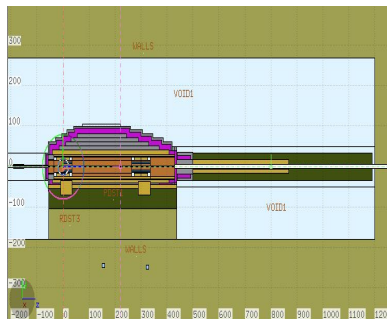# CPS meeting 06/26/2023

1. Shield optimization and Neutron fluence across the CPS .

2. Prompt Dose Equivalent and Activation around CPS .

3. PDE and Activation around Beam Line.
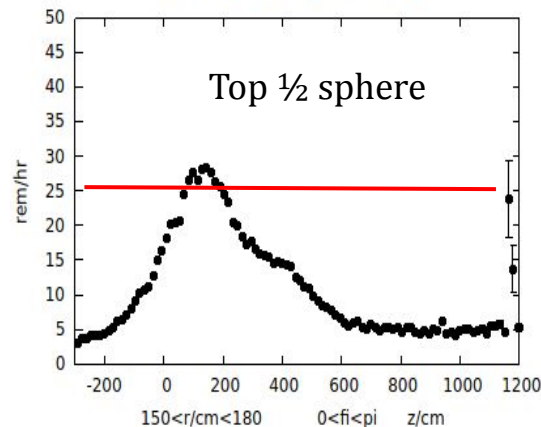
4. Round and "Stingray" channels.

5. Coil lifetime.

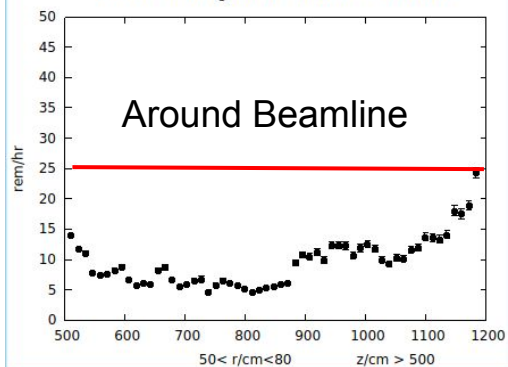# Prompt Dose Eq. around CPS and B+Concr. beam line shielding .
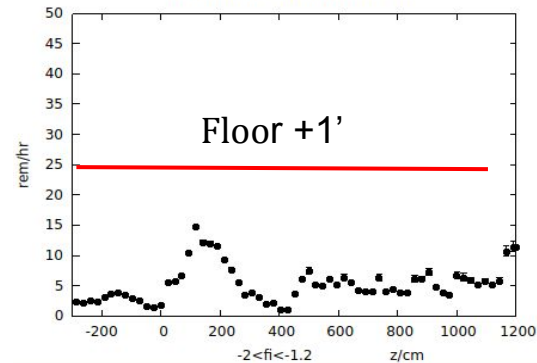

PDE top 1/2 sph rem/hr bentcoil-65-m23ref7 91

5 rem/h

5 rem/hr

PDE rem/hr bentcoil-65-m23ref7 91

Top ½ sphere

150<r/cm<180   0<fi<pi   z/cm
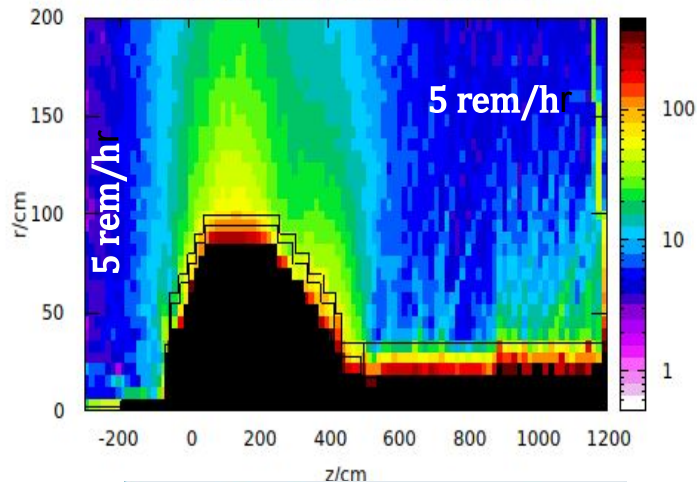
- PDE at floor level is below 15 mrem/hr

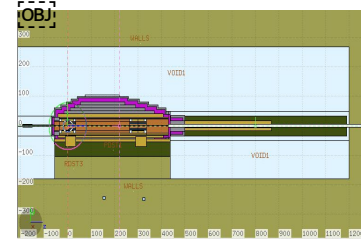PDE around PrMag/bemline bentcoil-65-m23ref7 91

Around Beamline

50< r/cm<80   z/cm > 500

PDE floor bentcoil-65-m23ref7 91

Floor +1'

-2<fi<-1.2   z/cm

Activation 1000+1 hr. CPS with beam line shielding .

