LASER RESEARCH CENTRE ELI BEAMLINES - RADIOPROTECTION ISSUES, SHIELDING DESIGN

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INTRODUCTION

The laser research centre ELI Beamlines:

- the first facility of planned four of the envisioned European ELI (Extreme Light Infrastructure) Project
- to be built in Dolní Břežany, Czech Republic
- shall develop a new generation of secondary sources for interdisciplinary applications in physic, medicine, biology and material sciences

Modern lasers are able to focus ultra-short high-intensity pulses onto targets and thus generate ionizing radiation. Therefore, radiation safety of workers needs to be explored and ensured.

ELI Beamlines characteristics			
General		Beams	
Experimental halls	6	Repeatition rate	0.1Hz-1kHz
Area of one ex-perimental hall	450-850m^2	Primary particles per shot	10^8-10^{12}
Laser systems	4	Pulse length	10-30fs
Laser power	0.5-50PW	Beam divergence	1°-40°
		Available beams	13

Mean energy of available beams [GeV]			
Electron	Proton	Associated electron	Photon
0.2	0.01	0.02	max. 1.9
0.5	0.1	0.05	
5	0.2	0.1	
6.1	3	1.5	
50			

OBJECTIVES

Assessment, evaluation and design of

- Civil structure
  - Minimal wall thickness
  - Influence of main technology penetrations
- Local dumps
  - Dimensions, shape, material

METHODS

Targeted effective dose limit:
public <0.1mSv/year
personnel <1mSv/year

- Radiological classification of areas
- Dose rate maps to assess penetrations

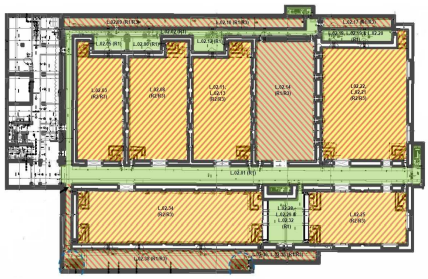
Calculations using:

- Monte Carlo codes: FLUKA, MCNPX
- Discrete ordinates code: ATTILA

RESULTS

Radiological classification

		μSv/day	Occupancy
	R0	<1	high
	R1	<4	high
	R2	<25	low
	R3	no limit	no entry
	R1/R3	Higher classification	
	R2/R3	during laser operation	

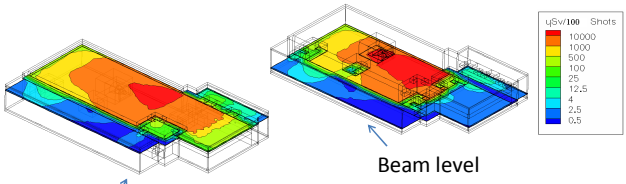


Civil structure design

Typical wall thickness: control rooms 120 cm
corridors 120-160 cm
labyrinths 100 cm

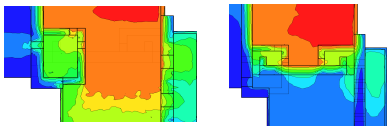
Concrete - ordinary
- magnetite the most exposed parts

Dose map calculation, e.g. 3 GeV proton source, 6x10^11/shot, 0.1Hz, total operating time 15 min/day



Beam level

0.5m below roof, above Control Room



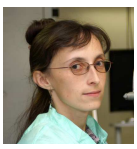
Penetrations: 0.5m below roof at beam level

Local dumps

Simple geometries – cylinders, cubes, some with cavity to allow particles to impact deep within the dump to reduce scattered radiation
Materials – aluminium, concrete, graphite, iron, lead

CONCLUSIONS

ELI Beamlines will host prompt high energy sources of electrons, photons and protons. Bulk and local shielding has been designed and assessed using Monte Carlo and discrete ordinates codes to ensure radiation safety of personnel.



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Project web page:
www.eli-beams.eu

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