Requirements and constraints for Beam Transfer equipment

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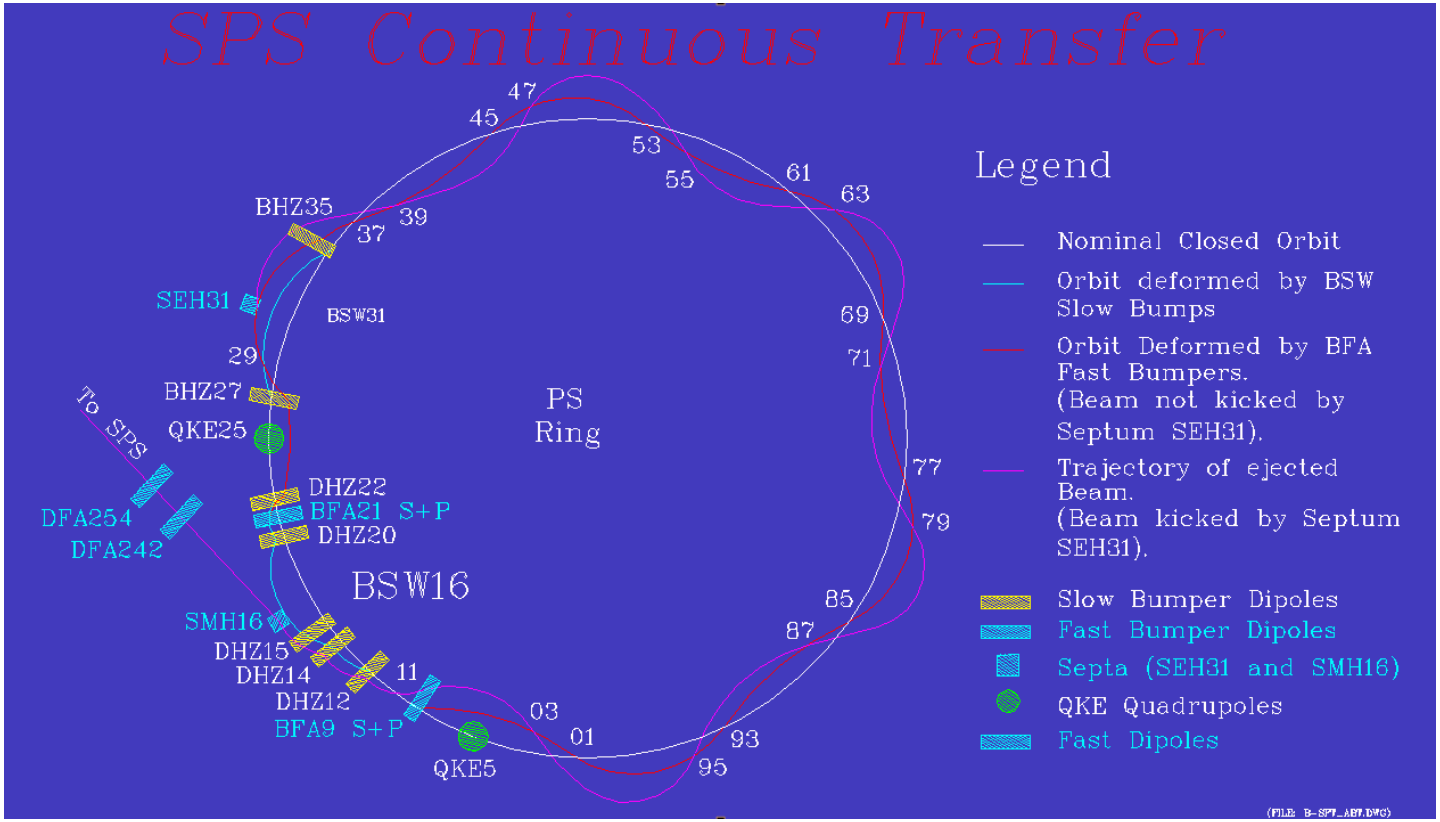
Extraction variants and consequences

- CT:
  - SEH31→ beam slicing septum highly radioactive; PS machine activation spread around circumference
- MTE
  - SMH 16 → Too radioactive to work on after use with MTE (debunched beam swept across blade)
  - Possible mitigation:
    - Spoiler → radiation remains close to maintenance intensive object
    - Dummy septum (ss15)
    - MTE –CT hybrid

