Integration into the future

Professional Solutions on Automation
JSC RASU Products and Services Catalog
Dear colleagues and partners!

It is a sense of the future, however distant or close, that makes us move forward. And for this future to be a success, one needs to embrace oneself for it now.

Our team aims to ensure that you face the future with anticipation and bright expectations. Our team helps you grow integrated into this future today.

Only by joining our efforts, we will be able to reach new heights, ensure independence from political winds of change and offer our partners the best possible solutions that meet the stated needs as much as possible.

We offer an individual approach to addressing each of your challenges. And our goal is to help you find the best solution that will ultimately lead to unsurpassed results.

Andrey Butko
CEO, JSC RASU
Rusatom Automated Control Systems JSC (JSC RASU) is a system integrator in process automation (I&C area), manufacturing and supply of electrical equipment, design and construction of electric grid facilities (Electrical Engineering area).

The key expertise and capabilities of JSC RASU are based on many years of successful experience in development, design, commissioning and support of nuclear and thermal power plant projects.

Our company provides its customers with integrated solutions and offers a full range of services on automation and power supply of facilities at all stages of their life cycle: starting from conceptual design of the facility and ending with warranty and post-warranty service for its entire service life, and decommissioning solutions followed by its subsequent modernization and/or replacement.

We offer our Customers state of the art and safe solutions of various complexity using highly reliable equipment with top-level performance and comprehensive functionality developed and manufactured by Russian engineers in Russian companies of Rosatom State Corporation.

JSC RASU is a reputable partner focused on a long-term and mutually beneficial cooperation and striving for fruitful joint business development with its customers.
OUR ADVANTAGES

- A specialized Rosatom company
- Proven expertise of a mature player
- Experience in implementation of complex large-scale projects
- Access to the leading Russian and global technologies and developments
- A single center for I&C and electrical engineering capabilities in the nuclear industry
- The unified technical policy in I&C and electrical engineering
- Support at all stages of activities
- Optimal implementation time
- Flexible financing conditions
- Test site with a total area of 3000 sq.m. for functional I&C tests

> 60 years
of successful experience in implementation of NPP I&C projects at critical facilities

> 1000
The total number of employees makes more than 1000 people

> 38 years
Average age of employees

> 20
power units equipped with our I&C systems in 14 countries

> 450
engineers and technical specialists involved in I&C and EE design and development

> 30
partners among manufacturing, design and research Russian companies
JSC RASU Project Geography in Power Sector and Oil & Gas Sector

NPP
1. Balakovo NPP
2. Kalinin NPP
3. Kola NPP
4. Novovoronezh NPP
5. Rostov NPP
6. Beloyarsk NPP
7. Leningrad NPP
8. Kursk NPP
9. Paksh NPP
10. Kudankulam NPP
11. Bushehr NPP
12. Tyanvan NPP

Balakovo (Saratov oblast)
Udomlya (Tver oblast)
Murmansk oblast
Voronezh oblast
Volgodonsk (Rostov oblast)
Zarechny (Sverdlovsk oblast)
Sosnovy Bor (Leningrad oblast)
Kurchatov (Kursk oblast)
Hungary
India, Tamil Nadu
Iran, Bushehr
China, Jiangsu
JSC RASU Project Geography in Power Sector and Oil & Gas Sector

**Oil**

1. Gas compressor stations
2. Ring oil product pipeline
3. Oil terminal
4. Oil terminal
5. Cherkasy LODS
6. Priboi LODS
7. BN LODS
8. Senno LODS
9. Volodarskaya LODS
10. Syzran LODS
11. Sokur LODS
12. Voskresenka LODS
13. Nizhnevartovsk oil refining facility

**Thermal generation**

1. Perm TPP
2. Beryozovskaya GRES-1
3. Sredneuralskaya GRES
4. Stavropolskaya GRES
5. Krasnoyarsk TPP-1
6. Krasnoyarsk TPP-2
7. Surgut-2 Power Station
8. Kalininskaya TPP-2
9. Severo-Zapadnaya TPP
10. Ivanovo TPP
11. Sakmar TPP
12. Mutnovskaya GPP
13. Volzhskaya TPP-1
14. Zmiiv TPP
15. Kyiv TPP
16. Aksu TPP
17. Kostolac TPP
18. Suizhong TPP
19. Obra TPP
20. Harta TPP
21. Yusufiyah TPP
22. Gorazal TPP

**Gas**

1. Main gas pipeline
2. Gas control station
3. Main gas pipeline
4. Main gas pipeline
5. Main gas pipeline
6. Main gas pipeline
7. Main gas pipeline
8. Preliminary gas processing terminal
9. Gas compressor stations

**IRAN**

**SERBIA**

**IRAQ**

**BELARUS**

**UKRAINE**

**BANGLADESH**

**CHINA**

**KAZAKHSTAN**

**HUNGARY**

**RUSSIA**

**INDIA**

**BULGARIA**

**KOREA**

**JAPAN**

**MONGOLIA**

**TURKEY**

**Uzbekistan**

**Vietnam**

**France**

**Singapore**
INTRODUCTION

Rusatom Automated Control Systems Company has an extensive experience in the field of automation of various nuclear power generation facilities, capabilities of integrating various equipment, systems and technologies into a unified I&C of the enterprise, which are proved by already implemented projects you can look through in a reference map of this catalog.

The Company possesses all required infrastructure and ensures the entire design lifecycle of Instrumentation and Control Systems for various industries. The Company is ready to offer the Customers the best practices in the area of developing the automated systems with different levels of complexity, using highly reliable, efficient and robust equipment, developed and manufactured by Russian engineers at enterprises of Rosatom State Corporation.

Procedures for all development stages are defined and executed in accordance with national standards, in particular, GOST 34.601-90, GOST 34.602-90, GOST 34.201-89.

V-MODEL OF STANDARD I&C LIFECYCLE

1. Instrumentation and Control System Design
2. Concept of I&C system
3. Functional design
4. Technical design
5. Technical and functional design review
6. Equipment selection
7. Commissioning and testing
7a. Engineering review
In general, the design procedure for automated system is based on a state-of-the-art V-model of development lifecycle, describing a standard I&C lifecycle.

The peculiarity of this model against the others is that it is focused on actions aimed at verification, validation and certification of the product during development at early stages. It shows, that the product testing is discussed and planned at early stages of development lifecycle. These verification, validation and certification processes are indicated by lines 5a, 6a and 7a between correspondent stages of V-model.

**DESCRIPTION OF V-MODEL DESIGN STAGES**

1. **Design Assignment. Upper Level Requirements**

At the initial development stage the facility is examined by specialists, visiting the Customer. While performing an examination the specialists collect and analyze data on organization, production structure and operation of the automation object. A regulatory base on the examined processes, organizational and production structure etc. can be the source of the data.

Analysis of automated systems, already operating at the automation object, is also performed during the examination. At this stage it is necessary to define a degree of impact and integration of developed I&C system into existing systems.

Based on obtained data the main functional and user requirements for I&C system are specified.

2. **Automation System Design,**
   including the following stages:

   I. **Development of I&C Architecture**

   Specialists of JSC RASU Design Division shall develop architecture of the automated system and I&C conceptual design based on pre-design examination and in accordance with existing requirements. To achieve this, the requirements of the Contract for facility construction and requirements of standards and regulatory documents shall be taken into account to elaborate architecture, meeting all criteria of the Customer. Therefore several conceptual solutions can be developed to choose from. This documentation is used to justify licensing of the facility.

   II. **Development of Requirements Specification (RS)**

   Before designing the I&C system, JSC RASU specialists review the terms of the Contract. Based on requirements of the regulatory documents and international standards the Requirements Specification for Instrumentation & Control System is prepared in accordance with requirements of GOST 34.602. A detailed Requirements Specification for I&C system is prepared for foreign customers (or if required by the terms of the Contract).

