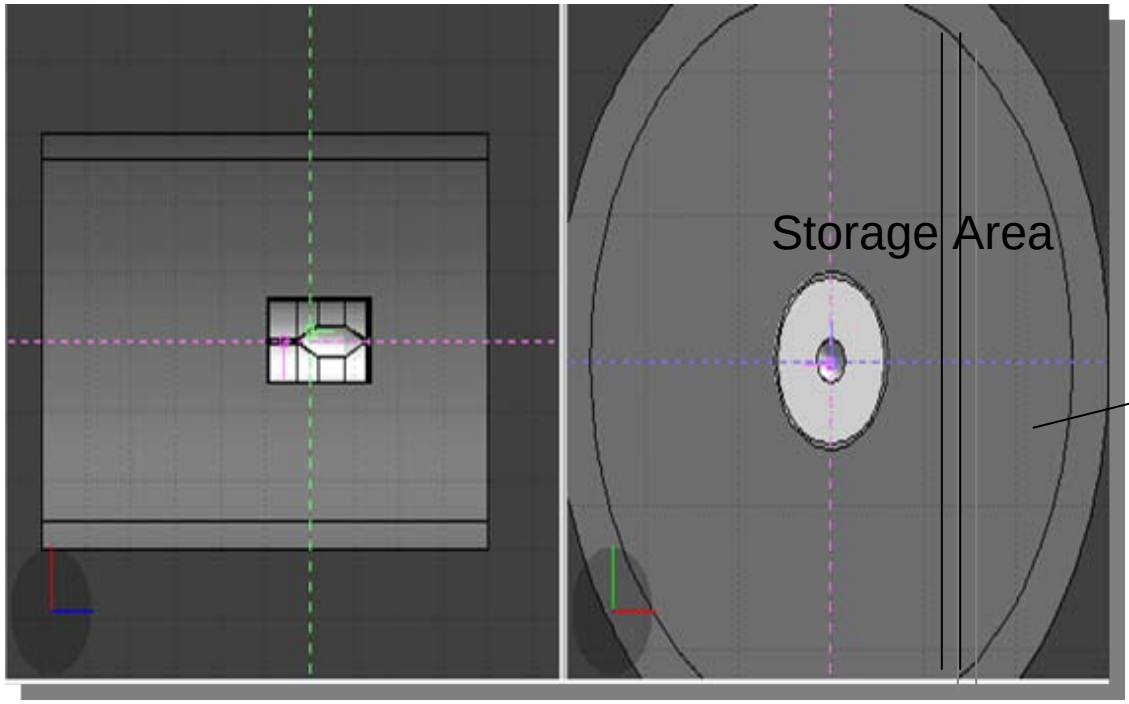


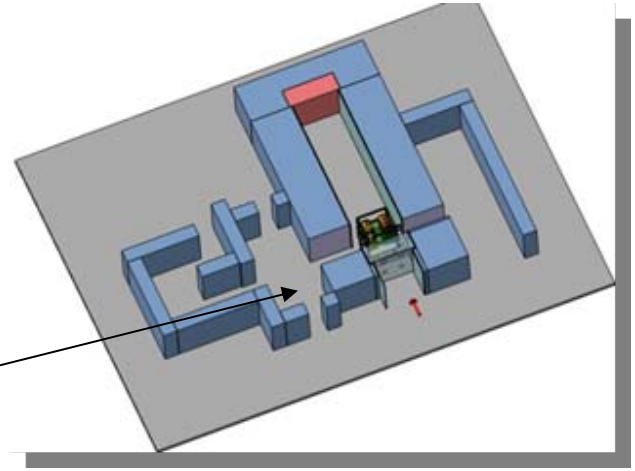
After a year

Storage Area : Investigation

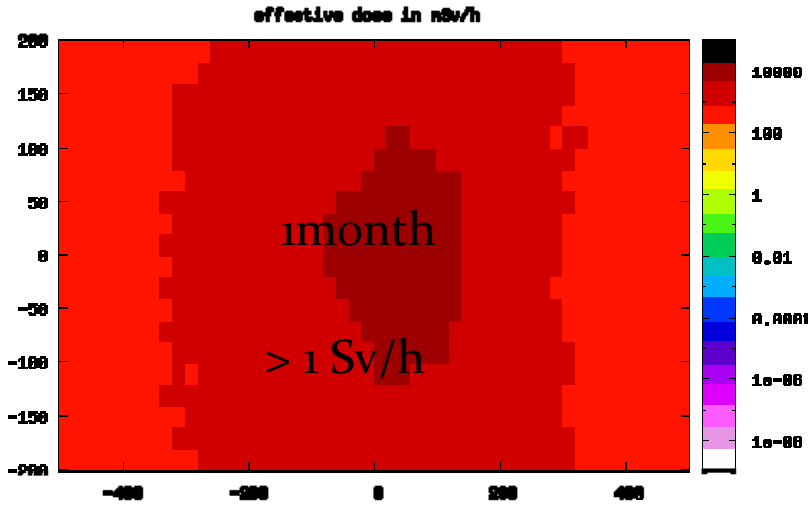
Hot cell preliminary investigation:

