The project includes the reconstruction and replacement of electrical equipment on 20 machines which are parts of two ECS systems (Excavator - Conveyer - Spreader) within RITE Gacko (mine and power plant Gacko). Existing machines have operated for about 30 years and in order to ensure further smooth operation and maintenance of the capacity of the entire system, it was necessary to carry out a complete reconstructuring of mechanical and electrical equipment. The total installed capacity for ECS 1 and ECS 2 is about 12MW.

The scope of the contracted work included:
- Construction electric design and as-built design;
- Delivery of electrical cabinets with built-in low voltage equipment;
- Delivery of new electric motors and frequency inverters;
- Delivery of control cabinets;
- Application software;
- Commissioning;
- Training.

The First ECS System has the following machines:
- Bucket Wheel Excavator ER 1250;
- Loading unit - transporter BRs 1200;
- Six rubber belt conveyers with;
- Spreader ARs 1200;

The second ECS System consists of:
- Bucket Wheel Excavator ER 1250;
- Loading unit - transporter BRs 1200;
- Six rubber belt conveyers with;
- Spreader P 1600;

It has been planned that the third Excavator ER 1250 work combined for both ECS systems, and that the spreader OS 1600 work within combined system in the field C, PK "Gračanica", Gacko. The first ECS system has been put into operation by the end of August 2013 as well the remaining machines. Distribution systems (low and medium voltage plant), the resistor starters, transformers and control systems are housed in a container-like room with heat and insulation coating and air conditioning, selected according to the dissipation.

The control system is based on a programmable logic controller - PLC with distributed I/O units (input/output units). Supervising, monitoring, and adjusting of relevant parameters of the control system of the machine is done via the operator panel. Between neighboring machines it is designed the exchange of blockade conditions terms by a wired connection, by potential-free contacts. It was also set the radio data transmission system. It can output the emergency stop and machine stop signals.

Machine ER 1250 is a Bucket Wheel Excavator on crawler tracks with rotating arms. It is designed for digging overburden in depth and height block work. The capacity is 1250 m³ of solid mass/h. Installed capacity is 1100kW. Old, existing motors on the drives of the bucket wheel, feeder, conveyors, superstructure lifting and rotary motion and cable drum are replaced by new three-phase squirrel cage asynchronous motors. Control and management of these motors is achieved via single drive frequency converters and multi-drive frequency converters with recuperation. Control is carried out by the operator from the booth on the superstructure. A distributed I/O unit is located at substructure. Connection with the superstructure is achieved via PROFIBUS amplifier and slip rings.

Loading unit - transporter is designed for materials handling from bucket wheel excavator to the transportation system. It is, as excavator, crawler tracks type machine with the reception and disposal arms that can rotate. Installed capacity is 750kW. Old drives on superstructure rotary motion, receiving conveyor and cable drum are replaced by new three-phase squirrel cage asynchronous motors. Control and management of these motors is achieved via a single drive frequency converters. Disposal conveyor motor is asynchronous slip-ring motor 6kV, 250kW, with rotor start-
Mikro Kontrol has done a complete electrical design and application software, supply of frequency converters and commissioning.

For the transport of overburden in the open pit “Gracanica”, RiTE Gacko, transport system consisting of four conveyors with a rubber belt 1400mm wide was installed. Transport system connects crusher on one side, as an input element of the system, to the spreader at the other side.

Each conveyor includes drive consisting of three motors, power 315kW each, which are driven by frequency converter type Siemens Sinamics G150. Besides the conveyor’s main drive, the system also includes a number of auxiliary elements: lubrication system, thrusters, measurement - control and signal parts, lighting, ...

The system is controlled by the PLC controller. The operator has a possibility of choice between automatic (blocking) and the individual work of the transporter.
In March 2011 MIKRO KONTROL, as a Siemens subcontractor, has signed the contract agreement on implementation supervisor and control software (PCS 7 (DCS) SCADA) as part of “Project of reconstruction of cooper-smelter works and construction of sulfuric acid plant” for RTB Bor.

The complete work is divided in:
• detailed electrical design
• installing electrical cabinets
• developing PCS 7 application software
• commissioning and training
• as-built design

The new supervisor and control system is installed on the line 1 of cooper-smelter works and is connected to existing process equipment and includes the following components:
• reactor
• flame furnace and heating furnace
• boiler
• filters

Implemented supervisor and control system is based on Siemens SIMATIC PCS7 DCS system. It consists of AS (Automation Station) based on S7-400 PLC. Task of AS is to execute the control algorithm and to communicate with decentralized nodes via the Profibus DP. Since the nature of the production process does not tolerate faults and stopping there are two redundant server OS (Operator Station), that communicate over Industrial Ethernet with each other and with AS, making together Plant bus. WINCC SCADA application is running in the OS server with two monitors for operator control and monitoring. Process picture and runtime information can be displayed on each monitor simultaneously during runtime. The system includes the ES (Engineering Station) of the Simatic PCS7 DCS. ES is used for configuration and programming of AS and OS systems and for monitoring of AS. Complete project was realized in PCS 7 tool using CFCs (Continuous Function Chart), program for the realization of continuous algorithms (processing the signal, interlock, PID regulation loop), SCL (Structured Control Language) programming language similar to Pascal for the implementation of non-standard automation algorithms, SFC (Sequential Function Chart), program for the realization of sequential algorithms. Approximately 250 real-time process AS objects (PO) were implemented during developing this project.
“Crusher plant” is supplied with coal from open pit mine “Tamnava-West Field”. There, coal is ground and loaded into wagons for the power plant “Nikola Tesla” in Obrenovac. Transport of coal through “Crusher plant” is done through 24 belt conveyors. As part of the transport, there is the combined machine RS1 which is used for temporary storage of coal. Coal and coal dust is transferred by belt conveyor feeders in 8 bunkers which is used for temporary storage. Split coal near wagons is sent back to the bunkers by elevator. Four belt weighing scales measure transported coal. The choice of technology line, i.e. the redirection of coal transportation is carried out using five foundries and three mobile cars. Coal is ground in the four crushers. As protection, in front of each crusher, the device for metal materials recognition is set. For the purposes of the consumer, through the cribble the raw coal screening (dusting) is made. Sampling of coal for testing is performed using 4 units, sampler.

Coal transporting from coal bunkers to the conveyor belt is carried out using five extraction units.

Coal wagons are fed with coal using four feeders, and are transported by rail to the Thermal power plant „Nikola Tesla”. 

Mikro Kontrol, Belgrade, in consortium with Siemens Belgrade, has successfully completed reconstruction all lines in crusher plant. The entire work included the development of the main electrical design, detailed design and as built design, delivery and installation of equipment and commisioning.
Crusher plant control system revitalization included the following phases:

- Development of main electrical design.
- Development of detailed electrical design.
- Installation, delivery, installation and connection of 14 electrical cabinets with control equipment, two rack cabinets with computer and networking equipment, LCD TV 70”.
- Development of user program and generation of reports (shift, daily, ...).
- Commissioning.
- Development of electrical as built design.
- Training.

The new control system is built to increase the level of reliability of all parts in Crusher plant. It provides a safer and more accurate monitoring of Crusher plant, which quickly recognizes the warning and alarm state of all parts. In this way, the problem is quickly detected and can be solved very fast. The duration of the production delay is significantly shortened. The control system automatically generates necessary reports (daily, shift, month, ...). All necessary data during the process are stored in the archive station. Analysis of these reports helps to identify critical points in production, which allows the application of appropriate measures for their removal, as well as to improve and enhance the overall production.

The entire process is done in three shifts, 24 hours, without interruption. It was necessary to install the control system that has a high level of reliability and security, that can process a large number of signals, that is connectable with other control systems in Crusher plant and can provide the availability for future expansion. For this reason, we chose the Simatic PCS7 (Process Control System), which is basically, a DCS a decentralized control system.

The control system handles over 2000 signal. Signals from individual devices are collected in the distributed units in 12 locations. Signal processing and user program execution is performed in AS (Automation Station). Distributed units and AS are connected by optical cables, PROFIBUS DP protocol in a redundant ring. The monitoring system consists of two redundant OS (Operator Station), SCADA server (SCADA operator stations), an ES (Engineering Station), five OS clients and one archive server. As the process does not suffer delays in production, there is a level of redundancy derived in AS stations (PLC), also in PROFIBUS DP network processor and network, and in OS SCADA station. In case of failure of the main unit (AS, OP, or network), auxiliary (backup) device, automatically and without delay takes over the control. To meet the needs of the individual devices, locally, on each of the control cabinet in which peripheral units are placed, there is touch panel, where you can see all the data related to the work Crusher plant.
Mikro Kontrol carried out the project “Replacement and reconstruction of control and monitoring system on facility of III phase Dry separation – Vreoci.” The project represents a modern solution of monitoring control system based on networked PLC devices and SCADA monitoring system. The project is carried out with OMRON controlling components. The system is implemented in record time, during the duration of scheduled maintenance and the maintenance works have not caused a single day of unplanned delay. On U2 facility, replacement of the old “PROCONTIC” system has been performed that consisted of four units of capacity of 256 inputs / outputs each. The new system is implemented based on one PLC of corresponding capacity with specific improvements and function expansions. First of all, this relates to increased safety and signaling during some of the lines starting, more exactly automatic starting after stoppage. In the installation and in the dispatcher’s room, graphic touch operator panels are installed, on which process visualization is provided, complete diagnostics and alarm displayed. The PLC configuration allows the reception of current and temperature measurements of motor coils. On installation Daily bunker, control system reconstruction has been carried out. The preceding relay logic has been replaced with PLC devices. The gliding train and each of the “aside shovelers” are controlled with one PLC. Here is the PLC configuration that is intended for common functions and contains measuring inputs for level signals in individual cells of Daily bunker, motor’s currents and temperatures. On Loading place installation, PLC system with corresponding measurement inputs for motor coil’s currents and temperatures signals is implemented. A graphic operator touch panel for diagnostics and visualization needs exists. In the Administration building and in Maintenance rooms, monitoring SCADA applications are carried out. Besides visualization, parameters necessary for quality monitoring of working processes and control system itself are on disposal. As PLC network, “Controller Link” is selected, because of outstanding performances in operating and multiple advantages that offers in system maintenance. As SCADA network, Ethernet is used. The cabling of control system is carried out with optic fibers, to assure higher reliability during operation. From all locations of the system, it is possible to monitor, perform diagnostics and programmer interventions on each PLC device in the network. For the delivered system, Mikro Kontrol provides full technical support and spare parts during and after the warranty period.
POMETON TIR, Bor
Reconstruction of production facility “Factory of copper powder Pometon TIR”

Copper powder protected from oxidation with purity of 99.5%-99.7% is widely used in industry processes and products (sintering, braking systems, contacts, welding,...)

In the reconstruction of production facility “Factory of copper powder Pometon TIR”, Mikro Kontrol has performed the following:
• installing electrical cabinets for monitoring and control (PLCs, touch panels, SCADA, frequency inverters and temperature controllers)
• detailed electrical design
• supervision of electrical works
• developing of supervisor and control software (PLC, touch panels, SCADA)
• commissioning, training and functional testing
• developing as-built design

The entire technological sector consists of over 40 motors, 40 electro-magnetic and motor valves, and thyristor heater controllers power 3x64kW. Reconstructed sectors are:
• electrolysis
• separation and washing the copper powder
• drying and sieving

The technological process starts by electrolyzing copper in order to obtain a suspension of copper powder and sulfuric acid. The suspension is transported by vacuum system to centrifuges. Centrifuge(machine) performs separation copper powder from the suspension as well as washing and drainage. Copper powder is then transported to the part of the plant for drying. There the process of separation of copper powder by the size of granules is performed.

After commissioning, the new plant were significantly increased quality and production capacity.
METALLURGY
High efficiency of the burning process at the Blast furnace plant can be achieved by providing constant parameters of the income material, e.g. sintered ore. During sintering process the iron ores are thermal treated, the carbonate, sulfide and oxide molecules are dissociated, and the final goal is to provide “self-melted” sinter material which is smelted easily at the Blast furnace plant.

The project task was the reconstruction and modernization of the sintering and cooling line for iron ores, with gridding and transporting classified material toward the blast furnace.

TECHNOLOGICAL DESCRIPTION

The raw material comes over conveying system to the Sinter plant, level 36m; with water regulating valve it is wetted in the Secondary mixer drum, and transported by the Heat distributor into the Flow hopper. The regulated drive of the Drum feeder takes it from the hopper, and feeds the cars of Sinter-machine conveyer; this conveyer steadily carry the mixed ore into the Furnace, over 18 Vacuum chambers, and delivers it to the Crusher.

Furnace is a set of burners, located over first four vacuum chambers. It is fueled with natural gas or blast furnace gas, which is combined with air to create an optimum burning mixture. The gas and air regulated valves are provided for the temperature regulating loop. The crusher breaks up the processed sinter material and feeds it to the Line cooler.

The main part of the line cooler is the regulated-drive-conveyor, which is equipped with 8 cooling fans, and designed to cool the processed material and deliver it to Self balance screen; after classification the material is transported to the blast furnace.

During each of the sintering phases, the process of filtering is performed; two Electric precipitators, together with the Knock-off devices and conveyer system are used for dust cleaning. The middle voltage motor Fan sucks the dust air through filters, and emits clean air to the atmosphere.

CONTINUOUS REGULATION LOOPS

Flow hopper level control

The control system regulates the material level in the bin according to signal input from level sensor, and controls two Dosing Scale Conveyers to provide the regulated flow of material into the secondary mixer.

WATER FLOW CONTROL

The control system commands to water regulation valve according to requested water flow ratio from moisture regulating loop (cascade control systems).

Temperature regulation in vacuum chamber 17

The sinter process is regulated by controlling the speed of the sinter machine conveyer, according to target temperature profile in all 18 chambers, with the peak value at 17th.

FURNACE TEMPERATURE REGULATION

The control system commands to air regulation valve and gas regulation valve according to requested fuel-air ratio from the temperature regulating loop.

CONTROL SYSTEM STRUCTURE

Control system is realized with decentralized architecture; the heart is Master PLC, where the control algorithm is executed; PLC communicates over Profinet DP (optical cable) with 8 distributed and decentralized I/O nodes. The exception is decentralized node at electric precipitation location, e.g. that is separate PLC which communicates with master as Intelligent slave.

The decentralized periphery is located at separate and distributed control cubicles Each of them, together with master PLC, consists of several digital and analog I/O signal modules. The total number of I/O signals is:

- 1275 digital inputs, with relay interface
- 248 digital outputs, with relay interface
- 137 analog inputs, with isolating amplifiers (including thermocouple and Pt100 signals)
- 8 analog outputs
Two 15” color-screen touch panels are used for process control and monitoring. The visualization and data logging is performed with SCADA system, which consists of two clients and one server PC. The HMI’s, SCADA PCs and master PLC establish an Profinet LAN.

SCOPE OF WORK
The sinter line control system reconstruction and modernization process consisted of the following phases:
- Dismantling of the old control system, cable inspecting with eliminating damaged and unnecessary cables
- Electric design phase
- New cable trays, pulling new cables (signal and energetic, total length approx. 22km)
- Pulse line test and reconstruction, delivery and assembly pressure, flow and temperature sensor devices (29 Siemens Sitrans sensors, 45 temperature sensors)
- Delivery and assembly two dosing scale conveyers Siemens Milltronics, capacity 200t/h
- Delivery and assembly a moisture sensor
- Delivery and assembly 6 AC motors for the drum feeder, sinter machine and line cooler drives (instead of old DC motors)
- Production, delivery, assembly and connecting 11 control cubicles and MCCs, 2 control pulpits and approx. 70 local pulpits
- Control algorithm software realizing, Factory acceptance test (FAT), Site acceptance test (SAT), cold tests and production phase commissioning

Since the contracted term the job finishing was 170 days, some phases had been overlapped (dismantling and electrical design, electrical design and control panel production phase, e.t.c.). Although, the complete job was done in 150 days.

