

LS2 Activities: LHC controls IV

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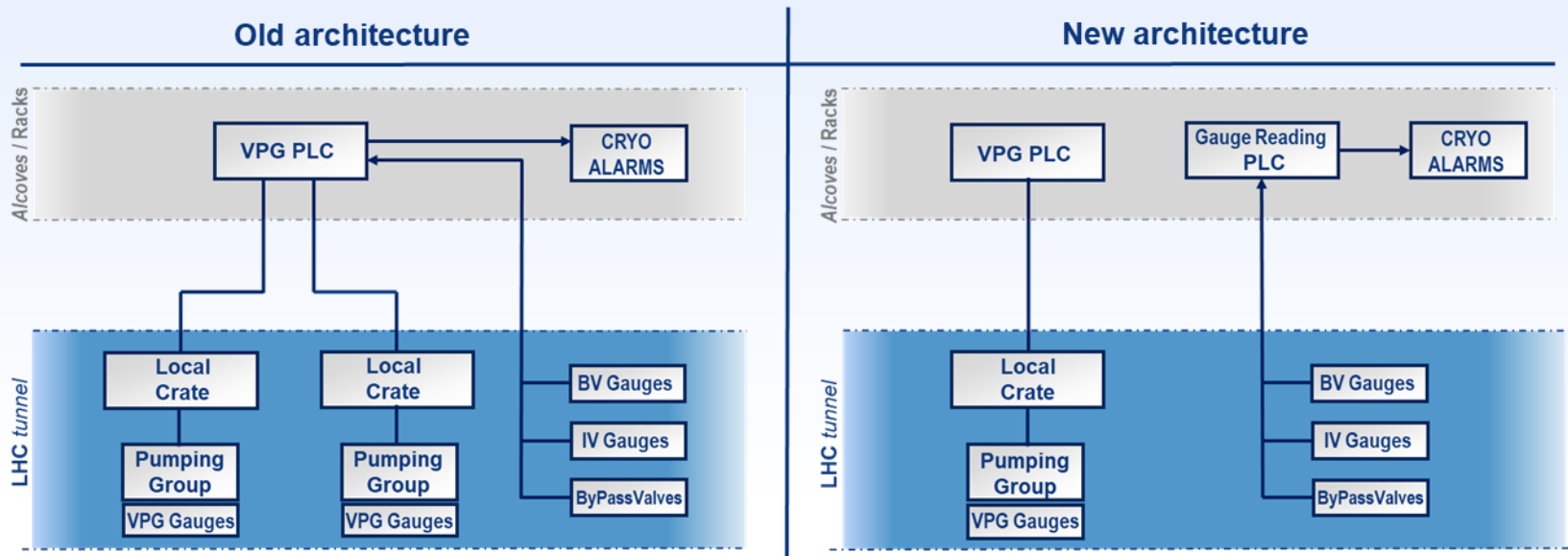
Installation

