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C4Or1B-03: Process control system evolution for the LHC Cold Compressors at CERN

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The Large Hadron Collider (LHC) operates using superfluid helium provided by eight large refrigeration units (2.4 kW @ 1.8 K each). These units supplied by specialized cryogenic industrial suppliers are composed of serial hydrodynamic cold compressors based on an axial-centrifugal impeller coupled with volumetric warm screw compressors.

The process control systems delivered by the suppliers have been installed, commissioned and operated reliably for more than 13 years. However, the implemented process control closed configuration approach limits of the operational diagnostic, and required operational flexibility and adaptability of the cold compressors systems. In the frame of the CERN evolution of process control standards, the LHC cryogenic operational requirements together with the end of electronic components life cycle has motivated an upgrade of the whole process control system.

Through a step-by-step analysis process including the initial operational risk analysis, CERN has conceived and engineered two prototypes with their dedicated functional analysis and process control logic to cover the complete range of system operation. These prototypes have been initially fully tested in an off-line configuration and after that validated in real system operation.

This paper presents the whole process, the successful results obtained and the perspectives for the future deployment during the LHC Long Shut-Down 2 (2019-2020) period.

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