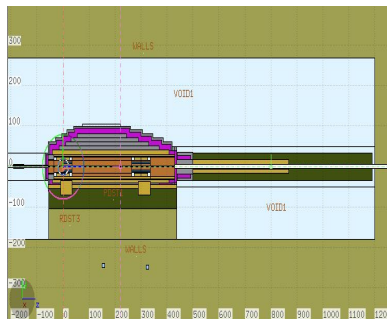


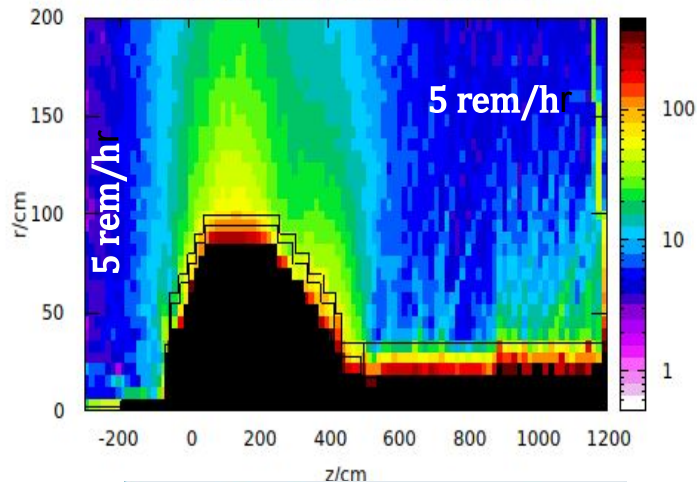
CPS meeting 06/26/2023

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.

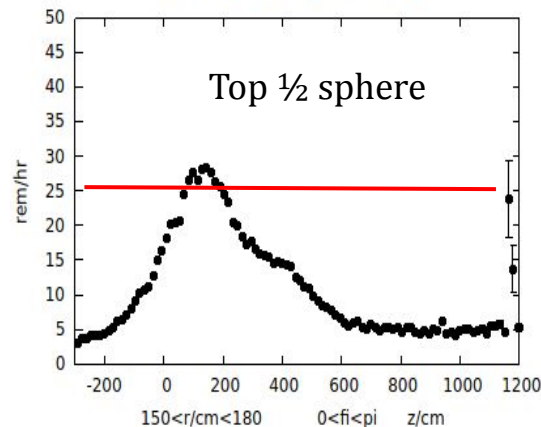
Prompt Dose Eq. around CPS and B+Concr. beam line shielding.



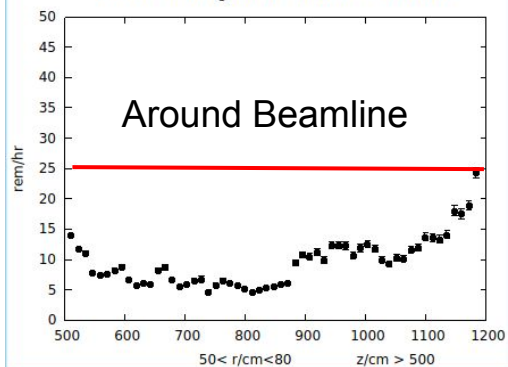
PDE top 1/2 sph rem/hr bentcoil-65-m23ref7 91



