



RAMSES

RAdiation **M**onitoring **S**ystem
for the **E**nvironment and **S**afety

6th LHC Radiation Workshop
CERN – 29-30 November 2007

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on behalf of the RAMSES team
(SC/RP, SC/IE and TS/CSE)

EDMS 883742



RAMSES Project



Mandate/Scope

- The RAMSES will provide LHC, and finally CERN, with an integrated **RA**diation **M**onitoring **S**ystem for the **E**nvironment and **S**afety covering acquisition, transmission, logging and display for the LHC machine, LHC experiments and experimental areas.
- The Safety Commission will exploit this system to assess radiation risks and to control the release of radioactivity.

RAMSES for Personnel Safety

RAMSES NOT for ~~equipment protection~~



RAMSES Project



Main functions

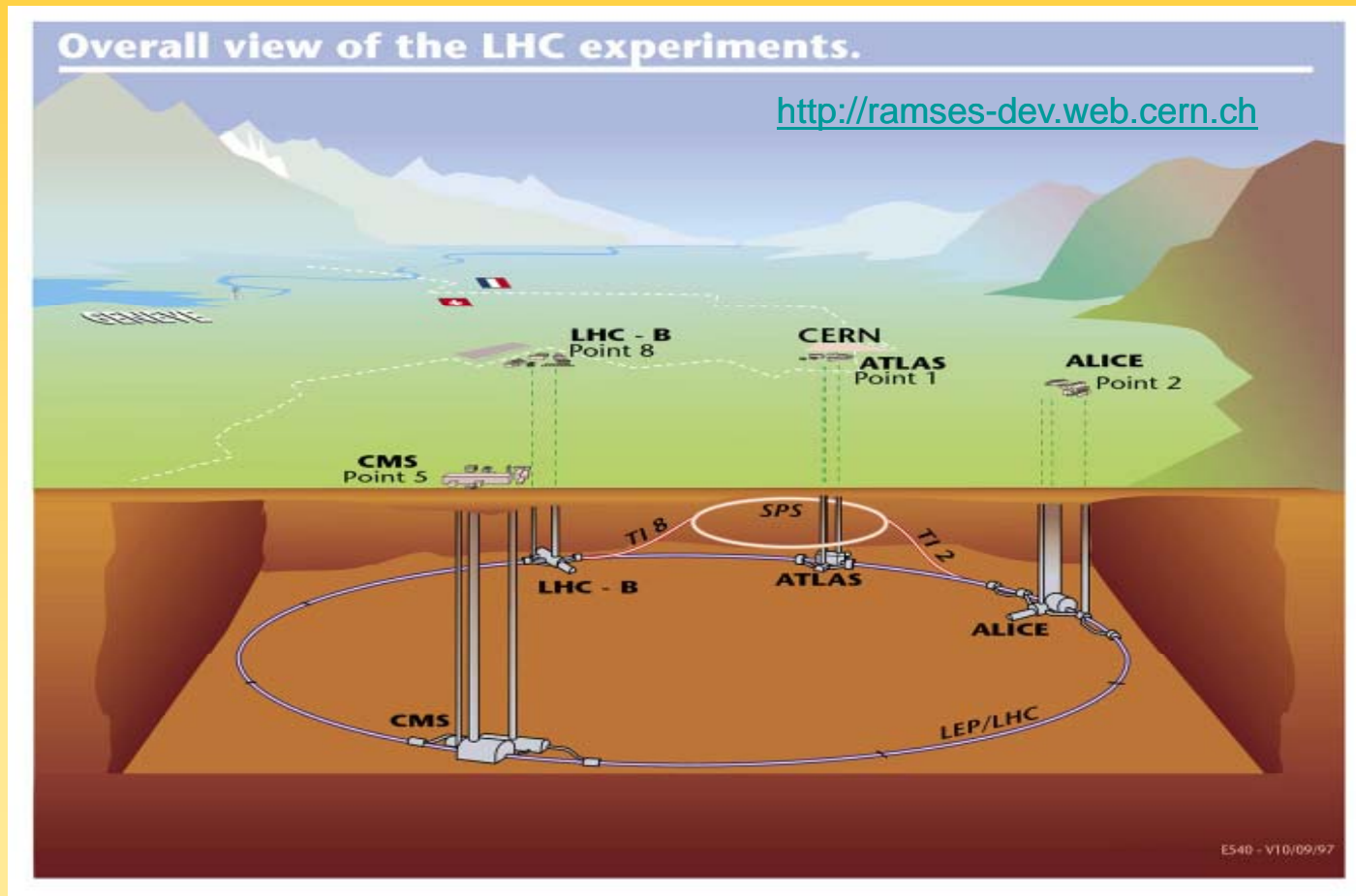
- ◆ **Monitoring radiation variables (local and remote display)**
 - Permanent real-time monitoring of ambient dose equivalent rates and ambient dose equivalents in the working environment (underground accessible areas, on the surface and in the environment)
 - Permanent real-time measurement of radioactivity in released gases and fluids (radioactive nuclides)
 - Permanent measurement of induced activity during LHC stop/shutdown
- ◆ **Alarm functions (local and remote)**
 - Generate radiation alarms based on ambient dose equivalent rates and ambient dose equivalents (SIL-2 for local alarm)
 - Generate interlock signals (SIL-2)
 - Generate technical alarms
- ◆ **Long term permanent and reliable data logging**
 - Measured values
 - Events (radiation alarms, interlocks, system fault alarms, technical alarms)
 - System configuration



RAMSES Project



The radiological safety of the LHC and CNGS will be ensured by the on-line acquisition from some **360 measurement devices** of **15 different types** spread over the access points (both surface and underground installations).



