

The RPC up scope



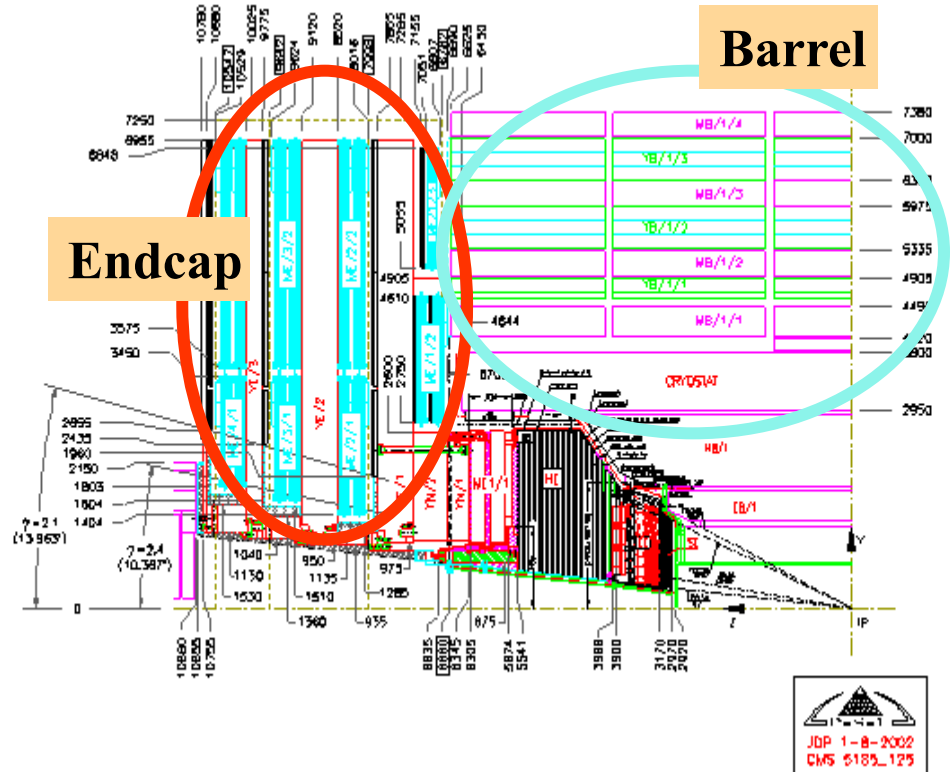
S. Buontempo
INFN - Naples

- **Restore the TDR low η design**
- **Basic step: resume HPL order and QA**
- **Chamber design Xcheck and validation**
- **Preparation of 3 assembly sites**
- **Milestones, Schedule, Organisation**

The RPC up scope



Scope:
Restore the low η
TDR design



	RE 1/1	RE 1/2	RE 1/3	RE 2/1	RE 2/2	RE 2/3	RE 3/1	RE 3/2	RE 3/3	RE 4/1	
No. of chambers	36*2	36*2	36*2	18*2	36*2	36*2	18*2	36*2	36*2	18*2	

**Upgrade
Phase I**

Restore the TDR low η design



- ❑ Use identical chamber design ; modest integration required
- ❑ Build station RE4 i.e. 144 RPC of the low η type + spares (56 for full RE)
- ❑ Install on non IP side of YE3, on top of CSC's (electronic side)
- ❑ Define all services needed for RE4 station (in UXC) (See Walter talk)
- ❑ Test and validate possible improvement with respect to original design discussed in the Muon Upgrade Integration Task Force: upgrade cooling (See Walter talk).

Basic step : HPL Procurement and QC



PamPla firm not on the market anymore

Bakelite alternative firm found (Puricelli, Milan), having part of PamPla expert personnel and mass production capability



After few trials, first 5 prototypes with expected resistivity produced in April 2010 : VERY uniform values both inside a single panel and panel-to-panel

Bakelite Pilot production (50 sheets) done in June 2010: used for gap pilot production (June-July 2010) both in GT (Italy) and Kodel (Korea) sites

First gaps with new bakelite were tested at CERN starting in September 2010 for basic QC