Commissioning



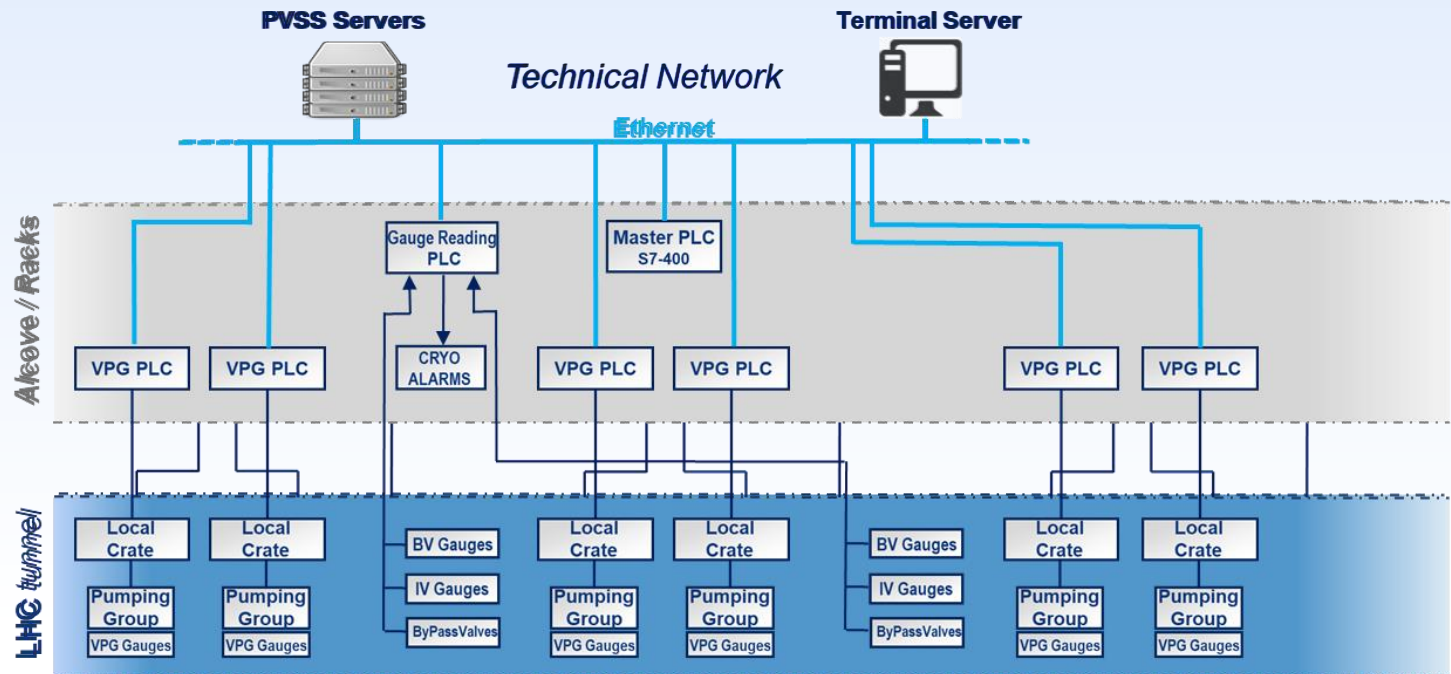
PLC consolidations

- VPG PLC Controllers
 - Existing PLC controllers for Pumping Groups became obsolete (Siemens S7-300).
 - They are operating 15 years already. Close to their end of life.
 - New Architecture:
 - One dedicated PLC per VPG and the VPG gauges.
 - New PLC for gauge signals & CRYO Alarms.
 - Improved reliability, easier maintenance, well-ordered installation.



PLC consolidations

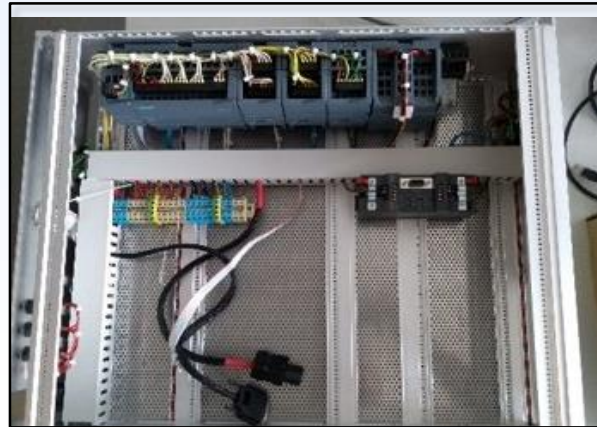
- VPG PLC Controllers
 - New Architecture:
 - Removal of Siemens MPI (Multi-Point Interface) communication.
 - No Master PLC connection. Decentralized control. Reliability.
 - Ethernet communication.
 - Remote access to the PLC. Remote programming & configuration.
 - Easier & fast diagnosis, troubleshooting & maintenance.



PLC consolidations

- VPG PLC Controllers
 - New VPGF PLC design: One crate for all VPGF cases.
 - One PLC program. Configurable hardware with DIP switch.
 - Based on the Siemens S7-1200 PLC.
 - Ethernet communication.
 - Production at external company. 216 controllers produced.
 - Additional redundant pumping groups for Inner triplets at Points 1, 2, 5 & 8.
 - Tested in the ICM lab and installed in Service areas and Alcoves.

