Heat and mass transfer analysis for the design of the cryogenic system for the HL-LHC IT String

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The High Luminosity LHC (HL-LHC) project is aiming to upgrade the LHC collider by increasing its peak luminosity by a factor of five. The Inner Triplet (IT) magnets of Interaction Regions 1 and 5 will be replaced by new magnets cooled by pressurized HeII at about 1.9 K. A string of magnets, about 60 m long, representative of the final HL-LHC configuration, will be installed in the SM18 test facility at CERN in 2021 to validate the assembly procedures and to investigate the collective effects.

The cryogenic system of to cool the HL-LHC IT String consists of two sub-systems: 1) the String Cryogenic Transfer Line (SQXL) and 2) the Proximity Cryogenic Distribution System (PCDS). The SQXL is the section of transfer line that connects to the magnets and reproduces the characteristics of the cryogenic transfer line to be installed in the LHC tunnel. The PCDS includes all the equipment required to connect the HL-LHC IT String to the SM18 cryogenic infrastructure and perform the foreseen operation modes.

We present the heat and mass transfer studies performed to determine the layout and assess the performance of the Cryogenic System of the HL-LHC IT String. The study focuses in particular on the cool down, the performance required in the various operating modes and following magnet quenches.