# THE UPGRADE OF CONTROL HARDWARE OF THE CERN NA62 BEAM VACUUM

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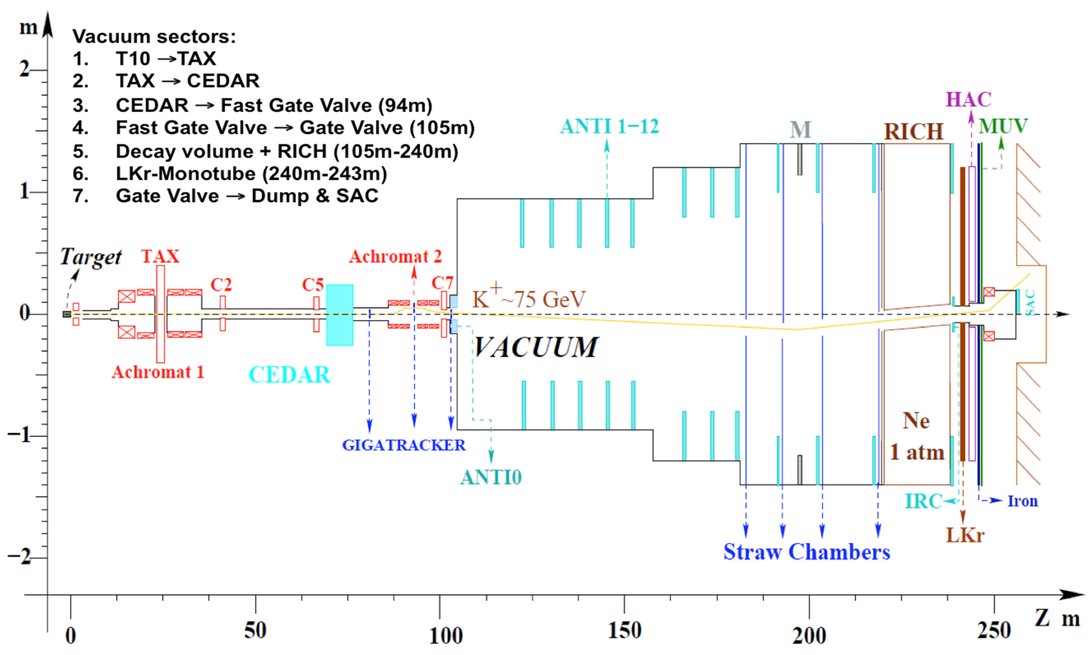
2015 ICALEPCS melbourne • australia

