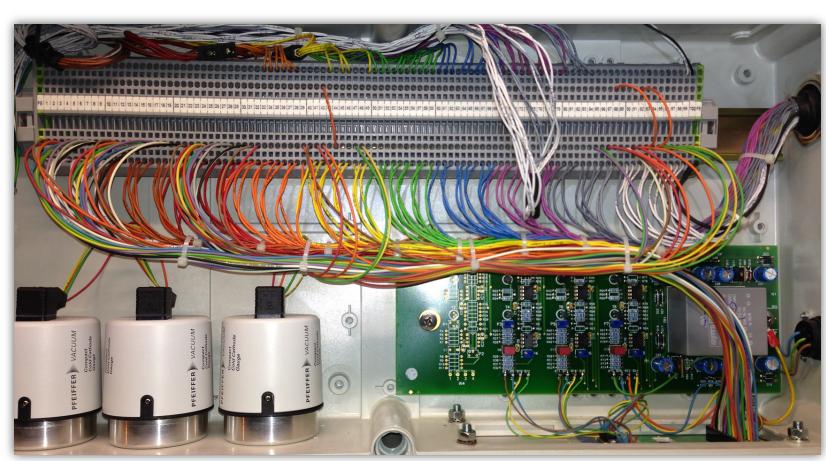




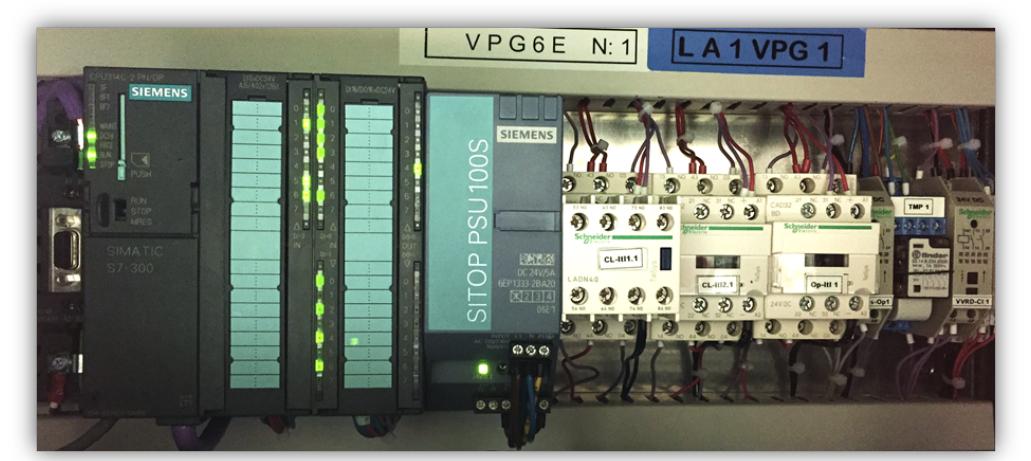
# CONSOLIDATIONS ON THE VACUUM CONTROLS OF THE CERN ACCELERATORS, DURING THE FIRST LONG SHUTDOWN OF THE LHC



