NEW AUTOMATED CONTROL SYSTEM FOR THE KURCHATOV`S SYNCHROTRON RADIATION SOURCE

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Abstract

The paper describes the new automated control system (ACS) for the Kurchatov syncrotron radiation source (KSRS), which is based on the modern servers and network equipment, VME equipment, National Instruments modules, time server, power equipment with built in intelligent controllers. The new system includes around 2300 control channels and 5900 measuring channels. Control programs that provide user interfaces, monitoring of the system operation, data acquisition, data processing and data storage, were developed using Citect SCADA 7.2, SCADA Historian Server, LynxOS Runtime, LabVIEW-2013, OC ARTX166, PCAN-Evaluation. The new ACS KSRS has allowed to increase the number of control and measuring channels, to increase the speed and accuracy of the measurements, to increase the speed of data processing and data transmitting. As a result, the main parameters of the KSRS have been improved and its work efficiency increased.

NEW AUTOMATED CONTROL SYSTEM AT KURCHATOV SYNCHROTRON RADIATION SOURCE

The description of new automated control system of Kurchatov`s synchrotron radiation source which is realized at the present time is presented in the paper. The necessity of automated control system modernization is explained by the equipment replacement in which we take state of art hardware decisions for facility control and increase the processing and transmitting data speed are considerably increase and the requirements to measurement accuracy are become more strict.

The paper [1] presents the detailed description of all control levels (lower, server and upper) of new automated control system and integration of SCADA system CitectSCADA v.7.2 into facility control system which provides the facility control, alarms notify, detailed reports preparation, acquisition and storage of historical data et al.

New automated control system essentially differs from previous system. New control system has multilevel equipment structure and uses a distributed control system instead of centralized used in the previous system. This allowed to increase the reliability of the control system, reduce the time and hardware resources on any data operation (read, write, processing), increase a flexibility and improve a performance of new control system. All equipment involved into facility control system (operator's work stations, servers, crates with single-board computers, microcontrollers, oscilloscopes) are connected to a local network divided hardware on 3 levels: lower, server and upper level (see Fig. 1). The organization of such a three-level local network allows to restrict access to the execution units thereby increasing reliability of the accelerator facility.

Lower Level

At the lower level of new control system acquisition of diagnostic data, execution of local and global facility technological systems control algorithms are carry out. The main part of the equipment used at this level are VMEbus standard equipment. The main units performing the required algorithms are VME single-board computers Emerson MVME5500 based on the PowerPC MPC7457 processor and the Marvel GT-64260B host bridge with a dual PCI interface and memory controller. On singleboard computer real-time operation system LynxOS v.4.2 and special software are operated. In some cases, we will be use the equipment of such companies as National Instruments, Tektronix, I-Tech, B&R etc. or an unique equipment of our own design.

There are 8 subsystem at this level. Each subsystem controls only a certain part of the accelerator complex.

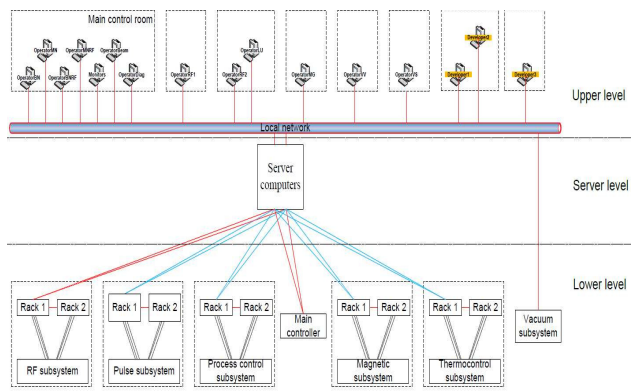

Figure 1: The layout of new automated control system at Kurchatov`s synchrotron radiation source.

SYSTEM OF THERMOMONITORING AND TERMOSTABILIZING

The modern system of thermomonitoring and thermostabilizing of KSRS is described [2,3]. The system provides: a monitoring of temperatures of the magnets and RF resonators of KSRS; the informing of operator on the violations of the technological process course; the data protection from an illegal access; the archiving and the

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displaying of the archive data in a trend type. The system includes 480 temperature sensors of the AD592 type, providing the accuracy of measurements 0,2 C0. System of thermos stabilizing of the linear accelerator the proportional integral differentiating regulator for support of stability of temperatures at the level of 0,05 C.