Scenario 1:
Impact of continued use of CT

Beam extraction elements used for CT only



- BFA21-9 Staircase, BFA21-9 Pedestal
- SEH31, SMH16
- DFA242, DFA254

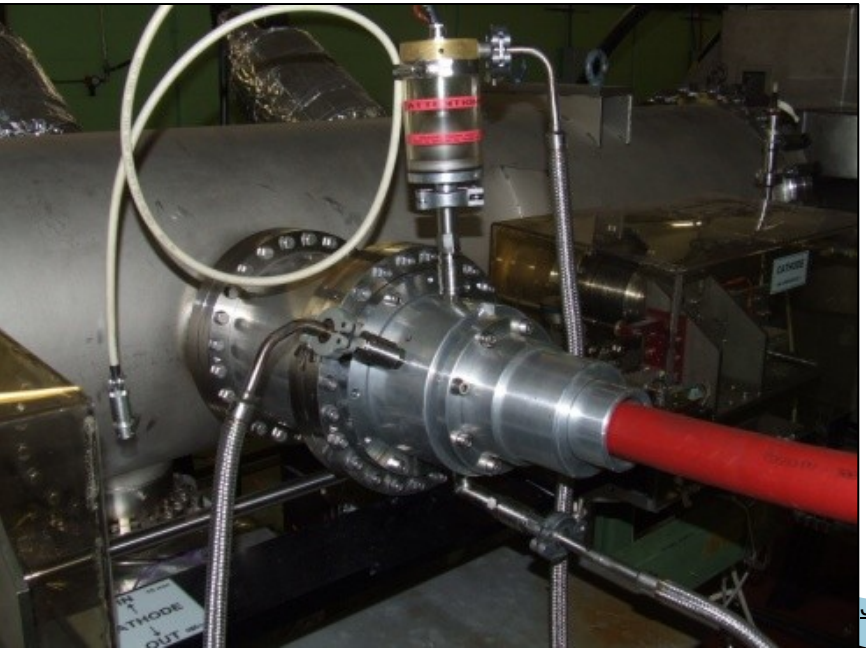
Septum SEH31

Present status:

SEH31.1: installed in PS (2010+2011)

SEH31.2: removed from PS January 2010, under nitrogen, to be renovated (2mSv/h at 40 cm).

SEH31.3: removed from PS after accident: diffuser wires broken. To be renovated in 2011.



Required CT Controls modernisation

- Full consolidation of CT electronics & controls mandatory for continued operation after 2013
  - Eradication of obsolete hardware (CAMAC, electronics…)
  - Implementation of full PPM functionalities on CT equipment
  - Conservative approach will be deployed to obtain standardisation with new and existing equipment and uniform integration within INCA
- Replacement needed of obsolete
  - Power distribution
  - fault detection
  - interlock and monitoring chassis
- Rejuvenation needed of RSG switches
- HV cables in CT generator area contain PVC and must be replaced.
- Open issues:
  - Rack space availability for electronics & controls in 359 for common exploitation of MTE & CT has to be studied in detail.
  - **Can only be done during a long shutdown**

Spares situation

- Septum 31:
  - No operational spare SEH31
    - To be done:
      - Cathode polishing
      - Manufacture of HV deflectors
      - Septum foils procurement
      - Modification of 3M Fluorinert insulation regeneration station to SEH23 (eradication of oil insulation in HV feedthroughs).
- Kickers: CT equipment is 40 years old
  - Spare vacuum tank for BFA9 and 21 exists,
  - Spare parts for the power converters available,
  - No major problems expected.

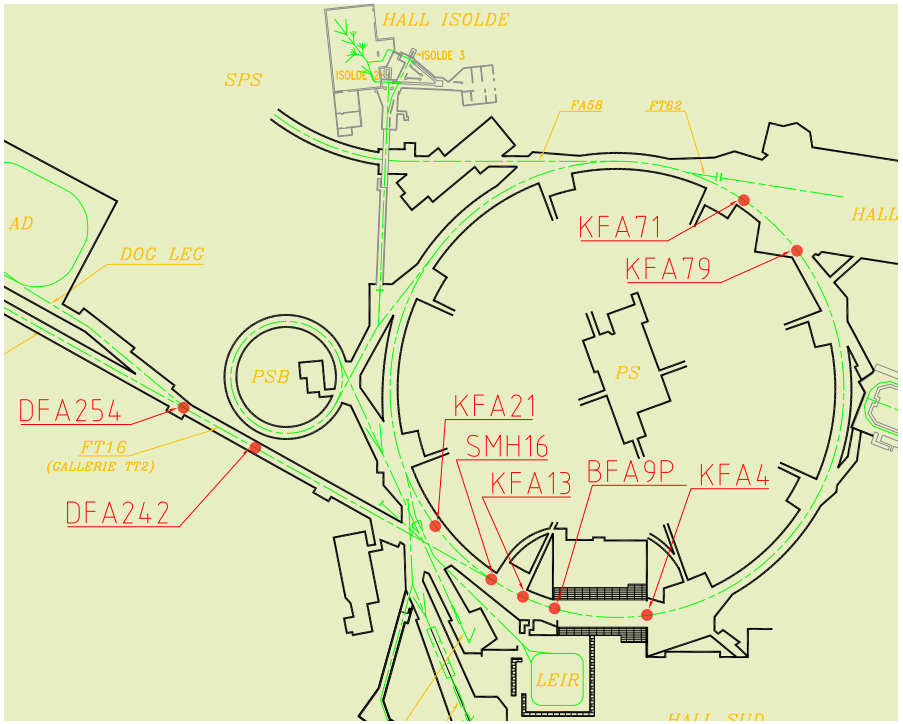
Resource requirements for cont'd use of CT