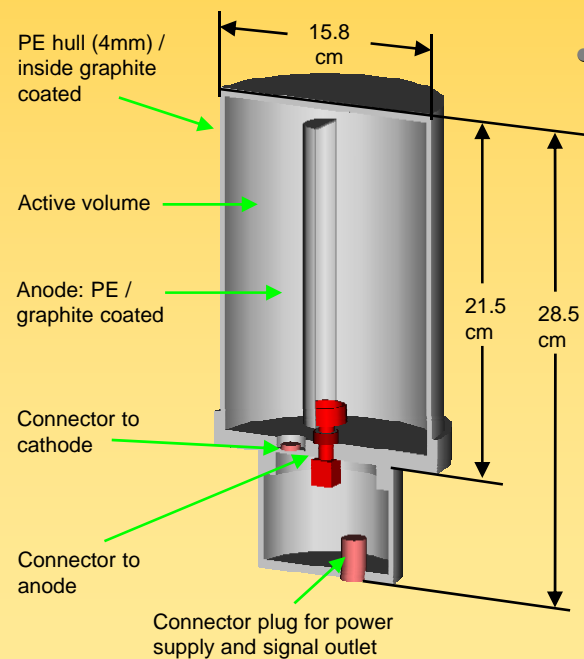
Monitors for radiation protection

- ◆ **LHC accelerator and experimental areas :**
 - Area REM-Counter monitor [ARC];
 - Area Gamma dose rate Monitor [AGM];
 - Area Mixed field radiation Monitor [AMF];
 - **Tunnel Gamma dose rate Monitor [TGM];**
 - **Tunnel Mixed field radiation Monitor [TMF];**
 - **Induced Activity Monitor [IAM];**
 - X Rays Monitor [XRM];

 - Alarm radiation display [PAD];

Main characteristics

- Measure the ambient dose equivalent and ambient dose equivalent rate in photon fields (beam off);
- Plastic ionisation chamber (3 litres, 1 atm. Air-filled);
Manufactured by PTW Freiburg;
- Performances :
 - Measuring range : 5 μ Sv/h to 500 mSv/h
 - Energy range : 50 keV to 7 MeV
 - **Measuring time : from 1 to 3600 s**
Typical value 60 s
 - HV = 1 kV



[2] Reference H. Vincke et al.

Tunnel Monitors

Main characteristics

TGM

TUNNEL GAMMA DOSE RATE MONITOR



- Measure the ambient dose equivalent and ambient dose equivalent rate caused by photons or minimal ionising particles (e.g. muons);
- Centronic IG5 – A20 (20 atm. Argon);
- Performances :
 - Measuring range : 100 nSv/h – 10 Sv/h,
 - Energy range : 50 keV à 10 MeV,
 - Linearity (over measuring range) : $\pm 10\%$ (réf. 662 keV),
 - Measuring time : from 0,1 to 3600 secondes (typ. 30s)
- Extensive Monte-Carlo simulations (FLUKA code) and experimental results (at CERF*).

* CERN-EU high-energy reference field

Reference C. Theis et al.

Main characteristics

TMF

TUNNEL MIXTED FIELD RADIATION MONITOR



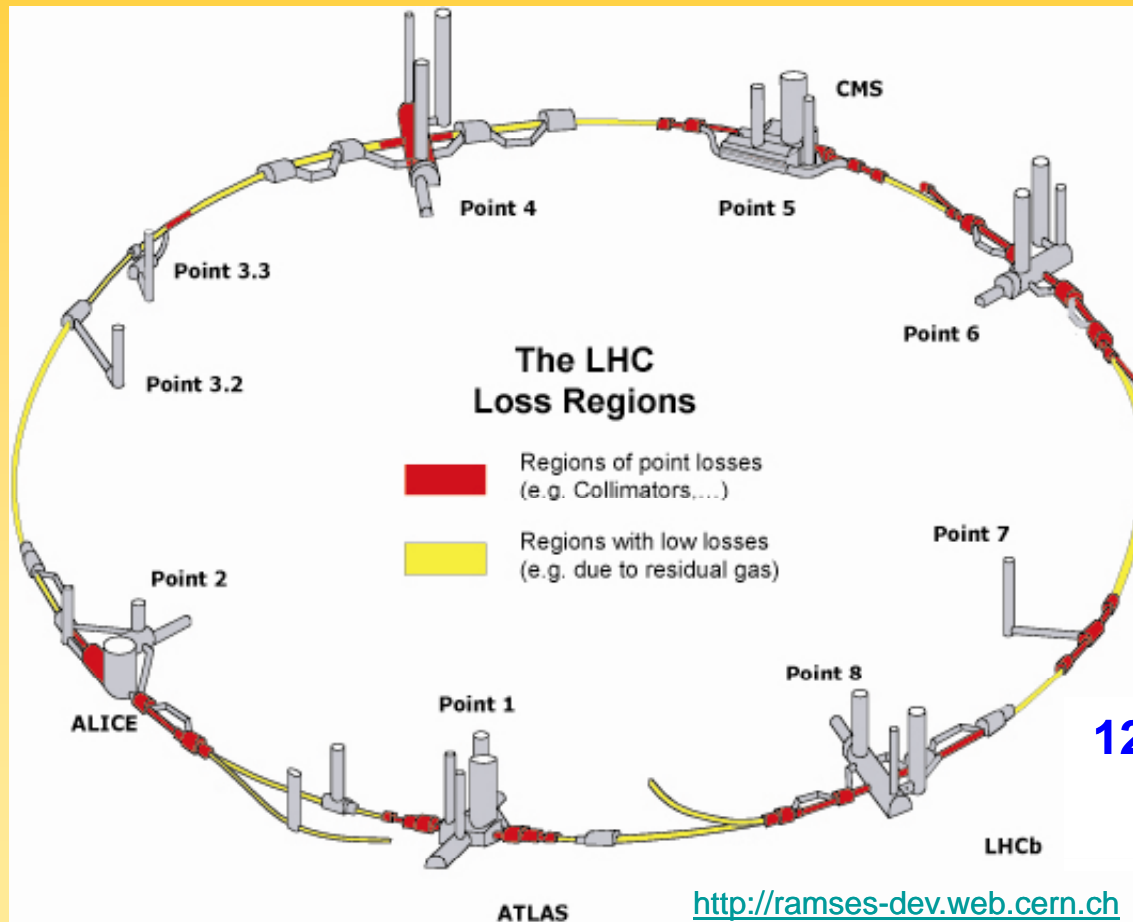
- Measure the ambient dose equivalent and ambient dose equivalent rate in mixed radiation fields consisting in high-energy charged particles (protons, pions, muons, electrons, positrons) and neutrons and photons;
- Centronic IG5 – H2O (20 atm. Hydrogen-filled);
- Performances :
 - Measuring range : 1 $\mu\text{Gy/h}$ to 10 Gy/h,
 - Energy range : 65 keV to 10 MeV,
 - Linearity (over measuring range) : $\pm 10\%$ (réf. 662 keV),
 - Measuring time : from 0,1 to 3600 secondes (typ. 30s)
- Extensive Monte-Carlo simulations (FI UKA code) and experimental results (at CERF*) in order to extend the application field to mixed high energy fields.

