Powering interlock changes during LS1

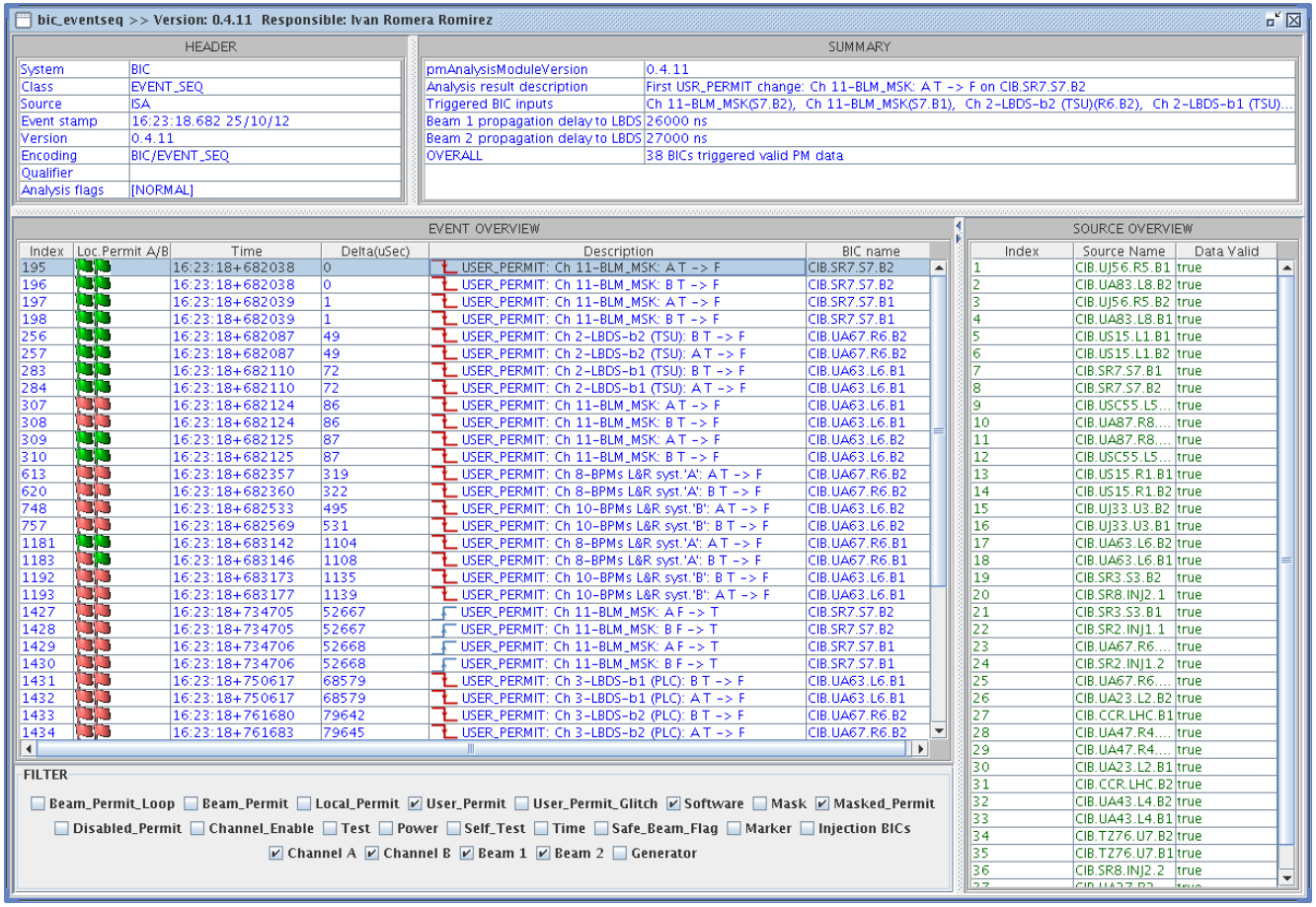
I. Romera
on behalf of TE-MPE-MS…

Outlook

- Powering Permit 60A
- Access powering interlocks
- Global protection mechanisms
- Other activities

Beam dump after losing PP_60A

- **25.Oct.2012 16:23:18.685 => Beam dump at stable beams**
  - Reason: Orbit correctors switched off before the dump



bic_eventseq >> Version: 0.4.11 Responsible: Ivan Romera Romirez

HEADER

System	BIC
Class	EVENT_SEQ
Source	ISA
Event stamp	16:23:18.682 25/10/12
Version	0.4.11
Encoding	BIC/EVENT_SEQ
Qualifier	
Analysis flags	[NORMAL]

SUMMARY

pmAnalysisModuleVersion	0.4.11
Analysis result description	First USR_PERMIT change: Ch 11-BLM_MSK: A T -> F on CIB.SR7.S7.B2
Triggered BIC inputs	Ch 11-BLM_MSK(S7.B2), Ch 11-BLM_MSK(S7.B1), Ch 2-LBDS-b2 (TSU)(R6.B2), Ch 2-LBDS-b1 (TSU)...
Beam 1 propagation delay to LBDS	26000 ns
Beam 2 propagation delay to LBDS	27000 ns
OVERALL	38 BICs triggered valid PM data