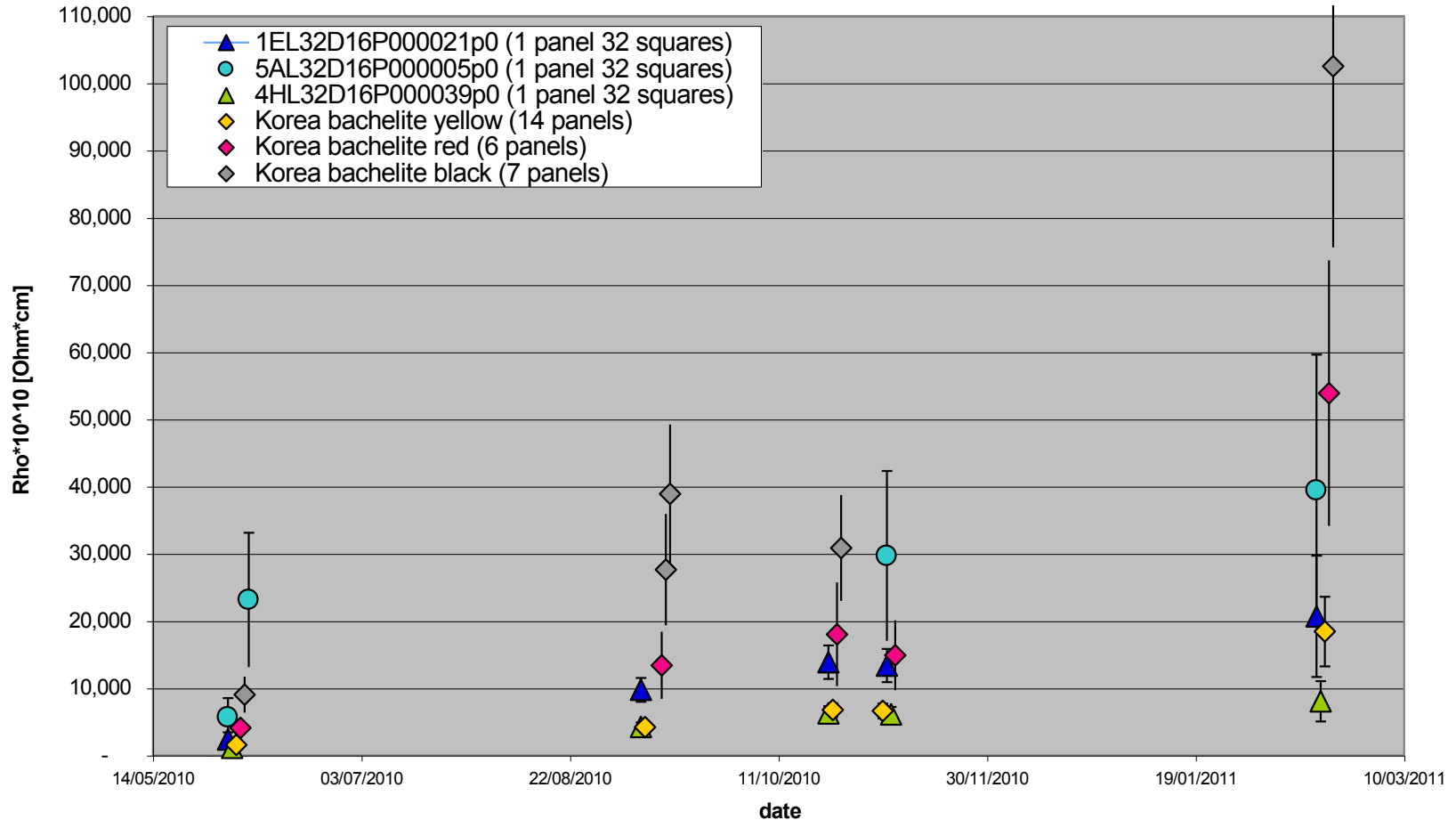
If gap QC results would have been OK we were planning to order 600 bakelite sheets by the end of 2010 But ...

Basic step : HPL Procurement and QC



We got instability in resistivity value vs time !!

Puricelli bakelite - AVERAGE versus TIME



Basic step : HPL Procurement and QC



Resistivity was increasing by almost 1 order of magnitude in six months.

Test done both in single HPL panels and confirmed also on resistivity measurement on gaps in GIF with HV scan in Ar flow.

