MODERNIZATION OF THE ELECTRON BEAM STABILIZATION SYSTEM IN THE KSRS

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Abstract

The stabilization system is designed to prevent drift of the spot SR at the experimental stations by local changes of the orbit. This system was developed and implemented about twelve years ago as an element of the ACS and worked well. Produced by modernization has led to the need of adaptation of the system of stabilization not only in hardware but also in software. Work on updating of the stabilization system and will be shown next.

The running cycle of Kurchatov Synchrotron Radiation Source (KSRS) includes the injection of electrons with energy 80 MeV from the linear accelerator in the booster storage ring Siberia-1, the accumulation of a electron current up to 400 mA and, then, electron energy ramping up to 450 MeV with the subsequent extraction of electrons in the main ring, storage ring Siberia-2, and accumulation there up to 300 mA, and at last the energy ramping up to 2.5 GeV. [1] This mode is the basic mode for obtaining SR by users of the experimental stations. The high stability of the x-ray beam at the entrance of the experimental station is one of the most important conditions for the successful functioning of the SR source. (Fig.1)

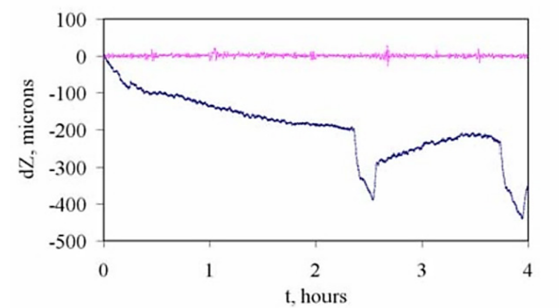

Figure 1: SR beam position at an entrance of experimental station. Bottom line – feedback system is switched off, top line – feedback is switched on. Standard deviation from initial position in last case was 4.5 microns.

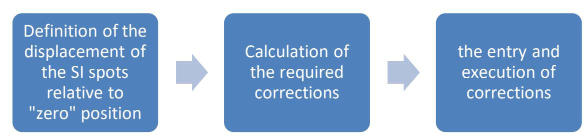

Figure 2: The principle of the stabilization system.

LOCAL FEEDBACK SYSTEM TO CORRECT SYNCHROTRON RADIATION BEAM POSITION AT SIBERIA-2 STORAGE RING

Stabilization system (SS) is part of a control system of accelerator complex and is designed to prevent drift of the spot SR at the experimental stations by local changes of the orbit [2].

Stabilization system provides feedback spot position SR at the experimental stations and the current in the correctors. Information about the position of the spot SR is obtained from the video camera, then it is calculated the deviation from the nominal position and the value of the required correction. Needed position of the beam in the area of the controlled channel is provided specific for this channel set, containing 3 or 4 corrector, so that the changes don't affect the orbit outside the correction area (Fig.2).

LOCAL FEEDBACK SYSTEM. REALIZATION AND MODERNIZATION

SR beam position monitor is a stripe of phosphor using side part of SR beam. A few dozen frames of digital image exposure is processed to determine the center of the spot of SR. The output of the program is the value of deviation of the beam from the nominal position. This value is written to the database table. Further there is a similar process the next channel. The operator at any time has the ability not only to enable or disable the stabilization, but also to adjust the position of the SR spots. In addition, there is the ability to accurately define the area of illumination to reduce the impact of probable defects of the camera and the phosphor (Fig.3).

The program calculate the necessary correction values, referring to the database, receives the position deviation of the beam from the nominal position and the set of coefficients for the calculation, selected in advance. The result of this program is the set of values of the currents of the correctors are also recorded in the database table. Further, similarly calculated for other stations (Fig.4).

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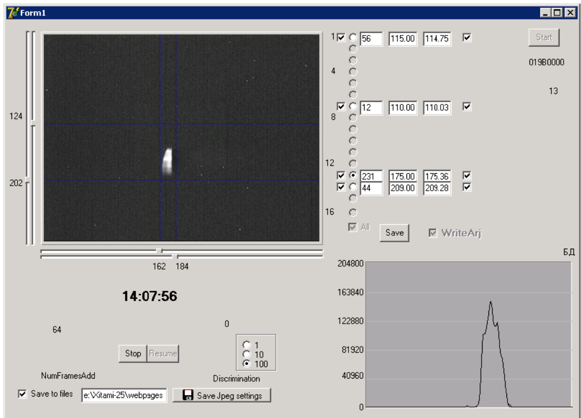

Figure 3: Program of determination of the spot position SR.