PDE rem/hr N=36.E-5 bentcoil-65-m23ref7 24

Activation mrem/hr 1 sph bentcoil-65-m23ref7 24

2 mrem/hr

r/cm

-130<z/cm<-100   -pi<fi<pi   z/cm

Activation mrem/hr 1 sph bentcoil-65-m23ref7 24

r/cm

470<z/cm<500   -pi<fi<pi   z/cm

Activation mrem/hr top 1/2sph bentcoil-65-m23ref7 24

130<r/cm<160

z/cm

130<r/cm<160   0<fi<pi   z/cm

Activation around DS bemline bentcoil-65-m23ref7 24

42<r/cm<72

z/cm

42<r/cm<72   z/cm
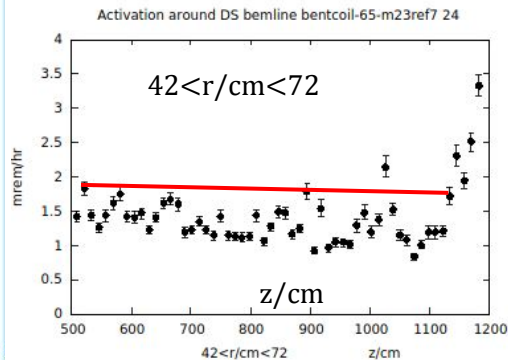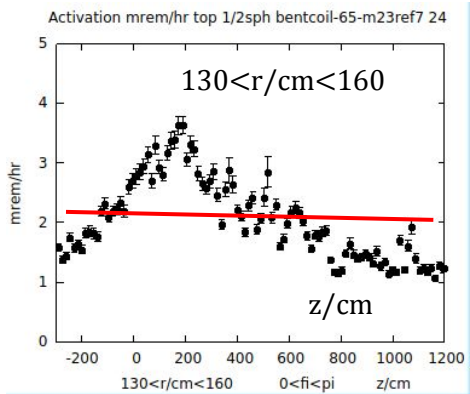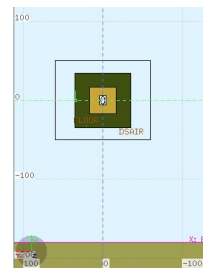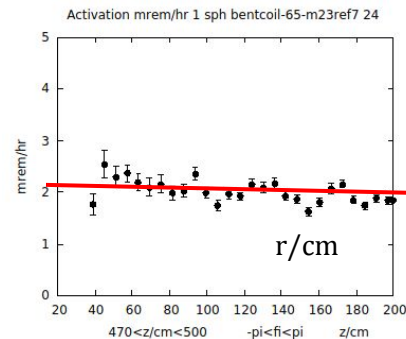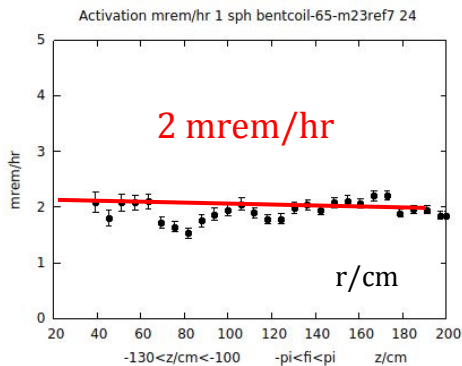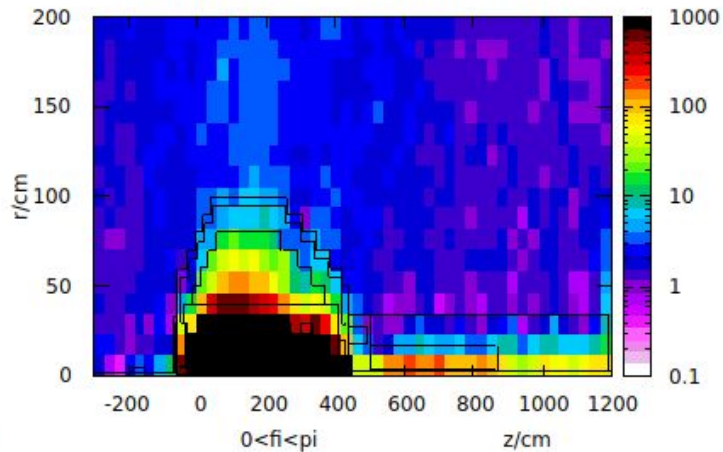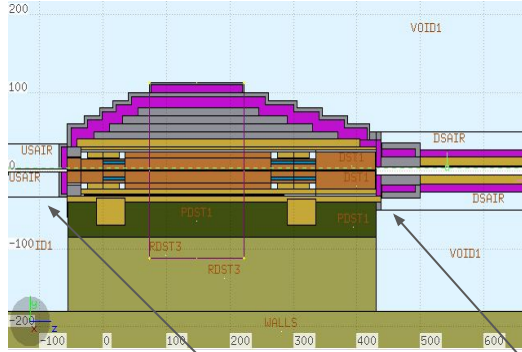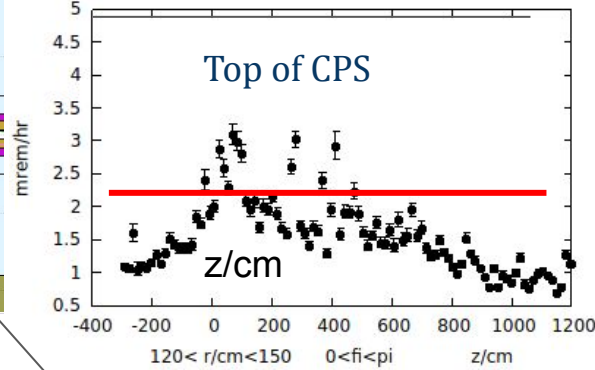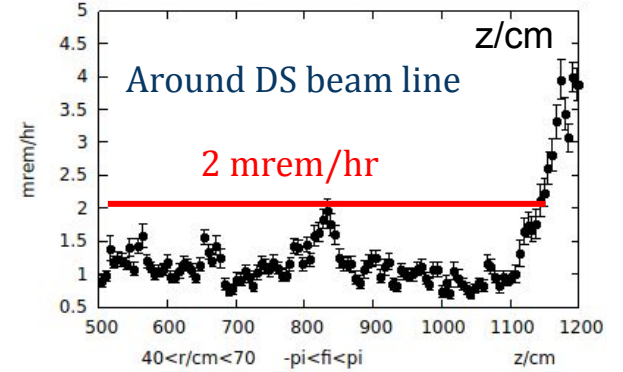
- Activation is below 3.5 mrem/hr

Activation.CPS with extra layer of BPE around CPS (R=112.5 cm). BPE around the beam line.