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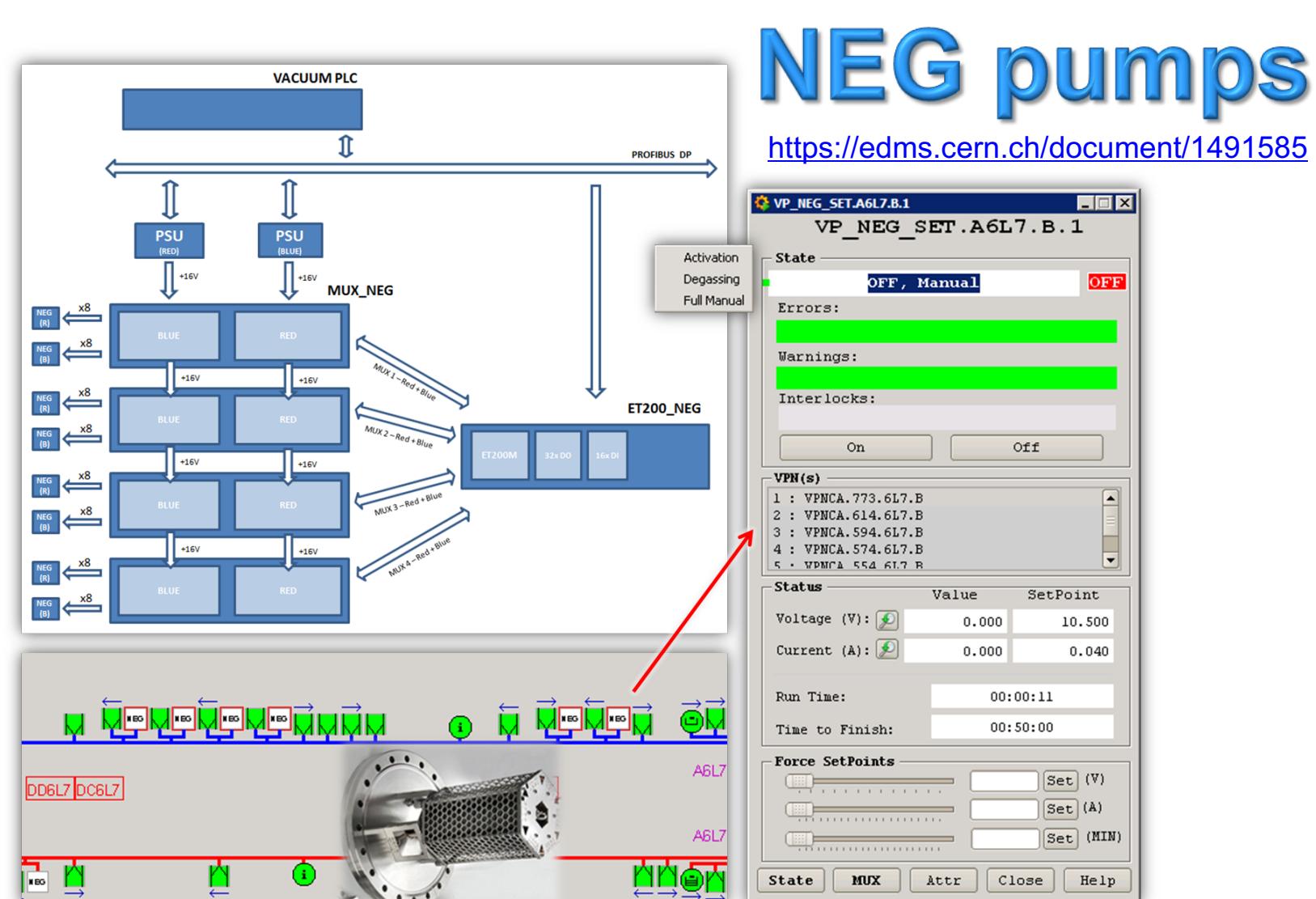
