RPC Power System

The RPC Power system is based on CAEN Easy3000 system technology and infrastructure. It includes mainframes and branch controllers, which realize the communication between the hardware (detector) and the software (Detector Control system, DCS) via the CAEN OPC server. The branch controllers (CAEN A1676A modules) are hosted inside the mainframes (SY1527) to control up to 6 Easy crates. Up to 7 HV boards and 5 LV boards can be housed in one Easy crate to supply the HV and LV power to the RPC chambers in the CMS detector and the power to the RPC Link system. The present SY1527 mainframes are planned to be gradually replaced by the CAEN SY4527 mainframes before 2022. Since many of the electronic components inside CAEN HV and LV boards of type A3512N and A3009 are already obsolete, it is planned to produce new boards of the same type with new in-built components, all compatible with the present equipment.

HV Power System

The RE3/1 and RE4/1 HV power system will be accommodated in the actual RPC HV power system, occupying 10 racks (S1H02 to S1H11) located in the underground service cavern (USC), therefore no new branches and mainframes will be required. The upgrade system will be distributed in 4 existing racks following the same regional power collection schema as of the present endcap detector: positive near (S1H08), positive far (S1H09), negative near (S1H10) and negative far (S1H11). The same type of CAEN A3512N 6-channel HV boards, supplying up to 12 kV negative polarity, will be used.

Unlike the present RPC Endcap HV system, one upgrade RE3/1 or RE4/1 chamber will be connected to one HV channel, therefore 72 channels or 12 HV boards, distributed equally in 4 new Easy3000 crates, will be needed. Eight HV Distribution boards, with 9 active and 1 spare channel each, will be used to split the power of each HV channel into 2 lines supplying power to the Top and Bottom chamber HV layers. Eight umbilical cables with 10 two-core cables inside will be needed to bridge the detector HV Patch panel (YE1 PP) located in the Experimental cavern (UXC). The US-UX connection for the upgrade chambers at the YE1 PP was already foreseen in the initial PP design. From there, single channel HV cables will go through the mini Cable Chains (mCC) to reach the YE3 where they will be redistributed around the peripheral cable trays. Numerous CPE Jupiter connectors will be demanded to realize the multiple connections from the HV boards up to the RPC chambers (see Table 2).

Table 2: RPC HV system components for the RE3/1 and RE4/1 upgrade project

|  |  |
| --- | --- |
| Equipment | Quantity |
| CAEN Easy3000 crates | 4 |
| 48V Service cables | 8 |
| Anderson Connectors for Service power | 32 |
| CAEN A3512N HV boards per crate | 3 |
| Total number of CAEN A3512N HV boards | 12 |
| HV coaxial cables | 80 |
| HV Distribution boards | 8 |
| HV Jupiter Connectors  | 1024 |
| Umbilical cables (8 needed, 1 already installed, inherited from GEM during LS2) | 8 |
| HV cables | 72 |

LV power System

The RE3/1 and RE4/1 LV power system will be an extension of the present RPC LV system, located mainly in UXC, powered, and controlled through CAEN A1676A branches from the USC rack S4F03. However, for cost and rack space optimisation, the powering schema of the upgrade chambers will differ from the one of the actual detector. To supply the LV power to the front-end electronics (FEB) we will replace the 12-channel, 8V/45W per channel, CAEN A3009 boards with 6-channel, 8V/90W per channel, CAEN A3016 LV boards. In addition, 2 A3016 channels will power three 20º chambers, instead of two 10º chambers as at present 2 CAEN A3009 channels do, in an optimal regime of operation of about ~70% of max power. This will provide excellent segmentation as one A3016 LV board will power 180º in phi coverage, therefore 2 boards per end and station or 8 boards in total will be needed. Those boards would require 4 new Easy3000S crates to be installed at the four corner towers of the endcap detector (positive near, positive far, negative near, negative far) and additional 2 branches in the Endcap LV mainframe in rack S4F03, to control the newly installed equipment for the upgrade chambers (see Table 2).

Lack of rack space and optimisation of costs may dictate that the very same racks and Easy crates of the present RPC LV system (already in UXC: X3A51, X3S51, X3J51 and X3V51) will be used to power the new chambers. This implies a redesign of the entire LV system by regrouping the existing LV power cables into smaller quantity of A3009 LV channels in order to liberate slots for 2 A3016 boards per crate in order to fully accommodate the upgrade equipment into the entire RPC LV system.

Table 2: RPC LV system components for the RE3/1 and RE4/1 upgrade project

|  |  |
| --- | --- |
| Equipment | Quantity |
| CAEN EASY3000S Crate | 4 |
| CAEN A1676A Branch Controller | 2 |
| CAEN A3016 board per create | 2 |
| Total number of CAEN A3016 board | 8 |