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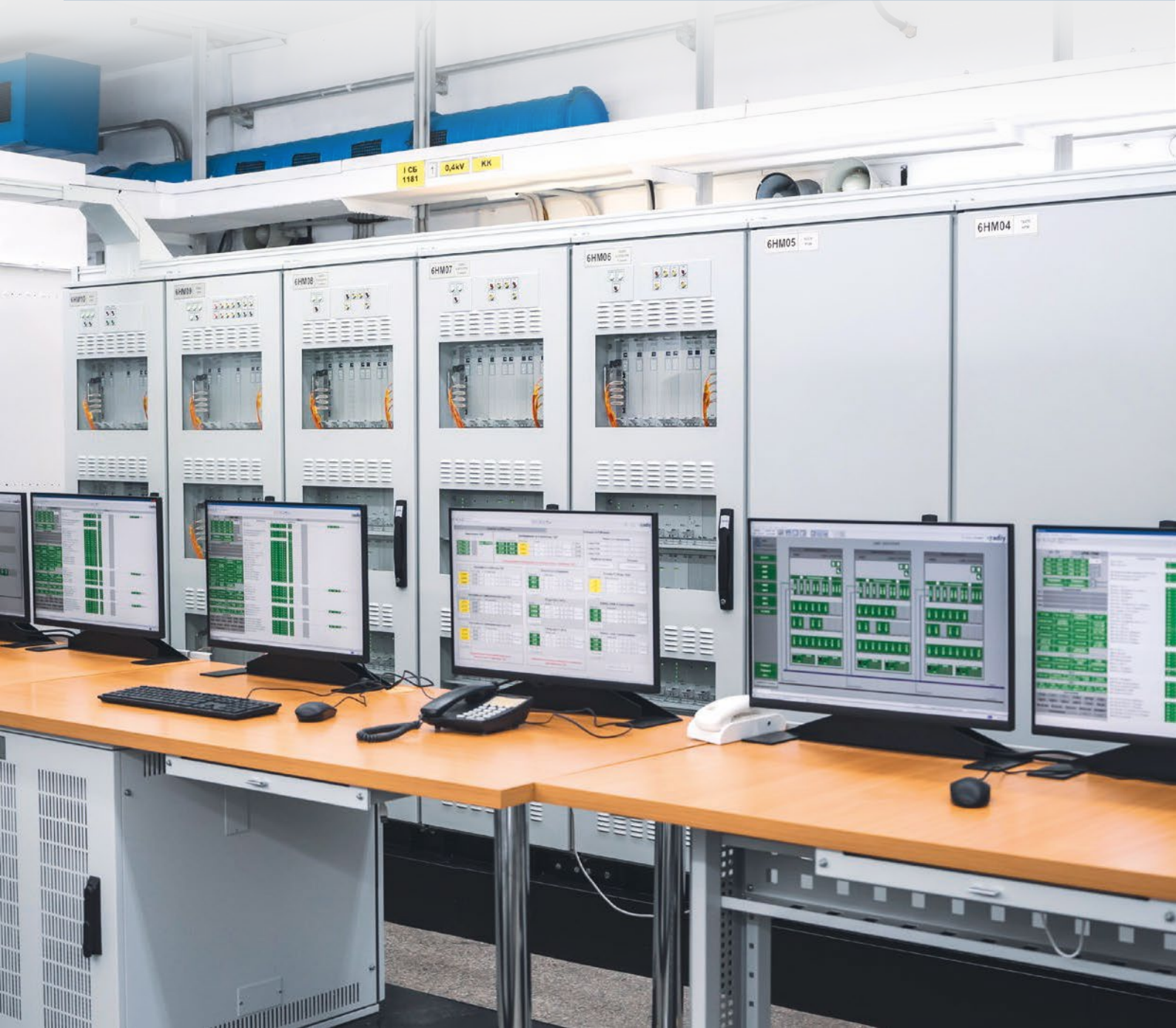
MODERNISATION OF REACTOR TRIP SYSTEM OF POWER UNIT NO. 6 WAS SUCCESSFULLY COMPLETED



