DISTRIBUTED CONTROL SYSTEMS (DCS)
COMPUTER CONTROLLED THERMAL POWER PLANT OPERATION

institute MIHAJLO PUPIN

TPP "KOSTOLAC B" – MRU System Modernisation

Financed by: Economic Association
"Thermal Power Plants and Mines Kostolac" Ltd

Project completion year: 2009-2014 (in phases)

PROJECT DESCRIPTION

The thermal power plant "Kostolac B" is located in Drmno near town Kostolac. It consists of two blocks (B1 and B2, 348.5 MW each) with total gross power of 697 MW which started with production in 1987, i.e. in 1991. With a share of almost 10% in the total production of the PE "Electric Power Industry of Serbia", the TPP "Kostolac B" is an essential factor of the electric power system of Serbia.

At the time of commissioning of the blocks B1 and B2, the TPP "Kostolac B" had the highest degree of automatization comparing to all other thermal power plants in Serbia. However, after nearly twenty years of the power plant operation and the fact that the technology in the field of energy progressed, it became obvious that it was necessary to perform the modernization of the control system, as well as refurbishment of the vital systems. Many foreign and domestic companies participated in the revitalisation project. The Mihajlo Pupin Institute, i.e. its daughter company "IMP-Automation and Control Systems", was primarily responsible for the modernisation of the control system. The complexity of the project was greater because the production capacity of the TPP "Kostolac B" consisted of the equipment from different manufacturers:

- Boiler – SES, Tlmače (capacity 1000 t/h, steam pressure at the boiler exit 186 bar, temperature 540° C)
- Turbine – type 18K348, Zamech, Poland, by license BBC (four-cylinder, single-axle, condensation with reheating, nominal power 348,5 MW, revolutions per minute 3000 r/min)
- Generator (349MW) – Dolmel, Poland (by license BBC)

The boiler was a one-pass type with compulsive circulation, designed to work with both fixed and sliding pressures. It was equipped with 8 pulverized coal burners installed tangentially, and 8 fuel oil burners that were used to start and stabilize boiler.

APPLIED TECHNOLOGY

Modernisation of the block B1 - phase 1

During the modernisation of the TPP Kostolac in 2008, when the capital repair of the turbine generator, set on the block B1, was performed, the first phase of the modernisation of the measurement, regulation and control equipment was also executed. The plant control was completely automated by the installation of the distributed control system (DCS) of the Mihajlo Pupin Institute which consisted of 18 redundant controllers.

The DCS system of the Institute was a result of many years of experience and work of the Institute experts and it was realized by the implementation of the Institute brands Atlas Max and View T-Power.

Modernisation of the block B2 – phase 1

Capital repair of the block B2 consisted of two phases. The first phase, which was completed in 2010, included the capital repair of the turbine generator set, turbine auxiliary plants as well as modernisation of the complete control system. The Mihajlo Pupin Institute applied the same technology as on the block B1 – the outdated and technologically obsolete system for control, measurement, protection and regulation was replaced.

The two-year monitoring of the block B1 operation and thus acquired experience enabled the Institute experts to improve additionally the DCS system on the block B2. At this stage, the control system for the pumping station, compressor station and crude oil plant was also modernized. These three plants were mutual for both blocks. Upon completion of the first phase of the block B2 modernisation, the total number of redundant controllers that made DCS system of the blocks B1, B2 and mutual plants, exceeded 40.

Turbine governor

Replacing the turbine governor was carried out as a separate entity within the Phase 1 of the Block B2 modernisation. Turbine governor, a product which the Institute Mihajlo Pupin was particularly proud of, was designed to automatically recognize different states and modes of the turbine operation and thus to optimize its operation. Considering that the turbine governor and the DCS master products were produced by the same manufacturer, they achieved excellent communication and thus optimized the operation of the whole block in the coordinated boiler-turbine mode operation. The functionality of the turbine governor was tested in practice, especially when working in the most demanding regimens, such as idling and island operation at the full load of 348.5 MW turbines.

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Along with the turbine governor, the Institute Mihajlo Pupin delivered also the advanced system turbine protection, as a particular technical solution. All protection channels were tripled and redundancy was achieved at all levels where the failure could occur.

Turbine governor was tightly coupled to the hydraulic - mechanical part which was reconstructed by the ALSTOM from Elblag (Poland), a subcontractor of the Institute Mihajlo Pupin. ALSTOM was engaged in the repair and adjustment of the oil regulation pipeline around the turbine, as well as new hydraulic elements on the new turbine governor.

Modernisation of the block B2 – phase 2

The second phase of the block B2 renovation was completed at the end of 2012 and it included a complete overhaul of the boiler plant with the reconstruction of the pipeline systems, mills and the electro filters. Also, a completely new system for deslagging produced by the ALSTOM from Stuttgart (Germany) was bought as well as new crude oil burners with reduced emission of nitrogen compounds from the plant PBS (Trebich, Czech Republic). The control and surveillance of these systems were integrated in the DCS system of the Institute Mihajlo Pupin.

Modernisation of the block B1 – phase 2

The block B1 in the TPP „Kostolac B" was turned off according to the plan on the 28th of February 2014, when the preparatory works for its revitalisation were started. After completion of the revitalization, the synchronization and integration into the electro power system were planned for the 1st of December 2014.

This last phase in the reconstruction and modernisation of the TPP Kostolac included the following:

- reconstruction of the pipeline system of the boiler plant,
- reconstruction of the pulverized coal burner regarding the improvement of the mills operation and the reduction of the of the nitrogen compounds emision,
- installation of new crude oil burners with reduced emission of the nitrogen compounds,
- reconstruction of electro filter plants,
- reconstruction of regulation oil pipeline, installation of modern three-channel protective hydraulic trip block and adjustment to new turbine governor,
- installation of new turbine governor due to block B2,
- generator repair,
- installation of new auxiliary generator system (station for the stator water cooling, station for the rotor hydrogen cooling and station for generator oil sealing).

Both old and new systems should be operated from the existing DCS system of the Institute Mihajlo Pupin, which should be updated for this phase of modernisation.

The following companies and enterprises participated in the implementation of the revitalization of the entire plant: ALSTOM (overhaul of turbine and generator) and Chinese CMEC (repair of the boiler) with subcontractors, as well as a large number of the Serbian companies engaged by the Economic Association "Thermal Power Plants and Mines Kostolac", including: BET Engineering, the Mihajlo Pupin Institute, the Faculty of Mechanical Engineering, Feromont, PRIM, Energoprojekt, etc.

ADVANTAGES OF THE APPLIED SOLUTIONS

Upon completion of the modernisation and reconstruction of the block B1 in 2014, the efficiency, stability and reliability in the operation of the TPP Kostolac were raised to the higher level. Modern equipment of the DCS system, which was installed in both thermal power plant blocks, enabled optimization and improved processing of the plants, more efficient supervision and increased safety and reliability in operation. The advanced alarm system contributed to the faster detection of the failures, as well as their easier and faster removal.

The system has the capability of archiving the large amounts of data during a long period of time that allows the analysis of each event, which significantly facilitates the work of the maintenance staff and system engineers. These features reduce operating costs of the power plant which increases its effectiveness and justifies the investments in the modernisation.

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