SYSTEM OF THERMOMONITORING AND TERMOSTABILIZING OF KURCHATOV SYNHROTRON RADIATION SOURSE

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Abstract

The modern system of thermomonitoring and thermostabilizing of KSRS is described. The system provides: a monitoring of temperatures of the magnets and RFresonators of KSRS; informing operator on violations of the course of technological process; data protection from illegal access; archiving and displaying of archive data in a trend type. The system includes 480 temperature sensors of the AD592 type, providing the accuracy of measurements 0, 2 C^0. System of thermo stabilizing of the linear accelerator the proportional integral differentiating regulator for support of stability of temperatures at the level of 0, 05 C^0 .

INTRODUCTION

The National Research Centre Kurchatov Institute, completed work on the creation of a new automated control system (ACS) accelerator-storage complex (ASC) "Siberia" [1-5] on the basis of modern servers, network equipment, the VME hardware, National Instruments company modules and new power ASC equipment (with built-in controllers). It uses software tools: Citect SCADA 7.2 (full version), Lynx OS Runtime, LabVIEW-2013 development environment Thursday PK-166 software, OS ARTX166, PCAN-Evaluation, and others. As part of a new ACS was developed modern system of temperature control and temperature stabilization of ASC "Siberia".

APPLICATIONS

TERMOCS operator's application consists of a set of video imaging that are designed to display information about the temperature adjustment is-ditch, lenses and bending magnets ASC "SIBERIA" [1-5]. In this video frame (Fig. 1) shows designed to display the current temperature correctors, lenses and bending magnets of a linear accelerator, a small storage, the EOC-1 and the EOC-2.

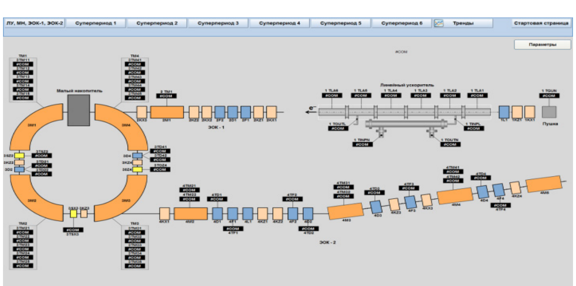

Figure 1: Video frame "LU, PL, EOC-1 and EOC-2".

In this video frame (Fig. 2) shows display the current temperature correctors, lenses and bending magnets in each superperiod Accumulate large-telja.

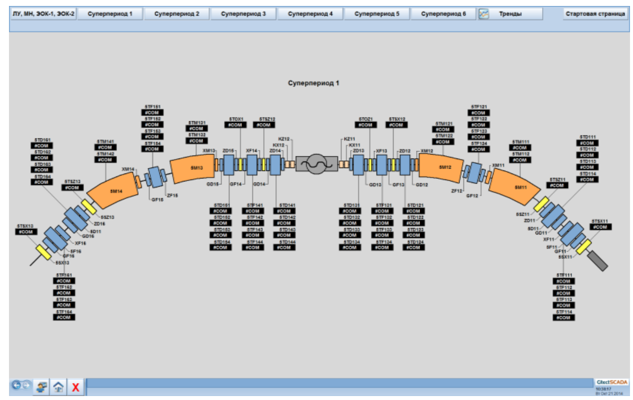

Figure 2: Video "Superperiod 1"- "Superperiod 6".

In this video frame (Fig. 3) shows intended to display archival temperatures in graphs.

Figure 3: Video frame "Trends".

WORKING WITH TREND

To work with the current and historical trends using «Process Analyst» (Fig. 4). The horizontal axis of the graph is the time axis, which is equal to the selected interval, co-tory user-configurable. The vertical axis represents the values of technological parameters imposed on the chart. Setting trends and management is carried out by the following elements:

- Addition and removal of curves with the trend;

• Coupling / decoupling curves (if the curves are linked, then all actions affecting the display of time intervals in the chart, are performed with all the curves);
• Show / hide the point plotting;
• Show / hide the arrow mark;
• Show / hide the curves.

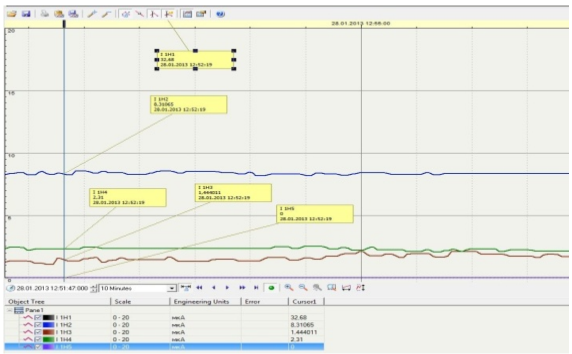

Figure 4. «Process Analyst».

With the help of these buttons you can save the desired presentation of graphs and Liu-bout time to load it from the file.
• In this field specify a time period for which the values are displayed graphs on the screen (the default interval is 10 minutes, but the User The-Telem can be changed) ;
• The initial time interval of the current screen (can be changed by the user);
• Final torque (can be changed by the user) of the current time interval on the screen;
• Enable / disable auto-scroll mode, all curves;
• Zoom in / out 2 times along both axes;
• Single arrow moves the chart on the floor of the interval forward;
• backward double arrow shifts the graph of a range;
• Curves in the plots shifted to a point on the axis of the date and time corresponding to the currently-th time;
• Activate zoom separate part of the graphs. By pressing this button the mouse cursor changes to a crosshair with which, the area on the chart. Cancel this mode can be with help of pressing the right mouse button again or by pressing the button ;
• Set acustom duration of the interval display time;
• Change the scale of the vertical spine;
• Adding new graphs is done by pressing the corresponding button.