   This stage is a key step, as it shall define requirements and procedure for development, elaboration and modernization of the system. Tests and system acceptance into operation shall be conducted in accordance with this document.

   III. **Development of Subsystem Requirements Specification (SRS)**

   Subsystem Requirements Specification shall be developed to further elaborate the architecture on the level of I&C subsystem and to provide detailed requirements for I&C subsystems. The information of these documents can be also used to carry out procurement with participation of equipment and subsystem suppliers.
IV. Development of Basic Design
In accordance with requirements of GOST 34.601 the JSC RASU specialists shall develop the basic design documents for instrumentation and control system. This documentation provides detailed description of adopted technical solutions as well as hardware and software used in the system. Then the developed materials are used to obtain a facility operation license.

The following technical documentation is developed at these stages:

- Explanatory note for basic (conceptual) design.
- Organizational structure.
- Hardware package (HWP) diagram.
- Functional structure.
- Automation diagram.
- List of I/O signals and I/O data.
- Description of automated functions etc.

A detailed list of documentation developed at all stages of automated system development is given in GOST 34.201-89. It is often unnecessary to prepare a full package of basic and conceptual design documents, described in GOST 34 standards. So, the minimum package of the documents shall be coordinated by the Customer and included in Requirements Specification for I&C system.

V. Development of Manufacturer Specification
The Manufacturer Specification for production of hardware & software package and for development of detailed design documents is based on developed Requirements Specification.

Development and Release of Detailed Design Documents

At this stage the detailed design documents, containing all the required and sufficient data are developed to ensure commissioning and operation of the I&C system and maintenance of operational parameters (quality) of the automation system in accordance with applicable design solutions and its execution, coordination and approval. Types of documents according to GOST 34.201.

Development or customization of the programs are performed at this stage, i.e. the programs and software tools are developed, the purchased software tools are selected, customized and(or) linked, and software documentation is developed in accordance with GOST 19.101.

This stage is often referred to as a stage for development of hardware, software and software & hardware tools of I&C subsystems.

4 I&C System Manufacturing
Software & hardware tools for automation set are produced at this stage in accordance with the following documents: Basic design, manufacturer specifications, structural and electrical diagrams etc.

5 Off-Line I&C Subsystem Tests
Acceptance (qualification) tests are performed at this stage at manufacturer’s plant. According to results of these tests the technical parameters of the products (subsystems) are verified for compliance with requirements, specified at stages 2.5 and 3. The tests are performed in accordance with programs of acceptance (qualification) tests on special test benches or in special certified laboratories in accordance with state and international standards.

Verification of algorithms, static and dynamic tests of application configuration are also performed at this stage.

Functional tests are performed at a special test site in the end of the stage. All defects are detected and removed to prevent their occurrence at the next stage 6.
Supply to Facility. Commissioning Activities

At this stage the Maintenance Equipment Set is supplied to the automation facility and commissioning activities are performed for I&C systems (offline adjustment of hardware & software tools, uploading date to the database and checking its maintenance system, adjusting all system tools). After commissioning is completed, the I&C is verified for compliance with Requirements Specification, Subsystem Requirements Specification, basic design and manufacturer specification.

Integration of Subsystems into Unified I&C. Putting into Commercial Operation

It is a final stage of development and implementation of I&C as a unified control system of industrial enterprise. At this stage all subsystems are integrated into unified I&C and I&C is integrated into upper level.

At the final stage integrated tests are performed, which include:

a) Operability tests of I&C system and checking compliance with the requirements specification in accordance with Preliminary Test Program and Procedure;

b) Removal of defects and introduction of changes into the documents on I&C, including operating documentation, in accordance with the test report;

c) Execution of I&C trial operation certificate.

The system is put into trial operation during which information on system operability is collected and processed, I&C trial operation results are analyzed, and if required I&C software is modified and I&C hardware is adjusted.

After the trial operation is completed the report on putting the system into commercial operation is executed.

At all stages of I&C development and implementation our qualified specialists will provide support of Instrumentation and Control System development and implementation to ensure pre-commissioning and commissioning of the entire system in due time.

I&C METROLOGICAL SUPPORT

JSC RASU renders services on metrological support at all I&C lifecycle stages.

- The specialists of JSC RASU develop documentation/sections of contract, design documentation on metrological support, drafts of procedures for primary and periodic calibration, drafts of procedures for measurement.

- At I&C commissioning and operation stages JSC RASU arranges activities in accordance with the tests procedure aimed at type approval, primary (periodic) calibration, including preparation and coordination of the required documents package, supervise activities until certificates are issued.

- At all life cycle stages JSC RASU performs activities on metrological evaluation including obligatory one in accordance with accreditation scope and accreditation certificate.

- Registration number of accreditation certificate in the area of assuring measurements uniformity to perform activities and rendering services on metrological evaluation RA.RU.312425 as of 22.02.2018
## PRODUCT SEGMENTATION MATRIX

<table>
<thead>
<tr>
<th>Product</th>
<th>Nuclear sector</th>
<th>Oil sector</th>
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<tbody>
<tr>
<td></td>
<td>NPP</td>
<td>NF</td>
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<tr>
<td><strong>SCADA systems</strong></td>
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<td>PORTAL SW</td>
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<td>CROSS SW</td>
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<td>SCADA ATOM-NN PC</td>
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<td><strong>Software and Hardware Tools of Software and Hardware Package</strong></td>
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<td>TPTS-NT SHT</td>
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<td>TPTS-SB SHT</td>
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<td>KIUM</td>
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<td>Electrical I&amp;C SHT</td>
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<td>IOPRS</td>
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<td>OC HW</td>
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<td><strong>I&amp;C Solutions for Nuclear Facilities</strong></td>
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<td><strong>I&amp;C Solutions for Oil &amp; Gas Industry</strong></td>
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<td>MES system for gas production enterprise</td>
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<td>Software and hardware tools for telemetry and automation</td>
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<td>Abnormal Events Detection System</td>
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<td>Automated Forced Draft Fan Control System</td>
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<td>Automated Gas-Compressor Plant Control System</td>
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<td>Compressor station Automated Control System</td>
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<td>Gas-Well Bunch I&amp;C System</td>
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<td>Automated Gas Odorizing System</td>
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<td>Automated Protection System</td>
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* For use in safety monitoring and control systems

**SHT** – Software & Hardware Tools  
**KIUM** – Universal Multi-functional Measuring Controller  
**Electrical I&C** – Electrical Equipment Instrumentation and Control  
**DA SHT** – Data Acquisition Software & Hardware Tools  
**TM SHT** – Telemetry Software & Hardware Tools  
**MES for gas production enterprise** – Manufacturing Execution System for gas production enterprise
<table>
<thead>
<tr>
<th>Transport</th>
<th>Extraction and processing</th>
<th>Conventional power</th>
<th>Page in the catalog</th>
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<tbody>
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</tbody>
</table>

Compressor station ACS – Compressor Station Automated Control System
Gas-Well Bunch I&C System – Instrumentation and Control System for Gas-Well Bunch

APS – Automatic Protection System
OC HW – Operator Control Hardware
IOPRS – Important Operation Parameters Registration System
PORTAL
Software Package

PORTAL is a software package aimed at performing the following functions of the upper level system: real-time data collection from remote points (objects), their processing and analysis, displaying to the operator, archiving and control of the remote objects.

STRUCTURE OF SOFTWARE PACKAGE

**Run-time system** is a basic platform ensuring implementation of the main functional features of the software package.

**Graphic editor** is a module used for convenient and efficient development of graphical user interface in process control systems.

