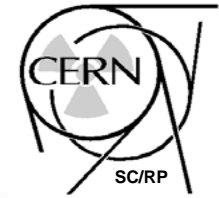


Radiation Monitoring at CTF3

CTF3 Buildings – weak spots
Radiation Monitoring system
Monitoring results – First Lessons

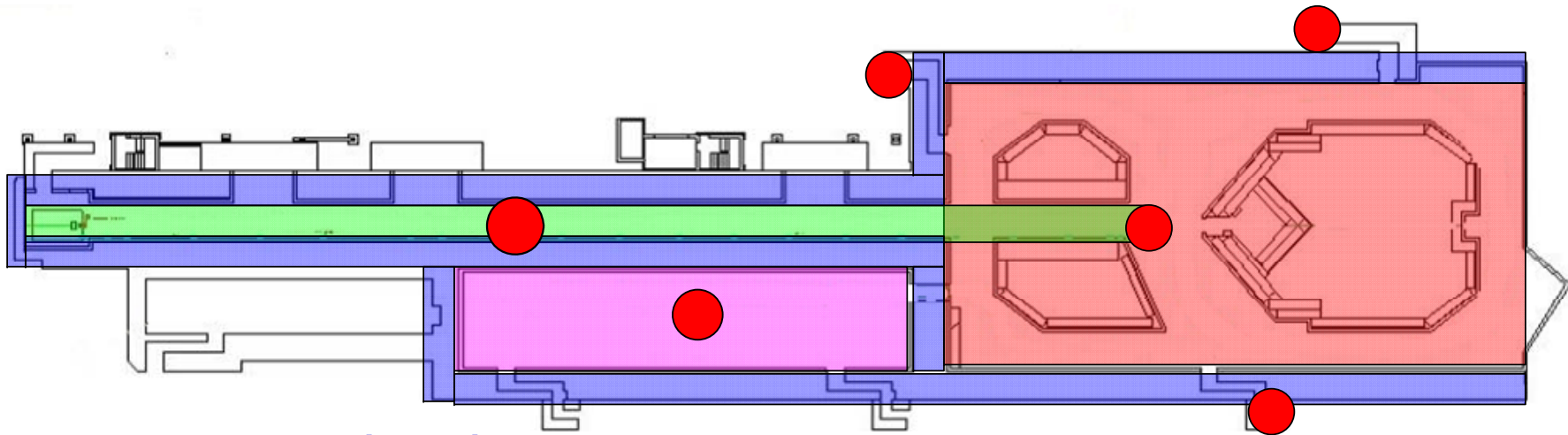
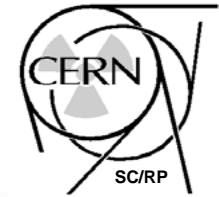
Idelette Floret, Thomas Otto, Daniel Perrin,
Markus Widorski
DG-SC Radiation Protection Group

Strategy for Radiation Protection



- CTF3 built in existing surface structures, built for another electron accelerator (LEP pre-injector)
- Wall thickness can hardly be modified
- “weak spots” where bulk shielding is broken or thin
- Monitor ambient dose rate levels and raise radiation alarm if limits exceeded
- Installation of the state-of-the-art RAMSES monitoring system (1st facility after CNGS & LHC)

CTF3- surface buildings



Lateral shielding 270 cm concrete

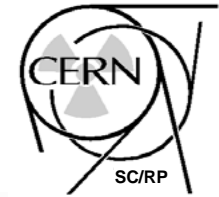
Roof shielding 240 cm concrete, accessible

Roof shielding 200 cm concrete, accessible

Roof shielding 80 cm concrete, inaccessible

● "weak spot" in bulk shielding

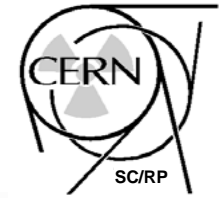
Ambient dose rate limits



- Area accessible to public:
 - 0.5 $\mu\text{Sv/h}$
 - 2.5 $\mu\text{Sv/h}$ for infrequently occupied areas (e.g. Parking)
- For example
 - Public spaces around CTF3 surface building

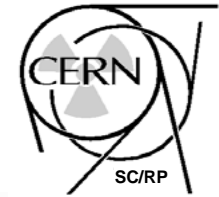
- Supervised Radiation Area:
 - 3 $\mu\text{Sv/h}$ at workplaces
 - 15 $\mu\text{Sv/h}$ in passageways
 - Obligation to wear a personal dosimeter
- For example
 - Klystron galleries

What is monitored ?



