

Integration of high eta RPCs RE3/1 & RE4/1 in CMS

5.5.7 Installation and integration

5.5.7.1 Mechanical aspects

The RE3/1 chambers will be mounted on the YE3 steel as shown in the figure 5.32. They will overlap the circular neutron shielding (18 trapezoids) attached to the YE3 and reach the cylindrical neutron shielding surrounding the collar that separates the yokes YE2 & YE3.

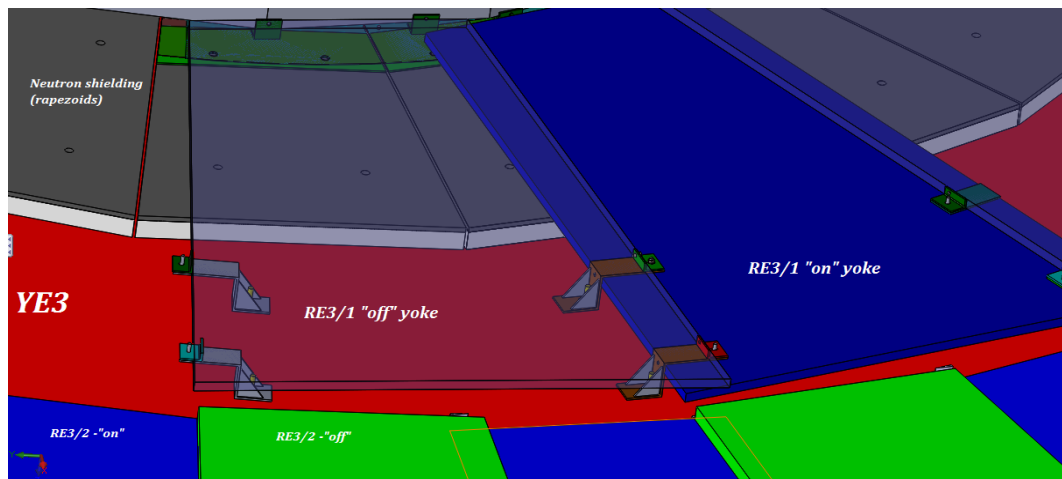


Figure 5.32: Schematic view of the mounting of RE3/1 chambers on the YE3 steel plate.

The chambers will be mounted directly to the yoke. Using the foreseen mounting points threaded into the yoke steel. Allowance for sagitta in the yoke with applied “B” field will be made using simplified kinematic mounts. The screws and washers securing the neutron shielding will be modified to make them flush with the outer lead part of the shield so increasing the available space in “Z”.

For RE4/1 the mounting is quite different as they mount to the same side of YE3 as the ME4s taking advantage of the CSC mounting posts which will be extended with large M24 studding. To these supports will be built a thin light weight frame made from aluminium alloy 8mm thick. The chambers are then screwed to this frame. This configuration is similar to that used for the RE4/2 & RE4/3 but the smaller frames and chambers are mounted separately.

Access for both chamber installation and commissioning of RE4/1 will necessitate the “push back” of the YE4 from the YE3. The negative end has been already operated but the positive end has yet to be commissioned. As the services will be behind the already installed chambers, their installation must be completed during the LS2 prior to the installation during YETS 21-22 and 22-23.

5.5.7.2 Power System

The High Voltage power system for the new chambers will be a copy of the actual system. The HV power modules CAEN A3512N will be installed in an additional rack at the end of the present USC RPC HV racks. This will necessitate the installation of 8 more umbilical cables from the USC to the UXC connecting via the YE1 Patch Panel (PP). From the main YE1 HV PP, where the connector location has been already planned, the cables will go through the Mini Cable Chains (MCC) to the

YE3 where they will be distributed around the peripheral cable trays taking them to both stations.

For what concerns the Low Voltage LV system, optimisation of costs dictates that the same Easy crates and LV modules (CAEN A3016) already in UXC will be used to power the new chambers. Re-cabling in front of the LV modules will be done in order to liberate the two modules required. Service power and communication bus for these crates, through the A1676A branch controllers, is done from the USC X4F03 rack. Tables 5.3 and 5.4 summarize the number of components for each system respectively.

Table 5.3: HV system components for the RE3/1 and RE4/1 project

item name	quantity
HV crates	4
HV boards per crate	3 DAVIDE
total number of HV boards	12
HV module limits (kV)	12

Table 5.4: LV system components for the RE3/1 and RE4/1 project

item name	quantity
LV crates	
LV EASY crates	DAVIDE
LV boards per crate	
total number of LV boards	
LV power consumption	

5.5.7.3 UXC and USC Rack space

The racks on YE3 are largely occupied. Space is required for re-cabling the LV system, DCS and associated FO patch panels. The two RPC gas racks are on X2 far. The RE3 gas racks have 12 spare channels for both the RE3/1 and RE4/1 chambers with 1 channel per 60 degrees.