EVENT OVERVIEW

Index	Loc.Permit A/B	Time	Delta(uSec)	Description	BIC name
195		16:23:18+682038	0	USER_PERMIT: Ch 11-BLM_MSK: A T -> F	CIB.SR7.S7.B2
196		16:23:18+682038	0	USER_PERMIT: Ch 11-BLM_MSK: B T -> F	CIB.SR7.S7.B2
197		16:23:18+682039	1	USER_PERMIT: Ch 11-BLM_MSK: A T -> F	CIB.SR7.S7.B1
198		16:23:18+682039	1	USER_PERMIT: Ch 11-BLM_MSK: B T -> F	CIB.SR7.S7.B1
256		16:23:18+682087	49	USER_PERMIT: Ch 2-LBDS-b2 (TSU): B T -> F	CIB.UA67.R6.B2
257		16:23:18+682087	49	USER_PERMIT: Ch 2-LBDS-b2 (TSU): A T -> F	CIB.UA67.R6.B2
283		16:23:18+682110	72	USER_PERMIT: Ch 2-LBDS-b1 (TSU): B T -> F	CIB.UA63.L6.B1
284		16:23:18+682110	72	USER_PERMIT: Ch 2-LBDS-b1 (TSU): A T -> F	CIB.UA63.L6.B1
307		16:23:18+682124	86	USER_PERMIT: Ch 11-BLM_MSK: A T -> F	CIB.UA63.L6.B1
308		16:23:18+682124	86	USER_PERMIT: Ch 11-BLM_MSK: B T -> F	CIB.UA63.L6.B1
309		16:23:18+682125	87	USER_PERMIT: Ch 11-BLM_MSK: A T -> F	CIB.UA63.L6.B2
310		16:23:18+682125	87	USER_PERMIT: Ch 11-BLM_MSK: B T -> F	CIB.UA63.L6.B2
613		16:23:18+682357	319	USER_PERMIT: Ch 8-BPMs L&R syst.'A': A T -> F	CIB.UA67.R6.B2
620		16:23:18+682360	322	USER_PERMIT: Ch 8-BPMs L&R syst.'A': B T -> F	CIB.UA67.R6.B2
748		16:23:18+682533	495	USER_PERMIT: Ch 10-BPMs L&R syst.'B': A T -> F	CIB.UA63.L6.B2
757		16:23:18+682569	531	USER_PERMIT: Ch 10-BPMs L&R syst.'B': B T -> F	CIB.UA63.L6.B2
1181		16:23:18+683142	1104	USER_PERMIT: Ch 8-BPMs L&R syst.'A': A T -> F	CIB.UA67.R6.B1
1183		16:23:18+683146	1108	USER_PERMIT: Ch 8-BPMs L&R syst.'A': B T -> F	CIB.UA67.R6.B1
1192		16:23:18+683173	1135	USER_PERMIT: Ch 10-BPMs L&R syst.'B': B T -> F	CIB.UA63.L6.B1
1193		16:23:18+683177	1139	USER_PERMIT: Ch 10-BPMs L&R syst.'B': A T -> F	CIB.UA63.L6.B1
1427		16:23:18+734705	52667	USER_PERMIT: Ch 11-BLM_MSK: A F -> T	CIB.SR7.S7.B2
1428		16:23:18+734705	52667	USER_PERMIT: Ch 11-BLM_MSK: B F -> T	CIB.SR7.S7.B2
1429		16:23:18+734706	52668	USER_PERMIT: Ch 11-BLM_MSK: A F -> T	CIB.SR7.S7.B1
1430		16:23:18+734706	52668	USER_PERMIT: Ch 11-BLM_MSK: B F -> T	CIB.SR7.S7.B1
1431		16:23:18+750617	68579	USER_PERMIT: Ch 3-LBDS-b1 (PLC): B T -> F	CIB.UA63.L6.B1
1432		16:23:18+750617	68579	USER_PERMIT: Ch 3-LBDS-b1 (PLC): A T -> F	CIB.UA63.L6.B1
1433		16:23:18+761680	79642	USER_PERMIT: Ch 3-LBDS-b2 (PLC): B T -> F	CIB.UA67.R6.B2
1434		16:23:18+761683	79645	USER_PERMIT: Ch 3-LBDS-b2 (PLC): A T -> F	CIB.UA67.R6.B2

SOURCE OVERVIEW

Index	Source Name	Data Valid
1	CIB.UJ56.R5.B1	true
2	CIB.UA83.L8.B2	true
3	CIB.UJ56.R5.B2	true
4	CIB.UA83.L8.B1	true
5	CIB.US15.L1.B1	true
6	CIB.US15.L1.B2	true
7	CIB.SR7.S7.B1	true
8	CIB.SR7.S7.B2	true
9	CIB.USC55.L5...	true
10	CIB.UA87.R8....	true
11	CIB.UA87.R8....	true
12	CIB.USC55.L5...	true
13	CIB.US15.R1.B1	true
14	CIB.US15.R1.B2	true
15	CIB.UJ33.U3.B2	true
16	CIB.UJ33.U3.B1	true
17	CIB.UA63.L6.B2	true
18	CIB.UA63.L6.B1	true
19	CIB.SR3.S3.B2	true
20	CIB.SR8.INJ2.1	true
21	CIB.SR3.S3.B1	true
22	CIB.SR2.INJ1.1	true
23	CIB.UA67.R6....	true
24	CIB.SR2.INJ1.2	true
25	CIB.UA67.R6....	true
26	CIB.UA23.L2.B2	true
27	CIB.CCR.LHC.B1	true
28	CIB.UA47.R4....	true
29	CIB.UA47.R4....	true
30	CIB.UA23.L2.B1	true
31	CIB.CCR.LHC.B2	true
32	CIB.UA43.L4.B2	true
33	CIB.UA43.L4.B1	true
34	CIB.TZ76.U7.B2	true
35	CIB.TZ76.U7.B1	true
36	CIB.SR8.INJ2.2	true

FILTER

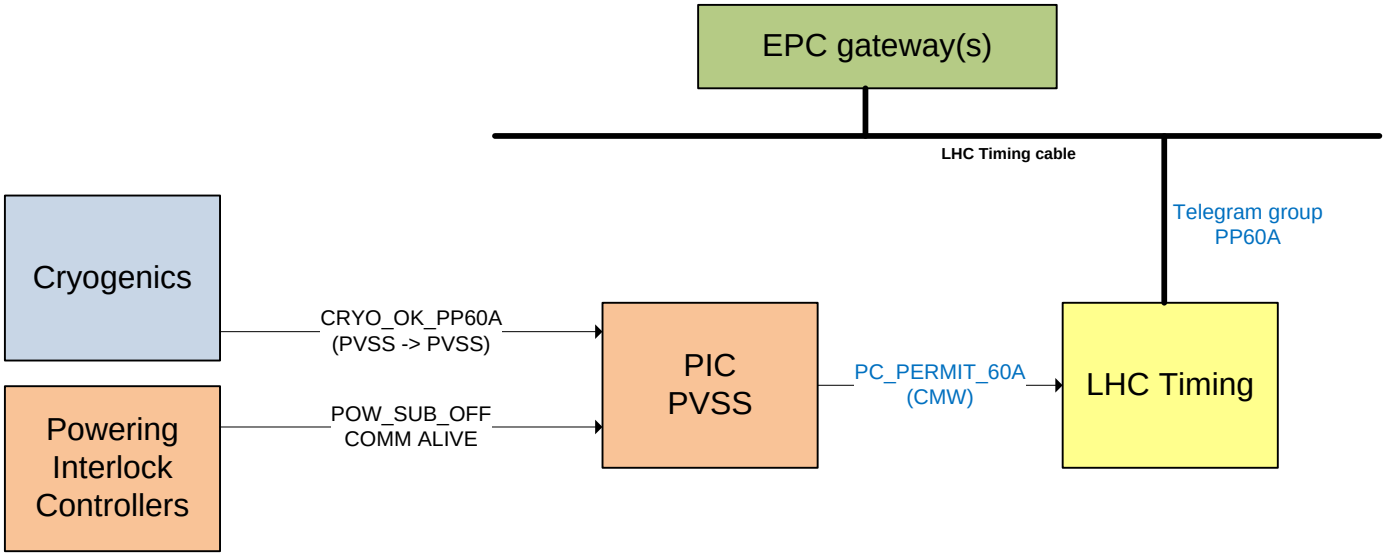
☐ Beam_Permit_Loop ☐ Beam_Permit ☐ Local_Permit ☑ User_Permit ☐ User_Permit_Glitch ☑ Software ☐ Mask ☑ Masked_Permit

☐ Disabled_Permit ☐ Channel_Enable ☐ Test ☐ Power ☐ Self_Test ☐ Time ☐ Safe_Beam_Flag ☐ Marker ☐ Injection BICs

☑ Channel A ☑ Channel B ☑ Beam 1 ☑ Beam 2 ☐ Generator

60A interlock implementation

- **No hardware interlocks** for 60A orbit correctors
- Protection **guaranteed by Power Converters**
- Interlocks **to avoid unnecessary quenches** of magnets and current leads and to help operations
- **PC_PERMIT_60A** derived from cryogenic and powering conditions and **sent via GMT** to EPC gateways