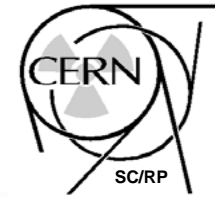
- During operation:
 - Monitor ambient dose rate $H^*(10)$ from stray radiation at “weak spots” (representative for the whole of the facility)
- During Tech. Stop / Shutdown:
 - Monitor ambient dose rate $H^*(10)$ from activated material to determine suitable working conditions for interventions

High-sensitivity radiation monitor

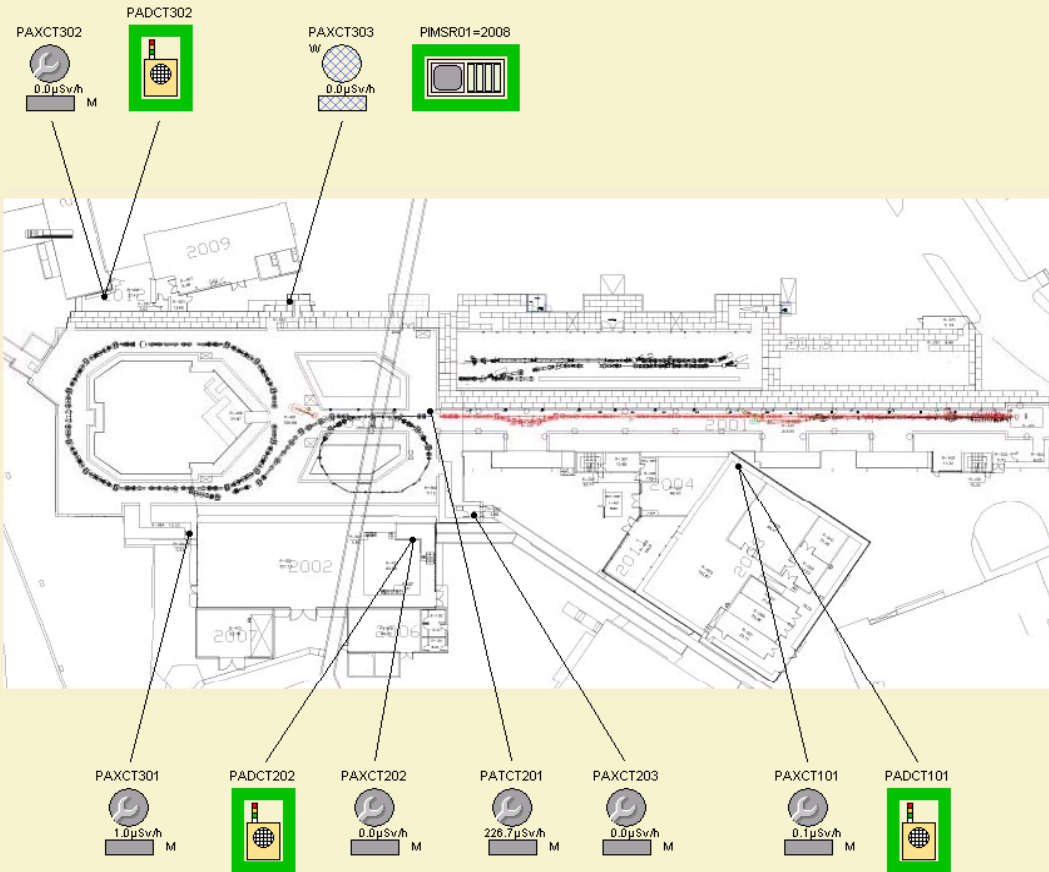


- For stray radiation
- Centronics pressurised ionisation chamber (2 MPa)
- Part of RAMSES system

Stray Radiation Monitoring (1)