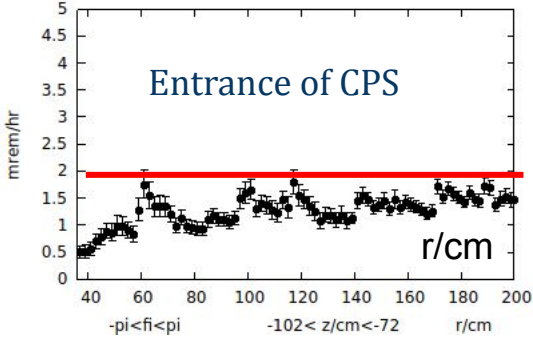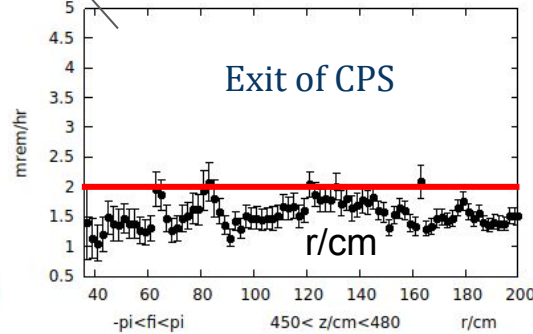Activation top 1/2 sphere of CPS bentcoil-65-m23ref8 24

Top of CPS

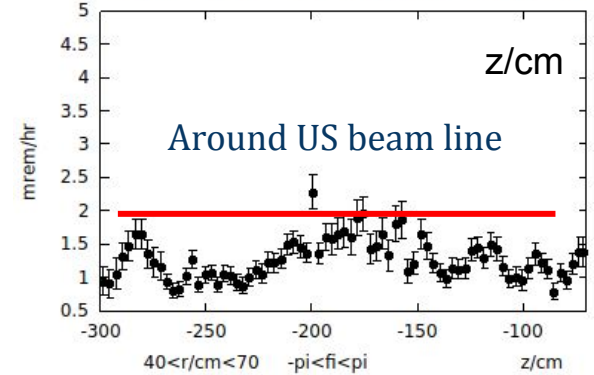Activatio around DS beam line bentcoil-65-m23ref8 24

Around DS beam line

2 mrem/hr

Activation US r-profile bentcoil-65-m23ref8 24

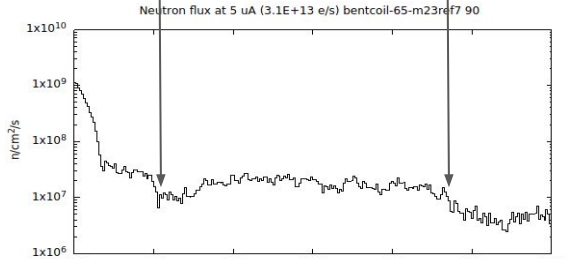Entrance of CPS

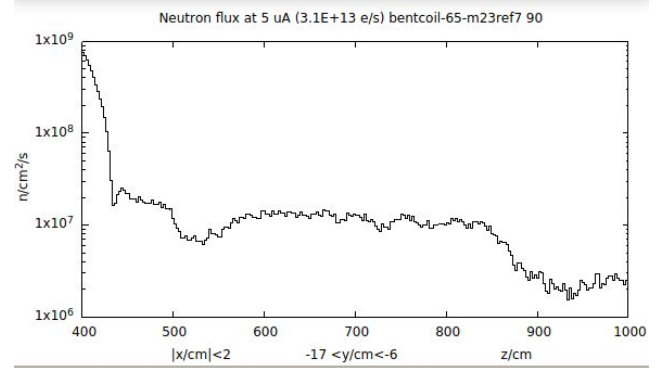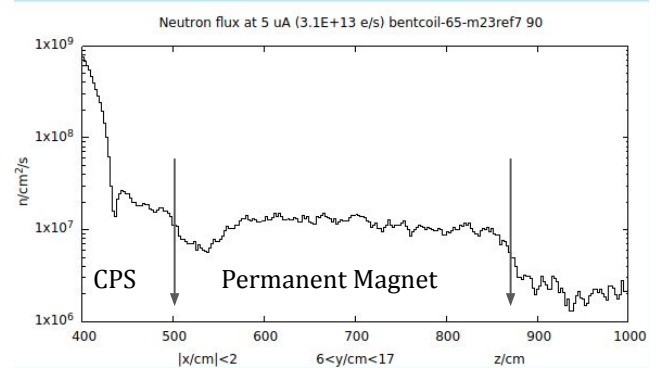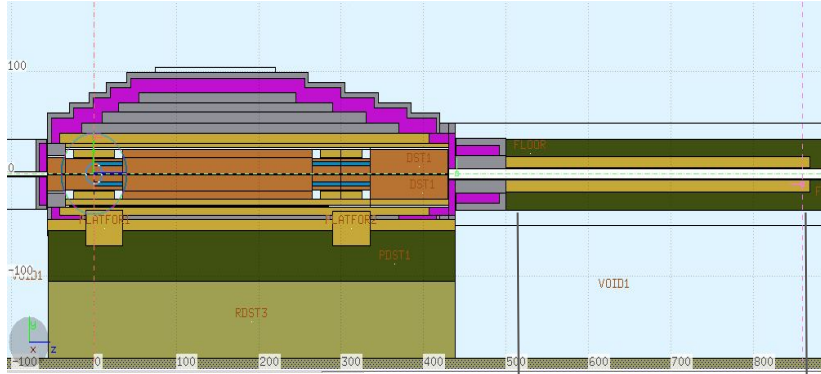Activation DS r-profile bentcoil-65-m23ref8 24

Exit of CPS

Activatio around US beam line bentcoil-65-m23ref8 24

Around US beam line

- Activation around CPS and beamline is below 2.5 mrem/hr !

