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Mon-Mo-Po1.01-04 [3]: Performance of the Large Hadron Collider's Cryogenic Bypass Diodes over the First Two Physics Runs, Future Projects and Perspectives

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Cryogenic bypass diodes have been installed in all superconducting dipole magnets (1232) and all main superconducting quadrupole magnets (392) of the Large Hadron Collider (LHC) at CERN, and operated during the physics runs since 2009. The by-pass diodes are a fundamental ingredient of the quench protection system for those main dipoles and quadrupoles magnets. Diodes are located inside the magnet cryostats, operating in superfluid helium and exposed to ionizing radiation. The connection between the superconducting magnet and the bypass diode is made through a mechanically clamping system and copper bus bars. Since their first installation, all LHC diodes have undergone at least one full thermal cycle (from 1.9 K to room temperature and back to superfluid helium temperature).
The evolution of electrical parameters as well as improvements and modifications made over a period of 10 years are reviewed under a critical eye.
The maximum estimated dose accumulated for one single diode is today of the order of 500 Gy. A test setup has been developed to qualify diodes for higher neutron fluences and integrated doses than they were initially. The setup was installed at CERN in a radiation test facility and diodes irradiated at cryogenic temperatures over 2018. The qualification process has allowed to identify three candidates that could be used for the new High-Luminosity LHC circuits. This paper will also report on the behaviour and performance of the diodes that have been measured.
With CERN preparing for LHC's High Luminosity era, the long-term strategy for cold diodes will be presented, based on the overall results and experience gathered so far.

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