		Manufacture	Installation	Cost (kCHF)	Resources (MY)	Remark
General (bat. 359)	- retention of the zone - false floor at intermediate level - space for the FAK new oil groups - Dismount part of the HV cable support structure		2013	100	0.1	Support from EN and GS dpt needed
Oil (B359)	- add cooling system with closed circuit - add instrumentation on all switch tanks (water flow, temperature)		2013	25	0.25	
Oil (PS)	- replace diala oil by ester - pumping group upgrade - cooling with closed water circuit instead of disposable tap water		2013	25	0.25	
RSG	refurbish 3 switch tanks to have A and B channels operational	2011, 2012	2013	30	0.25	
	replace Diala by ester in RSG	2011,2012	2013	25	0.05	
	remove end switch tank and three switch tanks to save space	2011, 2012	2013	2	0.1	
	rejuvenate faraday cages	2011, 2012	2013	2	0.15	
	rejuvenate lemo connectors	2011, 2012	2013	3	0.1	
PGs	rejuvenate faraday cages	2013	2013	1	0.05	
ERD1	installation of 4 (5 optional) switch tanks	2011, 2012	2013	1	0.05	Installation during 2011-2012 preferred
BFA9-21 P	- study and add interface oil-fluorinert on terminators - refurbish terminator	2011, 2012	2013	15	0.3	
BFA9-21 S	- study and add interface oil-fluorinert on connection boxes, suppress motor	2011, 2012	2013	10	0.15	
SMH16	Manufacture of new magnet blocks only	2012	2013	125	0.2	
SEH31	Manufacture of spares; deployement of 3M at 31+23	2011	2012, 2013	23	0.4	
	controls for 3M Fluorinert	2012	2013	30	0.25	
Electronics	Camac eradication, replacement of power distribution, renewal safety systems	2011,2012	2013	200	1.9	
RG220 cable replacement	Replacement with Halogen free cable, mainly bt 359		2013	1030	0.8	Support from EN and GS dpt needed
TOTAL				**1622**	**4.85**	

Scenario 2:
Impact of use of MTE

Beam extraction elements used for MTE

- KFA4, 13, 21 (MTE dedicated),
- KFA71, 79 (PS extraction kicker),
- BFA9 Pedestal
- SMH16 (PS extraction)
- DFA242, DFA254



Electronics & Controls: MTE

- Hardware:
  - Produced, tested and ready for installation;
  - Conservative approach to obtain standardisation with new MTE equipment.
- Software:
  - Controller level developed and validated;
  - Integration within FESA in progress;
  - Integration within INCA still to be studied into details (retrofit to newly installed MTE equipment to be considered).
- To be done:
  - Consolidation of electrical distribution in 359 (Conformity with latest electrical norms);
  - Consolidation of installation safety (Personal & Equipment);
  - Full re-cabling of installations in 359 (Clean-up and eradication of non-halogen free cables).
- Open issue:
  - **Can only be done during a long shutdown.**

Status for septum SMH16

SMH16.1; not operational, very radioactive to renovate

- 4 years run (2006-2009), 14×10^6 pulses
- still 1 mSv/h at 40cm January 2011;
- stored in PS tunnel since 2010

