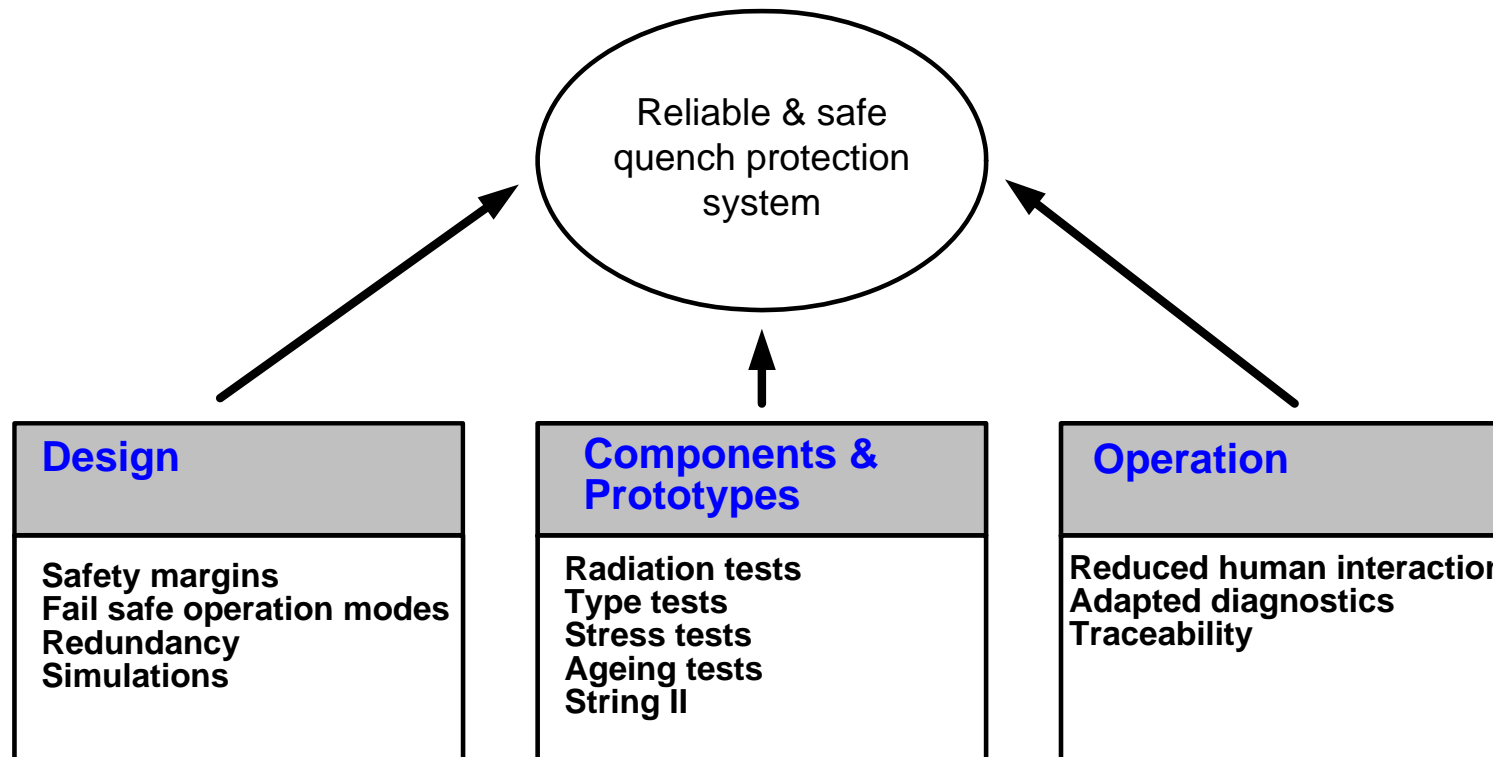


QPS Standard Component Failures

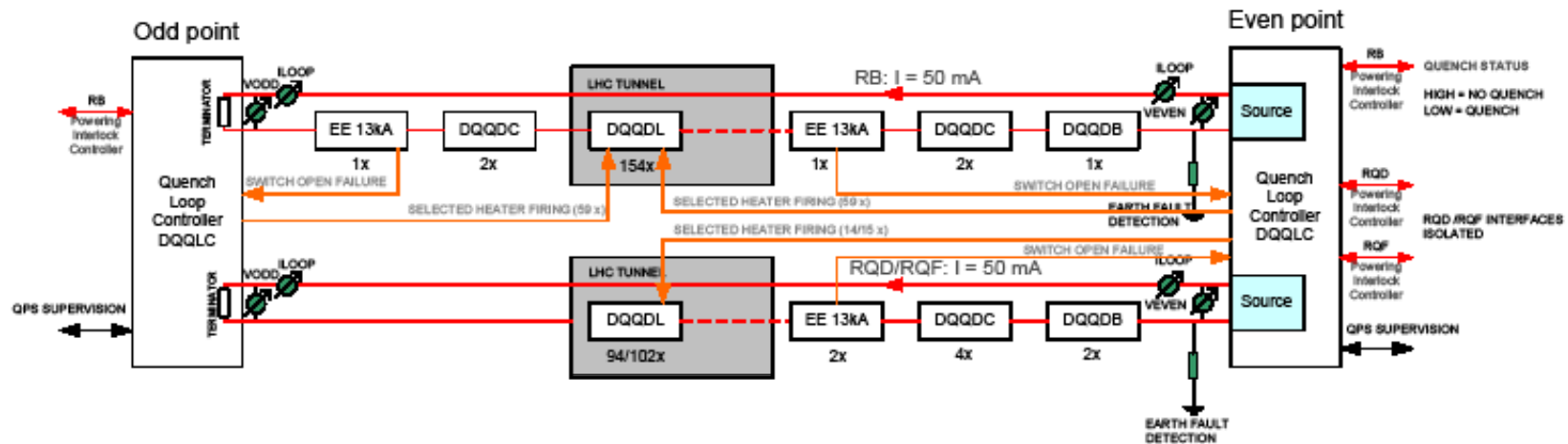
R. Denz TE-MPE-CP



- General convention for quench status signal:
 - HIGH = NO QUENCH LOW = QUENCH
- Quench status signal will change to LOW:
 - Quench detected
 - Detector power supply failure
 - Detector board disconnected
 - Instrumentation wire(s) lost
- Hardwired interlocks (current loops)
 - One interlock per circuit (exception RB interlock in odd and even point)
- Software signal for QPS power permit
 - Calculated by each individual controller and QPS supervision
 - Given per circuit and requested prior to powering or re-start of a ramp



- Active triggers for quench heater power supplies
 - Enhanced noise immunity, avoid massive magnet quenches
- Redundant power supplies for protection of all elements but main magnets (MB and MQ)
 - Installation of redundant power supply for main magnets optional (~ 1 MCHF)
- Redundant (after upgrade) UPS for all systems
 - Each UPS feeds 50% of quench heater power supplies
 - Guaranteed autonomy $t = 600$ s
- Redundant instrumentation wires for all detectors
- Redundant detection electronics always wired in 1 out of 2 configuration
 - Main magnet quench detector has a redundant analog input and comparator stage wired in a 2 out of 2 configuration (spurious trigger suppression)



DQQDC: detector HTS leads
 DQQDB: detector main busbar
 DQQDL: detector magnet
 EE13kA: energy extraction 13kA