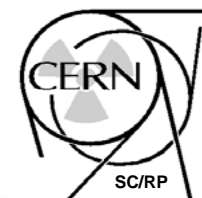


RAMSES
PS - CTF3
Stray radiation [Level 0]
Alarms not ack: 9
Filter applied: Yes
30/09/08 18:04:50
WorkStation ID: 24
User: mrettig
HostName: TEH14
Back
Forward
Up
Home
Refresh
Warning
Help
Print
Search

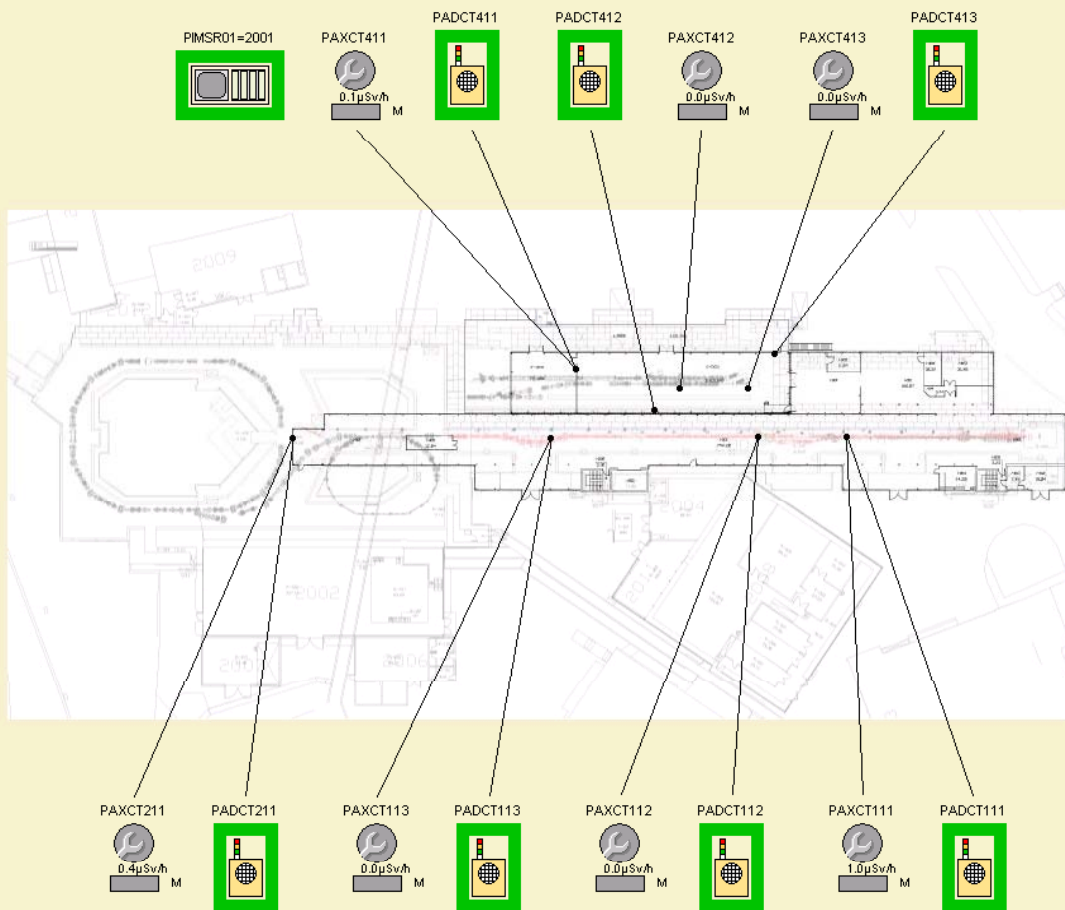


Stray radiation [Level 0]		Stray radiation [Level 1]		Induced activity			
ISOLDE		CTF3					
Date	Time	Event	Type	Zone	Instrument	Description	Level
30/09/08	14:13:04	Alarm on - ack.	System Fault	CTF3	PAXCT303	DA COM failure	C

Stray Radiation Monitoring (2)