VPGF_LHC prototype



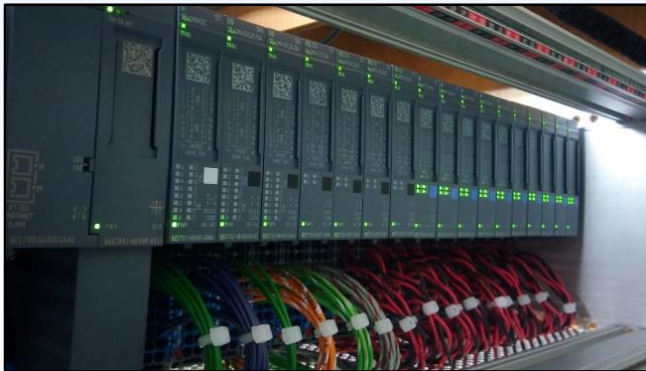
DIP switch configuration



PLC consolidations

- Gauge Reading PLC
 - Reads all the Insulation & Beam Vacuum gauges signals from the ARCs and new radiation tolerant electronics.
 - Reads the TPG signals at LSS.
 - Controls the By-Pass Insulation Vacuum valves.
 - Generates the CRYO Alarms.
 - Based on the new Siemens ET200SP PLC.
 - Ethernet connection.
 - 8 controllers ARC & LSS type produced at CERN.
 - 32 controllers ARC & LSS type produced at external company.
 - Tested in ICM lab and installed.

Gauge Reading Prototype



Gauge PLC – ARC type



Gauge PLC – LSS type

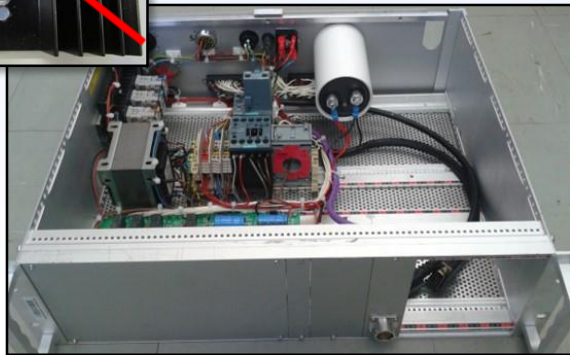


Radiation Tolerant Systems

- VPG New Local Crate.
 - Provides power locally, in the tunnel to Primary pump & VPG valves.
 - Re-designed, radiation tolerant, no active components.
 - Additional functionalities: Primary pump current, remote thermal relay reset, pressure switch.
 - Status VPG feed back using PLC voltage: Reliability.
 - Production at CERN in ICM lab. (74 controllers).
 - Tested in the lab and Installed in LSS (Higher radiation levels).
 - Modification of the existing controllers in the ARCs. (132 controllers).



