Status of activities at NCBJ on the slow-control

for the

PANDA cluster-jet target

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In January 2019 our team suffered a heavy loss:

our colleague **Dr. Andrzej Trzcinski** passed away on

Jan. 16th 2019 as a result of the cardiac problem.

Fortunately, **Jerzy Tarasiuk** a very talented programmist from

the Department of Physics, University of Warsaw,

who is here with me,

joined our team, inherited much of what left A.T.

and will continue the task to its successful completion.

To remind the audience, the field layer of the cluster-jet target is foreseen to be served by two CompactRIO's 9039 of National Instruments, which may each incorporate up to 8 C-modules, fulfilling various functions, for example:

1. 32-channel Digital Outputs (DO) - Current output pulses to turn on and off forevacuum pumps, open and close vacuum valves,

2. 32-channel Digital Inputs (DI) - Current input pulses, signalling reaction of a forevacuum pump being turned on and off, vacuum valve being opened or closed,

3. 4 channels of multidrop serial communication RS485 <--> RS232, each channel with up to 32 RS232 end devices, e.g. controllers of the turbomolecular pumps,

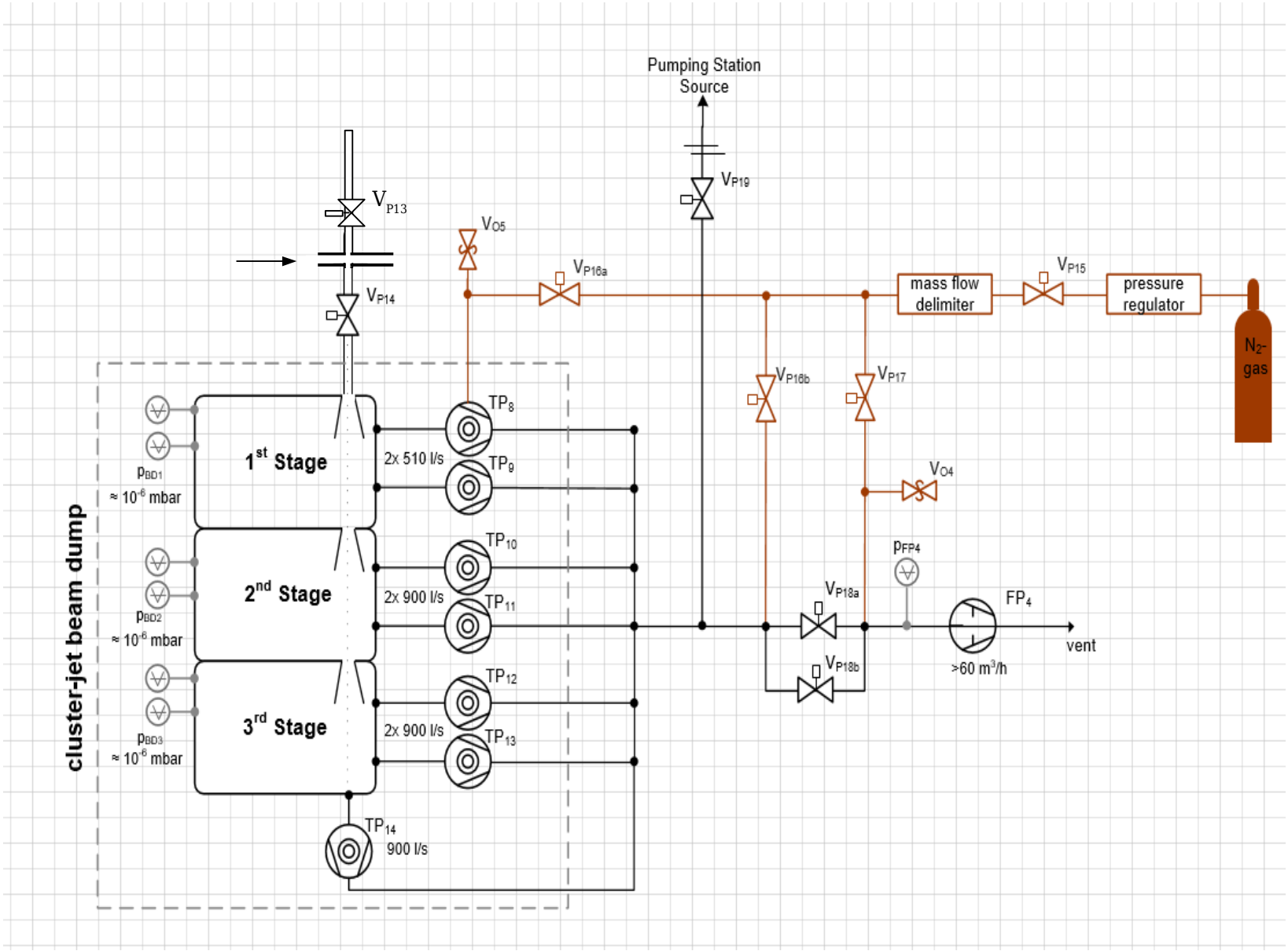
4. 32-channel amplitude to digital converter (ADC),