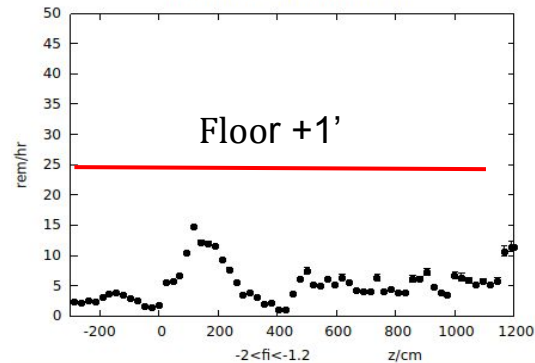
PDE rem/hr bentcoil-65-m23ref7 91



PDE around PrMag/bemline bentcoil-65-m23ref7 91



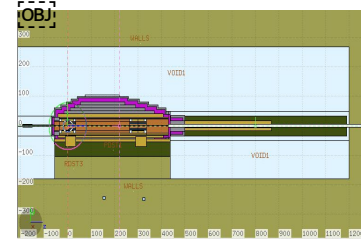
PDE floor bentcoil-65-m23ref7 91



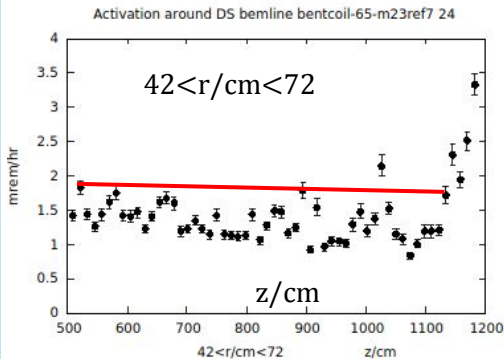
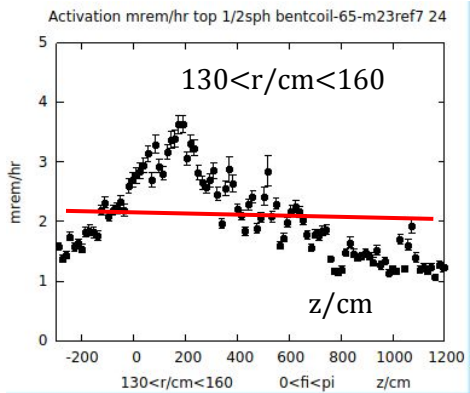
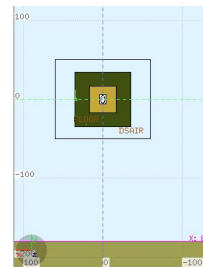
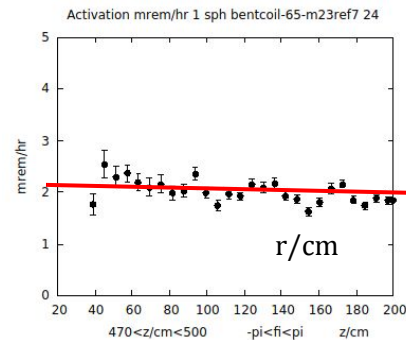
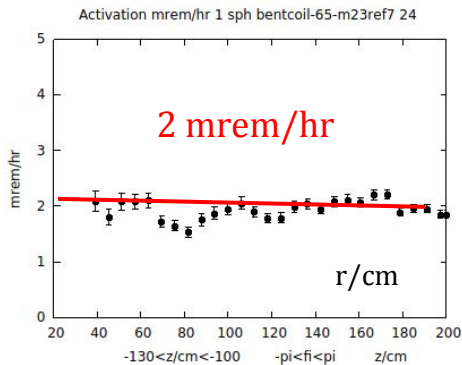
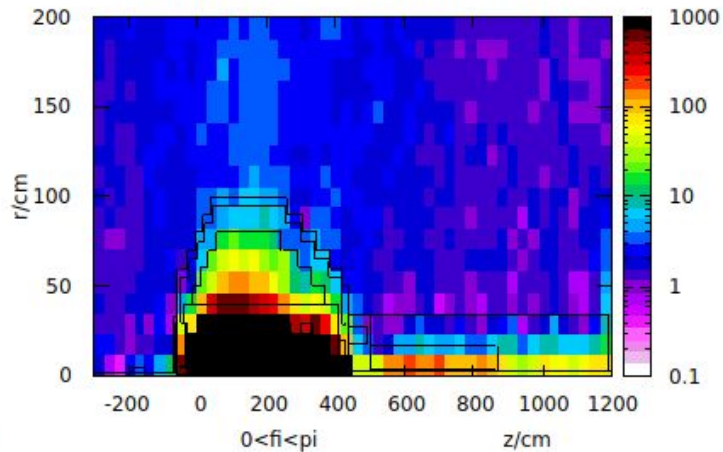
- PDE at floor level is below 15 mrem/hr



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

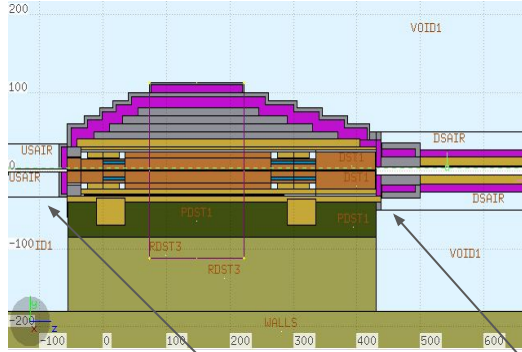


PDE rem/hr N=36.E-5 bentcoil-65-m23ref7 24

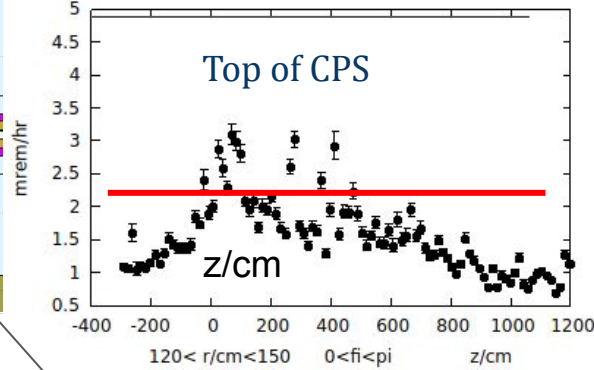


- Activation is below 3.5 mrem/hr

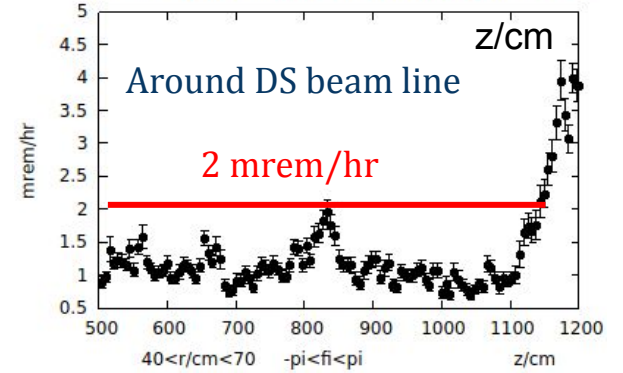
Activation.CPS with extra layer of BPE around CPS (R=112.5 cm). BPE around the beam line.