Local Crate prototype



CERN production

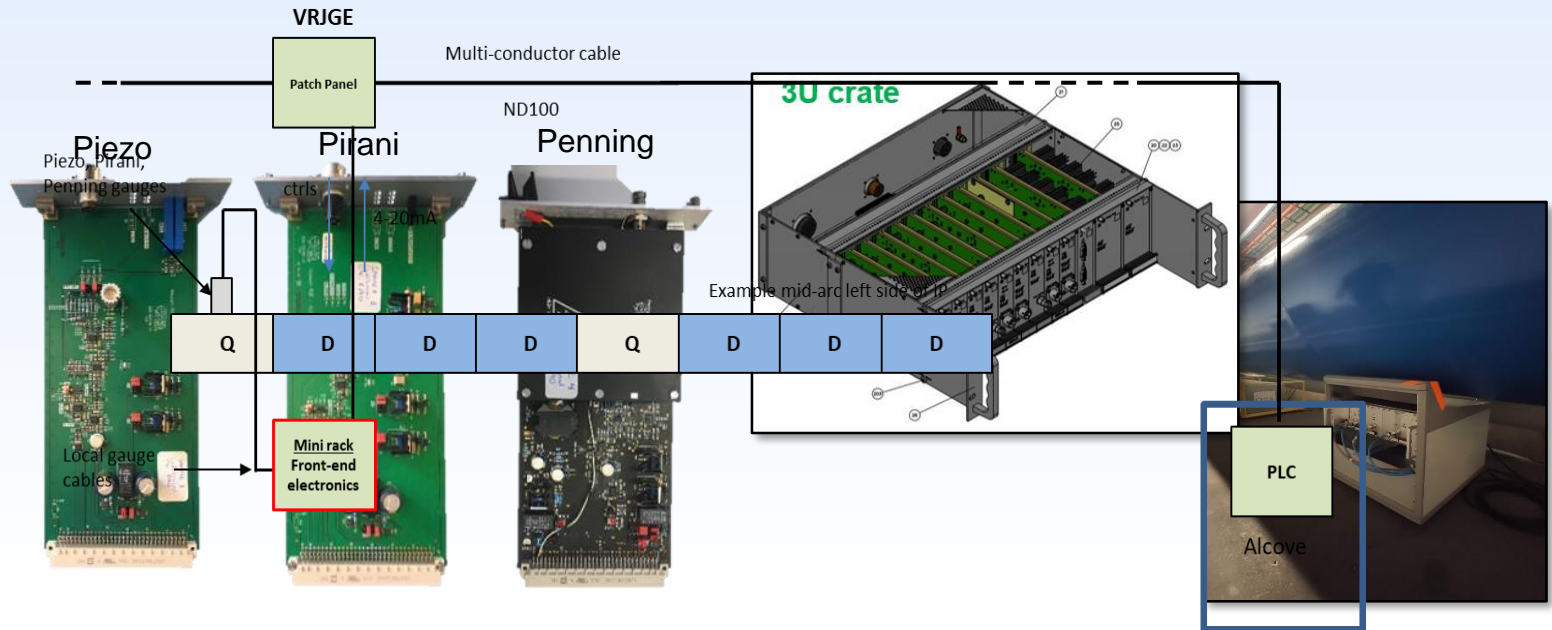


Testing in ICM lab



Radiation Tolerant Systems

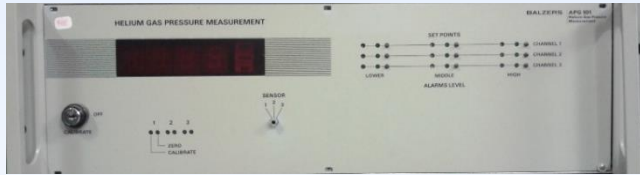
- Radiation Tolerant Electronics.
 - Developed, designed & tested to expected radiation levels up to 500 Gy.
 - Replacement of commercial active gauge electronics.
 - Piezo, Pirani & Penning gauge card.
 - 4-20mA signal transmission.
 - Amplify by-pass valves signal.
 - Installation in Depression Suppressors for LS2.



New Piezo Gauge controller

- Piezo gauge controller
 - Reads the signals of the piezo resistive passive gauges.
 - Direct Replacement of APG101 which became obsolete.
 - CERN design & production. (32 controllers installed).
 - Piezo gauges have unique gain & offset. Calibration required for accuracy through special procedure on-site.

APG101 piezo gauge controller



New in-house piezo gauge controller



Calibration procedure for piezo gauge controller



Installation

- Installation planning & collaboration with LHC coordination team, DLM and BVO sections.
- Preparation
 - Hardware reception and tests.
 - Order of materials and consumables.
 - Cabling manufacturing.
 - Radiation tolerant cards calibration & preparation.
 - Materials transports.

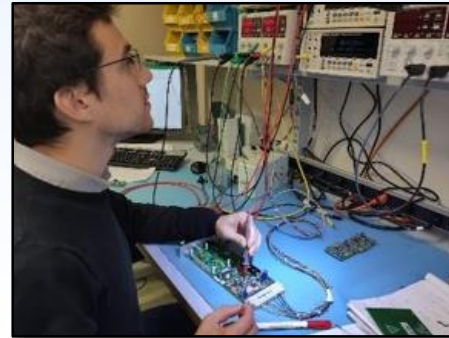
Reception



Testing



Calibration



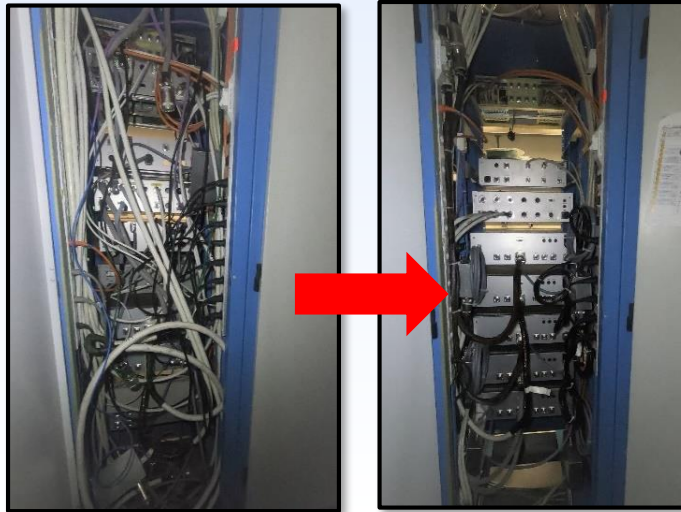
Transport



Installation

- Installation in Service areas & Alcoves
 - VPGF controllers Installation. (206 pcs).
 - Gauge Reading Crate Installation. (34 pcs.)
 - Piezo controllers Installation. (32 pcs) .
 - Racks rearrangements.
 - Cabling.