Reference C. Theis et al.

* CERN-EU high-energy reference field

Tunnel Monitors

Locations around LHC



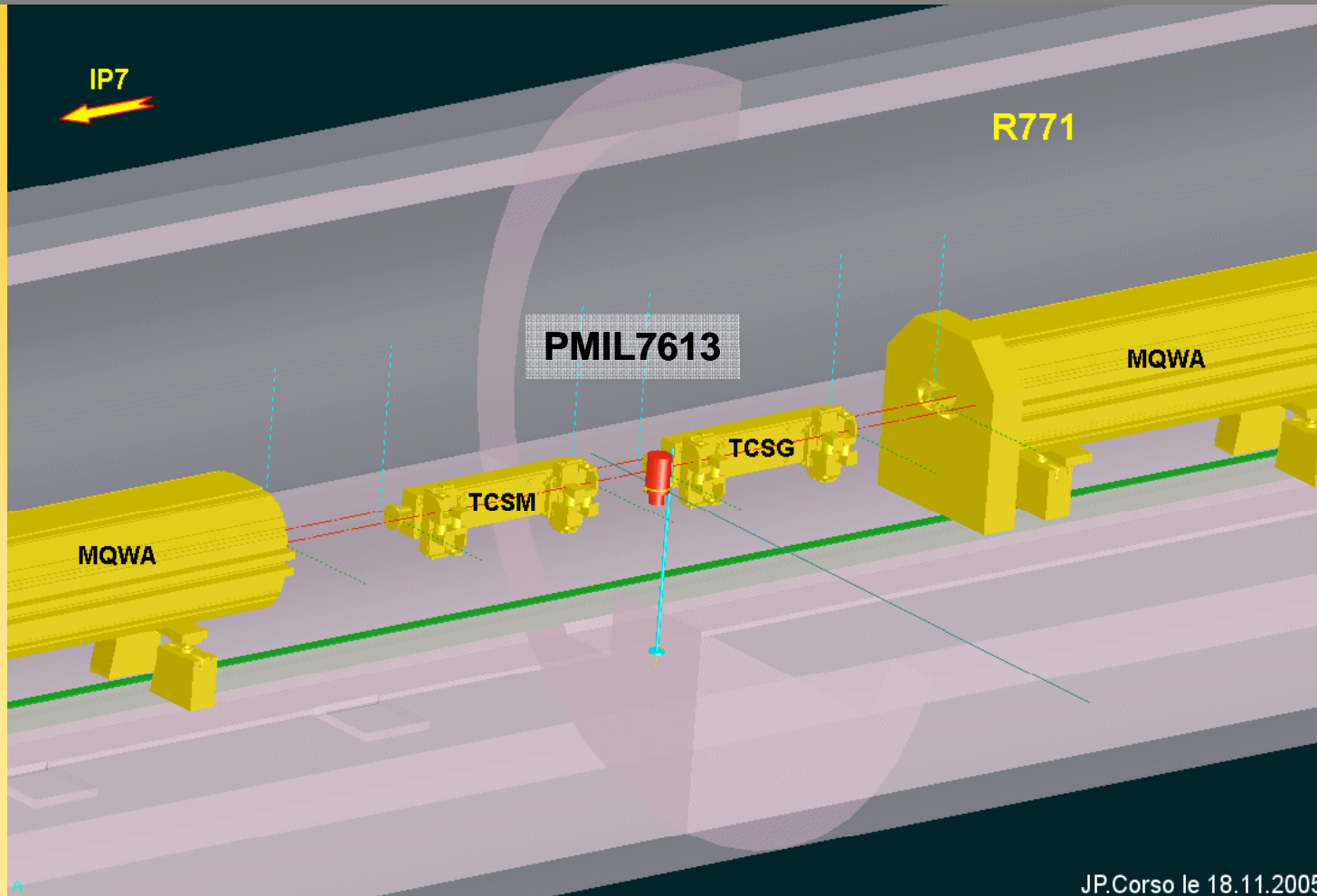
IAM are installed in **high loss regions** (red) around the LHC, close to components subject to activation due to beam losses (collimators, absorbers, kickers, etc.), used by RP during beam off;

TGM and TMF are installed behind shielding in UJ, US and UL galleries to monitor radiation levels during beam on.

