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AUTOMATION AND HEAT CONTROL IN POWER ENGINEERING

Experience Gained with Fitting the Combined-Cycle Plant of Unit 5 at the Razdan Thermal Power Station with Automated Control Systems

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Abstract—We describe the SPPA-T3000-based automated process control system developed in the course of retrofitting a standard 300-MW power unit into a combined-cycle plant equipped with a gas turbine unit, the heat of exhaust gases from which is recovered in the furnace of a once-through steam boiler modified for the possibility to operate according to the afterburning arrangement. Specific features relating to development of the automated process control system for the power unit subjected to retrofitting are pointed out, which are stemming from the fact that the process equipment has nonconventional elements and may operate in different modes: a combined cycle without afterburning, the traditional steam power cycle, and a combined cycle with afterburning. The structure of the power unit process control system's technical facilities is presented together with a detailed description of the architecture of its computerized automation subsystem/kernel, and the concept of integrating local control systems of separate process equipment items into the power unit automated process control system's computerized kernel is also described. We also give some details about the set of control algorithms Interavtomatika specialists have introduced on the basis of the modern SPPA-T3000 computerized automation suite/system, the use of which makes it possible to achieve a high level of fitting the equipment with automated control functions. The control algorithms have been developed with due regard to the requirements of making them as fully-variable ones with automatic adaptation to each mode of power unit operation. The full-scale training simulator uniting a real automated process control system and a detailed physical model of the technological process, which had been developed and put in operation before the power unit startup, is described.

Keywords: power unit, Razdan thermal power station, automation, computerized automation system/suite/kernel, integration of local systems, dry cooling tower, combined cycle with afterburning, gas turbine unit, full-scale training simulator

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Construction of Unit 5 at the Razdan thermal power station (TPS) in the Republic of Armenia was commenced in 1987. The initial project supposed construction of a standard 300-MW power unit comprising a K-300-23.5-3 steam turbine, a TGMP-344AS steam boiler, a TVV-320-2EKU3 generator, and a Heller-Forgo closed dry cooling tower [an air-cooled condensing device (ACD)] [1]. In 1991, the construction of this power unit, which had been finished by that time almost completely, was stopped immediately after the collapse of the Soviet Union, and the equipment that had been erected by that time, was preserved for a long period of time. The works were resumed only in the mid 2000s under the leadership of Gazprom (Russia) and its subsidiary company ArmRosgazprom (the Republic of Armenia), which is the owner of the Razdan TPS Unit 5. It is exactly in that period of time that a decision was made to modernize the standard 300-MW unit into a discharge-type combined-cycle plant (CCP) equipped with a 180-MW GT13E2 gas turbine unit (GTU) produced by Alstom. The heat of spent gases exhausted from the GTU was proposed to be recovered by subjecting them to afterburning in the furnace of the TGMP-344AS boiler, as a result of which the total power output was expected to grow to 480 MW.

DESCRIPTION OF THE RAZDAN TPS UNIT 5 AS A PLANT TO BE FITTED WITH AUTOMATED CONTROL SYSTEMS

In the initial period of construction, equipment of an automated process control system (APCS) was also installed, which was constructed using domestically produced technical facilities produced in the late 1980s. By the time the construction works were commenced, these facilities had become physically obsolete and outdated, and a new modern APCS had to be installed. The Interavtomatika Company was chosen