Slow-control system for the Hydrogen Cluster-Jet Test Facility at GSI *

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The present Hydrogen Cluster-Jet Test Facility at GSI has its origin in FERMILAB as a target in the E760/E835 experiment [1]. After dismounting and installation at GSI in the laboratory specially adapted for working with flammable gases, it is reinstated in its cluster-jet operation capability, serving in the same time as a testing ground for many elements of the future PANDA cluster-jet target [2]. We refer in this note to some results obtained in the course of development of its slow-control system.

The whole target system is foreseen [2] to be driven using National Instruments (NI) hardware and software, in the well-known LabVIEW environment. This can be achieved using essentially three elements: a PC, a programmable logic controller and the software that runs on both. The programmable logic controller to drive the PANDA target system is the NI $CompactRIO$. It combines an industrial real-time controller and reconfigurable field-programmable gate array (FPGA) chassis intended for industrial machine control and monitoring applications.

Soon after reinstallation of the Facility at GSI a cRIO-9074 with a few I/O modules have been installed, thus permitting experimenting with the slow-control of its vacuum and hydrogen-flow subsystems. An ultrapure hydrogen is supplied to the nozzle of the cluster-jet generator through a heated Pd-cell [Resource Systems Inc., mod. RSD-75]. This purifier requires that the Pd-alloy barrier is never heated or cooled in the presence of hydrogen. Therefore, for example, the 'turn-on' procedure evolves through the following operations performed step-wise:

- evacuation of the crude and pure gaslines to assure that no hydrogen is inside the Pd-filter,
- evacuation of the inlet gasline to the nozzle and the nozzle chamber,
- turning-on heating and setting the proper temperature of the Pd-filter,
- setting the proper pressure and flow-rate of the pure H_2 through the nozzle.

After completion of this stage, the system can be operated in a stable mode under the control of cRIO. Turning it off starts with evacuation of the crude and pure gaslines to remove traces of hydrogen from the Pd-filter, next takes place the evacuation of the inlet gasline to the nozzle and the nozzle chamber, afterwards the Pd-filter is purged by venting with nitrogen and its heating can be turned-off. The above listed elementary operations have been merged into two procedures within which they are executed automatically by the c-RIO. A nice GUI has been prepared to watch changing states of the system as it evolves in time on the PC screen .

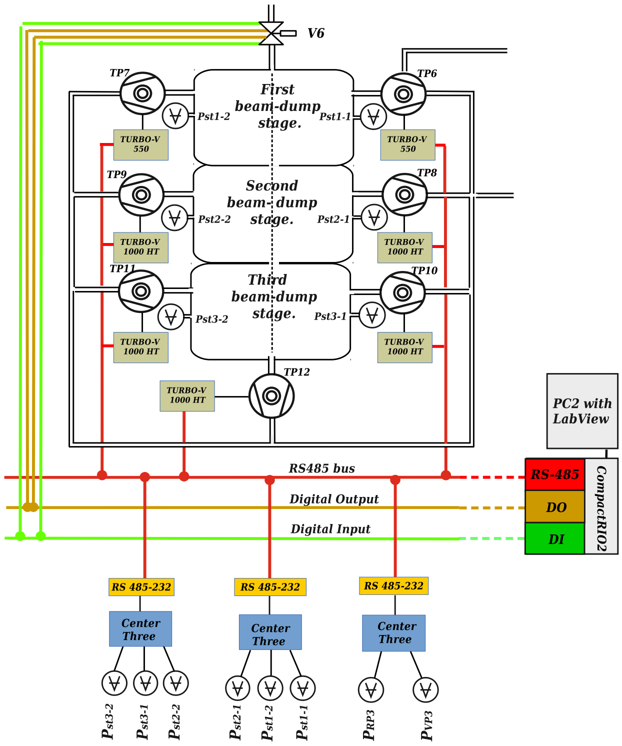

Figure 1: Vacuum devices of the cluster-jet beam dump served by the slow-control system.

An arrival of the cluster-jet beam dump from INFN-Genova marked a new milestone in the Facility's activity. The PANDA cluster-jet beam-dump features three differentially pumped chambers, each chamber pumped with a pair of turbomolecular pumps (TPs) and equipped with a pair of vacuum sensors - one for low- and one for high-vacuum range. An axis of rotation of the seventh TP (TP12 in Fig. 1) is shifted off the cluster-jet axis (marked with the broken line), so that clusters landing on its blades are destroyed immediately into atomic hydrogen and removed outside the beam-dump by the pump. Overall the cluster-jet beam dump plays an important role of minimizing hydrogen reverse load to the HESR beam-pipe with circulating antiprotons.

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A scheme of the beam-dump together with the vacuum devices is presented in Fig. 1. Due to lack of available space the fore-vacuum part has been ommited from Fig. 1. Slow-control is accomplished with the aid of $CompactRIO_2$ [$CompactRIO_1$ is foreseen for the cluster-jet source] using the three indicated C-modules. The lines leading to each of them represent in fact a bunch of conductors joining e.g. a single pin (out of the 32) in the DO-module with a particular wire going to a particular valve. The DI pins receive the status information. A control of TPs (including their turning-on and -off and following in real-time their essential working parameters, such as rotation speed, power consumption and temperature) is accomplished via a serial bus RS-485 permitting to access individually each TP via its controller. Reading of vacuum-pressure sensors involves conversion of their signals into digital form within the Center-Three units with the further making them individually addressable with the aid of RS232↔RS485 converters.

The part displayed in Fig. 1 has already been programmed in LabVIEW and its operation tested in a one-by-one and simultaneous turning-on and -off the seven turbopumps. A project of the rest of the vacuum system has been developed. It will be implemented and tested together with the rest of the future cluster-jet target for PANDA.

References

[1] G. Garzolio et al., Nucl. Instr. and Meth. A519 (2004) 558

[2] Technical Design Report for the $\overline{\text{P}}$ANDA Internal Targets: The Cluster-Jet Target and Developments for the Pellet Target, The $\overline{\text{P}}$ANDA Collaboration: W. Erni et al., http://www-panda.gsi.de/archive/TargetTDR/Targets_TDR.pdf

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