Neutron flux inside CPS (z/cm < 440) is more than 100 times higher and continue to climb!
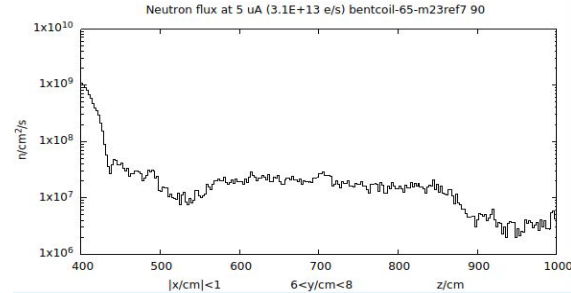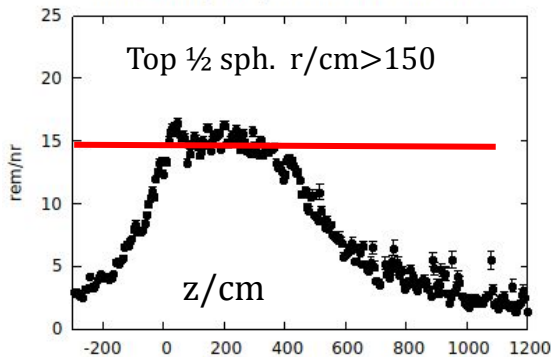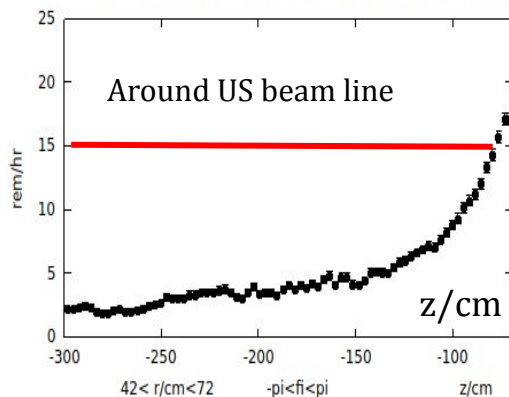

Outside CPS
LT=2E16/2.E7
=1.E9 s=
=30 years,

Inside CPS
LT<2/E16/1.E+9=
2.E7 s = 0.5 year.

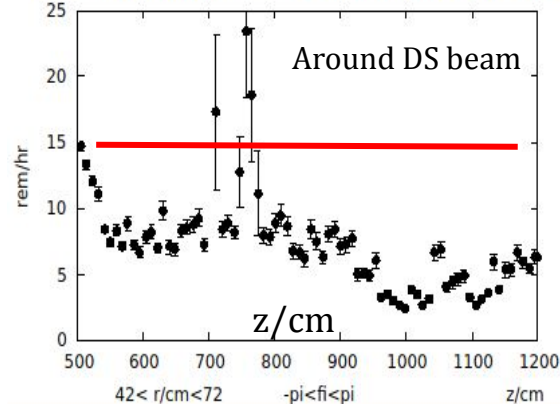# PDE. CPS with extra layer of BPE around CPS (R=112.5 cm). BPE around the beam line.

PDE rem/hr top 1/2 sphere bentcoil-65-m23ref8 91

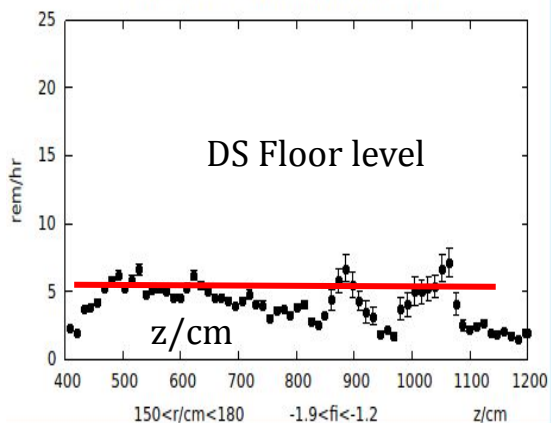Top ½ sph. r/cm>150

z/cm

PDE rem/hr around US bemline N=11.25E+6 rbentcoil-65-m23ref8 91

Around US beam line

z/cm

42< r/cm<72   -pi<fi<pi

PDE rem/hr around bemline N=11.25E+6 rbentcoil-65-m23ref8 91

Around DS beam

z/cm

500 600 700 800 900 1000 1100 1200

42< r/cm<72   -pi<fi<pi   z/cm

PDE rem/hr DS floor bentcoil-65-m23ref8 91

DS Floor level

z/cm

400 500 600 700 800 900 1000 1100 1200

150<r/cm<180   -1.9<fi<-1.2   z/cm

PDE rem/hr top 1/2 sphere bentcoil-65-m23ref8 91

-200 0 200 400 600 800 1000 1200

0<fi<pi   z/cm
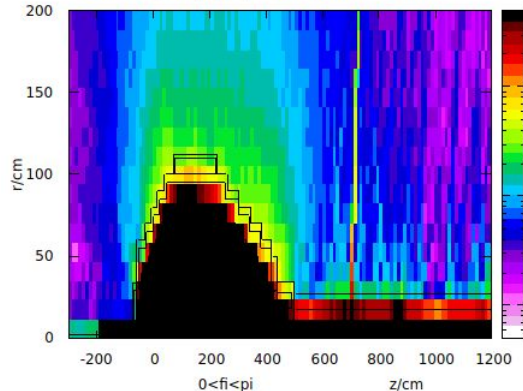
Power Deposition w/cm^3 N=5000 bentcoil-65-m23ref8 99

