

RECONSTRUCTION OF SINTER STRANDS ##5–6 BY AZOV CONTROLS LLC AND CONSTRUCTION OF CENTRAL CONTROL ROOM AT ZAPORIZHSTAL PJSC

Assigned tasks were as follows:

In 2016, priority at Zaporizhstal PJSC was given to sinter plant upgrading.

Azov Controls LLC was assigned to reconstruct the fifth and sixth sinter strands at first and then to construct the new object – sinter strands ##1–6 central control room (further referred to as CCR).

The following hardware was used:

- programmable logic controller Allen-Bradley ControlLogix L83;
- safety controller Allen-Bradley SmartGuard 600;
- frequency converters Allen-Bradley PowerFlex 753 and DC drive PowerFlex DC;
- hardware components Allen-Bradley, Phoenix Contact, Rittal;
- rack servers Hewlett Packard DL 360 и DL320;
- industrial switches Cisco Industrial Ethernet 3750 and 3010.

The following software was used:

- FactoryTalk View Server;
- FactoryTalk View Studio;
- FactoryTalk View Site Edition.

The following results were achieved:

The work done has resulted in major upgrading of sinter strands ## 5 and 6 control system as well as construction of the modern sinter shop control room at Zaporizhstal PJSC.





Implications for project implementation

Sinter production is a rather conservative highly mechanized and lowly automated process. Zaporizhstal PJSC sinter shop is no exception.

Technologically the shop consists of six continuously operated sinter strands. In order to provide pollutant emissions control, the sinter strands are equipped with systems of process gas cleaning and air aspiration from tail parts – intensive dusting source within finished product output area.

The previous sinter shop reconstructions were occasional. They were performed at different time periods and involved different contractors.

Combination of the above factors has caused one of the key sinter shop automation problems – scrappy hardware components.

In 2011, the plant joined one of the world's largest iron and steel holding companies – Metinvest. It was when major sinter shop upgrading started: upgrading of process cleaning systems at first, and then the one of the very sinter strands.

Thus, in 2016, the fifth and sixth sinter strands were reconstructed. It is noteworthy that the new control system of both strands has been based on Allen-Bradley ControlLogix PLCs. Along with process equipment reconstruction, sinter shop CCR construction started.





Implementation experience

Sinter strands reconstruction work package included the fifth and sixth sinter strands control systems upgrading (in 2016), followed by the fourth strand and charge-conveying control system upgrading (in 2017).

In the course of turnkey project implementation, installation, commissioning and major project activities including reconstruction sites survey as well as operating preferences and demands research were performed.



Within the scope of the works scheduled, ПІСЦ2 electric control room containing the above units control cabinets had to be remanufactured.

In view of continuous production, the works were performed under a tight schedule, using a phased approach, and required thorough production arrangement.

Each and every control and electrical component was replaced. In particular, power and control circuit supply systems were reconstructed, power supply diagrams were reconsidered, new behaviour and hardware components were introduced.

In terms of design, all the control cabinets are based on well-established Rittal control system involving the use of Allen-Bradley, Phoenix Contact and other hardware components. The new system advantage is application of the most advanced and

reliable frequency converters PowerFlex and DC drives PowerFlex DC produced by Allen-Bradley. Upgrading involved both manual control system (all the local control panels were replaced and the new sinter strand operator control console was installed) and APCS. Today, brain of the latter is programmable logic controller (PLC) ControlLogix L 83 by Allen-Bradley. The controller is based on modular architecture, which provides high flexibility and ease of use.

Application of this top-class device has allowed detecting and processing all the required signals and increasing the production automation level.



SmartGuard 600 is an essential safety system component. This device is efficient in safety monitoring solutions, monitoring, indication and lock functions. The use of this class of devices allowed to talk about the implementation of the automated operation of the sinter production. Naturally, a modern dispatch center of the central control room was required for this purpose.

