Controls
Electronics &
Mechatronics

BEAMS

CERN

RUN3 Interlock strategies for:
- LHC collimator and TDIS temperatures
- TDE N2 pressure

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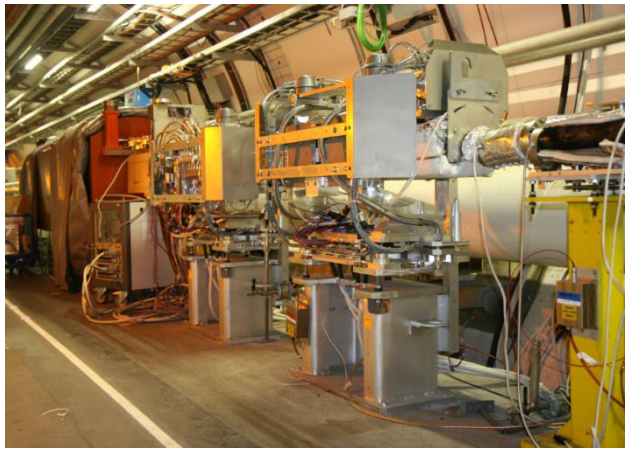
220th Machine Protection Panel Meeting (LHC topics), 18.3.2022

LHC Collimators and TDIS temperatures Interlocks #1

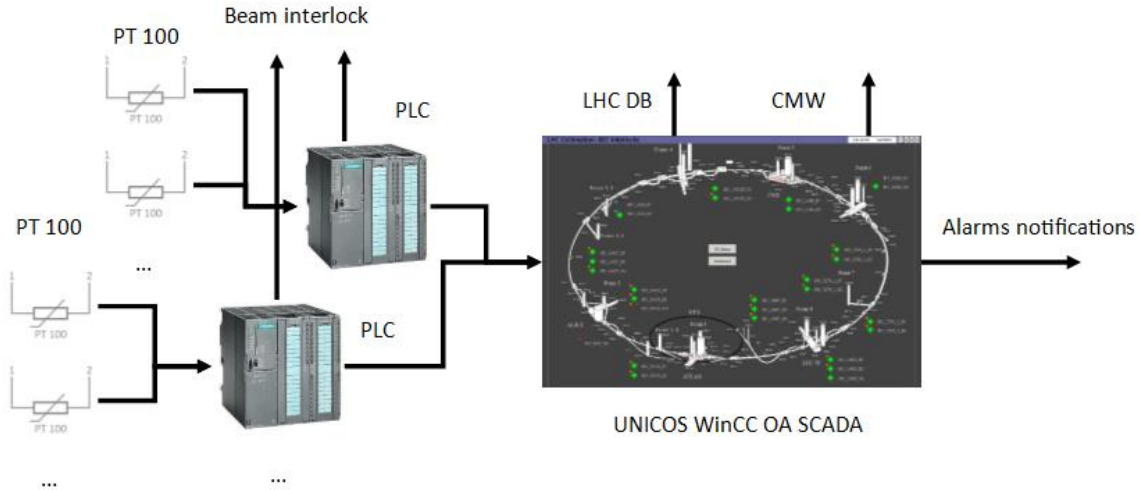
- Continuous monitoring and logging of collimators' and TDIS jaws and cooling water temperatures
- 731 temperature operational in the LHC
- TDIS cooling water flow is also monitored (2 per TDIS, 1 for upper and 1 for lower jaws)
- 12 PLCs directly connected to beam interlock and to UNICOS WinCC OA SCADA

PLC for temperatures monitoring



LHC collimator

LHC TDIS in IP8



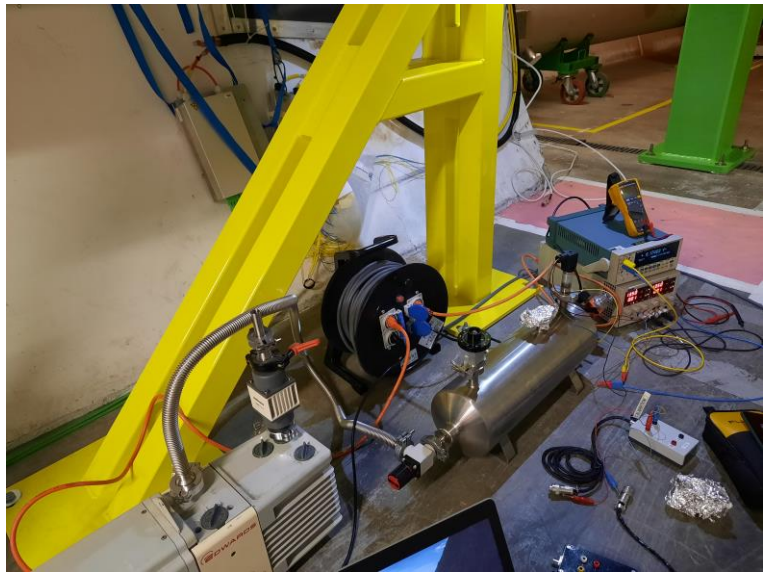
LHC Collimator and TDIS Temperatures monitoring system

