

# REVISION OF ZELENOGRAD SYNCHROTRON RADIATION FACILITY CONTROL SYSTEM

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## Abstract

Control system of Zelenograd Synchrotron Radiation facility, designed at the end 80-th last century, is in commission now. Old system was CAMAC based mainly. More advanced variant will consist in replacement of CAMAC modules with the embedded controllers. The report describes new hardware and software solutions.

## INTRODUCTION

In 80th years of the last century the Government of the USSR took the decision on construction in Moscow two specialised sources of synchrotron radiation: one - in Kurchatov Institute, another - in Zelenograd centre of science. Both of synchrotron radiation sources were supposed to build under the uniform basic project developed at Budker INP SB RAS in the beginning of 80th years.

The specialised Centre of Synchrotron Radiation in Kurchatov Institute has been physically started in the beginning of 90th years. It consists of the linear electron accelerator on energy 80 MeV (forinjector), intermediate electron storage ring "Siberia-1" on energy 450 MeV (a source of synchrotron radiation in the field of a vacuum ultraviolet) and big electron storage ring "Siberia-2" on energy 2.5 GeV (a source of synchrotron radiation in x-ray area). Since 1999 to present time KCSR RSC Kurchatov Institute works for users of synchrotron radiation. It is possible to familiarise with a current condition of a plant on <http://www.ksr.kiae.ru/>

The control system of a "Siberia-2" (see Fig.1) is based on the CAMAC modular system which components have been developed in 80<sup>th</sup> years, then in 90<sup>th</sup> have been partially modernized. 24-bit CAMAC-oriented computers are used in the control system [2]. Control hardware consists of 36 CAMAC crates, including modules of control of executive devices and modules of monitoring of synchrotron parameters.

Table 1: Channels of control and monitoring.

Accelerators equipment	Number of channel
Magnet systems of booster and main ring	600
Linac, RF systems, synchronisation	300
Vacuum monitoring	150
Temperature monitoring	450

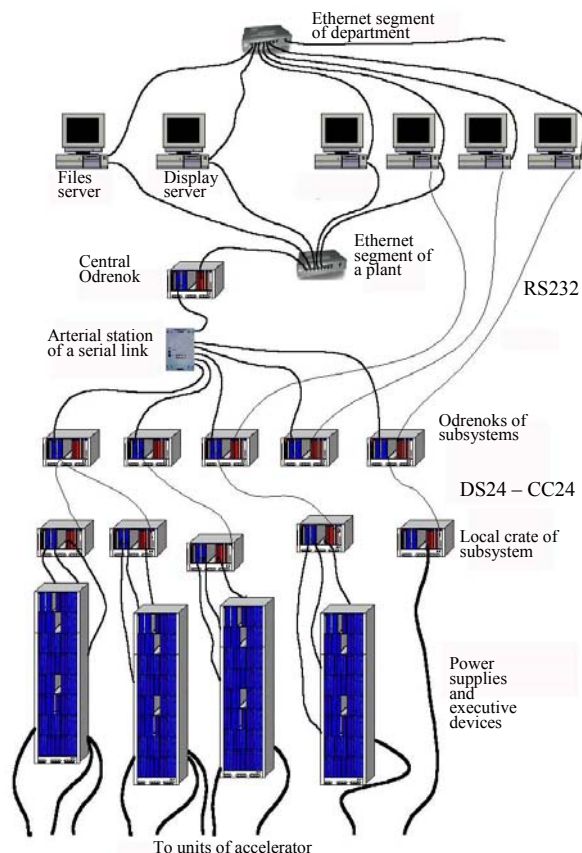


Figure 1: Structure of KCSR Control System.

The industrial storage facility (TNK) includes an injector on the base of 80-100 MeV linear accelerator, and two storage rings: lesser booster for energy of 450 MeV and main ring for energy of 2.5 GeV.

By the year 1988, equipment for two linear accelerators has been produced at INP SB RAS. The first linac was commissioned in 1992 at specialized SR complex in "Kurchatov Institute", Moscow. The second one has been made for TNK complex in Lukin State Research Institute for Problems in Physics, Zelenograd. In 2001, decision about assembling was made, and commissioning of the injector in Zelenograd was scheduled for the end of 2002.

In the end of 2005 there were commissioned booster ring and injector. Electron beam in booster ring was obtained with required parameters.

At the moment a control system of TNK was implemented as exact copy of "Siberia" control system. All equipment was controlled and monitored by CAMAC devices. All control system occupies 8 CAMAC crates with ADCs, DACs and so on designed and manufactured in 80<sup>th</sup>.