dP/dV<1.1 kW/cm^3

z/cm

0 50 100 150 200 250 300 350 400

0<r/cm<0.025   -1.7<fi<-1.4 z/cm
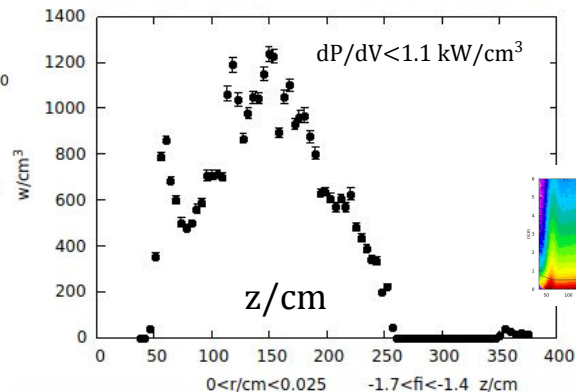
- PDE at floor level is below 7 rem/hr.   dP/dV<1.2 kW/qcm.

PDE. CPS with longer "stingray" channel. CPS R < 99 cm. B=0.9 B_n. Fe: core and 2 shield layers.

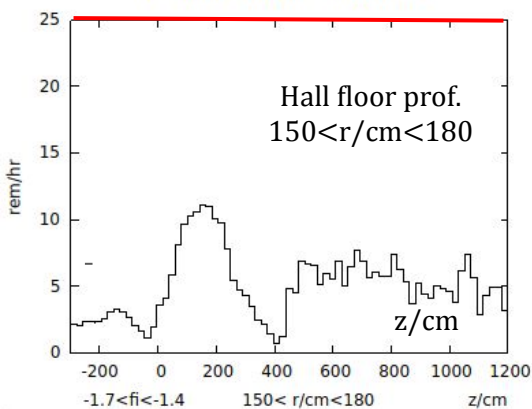PDE top 1/2 sphe. rem/hr bentcoil-65-m23ref9 91

CPS top z prof.
150<r/cm<180

z/cm

0<fi<pi   150< r/cm<180   z/cm
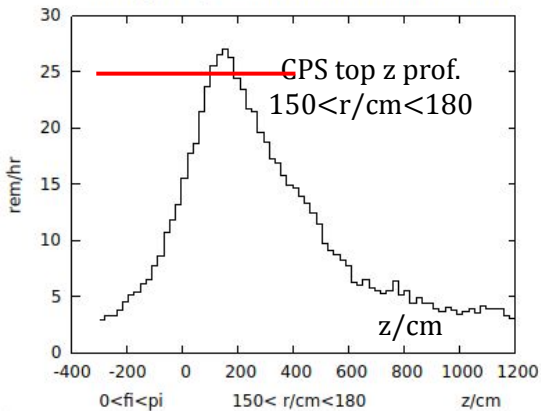
PDE US CPS +1/2' r-profile bentcoil-65-m23ref9 91
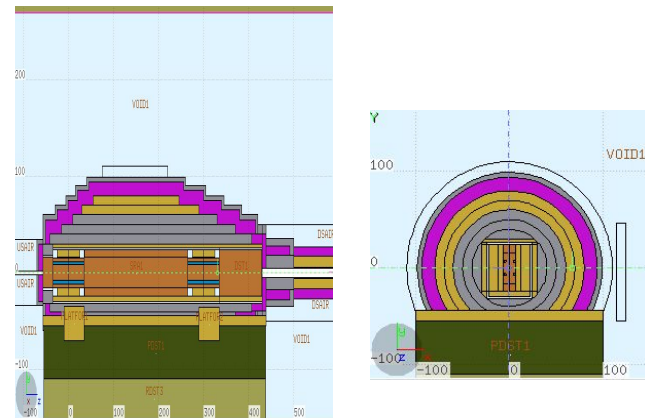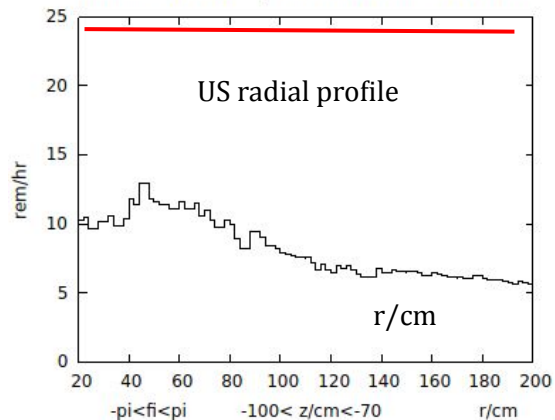
US radial profile