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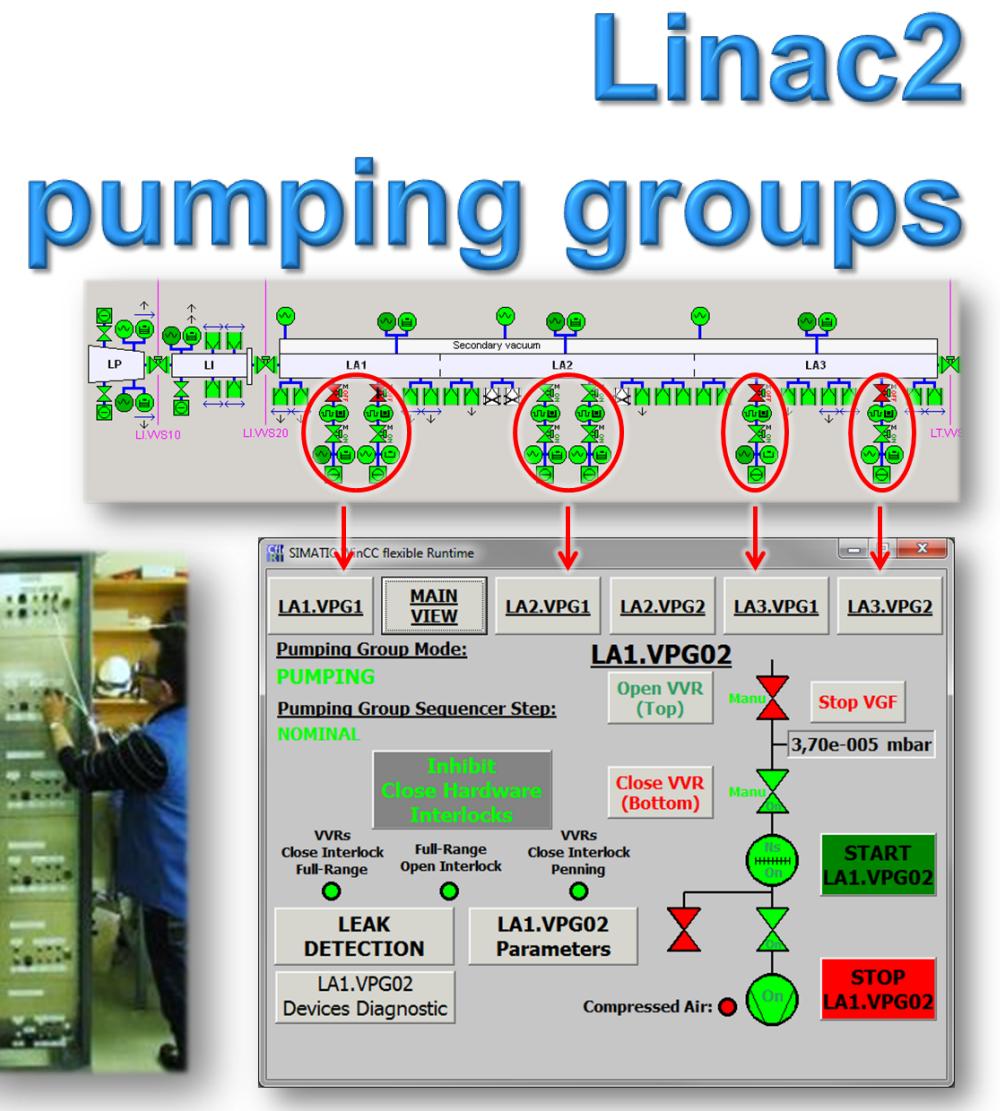
## Abstract