5. 16-channel current to digital converter (CDC).

The two CompactRIO's 9039 mentioned on the previous page are intended to serve separately the Cluster Jet Generator (CJG) and Cluster Jet Beam Dump (BD).

Since the programming work in LabVIEW has been hitherto performed mostly in relation with the Beam Dump. I decided to present to the audience its vacuum scheme.

It should be stressed that it is only partly funded and its components presently used in tests with the proton beam at COSY in Juelich do not fulfil the requirements put forward in the Cluster Jet Target TDR. The source of funding for the missing elements is unclear.

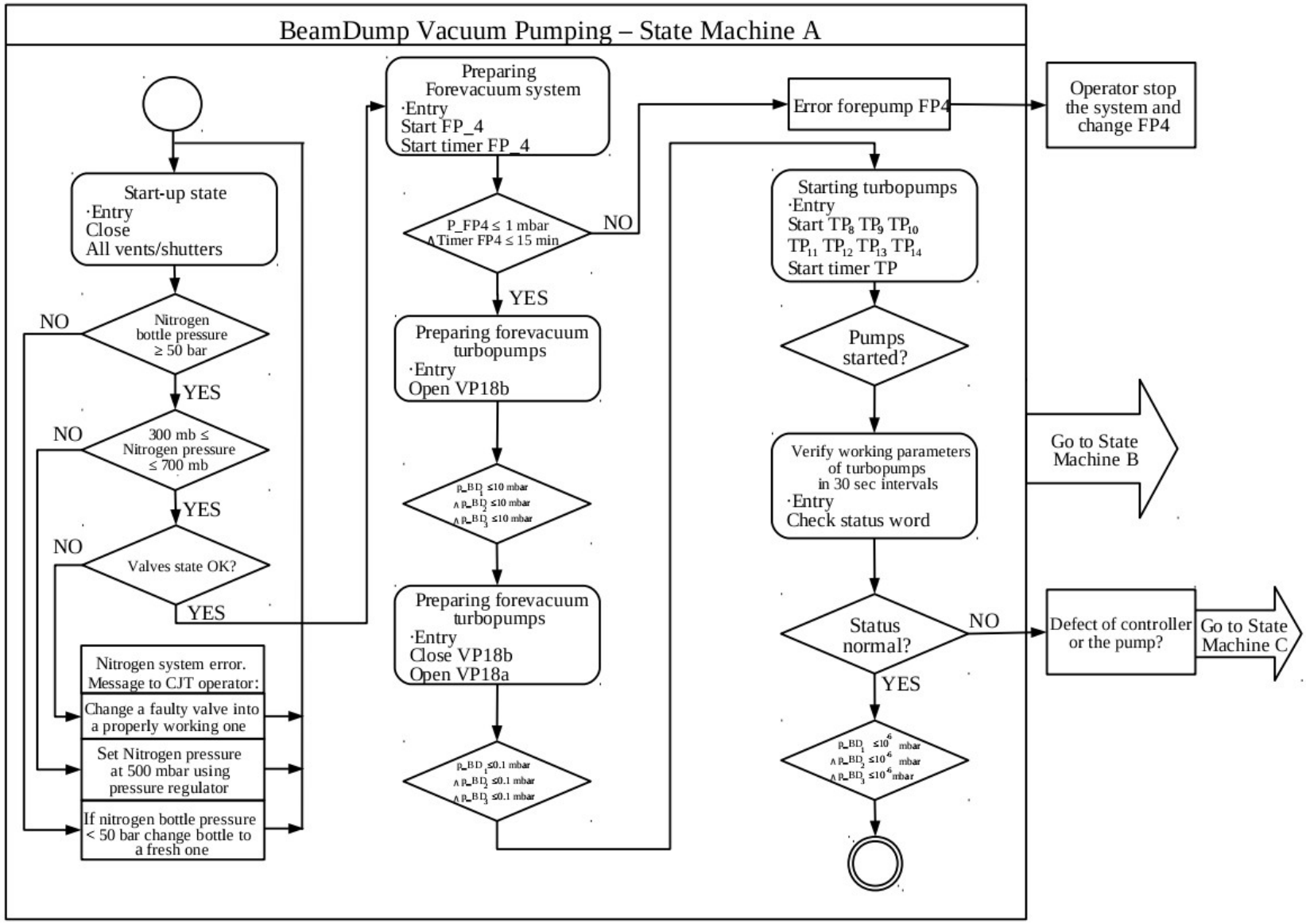


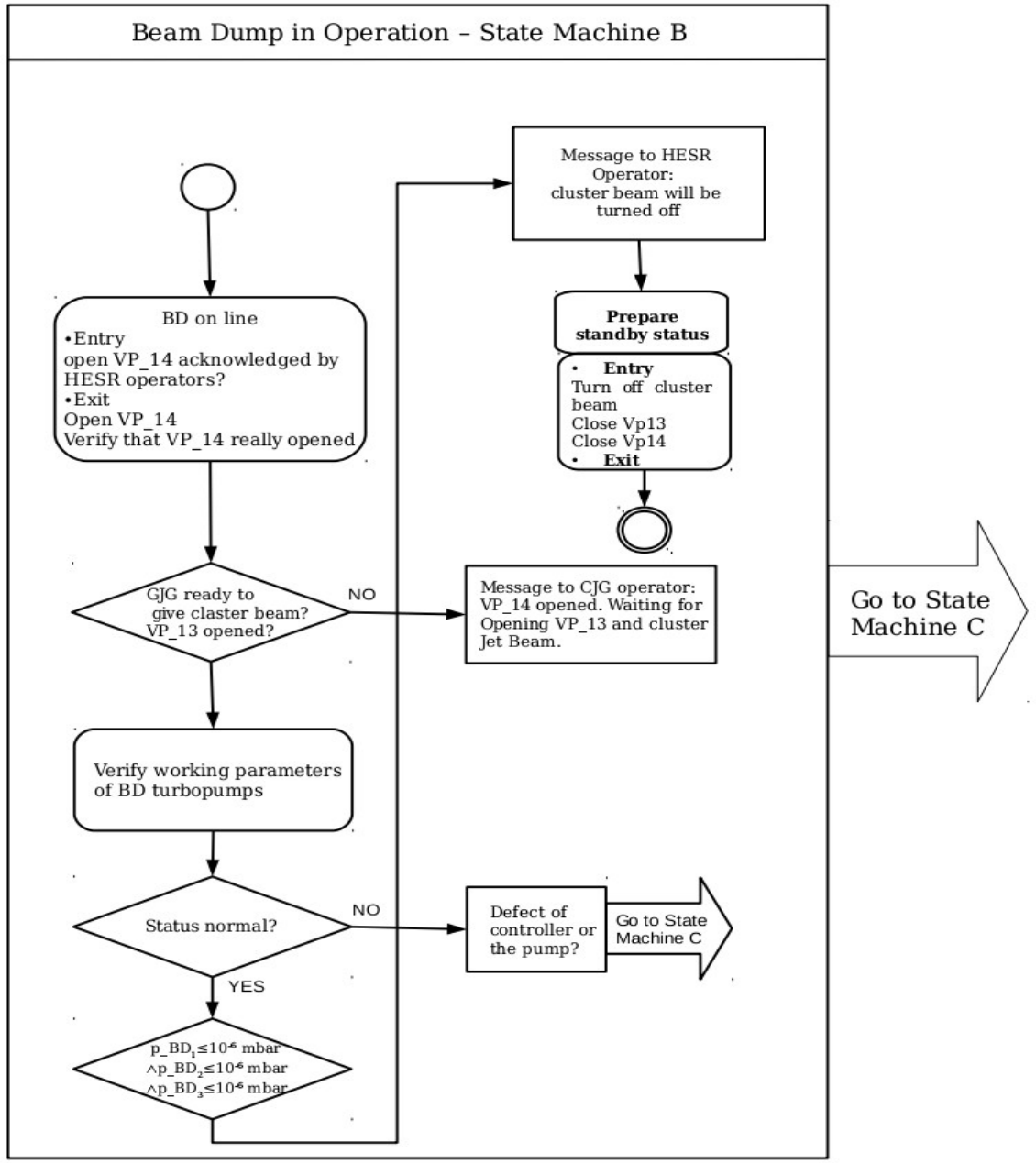
Vacuum scheme of the Beam Dump as used at present in tests at COSY-Juelich of the Cluster-Jet Target.