Beam dump after losing PP_60A

- **25.Oct.2012 16:23:18.685 => Beam dump at stable beams**
  - **16:20:38 =>** Ethernet switch communication problem with PIC in AL6

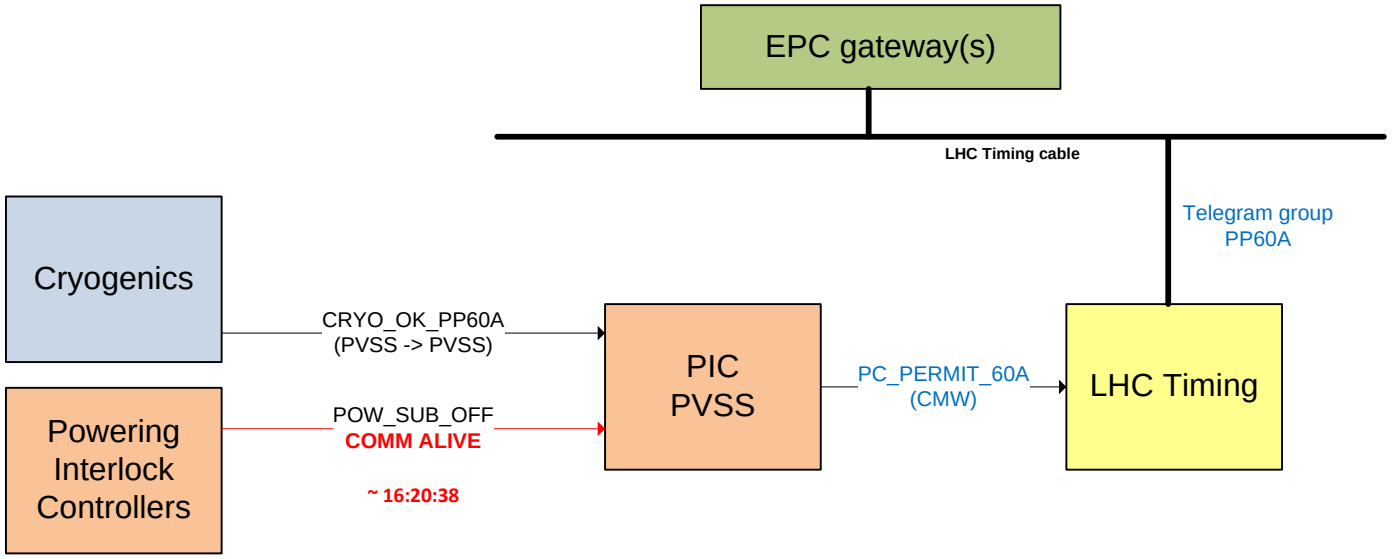
TECHNET of type Universe

Information | Interfaces | Neighbors | Alarms | Events

Show

1556 event(s) from 25-Oct-2012 13:00:00 CEST - 25-Oct-2012 19:00:00 CEST

Severity	Created On	Name	Event	Created By	Cleared On	Cleared By
			hpicfUsrAuthWMAFailVlan = 1 hpicfUsrAuthWMAFailPort = 4 hpicfUsrAuthWMAFailMAC = 00:0e:8c:f7:52:86			
	25-Oct-2012 16:20:38 CEST	p2613-1-ipz-s3c44-1	Alarm number 2433065 with probable cause id 0x10701 generated for device p2613-1-ipz-s3c44-1 of type 3Com44xx. The severity of this alarm is MAJOR.	System		
Major	25-Oct-2012 16:20:38 CEST	p2613-1-ipz-s3c44-1	Device p2613-1-ipz-s3c44-1 of type 3Com44xx is no longer responding to primary management requests (e.g. SNMP), but appears to be responsive to other communication protocol (e.g. ICMP). This condition has persisted for an extended amount of time. An alarm will be generated.	System	25-Oct-2012 16:26:11 CEST	System
			An "hpicfPortSecAuthFailure" event has occurred, from HPProCurve device, named p212-1-in5-shp2l-1.			



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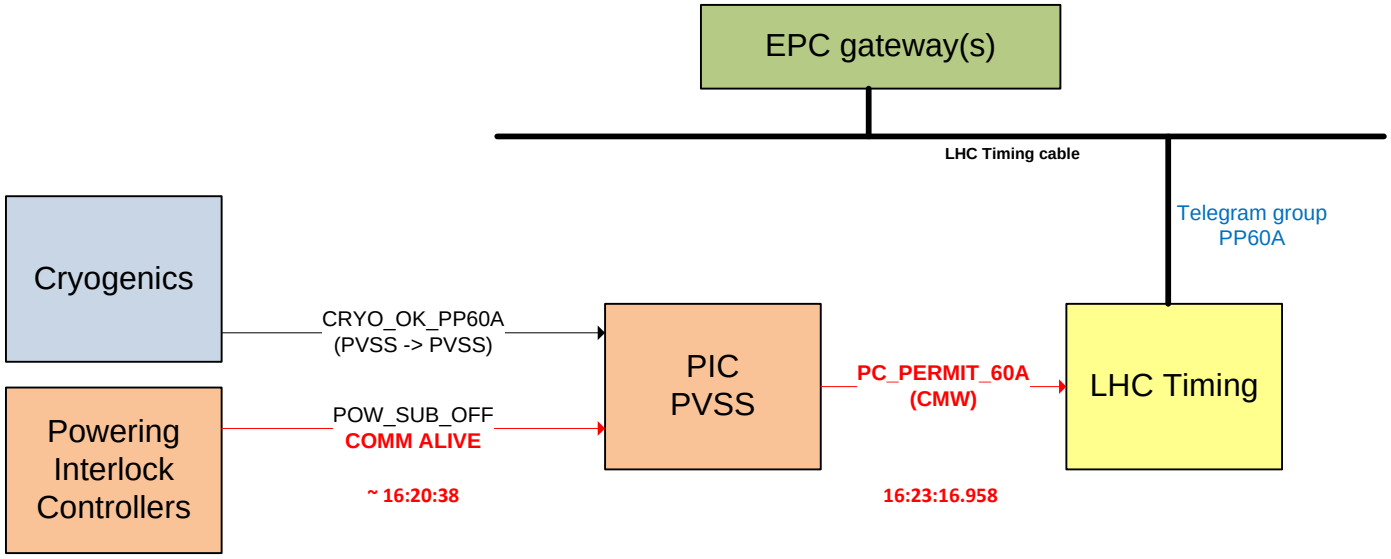