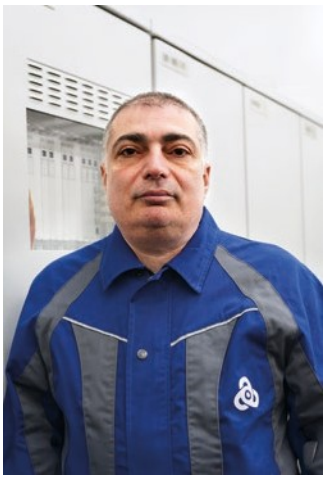
MODERNISATION OF REACTOR TRIP SYSTEM OF POWER UNIT NO. 6 WAS SUCCESSFULLY COMPLETED

SAFETY IS THE FIRST PRIORITY

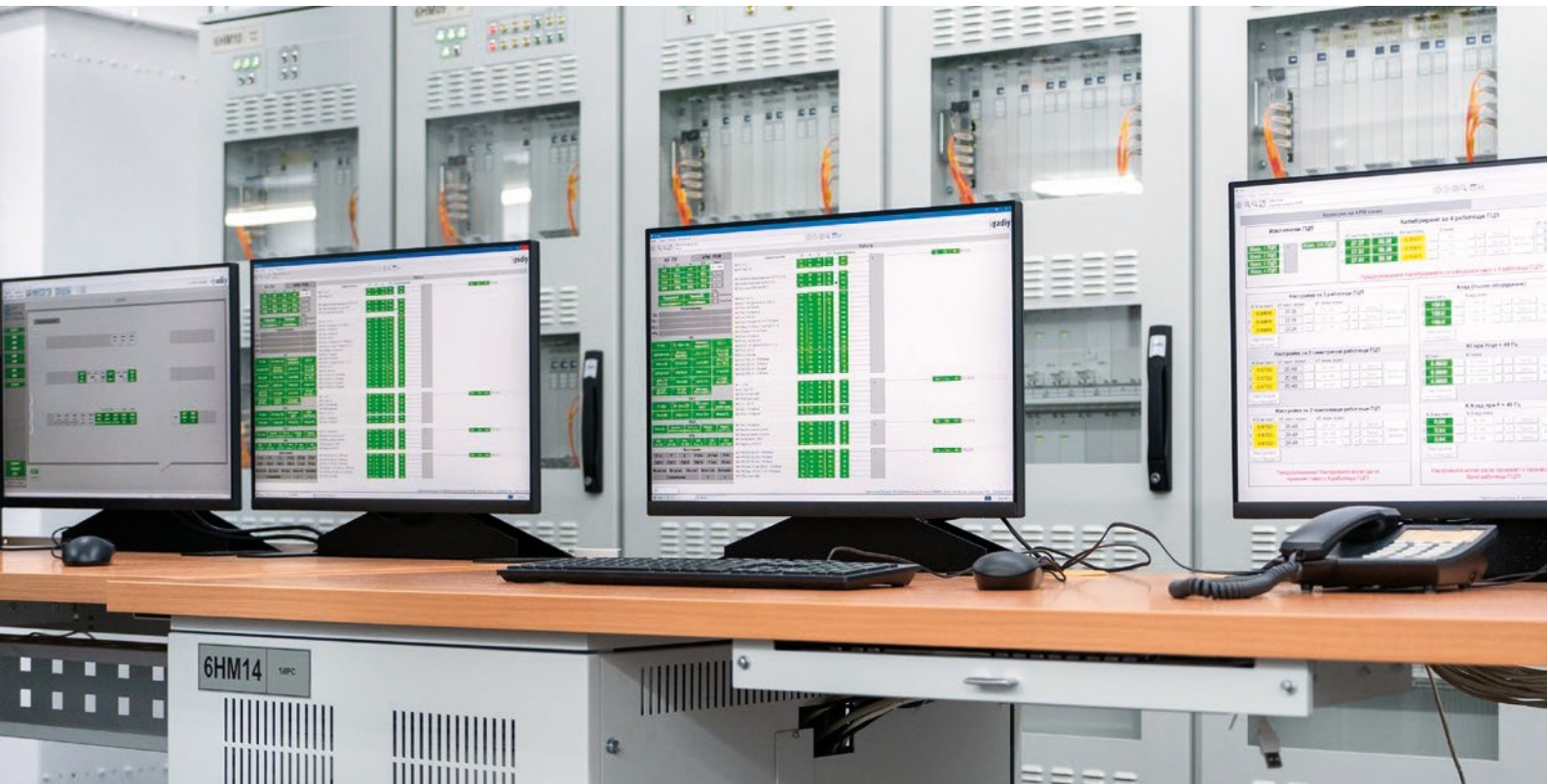
Maintaining a high level of safety and reliability of power generation at the nuclear power units at Kozloduy NPP is a top priority of the Company.