**Database configurator** is the software used for database maintenance. DB configurator performs the main functions related to data input, processing and storage.
**FUNCTIONAL FEATURES**

- Collection, processing and exchanging data on controlled process parameters with low level systems (LLS) software;
- Calculation of values of the design variables;
- Graphical representation of the process, received and archived data in a user-friendly format;
- Announcing the detected accidents related to controlled process and software & hardware tools operation and recording actions of personnel during accidents;
- Equipment remote control;
- Data access control;
- Monitoring the availability of system nodes, the state of the nodes, the status of current tasks and processes;
- Recording events related to controlled process and actions of the personnel, responsible for system operation and maintenance;
- System operation control, functional and group control;
- Transmitting data to external systems;
- Database generation and maintenance

**KEY FEATURES**

- High scalability, dynamic addition of workstations
- Ensuring cybersecurity at all stages of the system lifecycle
- Cross-platform software
- Powerful data visualization device: graphs, histograms, trends, diagrams, slices etc.
- Customizable reporting environment (on demand/schedule/event)
- Special software for database generation and maintenance
- Support of at least 7 different alarm levels
- Powerful graphic editor with a built-in palette of components to create own elements
- Performing the entire scope of activities using one’s own resources from development to supply, implementation, adjustment and training
- Support of multi-display workstations
PORTAL
Software Package

Displaying data in graphs/histograms

Displaying data in tables

Alarm

Working with databases
ARCHITECTURE OF SOFTWARE PACKAGE

**CLIENT**
- Data display manager
- Graphic editor

**SERVER**
- Real time database
- Archiver
- Archive

**Visualization run-time system**
- Formats

**Real time database (copy)**
- Database management program
- Reception replicator
- Transmission replicator

**Real time database**
- Synchronization of DB and files
- Data processing manager
- Data exchange driver
- Data Communication Subsystem

**Data Communication Subsystem**
- Real time database (copy)
- Run-time database (copy)
TECHNICAL FEATURES

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum number of supported measurement points</td>
<td>750,000 points</td>
</tr>
<tr>
<td>Maximum rate of data reception and processing</td>
<td>50,000 signals per second</td>
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<tr>
<td>Rate of data transmission to external systems</td>
<td>200,000 signals per second</td>
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<tr>
<td>Time between signal reception and output to video format</td>
<td>&lt; 1 second</td>
</tr>
<tr>
<td>Maximum number of workstations connected at the same time</td>
<td>255</td>
</tr>
<tr>
<td>Supported data exchange protocols</td>
<td>DTS (UDP/TCP), IEC 60870-5-104, Modbus TCP/RTU, OPC, SNMP, HTTP (XML/HTML), ODBC, OLE DB</td>
</tr>
<tr>
<td>Interface language</td>
<td>Russian/English</td>
</tr>
<tr>
<td>Supported operating systems</td>
<td>MS Windows, SUSE Linux, Astra Linux, ALTLinux, OpenVMS, ROSA Kobalt</td>
</tr>
<tr>
<td>DBMS</td>
<td>Proprietary DB, SQLite, ORACLE, ODBC, OLE DB</td>
</tr>
</tbody>
</table>

USE WITHIN THE SYSTEMS

- Upper Unit Level System (UULS)
- Upper Plant Level System (UPLS)
- Automated Radiation Monitoring System (ARMS);
- Water Treatment Instrumentation and Control System (WT I&C)
- Electrical Equipment Instrumentation and Control (EE I&C);
- Chemical Water Treatment I&C (CWT I&C);
- Special Water Treatment I&C (SWT I&C);
- Special Building Instrumentation and Control System (Special Building I&C).

REFERENCE

- Kalinin NPP;
- Rostov NPP;
- Novovoronezh NPP;
- Kola NPP;
- Beloyarsk NPP;
- Leningrad NPP;
- Belarusian NPP;

MANUFACTURER

JSC Rusatom Automated Control Systems
rasu.ru
CROSS
Software Package

Complex of Distributed Tools for Network Processing (CROSS) – software platform intended for development of SCADA-systems used at Nuclear Power plants and nuclear facilities as well.

STRUCTURE OF SOFTWARE PACKAGE

- **Software tools**
- **Interface SW**
- **Auxiliary SW**
- **Object communication device SW**
- **Calculation server SW**
- **Display function SW**
- **Reports generation and printing SW**
- **Archiving module**
FUNCTIONAL FEATURES

- Reception, preliminary processing, reliability check and transmission of data on the process parameters;
- Organization of calculations and performance of online and offline calculation of the process parameters;
- Transmission of data and commands to the lower level Instrumentation and Control Systems;
- Display of measured and calculated parameters;
- Data exchange with external systems;
- Alarm of deviations of the process parameter values from the permitted setpoints;
- Registration, archiving, storage of the process information;
- Automated generation and printing of hard copies of the system output documents;
- Online diagnostics of the main functions performance and equipment state.

KEY FEATURES

- Modular structure of SW
- Self-diagnostics and integrity monitoring of SW tools, checks at each stage of data processing
- Resistance to load increase in emergency and transient modes
- Constant redundancy, including backup of the main nodes and components of network infrastructure
- The number of the process parameters being processed and the archive capacity are limited by technical features of the applied equipment
- Possibility of building secured systems of 1B and 1V class
- Powerful graphic editor VDesk allowing to redraw objects, to use vector graphic and to generate formats of different types (mimic diagrams, cartograms, panels)
- Deterministic performance of inter-task and network exchange functions
- Continuous monitoring and alarm in case of failure to meet the requirements of information security
**Alarm Display**

**Reports management**

**Real-time diagnostics**
TECHNICAL FEATURES

<table>
<thead>
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<th>Characteristics</th>
<th>Value</th>
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<tbody>
<tr>
<td>Maximum number of supported measurement points</td>
<td>500000 points</td>
</tr>
<tr>
<td>Maximum rate of data reception and processing</td>
<td>40000 parameters with the rate of 60 msec</td>
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<tr>
<td>Data archive capacity</td>
<td>Short-term (10 days) – 10000 parameters</td>
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<td>Long-term (3 months) – 1000 parameters</td>
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<tr>
<td>Node recovery time</td>
<td>30 minutes</td>
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<tr>
<td>Time between signal reception and output to video format</td>
<td>0.5 second</td>
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<tr>
<td>Supported data exchange protocols</td>
<td>Modbus RTU/TCP, SNMP, OPC</td>
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<tr>
<td>Interface language</td>
<td>Russian</td>
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<tr>
<td>Supported operating systems</td>
<td>Linux (RedHat, Debian) , MCBC 3.0, Astra Linux SE, QNX</td>
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<tr>
<td>DBMS</td>
<td>Propriety RTDB, interface modules with PostgreSQL, MariaDB (MySQL)</td>
</tr>
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USE WITHIN THE SYSTEMS

- SHP for industrial reactor plants;
- Upper Unit Level Systems of Nuclear Power Plants;
- Automation systems of separation plants.

REFERENCE

Research reactors:
- IVV type — NIKIET branch (IRM), Libya, Vietnam;
- IR and IRT type — NIKIET, Sevastopol, Riga, Minsk, Tomsk;
- VVR type — Gatchina, Obninsk;
- Special — MIR and SM-3 (NIIAR), IBR-2 (Dubna), IVG — land-based nuclear jet engine (Kazakhstan), PIK (Gatchina), MBIR (NIIAR).

Nuclear Power Plants:
- Beloyarsk NPP;
- Kursk NPP;
- Leningrad NPP;
- Smolensk NPP.

Other scope of application:
- AMCS of “LF-2” facility of PO Mayak

MANUFACTURER

JSC NIKIET named after N.A. Dollezhal
nikiet.ru
SCADA ATOM-NN software package is aimed at creating the software for collection, processing and archiving of data from field devices, at implementing algorithms, transmitting control actions and providing a human-machine interface for I&C equipment operators at nuclear facilities, in fuel & power sector, in automation systems for physical experiments, and at other complex process facilities.