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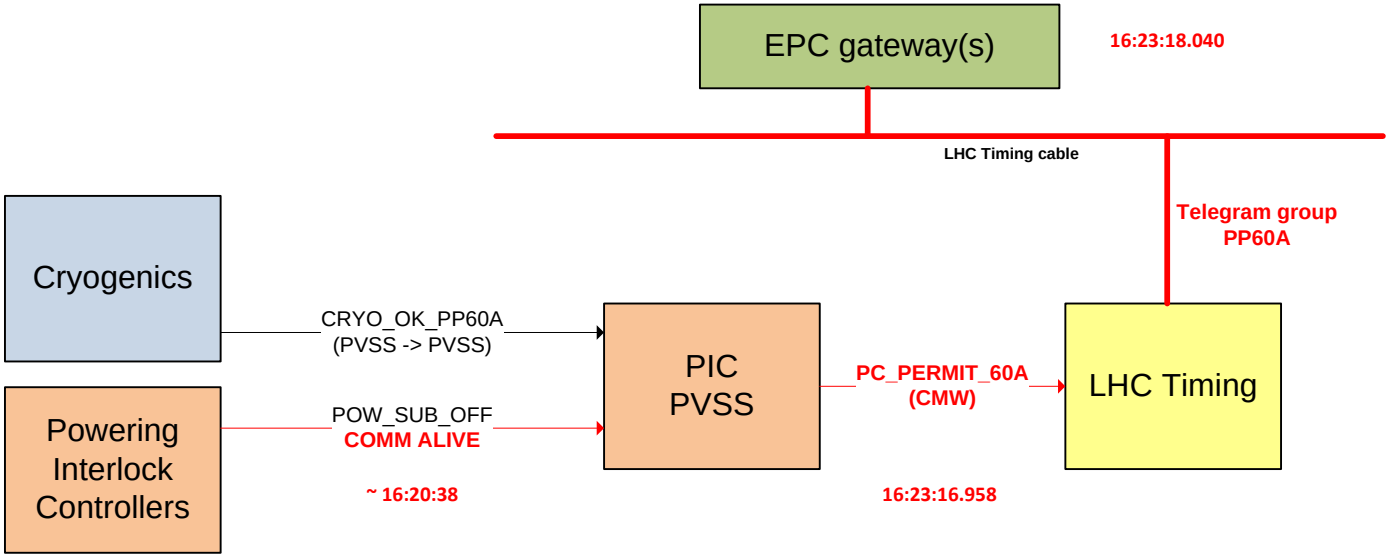

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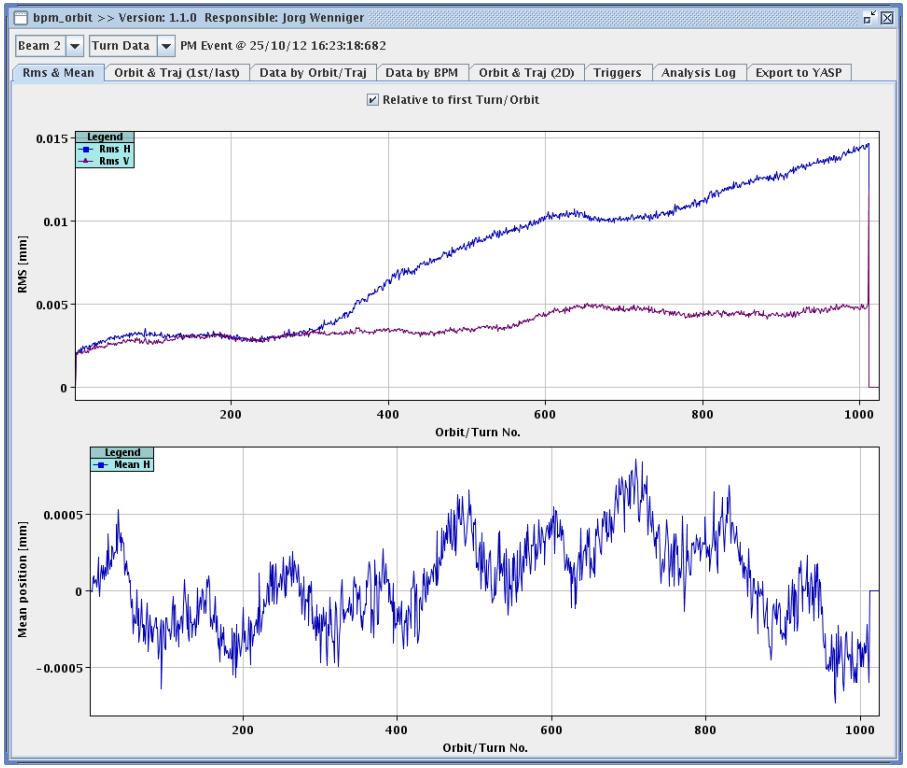
  - **16:23:18.040 =>** Slow power abort received by 60A Power Converters
  - **16:23:18.685 =>** Beam orbit affected and beams dumped by BLMs in SR7