Ensuring the safe and sustainable operation of facilities, in line with ever-increasing national and international requirements, is a continuous process covering all activities of equipment operation, maintenance and inspection. The aim of the set of technical and organizational measures implemented at different stages of the operation of the nuclear power units is to prevent possible risks in order to increase the safety and reliability of the equipment and to protect the plant personnel, the population and the environment.

As part of this process, modernizations of various types and scope are constantly being implemented to improve operating conditions, availability and the degree of production efficiency. Replacement of various process components with advanced equivalents is planned on the basis of in-depth analyses and is carried out in stages, during scheduled outages for annual scheduled outages.



Plamen Petkov,
Head of Control and Protection Systems and Radiation Control Sector



FUNCTIONS OF THE REACTOR TRIP SYSTEM, REACTOR POWER CONTROL AND LIMITATION SYSTEM

Systems including the Reactor Trip System, Reactor Power Control and Limitation System are responsible for the effective control of the reactor plant and/or for stopping the chain reaction in the event of emergency signals.
The equipment of these systems is involved in ensuring control of process and neutron-physical parameters and maintaining them within the limits of normal operation, as well as in providing automatic control of reactor power and process alarms for the operators of the Main Control Room (MCR).

PROCEDURE OF TECHNOLOGICAL UPGRADE

The modernization of Reactor Trip System, Reactor Power Control and Limitation System beyond their design life is included in the integrated safety improvement programs made for Unit 5 for the period 2017 – 2027 and for Unit 6 for the period 2019 – 2029. The objective is to maintain a sufficient level of operational safety margins.
The Terms of Reference for the modernization of Reactor Trip System, Reactor Power Control and Limitation System include the replacement of the emergency and preventive protections, the automatic power regulator, and the discharge and power limitation equipment operated at the two units of Kozloduy NPP with modern ones.
The scheduled activities at Unit 6 were implemented in November 2024, during the scheduled annual outage period. The upgrade of the first equipment set was implemented on the basis of the hardware of the Radiy platform, and using the RadICS I&C platform for the second equipment set. The replacement of Unit 5 equipment is scheduled for spring 2025.

PREPARATORY ACTIVITIES

Following the statutory contractor selection procedures, a contract was signed with a consortium – a company made under the Law on Obligations and Contracts ”Modernization of the Control and Monitoring System”, which included the engineering company “Aden Group” Ltd., as well as two Ukrainian companies – RPC Radiy and RPC “Radics” LLC, which in turn are manufacturers of both types of hardware platforms.

Given the large scope of the planned works, and before Unit 6 was shut down for annual outage, all new cables were laid to provide an interface between Reactor Trip System, Reactor Power Control and Limitation System and many other systems and equipment responsible for fulfilment of their design functions.
Before dismantling of the existing equipment of Reactor Trip System, all necessary temporary schemes were implemented to secure the refuelling of the unit core with nuclear fuel.

