DESIGN BRIEF OF THE SLOW CONTROL SYSTEM FOR THE MPD-TOF DETECTOR*

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TheMulti Purpose Detector (MPD) experiment at Nuclotron based Ion Collider fAcility (NICA) which is under construction at the Laboratory of High Energy Physics at the Joint Institute for Nuclear Research will be studying relativistic heavy-ion collisions. Such experiments give not only experimental data, but also a variety of operational parameters which should be monitored and controlled during regular operation. For this purpose, the Slow Control System is needed. This paper shows the design brief of the Slow Control System which is being prepared for the MPD-TOF detector.

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1. Introduction

The flagship project of Joint Institute for Nuclear Research (JINR) is the NICA facility [1] that consists of one fix target experiment (BM@N — Baryonic Matter at Nuclotron) working since February 2018 and will also include two colliding beam experiments: Multi Purpose Detector (MPD) and Spin Physics Detector (SPD) (see Fig. 1).

One of the subdetectors working for MPD-NICA is TOF. It gives the information about the time, which a particle created in the collision needs to move from the collision point to the detector. TOF, together with the Time Projecton Chamber (TPC), must be able to identify charged hadrons and nuclear clusters in the broad rapidity range up to the total momentum of 3 GeV/c [2]

$$m^2 = \frac{p^2}{c^2}\left[\left(\frac{1}{\beta}\right)^2 - 1\right] . \tag{1}$$

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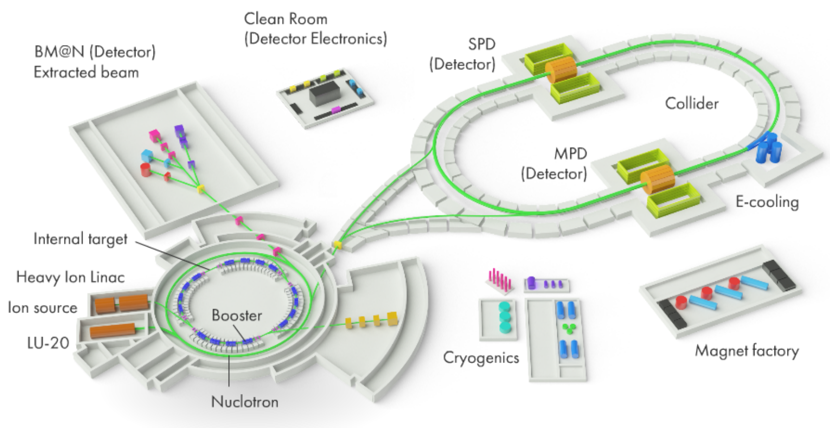

Fig. 1. NICA Complex at LHEP in Dubna [3].

For the charged particle identification (mass reconstruction), one needs to measure the following parameters: momentum of the particle, its track length and time of flight from the interaction point to the TOF detector: where m is the mass of the particle, p — the momentum and β is the velocity of the particle in respect to the speed of light [2].

2. MPD SCS

For proper particle identification (PID), measurements have to be very precise. Various parameters may influence the accuracy of PID in MPD-TOF. The most important parameters are: the temperature inside the detector and its gradient, gas mixture, gas temperature and voltage [4]. To monitor and control those parameters, the Slow Control System is needed [5]. SCS for MPD-TOF is currently being under construction and consists of many different hardware and software branches.

SCS should be modular, each module should be able to adapt itself to other experiments, it should possess the characteristics of being scalable. A lot of different types of users will have access to this system. A shifter should have totally different rights than an operator or an expert. The majority of the program sources should be open, in case it is needed to form additional coding. It is necessary to save all parameters, their maximal and minimal values, alarms and warning levels. Therefore, the EqDb database has been created [6].

The Slow Control System will be mounted in the racks cabinets. It is very important that each rack has the same basic equipment. Such a design lets the racks to be universal. The design, communication types and protocols, as well as the basic equipment of every rack will be the same, ensuring high uniformity of the entire system, simultaneously allowing one to adapt each rack for specific tasks by adding the appropriate equipment in designated slots.

The size of a rack cabinet is $1000 \times 800 \times 47$ U (1 U = 1.75"). All of them have:

— Restricted access system;

— Ventilation and cooling system;

— Remote access system;

— Fire extinguishing system;

— Electrical network analysing system;

— Standard interfaces;

— Cable analysing system.

The restricted access system allows one to divide the users into different groups and give them special access rights. There are two cooling systems in each rack cabinet: air and liquid. Moreover, each rack is connected to the air and liquid buses that allow the racks to work in the complex working regime. For the racks that consist of electronic devices, remote access is provided. In that case, each rack has its own IP address that can be used to link the rack to an authorized user. In case of fire, FRS-RACK®M will automatically extinguish the fire using gas, which is non-destructive for all electronic devices.

Vector currents coming from different phases are summed in the neutral wire. To maximize the equipment efficiency, the currents flowing through each phase should be equal. To measure the flow of currents, each rack is equipped with a LUMEL N43 device. Two main interfaces are in common use: RS485 and Ethernet. Moreover, certain devices are controlled by Digital Input and Output (5 V), Analog Input and Output (0–10 V), Analog Current Input and Output (0–20 mA), RS232 interface and USB. To prevent errors, each cable has its own address that is checked at the plug in. In case the address of the cable is not identical to the address in the database (EqDB), the red diode lights and SCS software give information about the incorrect connections.

3. Conclusions

This paper describes shortly the Slow Control System for the MPD-TOF detector. Data transmission mostly takes place through RS-485 and Ethernet interfaces. The designed part of the system is meeting all the requirements of the Slow Control System (Modular, Scalable, User groups based access level, Opened, equipped in Database). Most of the software is written in LabVIEW, however, SCADA is considered. The results of the testing procedures obtained up-to-now are promising and have confirmed full functionality of the produced sub-systems.

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