r/cm

-pi<fi<pi   -100< z/cm<-70   r/cm

PDE floor bentcoil-65-m23ref9 91

Hall floor prof.
150<r/cm<180

z/cm

-1.7<fi<-1.4   150< r/cm<180   z/cm

PDE DS +1/2' r-profile bentcoil-65-m23ref9 91

DS radial profile

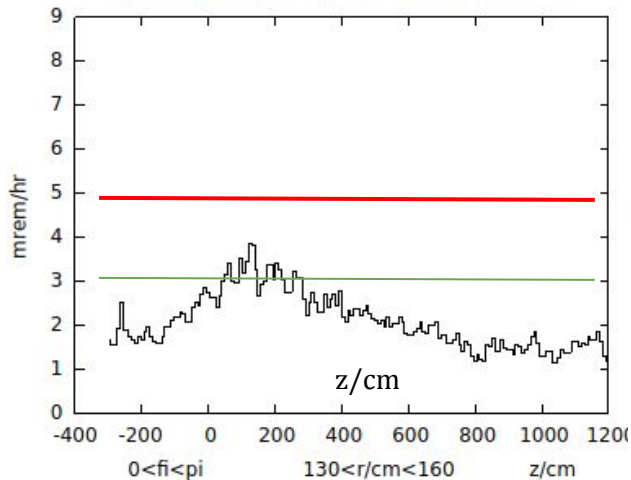r/cm

-pi<fi<pi   471< z/cm<500   r/cm
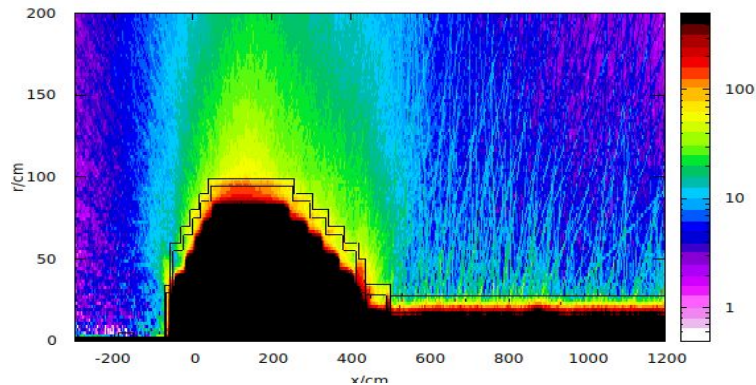
PDE rem/hr top 1/2 Sph. bentcoil-65-m23ref9 91
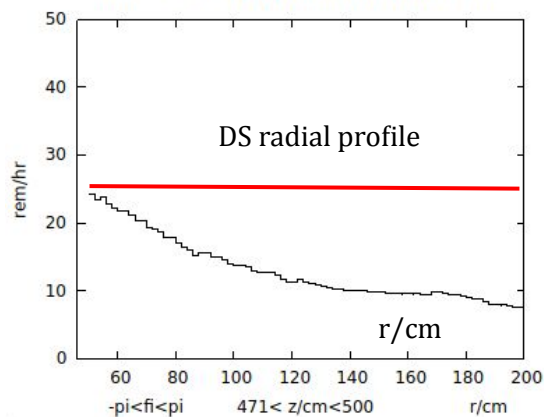
- **PDE at floor < 7 rem/hr meets limits of PAC48.**

Activation. CPS with longer "stingray" channel. CPS R < 99 cm. B=0.9 B_n. Fe: core and 2 shield layers.
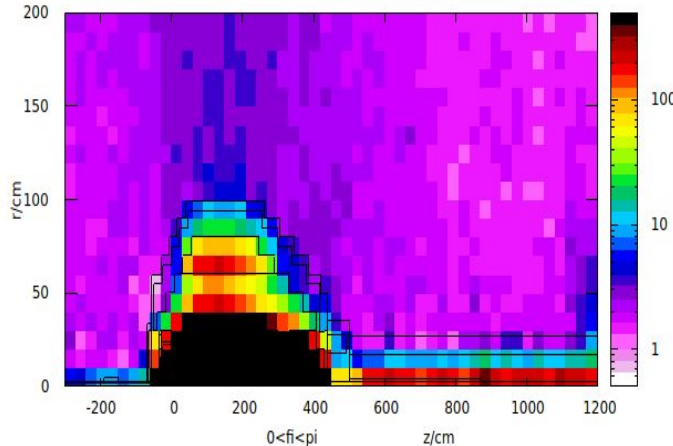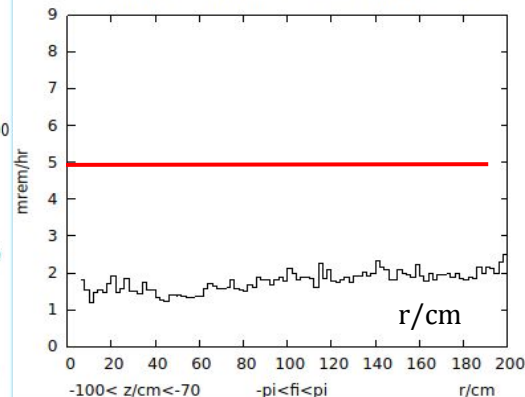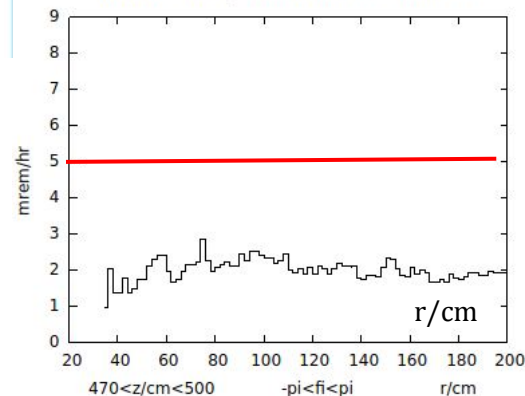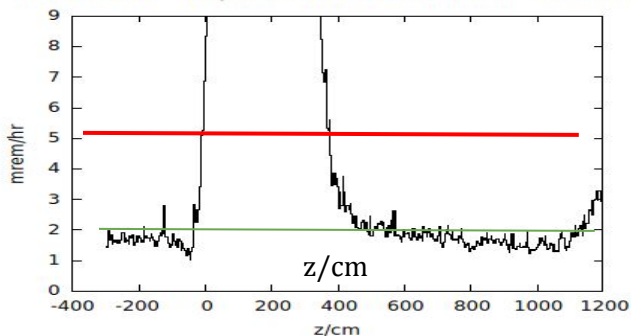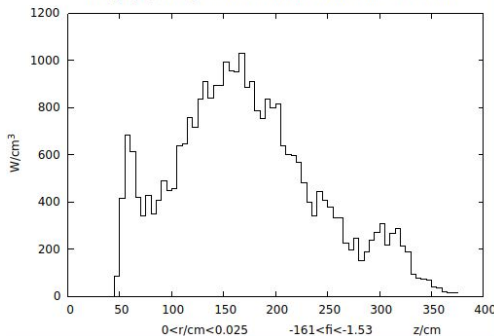
- Activation < 3 mrem/hr meets the limits of PAC48.
- Power deposition (!) dP/dV <1000 W/cm³

PDE and Activation around beam line. CPS R < 99 cm. B=0.9 B_n. Fe shield and neutron fluence.

