Cu cooling sets for RE4 upgrade for CMS

L. M. Pant[1,*], M. Kumar[2], V. K. S. Kashyap[1], C. Yadav[1], A. T. Chaudhari[2] and T. P. Sabharwal[2]

[1]*Nuclear Physics Division,* [2]*Mechanical Design and Prototype Development Division*
Bhabha Atomic Research Centre, Mumbai - 400085, India

**e-mail : lmpant@barc.gov.in*

During the ongoing 18 month Long Shutdown -1 (LS1: 2013-2014) at CERN, several upgrades for the CMS are taking place in order to fine tune it for the higher beam energy and luminosity from 2015 onwards. One of the major upgrades relates to the installation and commissioning of the fourth layer of RPCs (RE4) to enhance its trigger efficiency. The proposed RE4 upgrade project for CMS envisages another 200 RPCs to be built, tested, characterized, installed and commissioned jointly by India, Belgium and CERN. Of the total of 200 RPCs, India is mandated to built 50 RPCs of the RE4/2 type and 200 Cu cooling sets, 100 each for the RE4/2 and RE4/3 types [1].

The Cu cooling set is one of the several components, which goes into the assembly of an RPC and is important to cool the Front End Boards (FEBs) mounted on them and also the RPCs, as the performance of RPCs is very sensitive to variations in temperature differences. After having evolved the quality control procedures for fabricating the Cu cooling sets, they have been mass produced at MD&PDD [2]. Each Cu cooling set then undergoes a leak test at NPD with 20 bar of pressurized Argon gas and is ready for dispatch only after having qualified a leak rate better than 5×10^{-4} mbar.litre.sec^{-1}, as quantified by the CMS collaboration. It is very crucial to leak test these cooling systems, as they are then integrated with RPCs, and are further covered with aluminum screen boxes for installation at 100 meters below the ground surface at Point 5, at Cessy, in France and are not accessible once the Large Hadron Collider is operational. Further, as shown in Fig.4, the HV connector supplying bias to the gaps at about 10 kV sits very close to the Cu pipes carrying the chilled water supply. Fig.1, shows the RE4/2 Cu cooling sets ready for dispatch to CERN after having qualified the leak test criteria. So far 118 of the 200 sets have been dispatched to CERN, which includes 8 sets integrated to 8 RE4/2-RPCs assembled and characterized at NPD and dispatched separately to CERN in May 2013. Mass production of all the 200 sets has been successfully achieved and each month, beginning March 2013, we had been dispatching 20 sets each, after they have qualified the leak test criteria to CERN/U Ghent. Remaining 82 sets are to be leak tested in the coming months, out of which 40 sets shall be dispatched to CERN by the end of September 2013 and the remaining 42 sets would be required for the assembly of RE4/2-RPCs, which are scheduled to be assembled and characterized at NPD for subsequent dispatch to CERN in a phased manner from October 2013 to March 2014.

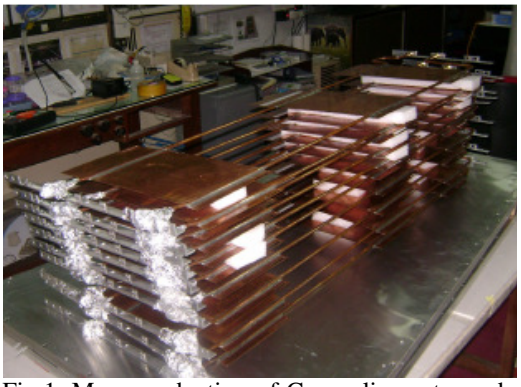

Fig.1, Mass production of Cu cooling sets ready for dispatch after qualifying the leak tests

The distribution of the leak rates of the 118 sets is shown in Fig.2. The leak rate for each Cu cooling set is measured three times and the

average value is plotted in Fig.2. As we see the distribution has a weighted mean at 0.5×10^{-4} mbar.litre.sec^{-1}. We see in the right side of Fig.2, that there are about 5 sets which have been rejected, having a leak rate greater than 5×10^{-4} mbar.litre.sec^{-1}. These rejected sets are from the very first pilot production, where procedures were being laid out about crimping of Sagana make double brass ferrules on semi-hard Cu pipes and measurement of the leak rates with 20 bar pressure of Argon gas [2].

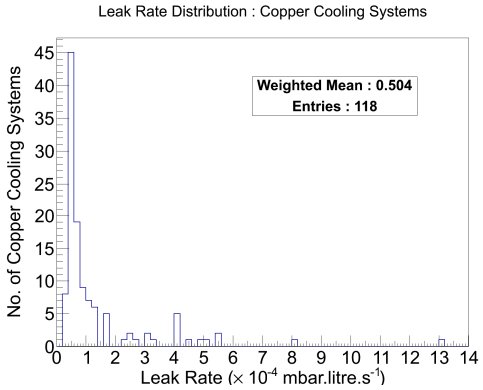

Fig.2, Distribution of leak rates for the 118 Cu cooling sets sent to CERN

The RE4/2-RPCs are assembled and built at NPD-BARC, characterized in terms of their performance parameters [3], fitted with Cu cooling sets and then dispatched separately to CERN. The RE4/2-RPC is then mated with RE4/3-RPC and a Super Module (SM) assembly is configured at CERN, as shown in Fig.3.

Fig.3, A Super Module Assembly under leak test for cooling sets at 904, CERN

The intermediate section between the RE4/2 and RE4/3 RPCs is connected via the soft Cu pipes, as shown in Fig.4. The SM assembly further undergoes a leak test before being subjected to hydraulic tests. 36 SM assemblies are required for the installation of the first end-cap scheduled in October 2013. All the required Cu cooling sets for installation of the first end-cap are secured at CERN.

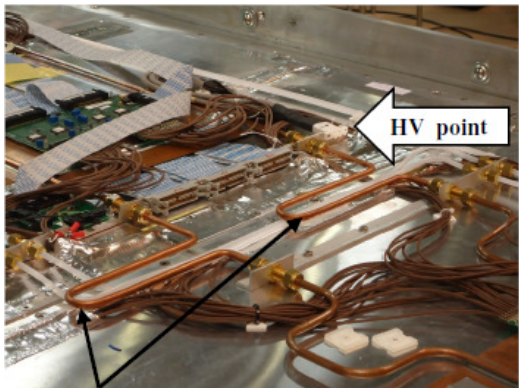

Fig.4, Soft Cu pipes used in the intermediate section between RE4/2 and RE4/3 RPCs

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References :

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