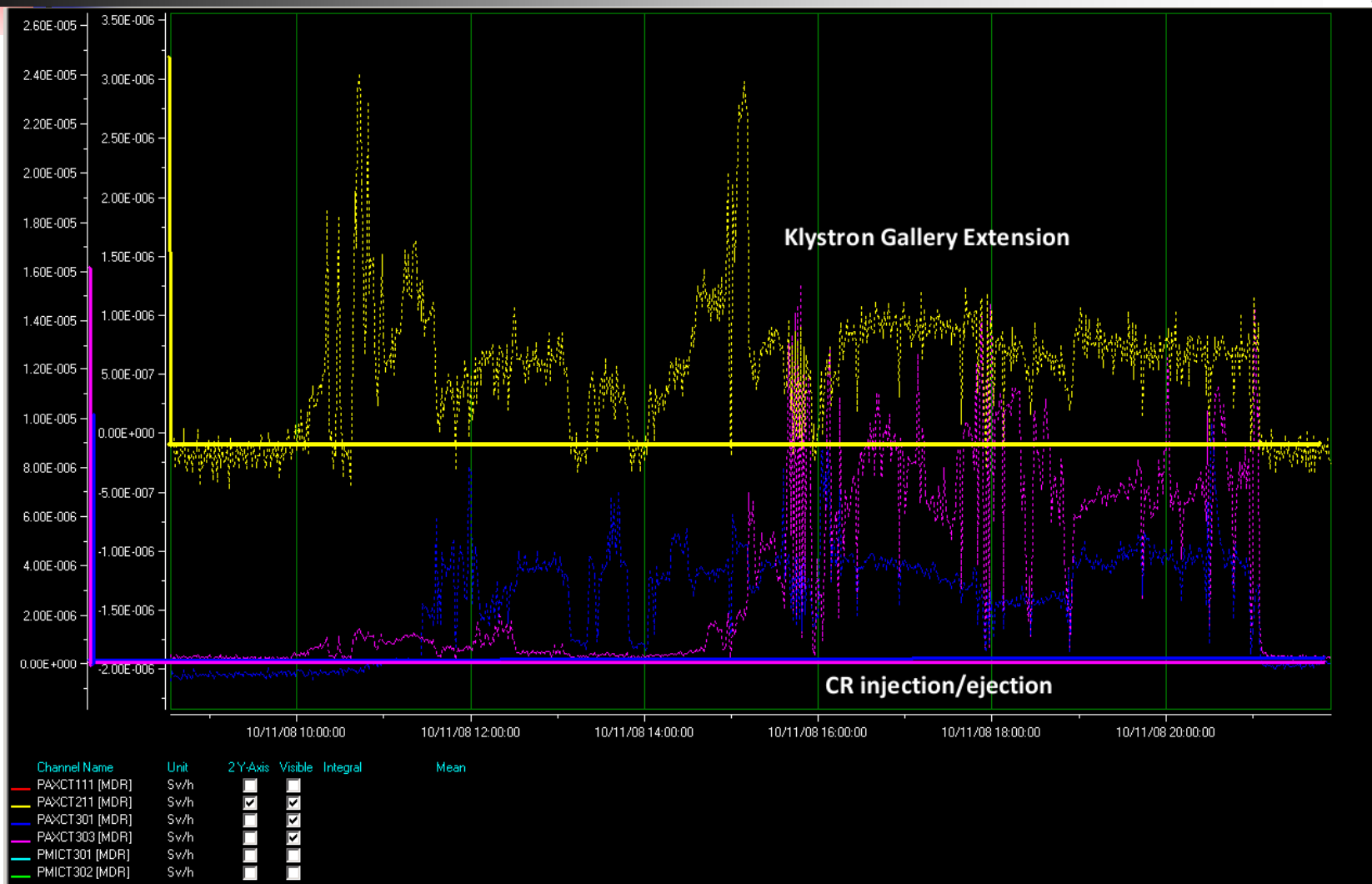
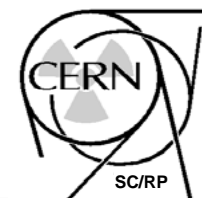