PDE arond US beamline bentcoil-65-m23ref9 91

Activation around beam line bentcoil-65-m23ref9 24

Neutron fluence r-profile bentcoil-65-m23ref10 53

Cu/Fe
Fe
Pb
BPE
Pb
Air

PDE arond DS beamline bentcoil-65-m23ref9 91

Activation around beam line bentcoil-65-m23ref9 24

PD r- profile bentcoil-65-m23ref10 54
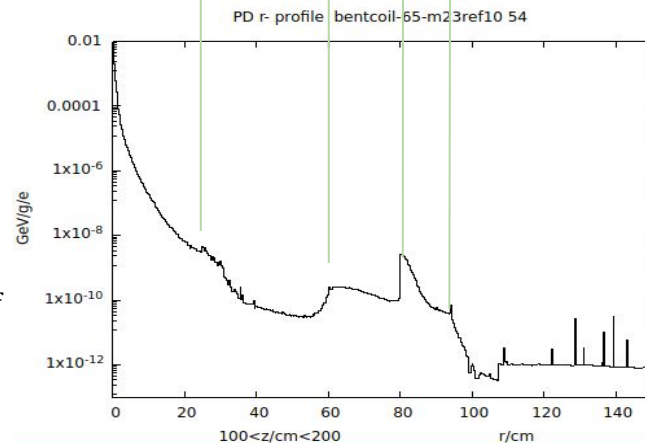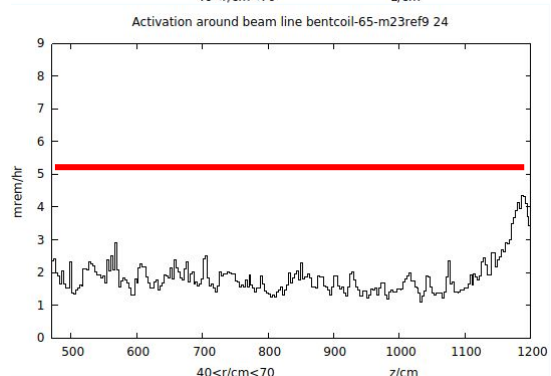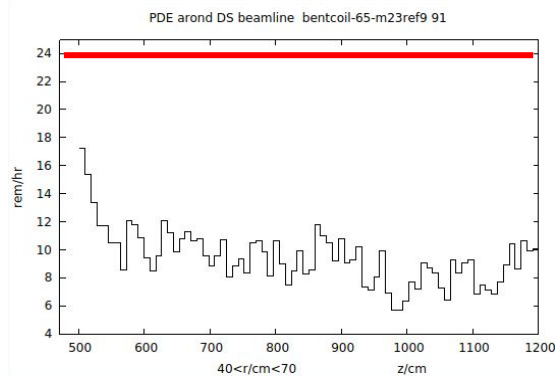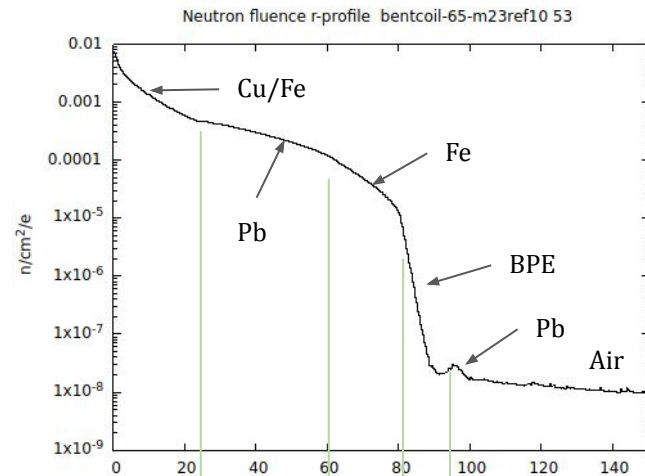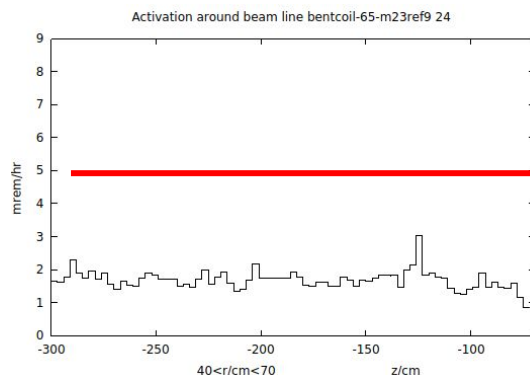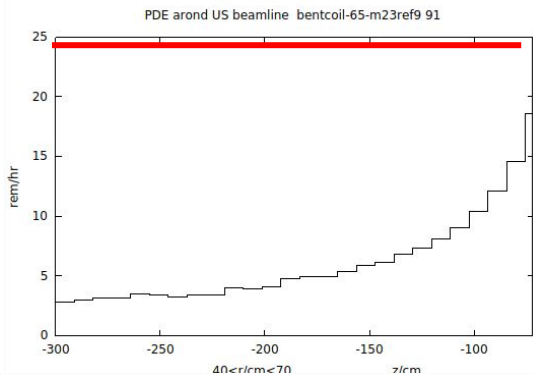
- Neutron related dose around CPS **may be reduced** optimizing Pb/Fe composition of shield layers.

- PDE and Activation around beam line allows **safe work of electronics and humans**.