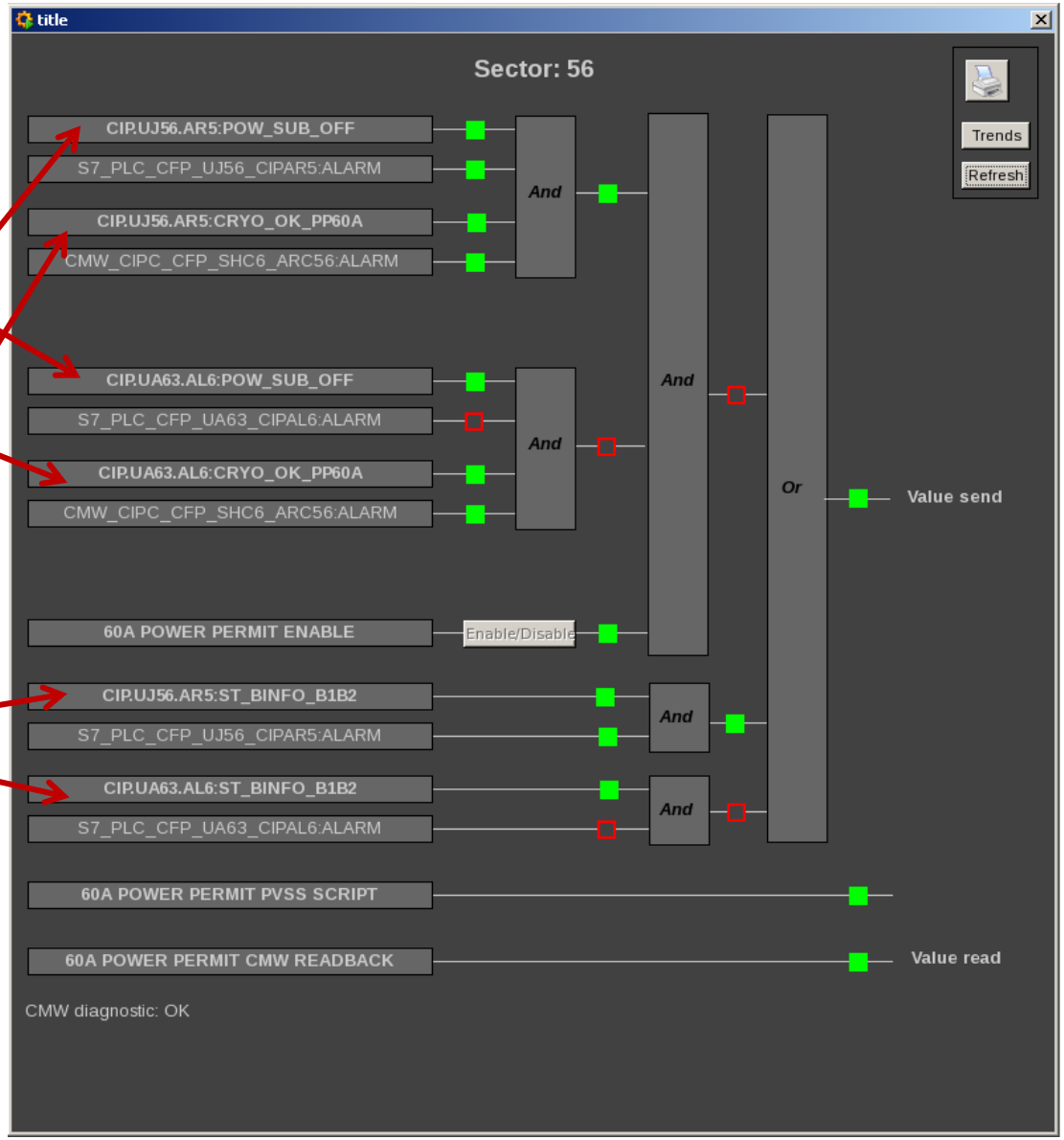


What we saw in PVSS…

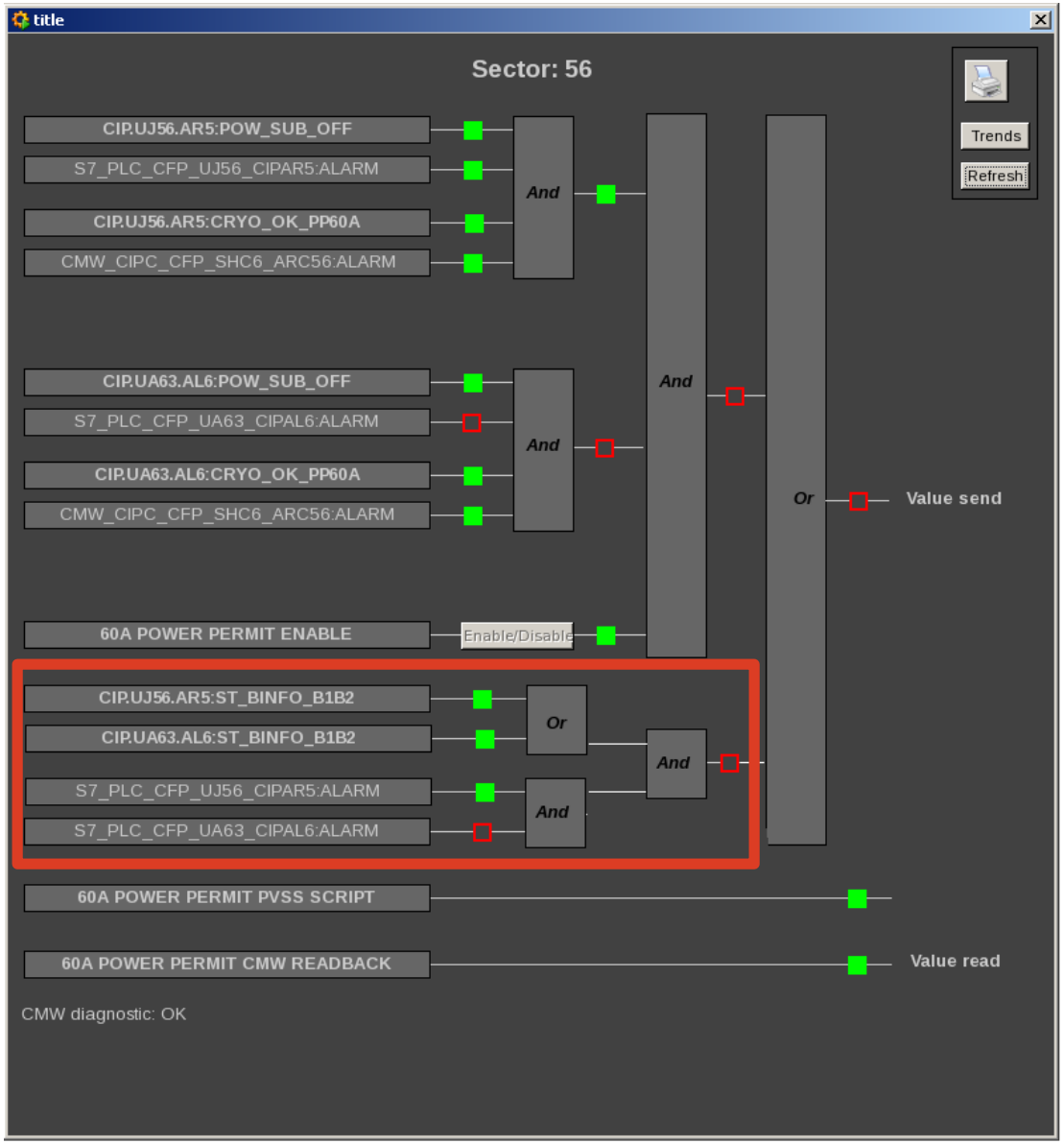
Powering subsector OFF

Cryo conditions 60A

Beam info

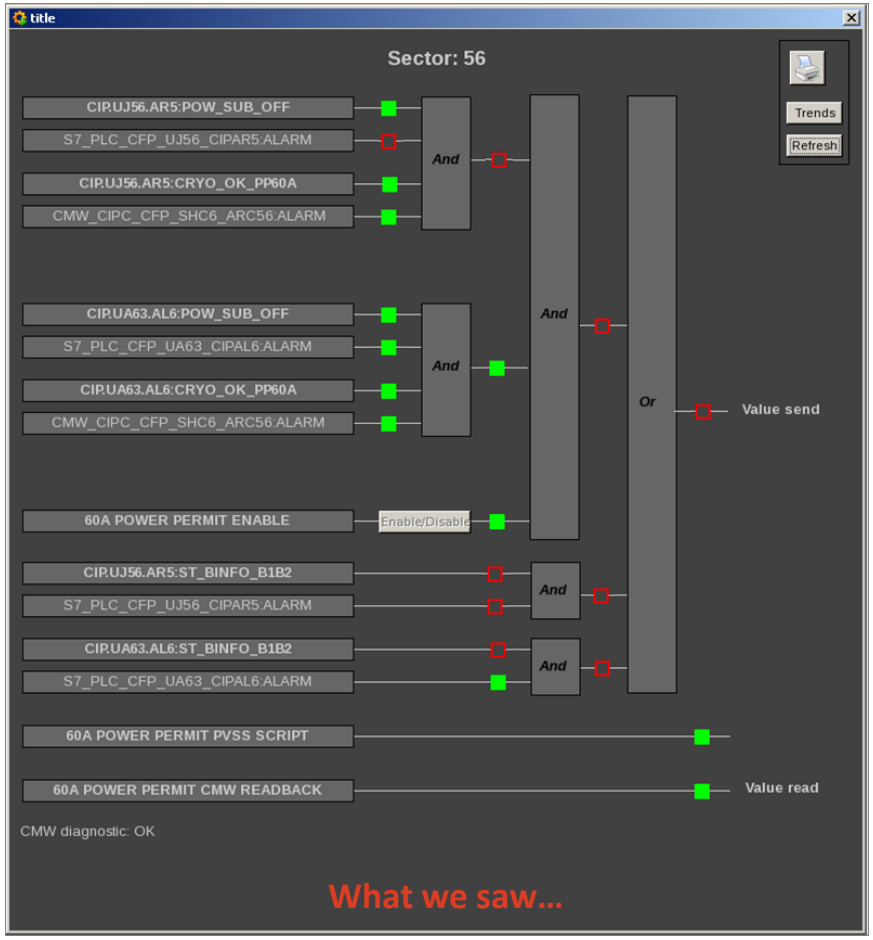


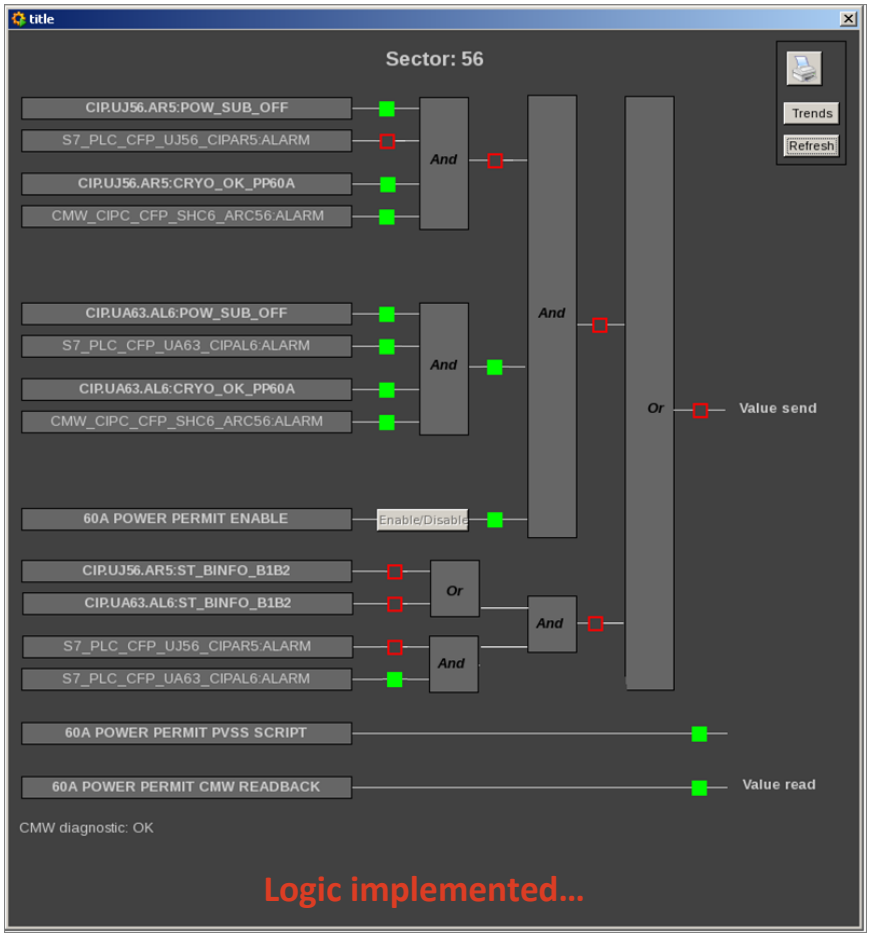
But logic implemented…



Similar events without beam…

- **9.04.2010 2h25 / 19.06.2010 11h54 (Sector 56)**
  - Network communication problem again in S56
  - This time without beam in the machine…





Conclusions

- Beams would have **never dumped with correct PVSS logic** due to a communication problem affecting a single PIC!!
- PVSS logic will be **corrected during LS1**