Detection electronics ruptures interlocks either with relays or PhotoMos devices.

- Several levels of testing
 - Device manufacturer & reception test @ CERN
 - Final complete functional testing prior to installation in the LHC
 - Functional tests after installation in the LHC repeated on a regular basis
 - Communication, interlocks, detection levels, quench heater circuits
 - All detection systems are equipped with an internal test mode feature allowing the generation of analog test signals on request
 - Initiated via QPS supervision by sending a sequence of 2 protected commands
 - Type testing done for each protection element
 - Functional tests, EMC tests, radiation tests ...
- Permanent supervision of all QPS devices
 - Data transmitted to LHC logging database
 - Analysis of each post mortem event (e.g. mandatory for quench heaters)

- Equipment so far installed in the LHC tunnel
 - Tolerant up to a total integrated dose of 200 Gy (1×10^{12} ncm⁻²)
 - Single Event Upset free
 - Tested & qualified in the former TCC2 radiation test area
- Cold diodes 2 kGy 1×10^{13} ncm⁻² (radiation hardened device → see LHC Project Report 688)
- Equipment installed in the LHC underground areas
 - Partly hardened and tested – main concern are SEE
 - Further tests and development to be done
 - Firmware to be adapted
- Equipment of the QPS upgrade
 - Partly tested in CGNS test area in 2008
 - Expected to work correctly in the dipole B location
 - Firmware to be adapted
 - Further testing necessary (next test in April 2009)