CURTISS-WRIGHT

# South-Ukraine NPP Implements RadICS Digital Safety System

## DIGITAL CONTROL SYSTEM SOLUTIONS

**Organization**
South-Ukraine NPP, a nuclear power plant operating in Ukraine.

**Challenge**
Aging safety systems were becoming less reliable and more difficult to repair.

**Solution**
Implementation of an Engineered Safety Factors Actuation System (ESFAS) and implementation of a Reactor Trip System (RTS) based on the RadICS digital safety platform.

**Results**
The plant has had no failures and no reactor shutdowns due to system errors since the new EFAS and RTS systems were installed.

*Curtiss-Wright has partnered with Radics, LLC — an international nuclear engineering company specializing in advanced, customized I&C solutions — to bring the RadICS digital instrumentation platform to the U.S. nuclear power market.*

Part of the South Ukrainian Energy Complex, the South-Ukraine Nuclear Power Plant (NPP) is located near the city of Yuzhnoukrainsk in the Mykolaiv region, approximately 350 kilometers south of Kiev. It is the second largest of five nuclear power stations in Ukraine, all of which are owned and operated by the State Enterprise National Nuclear Energy Generating Company, also known as "Energoatom," with three VVER-1000 pressurized water reactors and a net generation capacity of 3,000 megawatts. Construction of the plant began in 1975 and the first power unit was commissioned December 31, 1982, with the second and third units being commissioned on January 6, 1985 and September 20, 1989 respectively.

### AGING ELECTRONICS

Prior to this modernization initiative, South-Ukraine NPP utilized a Kaskad Unified Logic Control Unit, an analog T-1000R I&C system, and a unified electrical hardware complex (AKESR). Over time these systems became less reliable and more difficult to repair—replacement parts were hard to locate, and diagnostic capabilities were limited.

According to Andrey Bindyukov, deputy chief engineer at South-Ukraine NPP, the plant's engineering staff decided to upgrade to digital systems due to their proven reliability, the flexibility they offer for implementing software algorithms, and their more robust diagnostics. Digital systems provide more data about the I&C system itself and other connected equipment that can be used for performance-based monitoring and trending, such as to determine if a component has degraded over time and to alert engineers of its issues so that they can take action before it fails. Other diagnostic data can inform maintenance staff of less critical failures via alarms, allowing more time to take corrective measures.

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## THE DIGITAL SAFETY PLATFORM FROM RADIY

South-Ukraine NPP selected Radiy to assist with the upgrade project based on their extensive experience with digital safety systems in Ukraine, Bulgaria, and other countries. "Radiy was quick to respond to our request for assistance," says Bindyukov, who served as the team leader for this modernization and reconstruction initiative. "They presented a flexible solution that we could adjust to our needs."

Bindyukov and his team favored the RadICS platform because its architecture utilizes general-purpose building blocks that can be configured to accommodate multiple digital components. The platform consists of a logic module, both digital and analog basic input/output modules, and specialty modules, all housed in a seismically qualified chassis. This makes it easy to connect many types of input and output devices, such as sensors, transmitters, and actuators, as well as to accommodate a variety of interfaces, including indicators, display panels, and alarm systems.

Radiy spearheaded the implementation of the new digital safety platform in conjunction with the South-Ukraine NPP team, a project which included the design, production, acquisition, and commissioning of the system. In addition to the primary Engineered Safety Features Actuation System (ESFAS) and Reactor Trip Systems (RTS), Radiy developed and supplied switches and electrical distribution cabinets, installed fiber-optic communications links, and assisted with testing. "Radiy personnel resolved all issues that occurred during the installation of the I&C System and took care of unforeseen complications," Bindyukov adds.