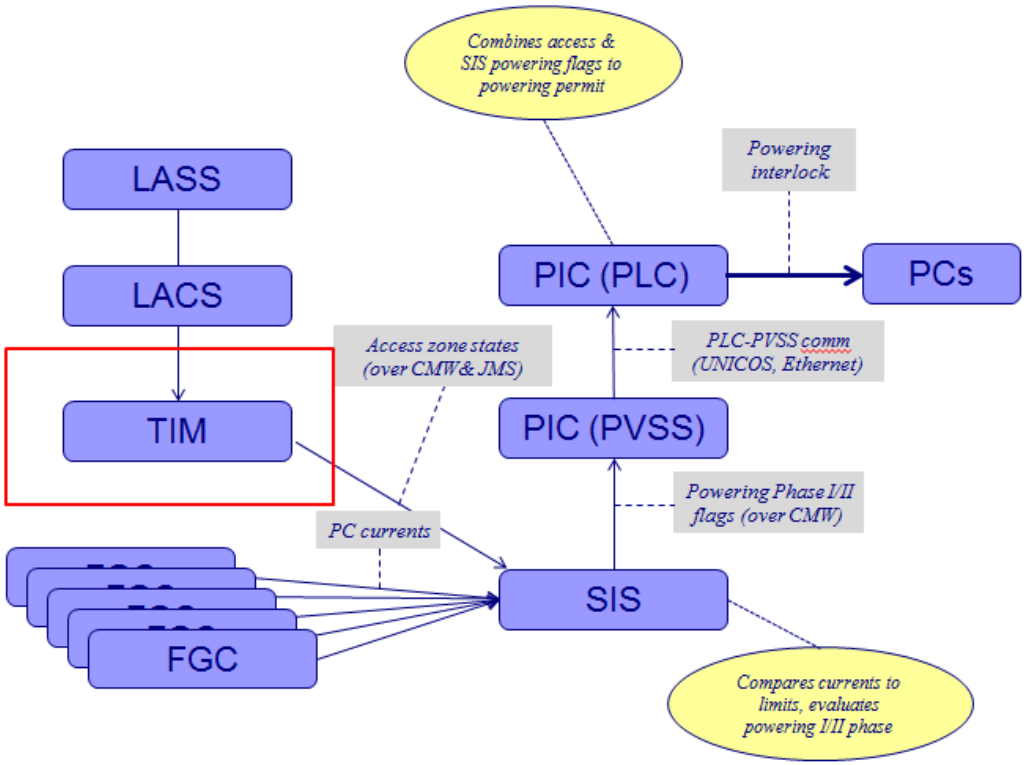
- Redundant software interlocks?
  - **1st proposal:**
    - **PC interlocks** not fast enough to detect that situation (≈ 500ms)
    - **PC interlocks** only active (so far) when PC at IDLE, ARMED and RUNNING states
  - **2nd proposal:**
    - **PVSS** could also request a **SLOW POWER ABORT to all PICs** in the sector
    - PIC would also trigger a **beam dump before loss detection**
    - Protection features **cannot depend on PVSS availability**

Outlook

- Powering Permit 60A
- Access powering interlocks
- Global protection mechanisms
- Other activities