FEATURES OF THE NEW SYSTEMS

The selected hardware platforms Radiy and RadICS I&C provide high reliability for the management of digital information related to nuclear safety, in line with the latest requirements for the use of a variety of hardware and software tools. The equipment is certified according to the requirements of the international standard IEC 61508:2010 “Functional safety of electrical/electronic/programmable electronic safety systems”.
The hardware on the selected two types of equipment platforms consists of separate modules with different functions that are located inside seismically qualified panels.
In addition to the parallel use of two independent sets, in order to guarantee the operational reliability of the Reactor Trip System, Reactor Power Control and Limitation System equipment, two independent technologies for the execution of all algorithm operations – programmable digital integrated circuits FPGA and CPLD – are embedded in each of their logic modules. FPGAs belong to a class of programmable logic devices that can be configured as needed without requiring the physical modification of the hardware. On the other hand, the CPLD electronic chips have a built-in non-volatile memory in which the configuration is stored even when the power is turned off. Thus, external control over the operation of the FPGA is implemented with their help. This allows external control over FPGA's operation.

PROJECT IMPLEMENTATION

Following the shutdown of Unit 6 on October 19, 2024, all of the equipment scheduled for replacement at the Reactor Trip System, Reactor Power Control and Limitation System, as well as a large amount of decommissioned cabling, was removed in order to make room in the cable shafts and routes for upcoming upgrade projects.

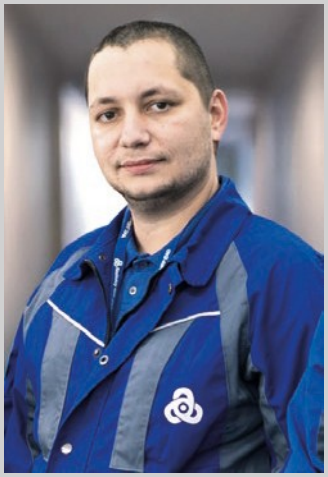
The new Reactor Trip System, Reactor Power Control and Limitation System equipment was installed in accordance with all design requirements and decisions. Following the completion of installation works, a number of organizational and technical activities were performed in accordance with specially developed programs, related to independent and functional testing by specialists of the “Control and Protection Systems and Radiation Control Sector” and “Operation of Control and Monitoring Systems” sector, who are responsible for maintenance, control inspections and performance of high-quality, efficient, timely and safe repairs, as well as operation of the equipment.

OBJECTIVES ACHIEVED

The use of a new generation of highly integrated hardware optimizes the number of control panels, resulting in reduced time for equipment maintenance, inspection, adjustment and repair, and as a consequence, reduced duration of scheduled annual outages. The new systems provide a higher level of diagnostics and control due to a higher degree of diagnostic coverage (over 95%), which reduces the response time for troubleshooting.
As a result of modernization of Reactor Trip System, Reactor Power Control and Limitation System, their operational reliability was increased, metrological characteristics and operating conditions of control and protection systems were improved.

FROM THE FIRST-PERSON POINT OF VIEW

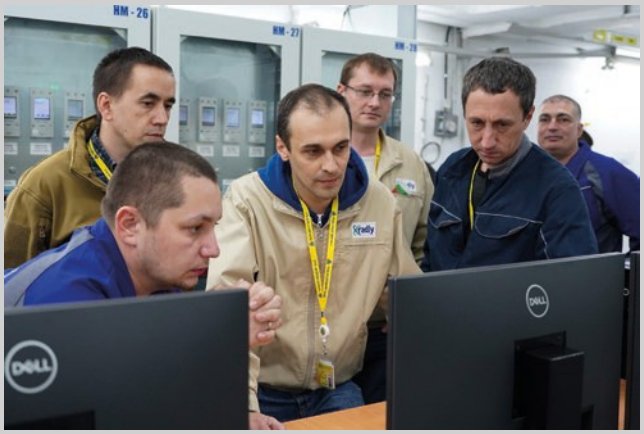
Daniel Czerwenski, Control and Protection Systems Technologist – Project Manager