The Mikro Kontrol engagement was as follows:
- Electrical engineers …… 9000 hours at the Site, and at the bureau
- Electricians …………… 13000 hours at the site
- Electricians …………… 5000 hours at the Factory
- Mechanicals …………… 1000 hours
The process of steel production takes place in a steel converter. Any charge needed to produce any steel grade consists of a technologically defined quantity of molten pig iron, steel scrap, a quantity of oxygen to be blown in, a quantity of nonmetallic additives and metallic alloys that have to be batched properly. When steel is obtained, slag and steel are poured into ladles and transported further on - slag towards slag dump and steel to area for out-of-furnace treatment and further on to casting division.

When there is a charge in the converter a large quantity of gases is released. Converter gases are extracted with high power fans (2MW) and with a fan system in which gases are subjected to treatment. The system is cooled with high pressure water (33 bar) supplied from a pump station which belongs to the energy generating unit.

PLC units series CS1 are networked by the Controller Link network in the form of an optical token ring. DeviceNET is used for a system of distributed inputs/outputs. The communication at SCADA level is Ethernet and an optic cable links the 2/2 pumping station with the main control room. Local process controllers are OMRON series ESAK controllers. The applied system has over 1000 input/output signals and demonstrates excellent performances and operating reliability in extremely hard industrial conditions.
US STEEL SERBIA, Smederevo
Iron ore bridge type stacker – refurbishment of the spreader conveyor

Iron ore bridge type stacker is a type of mining equipment used for spreading iron ore on the iron ore pile. Further, iron ore is brought by bridge reclaimer to the sinter line. The equipment is a part of the primary production in U.S. STEEL Serbia and it is situated on the stockyard called “Rudni dvor”. This is a heavy equipment operating 24 hours per day, due to the technology requirements, and without any spare.

Spreader conveyor operates 24 hours per day. Its role is to spread iron ore evenly to the ore pile and to provide a required shape of the pile with a trapezoidal cross-section. This is the most convenient way for further reclaiming of iron ore and transport to the sinter line.

Previously, the motor drive was without speed control and started direct-on-line. This often caused bridge non-alignment error, due to permanent changing of direction of rotation and mechanical shocks. This eventually caused frequent stoppage of the equipment and mechanical problems on the bridge construction, endangering life of the equipment.

Implementation of speed control on the spreader drive makes soft start and stop possible, speed adjustment and changing of direction of rotation without mechanical shocks. This improves equipment operation significantly. The problem of the bridge non-alignment error was fully eliminated, and operation became reliable.

US STEEL, Šabac
Welder’s Monitoring & Diagnosing System For Endless Black Sheet Strip Manufacturing By Faced Welding

Joining the ends of two rolls of soft steel strip, in order to produce an endless strip for later treatment, is performed on the faced welding machine – Welder ETL. During exploitation, it comes to welding interruption, due to failure on some of the machine’s elements (valves, extreme switches,...). In the existing system, no alarming system exists, that would point at certain causes of failure. Thus detection and elimination of failure would demand quite some time and quite some system holdup. In order to reduce the failure diagnosing time, a monitoring system was introduced, which continually monitors the welding process and in critical moments informs which of the elements can be potential causes of failure, i.e. hold ups.
US STEEL SERBIA, Smederevo
The Control System Of The Chrominance Tub

Mikro Kontrol has supplied control systems for the chrominance line, which has the following features:

- Do the monitoring of Adjuster parameters DC 15000, 20VDC
- Integrate function of scrubber management (fan, demi water)
- Measurement and control of temperature in the chrominance tub
- Measurement and control of level in the chrominance tub (ultrasonic level measurement)
- Manage and control the speed of blowers (frequency regulation)
- Automatic cycle of recirculation, rinse and the formation of chromic water
- Pump and three-position valves management
The point of the project is to produce control and supervisory system with SCADA remote supervising application of the new-delivered installment for waste water filtration and sludge separation. The project task is to install and put into work accessory for flow, density, temperature and level measuring which with SCADA supervisory system enables correct functioning of the following technological units:

- Reservoir in which by adding polymer in the inlet part you obtain sedimentation of suspended particles
- Sludge pumps – using frequency invertors you get continuous adjustment of these pumps capacity
- Stripe filter presses – they were delivered including local control panels and motors equipped with frequency invertors. The capacity is defined by filter stripe speed. Moisture separating degree is defined by two factors: filter strip speed and pressure of the filter strips on filter cake. The pressure on filter cake is adjusted by hydraulic from the local control panel
- Polymer preparation and dosage unit – the polymer dosage is defined by inlet flow into the reservoir and using that parameter the control system regulates output flow of the pump for polymer dosage
- Compressor – delivers compressed air to the filter press and polymer preparation unit

The control and supervisory system has functions of control and remote supervision (SCADA) and collects signals of:

- temperature from a temperature probe on the entering pipeline of the reservoir
- position of the electromotor regulating valve
- flow and density from the coriolis flow meter
- level from the reservoir level ultrasonic meter
- status of the rake – position, error, rake moment, lift position
- status of filter presses – function, damage, moment
- status of polymer stations – alarms, function
- status of compressors stations – function, error
- status of sludge pumps – start, top, alarm

Mikro Kontrol has installed and started up frequency regulators, type FV, for each drive - bridge, crab and hoist on nine overhead cranes in Zastava kovacnica, 5 ton to 36 ton capacity.

The system ensures soft start up and stopping, reduces any risk of skewing, prolongs the lifetime of each drive and facilitates maintenance.
The Dusting off plant is a system based on collection of gas and solid burning products which are developed through copper melting process and it consists of 12 electric induction furnaces, 4 foundry furnaces and brass swarf degreasing device in the Foundry of Copper Rolling Mill. The ventilation system is divided into three independent lines which contain supply covers, pipelines, vortex filters and dust filters. Filtrated gases run through centrifugal fan with variable speed, and afterwards disappear through the chimney. Control and regulation system is based on master slave configuration (Profibus DP) with 5 local distribution stations.

SARTID, Smederevo
Slab Cooling Unit
Control Unit

- It grips slabs weighing up to 40 tons that arrive from vertical and radial casting areas
- It places each slab in an empty pocket in a bath supplied with running water
- At the end of the design period and in compliance with production technology criteria, each cold slab is put into an exit roll,
- It ensures audio visual display of dynamic states in the system
- It enables fast trouble shooting in the system
- The control system supervises the elevator drive movement, rated at 250 kW, 60 kW traverse power, 7 kW roll power
For MARS CONTICAST TECHNOLOGIES Company from Riga, Latvia, six control systems for cast withdrawal on casting machine for vertical casting downwards were delivered. The system for cast withdrawal is with traction rollers, moved by an AC servo motor with brake, of 4,4 kW power, over servo gear reducer.

Withdrawal of cast profile is performed cyclically: movement-pause. The movement is defined as the turn angle of traction roller, expressed in mm, that the cast profile would cross in rectilinear movement and pause expressed in seconds and parts of second. The selected system allows movement up to 8 times per second, with step of 21 mm. Parameter change can be performed during casting, without stopping the machine. Measurement of temperatures important for the process are anticipates on system (in cast pot, surface of cast profile, input and output of crystallizer’s water,...) as well as burner’s operating control that heats the cast pot and measurement of fuel flow and cooling water.

For easier machine operating, technology monitor and perform adjustments during operating, these are anticipated:

• existence of so called knowledge base i.e. specific cast profile has recommended cast parameters (step, pause,...)
• data important for cast process during 24h is archived (selected profile, cast speed, temperature, quantity of cast profile in kilograms,...).

For the needs of „Kombinat Aluminijuma Podgorica“ MIKRO KONTROL reconstructed the machine for aluminium and other light metals slabs cutting. These reconstruction understood the designing, manufacturing of new electrical panels for electrical motor drives and control, programming and commissioning.

The installation of the machine enables the storage, bringing, positioning and cutting of slabs and the evacuation of cut boards and chips.

The slabs are craned on the amortization table which is a part of the supplying transporter. This transporter brings the slab to the input table where it is positioned to the size for cutting. After cutting the cut boards are brought by output table to the evacuation table wherefrom are further assumed by crane.

On the machine it has been installed 16 electric-motor drive and more than 20 hydraulic valves. The engine and hydraulic valves controlling is done from the new operator control panel. The saw motor is run by the SOFT STARTER, but the input/output table motors are run by FREQUENCY INVERTERS.
WATER TREATMENT
JP BEOGRADSKI VODOVOD
I KANALIZACIJA, Belgrade
Belgrade water supply was founded 115 years ago and over the years, it constantly expanded its capacity, following the demographic and industrial city growth. During this period, the number of Belgrade citizens increased 25 times, while the quantity of fabricated water increased 110 times. The 90’s crisis stopped all the development projects. It most affected the application of modern solutions in areas of water monitoring, fabrication control, distribution and quality.

Over its agency JICA (Japan International Cooperation Agency), the Government of Japan approved JKP BVK (Public Communal Company) (Belgrade Water Supply and Sewerage) a donation to carry out the Project for Promotion of Water Supply System in Belgrade. The scope of the project was to:

- Form SCADA (Supervisory Control And Data Acquisition) system for monitoring and control of wells, distribution pumping stations and reservoirs.
- Deliver pumps, frequency inverters and soft-starters necessary for reconstruction of 7 distributive pump stations
- Renew the equipment for water quality analysis

Project carrying out has been devised into two phases. The goal of the first phase was to form the SCADA system that includes 155 structures totally:

- MCC - Main Control Center 1 location
- LCC - Local Control Center 4 locations
- Pumping stations of type A (with local SCADA server) 14 locations
- Pumping stations of type B (without local SCADA server) 14 locations
- Well pumping stations 102 locations
- Reservoirs 20 locations

On tender, announced in Japan in January 2006, the carrying out of the job has been granted to Japanese Company EBARA and its subcontractor MIKRO KONTROL.

The main functional tasks placed in front of SCADA system were:

1. Data acquisition and archiving
   - real-time digital and analog data acquisition from all the facilities connected to the system (around 10,000 tags);
   - Archiving of all relevant gathered information, based on acquired data, into relational data base;
   - Displaying of real-time and archived data, over synoptic displays, trends, graphs and tables.
2. Real-time control and monitoring of well pumps
   - Remote control and monitoring for 65 well pumps located on the left bank of river Sava over LCC Bežanija;
   - Remote control and monitoring for 40 well pumps located on the right bank of river Sava over LCC Banovo birdo;
3. Real-time monitoring of distributive pumping stations and reservoirs
   - Monitoring 27 distributive pumping stations connected directly to MCC or over one of four LCCs;
   - Monitoring 20 reservoirs connected directly to MCC.
Hierarchically, according to information flow, the architecture of SCADA system is devised into three levels. Such organization was influenced by anticipated functions which the system had to fulfill, as well as the topology of the facilities located in the diameter of around 40km.

On the first, highest level, the MCC (Main Control Center) is placed, in which data is acquired, presented and archived from all the facilities connected into the system. On this location, a total of 6 servers and 4 workstations are installed:

* Master SCADA server represents the main SCADA server in the system. Inside it, real-time data is stored, collected from all facilities in the system. Besides the presentation of real-time data for workstations (around 400 displays), this server has the function to generate all types of graphical and tabular reports based on archived data;
* Master SQL server responsible for archiving all types of information collected in MCC and four LCCs into a relational data base for their later presentation and analysis;
* Backup SQL server is a redundant SQL server in the system, gathers data by replication from the master SQL server;
* DC (Domain Control) server responsible for proper domain functioning of entire SCADA system, with all services that such complex system like this one requires;
* GPRS (General Packet Radio Service) server has the role of communication server responsible for data acquisition from all facilities that are only connected via GPRS network with MCC. This server forwards the collected data to master SCADA server;
* WEB server distributes and presents data over the Internet in real-time and archives data into SCADA and SQL servers, available to all authorized personnel.

Second, middle, hierarchical level is represented by four LCCs (Local Control Centers). Each LCC has the duty to acquire, present and archive informa-
tion locally, from the facilities that make technologically rounded totalities, as well as to forward data further to MCC.

On each four locations, a total of 10 servers and 4 workstations are installed:

- Local SCADA/SQL servers for local real-time data presentation and archiving, installed on each of the existing four LCCs.
- Local/redundant DC servers installed on LCC Bežanija and LCC Banovo brdo.
- GPRS servers for data acquisition from well pumping stations on the left and right bank of river Sava, installed on LCC Bežanija and LCC Banovo brdo.
- TN (Telecommunication Network) server responsible for monitoring the entire telecommunication network of SCADA system, with all belonging communication lines and devices.

On third, lowest level, facilities connected to some of the four LCCs or directly to MCC exist. Besides controlling electro and communication cabinets on more relevant distributive pumping stations, local SCADA/SQL servers and workstations are installed. Main equipment in facilities consists:

- 59 controlling electro-cabinets manufactured and tested in accordance with IEC 60439-1/IEC 60204-1 standard;
- 14 server racks with belonging SCADA workstations;
- 126 new PLCs as well as around 80 existing on which applicative adaptations were made in order to connect them to the system;
- 25 touch operator panels;
- 20 chlorine analyzers;
- 26 L3 switches, 32 SHDSL routers and 149 GPRS routers;

All facilities are connected into a unique telecommunication system based on Ethernet. On well pumping stations as well as on reservoirs, data exchange with higher level centers, is carried out over Internet, applying GPRS routers. For all distributive pumping stations redundant communication links have been carried out. In dependence of location and availability, primary communication lines were implemented with fiber-optic cables, SHDSL, ADSL or WLL connection, while secondary communication routes are carried out over the Internet using GPRS routers.

Design of SCADA system, as the first stage in project realization, started during mid May 2006, while the entire equipment whose total weight was over 24 tons has been delivered to BVK in first half of October 2006. After installing and connecting the equipment on SCADA’s facilities, the system has been released into production at the end of February 2007.
During year 2007, the modernization project of 7 pumping station across Belgrade city's territory took place. This project has been carried out within the scope of Japan government’s donation, in accordance to a tender published in Japan in November 2006. This project has been carried out by Japanese company EBARA, while MIKRO KONTROL was again selected as subcontractor.

The project boundaries have been specified by tender documentation:

- Manufacture the technical documentation for equipment assembling that was the object of delivery
- Delivery of 24 pump power units
- Delivery of 8 frequency inverters in its panels
- Delivery of 16 soft starters in its panels
- Communication protocol manufactured between frequency inverters and soft starters with leading PLC
- Delivery of valves and pressure transmitters
- Delivery of Lab equipment

Pumping stations which are the object of donation have the following specifications:

1)PS-1a Bele Vode (PS – Pumping Station):
   - 3 horizontal pumps: 167 l/s, 160 m
   - Motor pumps: 400kW, 400V
   - 1 frequency inverter of 800A, 400V
   - Panels for storing the frequency inverters and soft starters in IP54 protection

2)PS-1b Bele Vode:
   - 4 vertical pumps: 250 l/s, 90 m
   - Motor pumps: 315kW, 400V
   - 1 frequency inverter of 800A, 400V
   - 3 soft starters of 720A, 400V
   - Panels for storing frequency inverters and soft starters in IP54 protection

3)PS-18 Tašmajdan:
   - 4 drowning pumps: 361 l/s, 66m
   - Motor pumps: 355kW, 400V
   - 1 freq. inverters of 800A, 400V
   - 3 soft starters of 720A, 400V
   - Panels for storing frequency inverters and soft starters in IP54 protection

4)PS-19 Bežanija:
   - 3 horizontal pumps: 200 l/s, 46m
   - Motor pumps: 132kW, 400V
   - 1 frequency inverters of 240A, 400V
   - 2 soft starters of 250A, 400V
   - Panels for storing frequency inverters and soft starters in IP54 protection

5)PS-23 Studentski Grad:
   - 5 horizontal pumps: 500 l/s, 53m
   - Motor pumps: 400kW, 400V
   - 2 freq. inverters of 800A, 400V
   - 3 soft starters of 720A, 400V
   - Panels for storing frequency inverters and soft starters in IP54 protection

6)PS-20 Zeleznik:
   - 2 vertical pumps: 240 l/sec, 140m
   - Motor pumps: 560kW, 690V
   - 1 frequency inverter of 690A, 690V
   - 1 soft starter of 720A, 690V
   - Panels for storing frequency inverters and soft starters in IP54 protection

MIKRO KONTROL’s task was:

- Manufacture the electro-technical documentation
- Delivery of frequency inverters, soft starters, distribution cabinets and other belonging equipment specified by technical documentation
- Installation of frequency inverters and soft starters with belonging equipment into distribution cabinets (panels) with IP54 protection level
- Testing the panels with installed equipment in maintenance shop
- Manufacture the communication software for monitoring and control of frequency inverters and soft starters

MIKRO KONTROL delivered all the arrangements on time.

