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Quantitative Reliability Demonstration from Production to Operation on the Example of the new Radiation Tolerant Power Converter Controller for the LHC

Highly reliable systems rely on methodical procedure during the design phase, production and deployment. This paper presents a methodology that covers production quality, reception tests and field analysis on the example of the mass produced accelerator control system for the LHC (FGClite). The production quality analysis of each board consists of functional tests based on the PXI test platform. Accelerated life tests at elevated temperature ("burn-in") are then used to accumulate mission time in order to prove a certain reliability level before deployment. Both production quality analysis and burn-in lower the number of post-deployment infant mortality failures significantly. In order to assess the FGClite reliability after deployment, the instantaneous failure rate is monitored quantitatively. This allows to detect possible early wear-out failures and forecast the number of failures for the next period of time. It is then discussed whether a constant failure rate is observed after deployment and appropriate to model electronic systems, since the applied Weibull Analysis is sensitive to certain assumptions.

Primary author: Mr TEVETOGLU, Tamer (CERN and Universitaet Stuttgart (DE))

Co-authors: UZNANSKI, Slawosz (CERN); Dr TODD, Benjamin (CERN); Prof. BERTSCHE, Bernd (Institute of Machine Components, University of Stuttgart); Mr HERZIG, Thomas (Institute of Machine Components, University of Stuttgart)

Presenter: Mr TEVETOGLU, Tamer (CERN and Universitaet Stuttgart (DE))

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