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CERN LHC Cryogenics: availability calculation tool improvement and new helium balance monitoring tool development

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The Large Hadron Collider (LHC) cryogenic system architecture is made up of eight independent cryogenic plants at 4.5 K linked with eight units at 1.8 K and the associated cryo-distribution system, supplying each of the eight ring sectors with superfluid helium for a total helium inventory of more than 130 tons. It is using a wide variety of equipment with over 3’ 500 operating conditions to manage in order to allow beams to circulate and be maintained for physics production. These conditions mathematically define the availability of the system. Meeting the requirements for the production of beam for physics imposes to maximize this availability. A constant attention is required on optimal functioning of cryogenics as well as its operational margins. This implies reliable and efficient tools to ensure a close and on-line follow-up. This presentation will briefly recall the LHC cryogenic system architecture before focusing on the definition and calculation of LHC cryogenics availability, taking into account operational margins. We will highlight the optimization and automating of the availability calculation tool performed during the RUN 2 period from 2015 to 2018 inclusive, allowing more precise statistics production in less time. Complementary aspects regarding the possibility to push data from the tool to the CERN Accelerator Fault Tracking (AFT) are presented. The ongoing development of an automatic tool to monitor the helium inventory based on the methodology developed for the automatic calculation of availability statistics will be introduced. Ongoing work to use these tools in collecting early warning signals data during operation, thus allowing to even more improve the overall availability of the LHC cryogenic system, will be discussed. Finally, the overall availability results and helium management of the LHC cryogenic system during the RUN 2 operational period will be presented.

Primary author: DELPRAT, Laurent (CERN)

Co-authors: FERLIN, Gerard (CERN); Mr YTTERDAL, Thomas (CERN TE-CRG)

Presenter: FERLIN, Gerard (CERN)

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