DESCRIPTION OF THE REALIZED SOLUTION
AUTOMATED WEIGHING AND ACCOUNTING SYSTEM OF BLAST FURNACES SCALE CARS

PURPOSES OF THE SYSTEM

- Raw materials weighing in scale car hoppers.
- Logging the exact weight of the materials received from a particular distribution bunker.
- Monitoring of the exact weight on the operator's panel.

Fig. 1. Screen of
scale car operator panel

- The system allows creating a task-list for scale car operator by HMI. The produced task-list is displayed on scale car operator panel and includes information about order and exact material weight.

Fig. 2. General screen of
HMI system

- The system allows an operator to set types of material for each bunker.

- Scale car control system recognizes bunkers used for loading materials.
- Process data communication between scale car control system and blast furnace control system through industrial Wi-Fi Ethernet network.

Fig. 3. Additional equipment diagnostics screen of BF3

- Automatic diagnostics of weighing, RFID, Wi-Fi and control system equipment including indication and logging on HMI system servers.
- Process data is archived additionally in the History-data server of the blast furnace shop. This data is used for Web-reporting system.
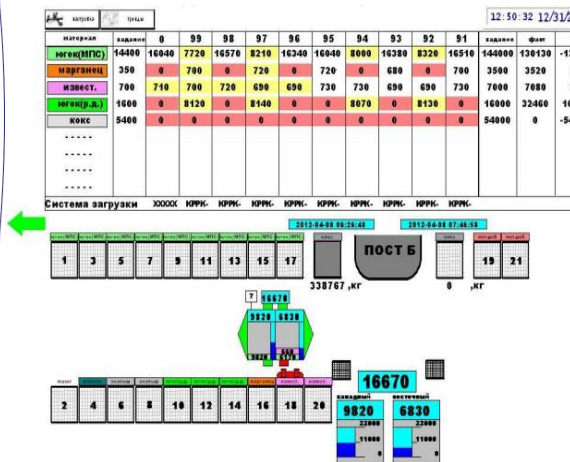
HARDWARE AND SOFTWARE USED IN THE PROJECT

- All the equipment applied for this project is installed in Rittal cabinets with a high-level protection.
- Weighing system is based on usage of Hardy Instruments strain transducers.
- There are RFID-tags installed on each material distribution bunker. These RFID-tags are used for determination of scale car location. The manufacturer of RFID equipment is Texas Instruments.

The Art of Engineering

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Control

- A control cabinet is installed in a scale car operator`s cabin. Considering that there is only 220 V DC power on scale car, we use Rockwell Automation power supply. It feeds the rest of equipment with 24 V DC. The two main benefits of using this type of power supply is a wide range of input power and its immunity to short power failures.

- Rockwell Automation PLC CompactLogix is also installed in a control cabinet in a scale car. It is used for collecting and processing data from all devices in a scale car including weight, current location, condition of limit switches. Also PLC is used for buffering information during Wi-Fi disconnections.

- HMI Rockwell Automation PanelView Plus panel is installed in a scale car cabin. It serves for displaying a "to-do-list" made by blast furnace foreman, the current location of the scale car, the current weight and the type of materials in hoppers, the latest operations and diagnostic information.

- Wireless communication is assured with industrial hotspots of Prosoft Technology. We have a vast experience in using Wi-Fi equipment of Prosoft Technology in heavy blast furnace environment.

- Additional displays are included in Rockwell Automation SCADA software project at the blast furnace foreman's workstation. Such displays are used to make a "to-do-list" for a scale car operator, displaying its current location, total weight and full list of loaded raw materials with weight of each type. Also a blast furnace foreman can see the type of the raw material loaded into each distribution bunker.