123 IAM, 16 TGM and 6 TMF installed at LHC
(+ 33 IAM in experimental caverns)

<http://ramses-dev.web.cern.ch>

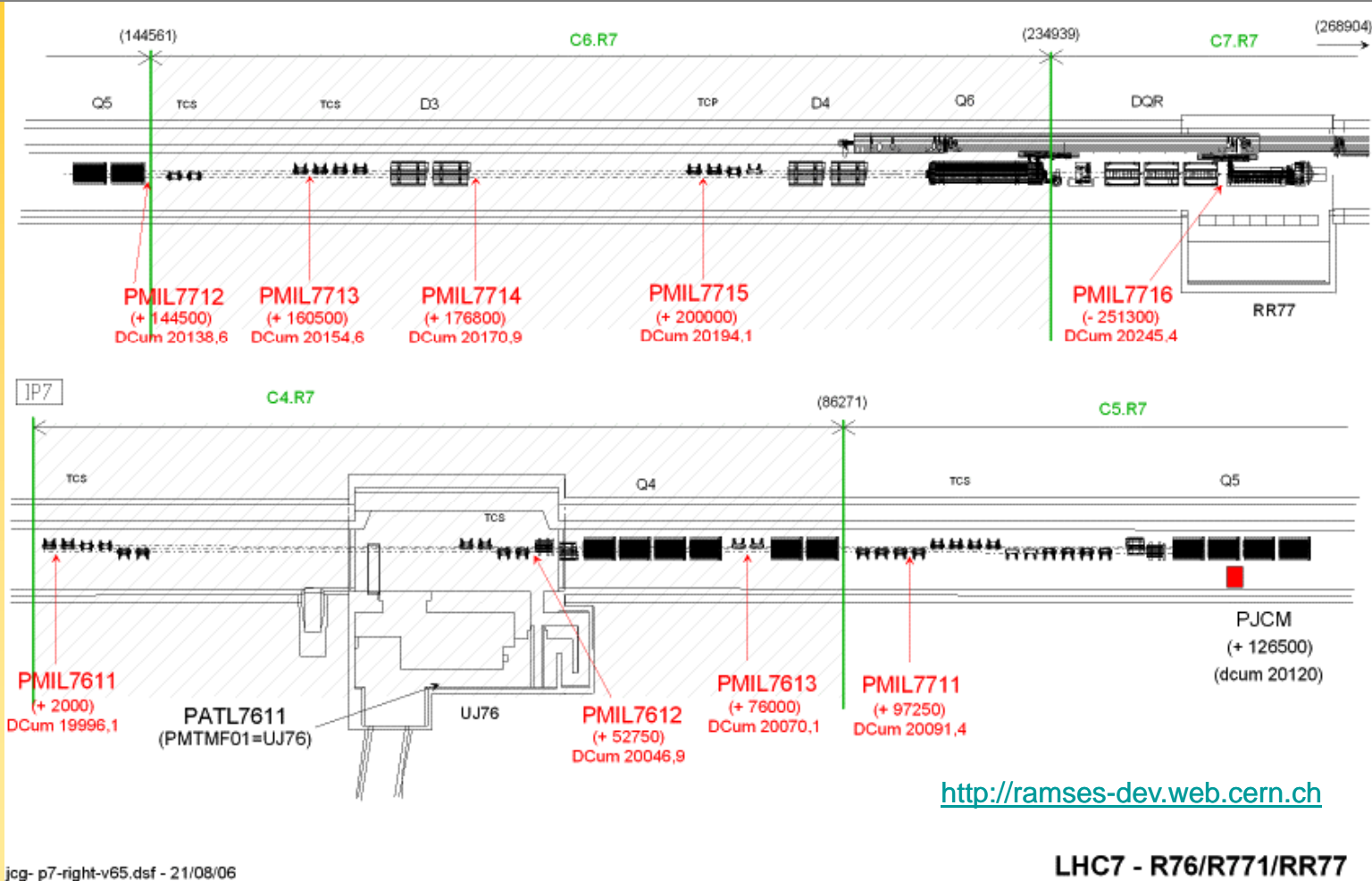
Typical IAM Integration at LHC



JP.Corso le 18.11.2005

Tunnel Monitors

Example: locations at LHC point 7



jcg- p7-right-v65.dsf - 21/08/06



RAMSES Project ARCHITECTURE

Created by: The RAMSES team



CERN
Integration Modules

LASER and DIP server



CERN HCI clients

CCC clients



SC clients



WEB CERN HCI client



WEB expert client



Internet

Acronyms

HCI: Human Computer Interface
 CCC: Common Control Center
 MCR: Meyrin Control Room
 SC: Safety Commission
 LASER: LHC Alarm Server
 DIP: Data Interchange Protocol

RAMSES
Software Infrastructure

Wireless configuration client



Engineering and configuration workstation



Central Supervision Servers



CERN HCI/WEB server



Measured Data/events and configuration database



SC expert HCI



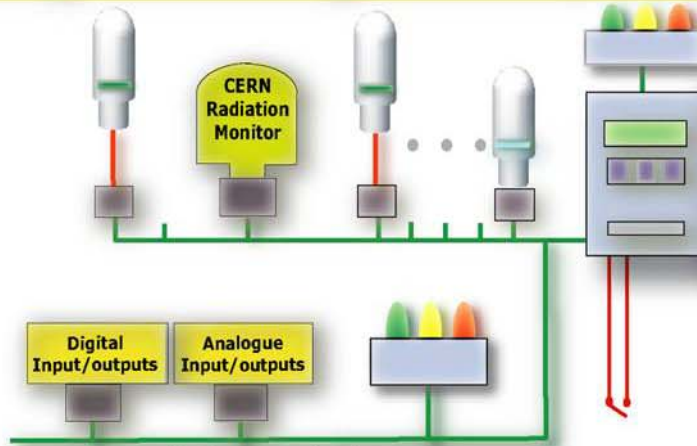
RAMSES
Monitoring Stations

Integrated meteorological Station

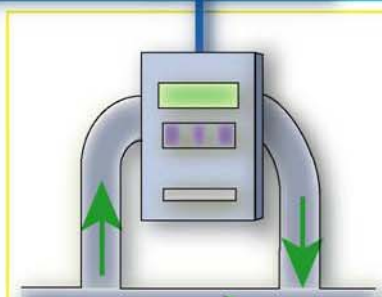
Integrated Monitoring Device

- Hand & foot monit.
- Picomur
- Site gate monit.
-

Integrated monitoring station



Radiation monitoring, alarms and interlock station



(It includes measurements of non-radiation parameters like water temperature, pH, etc.)