SMH16.2; operational in PS

- run 2010: 7.5×10^6 pulses → needs to be replaced at end of 2011 run

SMH16.3; Newly built,
operational spare

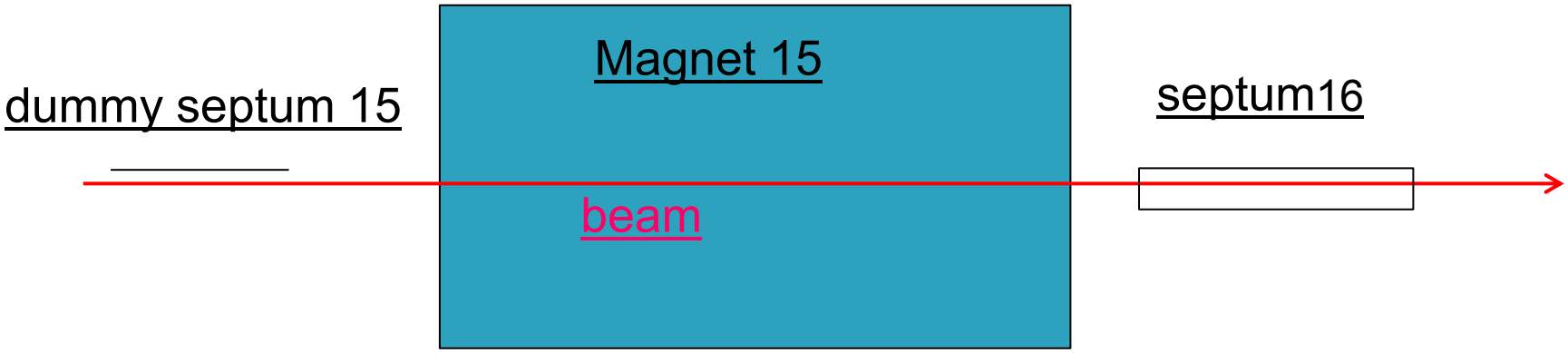
No operational spare SMH16 as from 2012!

→ additional spare to be built

A new method for reducing the radiation field around SMH16 with MTE

Installation of a dummy septum blade in SS15,
shadowing the blade of septum SMH16.

original idea from B. Goddard



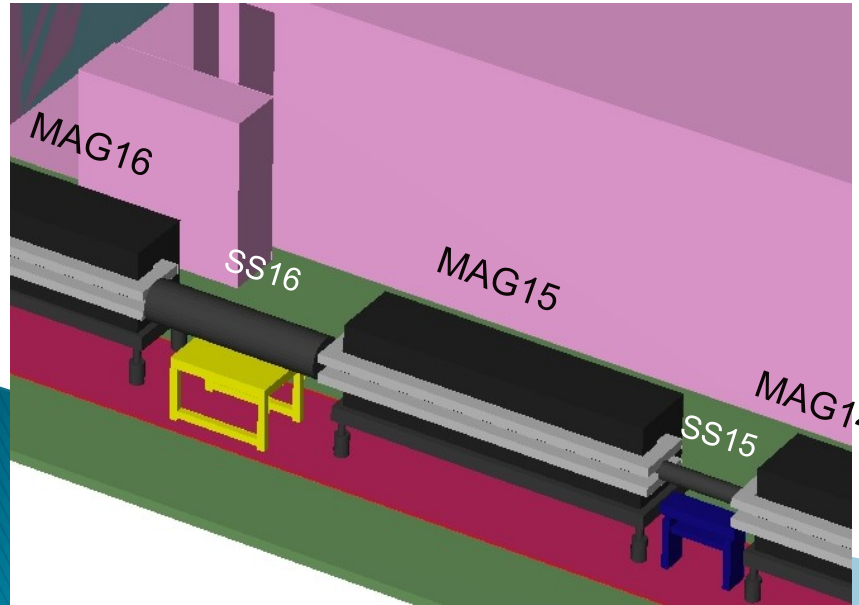
Assess the benefits of the new proposal by comparative FLUKA simulations of the radiation field in the region of SS16 by beam losses in the dummy septum 15 and in septum 16