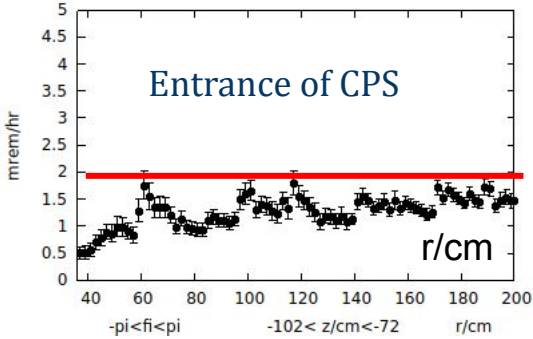
Activation top 1/2 sphere of CPS bentcoil-65-m23ref8 24



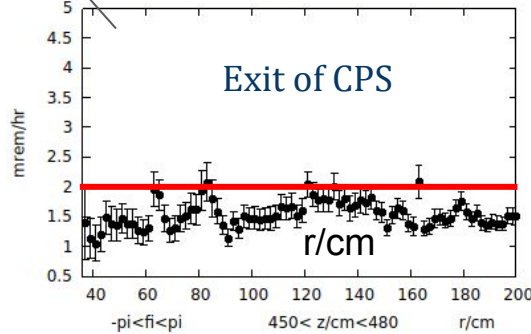
Activatio around DS beam line bentcoil-65-m23ref8 24



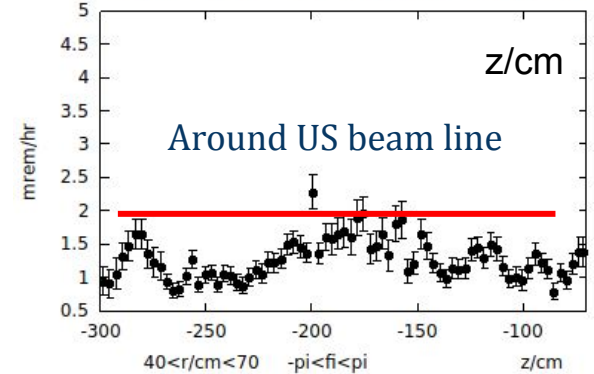
Activation US r-profile bentcoil-65-m23ref8 24



Activation DS r-profile bentcoil-65-m23ref8 24

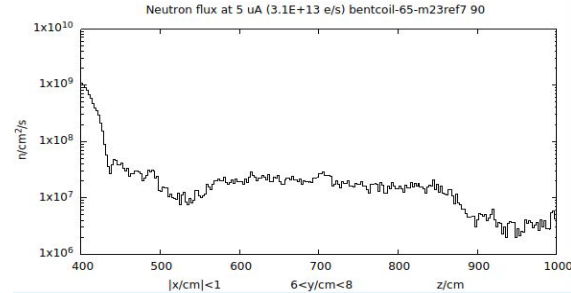
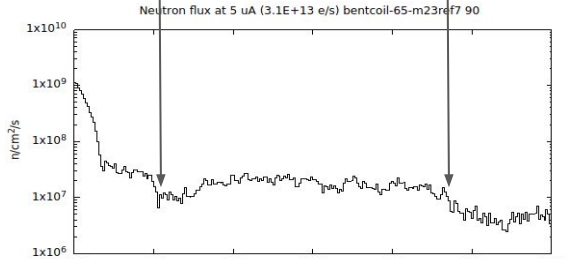
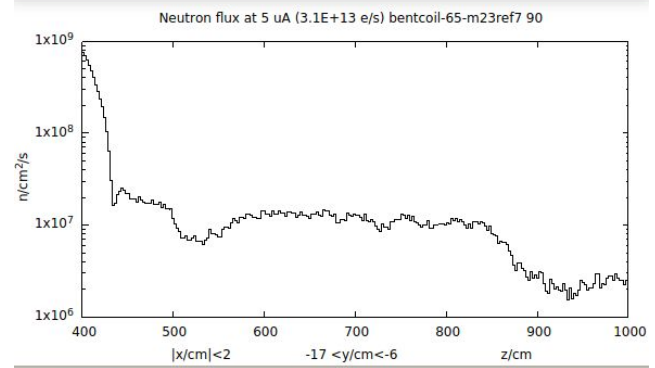
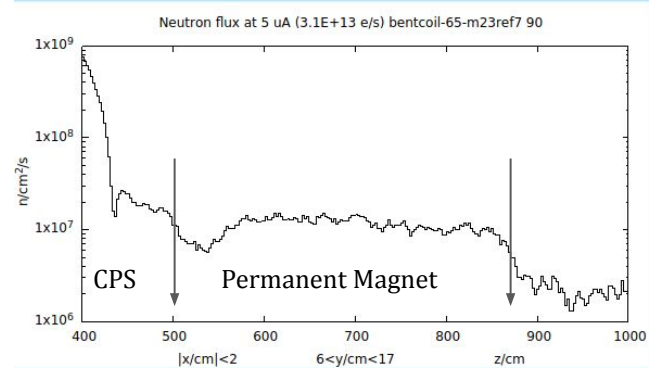
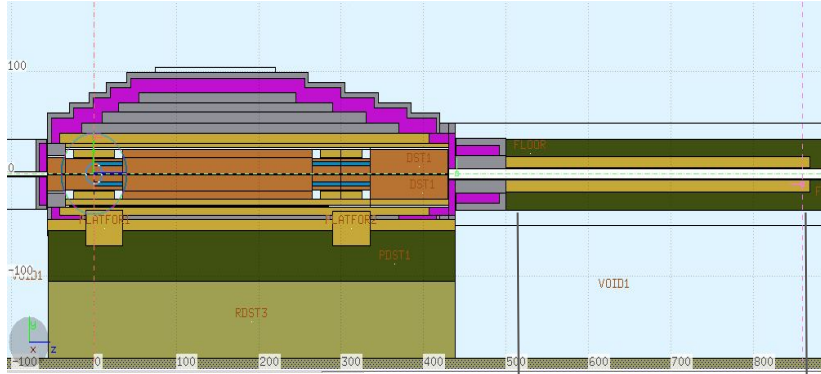


