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LHC Cryogenic Infrastructure Reliability, Towards High Availability

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The operation of the LHC accelerator requires a large cryogenic infrastructure composed of eight cryoplants at 4.5 K, eight units at 1.8 K and the associated cryo-distribution, supplying each ring sector and using a variety of equipment with over 3'500 operating conditions to manage. In order to maximize the availability of the machine and meet the requirements for physics, constant attention is required on cryogenics and its operational margins, which are highly dependent on several phenomena among them the electron-cloud heat loads originated from the beams, requiring careful management.

In this workshop, we will describe the LHC cryogenic system architecture and the reliability management using basic functional analysis and identification of critical failure modes. We will explain anticipated operation scenarios that can be set to mitigate, when possible, occurrence of failures. We will highlight the observed main failures in the past years and actions taken to either prevent or mitigate risk of occurrence. Finally, we will discuss ongoing work to collect detailed failure data during operation, in order to improve continuously the overall availability of the cryogenic system.

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