For two years (Spring 2013 – Spring 2015), the LHC went through its first long shutdown (LS1). Mainly motivated by the consolidation of magnet interconnects, to allow operation with 6.5 TeV protons. Injectors: standardization of vacuum controls; renovation of obsolete equipment. LHC: many new instruments; signal transmission integrity improved; exposure to radiation reduced. Many other systems repaired, consolidated or upgraded; several new installations. Several developments were needed, for new equipment types or new operational requirements.

	Cables	Instruments
CPS	500	700
SPS	500	80
LHC	1000	400
Projects	900	400
<b>TOTAL</b>	<b>2 900</b>	<b>1 580</b>



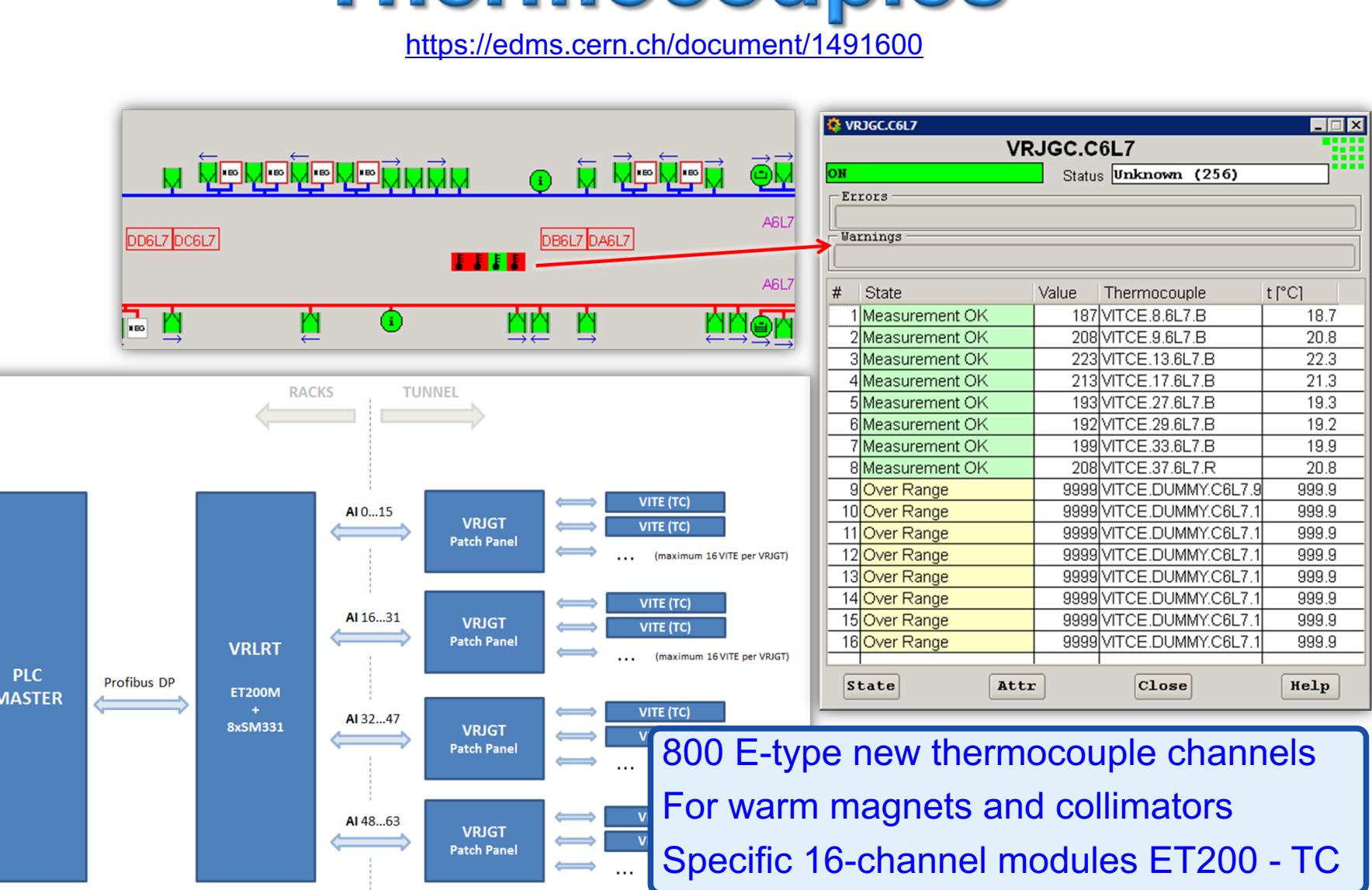
1 PSU per beam, feeds series of pumps in same vacuum sector  
MUX crate selects 1 from 8 sectors  
Up to 4 MUX, to select from up to 32 sectors (ET200 - DOs)  
Default values for : current, voltage, timeout  
in degassing & activation modes  
Manual mode with user set-points