These panels were released into production in 2008, and MIKRO KONTROL was hired by BVK.
MIKRO KONTROL performed a development of automatic control system for filter installations in Water Factory “Banovo Brdo”, Belgrade like a subcontractor of the company “RAD GM AD”.

Water Factory “Banovo Brdo” is one of the vital points of the Belgrade water supply system in contexts of processing, production and transport of drinking water in the water supply system. The factory treatment underground water which is supplied from water wells. The plant consists of three filter installations, each of them with the fourteen filter fields filled with sand. In first fase of filtration water pass through the aeration plant which remove iron in process of oxidation and deposition in retention pool. In second fase water pass through sand filters where mechanical filtration is performed and finally after disinfection with chlorine it is piped to the consumers.

Total plant capacity is 4100 l/s of purified drinking water.

Within reconstruction of first and second filter installation, we implemented a decentralized management system which monitors processes of filtration and washing of sand filters.

The main system components are:
- 38 programmable logic controllers (PLC)
- 38 touch operator-panels (TP)
- 4 controllers for measuring turbidity
- 28 ultrasonic level meters
- 42 pressure meters
- 4 drives to drive 110kW power pumps
- 3 drives to drive 110kW blowers
- 1 SCADA server
- 2 SCADA clients
- 2 L3 "switch"-a

SCADA system and Network of Controllers for water treatment plant is based on the Ethernet communication and each of the filter installation has its own master PLC. This PLC synchronizes all slaves PLC on that installation and sends all relevant data to master PLC of plant.
Downstream Pumping Station Ada Ciganlija
Pumping Station’s Electro Part - Reconstruction
User JP Ada Ciganlija

Upstream pumping station Ada Ciganlija has an important role in Sava lake’s hydro technical system and is one of the most important facilities in Ada Ciganlija.

Functions of this pumping station are:
- pump over lake water from Sava lake into “Small lake,”
- pump over lake water from Sava lake into Cukarica sleeve,
- pump over lake water from “Small lake” into Cukarica sleeve

Mikro Kontrol carried out full reconstruction of pumping station’s electro part that enclosed:
- Electro equipment delivery: power cabinet with measurement equipment, general protection and shutter drive’s automation cabinet, cabinets of drives of drowned pumps 110 KW and 45 KW with soft starters and general consumption cabinet,
- Work execution on electro installation of pump drives and motor shutters, domestic wiring and lightning conductor installation,
- contractor’s electro draft and electro draft of carried out facility

VODOVOD I KANALIZACIJA, Novi Sad
Control and energetics system of blowers drive revitalization in Water supply and sewerage Company of Novi Sad

Mikro Kontrol realized electrical wiring project for blowers drive, acquisition and delivery of the equipment, cable traces routing and wiring, process development algorithm based on user-defined cycles, commissioning and performance verification during exploitation.

Blowers control system is based on CJ2 programmable logic controller (PLC), manufactured by a Japanese company Omron. The controller is connected to the central SCADA application via Ethernet protocol. Electrical drives of blowers are driven by SOLCON (Israel-based Company) soft starters.

The blowers system technological task is production of air under controlled pressure, up to 500mBar, to be used in washing process of filter fields. Blowers can operate in both automatic and manual mode, and are coupled with central control system via communication lines, so that the operator can see all the relevant parameters of the process, which include:
- Air flow towards filter fields during air-cleaning and combined process in air-water cleaning
- Signalling to other parts of cleaning system, to enable quick response in case of disorders of blowing process

Extent of finished work and benefits for the customer:
- Elaboration of project documentation, executive design documentation and as-built design
- Production, delivery and linkage of distribution cabinets
- Performing electrical wiring in facility (cable routes, broaching and connecting cables)
- Selection, delivery, programming and commissioning of PLC (attest of functionality – SAT, FAT...)
- Manual making, training for operators, entire attested project documentation delivery

Benefits brought by control system are:
- Improved maintenance and regulation of process parameters so the process is repeatable
- Very fast detection and elimination of errors in the system, since monitoring and recording system of process parameters is based on Ethernet communication with a superior system.
In the renovation of Derventa water supply system Mikro Kontrol, as a subcontractor of firm Instel Bijeljina, delivered control and supervisory system based on GPRS communication of date exchange to the following locations:
- Korače, Bilića Vrelo, Babino Brdo, Tomasovo Brdo, Gakovic, Ljupljanka, Vrhovi, Rabic

The system consists of:
- two SCADA systems (one installed at the location of the Directorate at Derventa, and the other at KKC Korače) which via GPRS communicate with master PLC on the location of KKC Korače
- SMS server on the location of KKC Korače, which in the case of an alarm in the system, forward it via SMS to the maintenance staff numbers
- network of PLC device that by GPRS communication transmit control – supervisory signals
- flow, pressure, level meters installed in pumping stations, reservoirs,
- regulatory electrical valves installed at pipelines

The functions of the system:
- Recording data from reservoirs, pumping stations and having possibility of later analysis of them and display them in the form of reports
- Pumps switch on / off control based on level, flow and pressure signals.
- The operator on the SCADA system can monitor current levels in the reservoirs, the current valve open, active alarms in the system, and make decisions what actions to make
In order of water supplying system better functioning as well as for more efficient use of water resources in water supply system of Sremiska Mitrovica, an automation system has been delivered that covers control and monitoring of the following locations: Sremiska Mitrovica, Jarak, Martinci, Veliki Radinci, Belenovac, Suljan, Gruevci, Lekenice, Statovac, Mandjelos, Divolac, Cold, Lačar, Kuzmin, Sremiska Rača, Bostut, Sašinci, Ravne. Control system consists of following entities:

**Commanding control centre KKC**

This is placed on the location of water plant in Sremiska Mitrovica where two SCADA systems have been delivered (one for control of water plant, and the other one for control of peripheral dislocated pumping stations and reservoirs).

**Control and monitoring system of water plant**

- From well complex, with well pumps that transport the water towards the city, taking care of drive protection, and the mechanical system of the axe control.
- Based on the signal received from pressure transmitter, control pumps that switch on automatically (in automatic mode and manual operating mode).
- Switches on the chlorinator in dependence to requirements of chlorine level in reservoir and transports it towards the city, taking care of drive protection, and the mechanical system of the axe control.
- GCRA automatically logs all relevant data of water purification thus the technology engineer can later print the reports of chlorine level, water level in the reservoir, throughput, pressure on delivery pumps towards the city.
- PLC controls the process of water distribution toward town and integrates the following functions:
  - Switches on horizontal pumps that pump the water from the reservoir and transports it towards the city, taking care of drive protection, sequence and operating times of horizontal pumps, providing equal wear out of pumps.
  - Switches on the chlorinators in dependence to requirements of chlorine in the system.
  - All relevant signals sent by GPRS communication to superior system in KKC.

**Control system**

- Based on the signal received from pressure transmitter, controls the frequency inverter that maintains the set pressure by switching the horizontal pumps, i.e. managing their throughput (revolution speed of pump drive).
- Controls the soft starters that take care of the process of soft start and soft stop of well pumps, limit the starting current, taking care of drive protection, and the mechanical system of the axe of the pump itself, (with soft start there is no mechanical impact on axe).

Control system is located on territory of water supply system of Sremiska Mitrovica and has been carried out by Mikro Kontrol company.
VODOVOD, Počekovina
Control System

Delivered control system consisting of PLC, touch panel, frequency inverters, continuous level and pressure measurer has the function to provide next technological demands:

- to keep up the water level in distant main reservoir on the hill, indirectly by set pressure
- in the main pipeline;
- protection of the system dry running;
- protection of phase lost and asymmetry and motor overheating;
- transfer of signals to the distant dispatch center;
- integration of ‘sleep’, ‘snooze’ and ‘buster’ functions in the control algorithm;

A new pumping station was built, with an intention to pump additional water quantities during cycles when water levels in fountainhead «Krupac» drastically decrease. The pumping station provides additional 300-400 l/h of water. This is a pit type station with two wells approximately 100 m deep. One pump of 250 kW is installed in each of the wells, followed by its accompanying frequency regulator.

The pumping station is locally controlled from the main switchboard of the electro motor drive or remotely from the commanding control center of the old pumping station. The remote control in manual operation mode is anticipated to be performed from the command-control switchboard. In the automated mode, the commands are issued by a PLC, based on one of the three defined operation mode algorithms: (1) operation mode based on lake’s water level, (2) operation mode based on water flow (3) operation mode based on water level in supreme reservoir. The designed remote operation mode via PLC, allows full system flexibility for all operating modes. Water quantity tracking towards consumers is also made possible.

Favorably, the new pumping station brought an increase in water quantities. The applied frequency regulator substantially reduced the power consumption. The graph verifies that the committed power for 140 l/h flow is around 95 kW; it is only about 40% of nominal power that would be spent in the event when this flow would have been accomplished by repressing the pipeline.

JKP NAISUS, Niš
New Pumping Station On Fountainhead Krupac - Control System

KOTOR, Kotor
Control Systems Of Pumping Station Orahovac And Reservoir Dobrota 1, Dobrota 2 And Škaljari

Each one of PLCs is configured to accept signals with corresponding number of inputs and outputs (for instance, from discrete level sensors (MIN, MAX), analog level measurement, flow rate etc.) respectively, issue the commands to pump power generators. Besides the PLC on the existing switchboard cabinet door, local operator panels are also built in for reading the instant states. For communication inside the system, GSM modems are anticipated. The selected modems allow services selection within the scope of GSM network, which will be used for information transferring through the system.
The delivered control system carries out the following demands of technological process:

- Filtration cycle of water that passes through the filtering facility
- Filter cleaning cycle based on demands from the differential pressostat or on filter’s operating hours
- Automated control of electromagnetic pneumatic valves; these are executive organs for filtering and cleaning process (air or water, draining,...)
- Switching of well and dosage pumps and throughput adjustment, based on system demands
- Dosage of KMnO4, chlorine, PaCl in dependence of throughput and dosage pump control for the enumerated substances, with analogue signals generated by the PLC
- Pump replacement, taking care all pumps to be equally worn out
- Pump and entire system protection from dry run, over pressure, current
- Fire protection function i.e. in case of fire, water is delivered into factory (normal filling operation mode stops, the system switches to fire protection mode, pumps work with maximum throughput, i.e. maximum rotation speeds)
- GSM transfer of alarm signals, system operating, to phone numbers of responsible employees and maintenance crew

KUPUSINA, Sombor
Control System For Regulation Of Cleaning, Filtering, Chlorination, Dosing Of PaCk, KMnO4
The delivered control system carries out the following demands of technological process:

- Filtration cycle of water that passes through the filtering facility
- Filter cleaning cycle based on demands from the differential pressostat or on filter’s operating hours
- Automated control of electromagnetic pneumatic valves; these are executive organs for filtering and cleaning process (air or water, draining,...)
- Switching of well and dosage pumps and throughput adjustment, based on system demands
- Dosage of KMnO4, chlorine, PaCl in dependence of throughput and dosage pump control for the enumerated substances, with analogue signals generated by the PLC
- Pump replacement, taking care all pumps to be equally worn out
- Pump and entire system protection from dry run, over pressure, current
- Fire protection function i.e. in case of fire, water is delivered into factory (normal filling operation mode stops, the system switches to fire protection mode, pumps work with maximum throughput, i.e. maximum rotation speeds)
- GSM transfer of alarm signals, system operating, to phone numbers of responsible employees and maintenance crew
POWER
The subject of this work are two electric gantry cranes designed to work outdoors, to serve the hydro-mechanical equipment at the dam, the entrance building and mounting block HE “Djerdap 1” to unload the equipment from the lock in a single-individual work and coupled tandem work.

Each crane consists of a steel portal construction, cart and electric drives for main 160t and auxiliary 50t lifting, moving portal and moving cart. Inside the solid (downstream) leg of the portal is the operation cab of the crane.

Electrical part of this job included the replacement of all existing wound rotor motors with corresponding induction motors with cage rotor whose speed and torque is regulated by a frequency converter. Regulation, control and supervision of the crane performs a distributed PLC with the appropriate operator panel, located in the operator cab. As part of modernization of crane, it is provided the alternative remote control via radio control.

The control system includes motors drives controlled by frequency converters, of which:

- the two lifting actuators and carts derived within the system from energy recovery multidevice
- portals drives with two single controller coupled mutually to each other with equal distribution of load torque.

The control system also included the supervision and control of the amount of each hook, a safety circuit implemented safety relays, remote radio controls, monitoring wind speed and the corresponding alarm system, monitoring of cargo weight and the corresponding alarm system, the speed limit in relation to the position and load management driving portal in terms of synchronization of the drive on both sides, the integration of monitoring and control via the operator panel, lighting, signage, electrohydraulic pliers...

In addition to equipment supply, project documentation, writing application software, configuration controller and putting the system into operation MIKRO KONTROL was, along with its Consortium partner, primarily responsible for the reconstruction and modernization of the mechanical part of the crane, committed delivery, installation of new cable trolley, delivery and replacement of all cables.

Work on the reconstruction continues in 2014, on the operations of reconstruction and modernization of the second crane and tandem work of both cranes.
Modernization of electro bridge crane located in HE "Međuvršje" included:

• Fabrication of distribution cabinets with appropriate frequency inverters for each drive (lifting lowering 37kW, bridge drive 2x4kW and jaw drive 4kW).
• Delivery and installation of electromotor with cage rotor, brake, declutching devices and couplings.
• Manufacturing of new stands for electro motors and brakes.
• Operator cabin’s reconstruction.
• Assembly and delivery of device for crane control over radio link.

The advantages of modernized system are:

• Precise positioning of specific drives is provided, in accordance with operator’s demands.
• Wearing and tearing of declutcher is reduced, as well as of couplings and motor.
• Wearing and tearing of other machine elements on the crane.
• Crane swinging reduced.

As SIEMENS Belgrade subcontractor, MIKRO KONTROL delivered the control system of electro-filter ash and slag hidrottransport, which has the following functions:

• control two lines for ash transport by electro-hydraulic valves, frequency inverters, level measurer of slag...
• control the pumps of back water;
• control the electro-hydraulic aggregate;
• control the basaltic channel sliderule;
• control the draining pumps;

The control system is integrated in the system of power plant controlling.