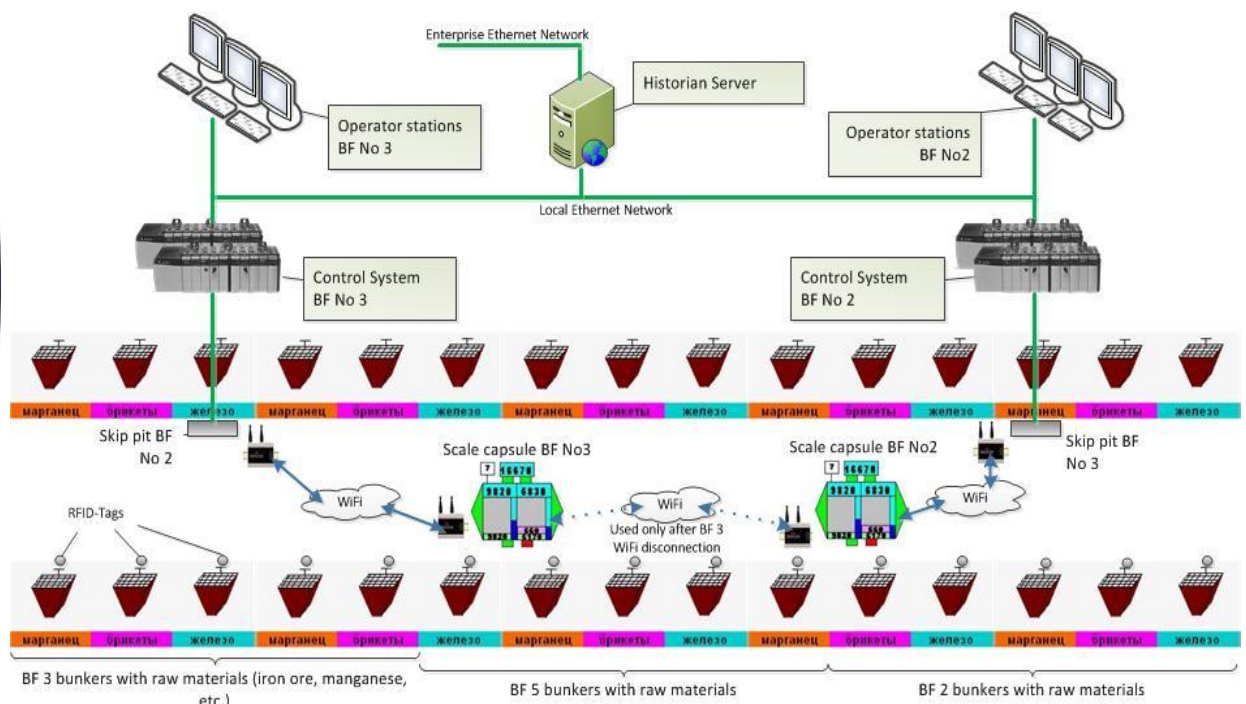- Reporting system is based on usage of Rockwell Automation Historian software.

Fig. 4. "Scale car weighing system including loaded raw materials reporting" automation structural scheme

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BENEFITS OF HARDWARE AND SOFTWARE USED IN THE PROJECT

- Advantages of using Hardy Instruments equipment:
  a) weight controller is installed directly in CompactLogix similarly to typical PLC module;
  b) weight controller configuration is in PLC program, which allows providing easy access to any data, service functions, diagnostic information using only PLC program software (RSLogix 5000);

Fig. 5. Weight scaling module from Hardy Instruments

  c) displaying all data, execution of calibration and service functions in the scale car operator's HMI panel is done directly through PLC without any additional subprograms or commands;
  d) easy access to diagnostic information both in scale car operator's HMI panel and in SCADA project at the blast furnace foreman's workstation;

Fig. 6. Tensometric load sensor from Hardy Instruments

  e) weight sensors calibration using C2 protocol, which allows making calibration using one measure point.

- Advantages of using Rockwell Automation PLC – CompactLogix:
  a) data exchange between all system components (blast furnace and scale car control systems, scale car operator and blast furnace foreman HMI) using standard Ethernet networks and WiFi without any hardware or software converters;

Fig. 7. PLC

  b) providing data buffering in PLC memory in case of WiFi disconnections;
  c) providing all possible maintenance, service or diagnostic functions remotely through WiFi.

- Advantages of using industrial hot spots of Prosoft Technology:
  a) almost failure-free Wi-Fi connection even in heavy blast furnace environment (very high metal dust level);
  b) ability of automatic switching to a hot spot of another blast furnace in case of collecting raw materials from distribution bunkers of that blast furnace;

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c) ability to work in repeater mode in order to provide Wi-Fi coverage to the most distant scale car;

Fig. 8. Radiomodem RadioLinx produced by Prosoft Technology

d) transparent connection for all network nodes which allows to send data from one node to another without setting any routes or running special commands, etc.

- Advantages of using Rockwell Automation Historian software:

  a) organizing history database of scale car operations in strict accordance with customer's requirements;

  b) flexible reporting tools provide a user-friendly data representation including process visualization, trends, charts. Such tools include only standard instruments;

  c) Web interface for users with different access level.

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