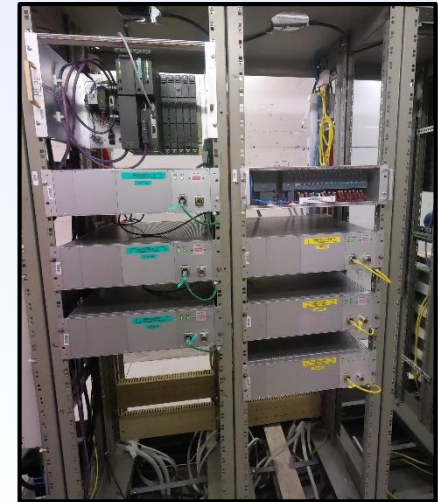
Rack rearrangements & cabling



Service areas



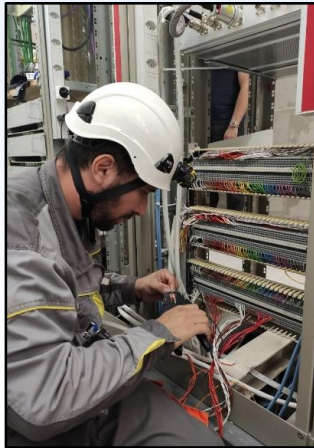
Alcoves



Installation

- Installation in Service areas & Alcoves
 - Terminal contacts modifications.
 - New powering cables. Powering from UPS.
 - MPI network removal & new Profibus network installation.
 - Labeling.
 - Installation of new turbo controllers in ARC12.
 - Removal of old equipment, TREC, Transport old equipment to Flex building.
 - Control chain test.

Terminal contacts



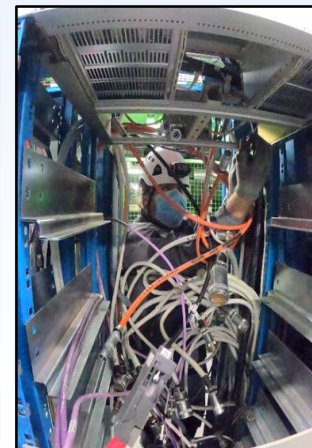
PLC configuration



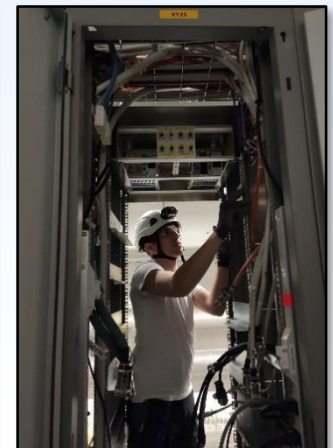
Rack Cabling



Rack de-cabling



Rack mechanical modifications



Installation

- Installation in the LHC tunnel:
 - Radiation Tolerant Local crates installation at LSS.
 - Installation for the new redundant pumping groups in inner triplets. (74pcs).
 - Modification of Local crates in the ARCs for compatibility with new VPGF controllers. (132pcs).

Radiation tolerant electronics Installation



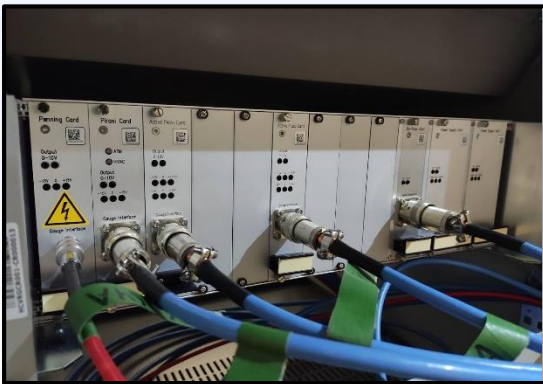
VRJGE boxes modifications



Installation

- Installation in the LHC tunnel:
 - Installation of new Radiation Tolerant electronics mini-racks & cabling. (48 mini racks / 208 cards).
 - Modification of VRGJE connection boxes. (224 boxes).
 - Connection of new VPGs in for inner triplets and ARC12.
 - Removal of old equipment, TREC, Transport old equipment to Flex building
 - Control chain tests.