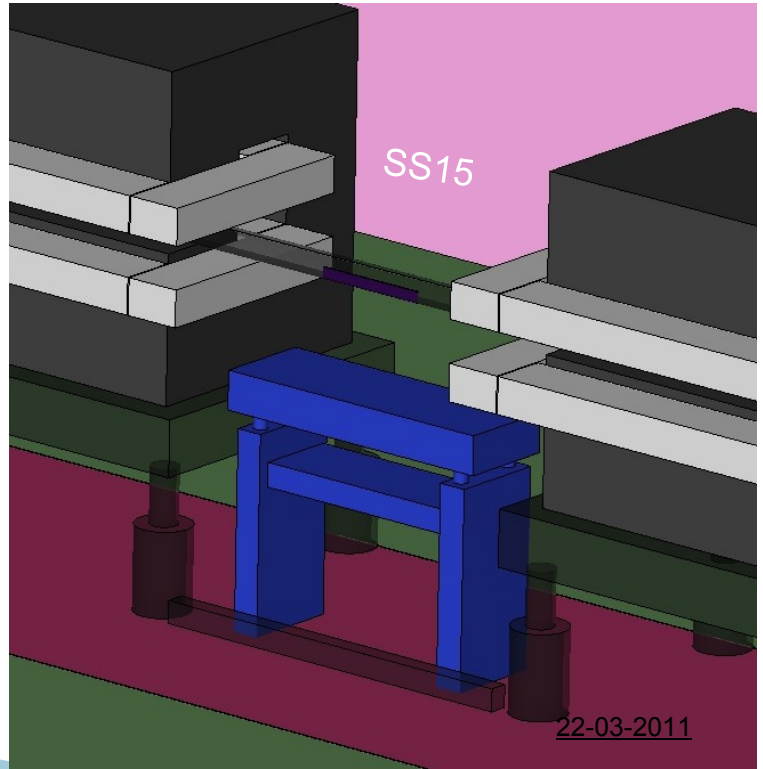
PS Straight Section 15

Present situation:
dipole and quadrupole magnets inside the SS15

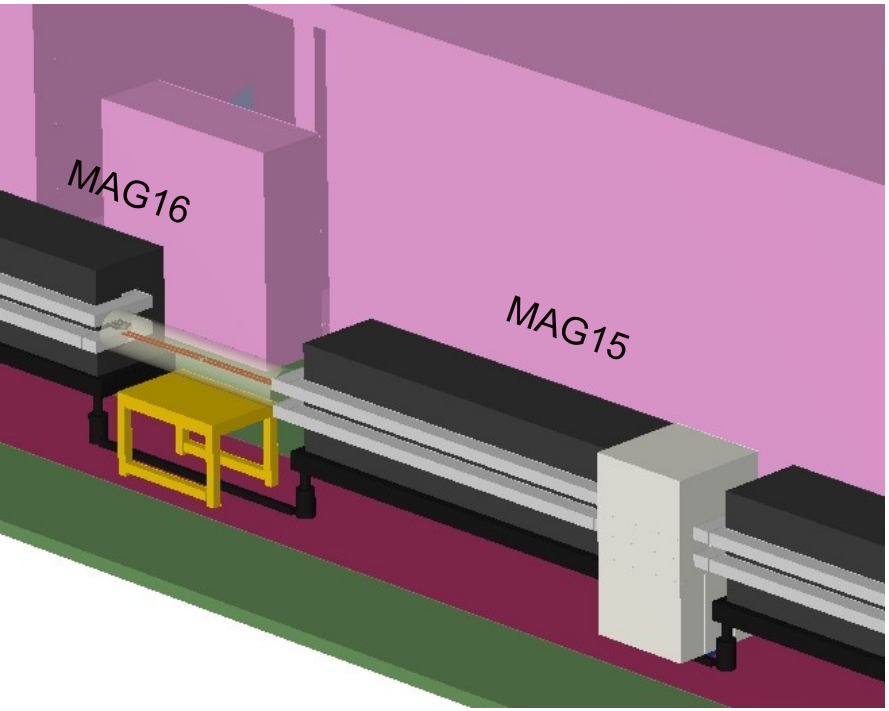
New situation:
Dummy septum – a 40 cm long blade installed inside the vacuum of the beam tube; material choice (W or Cu) studied.

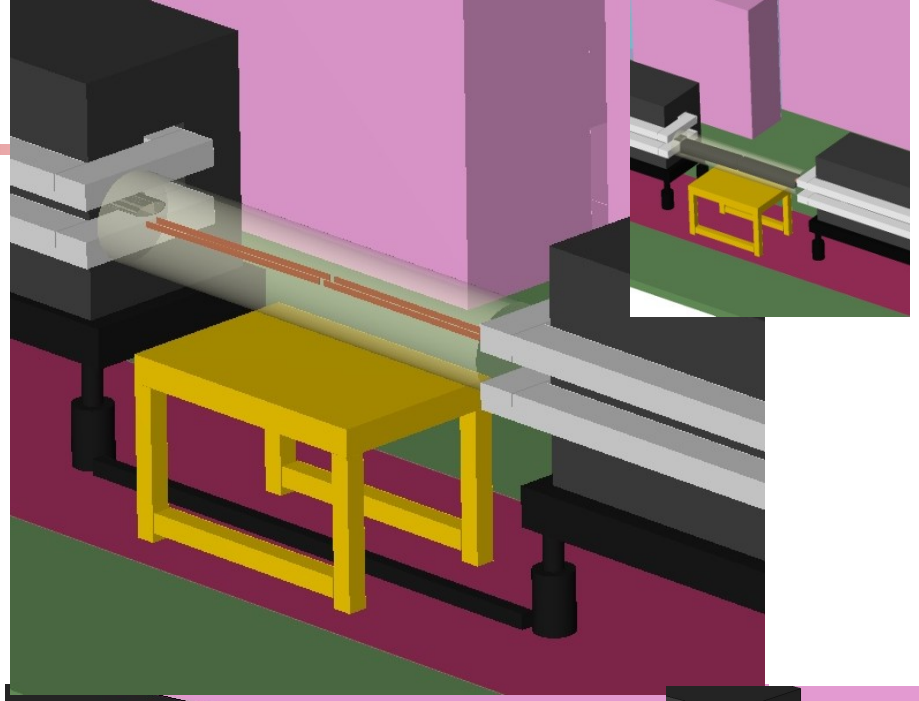
New situation:
-magnets removed, add covering of the beam tube (radius 10cm, thickness 6mm, stainless steel)