## A NEW REACTOR TRIP SYSTEM

Reactor Trip Systems are designed to monitor vital operational parameters and are responsible for automatically shutting these systems down in the event of an emergency. South-Ukraine NPP's new RTS offers the following critical capabilities:

- Continuous monitoring of neutron flux values and other process variables in the VVER reactor vessel, as well as the transmission of shutdown signals if these variables exceed pre-established set points

Engineered Safety Feature Actuation System at South-Ukraine

- Transmittal of vital information such as initiation status, plant status, and diagnostic data to the control room for the surveillance and monitoring of other safety and non-safety systems

## A NEW ESFAS

The Engineered Safety Features Actuation System provides protection, blocking, and monitoring of the actuators. It automates key process controls, allows operators to manually control the actuators remotely, and governs all functions that are necessary for NPP safety, including:

- Information and data acquisition
- Signal conditioning and control of safety signals, detectors, and sensors
- Full-scope diagnostics

## EFFICIENT, TROUBLE FREE OPERATION

According to Bindyukov, the primary advantages of the new digital safety systems include trouble-free operation and more reliable diagnostics—huge improvements over the previous system. The improved reliability of the new system minimizes corrective maintenance, while internal diversity eliminates common cause failure issues. Self-diagnostic testing features reduce the load on plant personnel by eliminating the need for scheduled surveillance and facilitating condition-based maintenance; for example, alarms in the online monitoring system can replace the need for analog channel checks. Fewer modules mean fewer spare parts need to be stocked in the warehouse. Other major advantages of the digital safety systems include:

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*"Since [the installation] there have been no failures and no reactor shutdowns due to system errors. We carry out scheduled maintenance and diagnostics of components in order to prevent failures."*

*— Andrey Bindyukov, deputy chief engineer at South-Ukraine NPP*

- An easy-to-use human-machine interface allows operators to easily monitor diagnostic functions
- Automatically warnings for operators of potential system failures, simplifying maintenance and boosting the efficiency of the operations team
- All components are designed to meet IEC standards for safety-related service

"We installed RTS in 2015 and ESFAS in 2019 and since then there have been no failures and no reactor shutdowns due to system errors," Bindyukov reports. "We carry out scheduled maintenance and diagnostics of components in order to prevent failures." Since the 2019 project, two more RadICS-based ESFAS have been installed at South-Ukraine NPP's Unit 3.

## ADHERING TO MAJOR SAFETY STANDARDS

The new digital safety platform design complies with the following important safety standards from the IEC/IAEA/IEEE: IEC 61508, IEC 61513, IEC 62566, IEC 60880, IEEE Std 603, IEEE Std 384, IEEE Std 7-4.3.2, NS-R-1, NS-G-1.3, and NS-G-1.

South Ukraine NPP (Unit 3) Reactor Trip System

The new platform also meets all pertinent NRC safety standards related to:

- Reliability
- Single failure
- Redundancy
- Independence
- Common cause failure protection
- Technical diagnostics and monitoring availability
- Functional quality
- Functional stability
- Resistance to power parameter variations
- Electromagnetic compatibility and emission restriction
- Human error prevention
- Unauthorized access protection
- Cybersecurity

## INTEGRATED DIGITAL SAFETY SOLUTIONS FROM CURTISS-WRIGHT

Based in part on Radiy's successful implementations at South-Ukraine and other European sites, RadICS has become an essential component in a new set of digital safety systems that Curtiss-Wright offers to the U.S. market. The RadICS platform forms the basis of Curtiss-Wright's NRC-approved Digital Safety System, a functionally and technologically internally diverse replacement for analog and digital safety-related systems at nuclear power plants throughout the United States.

On July 31, 2019, the U.S. Nuclear Regulatory Commission approved the RadICS I&C platform for use in safety-related systems in nuclear power plants, a decision that was supplemented by their June 2021 acceptance of the RadICS Topical Report Supplement for three new modules (TIM, RIM, WAIM) for the platform. This ongoing support continues to pave the way for the technology at U.S. nuclear power plants.

CONTACT INFORMATION:
1350 Whitewater Dr., Idaho Falls, ID 83402 USA
Tel: +1.208.497.3535 | DSS-Sales@curtisswright.com