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Reliability analysis of the new beam Interlock system for CERN's accelerator complex

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The Beam Interlock System is a key element of machine protection in CERN's accelerators. It provides a fast and reliable way to link the accelerator systems to the beam dumping system, which ensures the safe extraction of the beams. This paper presents the reliability study of the new Beam Interlock System, which will replace the current system and will be deployed during CERN's Long Shutdown 3. The upgrade features many improvements while maintaining the proven architecture of the previous system. In the study, each of the system's boards were analysed through a detailed, component-level FMECA. This approach quantifies all operational risks, as well as identifies the most critical components. The risk on the system level is estimated using a global reliability model, which establishes functional dependencies between individual boards. It accounts for system-level redundancies, inspection and maintenance strategies. The results show that the stringent reliability requirements, set in the view of possible catastrophic damages to the equipment in case of malfunction, are met with safety margins. They also highlight the importance of appropriate maintenance, testing and monitoring.

Footnotes

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