Coil LT > 200 years. "Stingray" channel. CPS R < 99 cm. B=0.9 B_n. Fe: core and 2 shield layers.
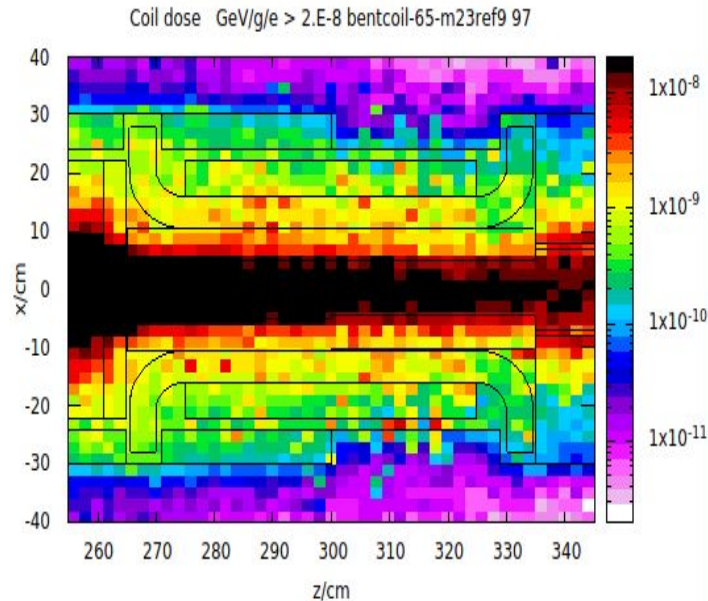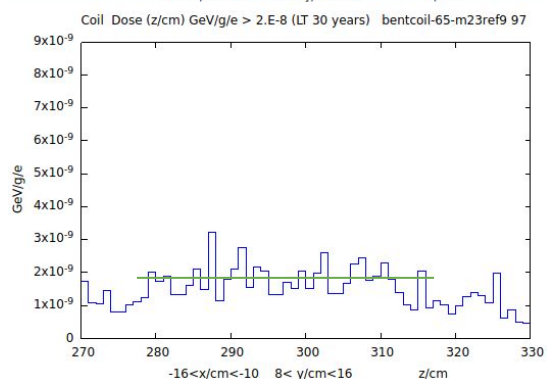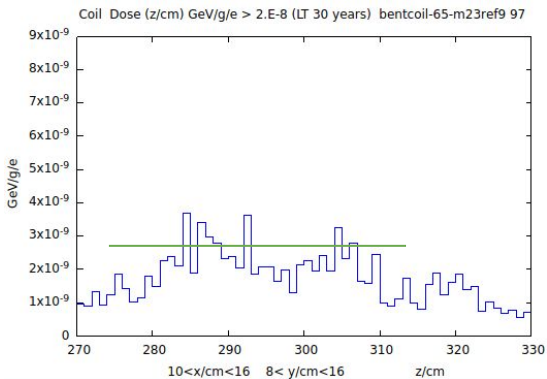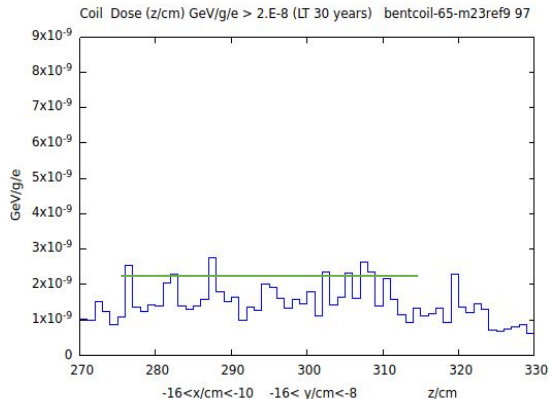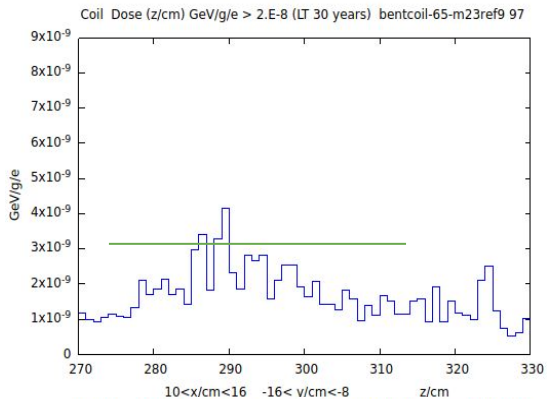
- Dose 2.E-8 GeV/g/e translate to LT=30 yr => Dose 3.E-9 GeV/g/e translate to LT=200 years.
- Practically infinite LT of DS coils.

Summary

1. CPS meets radiological requirements of PAC48:

2. Activation $<$ 3 mrem/hr.

3. Prompt Dose Eq. at floor level < 5 rem/hr (25 rem/hr - PAC 48).

4. Activation around beam line < 2 mrem/hr.

5. Prompt dose around beam line < 15 rem/hr.

6. Absorber channel design excludes risks of overheating; no vertical surfaces.

7. CPS diameter $=198$ cm (with 2 Fe layers) may be further reduced.

8. May be vacuumized (with round beam channel).

Advantages

1. Nominal Magnetic field - 2 times lower => cheaper magnets.

2. Allows alignment within a "cave" for the central part (3 tons only).

3. Absorber Max Temperature - 2-3 times lower => higher beam intensity.

4. Width - 1.5 times lower   (2 m vs 3 m) = > may be place more upstream.

5. Total Length - 1.6 times lower   (5 m vs 8 m).

6. Weight - 1.7 time lower   (75 metric tons vs 125).

7. No risk of Copper overheating/contamination <= no vertical planes in Absorber.

8. Standard shielding materials (do not create debris or dust).

9. Cost - lower, within accuracy.