STRUCTURE OF SOFTWARE PACKAGE

**Programming environment** is aimed at configuring the SCADA-system and includes the following components:
- Graphic editor;
- Database editor;
- Data processing script editor;
- Component for automatic update and configuration version control.

**Runtime environment** environment is aimed at performing the general system functions, integration functions, data processing & storage functions, visualization functions and command transmission functions.
FUNCTIONAL FEATURES

- Data processing;
- Data interchange with field I&C subsystems;
- Data archiving;
- Events logging;
- Data interchange with external programs;
- Information display;
- Registration of control commands;
- Editing the signals database;
- Editing the formats;
- Editing the data processing scripts;
- Automatic configuration update;
- Diagnostics of software and hardware tools;
- Self-diagnostics;
- Protection against unauthorized access and differentiation of user rights.

KEY FEATURES

- 100% open source, including libraries
- Creating virtual automated control systems
- Specialized data display tools for nuclear power sector and heat & power sector
- Support of “hot” redundancy of servers and channels
- Built-in graphic editor and data processing script editor
- Proprietary human-machine interface
- Component-based structure which can be used in SHP of various configurations
- Differentiation according to access level
- Diagnostics support of software & hardware tools and software
- Support of redundant and distributed structures and implementation of a thin client
- Proprietary run-time database
- Building multi-level hierarchical distributed systems
TECHNICAL FEATURES

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum number of supported measurement points</td>
<td>250,000 points</td>
</tr>
<tr>
<td>Maximum rate of data reception and processing</td>
<td>10,000 signals per second</td>
</tr>
<tr>
<td>Time between signal reception and output to video format</td>
<td>1 second</td>
</tr>
<tr>
<td>Supported data exchange protocols</td>
<td>Modbus TCP, SNMP, OPC UA, IEC 61850, IEC 60870-5-104</td>
</tr>
<tr>
<td>Interface language</td>
<td>Russian/English</td>
</tr>
<tr>
<td>Supported operating systems</td>
<td>Linux OS (Astra Linux SE, SUSE etc.)</td>
</tr>
<tr>
<td>DBMS</td>
<td>PostgreSQL</td>
</tr>
</tbody>
</table>

USE WITHIN THE SYSTEMS

• I&C for gas transportation facilities
• I&C for oil refining facilities

REFERENCE

• I&C for the South-Balyk gas compressor station
• I&C for the UPN-2 oil refining unit of Nizhnevartovsk oil refinery plant

MANUFACTURER

Branch of FSUE RFNC-VNIIEF
Research Institute for Instrument Systems named after Y.E. Sedakov
nniis.nnov.ru
**Purpose**

TPTS-NT Software & Hardware Tools are software and hardware complex of automation tools designed to build automated process control systems (I&C) of various production types. TPTS-NT is the basic platform for the constructing an I&C and it includes a set of hardware and software tools for control and monitoring of a process facility, system interface with peripheral devices, providing the system with the necessary power supply level, as well as engineering, configuration and diagnostics tools.

**Main Functions**

- Acquisition and processing signals from field-level sensors for the process and auxiliary equipment;
- Implementation of algorithms calculating process parameters;
- Data transmission to the upper I&C level to present data to an operator;
- Implementing control functions for process and auxiliary equipment in an automatic mode and upon an operator’s commands coming from the upper level;
- Implementing functions of process safeguards and interlocks;
- Data exchange with other software/hardware packages;
- Diagnostics of hardware with local malfunction alarm and transmission of data with diagnostic results to the upper level;
- System engineering and configuration.
KEY FEATURES

- Unique Russian system solutions protected by patents of the Russian Federation
- Completely Russian production: from printed circuit boards to a cabinet design
- Modern component framework meeting the highest requirements for performance and reliability
- The possibility of building both centralized and distributed control systems
- Modular design of the architectural solution, flexibility and scalability of the configuration
- The response time of the system is within 10...100 ms
- Communication with smart devices via digital protocols
- Fully and partially redundant or non-redundant structure
- Continuous automatic self-diagnostics of system rack components
- Service life is at least 30 years. Operation mode is 24/7
- Time of replacement of a standard replaceable item shall not exceed 60 min
- End-to-end CAD tools of process control algorithms, application software and assembly documentation – GET-R1
- Simulators of actual sensors and actuators for modelling real situations
- Time resolution of input discrete signal sequence is 1 ms
- Cybersecurity: original firmware, no operating systems, proprietary formats of the network telegrams

APPLICATION AREAS

Power generation facilities
- Nuclear Power Plants
- Thermal power plants and heat-and-power plants
- Hydro power plants

Oil and gas industry
- Oil & Gas production
- Oil refineries and petroleum chemical plants
TPTS-NT PLATFORM SCOPE

INSTRUMENT RACK (IR)
STAND-ALONE INSTRUMENT RACK (SAIR)
Instrument racks and stand-alone instrument racks are designed to perform the main process control and monitoring functions as well as data communication and diagnostics functions for the overall system. Stand-alone racks are designed for arrangement of remote (local) control stations with remote control equipment and can be equipped with a touchscreen.

POWER SUPPLY RACK (PSR)
A power supply rack is used to provide the entire TPTS-NT system with a stable power supply of 220 V DC and/or AC:
- DC voltage of 24.7 V (24V) nominal value;
- DC voltage of 220 V nominal value;
- DC voltage with nominal value from 50 V to 150 V.

