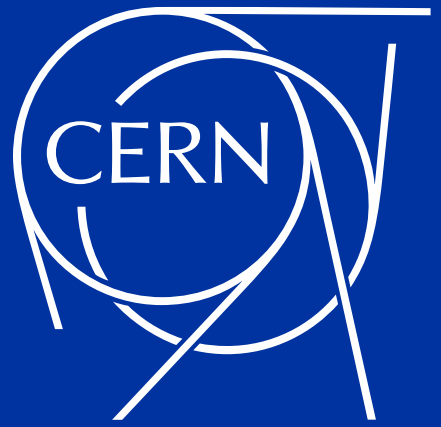

Machine Protection Panel Meeting #257

Modification of Interlocks for RQ4 Circuits at P1 and P5

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21 February 2025

Background

LMC Taskforce initiative

- The LMC mandated a taskforce to assess the impact of radiation on equipment lifetime in the LHC inner triplet regions and propose mitigation measures [CDS 2882512].

Identified Solution

- To reduce radiation exposure on the inner triplet main quadrupole magnets in IR1 (ATLAS) and IR5 (CMS), the taskforce proposed operating with reversed electrical polarities of the RQX circuits.

Implementation & Required Actions

Implementation & Consequences

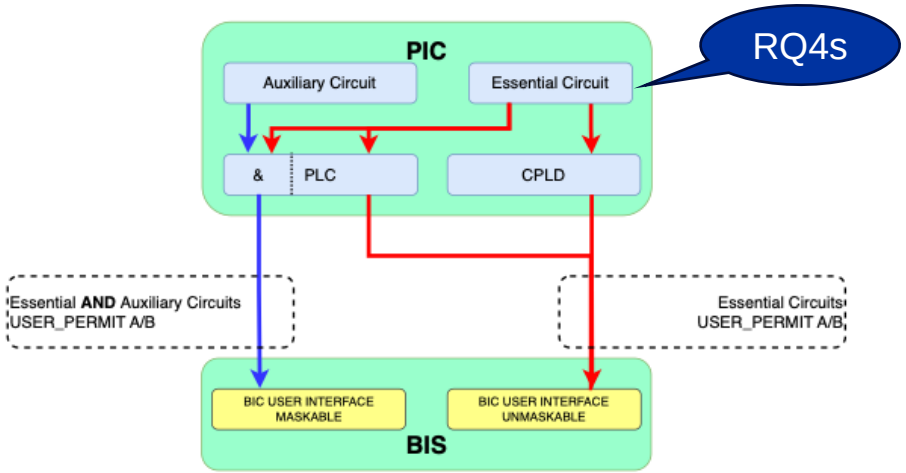
- The reversed polarity were **first implemented in IR1** (ATLAS) **in 2024**.
- This required **switching off the RQ4 circuits in IR1** to align with the new optics configuration.
- However, this led to a **significant increase in background radiation** in the **forward experiments at P1**, **negatively affecting physics production**.
- A review concluded that the best approach is to **reverse the RQX polarity in P5** while **restoring the original configuration in P1** [497th LMC].