Radioactivity in fluids monitoring station



RAMSES DATA FLOW

Created by: The RAMSES team



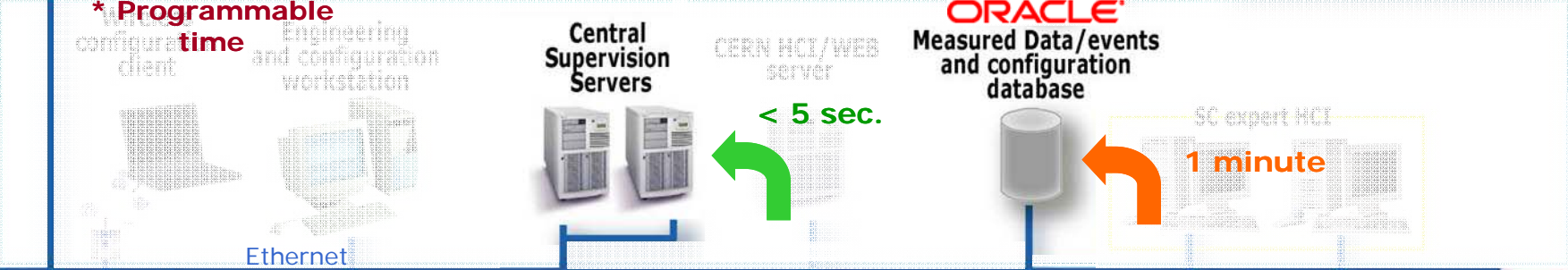
Acronyms

HCI: Human Computer Interface
 CCC: Common Control Center
 MCR: Meyrin Control Room
 SC: Safety Commission
 LASER: LHC Alarm Server
 DIP: Data Interchange Protocol

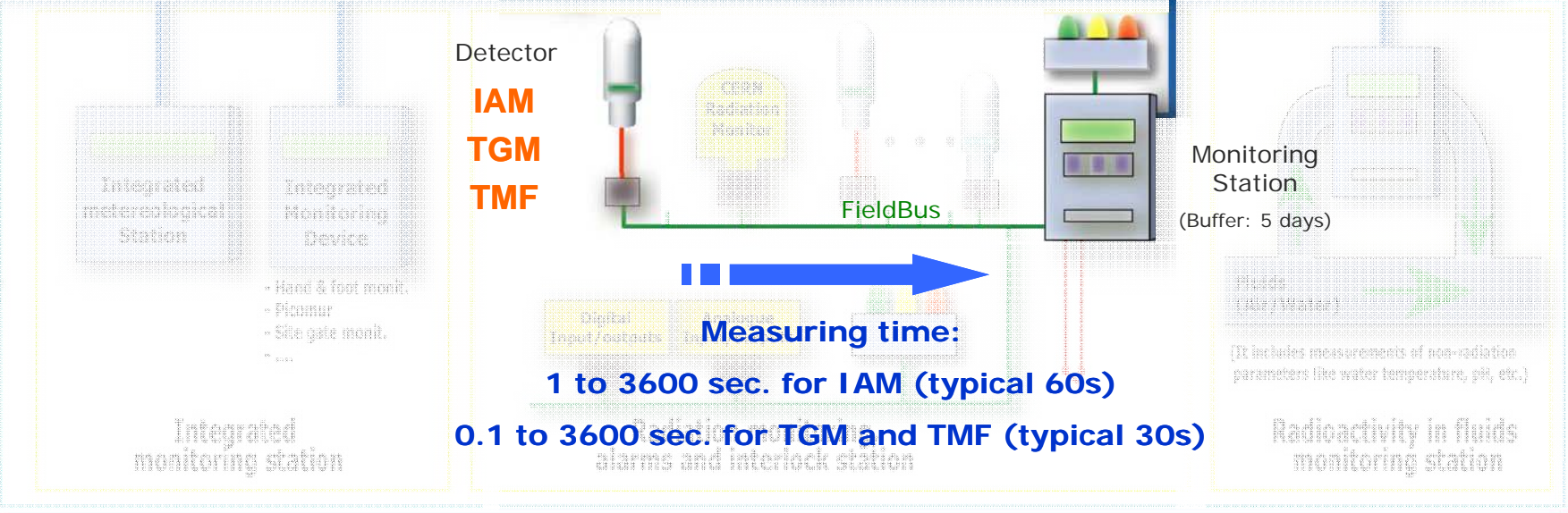
CERN Integration Modules



RAMSES Software Infrastructure



RAMSES Monitoring Stations





RAMSES DATA



How RAMSES Data could be used

- **DAI (Data Analysis Interface) → RAMSES consoles (specific tool)**
(last 2 weeks high time definition data then data reduction but not for time windows of one hour before and after radiation alarms)
- **DIP (Data Interchange Protocol) → RAMSES publishes** radiation measured values on DIP. DIP API allows to integrate RAMSES values in your own applications.

<http://itcofe.web.cern.ch/itcofe/Services/DIP/welcome.html>

- **LASER (LHC Alarm Service) → RAMSES is an alarm provider** to the alarm service for the operation of the accelerator chain and technical services (CO/AP).