COUPLING RACK (CR)
A coupling rack is designed to connect TPTS instrument racks with peripheral devices (low-voltage switchgear, instrument transducers and sensors, etc.) and ensures the following:
- Transition from one type of cable to another;
- Distribution of cores of one external cable on individual cables connected to different instrument racks;
- Galvanic isolation of IR circuits and connected circuits of peripheral devices;
- Additional current loading;
- Increase of current through contacts of external devices of electrical signals from one type to another one.
# TPTS-NT TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>• Redundant/partially redundant in the hot standby mode at the level of modules and data exchange buses;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Non-redundant.</td>
<td></td>
</tr>
<tr>
<td><strong>Hardware configuration</strong></td>
<td>• Connecting I/O station to one AP</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>• I/O station is installed in one IR rack</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>• I/O station is installed in one stand-alone instrument racks SAIR without a screen</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>• I/O station is installed in one stand-alone instrument racks SAIR with a touch screen</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>• Modules for connection with processor are installed in one I/O station</td>
<td>16</td>
</tr>
<tr>
<td><strong>Software Configure</strong></td>
<td>• Up to 256 individual control functions;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Up to 64 functions of automatic control;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Up to 32 units of step programs (with assignment of up to 99 steps for each program);</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Up to 256 control units;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Up to 8 channels of group control</td>
<td></td>
</tr>
<tr>
<td><strong>Dynamic (time) characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Process Interface Modules (PIM)</strong></td>
<td>• Unified current signal input module, not more than</td>
<td>10 ms</td>
</tr>
<tr>
<td></td>
<td>• Unified current signal I/O module, not more than</td>
<td>20 ms</td>
</tr>
<tr>
<td></td>
<td>• Discrete signal I/O Module, not more than</td>
<td>1 ms</td>
</tr>
<tr>
<td></td>
<td>• Pulse signal input module (duration at least 3 microseconds, 0,1-150000 Hz)</td>
<td>1 ms</td>
</tr>
<tr>
<td></td>
<td>• Individual Control Module, not more</td>
<td>2 ms</td>
</tr>
<tr>
<td></td>
<td>• The control module, not more than</td>
<td>5 ms</td>
</tr>
<tr>
<td></td>
<td>• The input module for signals of thermal electric transducers and resistant temperature detectors as well as unified current and voltage signals:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• For unified current signals</td>
<td>10 ms</td>
</tr>
<tr>
<td></td>
<td>• For unified voltage signals</td>
<td>10 ms</td>
</tr>
<tr>
<td></td>
<td>• For signals of thermocouples and thermal electric transducers</td>
<td>150 ms</td>
</tr>
<tr>
<td><strong>Automation Processor (AP)</strong></td>
<td>• The cycle time of application algorithms (depending on the application software scope)</td>
<td>50/-100 ms</td>
</tr>
<tr>
<td><strong>Communications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EN Bus</strong></td>
<td>• The main distribution bus, data exchange between AP and AC, TPTS-SB, topology</td>
<td>Ring</td>
</tr>
<tr>
<td></td>
<td>• Fast Industrial Ethernet Interface</td>
<td>100 Mbit/s;</td>
</tr>
<tr>
<td></td>
<td>• Number of connected devices</td>
<td>up to 800</td>
</tr>
<tr>
<td></td>
<td>• Transmission medium</td>
<td>Fiber optic</td>
</tr>
<tr>
<td></td>
<td>• Length of fiber optic cable:</td>
<td>up to 3 km</td>
</tr>
<tr>
<td></td>
<td>• multi-mode fiber</td>
<td>up to 80 km</td>
</tr>
<tr>
<td></td>
<td>• single-mode fiber</td>
<td></td>
</tr>
<tr>
<td><strong>ENL Bus</strong></td>
<td>• The radial bus, data exchange between AP and IOS, topology</td>
<td>Star connection</td>
</tr>
<tr>
<td></td>
<td>• Fast Industrial Ethernet Interface</td>
<td>100 Mbit/s</td>
</tr>
<tr>
<td></td>
<td>• The number of devices connected (IM) to a channel (totally two channels)</td>
<td>up to 16</td>
</tr>
<tr>
<td></td>
<td>• Transmission medium</td>
<td>Twisted pair</td>
</tr>
<tr>
<td></td>
<td>• Length of cable</td>
<td>up to 100 m</td>
</tr>
<tr>
<td><strong>Smart Sensors</strong></td>
<td>• Module of communication via RS485 Interface, communication protocol</td>
<td>MODBUS</td>
</tr>
<tr>
<td></td>
<td>• Module of communication via Ethernet Interface, communication protocol</td>
<td>IEC61850</td>
</tr>
<tr>
<td><strong>External factors, design parameters, reliability</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ENVIRONMENTAL FACTORS</strong></td>
<td>• Operating temperature range (boreal climate UKHL4 according to GOST 15150-69)</td>
<td>from +1°C to +40°C</td>
</tr>
<tr>
<td></td>
<td>• Seismic resistance by MSK64 scale according to GOST 30546.1 (35 m above the ground level)</td>
<td>8 points</td>
</tr>
<tr>
<td></td>
<td>• Mechanical design group according to GOST 30631-99</td>
<td>M42</td>
</tr>
<tr>
<td></td>
<td>• EMC according to GOST 32137, equipment group/performance quality criteria</td>
<td>IV / A</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>• Dimensions of one rack, LxWxH, mm</td>
<td>1 000 x 400 x 2 200</td>
</tr>
<tr>
<td></td>
<td>• Weight, not more:</td>
<td>350 kg</td>
</tr>
<tr>
<td></td>
<td>• Protection according to GOST 14254-96</td>
<td>IP20</td>
</tr>
<tr>
<td><strong>Safety Class</strong></td>
<td>• According to NP-001</td>
<td>3N</td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
<td>• The mean time between failures in implementation of a process safeguard function, hours</td>
<td>0.253 x 10^6</td>
</tr>
<tr>
<td></td>
<td>• The mean time between failures in implementation of an automatic control function, hours</td>
<td>0.279 x 10^6</td>
</tr>
</tbody>
</table>
### INSTRUMENT RACK (IR)

![Instrument Rack Diagram](image)

#### THE SCOPE OF INSTRUMENT RACKS AND STAND-ALONE INSTRUMENT RACKS, DESCRIPTION OF FUNCTIONS

<table>
<thead>
<tr>
<th>Name</th>
<th>Purpose</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Cabinet rack</strong></td>
<td>A welded steel structure with a frame fixed on it designed to accommodate 19-inch equipment (crates with different functional modules).</td>
<td>1</td>
</tr>
<tr>
<td><strong>2 Automation Processor (AP) includes the following:</strong></td>
<td>Made as a 3U crate it implements the algorithms for calculating process parameters, functions of process safeguards and interlocks and automatic control, as well as data communication functions for input/output stations (IOS) and other AP and diagnostic functions. May ensure operation of up to 16 input-output racks</td>
<td>1</td>
</tr>
<tr>
<td>ENC Communication Module</td>
<td>Data communication functions via the EN bus</td>
<td>2**</td>
</tr>
<tr>
<td>FNC Functional Module</td>
<td>The main algorithms of process control and interaction with IOS via the ENL bus</td>
<td>2**</td>
</tr>
<tr>
<td>Power Supply Connection and Indication Module (PSCIM)</td>
<td>Ensuring power supply of 24V to all AP modules; Alarm and indication of AP modules malfunction</td>
<td>2**</td>
</tr>
<tr>
<td>Communication module on RS485 (RSL) interface</td>
<td>Data communication with smart devices on RS485 interface with MODBUS RTU and MODBUS ASCII protocols able to be connected to one module. Connection with the FNC module shall be ensured via the ENL bus</td>
<td>6**/8***</td>
</tr>
<tr>
<td><strong>2 Automation Controller (AC) includes the following:</strong></td>
<td>It is designed to solve automation tasks with a small number of monitored parameters and territorial distribution of controlled objects. Made as a 3U crate it unites functions of control and communication with an object.</td>
<td>1</td>
</tr>
<tr>
<td>Automation Processor Module (APM)</td>
<td>It implements the functions for calculating process parameters, control, diagnostics and data exchange with other AP/AC</td>
<td>2**</td>
</tr>
<tr>
<td>Discrete Signal I/O Module</td>
<td>Input/output of discreet signals with diagnostics of connection circuits and monitoring output signals values</td>
<td>16*****</td>
</tr>
<tr>
<td>IEC61850 (SP-E) Interface Module</td>
<td>Data communication with smart devices on the Ethernet interface with IEC1850 protocol able to be connected to up to 12 devices to one module.</td>
<td>16*****</td>
</tr>
<tr>
<td><strong>3 Input-output Station (IOS), includes the following:</strong></td>
<td>Made as a 6U crate it implements acquisition and preliminary processing of input signals from process sensors, issues control signals to actuators and ensures data communication with AP via the ENL bus</td>
<td>Note****</td>
</tr>
</tbody>
</table>
## The Scope of Instrument Racks IR and Stand-Alone Instrument Racks SAIR, Description of Functions

<table>
<thead>
<tr>
<th>Name</th>
<th>Purpose</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Module (IM)</td>
<td>Data communication between IOS and AP/AC via the ENL bus</td>
<td>2**</td>
</tr>
<tr>
<td>Process Link Module (PLM)</td>
<td>Reception and preliminary processing of input signals, transmission of output signals and control commands. The list includes 8 different I/O modules.</td>
<td>16</td>
</tr>
<tr>
<td>Rack Monitoring Module</td>
<td>Acquisition of diagnostic signals from components of instrument racks, power supply racks and coupling racks as well as information issuance to the AP</td>
<td>1</td>
</tr>
<tr>
<td>Interface Gateway Unit (IGU)</td>
<td>Made as a 3U crate it ensures TPTS-NT information exchange with ULS</td>
<td>1</td>
</tr>
<tr>
<td>Network Switches</td>
<td>They are intended for arrangement of data exchange among various modules, crates and instrument racks via the EN and ENL buses</td>
<td></td>
</tr>
<tr>
<td>Connectors</td>
<td>A connector set for external communication cables</td>
<td></td>
</tr>
<tr>
<td>Power Supply Unit</td>
<td>Conversion of external supply voltage of 220V DC/AC into voltage of 24V DC to supply modules of a stand-alone instrument rack</td>
<td>1</td>
</tr>
<tr>
<td>Touchscreen Control Unit (TCU)</td>
<td>PA interfacing with a touchscreen in the scope of a stand-alone instrument rack</td>
<td>1</td>
</tr>
<tr>
<td>Touchscreen</td>
<td>Visualization and local control</td>
<td>1</td>
</tr>
</tbody>
</table>

