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Mon-Af-Po1.16-04 [47]: Protection Studies of the HL-LHC circuits with the STEAM Simulation Framework

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This paper presents a summary of protection studies being performed within the scope of the High-Luminosity Large Hadron Collider (HL-LHC) upgrade with the STEAM (Simulation of Transient Effects in Accelerator Magnets) simulation framework.

The HL-LHC upgrade features new technologies that are to be introduced into the Large Hadron Collider (LHC). This includes challenging Nb3Sn-based magnets with current densities that exceed those of the NbTi-based magnets presently used in the LHC, as well as new protection strategies such as the Coupling-Loss-Induced-Quench (CLIQ) device. Therefore, it is important to study the impact of these new technologies on the transient behaviour and protection aspects of the HL-LHC upgrade. These studies feature quench simulations of the various HL-LHC circuits where both the protection of the magnets and the busbars are considered. In addition, less common simulations types are done, such as studies of the impact of spurious quench heater and CLIQ firing on the beam, and the impact of fast losses arising from asynchronous beam dumps on the voltage-to-ground in the affected magnets.

The STEAM framework provides numerical tools for the efficient and accurate modelling of accelerator magnets, busbars and circuits. Beyond accurately modelling individual system components, STEAM also emphasizes the systems-engineering point of view, under which failures in one component (magnets, busbars, circuits, controls, etc.) cause system-wide repercussions that are studied with a cooperative simulation approach. These studies are relevant for the understanding of protection aspects and the preparation for the HL-LHC upgrade. Moreover, they will serve as references for performance evaluation of the upgraded machine.

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