In manual mode, all actuator’s drive (valves and pumps) is accomplished by manual commands, over a “touch-screen” panel, but the execution sequence of these operations is defined and conditioned by the program (for instance the condition for pump operation on suppressing side is the nominal level in the reservoir, pressure in the system, then valve openness on the suction side and on the suppressing side, as well as pump functioning on the suction side). The automatic mode is initiated by activating a button on the “touch-screen” panel, in case the initial conditions are fulfilled (level in the reservoir, valves in closed position, pumps in good order). Sequentially, and mutually conditioned, all the other line devices are activated: valve on suction side, pump on suction side, after accomplishing the adjusted pressure – the valve on suppressing side and the pump on suppressing side. During operation, states of relevant parameters are monitored (the level in the reservoir, the pressure in the pipeline, working/faulty pump), and it is alarmed, i.e. the process is stopped in case any of the parameters exceeds the allowed range. The sequence of line drives deactivation is also defined by the program. The setting of the electromotor pump’s revolution speed on suppressing side, in both manual and automatic operating mode, is issued in one of the two ways (mode selection is performed on the “touch-screen” panel):

• the reference is specified to frequency inverter via the “touch-screen” potentiometer
• the reference is calculated by program’s PID algorithm, with feedback connection by hidromixture level in the reservoir

Transportation Control System for Electro Filter Ashes and Cinder

The transportation line for electro filtered ashes and cinder, hydraulically carries the mixture of water, ashes and cinder to a remote dump, 2 km away from the steam power plant. The line starts at the hidromixture reservoir, in which the level of hidromixture is continually and discretely measured (minimal level signal). Two hydraulic pumps provide the transportation, one on the mixture suction side and the other on the mixture suppressing side. The electromotor pump’s power is 220 kW. The pump on the suction side is connected directly to power line, while the pump on the suppressing side is driven by a frequency inverter. Along the line, the states of electro-hydraulic valves are monitored and checked, whether the valves are open or closed, on both the suction and suppressing sides, motor pump currents, pump revolution speed on suppressing side, as well as the hidromixture pressure in the pipeline. The line’s control system functions in two modes: manual and automatic.

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• Fabrication of distribution cabinets with appropriate frequency inverters for each drive (lifting lowering 37kW, bridge drive 2x4kW and jaw drive 4kW).
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• Wearing and tearing of other machine elements on the crane.
• Crane swinging reduced.

As SIEMENS Belgrade subcontractor, MIKRO KONTROL delivered the control system of electro-filter ash and slag hidrottransport, which has the following functions:

• control two lines for ash transport by electro-hydraulic valves, frequency inverters, level measurer of slag...
• control the pumps of back water;
• control the electro-hydraulic aggregate;
• control the basaltic channel sliderule;
• control the draining pumps;

The control system is integrated in the system of power plant controlling.

In manual mode, all actuator’s drive (valves and pumps) is accomplished by manual commands, over a “touch-screen” panel, but the execution sequence of these operations is defined and conditioned by the program (for instance the condition for pump operation on suppressing side is the nominal level in the reservoir, pressure in the system, then valve openness on the suction side and on the suppressing side, as well as pump functioning on the suction side). The automatic mode is initiated by activating a button on the “touch-screen” panel, in case the initial conditions are fulfilled (level in the reservoir, valves in closed position, pumps in good order). Sequentially, and mutually conditioned, all the other line devices are activated: valve on suction side, pump on suction side, after accomplishing the adjusted pressure – the valve on suppressing side and the pump on suppressing side. During operation, states of relevant parameters are monitored (the level in the reservoir, the pressure in the pipeline, working/faulty pump), and it is alarmed, i.e. the process is stopped in case any of the parameters exceeds the allowed range. The sequence of line drives deactivation is also defined by the program. The setting of the electromotor pump’s revolution speed on suppressing side, in both manual and automatic operating mode, is issued in one of the two ways (mode selection is performed on the “touch-screen” panel):

• the reference is specified to frequency inverter via the “touch-screen” potentiometer
• the reference is calculated by program’s PID algorithm, with feedback connection by hidromixture level in the reservoir

Transportation Control System for Electro Filter Ashes and Cinder

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In manual mode, all actuator’s drive (valves and pumps) is accomplished by manual commands, over a “touch-screen” panel, but the execution sequence of these operations is defined and conditioned by the program (for instance the condition for pump operation on suppressing side is the nominal level in the reservoir, pressure in the system, then valve openness on the suction side and on the suppressing side, as well as pump functioning on the suction side). The automatic mode is initiated by activating a button on the “touch-screen” panel, in case the initial conditions are fulfilled (level in the reservoir, valves in closed position, pumps in good order). Sequentially, and mutually conditioned, all the other line devices are activated: valve on suction side, pump on suction side, after accomplishing the adjusted pressure – the valve on suppressing side and the pump on suppressing side. During operation, states of relevant parameters are monitored (the level in the reservoir, the pressure in the pipeline, working/faulty pump), and it is alarmed, i.e. the process is stopped in case any of the parameters exceeds the allowed range. The sequence of line drives deactivation is also defined by the program. The setting of the electromotor pump’s revolution speed on suppressing side, in both manual and automatic operating mode, is issued in one of the two ways (mode selection is performed on the “touch-screen” panel):

• the reference is specified to frequency inverter via the “touch-screen” potentiometer
• the reference is calculated by program’s PID algorithm, with feedback connection by hidromixture level in the reservoir
ZASTAVA ENERGETIKA, Kragujevac

Electro Filter For Flying Ashes Limiting In Exhaust Gas - Control System

The beneficiary’s demand is not to exceed the concentration of flying ashes in exhaust gas chimney of ZASTAVA ENERGETIKA beyond the limits of 0.05 g/m^3.

The method to limit the concentration is installing an electro filter. The peak value of direct output voltage is from 70 kV to 105 kV. The voltage regulation on the low voltage side (380 VAC) is done with a thyristor.

The starting angle is adjusted, of anti-parallel connection of two thyristors, that are serially connected to the high voltage transformer’s primary. PLC, except that it generates the necessary starting impulses for thyristors and performs voltage regulation, also carries out the function of maintaining the initially set number of sparks per minute (maximally from 70 to 100 sparks per minute).

Reconstruction and modernization of portal crane 2x110t+2x15t and bridge crane 10t in Hydroelectric Power Plant „Zvornik“ Mali Zvornik

Reconstruction and modernization of portal crane 2x110t+2x15t includes replacement of the entire electrical equipment and mechanical equipment partly. To realize this aim it has been necessary to do the following:

- Replacement of all the electric motors with wound rotor, by adequate ones with squirrel cage rotor
- Replacement of all the couplers that connect the engine and reducer
- Replacement of all brake system
- Reconstruction of a cabin
- Upgrade the control with radio network connection
- Replacement of all cables, limit-switches and lighting
- Installation the system for measuring driving axles load
- Instalation of measuring tension cables with loads larger than 0.5 t, on hooks 2x15t
- Instalation of measuring wind speed
- Instalation of fast winch 3.2t weight, and supporting beam on the roof of the crane
- Speed control by frequency converter on all electro-motors
- Inspection of all reducers and in accordance with the user replacement of worn elements
- Making out the electro-mechanic projects of as-built, testing and making the certificate (permission for the use)

Reconstruction and modernization of bridge crane 10t includes delivery, removal of old and installation of new equipment:

- Replacement of all the couplers that connect the engine and reducer
- Replacement of all brake system
- Reconstruction of a cabin
- Instalation the control of radio network connection
- Replacement of all cables, limit-switches and lighting
- Speed control by frequency converter on all electro-motors
- Inspection of all reducers and in accordance with the user replacement of worn elements
- Making out the electro-mechanic projects of as-built, testing and making the certificate (permission for the use)

JP ELEKTROPRIVREDA SRBIJE
FD DRINSKO LIMŠKE HIDROELEKTRANE, Bajina Bašta

HE ZVORNIK, Mali Zvornik
The delivered control system carries out the following technological process demands of pump pressure and throughput maintenance:

- Maintains defined throughput and pressure in pipeline, depending on the selected operating mode.
- Locally operated from the touch terminal or remote SCADA (CITECT).
- Communication through Ethernet.
- Automatic adjustment to appeared pressure in installation and decision making whether to turn the pumps off or switch them on in order to achieve the defined pressure and throughput.
- Pressure and throughput signals recorded and displayed on the terminal on PC, where SCADA resides.
- Alarm states displayed.

**Energy Consumption Optimization in Heating Station**

In the heating energy production and distribution system, an important contributor to power consumption are huge power electromotor drives of blowers of fresh air (two per boiler, of 75kW power), recirculation pumps (one per boiler, of 45 kW power), and circulation pumps (four in the system, from which three in operation, of 220kW power). Besides the effect of reduction of total engaged power and reduction of peak consumption (logged with max graph device), appliance of frequency inverters on drives that directly or intermediately adjust some process parameter - heat, pressure, level of oxygen in flue gases, contributes to reduction of combustibles (fuel oil, emulsion, gas), increases the lifetime of drives, as well as protects the environment. All four contributions have its material value, especially in light of new regulations that govern the respective areas (changes in manner of calculating power consumption, changes in combustibles prices), while obeying the ecological standards, is not only our duty according to law, but towards the future that follows. Mikro Kontrol has carried out the installation and released into production the frequency inverters on blowers of 75kW and on recirculation pumps, in heating station in Trstenik, at the beginning of heating season 2007 / 2008. Frequency inverters were installed on drives of two hot water delivery line boilers made by “Đuro Đakovic”, of 35MW / boiler power. Inverters of fresh air blowers of individual boilers were placed in separate, while the inverters of recirculation pumps of both boilers were placed in same distribution cupboard. The existing distribution to blowers, pumps respectively, has been used. At the end of first heating season, 18% reduction of power consumption has been recorded, without control system malfunction (Investor's official data).

**JKP ENERGETIKA, Trstenik**

Energy Consumption Optimization in Heating Station

**Heating plant KRALJEVO, Kraljevo**

Control System For Pressure And Throughput Regulation (2x45kw) On Boiler Thrust

The delivered control system carries out the following technological process demands of pump pressure and throughput maintenance:

- Maintains defined throughput and pressure in pipeline, depending on the selected operating mode.
- Locally operated from the touch terminal or remote SCADA (CITECT).
- Communication through Ethernet.
- Automatic adjustment to appeared pressure in installation and decision making whether to turn the pumps off or switch them on in order to achieve the defined pressure and throughput.
- Pressure and throughput signals recorded and displayed on the terminal on PC, where SCADA resides.
- Alarm states displayed.
The point of a project was automation of a new coal furnace in which MIKRO KONTROL delivered and installed the complete instrumentation of the furnace: differential pressure, flow and level meters.

Control system of the furnace is based on PLC, while system and commands parameters are operated by TOUCH terminal. Benefits of control system in purpose of burning and steam producing regulation according to specified technological algorithm, are:

- automatic transport of solid fuel into fireboxes (use of frequency inverter)
- maintenance of set subpressure in firebox through the usage of servo drive (suppresses the flow of air that ventilator sucks in)
- control is local over touch terminal or remote SCADA
- displaying the firebox consumption, firebox utilization, outside temperature, operating temperatures,...
- archiving the pressure and throughput signals and displaying them on PC terminal where SCADA is situated
- displaying the alarm states

Control system delivered carries out the following demands of technological process:

- Maintenance of set throughput (addition) of solid fuel into fireboxes (use of frequency inverter)
- maintaining of set subpressure in firebox through the usage of servo drive (suppresses the flow of air that ventilator sucks in)
- control is local over touch terminal or remote SCADA
- displaying the firebox consumption, firebox utilization, outside temperature, operating temperatures,...
- archiving the pressure and throughput signals and displaying them on PC terminal where SCADA is situated
- displaying the alarm states

Regulation algorithms of the system were closed up in PLC which successfully lead steam producing, too, due to analog signals as:

- pressure in the installation, pressure of the air (PID regulating circle on fresh air ventilator), temperature of flue gases, temperature of water in the supplying reservoir, water pressure in the boiler, underpressure in the fire-box (PID regulating circle on flue gases ventilator), boiler level (PID regulating circle of supplying pump), flow through the boiler (position of servo-motor).
Control system of boiler room on fuel oil consists of SCADA system, which with PLC carries out the function of tracking of temperatures, pressures, levels, pump operating and controls the operating of the burner, supplying reservoir, supplying pumps, ... Technologically, it is defined that the outside environmental temperature directs the process of water temperature maintenance on output delivery line. The change of external temperature, according to previously determined curve (chart) sets the water temperature (maintained in regulation circuit on steam hot water duct exchanger) of output delivery line. This way the temperature of delivered hot water towards the consumers is maintained, and according to that temperature, all the other processes in boiler room are coordinated (burners, pressures, pump operating,...) Delivered control system carries out the following demands of technological process:

- Tracks the level of fuel oil in fuel oil reservoir
- Tracking and maintaining the fuel oil temperature in saving head of fuel oil reservoir and in fuel oil tank
- Tracking and operating of circulation pumps of fuel oil in fuel oil substation
- Tracking and operating of reloading pumps in fuel oil substation
- Tracking and maintenance of fuel oil temperature in circulation system of fuel oil on steam warmer
- Fuel oil pressure tracking in fuel oil circulation system on fuel oil steam warmer
- Water condensate level tracking and maintaining in condensate tank
- Level tracking and maintenance of supplying water in tank of supplying water
- Temperature tracking and maintenance of supplying water in tank of supplying water
- Pressure tracking in water degasser
- Steam temperature tracking on steam splitter
- Temperature tracking and regulation of starting and returning water on steam hot water duct exchanger
- Steam pressure tracking on technological steam pipeline
- Steam pressure tracking on boilers
- Burner operating tracking
- Tracking and operating of boiler's supplying pumps
- Temperature tracking of exhaust gases on boilers
- Temperature tracking of fuel oil on boilers

Several heating substations are carried out for the needs of »JP OBRENOVAC« during year 2004. The control system consists of PLC, frequency inverter, operator panel, measurement equipment, GSM modem etc. A substation can be controlled manually and automatically. In automatic mode, level and flow regulation in secondary circle is performed and cyclic pump-running is also provided as well as monitoring of all relevant running states and alarms. The application of GSM modem allows remote monitoring of heating substations as well as alarming the corresponding departments.

A realization of central monitoring system is anticipated for all newly built and revitalized heating substations.
INDUSTRY
The existing equipment (“old” boilers), the total heat capacity of 31.7 MW, together with 3 new hot water, membrane boilers, each thermal power of 50 MW, make a unique heat source of total heat output 181.7 MW, nominal temperature regime 140/80°C. Based on the settings of hydro-mechanical part of the project and the required conditions, the control algorithm is implemented with a constant flow rates in the network in 4 different modes of flow and sliding temperatures of returned water from consumers.

This mode of heating plant control is characterized by:
- easy control of the facility;
- safety in boilers work (feed water temperature higher than the minimum ones);
- stability of the system in relation to possible changes in the work of heat energy submitted to the consumer;
- in normal mode the plant works without recirculation;

Mikro Kontrol, thanks to the rich experience and successfully realized projects in designing, construction and commissioning of automatic control systems in various industries, as well as regarding the fact that it is the only certified solution partner of Siemens in the field of process control systems (DCS Simatic PCS7) in Serbia, is identified and selected as a reliable partner for the realization of this control system. We justified this trust in the best possible way.

Siemens, Belgrade

DCS PCS7 control system in a heat boiling system Fiat Automobiles Serbia in Kragujevac

For the purposes of the new plant, “FAS-FIAT AUTOMOBILI SERBIA” in Kragujevac, a completely new energy block was designed in accordance with the requirements of production and heating, part of which is a new boiler facility.
Control subsystem for AS plants was elected Siemens DCS (Distributed Control System) PCS7, with redundant CPU S7-417-4H. Also, the operator control subsystem (OS) is based on redundant servers; considering that the heating plant is in operation 24 hours, i.e., power supply, signaling and control must not be interrupted, system for measurement, control and monitoring is based on the usage of reliable process computer - redundant programmable logic controller (PLC).

For processing computer (PLC) it has been selected industrial controller of high reliability, insensitive to errors, designed with redundancy type 1 of 2, so it remains available in case of failure of one of the subsystems; this is "Fault tolerant system," and implies that all major components of a computer system are duplicated.