Note:  
* Configuration with installation of an automation processor and automation controller in one rack is possible.  
** The quantity is defined taking redundancy into account.  
*** Without installation of a AP functional and communication modules.  
**** For IR – 4 stations, SAIR with no screen – 3 stations, SAIR with a screen – 2 station.  
***** Maximum quantity of the same-named units being installed.
Software & Hardware Tools of Normal Operation Systems
TPTS-NT

TPTS-NT PLATFORM ARCHITECTURE

IS

ULS

IR1

SW

SW

IGU

AP

RSL

RSL

ENC

FMC

RSL

RSL

ENC

RSL

IRn

SW

SW

IGU

AP

RSL

RSL

ENC

FMC

RSL

RSL

SWL

SWL

IOS1

IM1

IM2

IM1

IM2

PLM1

PLM2

PLM3

... PLM16

PLM1

PLM2

PLM3

... PLM16

Sensors, process parameters transducers, actuators
Software & Hardware Tools of Normal Operation Systems

**TPTS-NT**

Output to the upper level bus
EN bus backbone (fiber optic cable)
EN bus customer item (shielded twisted pair)
ENL bus (shielded twisted pair)
Input/Output bus (on across-board)
Connections via S485 (MODBUS) interface
Wire connection with sensors

- ENC – communication module
- FMC – functional module
- RSL – RS485 data exchange module
- SW – EN bus switch
- SWL – ENL bus switch
- ULS – Upper Level System
- ES – Engineering Station
- DS – Diagnostic Station
- TCU – Touchscreen Control Unit
- IGU – Interfacing Gateway Unit
- IM – Interface Module
- AP – Automation Processor
- IR – Instrument Rack
- SAIR – Stand-alone Instrument Rack
- IOS – Input Output Station
- PLM – Process Link Module
USE WITHIN SYSTEM SCOPE

Power generation facilities
- Instrumentation and Control Systems for thermal and nuclear power plants (regarding normal operation) including the Turbine Control and Protection System Electrical Equipment (TCS EE, TPS EE); I&C System for Turbine Generator Auxiliaries TG I&C, etc.
- Safety Related Normal Operation Instrumentation and Control Systems including the initiating part of preventive protection (PP IP), etc.
- Automatic control systems for gas turbine plants, steam turbine plants, TPP and CHPP common plant equipment
- Instrumentation and Control System for the HEP hydropower unit, etc.

Oil and gas facilities
- Control systems for gas turbine pump stations at oil fields (GTPS)
- Control systems of unified oil processing units (UOPU) and crude oil distillation plants (CODP)
- Control systems of cluster and booster pump stations (CPS, BPS), compressor station (CS), etc.

REFERENCE PROJECTS
- Kudankulam NPP, India
- Suijun Power Plant (China)
- Novovoronezh NPP-2
- Leningrad NPP-2
- Kalinin NPP-2
- Rostov NPP-2
- Krasnoyarsk Thermal Power Plant-1,2
- North-West Thermal Power Plant
- Permskaya Thermal Power Plant
- Ivanovskaya GRES Thermal Power Plant
- South-Balyk gas field, RN Yuganskneftegaz
- Nizhnevartovsk oil refining station, etc.
(A total of more than 40 power and other industrial facilities)

MANUFACTURER
FSUE All-Russian Research Institute of Automatics named after N.L. Dukhov (FSUE VNIIA)
vniia.ru
Software and Hardware Tools of Safety I&C Systems

**TPTS-SB**

**PURPOSE**

TPTS-SB software & hardware tools refer to a software & hardware set of automation tools aimed mainly at building the Safety I&C systems of the nuclear power plant I&C (NPP I&C).

This package can also be used to build I&C for other industries, where control functions of Normal Operation Instrumentation & Control System (NO I&C) shall be separated from functions of Safety Systems (SS).

TPTS-SB is an evolution of TPTS-NT platform. TPTS-SB is compatible with TPTS-NT and includes a set of hardware and software for monitoring and control, and tools for engineering, configuration and diagnostics.

**MAIN FUNCTIONS**

- Measurement of process parameters, logical processing of the measured values and emergency detection;
- Implementation of control algorithms by protective actions generating initiating signals for actuation of the process safety systems and emergency protection systems;
- In case of accident individual control of SS actuators according to automatic and remote commands of SS and NO systems with priority given to SS commands;
- In case of no accident – control of actuators according to automatic commands of NO system and remote commands of the operator;
- Transmission of information to the upper I&C level to the operator for displaying data on controlled equipment state, values and facts of exceeding setpoints;
- Transmitting information on process parameters to NO systems and other I&C subsystems;
- Diagnostics of hardware with local local alarm on malfunctions and transfer of data with diagnostic results to the upper level;
- System engineering and configuring.
KEY FEATURES

- Unique Russian system solutions protected by patents of the Russian Federation
- Completely Russian production: from printed circuit boards to a cabinet design
- Modern component framework meeting highest requirements for performance and reliability
- Resistance to single failure due to multi-channel structure of control systems (up to 4 channels)
- Resistance to common cause failures due to diversity*
- Complete information compatibility and integration with the TPTS-NT platform
- Cybersecurity: No operating systems; parameterization of data exchange functions
- Minimum maintenance: Every two years without outage
- Continuous automatic self-diagnostics of system rack components
- Service life is at least 30 years. Operation mode is 24/7. Time of replacement of a standard replaceable item shall not exceed 60 min
- End-to-end CAD tools of process control algorithms, application software and assembly documentation – GET-R1
- Simulators of actual sensors and actuators for modelling real situations

* Software & Hardware Complex including two sets of software & hardware tools (diversity A and diversity B), based on different hardware and software (e.g. FPGA and micro-controller).

APPLICATION AREAS

Power generation facilities
- Nuclear power plants
- Thermal power plants
- Hydro power plants
SCOPE OF TPTS-SB PLATFORM

AUTOMATION INSTRUMENT RACK
Automation instrument rack is aimed at performing the following computational functions of the safety systems: automatic detection of emergency situation, generation of initiating signals of safeguards to initiate safety and emergency protection systems, providing alarm for operator control hardware and performing communication tasks with related components.

INPUT/OUTPUT INSTRUMENT RACK
Input/output instrument rack (I/O instrument rack) is aimed at collecting and primary processing the input hardware signals and transmitting the output signals to peripheral equipment via wired lines (current, voltage, thermocouple and thermal resistance signals etc.)

PRIORITY CONTROL INSTRUMENT RACK
Priority control instrument rack is aimed at receiving commands from the automation instrument rack processors, implementing majority logic (voting 2 of 3 or 2 of 4) and implementing priority control of the safety system actuators.