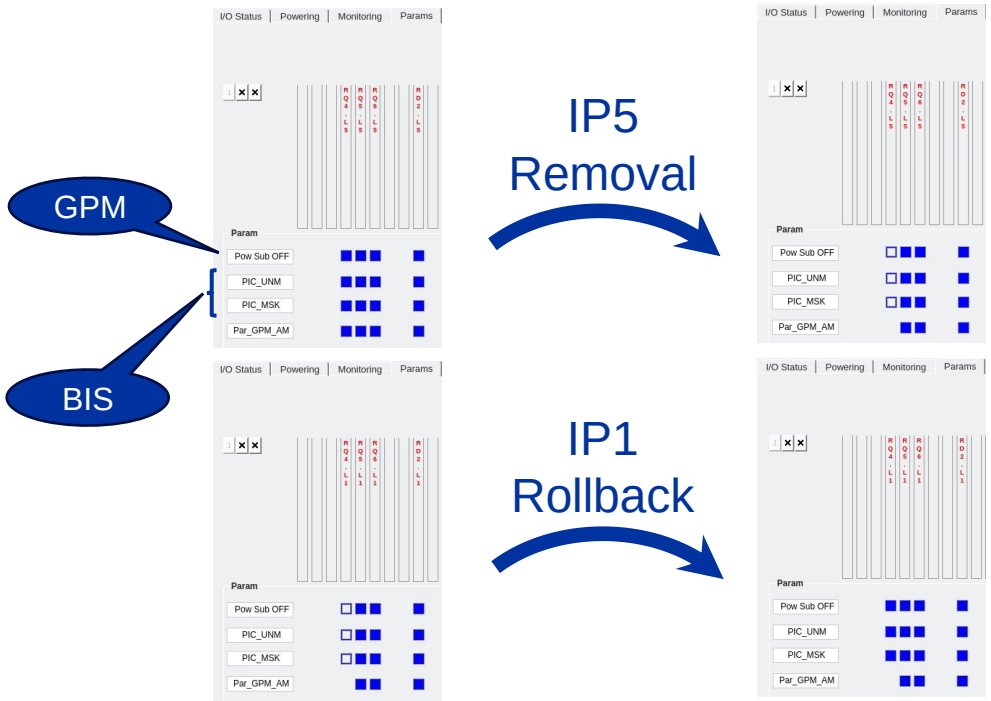
Required Actions

- Switching off the RQ4 circuits in IP5.
- Restoring the RQ4 circuits in IP1 to their original configuration.

Technical Modifications

- **Point 5 (IP5)**
  - Removal of RQ4.L5 and RQ4.R5 circuits from interlock.
    - Modification of CPLD firmware and PLC software.
    - Disabling BIS and GPM inputs.
    - Disable QPS_OK signals, bypass SIS logic, and deactivate HDS interlock in WinCC synoptic.
  - Super-locking of circuits (locking out power converters and quench heaters).
- **Point 1 (IP1)**
  - Restoration of RQ4.L1 and RQ4.R1 circuits into interlock:
    - Modification of CPLD firmware and PLC software.
    - Reactivation of BIS and GPM functionalities.
    - Reinstate QPS_OK signals, restore SIS logic, and re-enable HDS interlock in WinCC synoptic.
  - Removing super-lock and unlocking power converters and quench heaters.



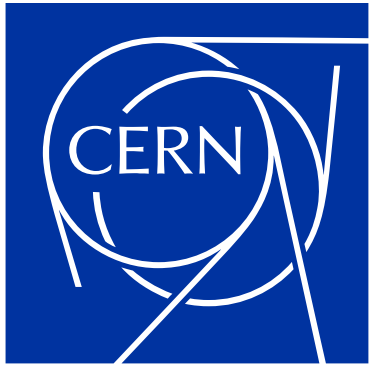


Validation and Tests

- **Tests to be performed after modification:**
  - PIC2 - Interlock tests.
  - PIC-BIC - Interlock connections between PIC and BIS.
- **Revalidation of affected circuits:**
  - Point 1: RD2.L1, RQ4.L1, RQ5.L1, RQ6.L1.
  - Point 5: RD2.L5, RQ4.L5, RQ5.L5, RQ6.L5.

Conclusion and Next Steps

- **Before HWC 2025:**
  - Deployment of PLC and CPLD software modifications.
  - Modification of high-level software: adjust QPS_OK signals, Software Interlock System (SIS) logic and HDS interlock in the WinCC synoptic application.
  - Preparation of tests (AccTesting).
- **During HWC 2025:**
  - Verification of interlock operation (PIC2 tests).
  - Super-locking of RQ4 circuits at P5 **following the completion of powering tests** for the LL5 and LR5 matching sections.
- **Rollback possibility:** All modifications are fully reversible if necessary.



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