New Radiation tolerant electronics mini-Rack



Mini-Rack connections

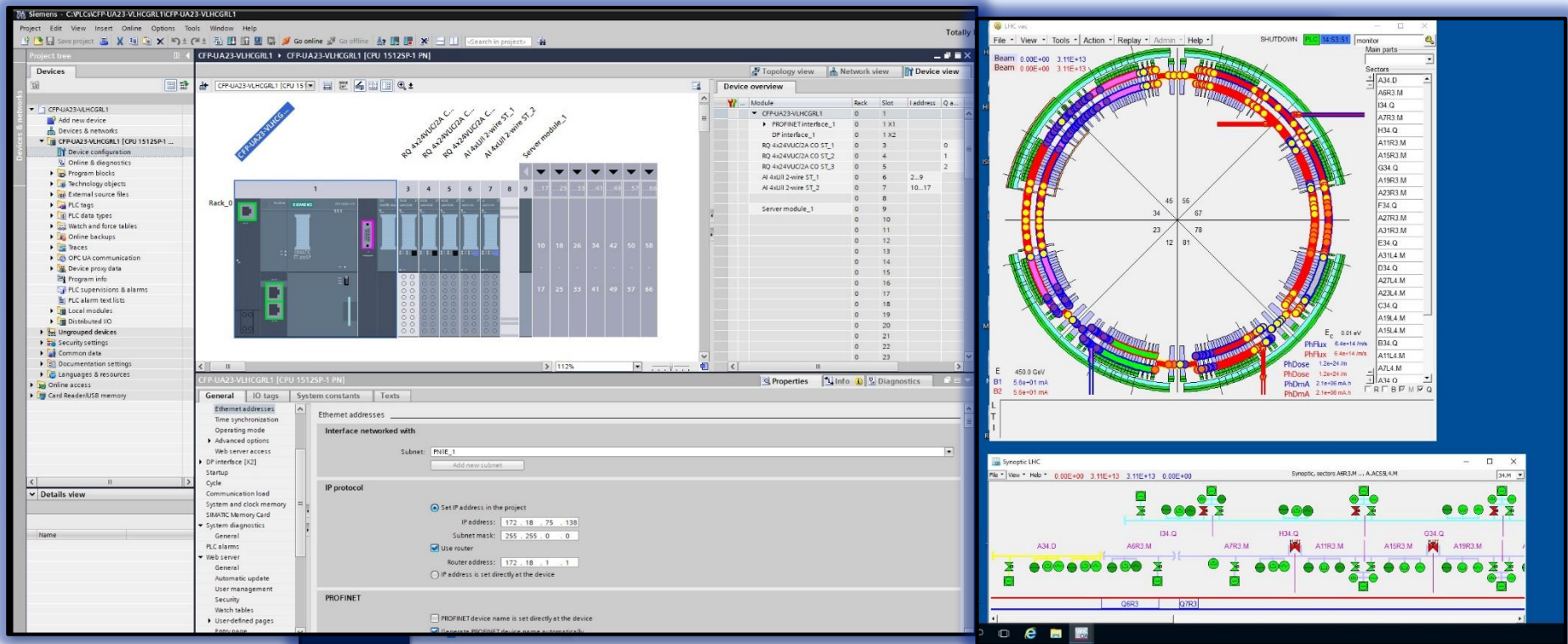


VRJGE box modifications



Installation

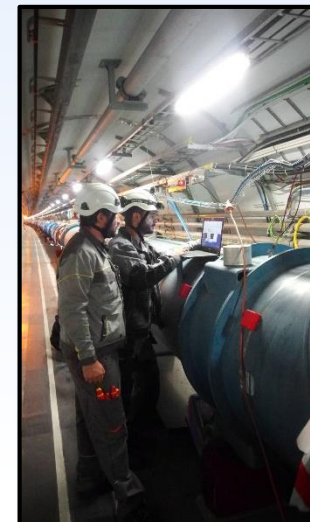
- PLC & SCADA upgrades.
 - Vacuum database updates with VacDB Editor. (developed in ICM).
 - Creation of PLC projects for Gauge Reading Crate in TIA Portal.
 - PLC updates for GRC and VPG per LHC octant.
 - SCADA updates per LHC octant.