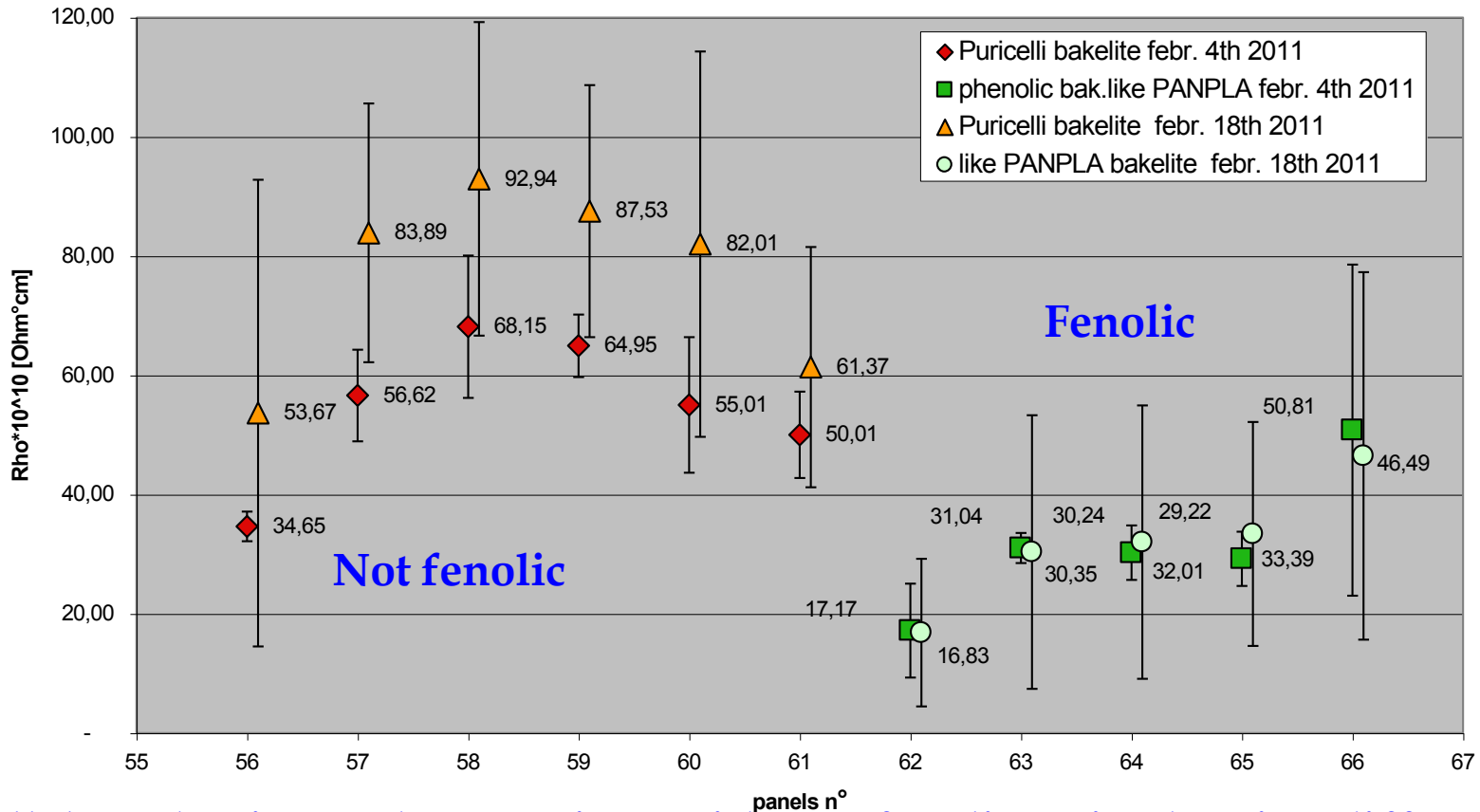
Effect NEVER visible in PamPla production

We agreed with Puricelli firm to use pre-impregnated kraft paper with fenolic resin (like PamPla) procured by external subcontractor Giacosa (Italy) (having also some ex PamPla expert personnel) and produce HPL panels in their site applying 90min thermal cycle (like in PamPla and VERY different from their thermal cycle of 60 min).

Basic step : Bakelite Procurement and QC

First production of samples with fenolic resin done in february 2011

Pu03; measures from 04-02 to 18-02-2011 - Average values by 16 measurements for each panel



Parallel production and comparison with non fenolic resin showing different behaviour vs time.

Basic step : HPL Procurement and QC



First prototypes done with small pressing machine in february 2011, proving the reliability of the thermal cycle and material.

After few trial we could reproduce the 90 min thermal cycle also on the large (3.2x1.6m) pressing device.

First successful tests done in April 2011, initial resistivity values at upper limit of acceptance range (6×10^{10} Ohm cm),

Under investigation the stability of the fenolic resin % on the kraft paper procured by the subcontractor Giacosa (Italy).

Basic step : HPL Procurement and QC



In parallel found another subcontractor Enso (Finland) for pre-impregnated kraft paper with fenolic resin, providing higher level kraft paper quality

Received in Puricelli first samples last week

Produced two set of samples with very good resistivity ($1-2 \cdot 10^{10}$ Ohm x cm).

First monitoring after 4 days: no drift.

To be monitored in next weeks the stability in time.

Goal is:

- to complete this set of stability measurements by the end of May,
- preproduction of 120 panels by June 2011 and remaining 540 panels by September 2011.

Bakelite technical specs updated and endorsed in April 2011.

Basic step : HPL mass production QC in Pavia



Agreed with Pavia group a two steps validation procedure:

- Bakelite production firm will measure the sheets with a portable device and ship to Pavia only samples in the expected range
- Pavia will provide the final validation of HPL using the automatised table with 9 measurement points. Validated sheets are shipped to RIVA firm for cutting procedure.



Bakelite Additional treatment:

- cutting in RIVA firm (Milano)
- surface cleaning in GT (Frosinone)

Pavia table has been restarted and will be re-commissioning in next weeks. Operation will start with validation of first 20 good resistivity panels produced by Puricelli and being delivered in these days.

Chamber design Xcheck and validation



Revalidated and updated the existing drawing from Pakistan to avoid retrofitting, as necessary in previous production. Cross checked all the chamber and gap dimensions

Mechanics Pre production done in December 2010 in China.

Validated at CERN ISR lab in January 2011.

Launched final production in March 2011.