It should be noted, that the construction of the central control room was conducted, so to sat, "from scratch" a completely new building was build for this central room. The layout was adopted to implement the tasks, which includes a server part based on Hewlett Packard servers, responsible both for the operation of the visualization elements of the video wall of the central control room, and for the work of operator

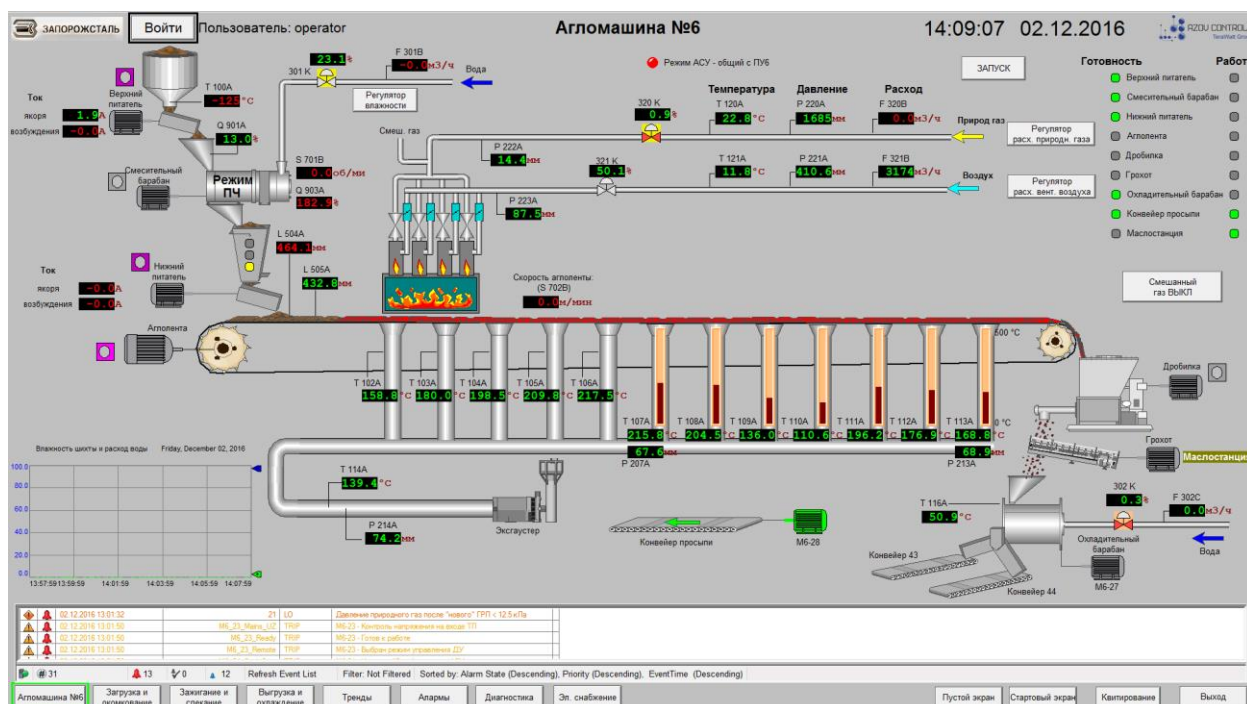


stations - automated workstations (AWP). Console-type monitors ATEN were used for local management of workstations. A system of information display with 27-inch 55 inch industrial monitors Samsung under the control of the video controller Christie. was designed and implemented to display the information.

The whole visualization system is based on Rockwell Software's FactoryTalk software.

It should be noted that the preliminary work that was done at the stage of modernization of the control systems of sinter machines No. 5 and 6,