Commissioning

- Commissioning planning & cooperation with LHC coordination team, DLM and BVO sections, according to cool-down schedule.
- Commissioning
 - Gauges IV and BV tests. Replacement / repair of faulty equipment. (670 gauges tested).
 - New R2E electronics commissioning and calibration.
 - Piezo & TPG Pirani gauges calibration. (186 gauges).
 - By-pass valves test. (56 Valves).

Tunnel Commissioning



Commissioning planning

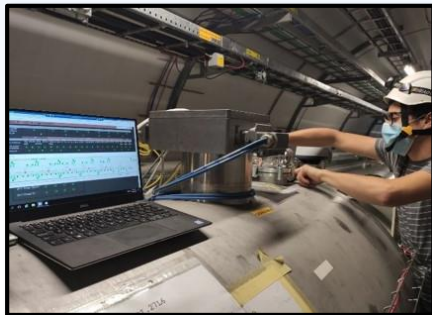
Month	October					November				December			January			Februa					
Week	40	41	42	43	44	45	46	47	48	49	50	51	52	53	1	2	3	4	5	6	
12 (100%)				BV Final Pump down (5 wks)		ELQA @ Warm	Pinch 13th		COOLDOWN 300-80 K				COOLDOWN 80-20 K					Final COOLDOWN			
23 (100%)			Commissioning			ELQA @ Warm	Pinch 13th		BV Final Pump down	Missing	CRYO						COOLDOWN 300-80 K			COOLDOWN	
34 (100%)	BV Final Pump down (5 wks)	LD	CRYO		ELQA @ Warm	Pinch 5th		COOLDOWN 300-80 K				COOLDOWN 80-20 K				Final COOLDOWN			ELQA @ Cold		
45 (100%)	Warm		COOLDOWN 300-80 K					COOLDOWN 80-20 K		Final COOLDOWN										ELQA @ Cold	
56 (100%)		PI	BV Final Pump down	LD	CRYO		ELQA @ Warm	Pinch 6th		COOLDOWN 300-80 K				COOLDOWN 80-20 K				Final COOLDOWN			ELQA @ Cold
67 (95%)						PI															
78 (100%)				Commissioning		LD	Missing														
81 (100%)	Pump down (5 wks)	CRYO		ELQA @ Warm		COOLDOWN 300-80 K				COOLDOWN 80-20 K		Final COOLDOWN						ELQA @ Cold			
						BV Final Pump down (5 wks)				COOLDOWN 300-80 K								COOLDOWN 80-20 K	Final COOLDOWN	ELQA @ Cold	
								Pinch 27th		COOLDOWN 300-80 K											

Commissioning

- Commissioning
 - VPGs tests and commissioning: Tested individually primary & turbo pump, valves, gauges & automation process. (206 VPGs).
 - CRYO alarms verification: Alarms were triggered using gauge simulators.
 - Official validation w/Cryogenics Group through special procedure. (400 alarms).

UNICOS CRYO Alarms Diagnostic Panel

1 - Sector 45 Vacuum Diagnostic																							
P4 Sector 45 - Vacuum Diagnostic Panel																							
1:20:39 PM 8/16/2019																							
IRL Vac Subsector	A			B			C			D													
VACO_NLOST	no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed													
VACO_OK	no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed													
	RF Cavity			LSS			ARC			LSS													
Mag Vac Subsector	AGAB2	AGAB1	A5R	B5P4	B5R	7R4	11R4	15R4	19R4	23R4	27R4	31R4	31L5	27L5	23L5	19L5	15L5	11L5	7L5	6L5	5L5	4L5	1L5
Mag Cryo subsector			D3 R4	D4Q5 R4	Q6 R4	07 09 R4	11 13 R4	15 17 R4	19 21 R4	23 25 R4	27 29 R4	31 33 R4	33 L5	31 29 L5	27 25 L5	23 21 L5	19 17 L5	15 13 L5	11 09 L5	06 L5	05 L5	04D2 L5	1T L5
VACM_NLOST	no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed	
VACM_OK	no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed			no rupture confirmed	



LS2 Activities: LHC controls IV

Thank you for your attention!



Questions?