POWER SUPPLY RACK
Power supply rack from TPTS-NT package is used. It provides the system with a stable power supply and generates the output voltage as follows:
- DC voltage of 24.7 V (24V) nominal value;
- DC voltage of 220 V nominal value;
- DC voltage with nominal value from 50 V to 150 V.
**AUTOMATION INSTRUMENT RACK**

![Diagram of Automation Instrument Rack](image)

**STRUCTURE OF THE AUTOMATION CONTROLLER CRATE OF AUTOMATION INSTRUMENT RACK, DESCRIPTION OF FUNCTIONS**

<table>
<thead>
<tr>
<th>Automation Controller Module Name</th>
<th>Purpose and Functions</th>
<th>Number</th>
</tr>
</thead>
</table>
| Automation processor module PMA-A(B)* | • Reception of digital data from I/O instrument rack via the I/O bus of safety system (SS I/O bus) on process and signals of adjacent systems;  
• Processing of received information in accordance with the specified application program configuration;  
• Process digital data interchange with automation processor module PMA-A(B) of the other safety system channels via interprocessor interfaces;  
• Processing of the above process signals from all four safety system channels according to voting algorithm “2 of 4” or “2 of 3” (depending on the number of safety system channels);  
• Implementation of the specified application program configuration on detection of emergency situation, generation of emergency and automatic protection signals, automatic control commands and safety system control;  
• Output of the generated output signals and SS automatic commands to I/O instrument rack and priority logic instrument rack respectively via digital communication lines | 1      |
| Multiplier Module MR-4A(4B)**   | • Multiplier connects automation processor module PMA-A(B) with I/O stations of I/O instrument racks or with priority logic stations of priority logic instrument racks in accordance with diversity  
• One MR-4 connects up to four I/O stations and one I/O instrument rack, or up to four priority logic instrument racks (up to 16 priority logic stations) | 11***  |

**Note:**  
* Diversity A is based on Freescale microprocessor, Diversity B is based on Xilinx FPGA.  
** Diversity A is based on Altera FPGA, Diversity B is based on Xilinx FPGA.  
*** Three MR-4 modules for connection with I/O instrument rack, eight MR-4 modules for connection with priority logic instrument rack.
INPUT/OUTPUT INSTRUMENT RACK (I/O INSTRUMENT RACK)

**STRUCTURE OF I/O INSTRUMENT RACK, DESCRIPTION OF FUNCTIONS**

<table>
<thead>
<tr>
<th>Name</th>
<th>Purpose and Functions</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input/output station (I/O station) which consists of the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process Link Module (PLM)</td>
<td>• Reception and preliminary processing of input signals, transmission of output signals to adjacent systems. The list includes 7 different I/O modules of various signals</td>
<td>16</td>
</tr>
<tr>
<td>Interface converter of Diversity A crate (IC-A)</td>
<td>• Connection of processor link module PLM of this I/O station of 'A' diversity with 'A' diversity automation controller AC-A of the automation instrument rack</td>
<td>1</td>
</tr>
<tr>
<td>Interface converter of Diversity B crate (IC-B)</td>
<td>• Connection of processor link module PLM of this I/O station of 'B' diversity with 'B' diversity automation controller AC-B of the automation instrument rack</td>
<td>1</td>
</tr>
<tr>
<td>Normal Operation interface Module (IM-NO)</td>
<td>• Process and self-diagnostics data collection from processor link module PLM of this I/O station</td>
<td>2*</td>
</tr>
<tr>
<td></td>
<td>• Transmitting data via ENL bus to AC-NO controller or AP, installed in TPTS-NT rack (NO I&amp;C system)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Receiving data from automation processor module (APM-NO) of normal operation via ENL bus and transmitting them to priority logic units of LCS</td>
<td></td>
</tr>
<tr>
<td>Normal Operation Automation Controller (AC-NO) which consists of the following:</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Automation processor module (APM-NO)</td>
<td>• Receiving data on diagnostics from I/O modules and output to BSHS interfacing gateway of TPTS-NT instrument rack (NO I&amp;C system) via EN bus for transmission to the upper level system</td>
<td>2*</td>
</tr>
<tr>
<td></td>
<td>• Calling maintenance personnel to TPTS-SB upon detection of malfunction</td>
<td></td>
</tr>
<tr>
<td>Input/output module for discrete signals (DSM)</td>
<td>• Control of instrument rack lamps</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>• Collection of hardware signals on malfunction of the standard replaceable items (SRI) of TPTS-SB and transmitting them to APM-NO automation processor module</td>
<td></td>
</tr>
</tbody>
</table>

Note: * Two modules: main module + redundant module.
## PRIORITY CONTROL INSTRUMENT RACK (PSIR)

![Diagram of PSIR]

### Priority control stations (PCS), 6U crate

### Automation controller of normal operation (AC-NO), 3U crate

### 24V power distribution kit

### EN, ENL bus switches

### Optical terminal boxes

### Structure of Priority Logic Instrument Rack (PLIR), Description of Functions

<table>
<thead>
<tr>
<th>Name</th>
<th>Purpose and Functions</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Priority control station (PCS) which consists of the following:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Priority logic unit (PLU) or priority logic unit for control valve (PLU-CV)</td>
<td>• Priority control of one actuator of electric engine, isolation valves, electromagnetic valve, switch (LCS unit) or actuator of control valve (PLU-CV) according to automatic and remote SS and NO system commands with priority given to SS commands</td>
<td>4</td>
</tr>
<tr>
<td>Switch voting module for Diversity A (SVM-A)</td>
<td>• Quadruple splitting of one channel of SS I/O bus (SS I/O bus). Switch voting module allows to connect up to 4 crates of priority logic stations to one SS I/O bus (one crate via the crate bus and 3 crates via external interfaces)</td>
<td>4</td>
</tr>
<tr>
<td>Switch voting module for Diversity B (SVM-B)</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Diversity A voting module (VM-A)</td>
<td>• Reception of automatic control commands from all SS channels and processing them according to voting algorithm</td>
<td>1</td>
</tr>
<tr>
<td>Diversity B voting module (VM-B)</td>
<td>• Output of voting result to PLU (PLU-CV) of this priority logic instrument rack • Output of actuator state signals to other SS channels</td>
<td>1</td>
</tr>
<tr>
<td>Normal Operation Interface module (IM-NO)</td>
<td>• Connecting PLU (PLU-CV) of this priority logic station with TPTS-NT (NO system SHP) via ENL bus; • Displaying information on NO IM malfunctions and malfunctions of PLU (PLU-CV) connected to it via NO path</td>
<td>2</td>
</tr>
<tr>
<td><strong>Normal Operation Automation Controller (NO-AC) which consist of the following:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automation processor module (APM-NO)</td>
<td>• Receiving diagnostics data from TCM and transmitting data to the upper level system via EN bus • Calling maintenance personnel to TPTS-SB upon detection of malfunction</td>
<td>2</td>
</tr>
<tr>
<td>Input/output module for discrete signals (DSM)</td>
<td>• Control of instrument rack lamps • Collection of hardware signals on malfunction of the standard replaceable items (SRI) of TPTS-SB and transmitting them to NO automation processor module</td>
<td>16</td>
</tr>
</tbody>
</table>
TPTS-NT TECHNICAL SPECIFICATIONS

Name | Description | Value
--- | --- | ---
**Functional**

**Design**
- Up to 4 independent monitoring & control channels
- Full information compatibility and integration with the TPTS-NT platform
- End-to-end CAD GET-R1 integrated with the TPTS-NT platform

**Hardware Configuration**

**I/O Instrument Rack**
- Acquisition and measurement of analog signals:
  - Unified current signals 0–20, 4–20 mA
  - Signals from thermal and electrical transducers (thermocouples) with a nominal static characteristic (NSH) of conversion in accordance with GOST R 8.585-2001
  - Signals from thermal resistance temperature detector with NSH in accordance with GOST 6651-2009

- Acquisition and processing of discrete signals:
  - Switching of closing/break dry contact or change-over dry contact with suppression of debouncing
  - Potential interference with noise filtering
    - low level from –31.0 V to +4.5 V
    - high level from +16 V to +31 V

- Output of signals to peripheral devices via wired connections:
  - Analog signals 0–20 mA, 4–20 mA
  - Discrete signals in the form of potential signal from 22 V to 26 V

- Power supply of sensors and electrical process transducers:
  - Power supply of discrete transducers of dry contact type with up to 200 mA direct current and voltage in the range from 22 V to 26 V
  - Power supply of primary transducers of dry contact type with up to 150 mA direct current and voltage in the range from 22 V to 26 V