RAMSES PS - CTF3 Stray radiation [Level 1] Alarms not ack: 10 Filter applied: Yes 30/09/08 18:05:24 User: mrettig WorkStation ID: 24 HostName: TEH14

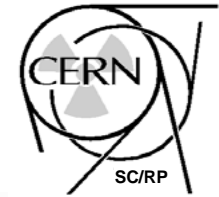


Stray radiation [Level 0]	Stray radiation [Level 1]	Induced activity
ISOLDE	CTF3	

Observation of stray radiation

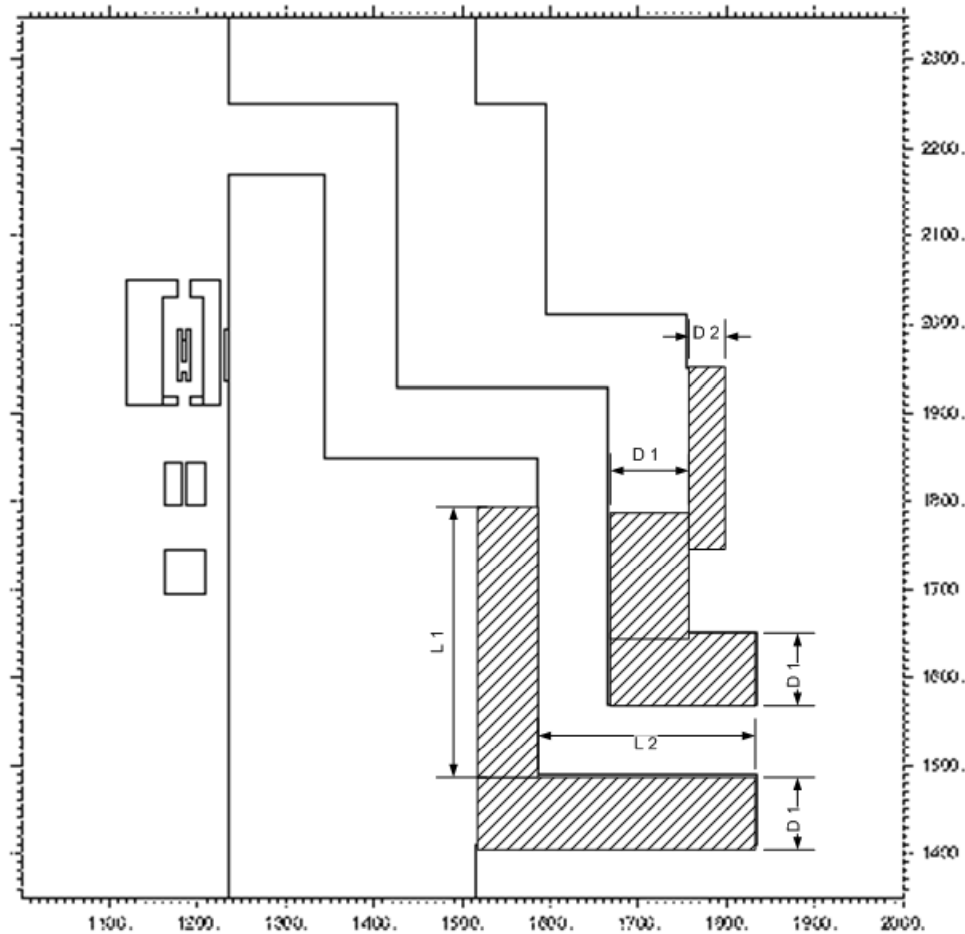
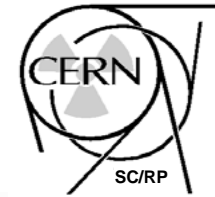


