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Radiation Protection studies for CLIC

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Radiation hazards

	Radiation Hazard	Examples
1	particle beams	prompt stray radiation from beam losses through shielding or direct exposure after intrusion into prohibited areas
2	activated solids	accelerator tunnel equipment (magnets, supports, collimators, infrastructure equipment), tunnel walls, rock
3	activated dispersed solids	corrosion of activated objects in accelerator areas or workshops
4	activated or contaminated liquids	water in cooling circuits in accelerator areas, ground water
5	activated air or gases	cooling gases and air in accelerator areas
6	radioactive aerosols	radioactive airborne particles from mechanical operations or airborne radioactive dust
7	radioactive surface contamination	Physico-chemical works on activated solids, dispersed radioactive sources
8	radioactive sources	calibration sources, test adapters (for the purpose to use the radioactive properties)
9	X ray generators	radiography generators
10	parasitic X ray generators	klystrons, RF cavities
11	naturally occurring radioactive materials	Radon, U, Th, ^{40}K, TENORM/NORM

Hazards mainly affecting civil engineering design → crucial to be considered in the PiP

RP relevant study topics

Residual dose rate from activation or activity levels
Potential and known loss locations
Drive beam and main beam dumps
Collimation systems
Drive beam PET structures
Positron production target
Ventilation systems
Water cooling circuits
Stray radiation during beam operation
Connections between beam/klystron tunnel to service caverns and access galleries (definition of accessible perimeter)
Klystron tunnel during RF power operation (w/o beam)

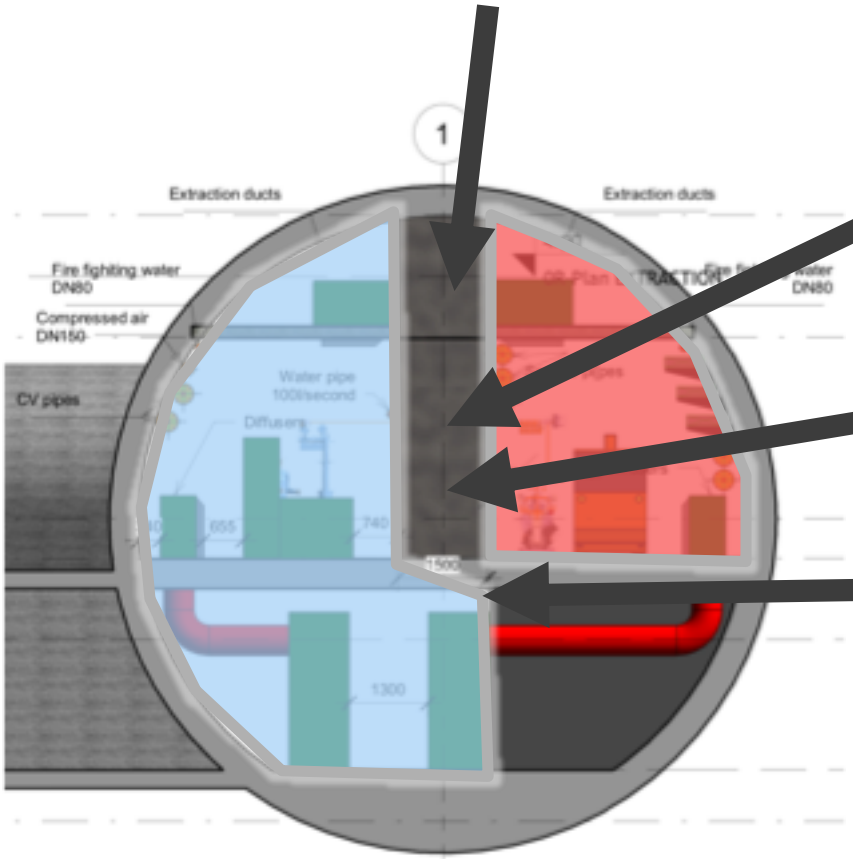
Addressed only qualitatively in PiP

Radiation Area Classification matrix

	Beam tunnel	Klystron tunnel	Service cavern
Beam operation	Prohibited	Prohibited	Non-designated area
RF power operation	Prohibited	Supervised Radiation Area	
no RF power to cavities, klystron-only operation or shutdown	Supervised/Controlled Radiation Area	Supervised Radiation Area	