Access Powering Interlocks

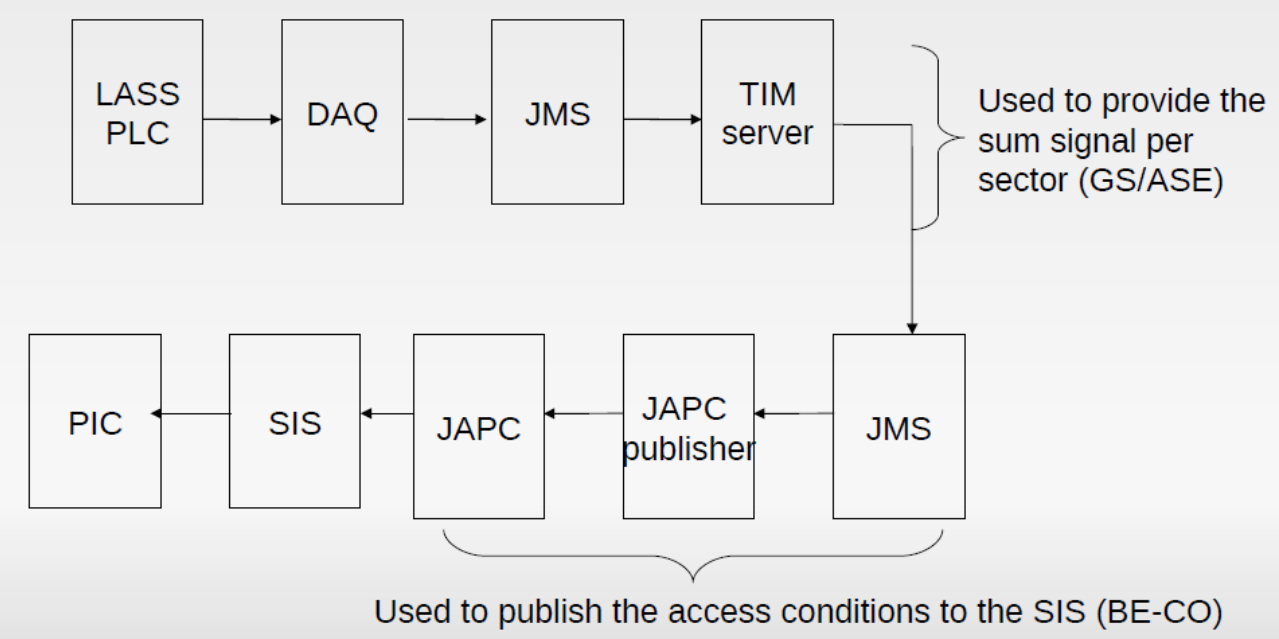
- After the incident in September 2008, **new rules for access applied**
- Existing software interlocks **prevent powering above phase I current limit** (1kA all circuits, 100A for RB) and send slow power abort on PIC if needed
- Logic based on a sector-by-sector basis, i.e: 8 independent signals…



Courtesy of J.Wenninger

Weakest link…

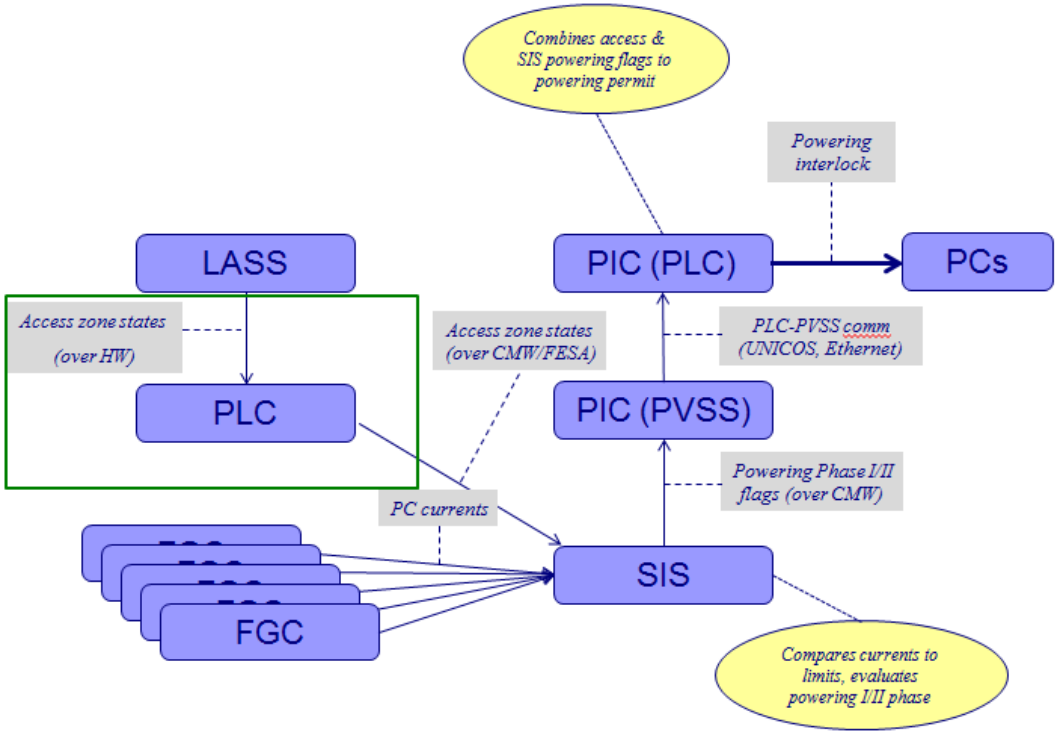
- Main problem: **Long (unreliable) chain of different SW** components to connect to ACCESS signals
  - Still, **interlock worked always** as expected (fails safe)
  - Improvements done: Masked when BEAM ON
  - Possible further improvements: Shorten SW chain by including JAPC publisher in TIM server



Courtesy of L.Ponce – see Chamonix 2010

Interlocks renovation

- It requires an **additional PLC** at the PIC side (CCR)
- Communication between **LACS and PIC-PLC via hardwired signals**
- PIC-PLC will publish access status **to CMW**
- PIC-PVSS will log all access **interlock transitions**
- ECR approved (EDMS 1246780)



