Issues around the “CRYO-OK” Signal

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Issues around the 'CRYO-OK‘

- Historically (→ STRING 2) “CRYO-OK” has been treated in a similar way as the “Power-Permit” signal
  - Necessary at the beginning of a powering sequence but not interlocking
  - Generation and transmission by software on supervision level
  - Decision up to operator whether to abort powering or not
- Approach not regarded as adequate for LHC (AT-ACR and AT-MEL)
  - Imminent risk of a quench
    - Quenches to be avoided whenever possible (cooling time etc…)
  - Potential problems with refill of the machine
    - Due to the likely change in temperature magnetisation in the magnets may/will change, even when no quench occurs
  - In consequence the absence of “CRYO-OK” should trigger a slow power abort (automatic ramp down of the machine)
    - In that case unmanned cryo operation may be possible

Conditions for CRYO-OK (L. Serio – see as well his recent MPWG presentation)

Accelerator Technology Department

- **CRYO-OK given (per powering sub-sector):**
  - Superconducting magnets, DFB's and DSL (superconducting links) OK
  - RF OK
  - Sector refrigerators OK
  - Ethernet communication OK
- **CRYO-OK removed:**
  - Magnets above (2 K or 4.7 K)
  - Liquid helium level below threshold in DFB (to cover LTS-HTS joint)
  - Liquid helium level in RF cavities below threshold or pressure above 1.6 bar
  - Current leads temperature above threshold (60 K)
  - DSL temperature above threshold (6 K)
- **i.e. consider only conditions that will rapidly (few minutes) provoke a quench (magnets, current leads, bus-bars)**

Transmission of the 'CRYO-OK‘ signal

- Three possible ways:
  - From CRYO supervision to PIC supervision (PVSS)
  - From CRYO PLC level to PIC PLC level
  - Hardwired link from CRYO to PIC

Reliability increasing

- Recommended solution is to establish communication between the concerned PLC’s
  - LHC hardware commissioning to find the correct settings and therefore maximize the availability of the system
    - Logic for CRYO request for current discharge implemented, monitored but not wired to PIC
  - Link to be activated once the system is well known and the settings have been fully validated at different operating conditions
    - Link regarded as mandatory for safe LHC operation