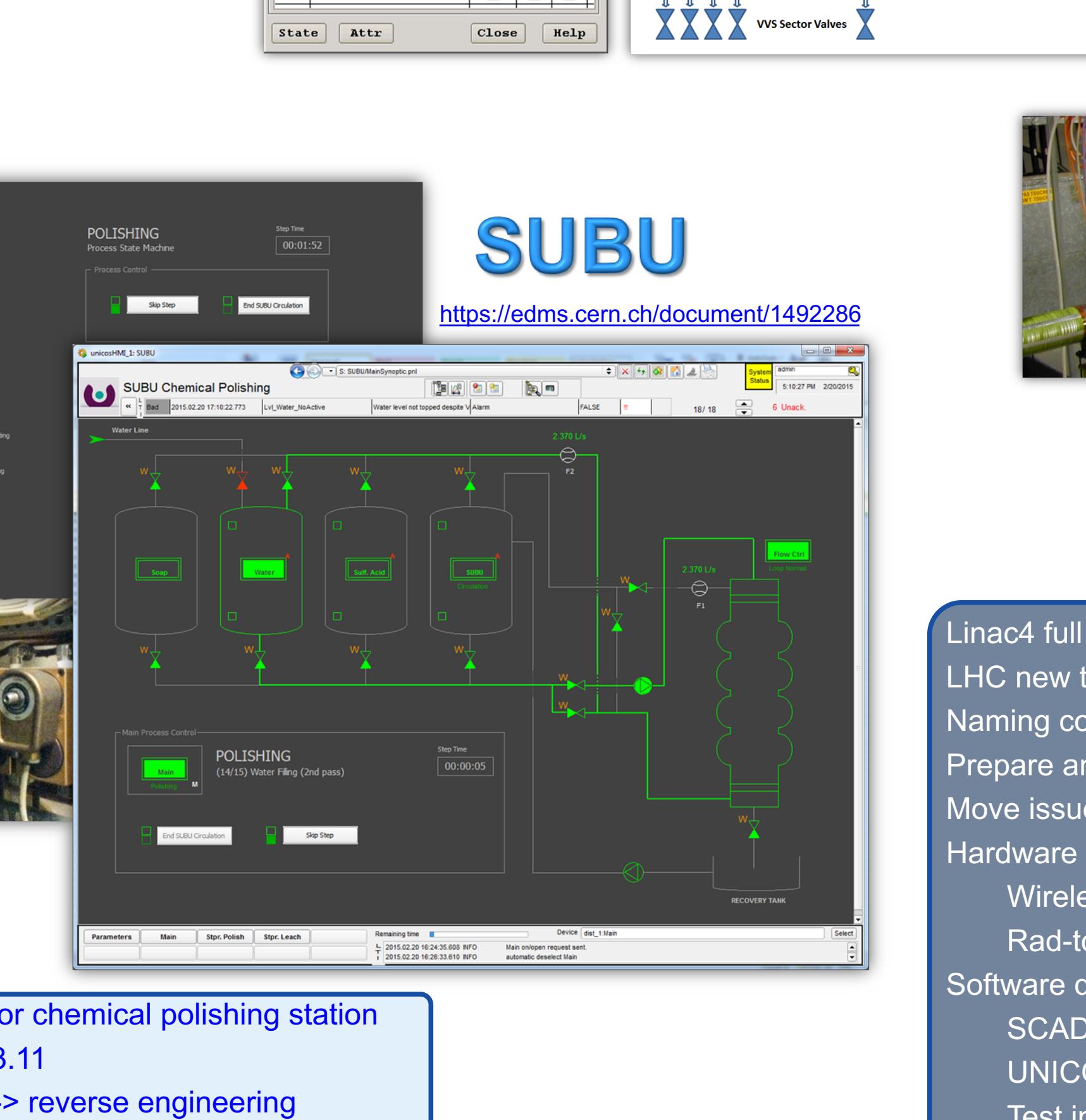
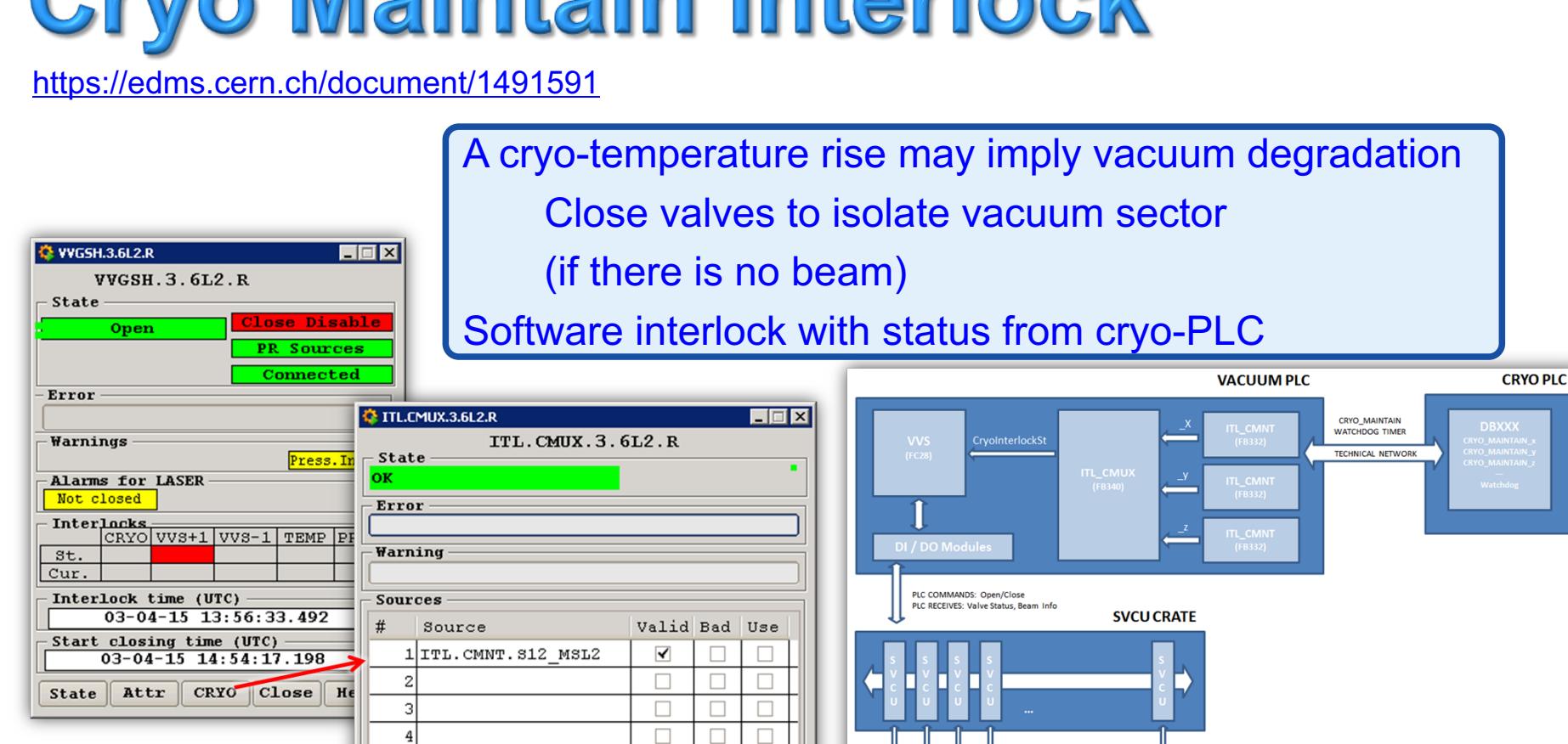
**LHC BGV gas injection**  
<https://edms.cern.ch/document/1505580>