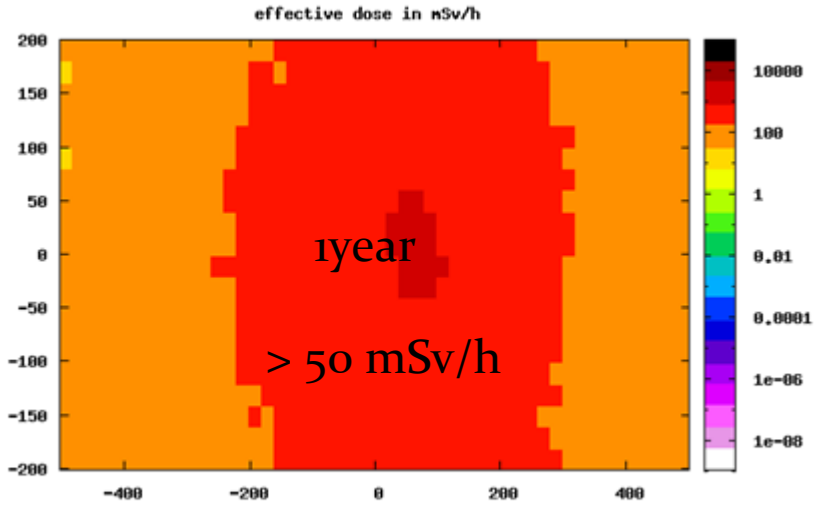
at 60cm distance from the outer conductor (calculation of the rates using 20cmx20cmx20cm mesh binning through out the layout
-> choose a slice of x-axis with 20cm thickness and 60cm away

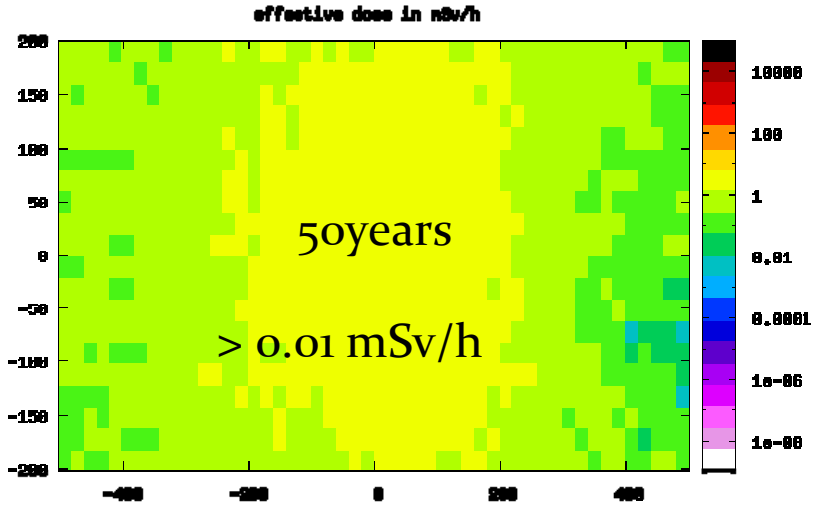


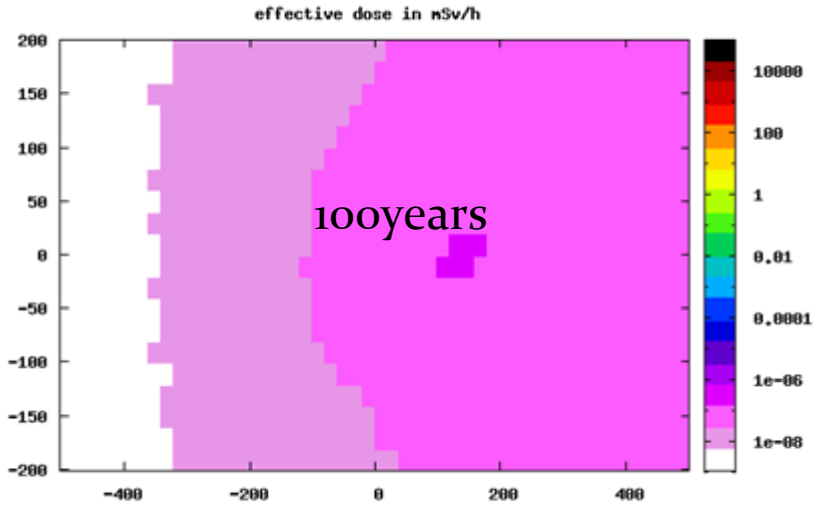


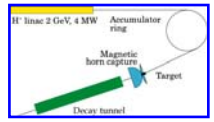
Storage Area : dose equivalent rate map











Next Steps :

- Estimate the contribution of each element to the dose rate
- Investigate the hot cell structure, maintenance operation
- Individual and collective dose rate calculation with cooling times
- Costing