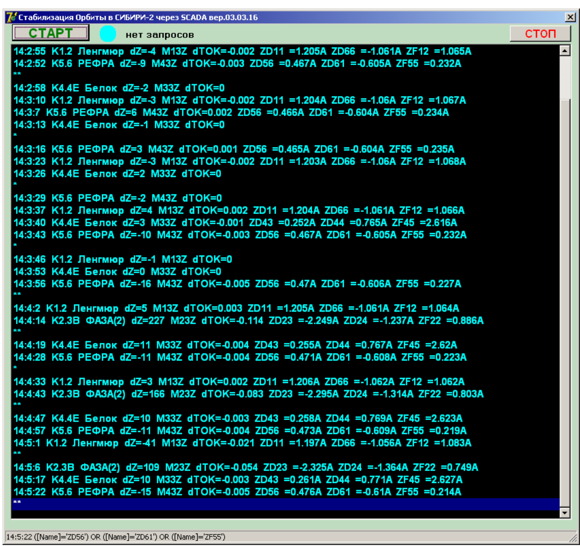

Figure 4: The program of calculate the necessary corrections.

Program designed for entering setpoints (BANK), taking data from the database, puts the calculated currents in the DAC power sources of the correctors by using the programmable controller K167.

The division of the system into blocks and use database tables allows you to add new stabilized channels and change the stabilization settings simple edit the appropriate fields in the database without making any changes to the program code. This system was developed and implemented about twelve years ago as an element of ACS and well-proven. Started a few years ago the modernization of the automated control systems of accelerator complex has led to necessity of adaptation of the stabilization system both in hardware and software.

The introduction of the SCADA system of the company Citect changed the organization of data exchange. The replace the power supply UM-6 and TIR-25 to PCS-6A and PCS-20A and using the power control correction (BUK) required the use of a controller of the magnetic system (CCMS) NI cRIO-9081 [3-5].

The updated system of the stabilization program the deviation of spot position SR is used with minimal changes.

The program calculate the necessary correction values, referring to the database, receives the position deviation of the beam from the set and the set of coefficients to calculate, chosen in advance, however, the output from this program is used by the SCADA system, which creates a boot table for the controller of the magnetic system. Next, the CCMS, based on the values obtained, generates commands for the BUK, which directly controls the power supplies of correctors.

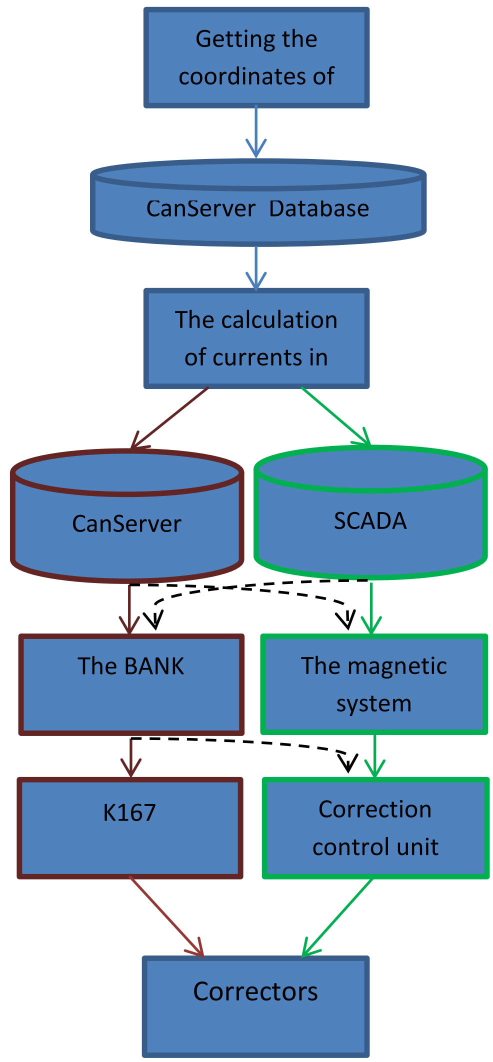

Figure 5: The old and the new stabilization system.

The upgrade is performed without stopping complex, so it is important to maintain compatibility of software and hardware units of the old and updated control systems. To achieve compatibility, the program calculating the correction value, outputs the result of calculation in the database, and SCADA. Program BANK got the opportunity to take source data not only from databases, but also from the SCADA and to operate not only K167, but BUK (Fig.5).

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This approach leads to redundancy, however, allows the use of both new and old components and software modules in almost any combination, which in turn allows you to debug new and modified during technological breaks in the work setting.

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