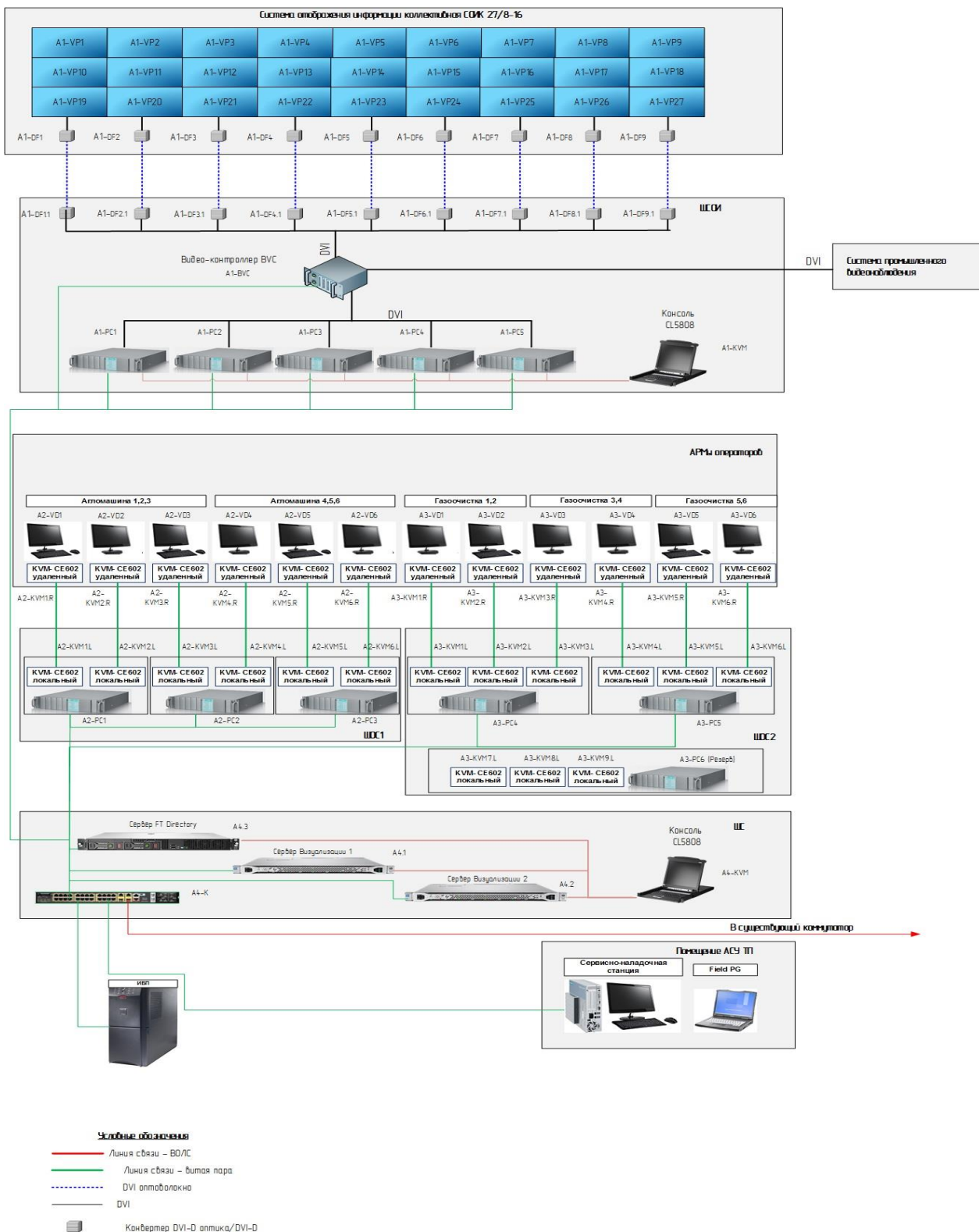
when the software engineers of Azov Controls LLC detailed the visualization of the corresponding units in the FactoryTalk Studio software complex, as well as at the stage of commissioning The program of testing of mechanisms in the automatic control (ACS) mode has been fulfilled. Through the implementation of this task, the operational staff of the sinter tankhouse of PJSC "Zaporizhstal" was able to monitor the parameters of key indicators such as temperature, pressure, humidity, speed of machinery, monitor equipment status and obtain information about possible malfunctions in the real time.





In accordance with the terms of reference, five APM operators, two for agglomeration machine operators and three for gas cleaning operators, were directly organized in the central control room.

The layout of the visualization management system is as follows





List of used software and hardware

1. DC Drive

The sinter belt motor is controlled by a DC-to-DC converter PowerFlex DC with EtherNet support from Rockwell Automation.



The DC-to-Power Converter PowerFlex combines high performance with flexible control, and its use makes it possible to obtain functional and economical drive systems and control systems.