<http://service-alarm.web.cern.ch>



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Demonstration



Supervision

(Home page)



ramsesteh3 - Remote Desktop

RAMSES HOME Alarms not ack: 257 20/11/07 14:10:38 WorkStation ID: 13
 Filter applied: No User: HostName: TEH3

RADIATION MONITORING SYSTEM
for the ENVIRONMENT and SAFETY

Version 1.13e

RAMSES HOME - Please enter your login/password

PT1-ATLAS | PT2-ALICE | PT3 | PT4-RF | PT5-CMS | PT6 | PT7 | PT8-LHC.B | T12 | T18 | PREVESSIN | MEYRIN | CNGS | SPS | MS-USA | SYS-PC | SYS-MS | TEST

Date	Time	Event	Type	Zone	Instrument	Description	Level
20/11/07	14:09:56	Alarm on - not ack.	System Fault	ISOLDE	TMF TBL	DA COM failure	A
20/11/07	14:09:18	Alarm on - not ack.	System Fault	Environment (non-...	PMWF908	Measure quality fault	A
20/11/07	14:08:40	Alarm on - not ack.	System Fault	Environment (radi...	VGM922	Low flow status	A
20/11/07	14:08:17	Alarm off - not ack.	System Fault	PS	PHFL3391	HFM COM failure	A

20/11/07 10:25:09 - MS127 - MS CFG > New configuration inserted in RDB

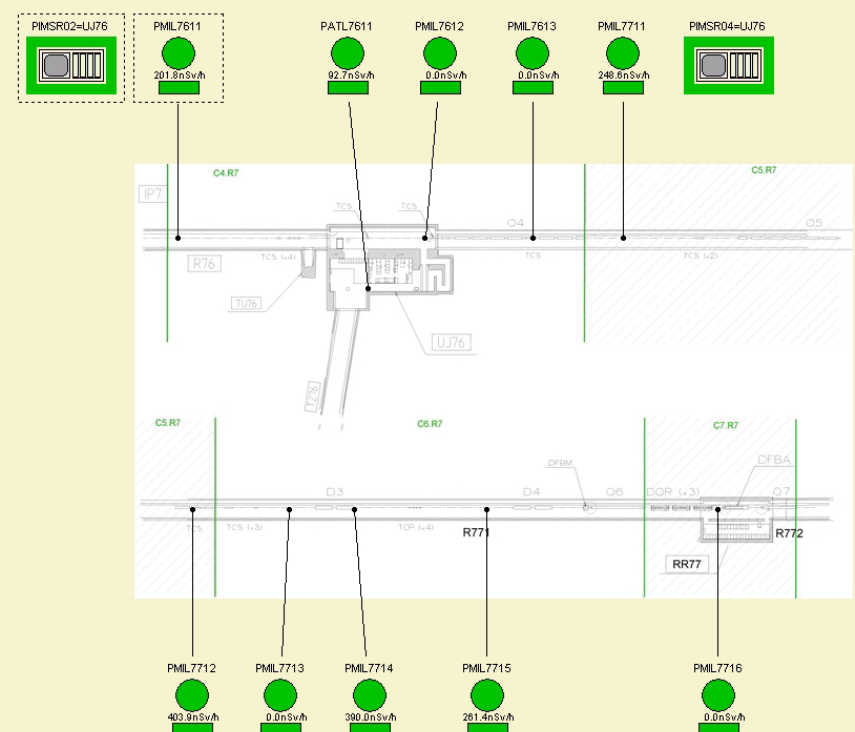
RADIATION Supervision

(LHC7 - UJ76)

ramsseteh3 - Remote Desktop

PT7 - R76 / RR77 Alarms not ack: 248 23/11/07 12:23:09 WorkStation ID: 13 HostName: TEH3

Filter applied: No User: uadmin



PMSR02=UJ76: 201.8 nSv/h
 PML7611: 92.7 nSv/h
 PATL7611: 0.0 nSv/h
 PML7612: 0.0 nSv/h
 PML7613: 0.0 nSv/h
 PML7711: 248.6 nSv/h
 PMSR04=UJ76: 403.9 nSv/h
 PML7712: 0.0 nSv/h
 PML7713: 390.0 nSv/h
 PML7714: 261.4 nSv/h
 PML7715: 0.0 nSv/h
 PML7716: 0.0 nSv/h

CH Name: PML7611
 Dose Rate: 201.821 nSv/h
 Mean DR: 310.458 nSv/h
 UTC Time: 23/11/07 11:22:30

Device Type: IAM
 Meas. Sampling Time: 30.0 s
 Alarm Threshold: 10000 nSv/h
 High Alarm Th.: 15000 nSv/h
 Alarm Sampling Time: 150.0 s
 Alarm Hysteresis: 5 %
 Calibration factor: 2.46E-08 A or cs / Sv/h
 Correction factor: 1.00

Channel status:
 Measure DA Type
 Prim. UA DA Power
 Sec. UA Parameters
 Alarm Sensor Cnx.
 High Alarm Sensor
 UA Trans.
 DA Com.
 Clock

Channel mode:
 Measure Maint. Simu.
 Off Test

Primary UA status:
 Normal H Alm Alm
 Off / Fault H Alm Test Alm Test

Secondary UA status:
 Normal H Alm Alm
 Off / Fault H Alm Test Alm Test

Status: Config | Ilock | UA
 MS Name: PMSR02=UJ76
 MSID / Type: 078 MSDA
 Domain:
 Zone: LHC
 Location: LHC7 - UJ76
 220V Battery Panel
 NTP In charge