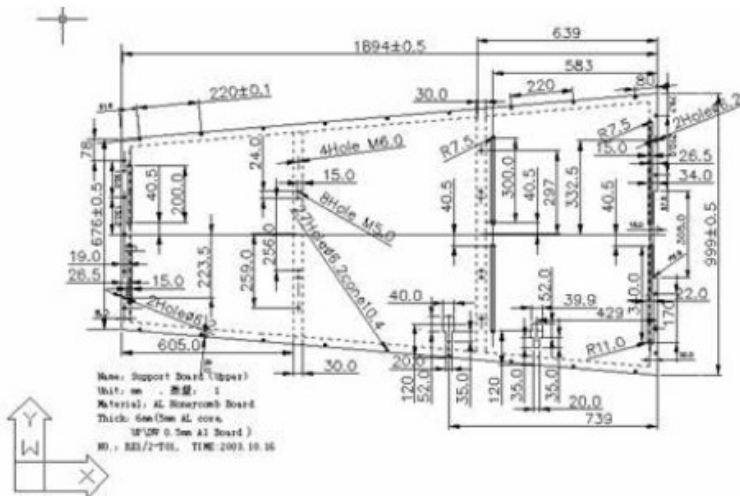


Figure 5.2: layout of a typical RE honeycomb plate

Gap Production



660 gaps to be produced (600 + 10% contingency).

We have two possible assembly sites: GT (Italy) and Kodel (Korea).

Decision will be taken on:

- Capability of proper QA and QC
- Costs

Both sites can produce all the gaps in 8 months.

Discussion is going on for the final strategy to apply.

Goal: Order placed in June to start preproduction of 120 gaps by July.

Training Chamber Assembly Teams



January 2011

Received at CERN first pieces of pre-production of mechanical components from China for 3 type2 and 3 typ3 chambers. Pieces validated and drawing corrected according to the assembly tests. Defined assembly protocols, validated procedures.

March 2011

Organised at CERN ISR lab a training campaign for team from India, Belgium and CERN for FULL chamber assembly (including mechanics, piping, cabling). Still pending final test of full module integration (see Walter talk), planned in June 2011

May 2011

Detailed list of chamber components produced and being validated in these days. Final document on RE4 web site cern.ch/re4 .

Goal: Order of full set of components for 30 chambers by May 2011.

Chamber Assembly Sites



Three assembly sites: Belgium, CERN, India supposed to be in operation by Summer 2011

Quality control for gas gaps/chambers foreseen :

- **mechanical QC of gas gaps (leak test, popped spacer test)**
- **dark current measurement of gas gaps**
- **detector electronics basic test**
- **chamber QC on cosmic test bench**

Chamber Production Strategy



Phase I (Summer 2011)

Pre produce and test 1 chamber in each assembly site

Phase II (September 2011 – December 2011)

Produce and test additional 9 chambers in each assembly site.

Phase III (January 2012 – June 2013)

Produce and test additional 50-60 chambers in each assembly site.

Chamber Production Sites: Ghent (Belgium)



Ghent RPC lab comprises :

- ~ 70m² area for assembly/testing allocated in old accelerator hall of the institute; easy access for detector transports; crane for heavy lifting
- additional detector R&D room (~45m²)
- air conditioned hut (~19m²) for chamber testing in a controlled environment
- Gas mixing and distribution system for P5-like RPC mix (12 outputs)

Assembly area



Climatized room



Chamber Production Sites: Ghent (Belgium)



- Large cosmic test bench under construction :
 - ❑ 2 X-Y planes (i.e. 4 planes) foreseen of $2 \times 2 \text{m}^2$; 85 scintillator strips of $200 \times 10 \times 1.5 \text{cm}^3$ delivered from IHEP Protvino last week (ordered in 2009 !!)
 - ❑ Readout of scintillators using Bicron BC-91A multicladd wls. round fibers (4 fibers per strip); 80 Philips XP1911 0.75" PMTs
 - ❑ VME/C++/Qt based DAQ under development
 - ❑ Pre-assembly tests of scintillators nearly done; started construction of final setup



- Manpower for RPC assembly : 2 physicists; 2 technicians; 1 new engineer (starting contract soon) + students

