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Solid State Thyratron Replacement for the LHC Klystron Crowbar

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The counter-rotating proton beams in the Large Hadron Collider (LHC) are captured and accelerated to their final energies by two identical 400 MHz Radio Frequency (RF) systems. The RF power source required for each beam comprises eight 300 kW klystrons. Each unit of four klystrons is powered by a 100kV/40A AC/DC power converter. A fast protection system (crowbar) protects the four klystrons in each of these units.

Although the LHC RF system has shown has very good performance, operational experience has shown that the five-gap double-ended thyratrons used in the crowbar system suffer, from time to time, from auto-firing, which result in beam dumps.

A solid state solution, based on a stack of thyristors, has been designed for a direct thyratron replacement and has been fully validated and installed in one of the four bunkers in the LHC in September 2012. After five month it has proven to give full satisfaction. Ten thyristors stack based crowbar are under production and tests to equip the three other bunkers, the tests stand and spare part.

Primary author: RAVIDA, Gianfranco (CERN)

Co-authors: Dr VALUCH, Daniel (CERN); BRUNNER, Olivier (CERN)

Presenter: Dr VALUCH, Daniel (CERN)

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