RF power operation

Ventilation duct (ø120 cm) crossing at each alcove



Source term: X ray production from RF power (600 MeV, e^- dark current + breakdowns)

Waveguide ducts (ø10 cm) every 2 m

Passage between klystron and beam tunnel to be confirmed

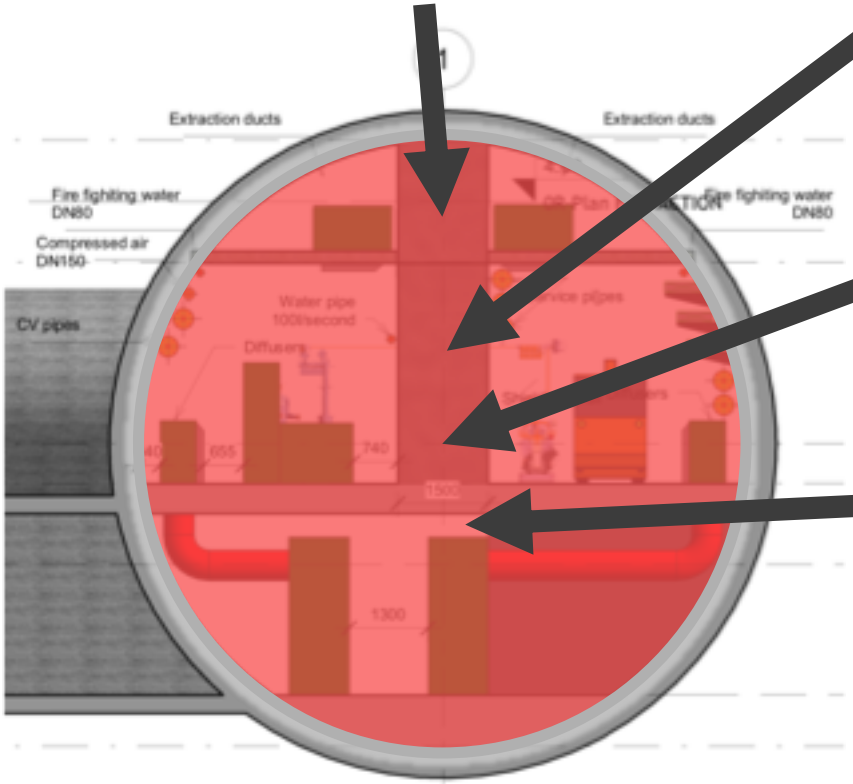
Closure of shielding gap (structural stability ?)

Shielding will confine X radiation to beam tunnel, such to keep klystron tunnel accessible.

Beam operation

Source term: Continuous beam loss (upper conservative limit: 10^{-3}) & incidental beam loss sustained for a short time

Ventilation duct (ø120 cm) crossing at each alcove

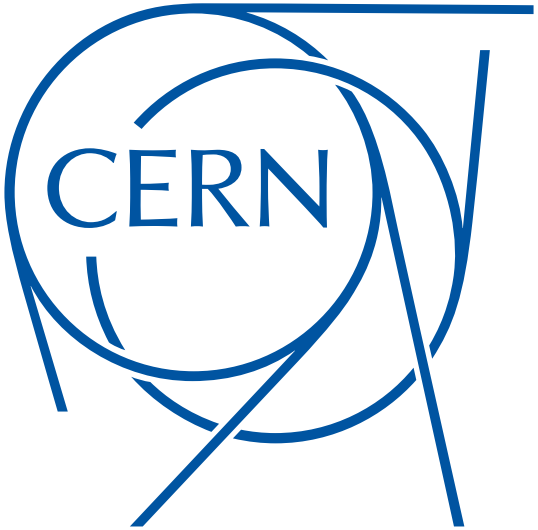


Waveguide ducts (ø15 cm) every 2 m

Passage between klystron and beam tunnel to be confirmed

Closure of shielding gap (structural stability ?)

Shielding will confine activation to beam tunnel, but R2E issues klystron tunnel to be addressed.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