RF GENERATORS CONTROL TOOLS

Now the technology equipment of KSRS is upgraded. At the same time, new equipment and software solutions for the control system are implemented. The KSRS main ring is the electron synchrotron with two 181 MH RF-generators, their control system provides measurement of parameters of generation, regulation of tuning elements in wave guides and resonators, output of alarm messages. (see Fig. 2). At the execution level the VME standard equipment is used.Server level is supported by Citect SCADA and the SQL historian server. The operator level of control system is implemented as a PC local network. It allowed to expand number of measuring channels, to increase speed of processing and data transfers, to have on deman historical data with the big of measurements

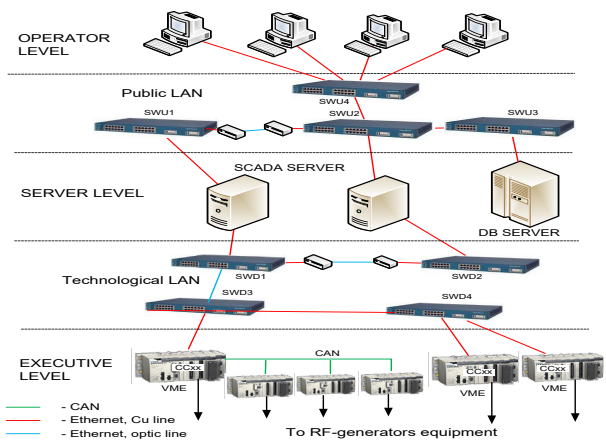

Figure 2: Structure of RF-generators CS.

In article the control system structure by KSRS RF generators, including the description of all levels of control is provided. Examples of implementation of the operator interface are given.

UPGRADE SYSTEM OF VACUUM MONITORING

Modernization project of the vacuum system of the synchrotron radiation source has been designed and implemented [1]. It includes transition to the new high voltage power sources for the pumps of NMD and PVIG–0.25/630 types.

The system is controlled via CAN-bus, and the vacuum is controlled by measuring pump currents in a range of 0.0001–10 mA. Status visualization, data collection and data storage is implemented on Sitect SCADA 7.2 Server and SCADA Historian Server. The system ensures a vacuum of 10^{-7} Pa. The efficiency and reliability of the vacuum system is increased by this work, making it possible to improve the main parameters of the SR source.

THE POWER SUPPLY SYSTEM FOR CORRECTORS AND FOCUSING LENSES

The modernization project of the low-current power supply system of Kurchatov Synchrotron Radiation Source has been designed and is under implementation now. It includes transition to the new power suppliers to feed electron beam orbit correctors and focusing lenses.. Multi-level control system, based on CAN/CANopen fieldbus, has been developed for specific accelerator applications, [4] which allows startup and continuous run of hundreds of power supplies together with the other subsystems of the accelerator. The power sources data and status are collected into the archive with the Sitect SCADA 7.2 Server и SCADA Historian Server.

The following operational parameters of the system are expected: current control resolution - 0.05% of IMAX; current stability - $5*10^{-4}$; 10 hours current variance – 100 ppm of IMAX ; temperature drift - 40ppm/K0 of IMAX.

As a primary power source we use industrial single output power supply, which feeds PWM switches. The PWM frequency is determined taking into account acceptable level of current ripple in the resistive load, which must not exceed 0.1% of maximum current value. In our case the PWM operates at 50 KHz, allowing more then 1000 primary steps for each PWM channel. High resolution PWM of the TMS320 microcontroller provides extra 120-130 PWM levels within a primary step.

FIRST OPERATION OF NEW ELECTRON BEAM ORBIT MEASUREMENT SYSTEM AT SIBERIA-2

The paper focuses on the results of commission and usage of the electron beam orbit measurement system at synchrotron radiation source SIBERIA-2 [5,6] The main purpose of new orbit measurement system creation is an improvement of the electron beam diagnostic system at the storage ring. This system provides continuous measurements of the electron beam closed orbit during storing, ramping and operation for users. Besides, with the help of the system it is possible to carry out turn-by- turn measurements of the electron beam trajectory during injection process. After installation of new orbit measurement system we obtained a very good instrument to study electron beam dynamics into the main storage ring in detail. The paper describes the new orbit measurement system, its technical performance, the results of commission and our experience.

THE FEEDBACK SYSTEM FOR DAMPING COHERENT BETATRON AND SYNCHROTRON OSCILLATIONS

In the article the bunch-by-bunch feedback system for damping coherent betatron and synchrotron oscillations of the electron beam which is realized at the present time at

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the synchrotron radiation source of the Kurchatov Institute is presented [7,8]. An installation of the new feedback system into the storage ring will allows to improve a quality of synchrotron radiation beams. In particular, with the help of the feedback system it's possible to increase a maximum stored beam current at the beam injection energy (450 MeV) and at the operation beam energy (2.5 GeV) the system will provides an additional electron beam spatial stabilization. In the article a description of the new feedback system, principals of the operation and its technical characteristics are presented. Also, kickers used in the system, which design is of a special interest, are described.

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