Beam Gas Vertex detector (Ne, Ar)  
for beam size measurement  
Standard pumping group + analogue valve  
Automatic injection mode with PLC sequencer

## Thermocouples

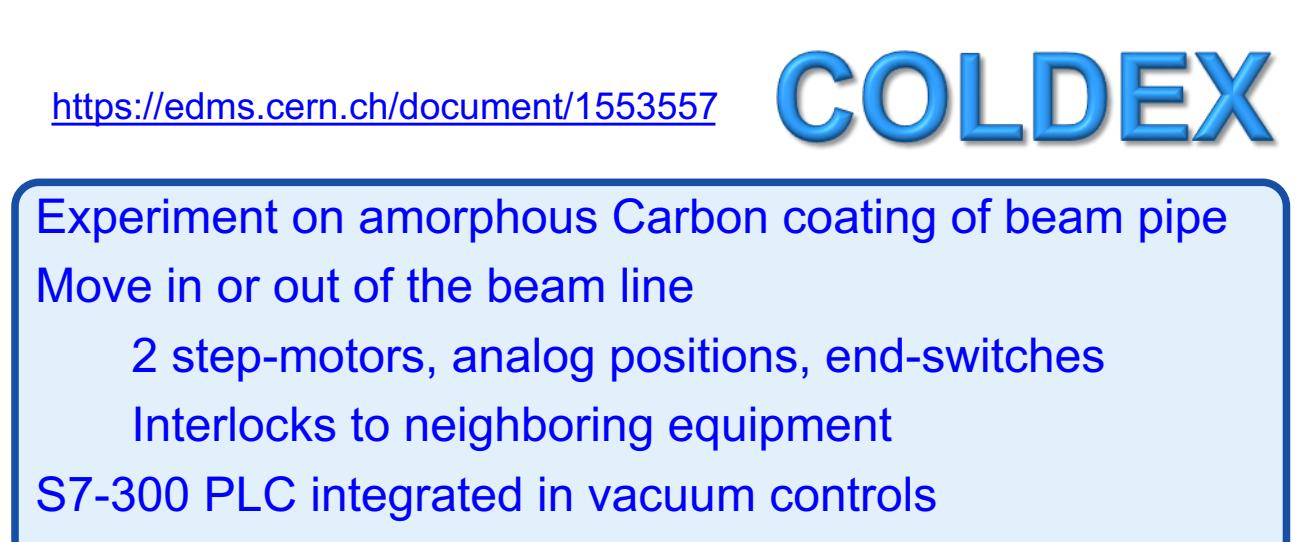


## Cryo Maintain interlock



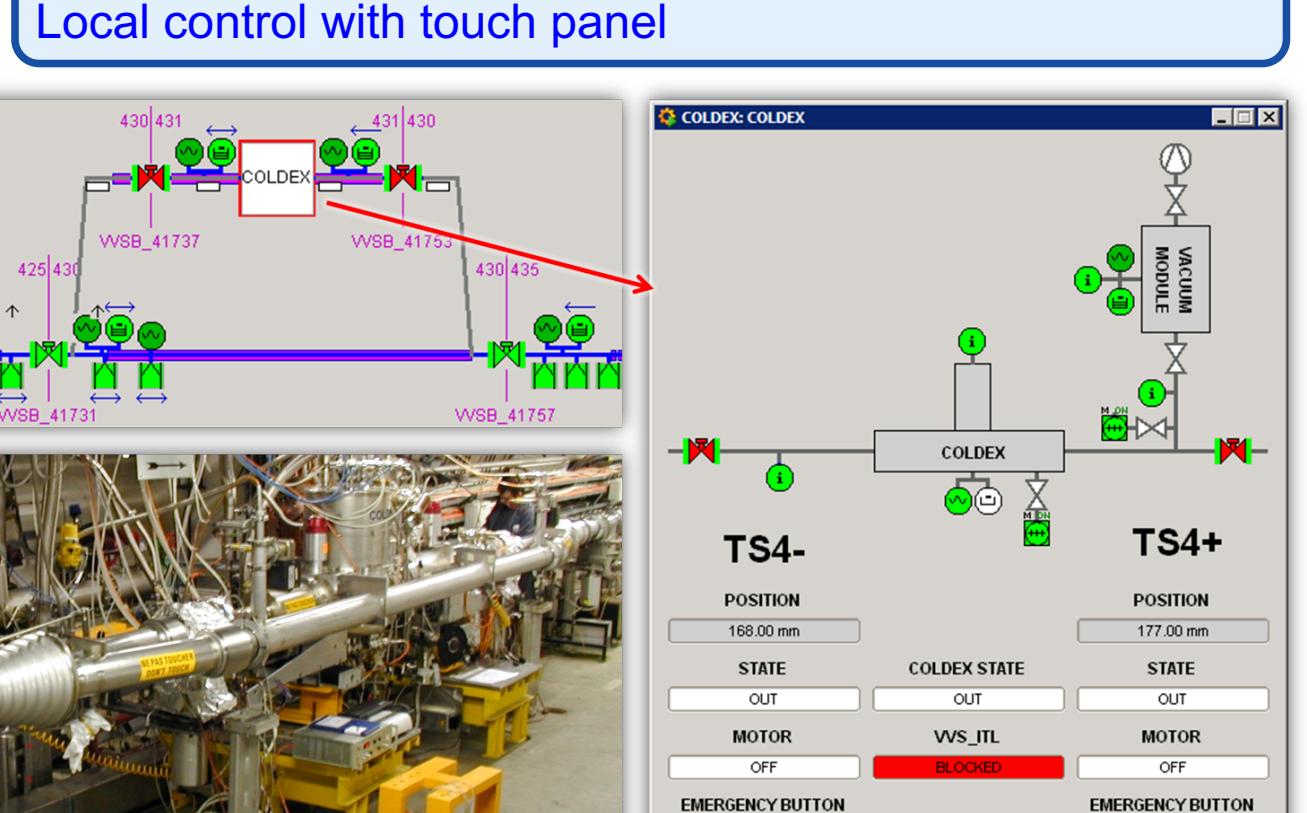
**TPG gauge controller**  
<https://edms.cern.ch/document/1553549>

Renovation of old & slow SCADA/PLC function for TPG  
Now all parameters & status cyclically requested by the PLC to all TPG  
All data logged in SCADA -> historical follow-up



**COLDEX**  
<https://edms.cern.ch/document/1553557>

Experiment on amorphous Carbon coating of beam pipe  
Move in or out of the beam line  
2 step-motors, analog positions, end-switches  
Interlocks to neighboring equipment  
S7-300 PLC integrated in vacuum controls  
Local control with touch panel



**From LS1 to LS2**

Linac4 full sector test; CPS new pumping groups; SPS re-sectorization + crab cavities  
LHC new turbo controllers; new mobile group controllers; modified layout  
Naming convention for instruments  
Prepare and upload information to Layout & Asset Management DBs  
Move issue-tracker (VTL) to Infor-EAM + JIRA  
Hardware developments :  
Wireless for mobile equipment (fieldbus, 4G+); industrial ion pump controllers;  
Rad-tol electronics for gauges; new controllers for sector valves  
Software developments :  
SCADA historical trends : valve operation ; TPG follow-up; color map  
UNICOS convergence : new vacuum field objects & SCADA functionalities  
Test in Isolde-Complex (already has UNICOS-CPC) ; then Linac4 ; global in LS2  
Next LS2 (2019-20) : Injectors upgrade; LHC maintenance & consolidation; HiLumi-LHC