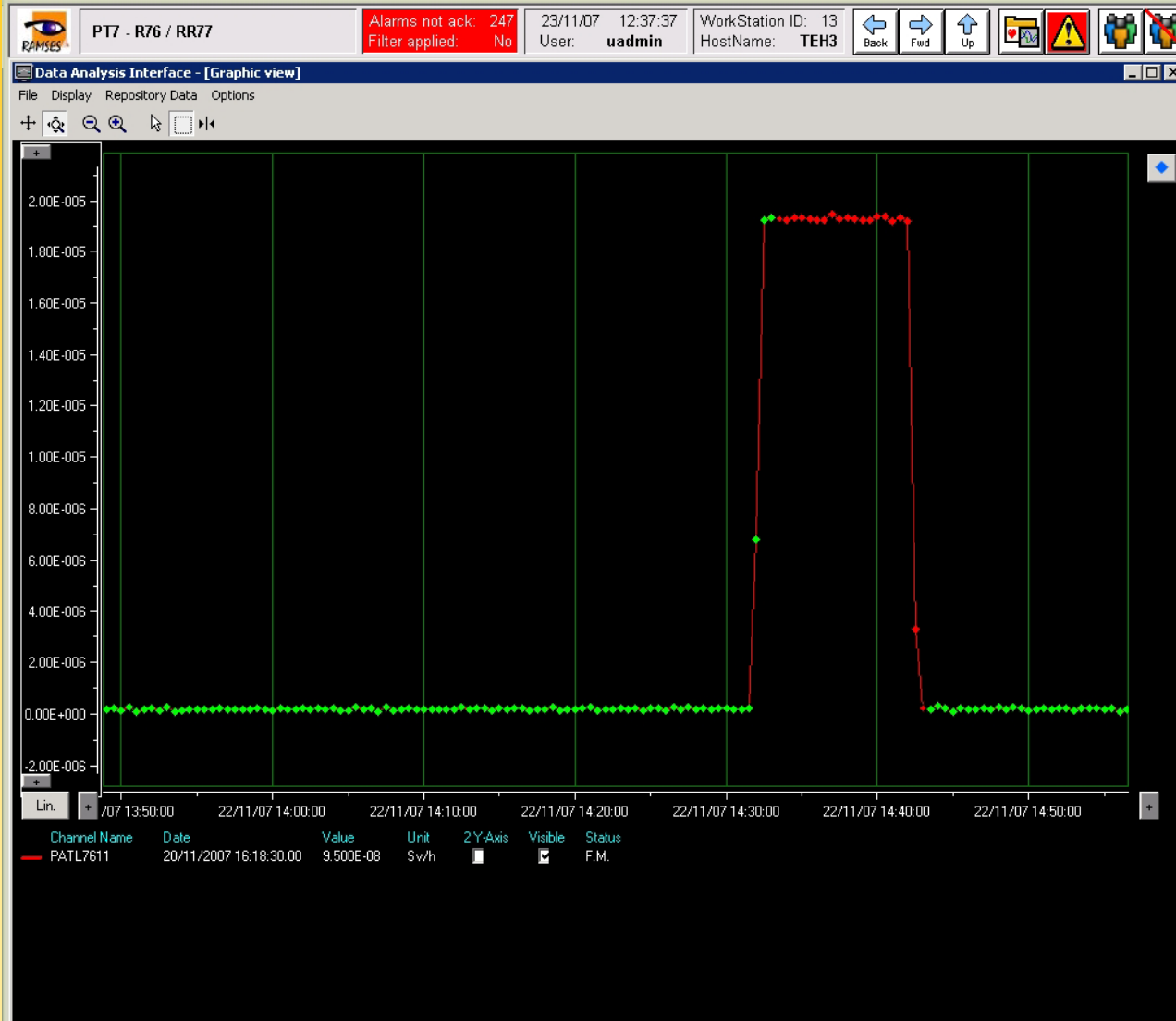
Date	Time	Event	Type	Zone	Instrument	Description	Level
23/11/07	12:21:37	Alarm off - not ack.	System Fault	Environment radi...	VGM922	Low flow status	A
23/11/07	12:21:37	Alarm on - not ack.	System Fault	Environment (radi...	VGM911	Low flow status	A
23/11/07	12:15:47	Alarm off - not ack.	Radioactivity Air	LHC	PATL5311	Alarm detected	B
23/11/07	12:14:32	Alarm off - not ack.	Radioactivity Air	LHC	PATL5311	High Alarm detected	A

23/11/07 07:58:18 - MS076 - MS CFG > RDB request error : new configuration not inserted in RDB