The control and monitoring scope of DCS involve 29 motor-actuated and hydraulic-activated valves, 17 frequency-driven pumps, 29 process transmitters and 15 regulating loops (standard and cascade PID implemented), 7 energy-calculating devices on Profibus DP.

The operator stations network includes five client computers (two standard and three with "touch screen" display for local monitoring of control system of new boilers. Engineering Station, combined with one of the client stations, was used in the phase of control and monitoring applications development and its commissioning, and currently is used to maintain and upgrade applications.

The specific in designing of the control system is the fact that a unique system of control and monitoring should consolidate control subsystems from different manufacturers:

- control and supervision of Weishaupt burners of old boilers
- control and supervision of Oilon burners of new boilers
- control and supervision of Auma valves with redundant Profibus interface
- local control of new burner management system via a computer with a "touch screen" display.

Unlike standard tasks for control (valves, motor drives, regulations), that are richly supported by PCS7 libraries (at level of AS and OS programming), given specific tasks demanded of Mikro Kontrol engineers’ development of special software algorithms, communications, control and graphical display. Project implementation of the new boiler control system by Mikro Kontrol included the following phases:

- Design of network communications
- Operational design and as-built project of control system, including the precise definition of the control algorithm
- Expert assistance in equipment selection
- Supervision of installation, delivery and connecting 10 fields of distribution boxes in the MCC and control room; field types: power - energy, a field with PLC (AS), computers and communication equipment, fields with decentralized peripherals, fields with electric-motor drives of the pumps (by frequency converters)
- Parameterization of frequency converters and Auma electric actuators, with commissioning
- Programming and commissioning of control system.

Following profile workers were involved during the job realization:

- engineers in the design office and at the site (2800 engineer hours).
During the 4th phase of Serbian heating plants rehabilitation project, which is financed by the Federal Republic of Germany Government through KfW bank, installation of economizer has been realized on three boilers of „Trkalištè“ heating plant, which is part of JKP „Toplana“ Šabac.

„Remming d.o.o.“ company from Novi Sad, reputable manufacturer of boilers and thermal power process equipment, which got the tender, engaged our company as a perennial and reliable partner for realization of economizer control system.

Purpose of economizer installation on three existing steam/hot water boilers 14MW, two of which are with combined burners using gas and oil fuel, and third with burner using gas, was to efficiently use the power of burner by using heat of exhaust gases. In that way savings in the JKP „Toplana“ budget have been made, and due to that in end-user budget also.

Backwater from network is transported to mixing valve through ON/OFF electromotive ball valves and circulating pump. Mixing valve function is to, depending on external temperature, mix backwater and water heated in economizer in certain ratio. By doing so wanted temperature of water incoming into boiler is reached.

Furthermore, required power of burners is reduced (proportional to the difference between desired temperature of water going out from boiler and temperature of water incoming into boiler).

Beside automatic mode which has been described, the economizer control system allows users to choose mode which prevents water freezing (when the burners are off, and the external temperature is very low, circulating pump and mixing valve are heating hydraulic installation which is located outside), and also manual mode (optionally, in case of tests or maintenance).

Control system of economizer for boilers in heating plant „Trkalištè“, JKP „Toplana“ Šabac, is based on programmable logic controller (PLC) produced by Omron, CJ2 Series, and on operating colour „touch-screen“ panel, NB Series, 5.6.

Processing module supports programming language standard IEC61131-3: Structured Text (ST), Sequential Function Chart (SFC) and Ladder. Function blocks library, predefined and tested, related to common technological units, significantly reduces time required for programming of the application.

As a part of control system there is also ultrasonic measurer of heat ("calorimeter"), which exchanges information with PLC through RS485 / RS232 communication interface.

Project realization of control system for new boiler room by Mikro Kontrol included these phases:
• Elaboration of as-built project documentation and as-built design
• Production, delivery and linkage of distribution cabinets
• Performing electrical wiring in facility (cable routes, broaching and connecting cables)
• Selection, delivery, programming and commissioning of PLC and HMI control system

During the realization of these steps following profiles of workers were enlisted:
• Engineers in project bureau and on the field (300 engineer-hours)
• Electromechanics in workshop and on the field (500 mechanic-hours)

Realization of economizer control system has been performed during the heating season, so the mission was to provide continuous delivery of thermal power to consumers. Because of that, time required for performing works on each of three boilers had to be minimized, so that in every single moment at least two of three boilers were available.

By installing of economizer and adequate optimization of control system parameters, significant savings were achieved in the budget of customer (JKP „Toplana“) and consumers using remote heating system in Šabac.
TEHNOMETAL, Dašnica - Aleksandrovac

Control system for PET bottles blowing line

“Tehnometal” company, a well-known Serbian manufacturer of machines and production lines for blown packaging, filling, enclosing, labeling and packing of bottles, has manufactured production line for PET bottles blowing, for a Slovakian customer. Technological unities of the blowing production line:

- Electro-hydraulic manipulator for transportation of preforms to pallets (1m³ volume)
- Electromotive preforms elevator
- Preforms orientation separator
- „Entry star“ – a mechanism for handling preforms from separator, and for their transportation to chain conveyor
- Chain conveyor
- Two thermal tunnels with IR heaters installed, total power 102kW
- Transport mechanism for handling heated preforms and their transport to pressing tool
- Tool (press) with four “nests“ for preforms placement and a tool for bottom extraction, along with 4x3 groups of electro-pneumatic quick response valves (pre-blowing, blowing and unloading)
- Transport mechanism for the extraction of formed bottles from the tool
- System for air transportation of bottles

Production line characteristics are:

- It is used for forming bottles of 0.5l to 2l volume, of any shape
- Maximum capacity 1235 cycles/h (up to 5000 bottles/h)
- Installed capacity 120kW
- Thyristor-regulated IR heaters
- Servo motor drives of high accuracy and dynamic response used in mechanism for transportation of preforms / bottles, to / from press tool, and in bottom-extraction tool
- Preforms are transported to „entry star“ by elevator’s and separator/electrical drives. Main machine drive, consisting of frequency inverter regulated drive, moves the entry star, chain conveyor and the mechanism for opening/closing of main tool (press). Chain conveyor transports preforms through two symmetrically placed thermal tunnels, with IR heaters located at multiple levels; these heaters are controlled by specially designed thyristor power regulators, with a task to adequately heat up preforms, preventing „irradiation“ at the same time, and to establish oriented effect of IR heaters. Using signals obtained from the main drive shaft encoder, mechanisms for transportation of heated preforms to the press tool, and extraction of formed bottles from the tool, are initiated according to predefined CAM profile. Open/close cycle of the press tool is conditioned by the main drive speed, i.e. by the defined production capacity. Once the heated preforms are in the press, it is necessary to stretch them in predefined cycle time, according to strictly defined coordinates, using stretch-machine’s servo drive. During the process, it is also necessary to activate electro-pneumatic valves in accurate (and short) time intervals, to define the shape of bottle. Bottles are then taken out of the press, and into the container, by air-transport system.

Mikro Kontrol realized control system for PET bottles blowing, in cooperation with a partner company Inel, from Krusevac; Inel defined project task, projected and realized thyristor-based IR heater power regulators, while Mikro Kontrol implemented project task into desired functionality of production line and all of its drives.

Harsh requirements for machine capacity (up to 5000 bottles/h) and CAM synchronization of multiple technological unities dictated the choice of control system based on new Omron NJ platform of controllers for machine automation. NJ controllers series is a new product on the global market, and a leading one in terms of technical characteristics.

Key features of NJ controller that lead to choosing them for this application were:

- Intel Atom processor designed for industrial environment, with high computation speed and real-time response
- Control of all machine functions from one place, using one software package (synchronized axis movement, regulation of process variables, sequential algorithms of work)
- Ability to control up to 64 axes (encoders, servo, frequency inverters), with linear, circular and helical interpolation, while programming by PLC standard
- Integration of all drives and peripherals through a single network – Ethercat (servo drives and motors, frequency inverters, encoders, decentralized I/O), ability to control up to 192 Ethercat „slave“ units
- System cycle: 50μsec for 16 axis, Ethercat cycle: 1μsec fixed
- Remote access and HMI connection through Ethernet IP network

Driving of preforms and bottles transportation mechanisms, and bottle stretch mechanism are performed by Omron servo drives, Accurax GS series, connected to NJ controller through Ethercat (as „Motion bus“). Parameterization and supervision of production line is performed through Omron NB „touch-screen“ panel.

Realization of project of control system for new boiler room done by Mikro Kontrol included the following phases:

- Technical documentation
- Selection, delivery, programming and commissioning of PLC and HMI control system

Advantages of implementation of control system are: Described control system provided the end-user with a reliable, high performance tool (up to 5000 bottles/h), which offers almost endless possibilities for design, including designers directly into the development process; one can directly affect the looks, shape, and quality of bottles by choosing appropriate tool and process parameters, available at operator-interface of the production line.
International company „Electrawinds“, world-known name at the „green energy“ producing field, together with their partner company in Serbia invested in the animal-waste material processing plant, with bio-fuel ingredients as final product; it appears in the liquid - tallow form (the fuel for diesel-electric generators), also in the meat-and-bone meal form MBM (the co-fire in different industries).

The factory building was realized in accordance with the „Cleaning of Serbia“ action of the Republic of Serbia Government, and was an ideal solution for two goals: the animal-waste elimination, and renewable energy source production. This factory will enable processing of 150,000t of animal waste, which can’t be used for human nor for animal appliance. According to estimations performed before the project realization, approx. 80% of animal waste on the Serbian territory couldn’t be processed, which was serious ecological problem. This „zero-waste“ project the complete transport and processing will be done in accordance with EU regulations.

REMMING, Novi Sad
The rendering plant control system at „Energo Zelena“ production facility in Indjija

The realization of several processing plants (tank-farm plant, water-supply and heating-station plant, the MBM transport plant). „Electrawinds“ / „Energo Zelena“ committed to „Remming“ company, who engaged „Mikro Kontrol“ for the electrical design job, the MCC and Control cabinets producing job, electrical work at the site and PLC / SCADA control program realization.

Tank farm plant consists of group of tanks, used for liquid product storage and settling, together with associated pipelines and process equipment (regulating and ON/OFF valves, massflow, level, pressure and temperature sensors, and frequency-driven pumps). The MBM transport and storage plant consists of storage tanks, worm-conveyers for tank discharge, and conveyers dedicated for MBM material transport towards shipping station („jumbo“-bags, i.e. weighing scale, or to truck filling station)

Water supply line consists of reservoir tank, frequency-driven pumps dedicated to water pressure regulation, assigned pipelines and process equipment (regulating and ON/OFF valves, massflow, level, pressure and temperature sensors).

Thanks to our reach experience at well-done jobs of electrical design, realization and commissioning of automation systems, and thanks to the fact we are owners of Siemens Solution Partner certificate for PLC/HMI/Industrial Networks, Mikro Kontrol is recognized and elected as a partner for this job; as many times before, we justified that confidence.

As the core for PLC control subsystem, the Siemens CPU S7-317 was chosen, together with decentralized Profinet I/O and motor-drive periphery.

The operator control subsystem is based on Wincc SCADA server – client configuration. The OS network consists of two computers (two screens per each of them), and the server computer with redundant power supply module and redundant HDD’s.

The control and monitoring scope of tank-farm control system covers 5 electro-pneumatic positioners used as regulating valves, 25 ON/OFF electro-pneumatic valves, 6 frequency-driven pumps with Profinet communication interface, 23 DOL motor drives (conveyers, worm-conveyers and mixers), 17 sensors, 6 regulating loops (software PID loops for the temperature regulation and water pressure regulation), and 8 sequentional procedures for material transfer.

We want emphasize that, for the first time at Serbian market, Mikro Kontrol delivered, mounted and commissioned 3D-level sensors, used for 3-dimensional MBM tank level visualization; its purpose is not only for tank filling and discharging sequences, but also to enable operators to have „clear picture“ of the real material shape inside the tank (in order to prevent „hills“ forming during filling, and sticking material at the tank walls during emptying).

The tank farm control system realization involved following phases:
• "As-built" Electrical design, in the form requested for use-permit certificates according to Serbian laws;
• control panels manufacturing, delivery, mounting and wiring;
• electrical work at the site;
• programming and commissioning of PLC and SCADA application.

Following profile workers were involved during the job realization:
• engineers in the design office and at the site (1200 engineer – hours);
• electricians at the Mikro Kontrol factory, and at the site (2500 electrician – hours).
Sugar factory
SUNOKO, Pećinci
FAT application software for PLC and SCADA

The implementation of the project DCS control system for factory desugarization molasses, Sunoko Pećinci. Technological project factory for desugarization molasses has been done by the French company Novasep, and Mikro Kontrol was responsible for performing electrical project and control software. The factory designed production capacity is 300 t of molasses per day, 335 days per year. Three different fractions are derived as production result:
- raffinat (semi-final product used in animal food industry)
- betaine (semi-final product used in pharmaceuticals industry)
- sucrose (semi-final product sending back to sugar production plant)

One of the phase in the project control system is FAT application software for PLC and SCADA. The system is designed that PLC leads the entire process, which includes four technology units integrated with SCADA software. On the development of each operational entity PLC and SCADA software has been involved software team that participated in the writing of software. The testing lasted 6 weeks.

In the process of testing the implemented simulation, was involved software team that participated in the writing of software, and oversight of tests carried out by representatives of the company Novasep. From company Novasep, the tests involved technologists and automation. The testing lasted 6 weeks.

Sugars factory
SUNOKO, Pećinci
Noodle dryer machine control system

Sunoko company has installed steam noodle dryer in its manufacturing section Pećinci. Purpose of steam noodle dryer is to dry pressed noodles made of sugar beet to 90%DS, with maximal energy efficiency and minimal air pollution.

Steam under pressure of 27 bar is brought to the dryer, where it condenses and leaves the dryer as water, which is then used furthermore in the process. All incoming energy is transformed into low pressure steam, which is produced by evaporation of noodles. Pressure of that steam is being regulated at 3 bar and is used at first level of evaporation; in that way complete energy regeneration is performed, along with preventing air pollution and unpleasant smell.

As drives in sugar refinery are already driven by Siemens Distributed Control System (DCS) PCS7, with network based on S7-400 and its OS system (made of redundant servers and client network), the request was to integrate new dryer into existing control system. Implementation of this request was performed in several phases:
- Upgrade of PCS System version from version 6.1 to version 7.1: previous PCS7 system v 6.1 reached the limit of its resources (PO, communication jobs, messaging system, possibilities of hardware reconfiguration), so this and any further expansion demands buying an upgrade of PCS7 version, its installation, changing of technological blocks (using advanced possibilities of new libraries), examination and commissioning with preservation of all previous sugar refinery drives' functions.
- Elaboration of executive design of control system and electromotive drives
- Making, assembling, examining and connecting of distribution and control cabinets
- Commissioning of noodle dryer control system

Thanks to perennial experience in maintenance and expanding of Siemens PCS7 automatic control system in all Sunoko sugar refineries and being the only certified Siemens solution partner for integration of DCS automatic control systems. Simatic PCS7 in Serbia, Mikrokontrol was chosen as a reliable partner for realization of this project. We have justified that confidence once again.

Project realization control system for new boiler room by Mikro Kontrol included these phases:
- Executive design and as-built design of control system, including precisely defined control algorithm
- Professional assistance in selection of the equipment
- Supervision of installation, delivery and linkage of distribution cabinet fields in MCC and command room types of fields: power supplying field, decentralized periphery field, fields with electromotive pump drives (frequency inverters and Simocode intelligent starters)
- Parametrization and commissioning of frequency inverters
- Programming and commissioning of control system

During the realization of these steps following profiles of workers were enlisted:
- Engineers in project bureau and on the field (60 engineer-days)
- Electromechanics in Sunoko factory (50 mechanic-days)
- Electromechanics in Mikro Kontrol factory (10 mechanic-days)

By executing noodle dryer control system, apart from efficient and reliable facility required during production of sugar, customer has got energy efficient solution with minimal negative effect on the environment.
Sugar factory
SUNOKO, Pećinci

The control system of the boiler in the sugar plant Pećinci

Sunoko company installed coal-fired boiler in the production facility Pećinci and requested the control system for that plant. The boiler fuel is coal in two fractions: large fraction burns through the controller layer of coal on the grid, while small fraction burns by pneumatic particles combustion (PLP).