The LabVIEW program to serve the Beam Dump is prepared according to the same general rules as defined in the Detector Control System (DCS) TDR for every PANDA subsystem. It has the form of a State Machine with the following three states between which it will later make transitions under commands from the PANDA Supervisory Control System:

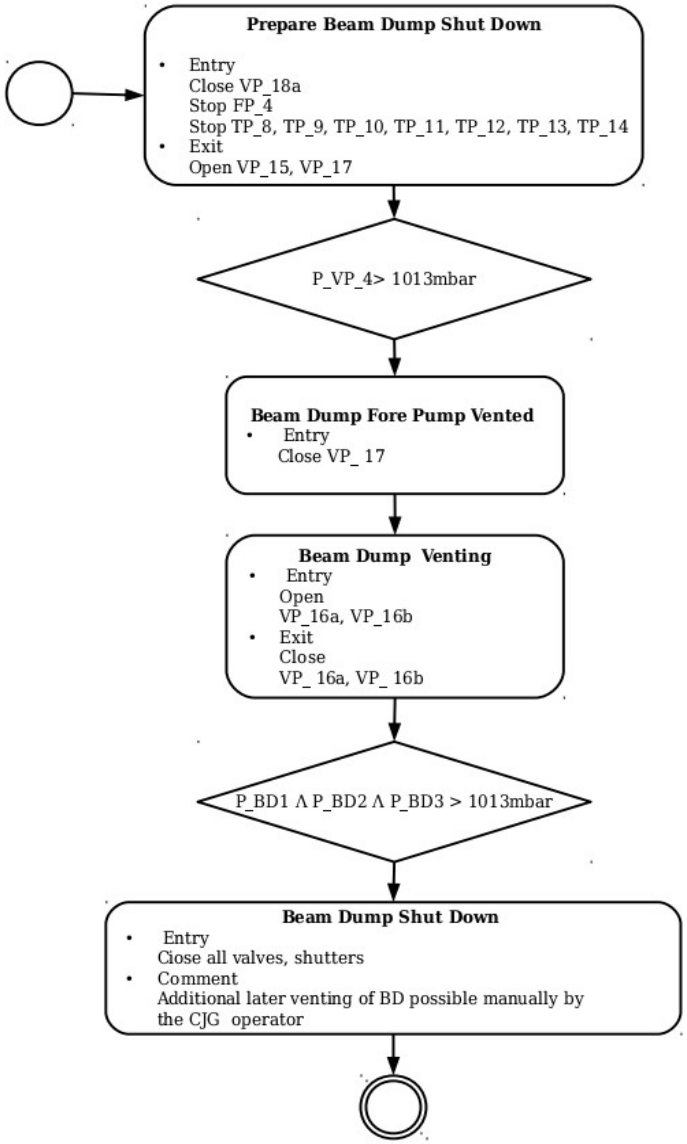
1. **Beam Dump Off** ; vented with Nitrogen,
2. **Preparing Vacuum**; to open V_{P13} and V_{P14}
3. **Standby**; Vacuum better than 10^{-6} mbar. V_{P13} and V_{P14} closed
4. **Beam Dump Running**; V_{P13} and V_{P14} open, cluster beam flows into the beam dump.,
5. **Shutting down**; Pumps turned off, slowing down turbopump propellers with increasing flow of Nitrogen.