This converter is easily configurable. In addition to 12 digital inputs / outputs, the drive is equipped with four analog outputs, and three inputs.

2. Security Controller

The SmartGuard 600 controller is designed for applications requiring the use of logic to provide the necessary security.



The safety controller is the optimal solution in cases where the capabilities of the safety relay are not enough, and the use of the integrated GuardLogix PAC safety controllers is economically impractical.

To ensure CIP and CIP Safety safety standards, the security controller is equipped with DeviceNet ports, for connection with Distributed I / O modules, and Ethernet / IP for connection with the main controller.

3. Frequency Converter

The mixing drum motor is controlled by a PowerFlex 753 frequency converter.



Data Exchange - The PowerFlex 750 Series supports the full range of network protocols to simplify integration with your architecture. The optional EtherNet / IP dual port module for the PowerFlex 750 series is a flexible and inexpensive tool for EtherNet/IP connectivity and supports the DLR function.

Preventive diagnostics is a prevention of unplanned downtime due to preventive diagnostics and built-in protective functions. These settings allow the PowerFlex 750 series to monitor information that affects the durability of the converter components.

4. Programmable Automation Controller (PAC)

The 1756-L83 programmable controller is used as the main controller of the sinter machine control systems No.5 and No.6.





Programmable automation controllers are a new generation of devices that combine not only the functions of managing production processes, but also the wide possibilities of network communications, control of multi-axis movement, protection and safety.

The ControlLogix 1756-L83 has a productive capacity that is increased by 45% compared to previous generation controllers, and a built-in 1 Gbps Ethernet / IP port. It supports event logging and configuration changes, digital signature and role control when accessing the controller for increased safety and security.

5. Network Solutions

Связь центрального контроллера с устройствами распределенного ввода/вывода, преобразователями частоты, контроллером безопасности выполнена на базе протокола Ethernet/IP с поддержкой фирменной технологии DLR от Rockwell Automation.



Advantages of DLR:

- a ring network topology is formed at the level of endpoint devices;

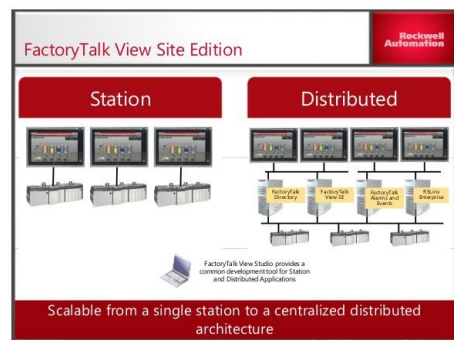
- the minimum time of connection recovery when the ring is broken (no more than 3 ms for a network of 50 nodes);

- advanced diagnostic function localizes the fault, which reduces the time spent on maintenance and repair.

DLR technology allows you to simplify the network architecture, providing constant flexibility of connections and compatibility with other topologies.

6. Application visualization software

Supervisory process control system for sintering machine AM AM №5 and №6 (SCADA-system) is based on the FactoryTalk View Site Edition package.



The applied visualization environment provides the following features:

- client-server structure of the visualization system;
- advanced means of displaying process graphs, alarms and accidents
- open databases based on the Microsoft SQL Server database.



The result of the project implementation by Azov Controls LLC

The result of the work done is a large-scale modernization of the sintering machine control system №№ 5 - 6 and creation of a modern dispatch center of the agglomeration department of PJSC "Zaporizhstal" – central control room, which has no analogues in Ukraine. The new facility allowed the operational services of the plant not only to monitor and control the main technological parameters of all workshop equipment, but also to perform automated management of these processes. The use of modern logical devices from Allen-Bradley in conjunction with FactoryTalk software enables the implementation of tasks of remote monitoring and control of production processes in the sintering cycle - regulation of energy supply, control of the sintering point and productivity of equipment. It should be noted that the capabilities of the created system are beyond the scope of the original terms of reference and at the moment the system is actively developing and improving.

Next stage of the reconstruction is the modernization of the control systems for conveyors of batch feeding and sintering machine No. 4, the implementation of which will occur in the near future.