There are 4 coal bunkers on the boiler, the two for big and two for small fractions. The coal is transported to a bunker over existing tape stock with coal.

As there are two boilers in the existing steam producing plant (boiler room) that are operated with Siemens 57-400 series controllers and decentralized control system (DCS) Siemens PCS7, the requirement was to integrate newly installed boiler into the existing management system. For this purpose it was necessary to develop electrical design of boiler control cabinets, develop and install the cabinets and implement the control algorithm.

Mikro Kontrol, thanks to years of experience in the maintenance and expansion of automatic control by Siemens PCS 7 in all Sunoko sugar plants, and as the only certified Siemens Solution Partner for the integration of DCS control systems SIMATIC PCS7 in Serbia, has been recognized and elected as a reliable partner for this project.

We justify this confidence this time, too!

The AS boiler control subsystem was based on the existing Siemens PLC S7-417H, insensitive to errors, designed with redundancy in type 1 of 2, so it remains available in the event of failure of one of the subsystems; it functions as “Fault tolerant system,” which means that all the major components of a computer system are duplicated.

New power rack cabinets and automation cabinet for the third boiler were made and installed. The system consists of 22 motor and hydraulic drives, 8 frequency regulated motor drives, a motor drive with softstarter, 59 M&R tags and 18 valves. For each drive it was made local control box with local commands.

The monitoring system consists of a redundant server pair and operator station network which has been expanded with two new ones. The new boiler control algorithm was developed, and the new screens were designed to monitor the status, input parameters and operate a boiler.

Engineering Station, combined with one of the client stations, was used in the phase of development the applications and for the management and supervision of its commissioning, and is currently being used to maintain and update the application.

The Mikro Kontrol implementation of the control system of the new boiler consisted of the following stages:

• Operational design and as-built design of the control system, including the precise definition of the control algorithm
• Expert assistance in selecting equipment
• Control cabinets fabrication in our factory
• Supervision of installation, delivery and mounting of control cabinets in MCC control room; field types: power supply field, decentralized I/O modules field, MCC field (consisting of frequency converters and softstarters).
• Parameterization of the frequency inverters and softstarters with commissioning
• Programming and commissioning of the control system

During the job realization, the following profiles workers were involved:

• engineers in the design office and at the site (60 engineer - days)
• electricians in a Mikro Kontrol factory (40 electrician - days)
• electricians in a Sunoko factory (40 electrician - days).
One of the most important technological processes in the production of sugar is syrup cooking in a vacuum devices, as a mode of crystallization. By crystallization the sucrose molecules have been "transported" from the syrup forms to a solid - crystal structure. In practice, two basic ways of cooking are implemented: discontinuous (Eng. "batch") and continuous (cascade) cooking. With discontinuous cooking the process is initiated and led independently in each vacuum device. In the continuous cooking the vacuum devices are interconnected and make the kind of series, or cascade from the point of transport of raw materials; during the time intervals the raw material is transferred to the next device in which different operating parameters are set up.

The advantages of continuous cooking are:
- easier control of process parameters
- greater energy efficiency, using lower-energy potential vapor
- greater efficiency - we get a higher content of crystals
- much of the campaign, vacuum devices spend in the stationary mode: a constant flow of syrup,
- constant steam consumption, less devices stoppages

By 2011 year the discontinuous cooking was used in all three sugar factories of "Sunoko group" for all three products (A, B, C). Plan of activities for 2011 year determined the task to implement continuous cooking on C product devices.

For years Mikro Kontrol has been upgrading PCS7 DCS (Decentralized Control System) which controls the entire process of production in sugar factories Pećinci and Kovačica and the process of cooking in Vrbas. In the realization of process system it is crucial to understand and implement technological requirements; as a number of years before Mikro Kontrol completed this task successfully. At the very beginning of the campaign the investor received control system that was functioning effectively and efficiently all the time of sugar production in the autumn of 2011 thanks to good work preparation and testing facilities, which we conducted during the phase of cold and hot tests.

For the realization of the work the following equipment, were delivered and installed and the following resources were engaged:
- 2000m galvanized racks, along with mounting brackets
- Swiped 4500m cable: LITC, PP00, Profibus PA and Profibus DP, with the installation of PA distribution box, 150m and 500m cable casings
- 850 engineer hours
- 2100 mechanic hours.
Sugar factory
SUNOKO, Vrbas

The control system of sugar cooking process

The process of sugar cooking takes place in a vacuum – appliances, including the three following stages:

- preparation: seeding mode selection, cooking steam pressure defining, defining of the juice inserting pressure
- syrup inserting: pressure regulation defining, defining the juice inserting speed, defining the regime of mixing,
- grain-making control of steam pressure oscillations, control of temperature oscillations, flow control of drawing crystal base;
- concentration: control of dry matter content, defining the technological point of weld end;
- discharge: pressure regulation in the device with level control,
- evaporation: temperature control;

There are three groups of devices in the factory in Vrbas, as follow: group A (6 appliances), group B (5 appliances) and group C (5 appliances); P&I diagram of the group A device is shown in the picture.

Besides the vacuum apparatuses in which the cooking takes place, there are other productive resources whose processing parameters are regulated and monitored:

- Reservoir ("Majška") for the crystal base;
- Reservoir ("Majška") for weld cooling;

The investor’s request was to automate the process of cooking in group A and B appliances, while for the C cooking only delivery of equipment was required.

The structure of the technological process of sugar cooking and related resources (facilities management), the required type of control of process parameters and sequencing of the technological procedure dictated the choice of management concept to be decentralized control system (DCS) platform Simatic PCS7. Also, the important role played technological "know-how" experience Mikro Kontrol engineers have for similar jobs in other sugar refineries of Sunoko group.

According to the concept of Simatic PCS7 DCS, cooking process is managed by the appropriate AS (Automatisation station), i.e. PLC S7-400; It’s job is to execute the control algorithm of that technology unit, also to control field equipment (valve actuators, motors, and collects the signals of process variables via Profibus DP / PA decentralized peripherals). Eventual expansion of DCS control system to other parts of the sugar refinery technology is provided via the communication Industrial Ethernet interface that is an integral part of AS’s.

OS (Operator Station) concept PCS7 DCS is based on two independent (stand-alone) computer operator stations with redundant connection. The nature of the production process does not tolerate delays in production, so it was designed the backup-operator station which automatically and without delay takes over the control in case of cancellation of master station.

From the operator's standpoint, it is provided work on two computers simultaneously.

OS stations are connected to the AS by Industrial Ethernet. Computers themselves are provided with multiVGA graphics card, and four monitors per computer; separate SCADA screen can be displayed on each monitor at a time. When implementing the OS part of the project, it was implemented more than 40 SCADA screen (Synoptics of certain parts of the plant, procedures screens, parameters of procedures screens, etc.).

Engineering Station (ES) Simatic PCS 7 DCS is used for configuration and programming of AS and OS systems, as well as for AS applications monitoring. The following PCS7 tools were used: CFCs (Continuous Function Chart), i.e. program for the realization of continuous algorithms (processing the signal, interlock, PID regulation loop), SCL (Structured Control Language), i.e. programming language similar to Pascal for the implementation of sequence control algorithms.
of non-standard automation algorithms (in this project in-line pH control), SFC (Sequential Function Chart), i.e. program for the realization of sequential algorithms (technology transfer procedures, CIP ...). Thanks to the redundant OS stations, any change in the configuration of the system (adding I/O modules, Profibus PA device), or changes in the control algorithm is carried out without stopping the production process.

During implementation of this project approximately 200 real-time process AS objects (PO) were implemented. Decentralized profibus periphery is realized using ET200S family interface and input / output modules, located in separate control panels.

During the realization of the project, 12 electrical cabinets with ET200S I/O modules were pre-wired and installed, located at the plant points where signal cables from the field equipment of specific vacuum apparatus were concentrated. Total number of related signals is:

- 300 digital inputs
- 190 digital outputs
- 110 analog inputs
- 30 analog outputs

Besides, 32 Profibus PA devices (SIPART positioner valve, transmitter of temperature and pressure) were connected to the system.

The realization of the project - Control system of cooking in Sugar factory “Backa” included the following phases:

- The definition of construction project and the project as built
- Delivery of equipment (wired cabinets of PLC, decentralized peripheral devices, computer equipment)
- Installation and connection of equipment on the ground
- Making of software applications and putting the system into operation
- Training of operators and maintainers of the system

A special feature of the task given the fact that the project had to be carried out during the sugar production campaign, in extremely difficult conditions (high temperature and humidity), and that the deadline for implementation of contract signing to commissioning cooking A and B was 45 days.

During the realization of the work workers of the following profile were involved:

- Engineers in the design office and on the ground (700 engineer - hours)
- Electricians on the ground (670 mechanic-hours)
- Electricians at the factory (500 mechanic-hours)

Sugar Factory SUNOKO, Pećinci

Sugar Factory in Pećinci has been used Simatic Process Control System PCS7 (version 6.1) DCS (Decentralized Control System) for several years. Owner asked for Serbian partner, i.e. a company which is able to provide support in control system expansions and upgrades, commissioning and maintenance; Mikro Kontrol qualified with its successful references, experience and specialist education of its engineers in Siemens PCS7 training centers.

In 2009 Sugar factory planned following jobs to be done:

- pH regulation at the first carbonatation plant
- GP filter juice level regulation
- Plate heaters temperature regulation
- B white and green syrup level regulation
- Vertical crystallizer cooling water temperature regulation
- Vertical crystallizer cooling water level regulation
- C syrup heating steam temperature regulation
- Operator control for several added drives, controlled by Simocode units (water, syrup, melassa pumps, quivers ..)

These jobs requested following realization phases:

- PCS7 control system expansion with new devices, including their configuration and parameterization: SIPART positioners, transmitters with Profibus PA interface, valves and binary sensors with AS-i bus interface, frequency inverters with Profibus DP interface, Simocode drives
- CFC (Continuous Function Chart) programs creation, i.e. regulation loops program implementation
- Graphical redesign of existing SCADA screens according to new plant organization (pipes, tanks ..), including new operator Faceplates for process object control and monitoring
- Control system commissioning took 4 days of process monitoring, 24 hours per day

Successful realization of control system upgrade project also asked reinstalling and reconfiguration of PCS7 Engineering Station (ES), and its accommodation to existing system; besides, a number of AS and OS process tags had also to be upgraded.
PLC accepts digital signals showing the status of drives and conducts the cutting process, button pressing and knife changing using both the signals and the programs installed. Frequency regulator performs several functions:

- It controls the 132 kW motor (the old DC drive has been replaced) that drives a drum (15T) in which sugar beet is cut into triangular chips,
- The operator can, by accelerating and lowering the cutting speed to maintain the required capacity constant,
- The operator can, by pressing push button forwards-backwards start the motor at low speed of 5 rpm in order to find a broken knife or a foreign object that may have dropped in,
- It operates the motor during change of knifes and stops it in the required position,
- It shows the speed and power consumption.

Touch panel is used to count knife changes, to ascertain the number of knives to be replaced, to control the state of drives, the tools changing arm, the current alarm state and the history of alarms.
Control system delivered carries out the following technological process demands of pressure maintenance in residential facility:

- Maintenance of constant pressure in building
- Pump switching thus all pumps have same operating life
- Switch on additional pumps in case one pump is not enough for pressure preservation
- Pump protection and protection of entire system from dry running, over pressure, current...
- Fire protection function i.e. operating mode in case of fire starts in the building (the normal operating mode stops and the operating mode switches to fire protection mode; pumps start to operate with full throughput, i.e. maximum revolution speed). Proper pump operating is daily checked at exactly defined time (tests the pump state and sends an error message if any of the pumps is not operational).

INN VINČA, Vinča
Automatic 124/123i Iodine Isotope Synthesis Module For PET Scanning

System control of 124i radioactive iodine isotope synthesis, as well as other iodine isotopes, used in medicine (health care) during PET (Positron Emission Tomography) for malignant tissue diagnosis.

The control system is based on a PLC, a temperature regulator and air flow regulator, connected to a RS485 network and SCADA system used for control and data acquisition.

The system includes the controlling of ON/OFF valves, the reference flow setting proportional to valve, the temperature curve setting in quartz oven with (124TeO2) enriched tellurium oxide target.

In SCADA system, the operator has on his disposal, besides manual, a choice between a number of automated programs (synthesis of radioactive iodine, cleaning, target preparation), and for each program on disposal are unlimited number of prescriptions that can be modified. For each program reports are generated.
XETI (XEnon Target for 123I production)

XETI is a fully automated station for production of radionuclide 123I. Production is based on irradiation of highly enriched isotope 124Xe in gas phase with protons of 30 MeV energy and current up to 120 μA. Special construction of the station allows very expensive gas 124Xe to be retrieved back from safety auxiliary systems in the case of crashing of station’s vacuum windows. Radionuclide 123I is used for SPECT diagnostics in nuclear medicine.

The control system is based on the Omron PLC Series CJ1M and CX-Supervisor SCADA applications on the Ethernet. Communication with several devices on the RS485 and RS232 channel is achieved through the SCU communication module that provides an open programming of communication protocols. SCADA application allows operator to create recipes, get reports on manufacturing (batch log), the possibility of manual and fully automated process control.
MESyMO is a dedicated module suitable for the synthesis of the radiopharmaceutical \([^{11}C]\text{-methionine}. The computer controlled, fully automated and GMP compliant module has two functional units, integrated into one device:

- \(^{11}\text{CH}_3\text{I synthesis unit;}
- \(^{11}\text{C}-\text{methionine synthesis unit.}

System is based on Omron PLC type CJ2M and SCADA application for monitoring and control. SCADA has a module for creating synthesis programs independent of order and type of the device being controlled with a set of a programming instructions (if - then, go to, call function, timers, counters etc.) allowing creation of programs for realization of completely independent technologies bounded only by the physical system to be controlled. Albeit program is created on PC, once loaded into the PLC it is executed independently of PC being present or not. Program is created in visual editor simply by clicking on available devices (valves, pumps, regulators…) and entering their parameters.

Benefits for consumer: Flexibility of writing programs for the synthesis of the radiopharmaceuticals on PC and reliability of the program execution on PLC, unlike other similar products where program is written and executed on PC platform and therefore the synthesis of the radiopharmaceutical process is dependent on PCs stability.

ELEX COMMERCE, Belgrade

NIS GAZPROMNJEFТ, Belgrade

Heating circuit control system in NIS Gazpromneft Ovča

Within the contracted work, Mikro Kontrol performed purchase and delivery of equipment, production of working algorithm based on defined technological parameters and commissioning with attestation of performance during the process of exploitation.

Heating circuit control system was made on the programmable controller platform designed for KGH applications with PXC 64 label, and the visualization and process interface were enabled through PXM20 dedicated panel. Regulation of water temperature was provided through delivery of regulatory three-way electromotive valves with VVF label and SKC actuator.

Technological task that control system has to realize is to keep defined temperature of the outgoing water in heating circuit. Keeping the value of outgoing water temperature is achieved through regulation of the openness of three-way valves in which hot and cold water is being mixed so that desired temperature is reached. Hot water is prepared in boiler which works independently from this heating system, while the set temperature is a functional dependency found as a result of measuring current outside air temperature (that function is also called sliding temperature characteristic and its target is to set higher temperature of water which goes into the heating process when the outside temperature is low, and to set lower temperature of water when the outside temperature is high.