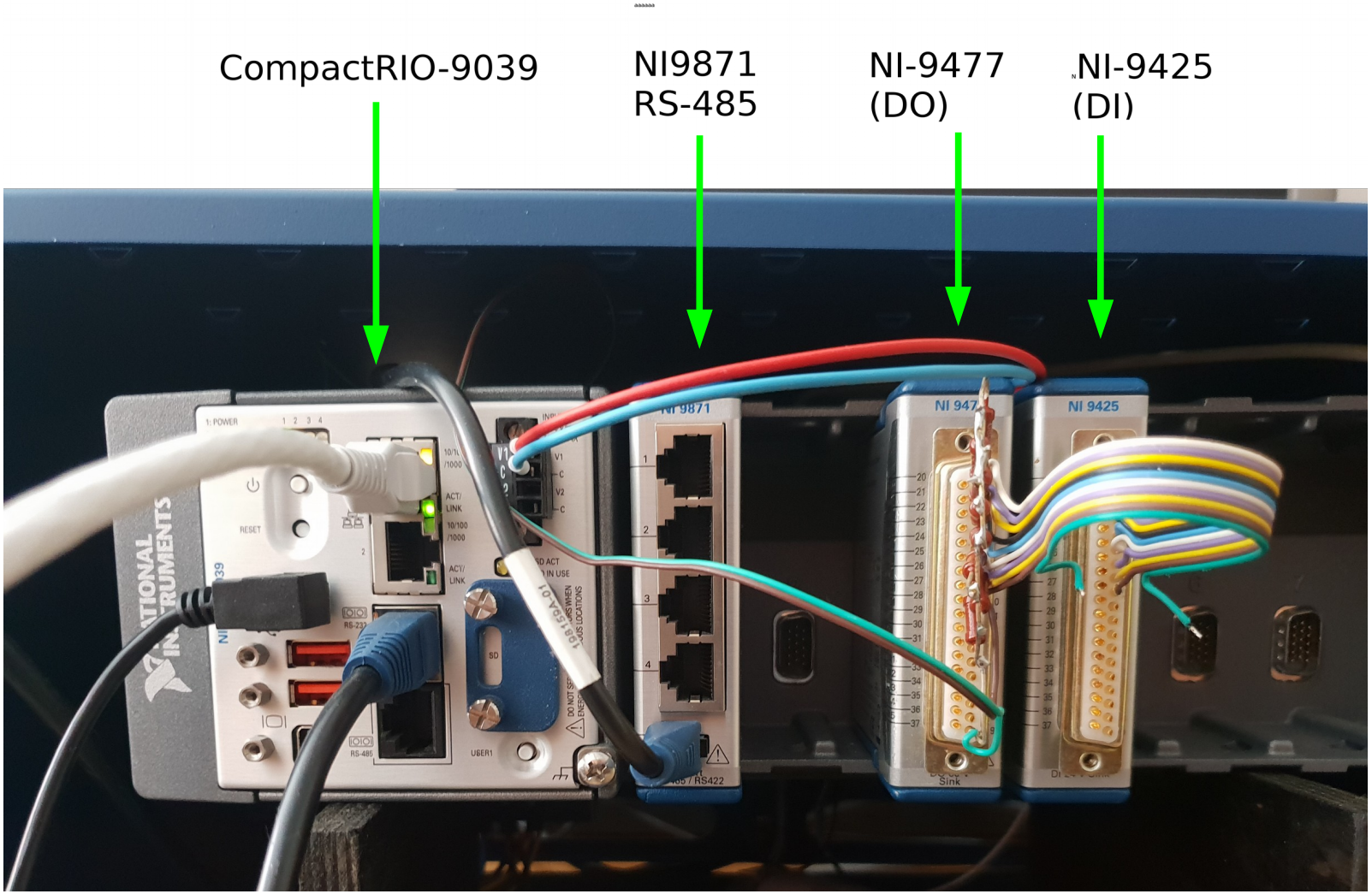
On the next three pages I will illustrate actions of the LabVIEW program upon performing the transitions 1→3, 3 → 4 and 4→ 5.