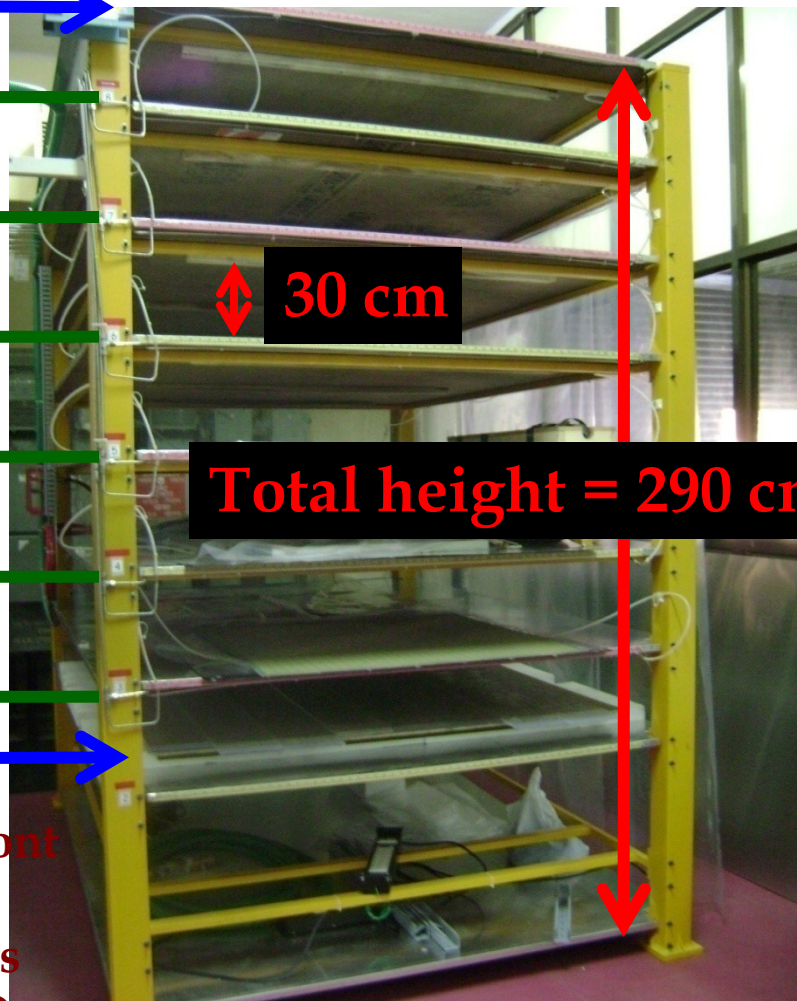
Chamber Production Sites BARC Mumbai (India)



Scintillators, shelf # 9

RPCs, shelves # 3 to 8

Scintillators, shelf # 2



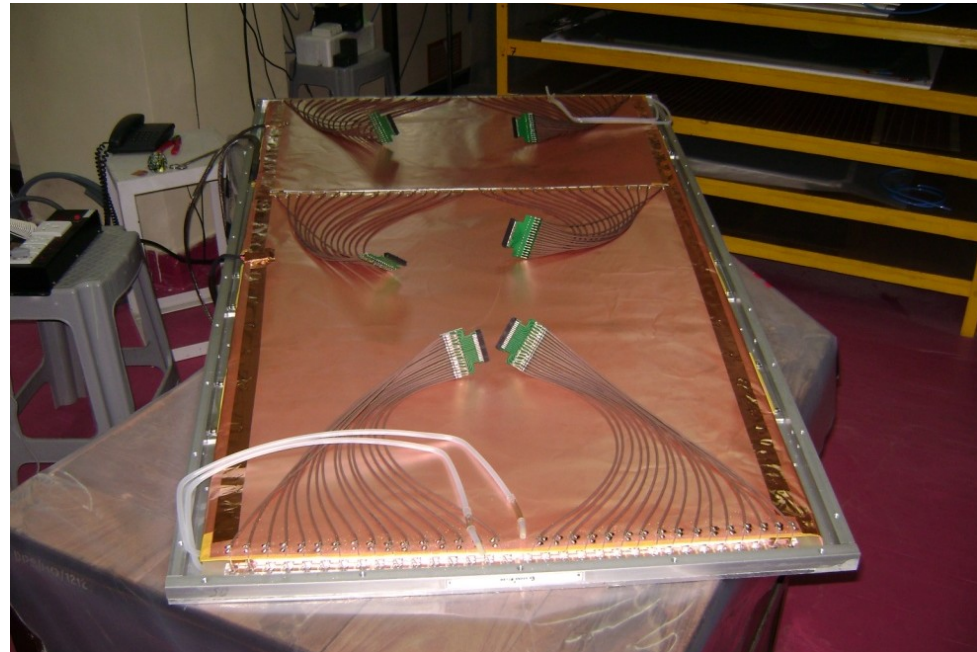
30 cm

Total height = 290 cm

- Two gas inlets at back & two gas outlets in front
- Seamless SS tubing for gas flow
- Plyboard shelves covered with 1 mm Al sheets
- Shelf # 1 for housing electronics, HVPS, DAQ