Activatio around US beam line bentcoil-65-m23ref8 24



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

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



Outside CPS

$$LT = 2\text{E}16 / 2.\text{E}7$$

$$= 1.\text{E}9 \text{ s} =$$

$$= 30 \text{ years,}$$

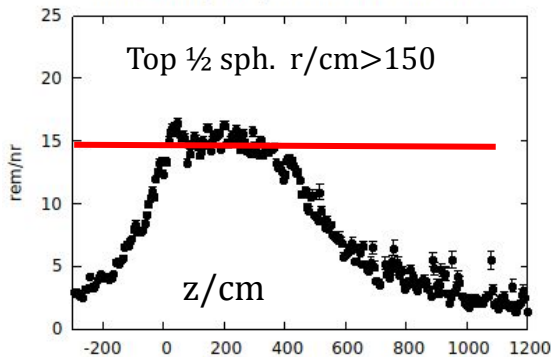
Inside CPS

$$LT < 2 / \text{E}16 / 1.\text{E}+9 =$$

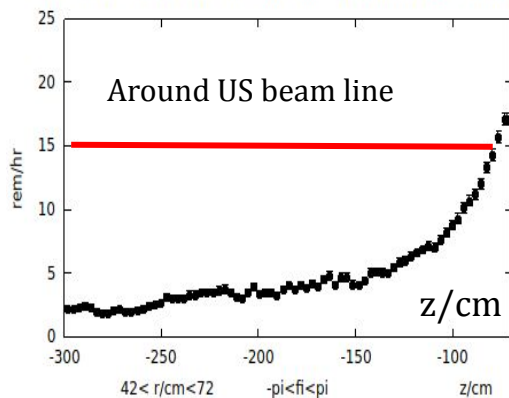
$$2.\text{E}7 \text{ s} = 0.5 \text{ year.}$$

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

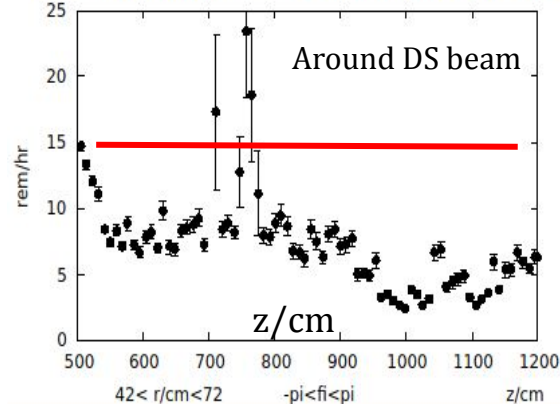
PDE rem/hr top 1/2 sphere bentcoil-65-m23ref8 91



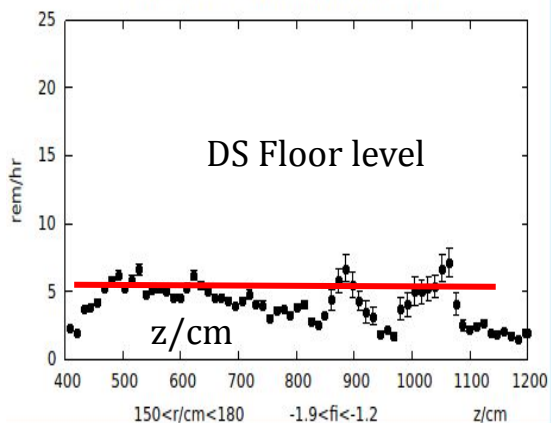
PDE rem/hr around US beamline N=11.25E+6 rbentcoil-65-m23ref8 91



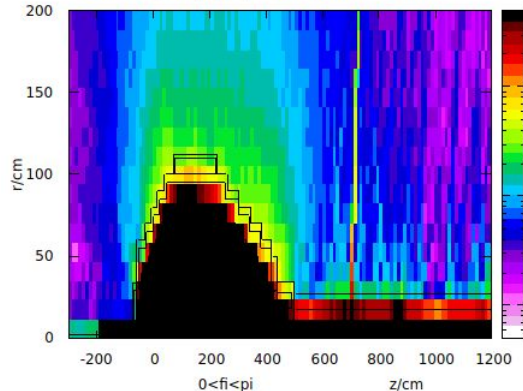
PDE rem/hr around beamline N=11.25E+6 rbentcoil-65-m23ref8 91