BeamDump Vacuum Pumping – State Machine A
Start-up state
·Entry
Close
All vents/shutters
Nitrogen bottle pressure ≥ 50 bar
NO
YES
300 mb ≤ Nitrogen pressure ≤ 700 mb
NO
YES
Valves state OK?
NO
YES
Nitrogen system error. Message to CJT operator:
Change a faulty valve into a properly working one
Set Nitrogen pressure at 500 mbar using pressure regulator
If nitrogen bottle pressure < 50 bar change bottle to a fresh one
Preparing Forevacuum system
·Entry
Start FP_4
Start timer FP_4
P_FP4 ≤ 1 mbar ∧Timer FP4 ≤ 15 min
NO
YES
Preparing forevacuum turbopumps
·Entry
Open VP18b
p_BD1 ≤10 mbar ∧ p_BD2 ≤10 mbar ∧ p_BD3 ≤10 mbar
Preparing forevacuum turbopumps
·Entry
Close VP18b
Open VP18a
p_BD1 ≤0.1 mbar ∧ p_BD2 ≤0.1 mbar ∧ p_BD3 ≤0.1 mbar
Error forepump FP4
Operator stop the system and change FP4
Starting turbopumps
·Entry
Start TP8 TP9 TP10 TP11 TP12 TP13 TP14
Start timer TP
Pumps started?
Verify working parameters of turbopumps in 30 sec intervals
·Entry
Check status word
Status normal?
NO
YES
p_BD1 ≤10^-6 mbar ∧ p_BD2 ≤10^-6 mbar ∧ p_BD3 ≤10^-6 mbar
Go to State Machine B
Defect of controller or the pump?
Go to State Machine C


Beam Dump in Operation – State Machine B
Message to HESR Operator: cluster beam will be turned off
Prepare standby status
• Entry
Turn off cluster beam
Close Vp13
Close Vp14
• Exit
BD on line
•Entry
open VP_14 acknowledged by HESR operators?
•Exit
Open VP_14
Verify that VP_14 really opened
GJG ready to give claster beam? VP_13 opened?
NO
Message to CJG operator: VP_14 opened. Waiting for Opening VP_13 and cluster Jet Beam.
Go to State Machine C
Verify working parameters of BD turbopumps
Status normal?
NO
Defect of controller or the pump?
Go to State Machine C
YES
p_BD1≤10-6 mbar
∧p_BD2≤10-6 mbar
∧p_BD3≤10-6 mbar

Beam Dump Shut Down : State Machine C





A photo of CompactRIO-9039 with power supplies, and C-modules DO, DI and a 4-fold RS-485 serial communication module.

Will there be a possibility to test the Beam - Dump LabVIEW program in August at COSY - Juelich together with the WWUM team???

We declare readiness to participate in such an endeavour.

THANK YOU FOR YOUR ATTENTION !