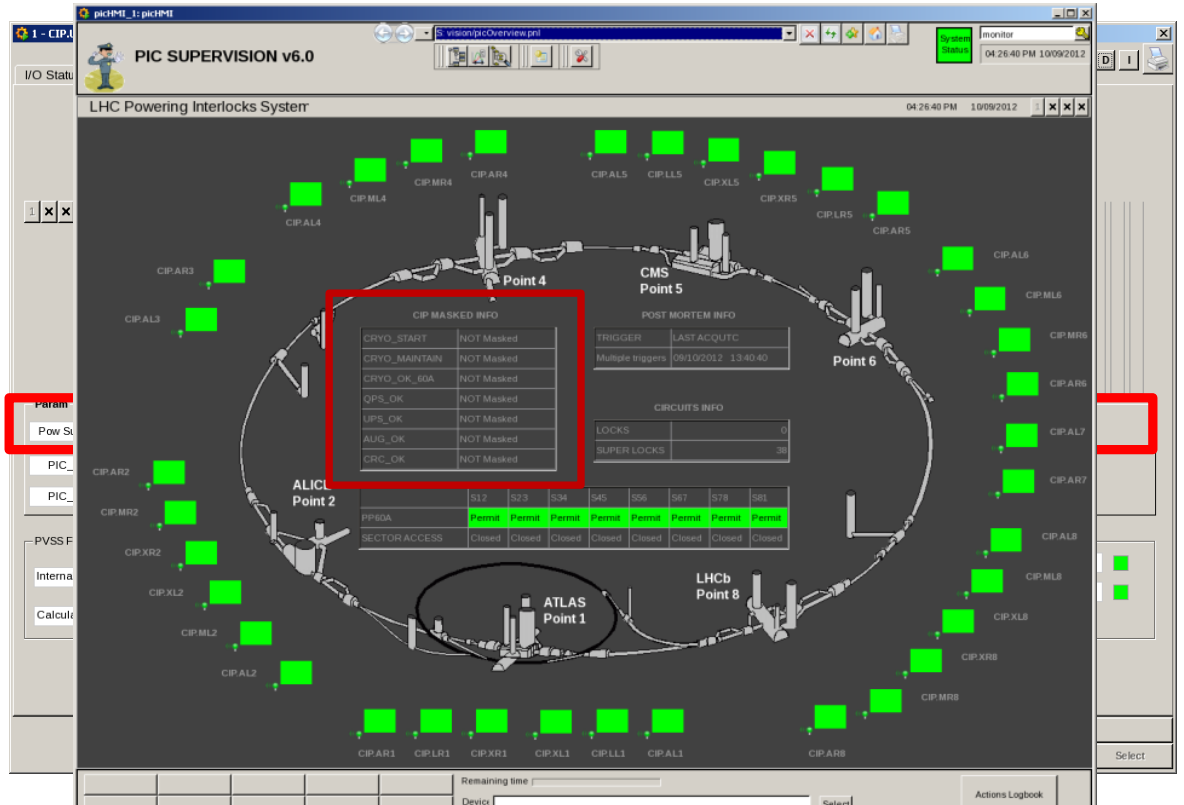
Courtesy of J.Wenninger

Outlook

- Powering Permit 60A
- Access powering interlocks
- **Global protection mechanisms**
- Other activities

Global protection mechanisms

- Protection mechanisms to **avoid quench propagation** to neighbor magnets
- **Circuit configuration** downloaded to Powering Interlock Controllers
- During **HWC** campaigns such global protection is **a bottleneck for testing!**
- Proposal is to make the Global Protection Mechanism **configurable via PVSS**
- Masking clearly **visible from PIC SCADA system**



Other activities

- **PIC:**
  - R2E relocation of 9 PICs to UL14/16 and UL557
  - Re-commissioning of UPS hardware links following UPS renovation

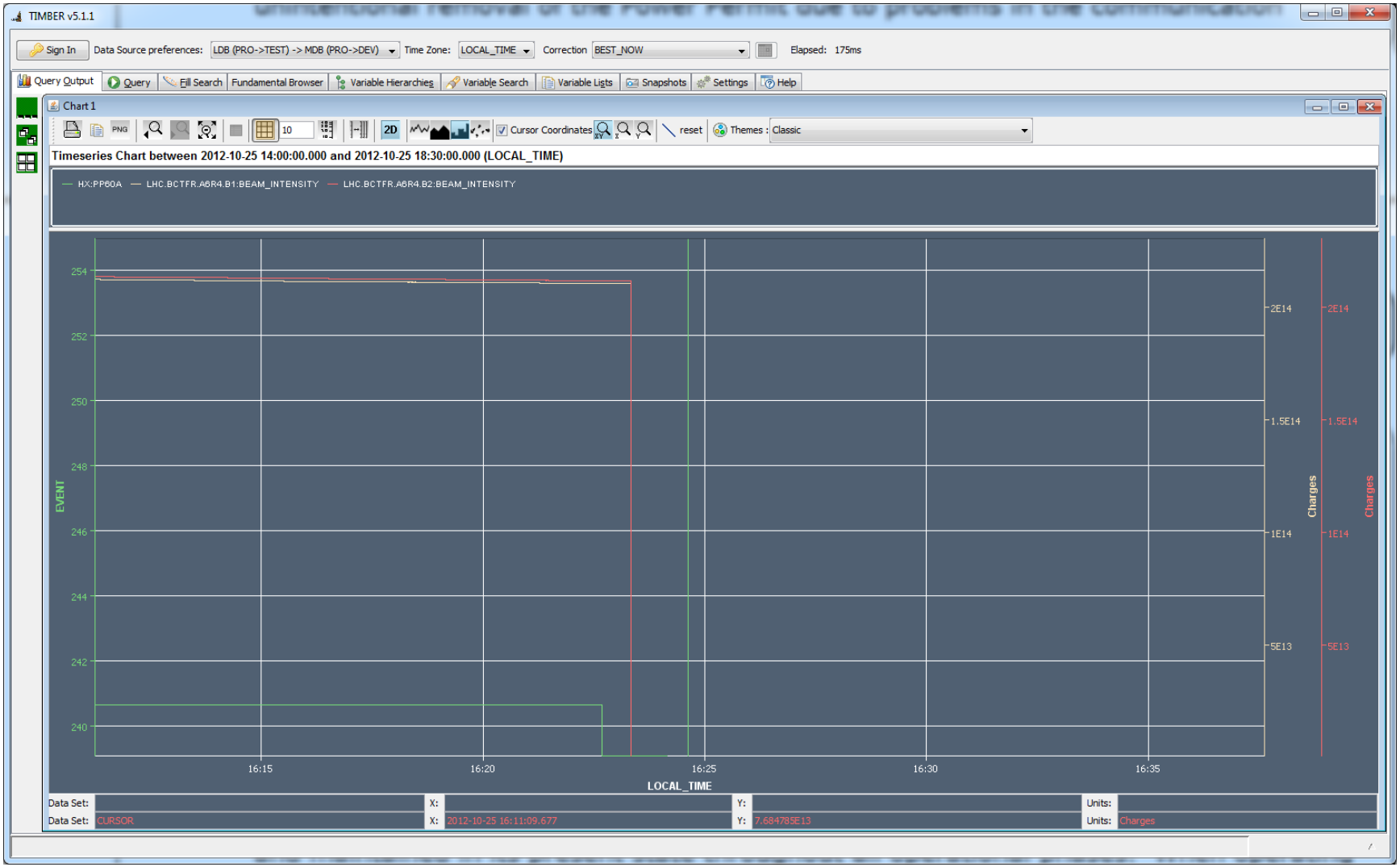
- **FMCM:**
  - R2E relocation of 1 FMCM from UJ56 to USC55
  - Close collaboration with EPC to improve immunity against electrical network perturbations
  - Controls renovation in SPS transfer lines

Thanks for your attention

References:

- 60A Powering Permit lost and beams dumped on beam losses (http://issues/browse/TE-MPE-COMS-379)
- Improvement of transmission dependability for the Power Permit of 60A DOC (https://edms.cern.ch/document/944765)
- ECR-Change of the Interlocking of Powering and Access systems (https://edms.cern.ch/document/1246780)

HX:PP60A


TIMBER v5.1.1
Sign In
Data Source preferences:
LDB (PRO->TEST) -> MDB (PRO->DEV)
Time Zone:
LOCAL_TIME
Correction
BEST_NOW
Elapsed: 175ms
Query Output
Query
Fill Search
Fundamental Browser
Variable Hierarchies
Variable Search
Variable Lists
Snapshots
Settings
Help
Chart 1
Cursor Coordinates
reset
Themes :
Classic
Timeseries Chart between 2012-10-25 14:00:00.000 and 2012-10-25 18:30:00.000 (LOCAL_TIME)
HX:PP60A
LHC.BCTFR.A6R4.B1:BEAM_INTENSITY
LHC.BCTFR.A6R4.B2:BEAM_INTENSITY
254
252
250
248
246
244
242
240
EVENT
2E14
1.5E14
1E14
5E13
Charges
16:15
16:20
16:25
16:30
16:35
LOCAL_TIME
Data Set:
X:
Y:
Units:
Data Set:
CURSOR
X:
2012-10-25 16:11:09.677
Y:
7.684785E13
Units:
Charges