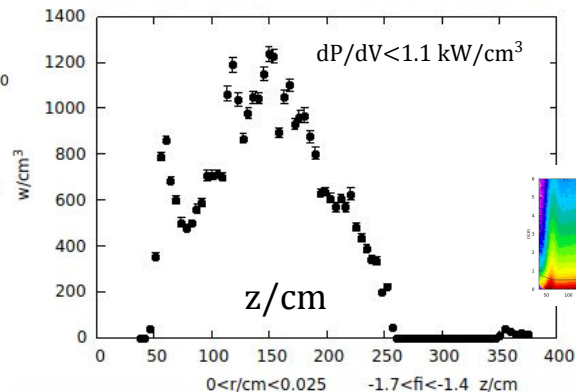
PDE rem/hr DS floor bentcoil-65-m23ref8 91



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



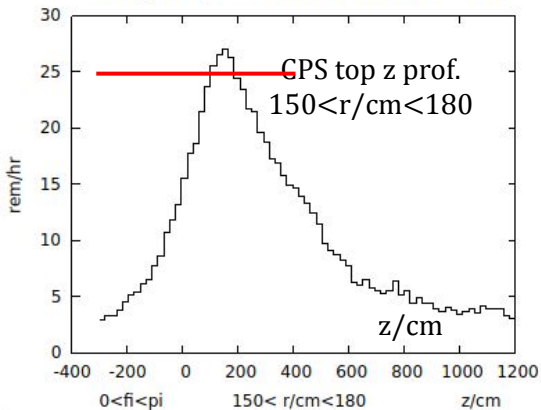
Power Deposition w/cm^3 N=5000 bentcoil-65-m23ref8 99



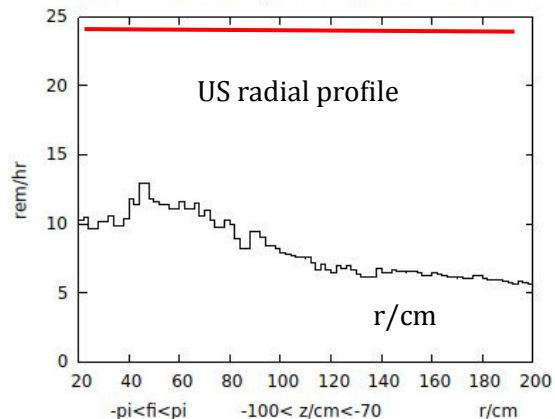
- PDE at floor level is below 7 rem/hr. $dP/dV < 1.2 \text{ kW}/\text{qcm}$.

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

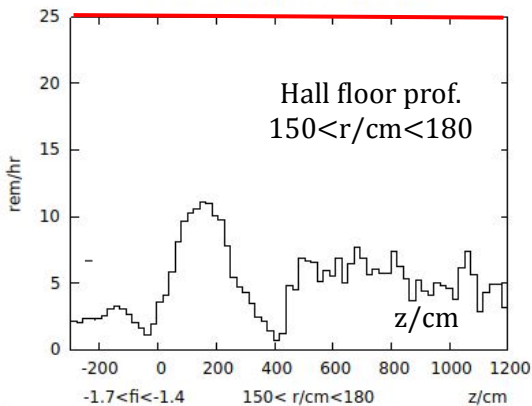
PDE top 1/2 spher. rem/hr bentcoil-65-m23ref9 91



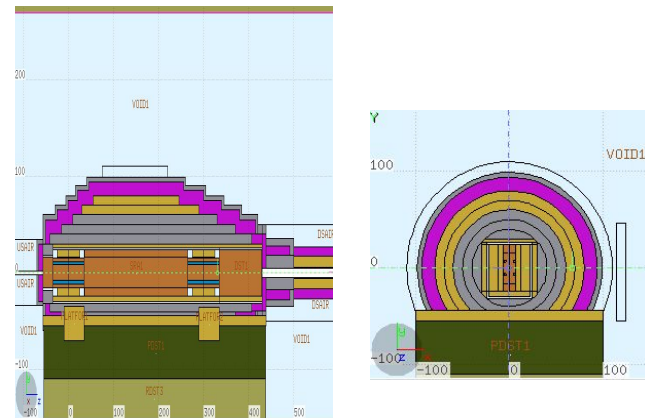
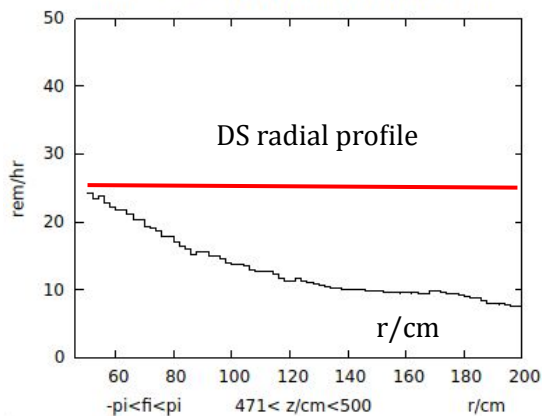
PDE US CPS +1/2' r-profile bentcoil-65-m23ref9 91