LHC Collimators and TDIS temperatures Interlocks #2

- During RUN2, for yet not fully identified reasons, some LHC Collimators and TDIS temperature sensors failed for certain periods of time. In these cases, non-reasonable values (e.g. 3276° C) or very fast temperature changes were read by the PLC. If they persisted for more than 12 seconds, the interlock was triggered and the beam was dumped.
- New filtering algorithm will be present during RUN3 operation, avoiding beam interlocks due to non-physical readings of the collimators jaws temperature.
  - ✓ Discussed and proposed @ 176 MPP meeting and the 248th meeting of the LHC Collimation Working Group.
- HW interlock will be triggered if:
  - ✓ **50 degrees < Jaw Temperature < 500 degrees for more than 12 seconds**
  - ✓ **40 degrees < Cooling Water Temperature < 500 degrees for more than 12 seconds**
  - ✓ **TDIS cooling water flow meter value < 0.5 l/min for more than 12 seconds**
- Interlock temperatures thresholds (currently set to 50 and 40 degrees for jaws and cooling water temperatures) could be adjusted eventually during operation for each individual sensor, as done in the past, in agreement with OP and equipment responsible
- Interlocks are tested and validated using a script integrated in UNICOS after each LS, could be done at each YETS
- If a broken temperature value will be filtered, an alarm is published by PVSS and the BE-CEM piquet service will be notified by the BIDs-controls piquet monitoring tools and the piquet will follow-up the “issue” with OP.
- Draft documentation done and ready to be sent for EDMS approval

LHC TDE N2 pressure monitoring interlock connection#1

- Pirani N2 Pressure gauge installed and calibrated at the entrance of each dump cavern (UD62 and UD68).
- Signal acquired by electronics conditioning unit and PLC located at UJ63 and UK67 (upstairs, rack TYDM01) via cabling that goes through patches at UA63 (rack VY06) and UA67 (rack VY18)



Calibration Setup, with support from TE-VSC
Procedure: EDMS 2480091

Entrance to UJ63, and rack location upstairs
https://edms.cern.ch/panoramas?id=47788120

Acquisition Rack –
Conditioning and PLC Acquisition

LHC TDE N2 pressure monitoring interlock connection#2

- During discussions during LS2, it has been decided to have the possibility to generate, if needed, SIS interlocks connected to the 2 LHC TDEs N2 pressure during RUN3, if too low
  - ✓202nd Machine Protection Panel Meeting (LHC)
- The reading of the N2 pressure gauge has been connected through a PLC that is publishing N2 levels through FESA

✓ The device names are the same as those used in run 2:

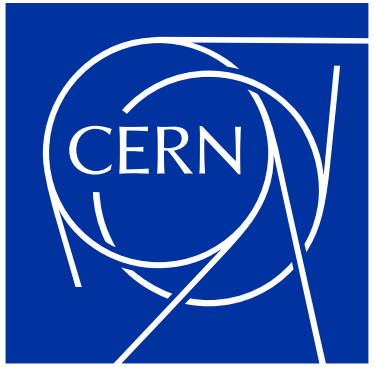
- VGMA.689462.B (for beam 1, at cavern UD68)
- VGMA.629462.R (for beam 2, at cavern UD62)

✓ The relevant FESA fields are:

- LHCTDEPressure/Acquisition/pressure (float value of the pressure sensor (mBar)) → SIS could be connected, threshold could be changed by OP
- LHCTDEPressure/Status/beamPermit * (bool value of the permit) → SIS could be connected, threshold value decided by equipment owner and OP and changed if needed by BE-CEM piquet expert

- Infrastructure ready to be connected to HW trigger if needed in the future
- Logging in NXCALS at 1 Hz (TDE_UD68:N2_Pressure_APR017 and TDE_UD62:N2_Pressure_APR017)
- Logging in postmortem database
  - ✓ Acquisition Points (s): [-180, -120, -60, -1, -0.9, -0.8, -0.7, -0.6, -0.5, -0.4, -0.3, -0.2, -0.1, **0**, +1, +2] , 0 is the time at dump event
- Draft documentation done and ready to be sent for EDMS approval

*name could be changed



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TDE instrumentation – PXI Acquisition

Feature	UD-68	UD-62
Thermal response	• 16 x PT100	• 16 x PT100
Dynamic response	• 15 x Strain gauges • 1 x Trigger Input for DAQ synchronization • 3 x In-house optical accelerometer • 1 x Laser Doppler Vibrometer	• 16 x Strain gauges • 3 x In-house optical accelerometer • 1 x Laser Doppler Vibrometer
Slow movement	• 3 x LVDT	• 3 x LVDT
General monitoring	• 1 x HD camera • 1 x Beam dump trigger	• 1 x HD camera • 1 x Beam dump trigger • 1 x Optic microphone

TDE instrumentation – PXI Acquisition

Sensors at front of dump

HD camera picture

Data acquisition rack