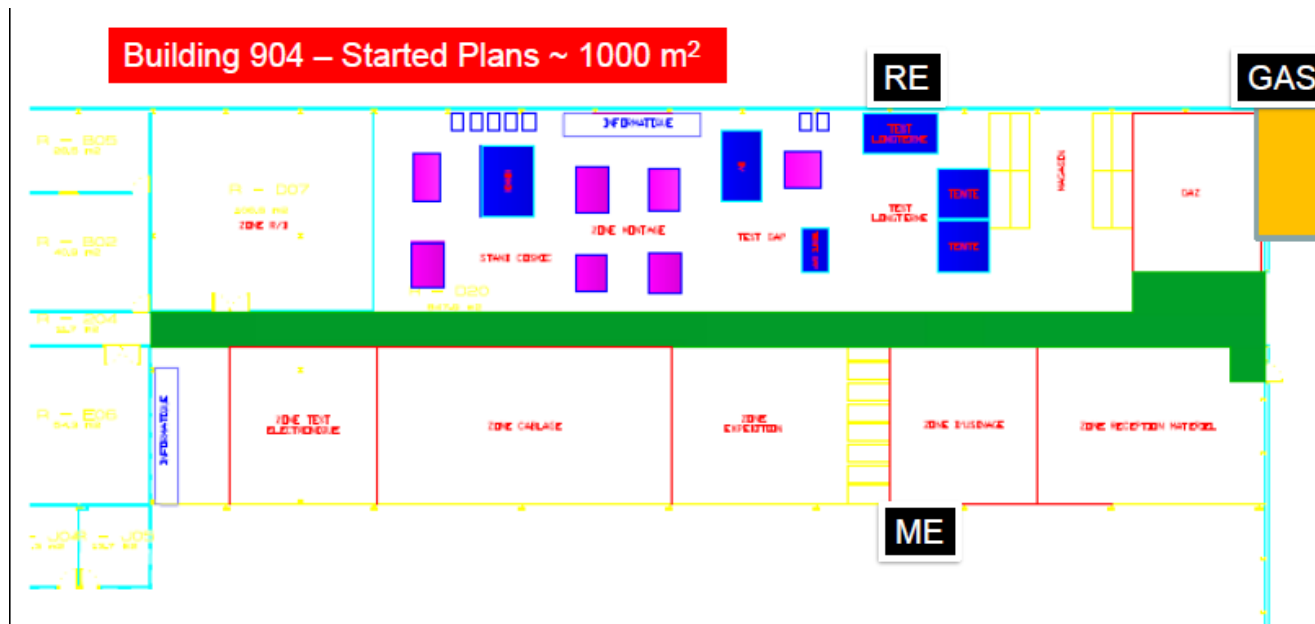
New Cosmic Rack commissioned

Chamber Production Sites BARC Mumbai (India)



Ready to go into assembly and test in summer 2011
Local manpower available

Chamber Production Sites: CERN – Bld 904



Ready to go into assembly and test in August 2011

Task coordinated by A. Sharma (see A. Ball talk for more details)

Local manpower to be allocated to specific tasks.