System affects several heating circuits of measuring and control, whose function is mostly similar, and that is: keeping the value of starting water temperature which goes out into a heating process by controlling and starting of three-way electromotive regulating valves (in which cold and hot water is mixed) placed on outgoing branches.

Realization of control system project for new boiler room included the following:

- Selection, delivery, programming and commissioning of programmable logic controller and HMI visualization interface.
- Making instruction manual, training for operators, delivery of entire attested project documentation.

Benefits brought by control system are these:

- Regulation of process parameters is performed automatically. The system automatically regulates outgoing hot water temperature as a function of measured ambient temperature.
- Very fast detection and elimination of errors in the system, since HMI monitoring system enables to visualize the entire process, display current and previous errors.
GUŠTER, Kragujevac
Manufacture Of Electro-Cabinets For Controlling „Georg“
- Transformer Core Cutting Line

„Gušter“ company from Kragujevac is engaged with reconstruction of transformer core cutting production lines, which are then exported to India. In cooperation with „Gušter“, Mikro Kontrol provided electrical documentation and delivered electro cabinets with control equipment. The production line has 19 drive units, 8 of them with servo AC motors 2kw and 3kw power, and 11 drive units are with three-phase AC motors regulated with frequency invertors 1,5 kW up to 5,5 kW power.

KAP-ANOTECH, Podgorica
Control And Supervision Of Raw Anode Production Process

Programmable controllers and PC with SCADA software are connected through "Controller Link" network of high performance.

Commands and real time process parameters monitoring, history, graphical displaying, trends and operating with prescriptions, is made possible by programmable touch panels (for each totality one panel). SCADA application allows complete process visualization, work with database, reports, alarms, trends and data history.

Possibility to expand on "FieldBus" communication level is made possible by adding a "DeviceNet" or "Profibus" module into PLC configuration.
Three phase asynchronous motor of 3kW power, drives the main drive, with which the transformer’s core is revolved. The drive speed is controlled with closed loop vector regulation device.

The pole arm drive, for winding up high voltage and low voltage windings, is guided by AC servo drive 1,3 kW. The control system allows the pole arm to follow the movement of main drive moving the wire continually, providing correct winding alignment.
TRAyAL
Factory of Heavy and Industrial Pneumatics
Mikser K7 - Monitoring Control System

Mixer K7 is a system that serves for production of semi finished products of rubber for different purposes. K7 Mixer’s equipment consists of a sampling subsystem (6 scales for: polymers, soot, white fillings, oils and waxes, with independent dosage paths) and a subsystem for mixing. The project involved the replacement of control and monitoring system previously implemented by “Chronos Richardson” company from Great Britain.

The control subsystem is based on two PLC’s, mutually interconnected with Controller Link network, intended for data exchange between PLC’s in industrial environment and color touch screen operator panel. The monitoring subsystem is implemented with three PC computers, with implemented application over a database (Microsoft Access) and SCADA application, that are mutually interconnected by Ethernet LAN.

On each computer, with corresponding access rights, it is possible to perform ciphering of materials and silos, script assignment and corresponding table assignment in database, process monitoring with alarm diagnostics capability, history review and report generating. PLCs on both locations have the duty to gather analog and digital signals from the process, current prescription processing and execution of facility’s operating system algorithm. Operator panel is placed next to mixer’s installation, and allows the operators basic monitoring over the process of sampling and mixing.
Automatic dust filter is used to clean dusty air. These filters are made in a type series with 3 to 10 separate chambers and filter bags. In the course of air filtering, filter bags become clogged and the control system is to shed each of them in succession.

The control system has been reconstructed by replacing the relay logics with PLC hardware-based control system.

The following operations are now conducted from the incorporated operator touch panel:

- parameter definition for the control system, entry of the number of chambers, entry of shedding cycle duration, entry of pause duration time (when the shedding of two adjacent chambers is finished and the drive is switched off after it);
- selection of operating mode in the plant: individual operation of drives with and without blocking and group (automatic) operation;
- monitoring of operation of all drives (worm, heaters, fans, rechanneling and shedding valves) and alarm sounding in case of any failure in them.

Cementara HOLCIM, Novi Popovac
Automatic Dust Filter Reconstruction

The product is stone of various granularity for use in Civil Engineering and food industry (sugar factories). The control system is based on PLC, dynamic scale for stone throughput measurement, operating panel and SCADA system for monitoring and data acquisition. The components communicate over RS485 network and Ethernet.

The operator has the option to choose the stone granularity. The conveyor belts and stone-breakers can be started locally or remotely, in manual and automatic mode. The SCADA system writes into database all relevant data about production - operating time of all drives, alarms, cumulative quantities of produced stone or quantities of produced stone by shifts.
The control system consists of:

PLC
- directs the furnace operating for ceramics sintering and integrates the following functions:
  - proper functioning verification (gas proof) of gas barriers according to cyclogram examination of gas barrier impermeability (gas barrier valve control and based on the preset state condition on gas installation the PLC makes the decision whether the gas barrier is working correctly)
  - automated furnace airing then ignition and valve opening for air and gas.
  - automatic starting of motor drives for fresh air pumping in, extraction of smoke gases and motor drives of air curtains
  - preservation of defined operating temperature. ( 1580°C ± 1°C ) (three-positioned regulation of gas and air valve, implemented with PLC with help of internal PID algorithm)
  - preservation of defined proportion of air and gas flow (PLC takes care that the technologic process of roasting/combustion is being preserved in an atmosphere enriched with gas in comparison to air in exact percentage, in order to obtain a product of good quality)
  - preservation of specified pressure of smoke gases in the firebox (5mmHg) (PLC with help of its PID algorithm generates analog references, revolution speeds for frequency inverters, in order to preserve the defined pressure)
  - furnace tempering till the desired operating temperature is reached (temperature directing in an interval, where the arrival to the operating temperature lasts 15 days)
  - carriage movement directing through the furnace, i.e. thrusting machine control (hydro aggregate with electromagnet distributors) and correction of carriage speed with ceramics passing through the furnace, in dependence to roasting time.
  - acquisition and monitoring of 13 temperatures, that form a curve, based on which the furnace has to operate by (reception of analog temperature signals, their processing and alarm generating in case they exceed the defined operating range)
Frequency inverters
- based on analog references received from the PLC (output values from internal PID algorithm in order to maintain the specified pressure of smoke gases) the frequency inverters start the smoke gases ventilators, change their speed and thus maintain the specified pressure.

Touch terminal
- input and specifying of operating temperature, proportion of gas and air, starting/stoping furnace’s motor drives, temperature displaying through the furnace, specifying the smoke gases pressure
- alarm displaying that occurred during operating, with date and time of appearance

SCADA
- visualization of entire process of ceramics sintering
- temperatures and all other alarms recording, dimensions that are important to the operator
- report generation for sintering temperatures, times of traveling/passing through furnace that are enclosed along with product
ZORKACOLOR, Šabac
Information System In Production Facility

In order to monitor the production process execution in production facilities of ZorkaColor, a system for monitoring and production process execution has been installed. In production, a large number of different products are present. While production is based on individual production directives, initiated by sales, the technology defines it and production executes it. The system provides mechanisms for production control and monitoring, in accordance to specific production orders, from raw material handing out in storehouse, over technological steps execution and sampling in production, to final product packaging. The goal was to carry out a system that will further enhance the production quality, reduce the raw material consumption, as well as reduce the errors influenced by human factor.

The system allowed the production directive from Oracle database to be directly visible on-line to the operator in production process on scale terminal, machine or workplace. Data entry into the system is based on barcode readers, making work much easier, and also reducing errors on data input from the beginning. For instance, the choice of raw material to be sampled is performed by reading the barcode from the raw material’s wrapping. The operator can not mistakenly insert another raw material, that is not present in production directive, because raw material selection by barcode reading proceeds to raw material sampling, and acknowledgement of raw material insertion is also performed by reading the raw material’s barcode from wrapping. The most different technical-technological reports are obtained, based on information gathered from production and stored into Oracle database.

For carrying this system out, requirement of equipment that shall easily couple into system was necessary in communicational and other ways, i.e. equipment of open type. The heart of the information system is Oracle RDBM, on which a system based on Omron’s CX-Supervisor relies on. In production, there are Omron PLCs and Omron touch operator panels. To carry out some of the scales, HBM and Tufco digital scale processors were used. On certain number of scales, an automatic dosage system was implemented. Also to carrying out the system, wireless barcode readers were used, whose bases were coupled with serial connection to Omron’s serial communication units of PLCs.

In this case, the information system and everything that it brings, has lowered to the outermost executive in production.
What is specific for this control system is that it has been carried out in Ex realization. The system consists of Touch panel certified for Ex and control part, in which PLC with two frequency inverters are placed. The control part is physically distanced from filler itself, and signals arrive and leave over Ex barrier. Also, the system is specific by the fact that servo drive is not used. Instead a classical (asynchronous motor and frequency inverter) used, contributing to lower the costs of entire system.

The control system has two basic operating modes: maintenance and automatic. In maintenance mode, basic system parameters adjustment is performed and faultiness is tested, while in automatic, there are two main modes: filling and washing. The system is completely freely configurable, both in mechanical and software sense – it has filling nozzles flexibility in each direction and sizes, while it can memorize up to 5000 recipes, or types of filling.

System performances depend on the type and quantity of material that is poured into bottle and can vary between 1000 to 3000 bottles per hour. Dosage precision is 0.1g and dosage error is below 1%. The system has an algorithm for dosage error autocorrecting as well as the ability to configure each nozzle independently. The display system for monitoring the filling allows two modes of monitoring: professional – it contains all measurements and calculations in tabular form and engineering – it contains the picture and algorithm of execution sequences. First regime is designated to operators in daily job execution, while the second one is designated to engineers during maintenance when certain problem exists.

The system also possesses a program for system washing with 5 options and operates according to time set or manually in dependence of washing type. With this system productivity increase is possible, while reducing investments during machine purchasing. It was prior procured from abroad and was put together with components hardly available and difficult for maintenance.
In the construction of the new silos in Zmajevo (the investor was Novi Trading NS), Mikro Kontrol supplied control-monitoring system of silos. The silos have a capacity of 34,000 tons, with three scales, two unloading ramps, two receiving points.

The delivered control-monitoring system consists of:

- SCADA system that visualizes the entire technological process of silos
- Touch terminal with which the operator, depending on the selected mode, turns on / off certain plants or leaves automation system to do that
- PLC devices that by collecting 496 digital signals and processing them through defined algorithm for managing of silos, do the turn on / off of some of the 240 electrical drives

The functions of the system:

- Record data from the process, subsequent analysis of the data and display in a report
- Control of inclusion / exclusion of conveyors, fans, bolts, valves, ... on the basis of pre-defined actions
- SCADA system operator can monitor the level of the silo, the valve position, engine and switches status, active alarms in the system, and decide what action to take
- Implemented algorithms affect the safety and proper functioning of the system, regardless whether the system is in manual, automatic, blocking or deblocking mode.

Control System For Grain Dryer - Bimal Brčko

The grain dryer in oil refinery “Bimal” Brčko has one tower, with three technological zones distributed at different peak elevations of the tower: upper and lower drying zones, and cooling zone. A steam exchanger is used as an air heater. Blowers and regulation valves direct the hot air into corresponding drying zones.

In each of the drying zones, the temperature is measured in six measurement locations, using a cord with temperature probes. Using isolated probes, alarm over-temperatures are measured in two measurement locations, as well as the regulation temperature. One humidity meter is used for both drying zones. It periodically samples the grain humidity on different peak elevations. This is the humidity PID regulator’s feedback signal, implemented in PLC’s application program. Regulation valves are used as executive bodies of PID’s control signal. Based on the initial and sampled grain humidity value, the algorithm commands the corresponding valve openness, thus passing through higher or lower quantities of hot air for drying.

The cooling zone resides on the lowest peak elevation of the tower. It has a cool air blower. A variable speed conveyor extracts the dried grain from the tower.

The grain dryer in Bačka Palanka has two identical towers. Three technological zones are distributed at different peak elevations of the tower: upper and lower drying zones and cooling zone.

In each of the drying zones, the temperature is measured in six measurement locations, using a cord with temperature probes. Also using isolated probes, alarm over-temperatures are measured in two measurement locations, as well as the regulation temperature.

Transforming this sampled regulation temperature value into humidity, the humidity PID regulator’s feedback signal is obtained which is implemented in PLC’s application program. Regulation valves are used as executive bodies of PID’s control signal. The algorithm, based on the initial and sampled grain humidity value, commands the corresponding valve openness, thus higher or lower quantity of hot air for drying is passed through.

The cooling zone resides on the lowest peak elevation of the tower. It has a cool air blower. A variable speed conveyor extracts the dried grain from the tower.

Besides the grain drying facility, this dryer plant also has the following auxiliary facilities: dust suppression facility (5 electro-pneumatic valves per tower), compressor station, suction fan, snail conveyor (3 per tower).
The following functions are also implemented:
- label height automatic correction, according to analog UV sensor signal
- temperature PI regulation of the glue, and the knife roller

Thanks to our reach experience at well-done jobs of electrical design, realization and commissioning of highly-dynamic automation systems, and the long-year successful cooperation with “Tehnometal” company, Mikro Kontrol is recognized and elected as a partner for this job; as many times before, we justified that confidence.

The high demands to machine dynamics and accuracy (250 bottles/min, cutting accuracy of ±0.5mm) determined the control system platform choice - the new Omron NJ machine controller; it is a brand-new Omron product at the world market, with state-of-the-art technology and superior technical performance. The labeling machine control system job is the first NJ implementation realized from the Serbian company (Mikro Kontrol), for the Serbian customer.

The main NJ controller characteristics are:
- Designed to meet extreme machine control requirements in terms of motion control speed and accuracy, communication, security and robustness
- Integration of Logic and Motion in one Intel Atom processor
- Up to 64 axes motion control
- EtherCAT and Ethernet/IP ports embedded
- Fully conforms to IEC61131-3 standard
- Certified PLCopen blocks for Motion Control
- EtherCAT comm. period: 1msec; controller cycle scan time: 500usec
- Remote access

The labeling machine control system was implemented as a 7” panel with EtherCAT connection to NJ. The main operator control is realized via Omron NB „touch-screen” 7” panel. The labeling machine control system realization involved following phases:
- Electrical design job
- Delivery, programming and commissioning of PLC and HMI systems

The period from the control system purchase confirmation, up to commission finish was 15 days only.
ALLTECH FERMIN, Senta
System For Monitoring And Control Of Different Sections In Yeast Manufacturing Facility

The system includes control of following sections:
- CIP system
- Molasses preparation
- Fermentor
- Yeast extract
- Anhydrous kiln
- Kiln with fluidization layer
- Wells

Each of the sections has local control that satisfies technological requirements. The control system is based on PLC and the user interface is based on TOUCH panels that allow visualization and operating with each of the sections. As enhancement of entire system, SCADA stations are established that are integrated into the existing Information system and allow further technological analysis as well as quality control of products. The entire system is based on Ethernet, DeviceNet and HostLink communication.
ALLTECH FERMIN, Senta
The Yeast Extract Plant Control System

After autolysis process, which takes place inside one (of eight possible) reactor, a raw material – yeast milk is transferred through following technology units: ultra-high temperature sterilizer 1, separators, filter, evaporator, ultra-high temperature sterilizer 2, and, depending of material type used (liquid, or powder) it flows toward package unit or dryer unit. The neighbouring technology units are separated by buffer tanks, with function to temporary store material until the moment the next unit is ready for production. The common technology units for whole plant are CIW (Central Industrial Washing) unit, and heating station unit (it delivers hot steam needed for material heating during production).

The project scope was a new control system setup on the existing process equipment base, with new technology programming and implementation: autolysis, separation, filtering, packaging and material transport procedures had to be programmed, and commissioned. The additional task was technological interface setup (i.e. process signal exchange) needed for the CIW phase and material transport phase with control systems of other suppliers: Alfa Laval, GEA Wiegand.