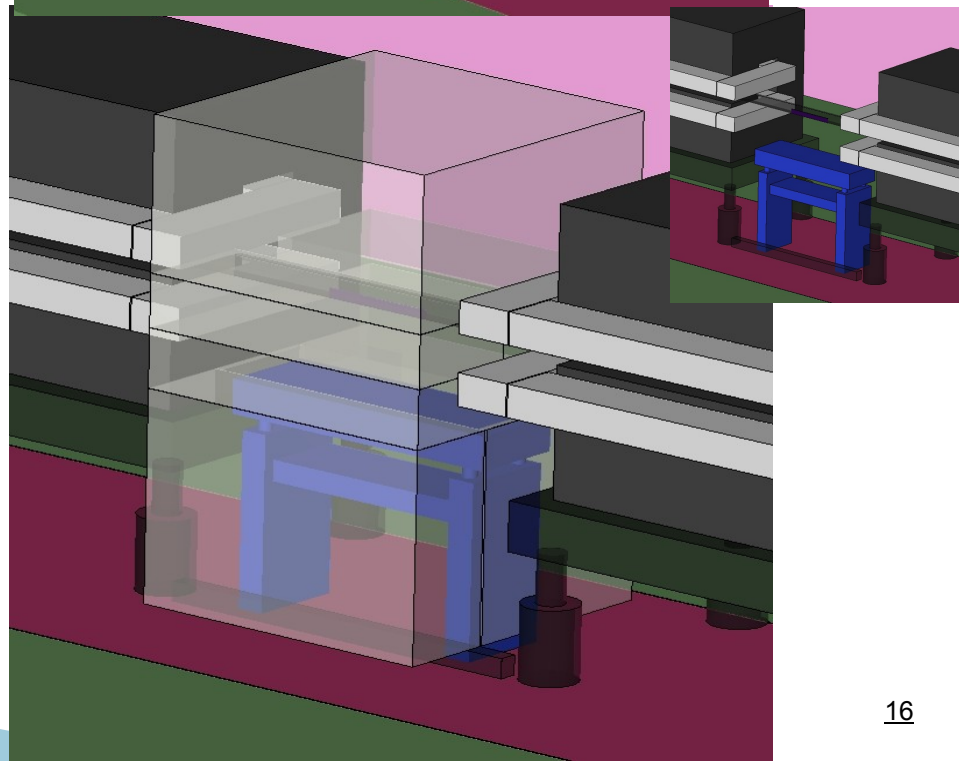




SS15 and SS16

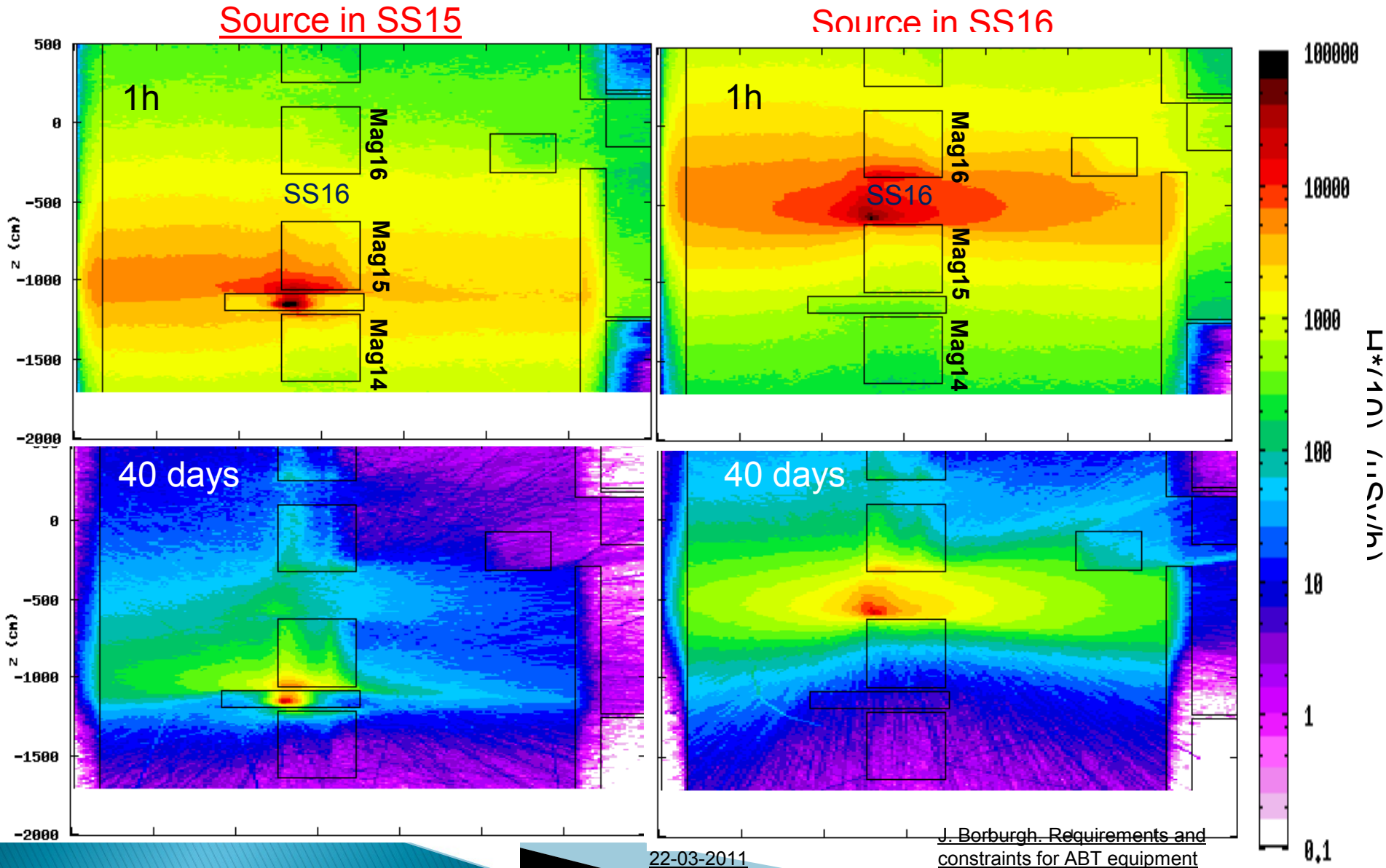






SS15 with dummy septum 15 inside surrounded by new shielding (not possible in case of SMH16); shielding material (concrete, iron, marble, borated polyethylene) studied

Residual Ambient DoseEq Rate (μSv/h) after cooling periods of 1h/40 days



Advantages by shifting the beam loss from SS16 to SS15

The FLUKA model was benchmarked by simulating the present situation. Subsequent calculations with the model demonstrated that a dummy septum in ss 15 will be effective.

The radiation field and resulting activation in the whole environment of SS16 can be reduced by factors of 10-40.

Additionally:

- the stray radiation on top of the PS complex (10 m above the SS15 and SS16) presently reaching up to 300 μSv/h can be reduced by a factor of 3 (thanks to addition of shielding around the dummy septum 15).

- the stray radiation at the D122.bis door presently measured to be 100 μSv/h can be reduced by a factor of 5.

Resource requirements for use of MTE

		Manufacture	Installation	Cost (kCHF)	Resources (MY)	Remark
General (B359)	- retention of the zone - false floor at intermediate level - space for the FAK new oil groups - Dismount part of the HV cable support structure		2013	100	0.1	Support from EN and GS dpt needed
Oil (PS)	- pumping group upgrade - cooling with closed water circuit instead of disposable tap water		2013	2	0.25	
PGs	rejuvenate faraday cages	2013	2013	1	0.05	
ERD 1	installation of 4 (5 optional) switch tanks	2011, 2012	2013	1	0.05	
BFA 9 P	- study and add interface oil-fluorinert on terminators - refurbish terminator	2011, 2012	2013	15	0.3	
SMH16	Manufacture of additional spare	2012	2013	365	0.6	
Dummy septum 15	Manufacture of dummy septum	2012	2013	250	0.95	
	remote displacement controls	2012	2013	30	0.25	
Electronics	Consolidation of electrical distribution, re-cabling	2011,2012	2013	250	2.1	
Bt. 359	Controls relocation		2013	75	1.0	
RG220 cable replacement	Replacement with Halogen free cable, mainly bt 359		2013	533	0.4	Support from EN and GS dpt needed
TOTAL				1622	6.05	

