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Outsource production and the design of Phase-2 CO2 cooling systems.

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During the planned long shut-down (LS3) period in the years 2026-2029, significant upgrades are scheduled for the LHC accelerator and its experiments." The main aspect of this upgrade involves installation of the next generation of silicon particle detectors in ATLAS and CMS experiments, which will require to dissipate several hundred kilowatts of heat. To manage the harsh conditions and thermal requirements of these detectors, a new CO2 cooling system based on the parallel operation of multiple modular units has been developed. Each one of these new modular CO2 units will consist of a cooling plant and an accumulator situated in the ATLAS and CMS service caverns, which deliver cold saturated liquid CO2 of -40°C to the silicon detectors via distribution manifolds and a series of long transfer lines. The plants and accumulators produce together liquid CO2 at a minimum temperature of -53°C. The pressures in the systems can be as high as 100 bars, which is the design pressure of all the system components.
The new systems are one order of magnitude larger in cooling power and volume than the previous systems installed at LHC. Consequently, extensive modifications were necessary to adapt the well-established 2PACL concept to meet these demanding cooling requirements. This involved, among other things, enlarging the size of the 2PACL plant, increasing the diameters of the piping up to industrial standards size DN50, and enhancing the capacity of the LEWA pumps to deliver 1.58 kg/s of CO2. Additionally, the accumulator has been relocated from the 2PACL plant, with its primary function now focused on set-point control, while storage of the additional CO2 volume is managed by a separate surface storage vessel. Another big change in the CO2 cooling concept is the introduction of the so-called accumulator flow-through. This involves the condensation of the vapor in the accumulator rather than in the plant condensers. This has the benefit of saving large amount of control heat in the accumulator.

This talk will cover the design of the new 2PACL system made at CERN, the challenges that were encountered, including in outsourcing the production of in-house designed units, and the solutions that were implemented into the final mechanical design of both Plant and Accumulator by the companies who are producing the units. The presentation will cover the production status as well as the effort made to achieve CE marking for both sub-systems.

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