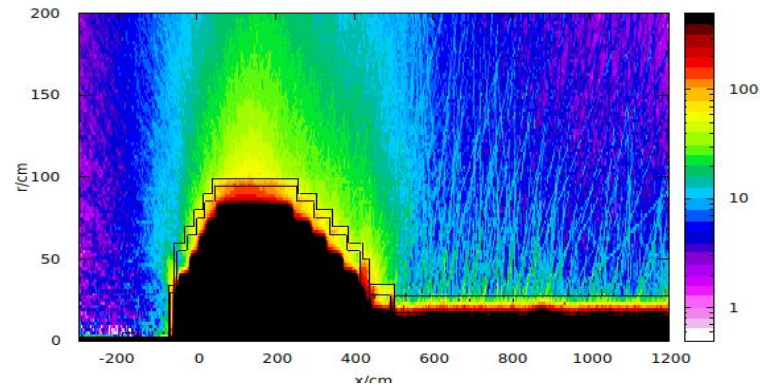
PDE floor bentcoil-65-m23ref9 91



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



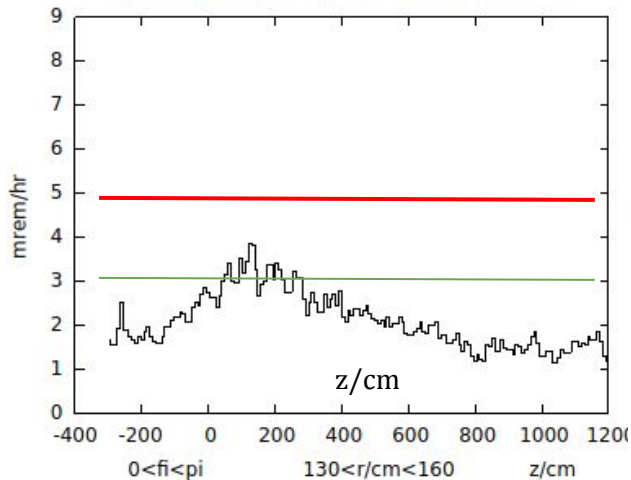
PDE rem/hr top 1/2 Sph. bentcoil-65-m23ref9 91



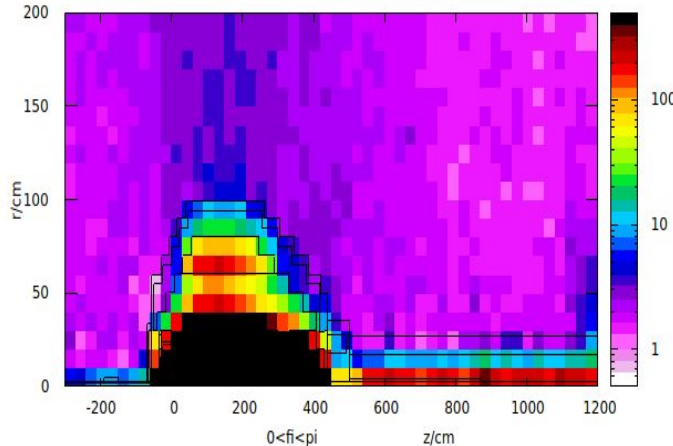
● PDE at floor < 7 rem/hr meets limits of PAC48.

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

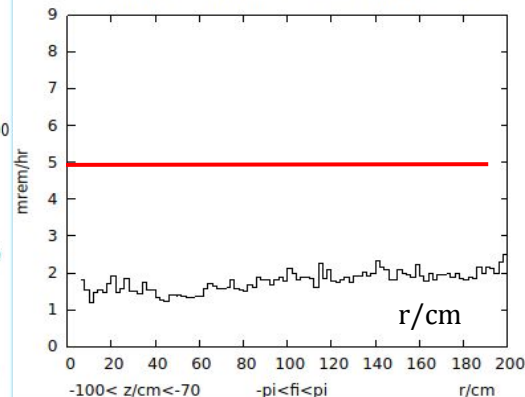
Activation 1000+1 hr 1' bentcoil-65-m23ref9 24



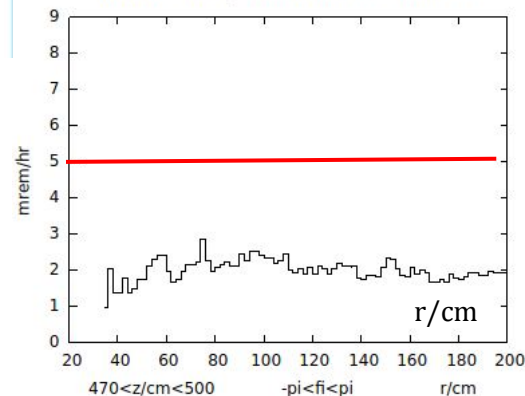
Activation 1000+1 hr mrem/hr bentcoil-65-m23ref9 24



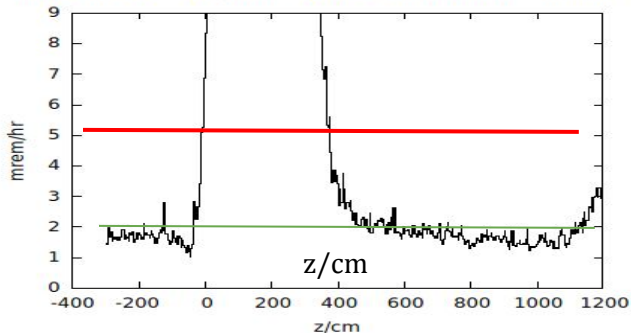
Activation US r-profile bentcoil-65-m23ref9 24