Stray Radiation



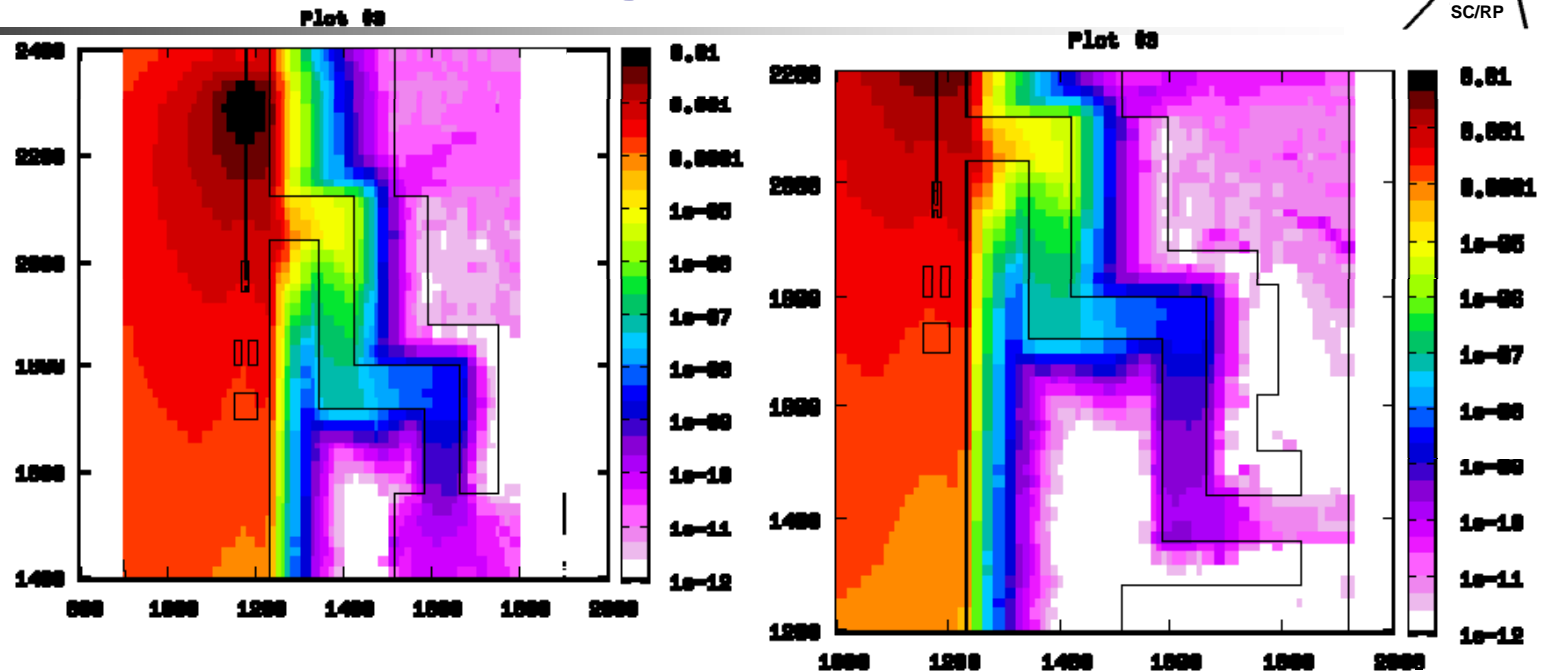
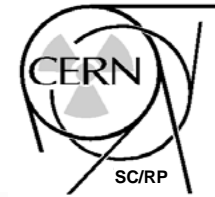
- The assumptions that the access mazes represent weak spots is confirmed
- Ambient dose rate limit for public area at emergency exits exceeded:
 - Observation of values $\dot{H} * (10) \cong 15 \mu\text{Sv h}^{-1}$
- Consequences:
 - Temporary fencing of emergency access, intensity limitation
 - Improvement of the mazes

Extension of the access labyrinth (originally for tail clipper)



	L 1	L 2	D 1	D 2
Alternative 1	200 cm	240 cm	80 cm	40 cm
Alternative 2	280 cm	160 cm		

Improvement of operational margin



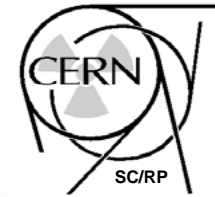
Beam loss at 2 m from exit for which ambient dose rate in public space will exceed $2.5 \mu\text{Sv h}^{-1}$:

1 %

55 %

(CTF-3 nominal electron beam with 3.5 A, $1.4 \mu\text{s}$, 5 Hz \approx 3.7 kW @ 150 MeV)