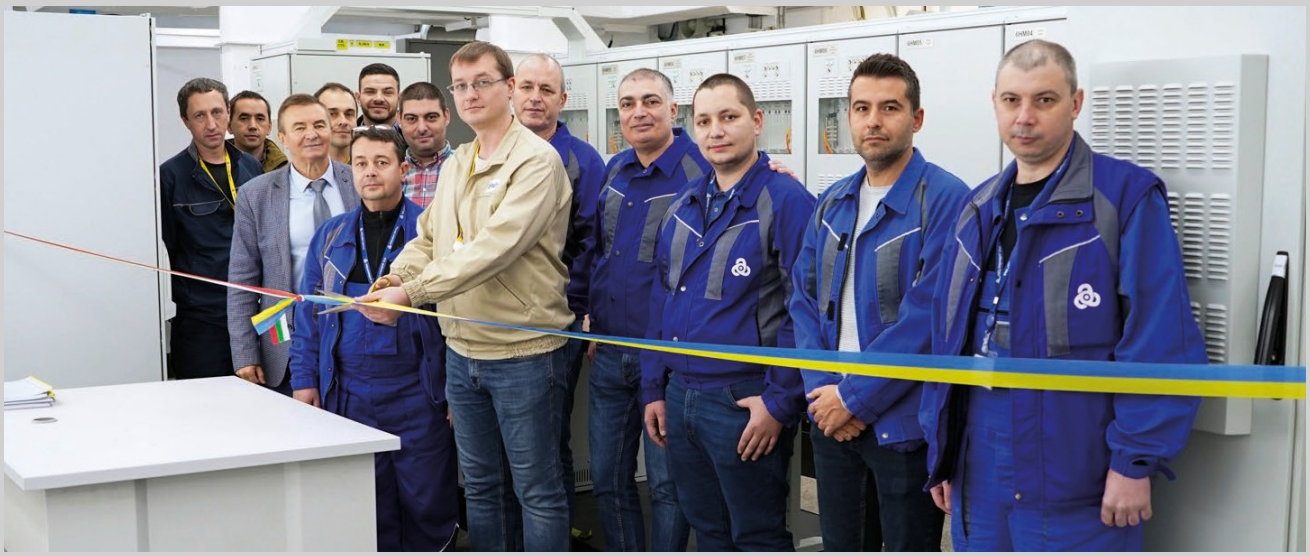
Within the approved schedule of planned annual outage in 2024 of the Power Unit No. 6 it was possible to fulfil all planned activities on dismantling of Reactor Trip System, Reactor Power Control and Limitation System, installation of new equipment, implementation of interfaces of automation, visualization and control tools with interfaced systems, adjustment and functional testing within the established 14-day period, although some of the activities were performed for the first time.

A significant contribution to the successful completion of the project within the planned timeframe was made by Nikolay Pyrvanov, project manager for the modernization of Rod Control System, Head of SUB group, specialists of Reactor Trip System laboratory, Anatoly Lyubenov from Operations Department and Miroslav Tomov, Chief Power Engineer for the control and monitoring systems. Thanks to the dedication and commitment of all those who worked on the modernization of Reactor Trip System, Reactor Power Control and Limitation System, excellent coordination of activities was ensured and an efficient organization of interface management with the related systems was achieved.

PARTNERS



The high quality of implementation of the activities assigned to the consortium “Modernization of the Control and Monitoring System”, which includes Aden Group Ltd. and the Ukrainian companies RPC Radiy and RPC “RadICS” LLC, contributed to the successful implementation of the equipment set modernization including Reactor Trip System, Reactor Power Control and Limitation System of the power unit No. 6 of Kozloduy NPP. The upgraded equipment fully meets international safety standards, including cyber security requirements.



The teams of Kozloduy NPP JSC and the Modernization SDC joint venture at the celebration of the successful completion of the project.