After following considerations:
- the great number of process data which had to be processed (74 analog inputs, 15 analog outputs, 540 digital inputs, 476 outputs)
- Profibus DP decentralized periphery (7 decentralized ET200S nodes with AI/AO/DI/DO modules, and 22 valve islands with total number of 476 valves)
- Profibus communication with ABB and Omron frequency inverters and Siemens Simocode drives – a total number of 25 frequency inverters and 10 Simocode drives
- the great number, and specific demands for regulation loops (level, temperature, flow, pressure, pH regulation), with 25 frequency inverters / motors and 7 regulating valves as actuator devices
- Industrial Ethernet communication with control subsystems of other suppliers (Alfa Laval for ultra-high temperature sterilizers, GEA Wiegand for evaporator)
- More than 100 automatic production sequences
- process data transfer into Alltech SQL Database
- the existing SCADA system transfer (executed in the “old” factory) into the new SCADA platform

we decided to resolve this task with DCS (Decentralized control system) hardware and software platform Simatic PCS7 (Process Control System). We are proud to say that Mikro Kontrol is a pioneer in enterprise of that kind among other Serbian companies.

Production plant consists of four relative autonomous technological units:
program for realization of sequential process flows (material transfer procedures, CIW, ...). During the ES phase of project realization, more than 1100 real time AS Process Objects (PO's) were used.

The communication with Alltech SQL database, and with existing Alltech SCADA system is realized with Open PCS7 station; an add-on OPC software provides an Modbus RS485 communication with power switches located at transformer plant and power distribution panel, also an Modbus TCP/IP communication with steam flow transducers.

The Industrial Ethernet network is realized with industrial Scalance switches / media converters, and with fiber-optic cables immune to noise produced by power consumers and energetic cables.

The project of yeast extract plant control system assumed following phases:

• Communication network design
• Control system design
• 13 control panel fields assembly and connecting (inside Master Control Cabinet room); there were following field types: power supply field, PLC field, LVSG field, drive field (consists of inverters and Simocode drives)
• 6 dislocated stainless-steel panels assembly and connecting with field equipment; panels contain ventil islands (cca. 476 valves) and ET200S decentralized periphery (process signal I/O's)
• An PC rack panel assembly and connecting (inside Master Control Cabinet room); rack contain computer stations (OS servers, Open PCS7), switches, media converters, ... An communication rack assembly and connecting (inside Command Control room); rack contain communication equipment (switches, media converters) needed for Terminal bus realization, also for connection to Alltech SQL database system and existing SCADA system)
• Program design and commissioning

Successful project realization asked following Mikro Kontrol engagement:

• Electrical engineers (3600 engineer – hours)
• electricians at the factory (1100 hours)
• electricians at the plant (500 hours)

According to Simatic PC57 DCS organization structure, a separate AS (Automationatization station) device, i.e. PLC Simatic S7-400 family, is assigned to these technological units. Their task is to execute control algorithm, to communicate, control and collect signals from Profibus DP decentralized periphery (frequency inverters, Simocode drives, valves, process signal transducers). Automationation stations are interconnected by Industrial Ethernet communication interface, used for real-time exchange of large quantities of process data; this connection is also used for communication with third-party control subsystems (Alfa Laval sterilisation, GEA evaporator).

The OS (Operator station) concept of DC5 PCS7 system is based on two redundant OS SCADA servers, and OS clients network. The production process is non-tolerant to stoppages due to equipment outage, therefore an backup station had been designed with purpose to take over process control if the master fails. OS servers use Industrial Ethernet for connection to AS system, (DC5 System or Plant bus), also an separate Industrial Ether- net for connection to OS clients network (DC5 Terminal bus). The SCADA application runs at both servers at the same time, and its screens are shown at OS client stations. OS client stations are delivered with multi-VGA graphic device, and two monitors per station; each monitor is able to show a separate screen, i.e. a 4 different screens can be shown at the same time. During the ES phase of project realization, more than 800 different screens are designed (process synoptics, procedure screens, interlocks, alarms, ...).

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The Engineering Station of Simatic PC57 DC5 is used for AS and OS system configuration and programming, also for AS program monitoring. During the project realization, a following PC57 tools had been used: CFC (Continious Function Chart), i.e. a program dedicated for continous algorithm realization (process signal preparation, interlocks, P&D regulation loops, ...), SCL (Structured Control Language), i.e. program language similar to Pascal dedicated for non-standard, complex automatization algorithm realization, SFC (Sequential Function Chart), i.e. program for realization of sequential process flows (material transfer procedures, CIW, ...). During the ES phase of project realization, more than 1100 real time AS Process Objects (PO's) were used.

The communication with Alltech SQL database, and with existing Alltech SCADA system is realized with Open PCS7 station; an add-on OPC software provides an Modbus RS485 communication with power switches located at transformer plant and power distribution panel, also an Modbus TCP/IP communication with steam flow transducers.

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Delivered control-monitoring system with creosote oil impregnation of wood and was designed to provide the following technical and technological requirements:

- Controlling the autoclave, burner, circulating pumps, electric-pneumatic valves to execute the given algorithm.
- Setting the recipe (on the SCADA computer) for wood impregnation with creosote oil (depending on types of wood that is impregnated).
- Guiding and recording the process of impregnation, and generating the reports on wood impregnation.
- Measuring and recording levels, temperature, pressure and flow important for technological process.
- Protective functions of the system from excessive pressure, temperature, dry running.

The control system consists of a PLC, touch panel, SCADA applications on PC which lead process based on the technological requirements of different types of wood impregnation.

**ALLTECH FERMIN, Senta**

Control system of enzyme station in the Yeast Extract Plant.

During 2013, MIRKO KONTROL realized enzyme station control system in The Yeast Extract Plant. Enzyme station realizes production of enzymes which are automatically injected into the reactor during the process of autolysis, under predefined conditions. System also provides CIP execution with all needed interfaces with central CIP system.

Scope of the work included:
- Electrical design,
- Construction and delivery of electrical panels,
- Application software (SCADA PCS7, HMI OP)
- Commissioning,
- Training.

System is realized on the existing PCS7 with all needed software and hardware adaptation. Software includes system for recipes creating and execution control. On the local HMI panel, the operator can realize some of the manual action, start next steps and also monitor current state of the system. In service mode it is possible to activate actuators in the system and monitor state of the sensors using local HMI panel.

**MERIDIJANA, Bijeljina**

Control-Monitoring System With Creosote Oil Impregnation Of Wood

Delivered control-monitoring system with creosote oil impregnation of wood and was designed to provide the following technical and technological requirements:

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- Protective functions of the system from excessive pressure, temperature, dry running.

The control system consists of a PLC, touch panel, SCADA applications on PC which lead process based on the technological requirements of different types of wood impregnation.
The system is designed so that each of the technological sections have the appropriate PLC, touch panel and electrical equipment located in the chromed electrical cabinet. Use of touch panel has completely eliminated use of conventional control elements (push-buttons, switches, selectors, ...). The complete man machine interface is developed in order to simplify control of entire process. All PLCs in the system are connected in a peer-to-peer network in order to fast exchange of data (status, licenses, immobilizer, alarm, ...). Central SCADA system provides monitoring, collecting and archiving the data of all processes in the production. After that all necessary report are generated. In designing of control system in POLIMARK, special care was directed to meet the HACCP requirements and ISO9001 standards.

After commissioning the new plant, quality and production capacity were significantly increased.

POLIMARK, Belgrade

Realization of automation systems

POLIMARK factory has displaced the majority of its production to a new location in Zemun in 2005, in one of the most modern factories in this part of Europe. Since Mikro Kontrol is a partner with POLIMARK for a long time in the field of automation and control, he has performed the following:

- installing electrical cabinets for monitoring and control (PLCs, touch panels, SCADA, frequency inverters and temperature controllers, signal processors)
- detailed electrical design
- developing of supervisor and control software (PLC, touch panels, SCADA)
- commissioning, training and functional testing
- developing as-built design

The entire system includes control of following sections:

- production of ketchup
- production of mayonnaise
- production of mustard
- production of sugar syrup
- raw material filling station
- transportation management of finished products to packaging machines
The process of dosing and mixing of raw materials in the Animal Feed Factory (FSH) is batch process, which produces the final product, and is an essential technological process in this type of production.

Batch process includes the following phases:
- Weighing of raw materials at a given recipe in each of the five scales
- Transport of measured batches to the reception (buffer) court over the mixers
- Mixing
- Transport of the mixed batch to the specified destination silo

In the mixing plant in FSH "Gebi" there are the following scales for the measurement of certain raw materials that make up a product:
- Scale for granular material with 14 associated silos and independent dosing routes
- Scale of powdered raw materials with 13 associated silos and independent dosing routes
- Scale of premix that is used to create the final product with 6 associated silos and independent dosing routes
- Scale of oil
- Scale of water

Additionally, there is a separate scale - premix with 7 associated silos where the premix is formed as an ingredient of the final product (and placed in one of six silos of scales premix for making the finished product - see above), or premix is formed as a final product for sale, according to a special recipe.

Independent dosing ways from specific silo to the scales are in fact screw conveyors with frequency-controlled electric motor; this method of dosing allows accurate measurement of raw materials participating in the recipe (dosing coarse/ fine, correction spills in successive cycles, etc.).

In the production process it is possible to participate a number of different raw materials belonging to a certain scale (i.e., dosing from different silos within a batch) and that dosing of some raw materials repeat during one batch.

Formed product from the mixer is transported to a given destination silo.

Transport of materials in the mixing plant is made by conveyor system according to the established blocking sequences, with the possibility of automatic speed correction of individual transporter, depending on other process values, for example measured current of the crusher.

In the application of the SQL database the following tables...
are created: a list of materials and raw materials to silos distribution, and based on established relationships between tables, the recipes for making the finished product or premix are defined and edit, and reports on production in a period of time as well as consumption of raw materials are created. Creating a recipe is the task of manufacturing technology, while the operator is able to call them and edit.

For the desired product operator sets the number of cycles (batches), mixing time and destination silo, and then starts the production. During production it is possible to change certain parameters of production and change the destination silo.

The investor’s request was to replace the old system of management, which was brought to the limits of its capacity, by a new, with all of the improvements in speed and quality that can be done reviewing the technological procedure of the algorithm and experienced engineers who have participated in the work.

The control system is based on next-generation processor family of Simatic S7-300 (CPU 319) whose resources (1.4MB program memory, speed of execution of basic instructions from 0.01 to 0.04 microseconds) guarantee reliable execution of a demanding code. By means of Industrial Ethernet connection the PLC is connected to the SCADA, providing high speed of data transfer, which is particularly significant at process with high demands regarding to the refresh rate of process data.

Considering that the nature of the production process does not tolerate delays in production, computer control system (OS) consists of two redundant Simatic WinCC workstations (master and backup), in which the synchronization control of data processing and database updates automatically. Upon any cancellation of master station, the backup station automatically takes control of the process, to repair and restore the master system.

Engineering Station (ES) is used for configuration and programming of PLC and OS systems, and to monitor the PLC application. Thanks to the redundant OS stations, any change in the control algorithm is performed without stopping the production process. Over engineering stations are also made changes in implemented application in SQL database (reports, recipes).

Regarding investors request to use existing control cabinets, where the I/O signals from the process had already been brought, we choose to connect them to the control system via Profibus decentralized peripherals family ET200S. An important reason that decided the choice was a small available space for modules accommodation, and the short time allowed for the transition from old to new system - a request that conditioned to minimize the time required for reconnection the signals.

Total number of related signals in 5 ET200S Profibus nodes is:
- 270 digital inputs
- 230 digital outputs

Besides, the 6 weighing scales had also been connected to the new control system by means of SIWAREX ET200M modules.

The realization of the project - Control system of mixing process plant in Gebi factory included the following phases:
- the definition of construction project and the as-built project; there was no documentation of old system, therefore each connection should have been examined and tested separately
- delivery of equipment (wired cabinets of PLC, decentralized peripheral devices, computer equipment)
- making of software applications and putting the system into operation
- training of operators and maintainers of the system

A special feature of the task given the fact that the allowed time for production plant stoppage was 5 days, and that full production capacity should be established in additional two days (7 days from beginning of the job).

This task was fulfilled successfully, with improvement of production capacity from 15 to 20% (Investor official data).
HVAC  Heating, Ventilating and Air Conditioning
TETRA PAK, Gornji Milanovac
HVAC System 5 Air Handling Units

Mikro Kontrol delivered, installed and commissioned BMS (Building Management System) with DDC (Direct Digital Control) controllers connected to the control computer with SCADA application in company „Tetra Pak“ in Gornji Milanovac. BMS system is monitoring 5 air handling units: AHU 1 and 2 for main production hall, AHU 3 and 4 for storage room, and AHU 5 for chiller room.

The system is designed in a way that speed of supply and exhaust fan which are driven by the frequency regulators, is determined by „demand control“ algorithm, using working signals from production line and their dissipation of heat energy which can be changed by the user.

Approaching SCADA the user has the possibility of controlling each of the controllers, editing parameters defined in controller, and examination of all variables of the system, system for event archive and alarm archive system.

This BMS system is based on SIEMENS equipment as follows:
- dampers activators
- valves and valve activators
- temperature sensors
- frequency regulators
- DDC controllers

National Bank of Serbia
Topčider, Belgrade
Control-monitoring system of the chiller plant

Mikro Kontrol, Belgrade, as a subcontractor of Interklima, Vrnjacka Banja, made the delivery, programming and commissioning the control – monitoring system of the chiller plant at Topčider Mint using the platform of Siemens controller PXC64 and operator panel PXMD3.

Function of control – monitoring system:
- monitoring the current consumption of cold water of machines that print money and based on that giving the command to switch on the required number of chillers
- the chillers are two-steps, and control system choose the step of work based on the cold water consumption
- supervisory functions over chillers is realized in a way that all current chiller alarms, modes and temperature of the installation are displayed on the operator panel.
Control system for steam boiler room is based on CJ2 programmable logic controller (PLC) platform, while the visualization and process interface are enabled through a color operator panel NB 5, and SCADA (CX-Supervisor) installed on a PC. All the mentioned elements are produced by a Japanese company, OMRON.

Technological task realized by this control system is maintaining defined pressure (9 bar) of steam used in the production process.

To achieve constant pressure in the system, controller regulates burner load, water level in the boiler, supply tank and condensate tank, by manipulating water pumps and regulation valves, that enable process execution according to a technological algorithm.

System is in control of multiple interconnected measurement-regulation loops; the most significant are:

- Temperature control in the supply tank and condensate tank, through control of electromotive regulation valves located in steam-guiding pipes
- Maintenance of constant levels in the supply tank, condensate tank and in the boiler, through control of electromotive regulation valves located in steam-guiding pipes and control of frequency inverter regulated boiler pumps
- Constant water conduction control in the boiler, through control of regulation desalinization valve
- Maintenance of defined steam pressure, through control of burner load

Control system unites all the safety functions of the boiler: high pressure and high temperature protection, low water level, no-water regime of pumps, gas ramp verification and burner group ignition control.

Project realization of control system for new boiler room by Mikro Kontrol includes these phases:

- Elaboration of as-built project documentation and as-built design
- Production, delivery and linkage of distribution cabinets
- Performing electrical wiring in facility (cable routes, broaching and connecting cables)
- Selection, delivery, programming and commissioning of PLC and HMI control system (functionality verification using SAT, FAT,...)
- Development of instruction manuals, operator training, delivery of complete attest – project documentation

Advantages of implementation of control system are:

- Security functions of system are integrated, predictability of process and failures is significantly better compared to other control systems
- Process repeatability is very good, improving maintenance and regulation of process parameters
- Error detection and removal in the system is very fast, since monitoring and logging of process variables is based on SCADA and HMI system, that enables visualization of the entire process.