Manpower from Belgium, India and Pakistan necessary for chamber assembly and QC

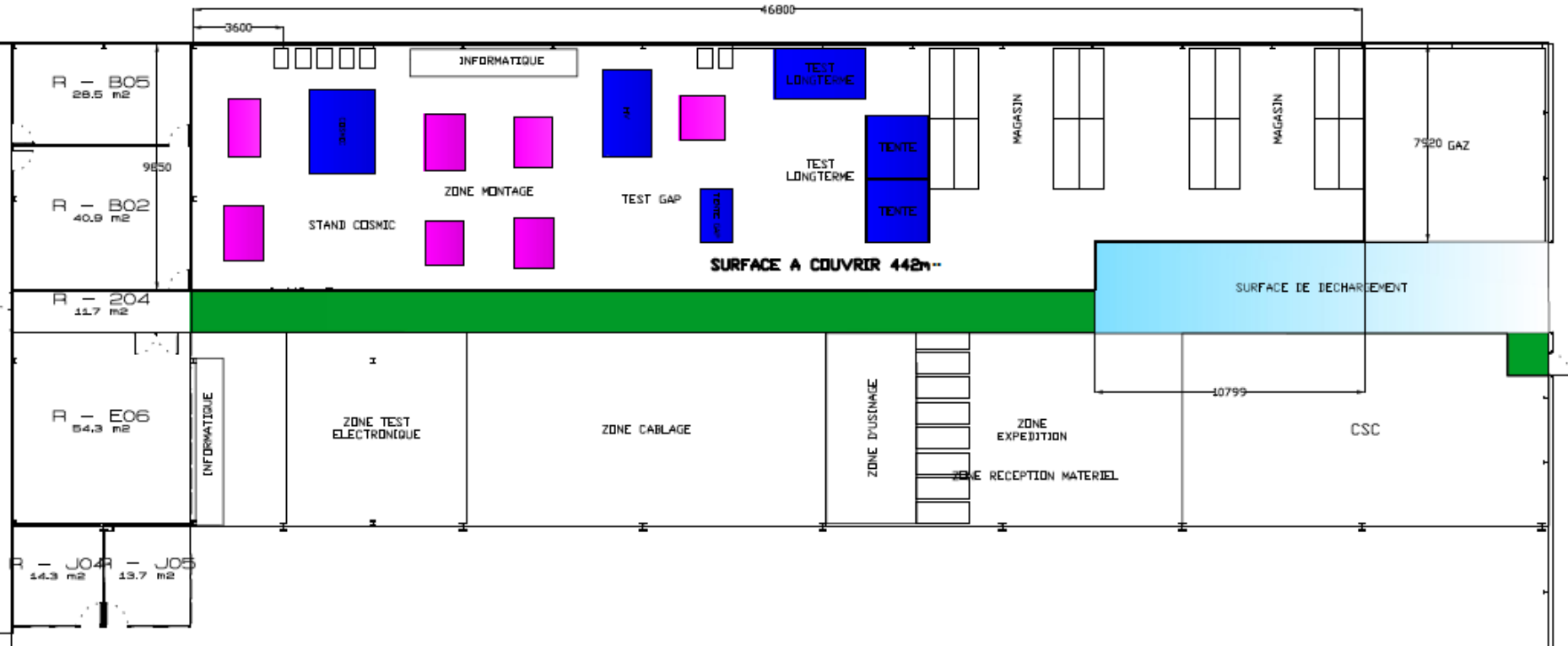
Production Site Layout at 904



PRODUCTION RPC Bt 904

CHATELAIN J-P 26/11/2010

46800

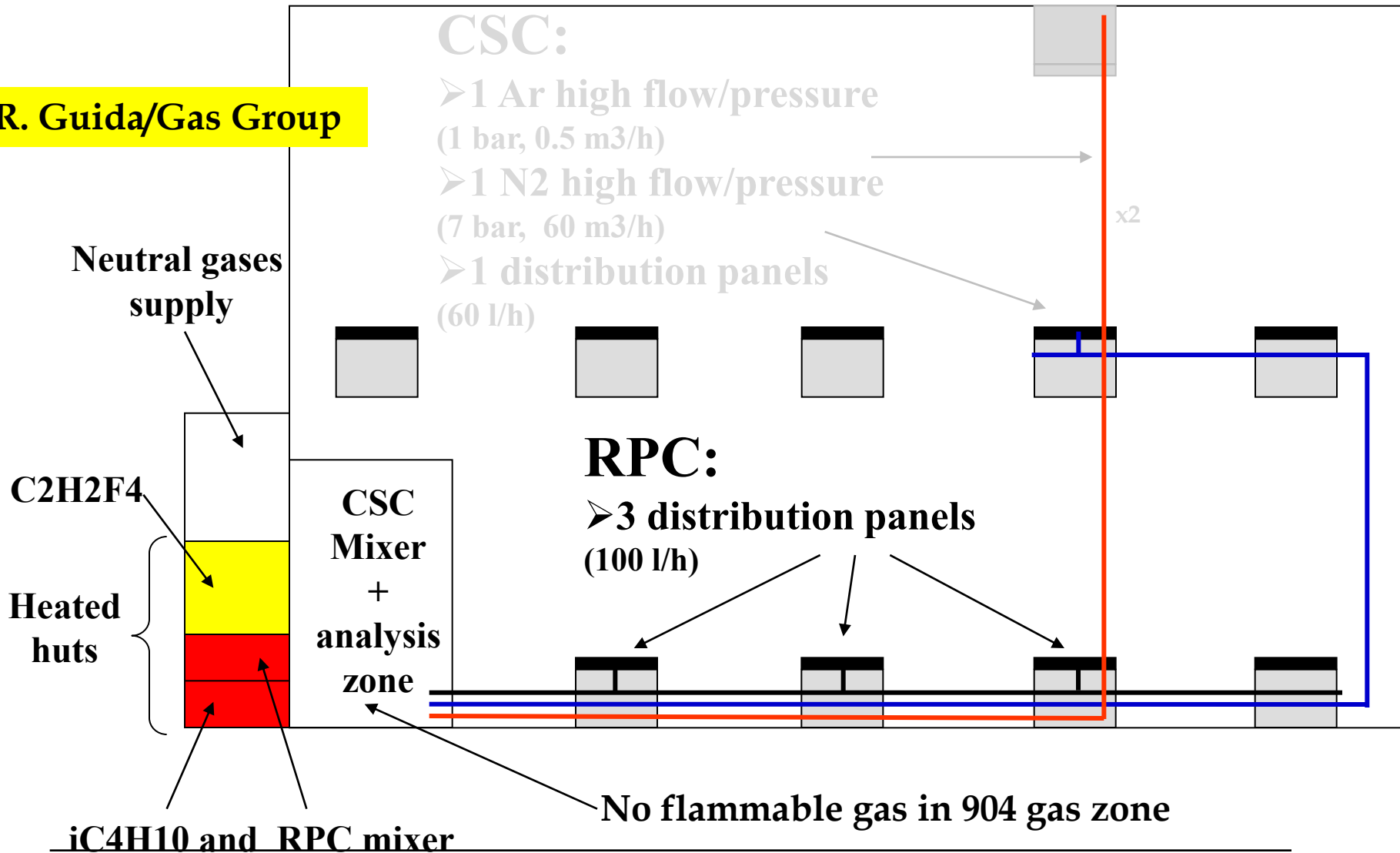


J.P. Chatelain

Gas system layout 904 v8



R. Guida/Gas Group



CERN

Cosmic Stand preparation



- **Cables connectors ordered**
- **Scintillators being upgraded**
- **PMTs to be purchased**
- **TDCs being ordered – common order with Gent**
- **(i) build and commission system with 4-5 chambers capacity**
- **(ii) expand to 10 chambers next year**
- **All system to conform to 904 move**
- **Target to be operational – August/Sept 2011**

Schedule: Achieved Milestones



Reviewed chamber design and validate new drawings with possible improvements

Mechanics mass production started in China (*)

Reviewed the integration/service needs according to MuUpgrade integration TF requests (see Walter talk)

Updated the cost estimate with market enquiries

FEB design reviewed and production started in Pakistan (*)

*** already started due to local fund availability constraints**

Schedule: Next Milestones



Final EDR by June 2011

Secure Bakelite pre-production within the CMS specification by middle June 2011.