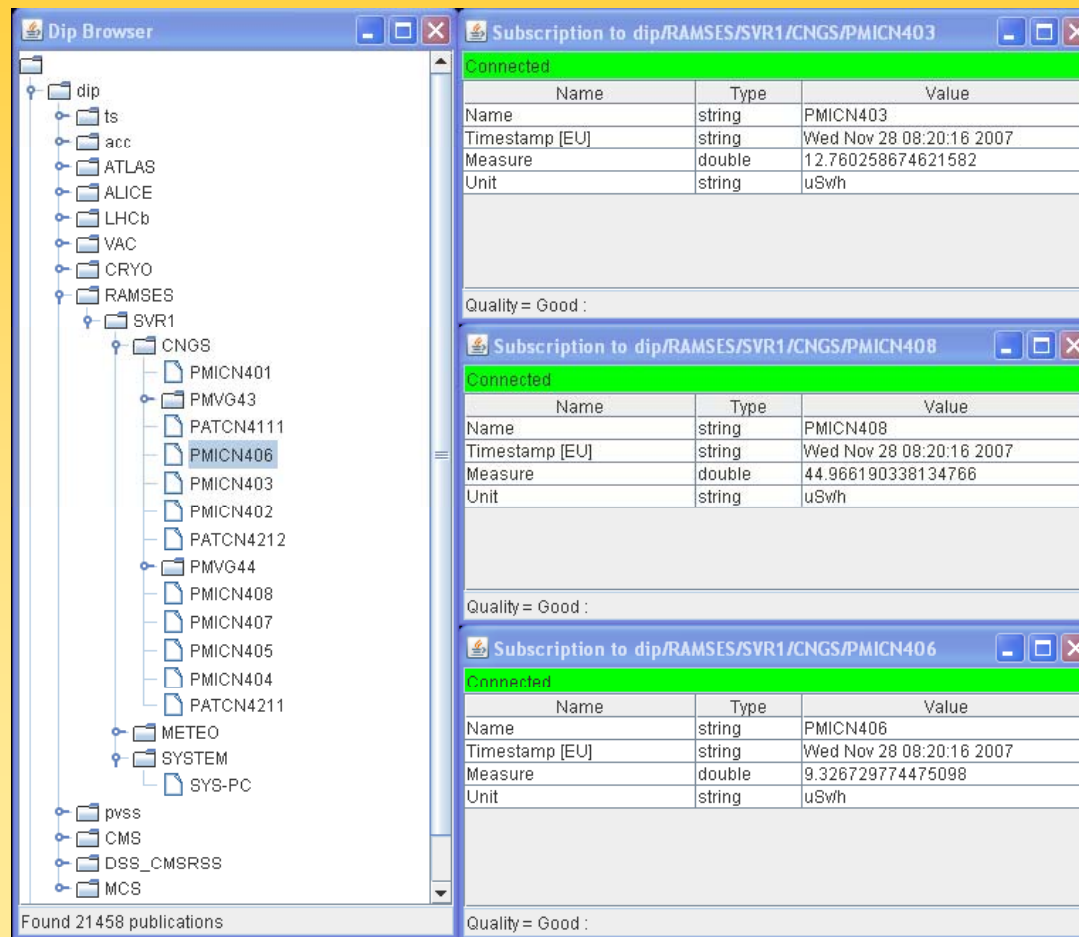


Supervision DAI

(LHC7 - UJ76 - PATL7611)



- DIP example:** DIB Browser tool (IT/CO/FE) is a simple application based on DIP API that allows simple browsing of data exchanged through DIP.



The screenshot shows the 'Dip Browser' application window. On the left is a tree view of the data hierarchy. The right side shows three overlapping windows, each displaying data for a specific subscription. The top window is for 'PMICN403', the middle for 'PMICN408', and the bottom for 'PMICN406'. Each window shows a table with columns for Name, Type, and Value, along with a Timestamp [EU] and a Measure value. The status 'Quality = Good' is displayed below each table.

Name	Type	Value
Name	string	PMICN403
Timestamp [EU]	string	Wed Nov 28 08:20:16 2007
Measure	double	12.760258674621582
Unit	string	uSw/h

Name	Type	Value
Name	string	PMICN408
Timestamp [EU]	string	Wed Nov 28 08:20:16 2007
Measure	double	44.966190338134766
Unit	string	uSw/h

Name	Type	Value
Name	string	PMICN406
Timestamp [EU]	string	Wed Nov 28 08:20:16 2007
Measure	double	9.326729774475098
Unit	string	uSw/h



RADIATION LASER

(LHC Alarm Service)



- LASER Alarm Console:

Date	Time	System Name	Identifier	Problem Description
N	09:17:50	ACCE_ZORA_SPS	BA3-870-R CHAINE_01	BOUCLE CABLEE OUVERTE...
N	09:30:42	ACCE_ZORA_SPS	BA1-868-R CHAINE_01	BOUCLE CABLEE OUVERTE...
N	10:19:00	RAD_HARDWARE	PAXN1645	Monitor Fault
N	10:19:00	RAD_HARDWARE	PATN822	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1321	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1644	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1721	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1585	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1262	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1583	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1642	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1461	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1522	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1443	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1441	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1581	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1462	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXN1643	Monitor Fault
N	10:19:00	RAD_HARDWARE	PAXSM05	Monitor Fault
N	10:19:00	RAD_HARDWARE	PBXU401	Monitor Fault
N	10:19:00	RAD_HARDWARE	PMS62	Monitor Fault
N	13:52:49	ACCE_ZORA_SPS	BA80-889-R CHAIN...	RESULTANTE BOUCLE CAB...
N	14:15:13	ACCE_ZORA_SPS	BA5-872-R CHAINE_01	BOUCLE CABLEE OUVERTE...
N	14:58:35	SPS_DUMP_KICKER	BA1	MKD not pulsing
N	14:59:16	SPS_DUMP_KICKER	BA1	Status fault
N	15:26:38	SPS-SIS	PERMITS	TT41 SW PERMIT no BIC...
N	15:26:52	SPS-SIS	PERMITS	TT40 SW PERMIT no BIC...
N	15:53:28	SURVEILLANCE	CNGS-LOGGING	CNGS-LOGGING source c...
N	16:08:33	ACCE_ZORA_SPS	ECX4-871-R CHAIN...	RESULTANTE BOUCLE CAB...
N	16:33:30	AUXPS	M1SB80 AU22P5	>1 P.S. OFF demanded ON
N	14:55:38	AUXPS	M1SBA1 AU87P5 TT10	>1 P.S. OFF demanded ON
N	16:30:07	SPS-SIS	ALARM	One or more SPS CODs OFF
N	08:41:26	SECU_GAZ_LHC	RE42-2402-TUN SG...	MANQUE OXYGENE RE42
N	08:41:33	SECU_GAZ_LHC	RE42-2402-R1 SGD...	ALARME CAPTEUR GAZ



RAMSES Project



Status of the system

◆ Present situation

- 100 % tunnel monitors are installed
- 90 % tunnel monitors commissioned
- Supervision → Under test
- Data Analysis Interface (DAI) → Under test
- Long term storage → Operational
- DIP interface → Operational
- LASER interface → Under test

◆ 2008

- 100 % tunnel monitors commissioned (February '08)
- Acceptance test of the Supervision (February '08)
- Acceptance test of the Data Analysis Interface (February '08)



THANKS for your attention

The RAMSES team

RAMSES web site → <http://ramses-dev.web.cern.ch>

References:

[1] Helmut Vincke, Norbert Aguilar, Doris Forkel-Wirth, Michel Pangallo, Daniel Perrin, Michel Renou and Chris Theis, *Measurements and simulations of the PMI Chamber Response to the Radiation Field inside the CERF Target Area*, CERN Technical Note SC-RP-2004-RP-TN