Induced Radiation Monitoring



RAMSES PS - CTF3 - Induced activity Alarms not ack: 16 Filter applied: Yes 30/09/08 17:08:26 WorkStation ID: 24 User: mrettig HostName: TEH14

Back Fwd Up

PMICT302	PMICT303	PMICT401	PMICT402	PMICT403	PMICT404	PIMSR01=2010
0.8 μSv/h	0.6 μSv/h	0.1 μSv/h	1.4 μSv/h	0.7 μSv/h	0.2 μSv/h	

PIMSR01=2003	PMICT301	PMICT201	PMICT103	PMICT102	PMICT101	PIMSR02=2001
	10.3 μSv/h	0.7 μSv/h	108933.2 μSv/h	30508.4 μSv/h	360764.0 μSv/h	

MS Name :	PIMSR01=2010
MSID / Type :	183 MSDA
Domain :	
Zone :	CTF3

CH Name :	PMICT401	
Dose Rate :	F 0.078	μSv/h
Mean DR :	F 0.070	μSv/h
Timestamp :	30/09/08	17:08:11
Device Type	IAM	
Meas. Sampling Time	12.0	s
Alarm Threshold	0	μSv/h
High Alarm Th.	0	μSv/h
Alarm Sampling Time	60.0	s
Alarm Hysteresis	10	%
Calibration factor	2.46E-08	A or CS / Sv/h
Correction factor	1.00	

Channel status	
<input checked="" type="checkbox"/> Measure	<input checked="" type="checkbox"/> DA Type
<input checked="" type="checkbox"/> Prim. UA	<input checked="" type="checkbox"/> DA Power
<input checked="" type="checkbox"/> Sec. UA	<input checked="" type="checkbox"/> Parameters
<input checked="" type="checkbox"/> CRC Param.	<input checked="" type="checkbox"/> Sensor Cnx.
<input checked="" type="checkbox"/> Alarm	<input checked="" type="checkbox"/> Sensor
<input checked="" type="checkbox"/> High Alarm	<input checked="" type="checkbox"/> UA Trans.
<input checked="" type="checkbox"/> Acknow.	<input checked="" type="checkbox"/> DA Com.
	<input checked="" type="checkbox"/> DA Clock