October 19, 2015
Paper ID: MOPGF103

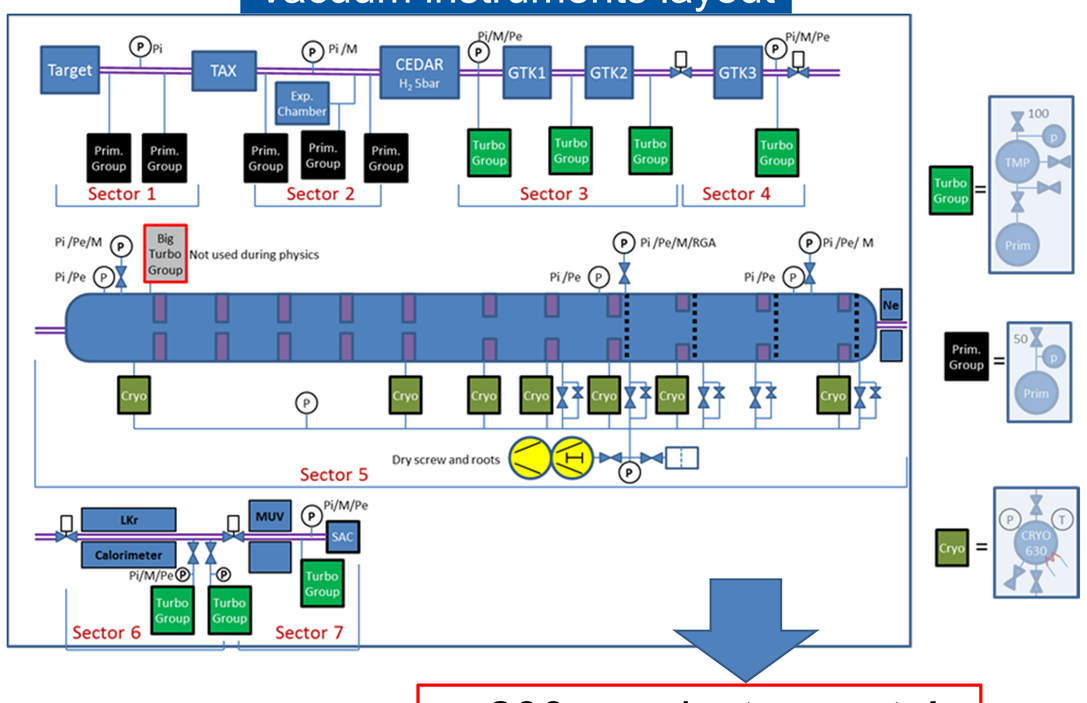
## Abstract

NA62 is the follow-up of the NA48 experiment, in the SPS North Area of CERN, and reuses a large fraction of its detectors and beam line equipment. Still, there are many new vacuum devices in the beam line (including pumps, valves & gauges), which required a thorough modification of the control system and a large number of new controllers, many of which were custom-made.
The NA62 vacuum control system is based on the use of PLCs (Programmable Logic Controllers) and SCADA (Supervisory Control and Data Acquisition). The controllers and signal conditioning electronics are accessed from the PLC via a field bus (Profibus); optical fibre is used between surface racks and the underground gallery.
The control hardware was completely commissioned during 2014. The nominal pressure levels were attained in all sectors of the experiment. The remote control of all devices and the interlocks were successfully tested.

## Vacuum sectors layout




## Vacuum instruments layout




>200 new instruments!

**Vacuum pumps**

**Primary pumps (VPR):** 5 Rotary vane @220V + 2 combined dry screw/roots @400V
**Turbomolecular pumps (VPT):** 7 x DN100 for normal operation + 1 x DN 250 for leak detection (not required during physics).
**Cryogenic pumps (VPC):** Required to achieve $10^{-6}$ mbar. There are 7 groups along the decay volume.