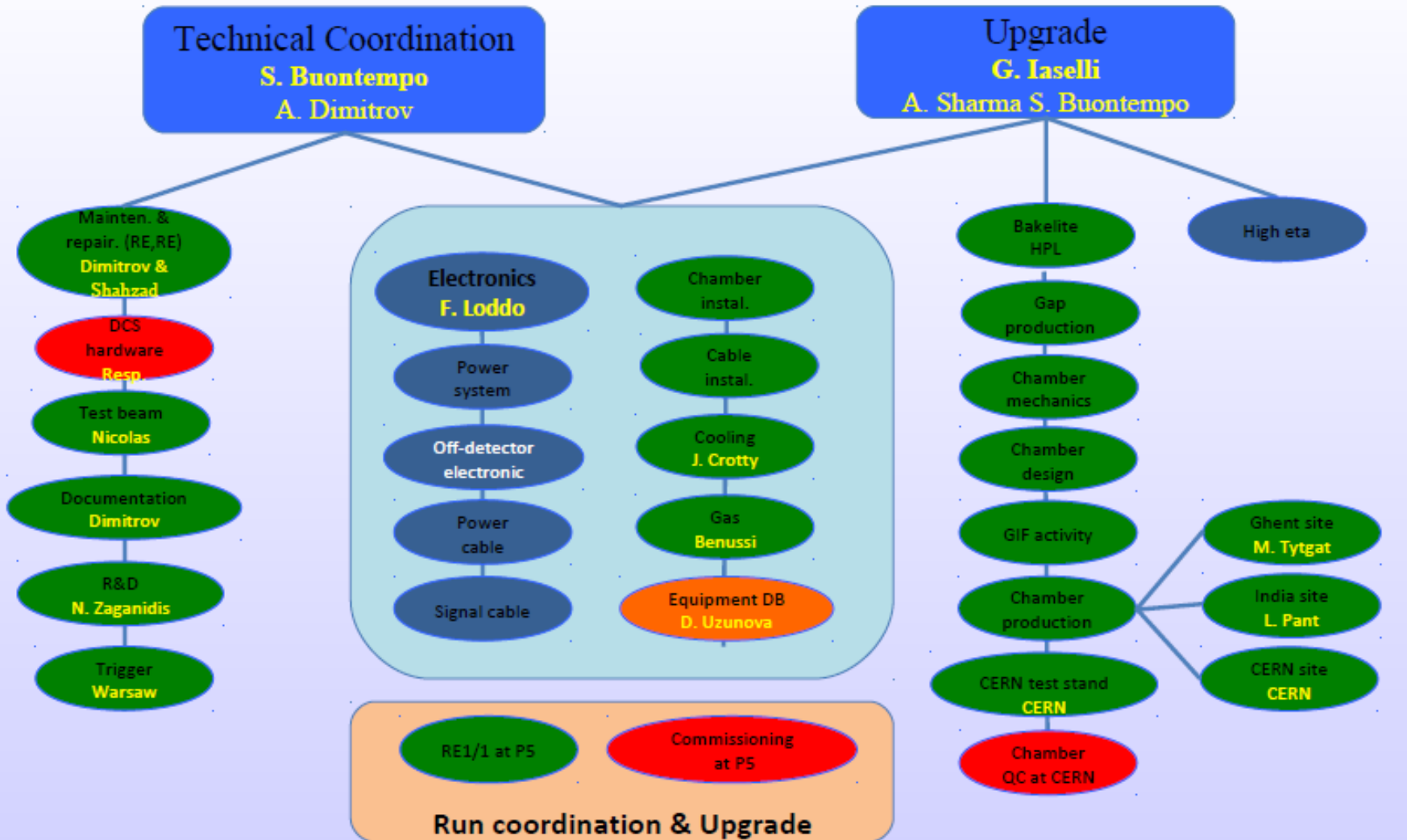
Secure Gap pre-produced and delivered to chamber assembly sites by August 2011.

1 chamber fully assembled and tested in each assembly site by September 2011.

Additional 9 chambers assembled and tested in each assembly site by December 2011.

Additional 50-60 chambers assembled and tested in each assembly site by March 2013.

RPC Project organization: Upgrade



8/02/2011

RPC organization chart

12

Covered
Manpower needed
Not covered

New responsibilities



- **INFN funds for LB system and chamber technical QC granted**
- **Consolidated responsibilities and tasks of CERN group (904 facilities, chamber assembly and QA, integration)**

BL=Belgium, CH=CERN, CN=China, IN=India, IT=Italy, KL=Korea, FI=Finland, PK=Pakistan, PL=Poland

Item	BL	CH	CN	IN	IT	KL	FI	PK	PL
HPL production/QA		x			x				
Gap production						x			
Cham. mechanics	x		x						
Chamber assembly	x	x		x					
Front-end production								x	
HV/LV system	x			x					
LB design					x				
LB production & testing					x				x
T/RH sensors		x			x				
Infrastructure		x							