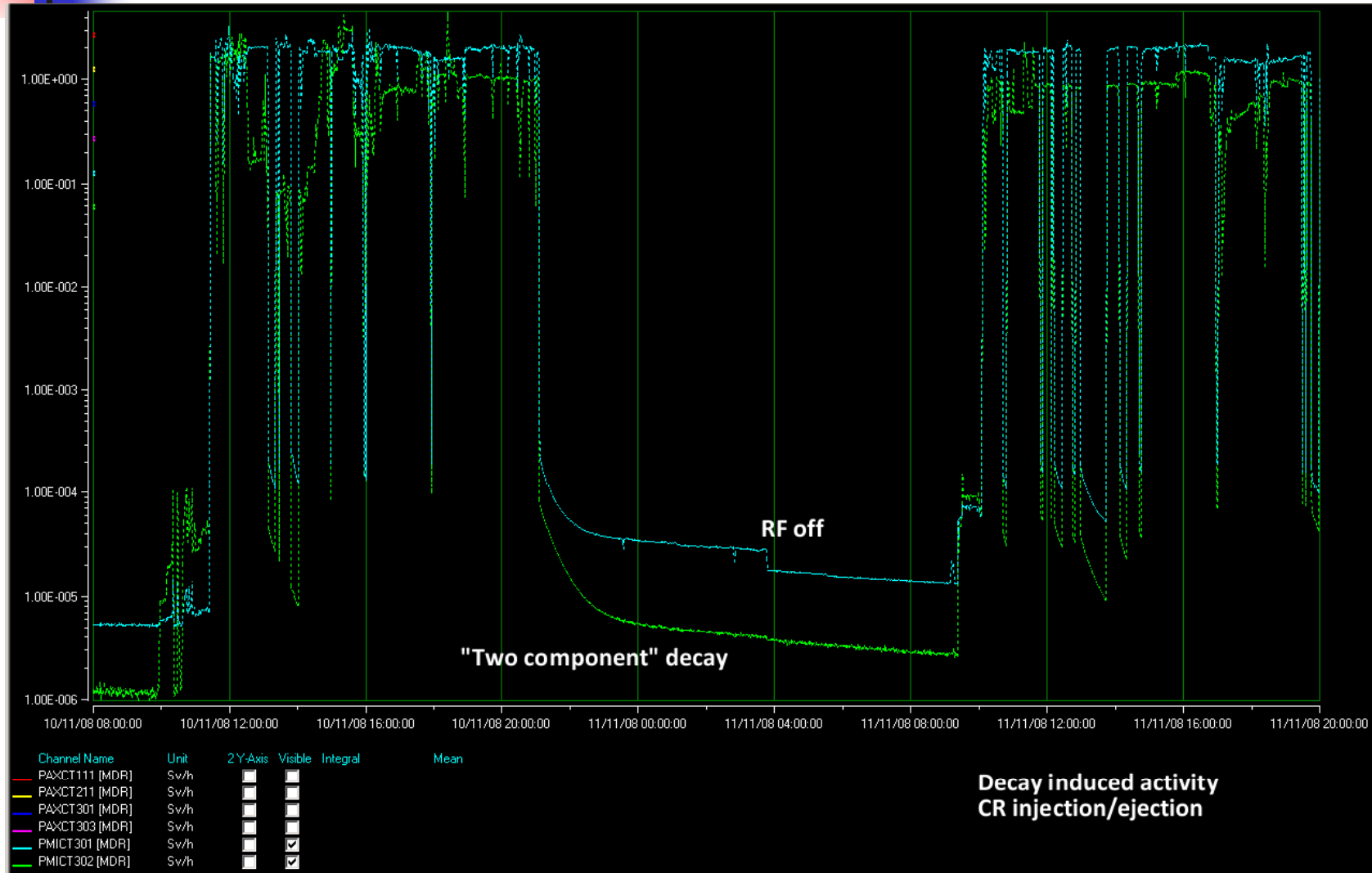
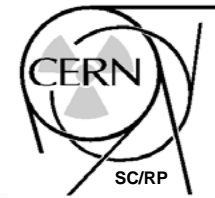
Channel mode		
<input type="checkbox"/> Measure	<input checked="" type="checkbox"/> Maint.	<input type="checkbox"/> Simu.
<input type="checkbox"/> Off	<input type="checkbox"/> Test	

Primary UA status		
<input type="checkbox"/> Normal	<input type="checkbox"/> H Alm	<input type="checkbox"/> Alm
<input checked="" type="checkbox"/> Off / Fault	<input type="checkbox"/> H Alm Test	<input type="checkbox"/> Alm Test

Secondary UA status		
<input type="checkbox"/> Normal	<input type="checkbox"/> H Alm	<input type="checkbox"/> Alm
<input checked="" type="checkbox"/> Off / Fault	<input type="checkbox"/> H Alm Test	<input type="checkbox"/> Alm Test

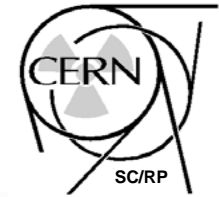
Trd... His... Cmd... Param...

Observation of induced radiation





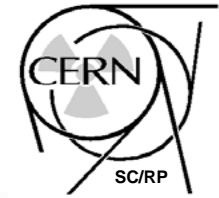
Residual dose rates



- Residual dose rates varies from spot to spot over orders of magnitude, depending on previous accelerator operation
- While **I**nduced **A**ctivity **M**onitors give a first indication, radiation survey before access remains mandatory
- During maintenance periods, authorised personnel can work in CTF3 without permanent supervision by RP personnel
- All material dismantled from the accelerator must be stored as radioactive material/waste



Summary



- CTF3 operates an electron accelerator with relatively high power ($P < 7.7$ kW) in surface buildings, designed for a different purpose
- In order to protect persons in accessible areas, beam loss monitoring is essential
- Compared to CERN's proton accelerators, residual dose rates low, but not negligible.
- Activation must be further studied for waste storage/elimination purposes