A revival of accelerators by obsolete equipment shipped to TNK in 90<sup>th</sup> in accordance with project was quite excused. However full scales automation by obsolete devices is impossible and has no sense. Nowadays BINP has a new generation of devices for automation using quite modern architecture and components. These devices are multifunctional intelligence embedded controllers with CANbus interface. Automation of new installation (FEL, VEPP-2000) [3,4] is based on these devices and new automation structures.

So, the project of control system Zelenograd Synchrotron Radiation Facility is offered to process considerably with perspective of use modern components and approaches, and also again to design the control software, naturally, using the available control algorithms checked in the Kurchatov Center of Synchrotron Radiation.

## OFFERED SOLUTIONS

A new implementation of control system will use successful experience of recently commissioned installations in BINP. Most of end equipment (power supplies for magnetic system, RF-stations, temperature monitoring modules) are provided by embedded controllers with CANbus interface. Connection these components with control computers is performed by Ethernet-CANbus gateways. It allows to minimize number of signal cables with intermediate connectors and distributing panels between terminal equipment and control devices.

By present time there is a settled tendency of creation and use of the completed devices including necessary embedded processor means, connected by standard serial interfaces (Ethernet, CAN, etc.) under standard network protocols. The use of modular systems is limited, as a rule, either operatively reconstructed, or specific, or systems of rigid real time with a greater stream of the information.

For example, the monitoring system of position of a bunch (pickup-station) is scaled on blocks, demands rigid synchronization on time and provides the big pulse stream of the information, therefore use of the modular standard in this system is quite justified.

On the contrary, the use of the modular standard for control/monitoring of magnetic system power supplies entails great volume of knit works and slot connections between racks of power supplies and a control rack (transfers of analog signals for control and measurement) and consequently demands other solution.

If to consider a rack or a box of supplies as the finished product - the multichannel power supply, to equip with its

embedded processor and to connect to a control system of the standard serial interface the quantity of external connections is essentially reduced. The approach can be distributed to systems of radiation safety, the vacuum and temperatures monitoring. In the BINP SB RAS number of modules is developed for embedding in similar products. Modules represent multichannel ADCs/DACs, added by digital inputs/outputs, devices for pulse synchronization [5]. The standard interface CAN providing comprehensible parameters of connection on speed and a noise defence is used. The offered structure of a control system is represented on fig.2. In the offered structure the quantity of the CAMAC-crates is reduced up to 2 pieces.

The decision stated above is successfully tested at creation of control system FEL BINP and modernization of VEPP-2 e<sup>+</sup>e<sup>-</sup>-collider [4] and subsystems of VEPP-5 BINP accelerator facility [6].

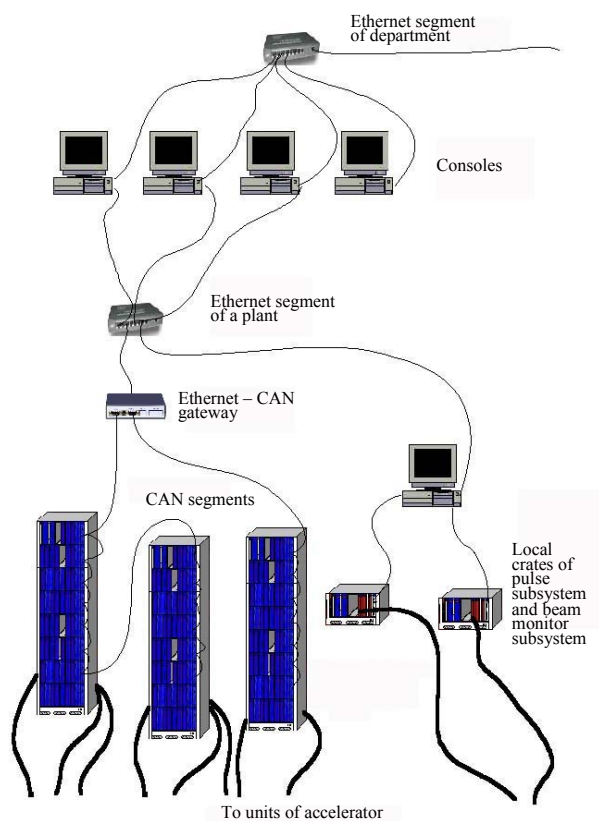


Figure 2: Suggested structure of Zelenograd Synchrotron Radiation Facility Control System.

The applied control software will need to be redesigned again, however there is an opportunity of wide use of the verified algorithms of control. Application in a control system of widely widespread personal computers allows to create applied programs of data processing and visualisation in the modern languages of programming (C++, Java, Delphi, etc.). Standard serial interfaces (CAN, Ethernet) allow to use for transfer of the information standard protocols (TCP/IP, UDP, CANOpen, etc.), libraries and drivers.

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