Additional racks space is required for the HV and data/control functions in the USC. The trigger system including fibre optic cable patch panels will be required in the trigger racks in the USC. Additional racks will be required adjacent to the S1F01 to 05 racks. Space is available in S1F06 adjacent to the present trigger system. If necessary space is also available in a rack (S1F00) closer to UXC.

5.5.7.4 Readout system

The data and control from the chambers is achieved by fibre optics rather than by copper cable. Given the few channels required for these fibre optic cables, they can be installed by hand as per the Trigger LB system in two of the six transfer channels between USC and UXC.

5.5.7.5 Cable routing

Services will transit through the gap formed by the RE3 rear face and the YE3. Trials have been performed that confirm that this is possible between these two smooth uninterrupted surfaces. This solution is preferable to installing services over the top of the presently installed RE3/2 & RE3/3 chambers as this would hinder access and removal of same. Running these services behind the chambers will require their installation prior to the chambers, meaning that installation should be done during LS2 prior to chamber installation in the following YETS.

The services are planned to be placed in ducts between the RE4 SMs and ME4s. They will be fed through the ample gap from the inner radius of RE4/2 towards the peripheral cable trays. This scenario will be facilitated and quickened if it remains scheduled to coincide with the change of the FE electronics on the CSCs.

Concerns of induced noise in the CSCs from the RPC services will be dealt with by joint CSC/RPC discussions and appropriate remedial action taken such as specific cable specification.

Figure 5.33: Picture showing the available space for RPC services between CSCs and RE4s chambers.



Although the MCC are quite full the near side (+X) chain has sufficient space for the HV and fibre optic services. The 8 umbilical HV cables and Fibre optics will fit in the 4 main cable chains. Optical fibres will go through the two FO transfer channels, between the USC and UXC, leading to the base of the main cable chains in the UXC.

5.6 Gas System

The gas mixture is identical to the present system. The only modification will be downstream of the UXC distribution racks. New piping and bulkheads will have to be installed around the yoke on the non IP side of the yoke for RE4/1. The presently installed piping foreseen for the original RE3/1 will have to be modified as it occupied all 12 channels on the rack. The bulkheads are in position on the yoke periphery. Their mapping will need modifying. All piping from bulkheads to the chambers will be required. Impedances, as used in RE4 SM system, will be installed on the peripheral structure to ensure a parallel flow to each chamber.

Gas Volumes & Flow Rates				
Per End Cap	Vol	Exchange	Chamber	Flow Rates
	[litres]	Rate/hour	per sector	per channel
			60 deg	[itres/hr]
RE3/1	4.5	1	3	13.5
RE4/1	3.5	1	3	10.5
RE3/1 Station	81	1	3	81
RE4/1 Station	63	1	3	63
Rack				144
Total System	288			288

5.7 Cooling System

The cooling system specification is a function of the electrical power distributed into the UXC cavern. Technical Coordination have requested that all electrical load be cooled, meaning that the minimum heat load should go into the cavern ventilation system. The chamber loads are significantly less than in the previous RPC chambers. Nonetheless the chambers and rack elements will be cooled by circulating water from the Endcap cooling circuit. The relatively small load can be accommodated by branching off from the present system.

Power dissipation for PetiRoc with integrated TDC

Channel	Chamber	FPGA+GBT	1 station	1 YE3	Rack Power	PetiRoc Dissipation
	384	20 + 1W	18		Eff 66%	
[mW]	[watt]	[W]	[W]	[W]	[W]	[W]
6	2.304	21	419	839	432	1271

One Endcap Power

1271

This value of dissipated power is approximately 10% of the total power dissipated on YE3s. This power should increase the coolant temperature by approx. 0.1deg C. The RE3/1 chambers will be cooled as planned in 2005 by extending the circuit of 2 of the RE3/2s to one RE3/1 chamber. Given the fragility of the cooling circuits on the RE4 SMs separate cooling circuits will be taken off the present mini manifold using tee connections and flow restrictors to equalise the flow in these parallel circuits.

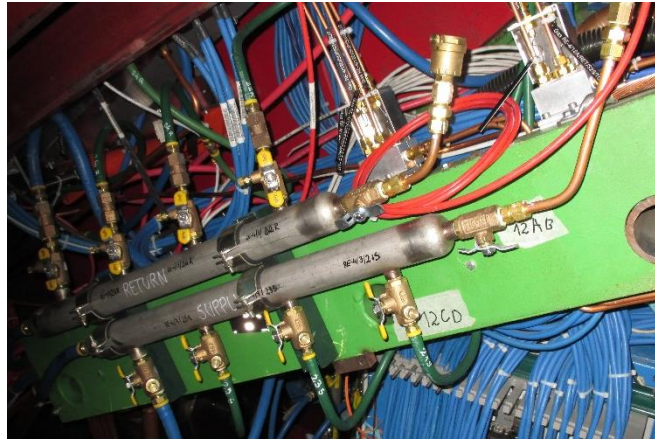


Figure 5.34: Picture showing the mini manifolds from where the RE4/1 chambers will be cooled by adding parallel circuits.