In the window that appears (Fig. 4) must be from the dropdown list box in the Connection (connection) to select Port-tion with CitectHistorian Knop and click Search (search), select the list that appears necessary pa-rameters to display by double-clicking the left mouse button. After selecting an optionally-sary settings you must press the "OK" button. To remove the scheduling is required in the "tree of objects" to select the schedule you want to delete and press on the appropriate button.

EQUIPMENT

Lower level equipment of the "TEMOKS" system is built based on the standard equipment of NationalInstruments company. Measuring and control is performed by NIsRIO-9073 Integrated 266 MHz Real-Time Controller and 2M Gate FPGA. The thermal control system uses AD592 temperature sensors (error 0.2 C ^{0}) and AD590 (error 0.5 C^{0}) . These advanced sensors replaced KT904 sensors that are not manufactured anymore. The temperature sensors (480 pcs.) use a 2-wire connection scheme. A new board was developed -16-channel multiplexer with a common signal amplifier to convert these signals into a voltage(0 –10 V).

Let us briefly review the TERMOKS system. From the database of the new ACS system configuration of an each temperature control sensor and its alarm settings get loaded into the NI cRIO-9073 controller : 1 lower to detect when a sensor is off and 2 upper - emergency and critical. When each of these levels is exceeded, high-current power supplies the magnetic system ASC "Siberia" is disconnected. Measuring signals from multiplexers are done by using two NI 9205 AI Differential / 32 AI Single-Ended, ± 10 V, 16 Bit Module and NI 9401 5 V / TTL, Bidirectional Digital I / O, 8 Ch Module. Then averaging over several points, translating into a temperature value, comparison with the settings and output signals of the relay interlocking is being performed using NI 9476 24 V, Sourcing Digital Output, 32 Ch Module. The acquisition cycle of all sensors including filtering and averaging is 2 s

To measure temperature in the thermal stabilization system we use conversion board that converts Pt100 sensor signals into signals of 0-20 mA and NI 9203 8-Channel, ± to 20 mA, 16-Bit Analog Input Module. Temperatures are read by the controller NI cRIO-9073, then calculated output value of the heating element is transmitted (using the NI 9265 4-Channel 16-Bit Analog Output Module) to the E5AN-H Omron module to control heating element's thyristors . Work cycle of thermal stabilization - 2. Temperature stability in the linear accelerator is 0,05 C^{o}

In video frame (Fig. 5.) shows a diagram of the system of thermal stabilization, the state is turned off, teley QF1 and QF2, contactors KM1 and KM2. With a given video system operator controls the heat setting.

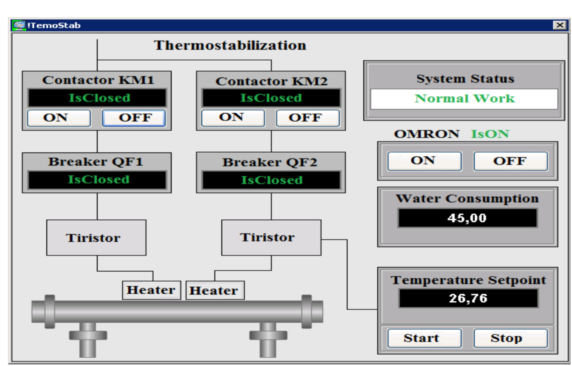

Figure 5: Control Window thermal stabilization system.

ISBN 978-3-95450-181-6

The graphs (Fig. 6) of the measured values of the water temperature at the inlet of the copper (TSX12) and aluminum (TSX11) circuits at the input (T1NPN) and output (T1OUTN) from the heater, as well as the average temperature of the linear accelerator structure (T linac average temperature). The latter varies between 0.05 ° C.

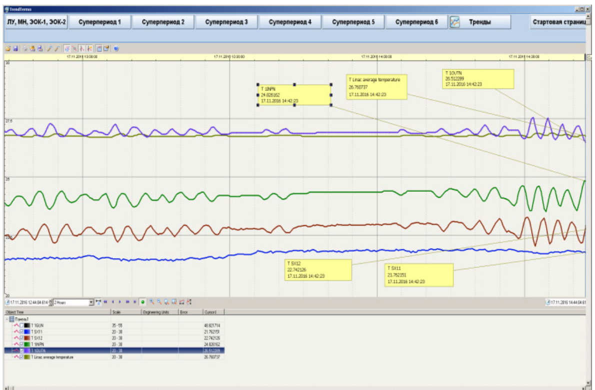

Figure 6. A screen shot of the archival program thermal stabilization system.

CONCLUSION

As a result of this work, a modern thermal control system and temperature stabilization by the use of new sensors, control and measuring equipment. Improve the reliability of the system and the ability to more effectively manage the accelerating-storage complex "Siberia, promptly obtain complete and accurate information from the server system. The system has the ability to improve the accuracy of temperature stabilization system of measurement to 0.01 C^0.

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ISBN 978-3-95450-181-6