Scenario 3:
Impact of use of MTE-CT hybrid

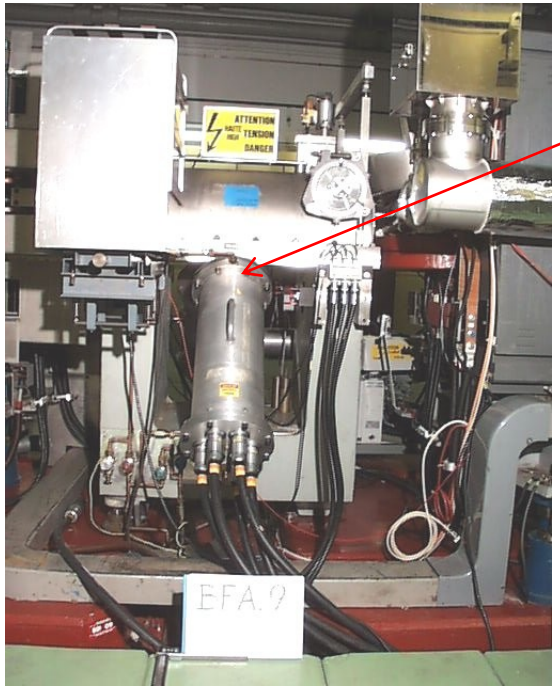
BT elements used for MTE-CT hybrid

All MTE elements,
+ electrostatic septum SEH31,
with KFA 21 with inverted polarity,
+ BFA 21 pedestal,
+ BFA9-21 Staircase (tbc.).

Can only be tested in 2011 during dedicated MD periods.

HV connection box implemented to allow quick polarity change of KFA21 → takes ~ ½ hour in the PS ring.

Improvements needed in PS ring



Interface oil-Fluorinert
to be added

oil pumping unit
to be rejuvenated

- interface oil-fluorinert to be added to avoid potential pollution of PS vacuum with oil in case of HV feedthrough failure.
- leak trays needed under the oil tank.
- mineral oil replacement by non toxic, high fire point ester oil.
- rejuvenation of oil pumping unit.

Required safety improvements in building 359

Not easy to implement if BFA9-21 staircases will continue to be needed

- leak trays needed under the oil filled high voltage generators
- false floor at intermediate level above the leak trays
- suppression on several stairs and widening of too narrow ones
- mineral oil replacement by non toxic, high fire point ester oil
- HV cable connection safety PLC to be implemented
- New cooling system with closed water circuit to replace actual disposable tap water one

Resource requirements for use of MTE-CT

		Manufacture	Installation	Cost (kCHF)	Resources (FTE)	Remark
General	-retention of the zone - space for the FAK new oil groups - Dismount part of the HV cable support structure		2013	100	0.1	Support from EN and GS dpt needed
Oil (B359)	- add cooling system with closed circuit - add instrumentation on all switch tanks (water flow, temperature)		2013	25	0.25	
Oil (PS)	- replace diala oil by ester - pumping group upgrade - cooling with closed water circuit instead of disposable tap water		2013	25	0.25	
RSG	refurbish 3 switch tanks to have A and B channels operational	2011, 2012	2013	30	0.25	
	replace Diala by ester in RSG	2011	2013	25	0.05	
	remove end switch tank and three switch tanks to save space	2011, 2012	2013	2	0.1	
	rejuvenate faraday cages	2011, 2012	2013	2	0.15	
	rejuvenate lemo connectors	2011, 2012	2013	3	0.1	
PGs	rejuvenate faraday cages	2013	2013	1	0.05	
ERD1	installation of 4 (5 optional) switch tanks	2011, 2012	2013	1	0.05	Installation during 2011-2012 preferred
BFA9-21 P	- study and add interface oil-fluorinert on terminators - refurbish terminator	2011, 2012	2013	20	0.3	
BFA9-21 S	- study and add interface oil-fluorinert on connection boxes, suppress motor	2011, 2012	2013	14	0.15	
KFA21	install polarity inversion box	2011	2011	10	0.1	
SMH16	manufacture of additional spare	2012	2013	365	0.6	
Dummy septum 15	manufacture of dummy septum	2012	2013	250	0.95	
	remote displacement controls	2012	2013	30	0.25	
SEH31	manufacture of spares; deployement of 3M at 31+23	2011	2012, 2013	23	0.4	
	controls for 3M Fluorinert	2012	2013	30	0.25	
Electronics	consolidation of electrical distribution, recabling	2011,2012	2013	450	4.0	
RG220 cable replacement	replacement with Halogen Free cable, mainly bt 359		2013	1030	0.8	Support from EN and GS dpt needed
TOTAL				**2411**	**8.65**	

Conclusions

- Desperate need for additional spare septum 16.
- Dummy septum in ss15 can reduce activation of the region of septum 16 with a factor 10-40.
- Which scenario will be used is still unknown and depends on the results of MD's to be performed this year and next.
- Definitive decision if the CT equipment is to be retained after 2013 is needed in autumn 2011.
- If MTE-CT Hybrid retained, it will not at all be evident to make BFA21-9 staircases ppm.
- Works in B359 need a long (one year) shut-down for completion (coordination with GS and EN needed).

Resource requirements

	Cost (MCHF)	Resources (MY)
CT	1.6	5
MTE	1.6	6
MTE- CT hybrid	2.4	9