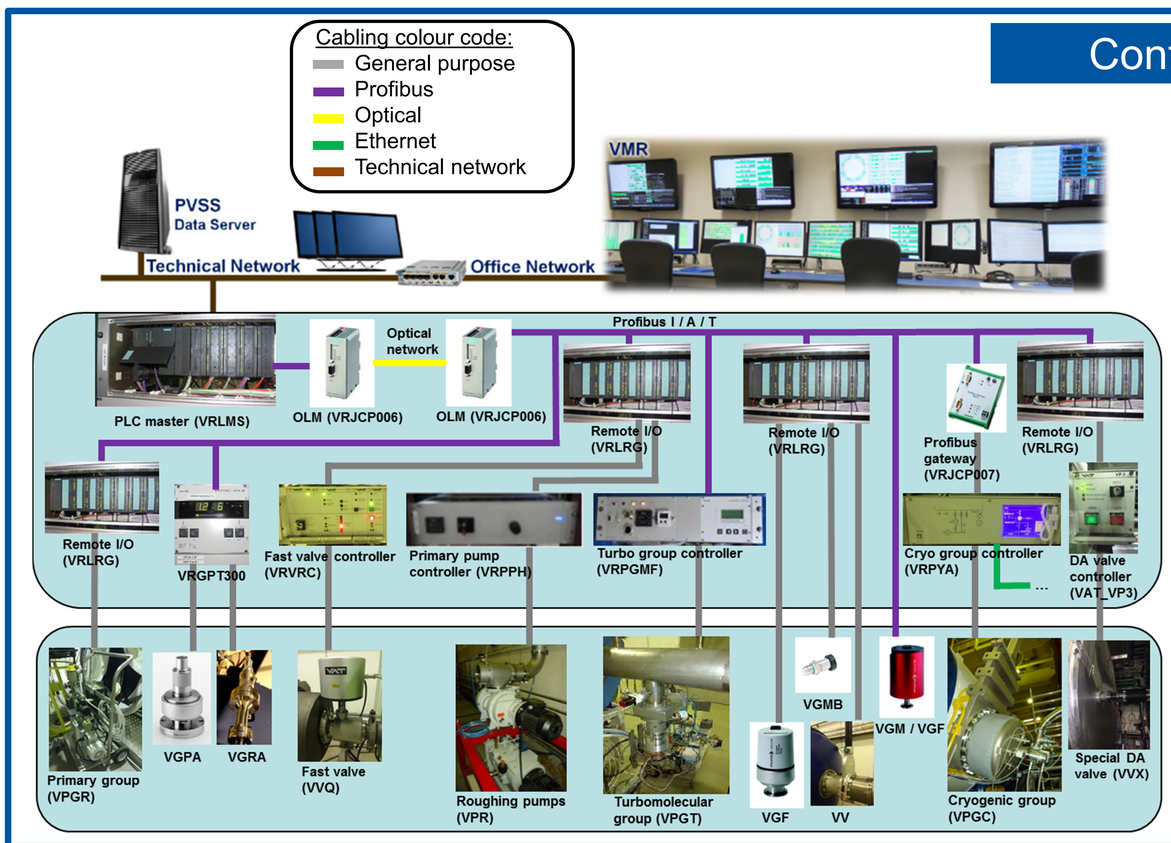
**Vacuum valves**

**Specific valves:**
-Fast shutter valve (VVQ) to prevent damage to equipment in case of CEDAR window rupture.
-*Guillotine* valve (VVX): Dual-acted gate valve for LKr calorimeter protection in case of power loss.
**Standard purpose electro-pneumatic / electromagnetic valves**: roughing valves, gate valves, intermediate valves, leak detection valves, turbo pump venting valves…

**Vacuum gauges**

**Specific gauge types**:
Active Profibus interfaced gauges(VGF, VGM)
Other **standard gauge types**:
Passive Pirani gauges (VGR)
Passive Penning gauges (VGP)
Active Membrane gauges (VGM)
Active Full Range gauge-pairs (VGF)

## Control system




- PLC architecture based on **Siemens™ S7-300 series**.
- The human-machine interface is a **SCADA** (Supervisory Control And Data Acquisition), built with Siemens **WinCC OA®**.
- New cabling network linking all the vacuum equipment.
- Specific Ethernet-based Master-Slave network for cryopump controllers.
- Three dedicated **Profibus-DP** networks:
  1. Profibus Alarms network (**I**).
  2. Profibus VPT network (**T**).
  3. Profibus All-purpose network (**A**).
- The required **HW alarms** have been implemented. The alarms are hard-wired with a dedicated cable from the master PLC crate to the Detector Control System.

Custom-made controllers

| Name | Description | Units |
|---|---|---|
| VRLMS | Master PLC | 1 |
| VRLRG | PLC Remote I/O station | 5 |
| VRPGMF | VPT controller | 8 |
| VRJTB | VPT patch panel | 5 |
| VRPPH | VPR controller | 2 |

Commercial controllers

| Name | Description | Units |
|---|---|---|
| VRPP | Primary pump local crate | 5 |
| VRVRC | VAT VF-2 fast valve controller | 1 |
| VRGPT300 | Pfeiffer-Balzers TPG 300 gauge controller | 5 |
| VAT_VP | VAT VP-3 dual-acting valve controller | 2 |
| VRPYA | HSR PCA700C VPC controller | 7 |

## Conclusion

The NA62 control hardware upgrade was a complex task that required the active participation and effort of several groups at CERN, including engineers, technicians, external workshops and industrial partners.
The cabling and control equipment deployment took place in spring 2014. The full system was commissioned during summer 2014. The measured pressure levels meet the nominal specifications in every sector. Hardware alarms are fully operational.

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ICALEPCS15, Melbourne, 2015
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