Cooling

The ECAL is cooled by water circulation. There are two systems. The first one will provide a precise thermal regulation of the front-end electronics and of the crystals and has to remove about 12 kW. The second is a simple cooling system which will maintain the temperature of the readout electronics below 25 °C and has to remove 100 kW. Both systems are inside the magnet of CMS. The water will be distributed by an array of soldered copper pipes. Each system is fed from outside by six input and six output pipes. The flow of water is around 50 l/s in the first system and 5 l/s in the second one. The total amount of water within the detector volume is estimated to be about 5000 l. The pressure of the water should be kept below 5 bars everywhere. All precautions to avoid leaks will be taken. Nevertheless, the level, the input and output temperature and the pressure of the water are permanently monitored. The in-flow and out-flow will also be controlled and an alarm generated if these are not equal. In the case of an anomaly, a system of interlocks controlled by computer isolates various parts of the system, stop the water circulation, and lower the pressure as much as possible in order to limit the amount of water escaping. In the case of a small leak, the system is stopped and evacuated. In the case of a water circulation problem (for example pump failure), a hard-wired interlock system will cut the low voltage power within one second, in order to avoid any temperature rise in the electronics.