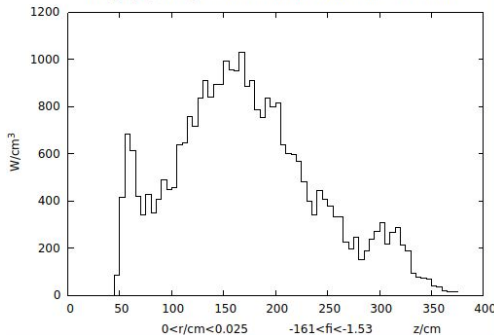
Activation DS r-profile bentcoil-65-m23ref9 24



Activation 1000+1 z-profile around beam bentcoil-65-m23ref9 24

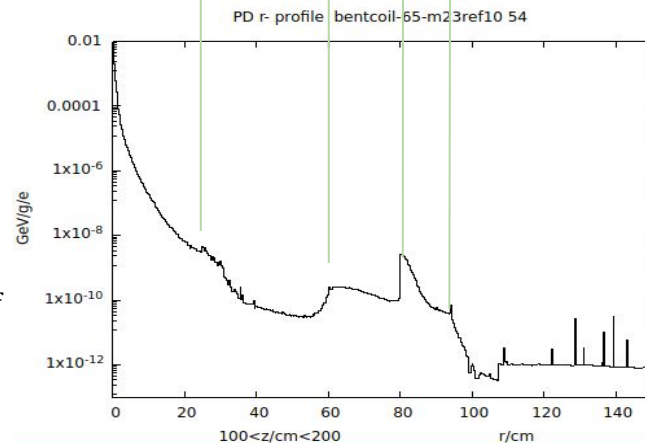
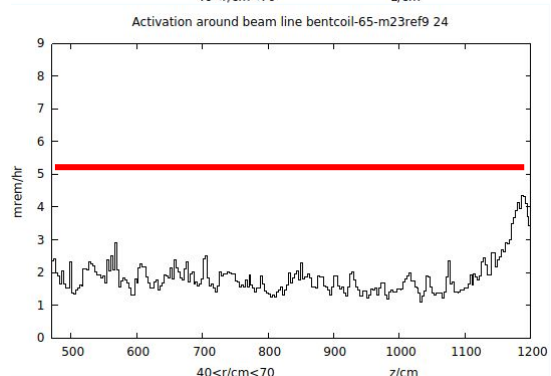
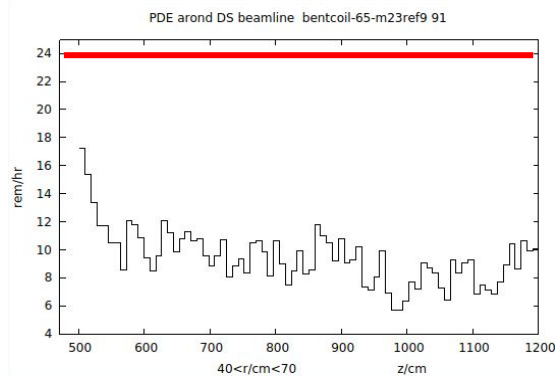
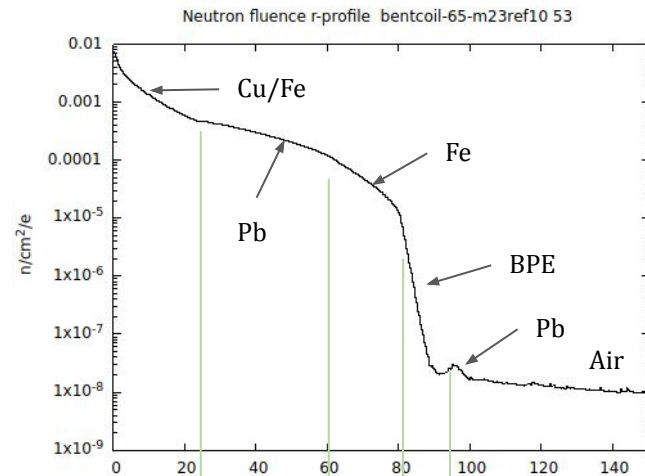
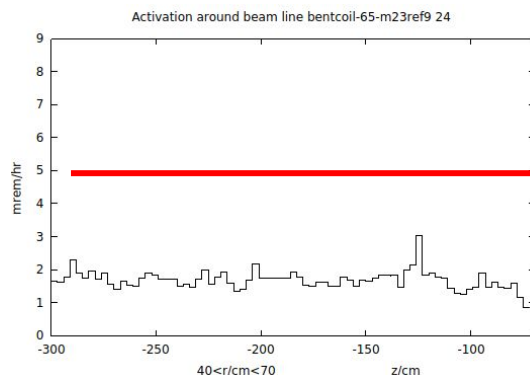
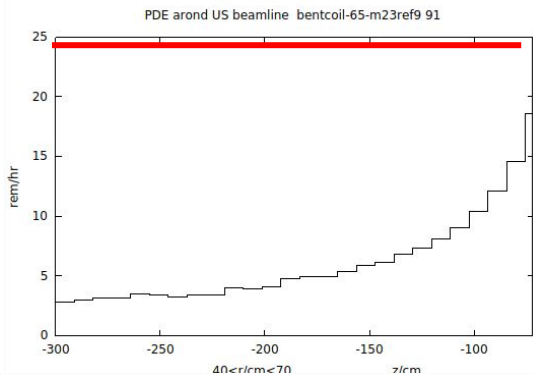


“Stingray” power profile at its bottom bentcoil-65-m23ref10 99



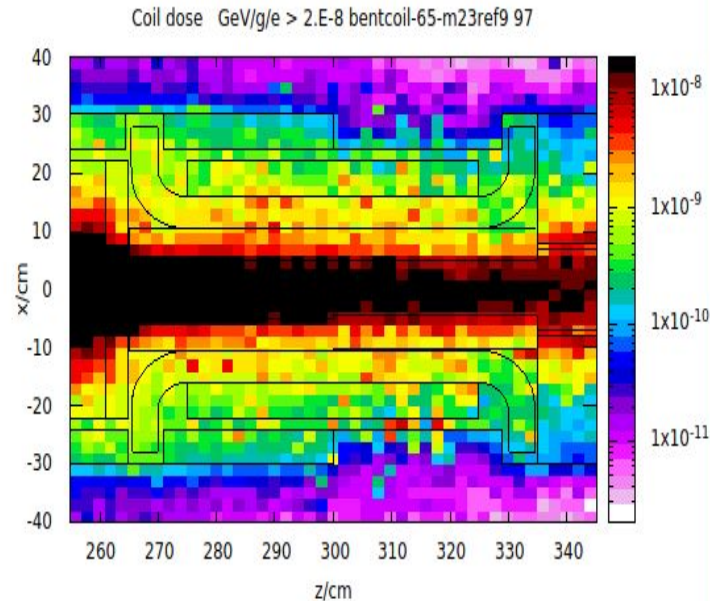
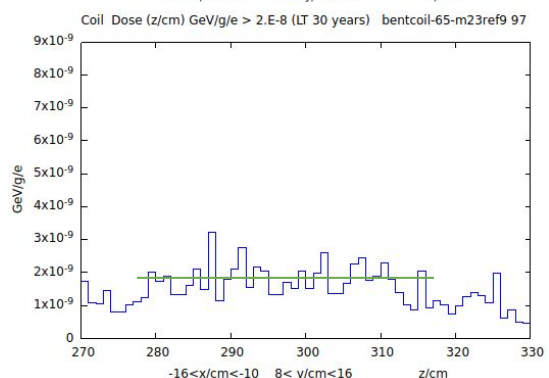
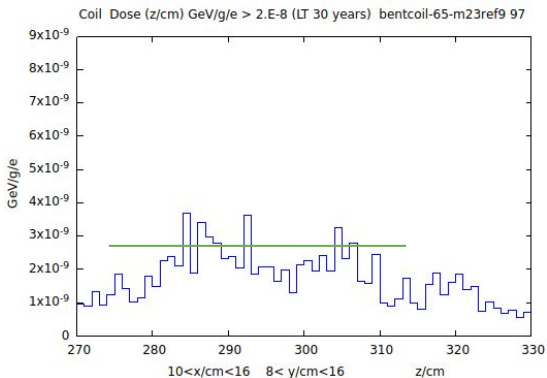
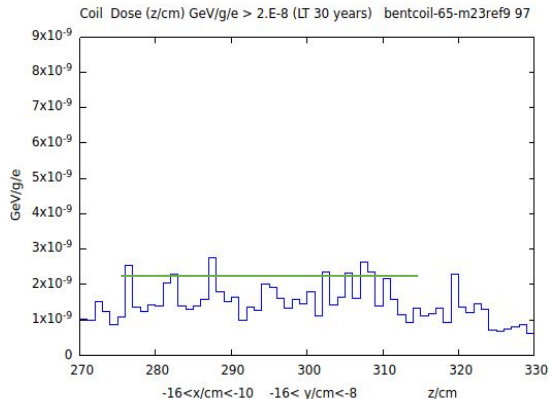
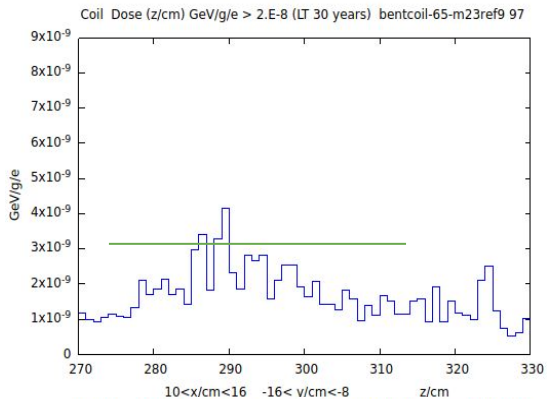
- Activation < 3 mrem/hr meets the limits of PAC48.
- Power deposition (!) $dP/dV < 1000 \text{ W/cm}^3$

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



- 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 \Rightarrow 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.