**Automation Instrument Rack**
- Independent execution of SS algorithms in two diverse options of Automation P processor Modules A and B
- Processing of process signals received from the I/O instrument rack while calculating the value of the process parameter and analyzing their reliability
- Processing of same-name process signals of all SS channels according to the voting algorithm («2 of 4» or «2 of 3» depending on the SS channel number)
- Calculation of temperature parameters values with automatic cold junction compensation for thermal transducers (thermocouples) and resistance of connecting wires for resistance temperature detectors
- Execution of algorithms for correction of measured values of various parameters (level, pressure, etc.)
- Reception and issuance of control and information analog, discrete and digital signals into adjacent systems

**Priority Logic Instrument Rack**
- 3 internal independent control commands receive and process path: 2 A and B diversity paths, 1 normal operation path
- Reception from the automation instrument rack and processing of the same-name control commands by actuators using the voting algorithm («2 of 4» or «2 of 3» depending on the SS channel numbers)
- Reception of automatic commands from diverse safety systems and NO system SHP
- Reception of remote commands from MCR/ECR Operator Control Hardware and from the Upper Level System
- Prioritizing execution of control commands for actuators from different systems
- Individual control of the following types of actuators: Isolation valves, electric motor, solenoid valve, switch, control valves
# TPTS-NT Technical Specifications

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dynamic (time) characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I/O Instrument Rack</td>
<td>• Time of transmission/processing cycle, maximum</td>
<td>20 ms</td>
</tr>
<tr>
<td></td>
<td>• Duration of input discrete signal recorded in I/O instrument rack</td>
<td>20 ms</td>
</tr>
<tr>
<td>Automation Instrument Rack</td>
<td>• Time of data processing cycle, maximum</td>
<td>20 ms</td>
</tr>
<tr>
<td></td>
<td>• Delay period of automatic control (from the moment of receiving data from automation instrument rack or priority logic instrument rack to the moment of automatic control command output from automation instrument rack), maximum</td>
<td>120 ms</td>
</tr>
<tr>
<td></td>
<td>• Generated events recording capability - minimum time between generated signals, defining sequence of their appearance, maximum</td>
<td>50 ms</td>
</tr>
<tr>
<td>Priority Logic Instrument Rack</td>
<td>• Time of data processing cycle, maximum</td>
<td>10 ms</td>
</tr>
<tr>
<td></td>
<td>• Delay time of SS automatic commands (from the time of receiving the command from priority logic instrument rack via I/O SS bus to the time of generating the control action), maximum</td>
<td>120 ms</td>
</tr>
<tr>
<td></td>
<td>• Delay time of automatic SS commands from NO system SHP, maximum</td>
<td>40 ms</td>
</tr>
<tr>
<td></td>
<td>• Delay time of remote SS commands from OC HW of SS MCR/ECR, maximum</td>
<td>40 ms</td>
</tr>
<tr>
<td><strong>Input/output buses and interprocessor SS interfaces of “A” and “B” diversity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN Bus</td>
<td>• Connection with configuration devices and ULS, between Safety I&amp;C SHP and NO system SHP, topology</td>
<td>Ring</td>
</tr>
<tr>
<td></td>
<td>• Fast Industrial Ethernet Interface</td>
<td>100 Mbit/s</td>
</tr>
<tr>
<td></td>
<td>• Number of connected devices</td>
<td>Up to 800</td>
</tr>
<tr>
<td></td>
<td>• Transmission medium</td>
<td>Fiber optic</td>
</tr>
<tr>
<td></td>
<td>• Number of switches in one ring</td>
<td>up to 50</td>
</tr>
<tr>
<td></td>
<td>• Length of fiber optic cable:</td>
<td>up to 3 km</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• multi-mode fiber</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• single-mode fiber</td>
</tr>
<tr>
<td>ENL Bus</td>
<td>• Data interchange between NO-AC and IOS and between NO AP (TPTS-NT) and priority logic instrument rack, topology</td>
<td>Star connection</td>
</tr>
<tr>
<td></td>
<td>• Fast Industrial Ethernet Interface</td>
<td>100 Mbit/s</td>
</tr>
<tr>
<td></td>
<td>• Communication of clients with the switch</td>
<td>Twisted pair</td>
</tr>
<tr>
<td></td>
<td>• Connection between racks</td>
<td>Fiber optic</td>
</tr>
<tr>
<td><strong>External factors, design parameters, reliability</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Factors</td>
<td>• Operating temperature range (boreal climate UKHL4 according to GOST 15150-69)</td>
<td>from +1 to +40°C</td>
</tr>
<tr>
<td></td>
<td>• Seismic resistance scale MSK64 according to GOST 30546.1 (above ground level of 10 m)</td>
<td>8 points</td>
</tr>
<tr>
<td></td>
<td>• Mechanical design group according to GOST 30631-99</td>
<td>M42</td>
</tr>
<tr>
<td></td>
<td>• EMC according to GOST 32137, equipment group/performance quality criteria</td>
<td>IV / A</td>
</tr>
<tr>
<td>Design</td>
<td>• Dimensions of one rack, LxWxH, mm</td>
<td>1000x400x2200</td>
</tr>
<tr>
<td></td>
<td>• Weight, not more:</td>
<td>350 kg</td>
</tr>
<tr>
<td></td>
<td>• Protection according to GOST 14254-96</td>
<td>IP20</td>
</tr>
<tr>
<td>Safety Class</td>
<td>• According to NP-001</td>
<td>2Y</td>
</tr>
<tr>
<td>Reliability</td>
<td>• Average service life of racks/modules, at least, years;</td>
<td>30/15</td>
</tr>
<tr>
<td></td>
<td>• Mean time between failures for automation processor module &quot;A&quot;/&quot;B&quot; of automation instrument rack, hours</td>
<td>0.305/0.375*10⁶</td>
</tr>
<tr>
<td></td>
<td>• Mean time between failures for priority logic unit of priority logic instrument rack, hours</td>
<td>0.317*10⁶</td>
</tr>
<tr>
<td></td>
<td>• Mean time between failures for I/O instrument rack modules</td>
<td>On demand</td>
</tr>
</tbody>
</table>
APPLICATION WITHIN SYSTEM SCOPE

Power generation facilities

- Initiating part of Emergency Protection (EP) and Engineered Safety Features Actuation System (ESFAS)
- Executive part of Engineered Safety Features Actuation System (ESFAS)

MANUFACTURER

FSUE All-Russian Research Institute of Automatics Named after N.L. Dukhov (FSUE VNIIA)
vniia.ru
ARCHITECTURE OF TPTS-SB PLATFORM

The figure shows TPTS-SB architecture based on 4-channel safety I&C system of NPP. Wired connections:

- EN/ENL bus (optical fiber)
- Safety system input/output bus of “A” diversity (optical fiber)
- Safety system input/output bus of “B” diversity (optical fiber)

Key terms:

- RCPS EE – Reactor Control and Protection System Electrical Equipment
- MCR – Main Control Room
- ECR – Emergency Control Room
- ES – Engineering Station
- Safety I&C – Safety Instrumentation & Control System
- Optical Terminal Boxes
- Operator Control Hardware
- Input/Output Instrument Rack
- Automation Instrument Rack
- EOS – Get-R1 CAD
- IOS – Optical Terminal Boxes
- AC-NO – Optical Terminal Boxes
- ПАМ – Optical Terminal Boxes
- ПСИ – Optical Terminal Boxes
- NO AC – Optical Terminal Boxes
- НКУ/КРУ – Optical Terminal Boxes
- LVC/MVS – Optical Terminal Boxes
- PCS – Optical Terminal Boxes
- 2v4 – Optical Terminal Boxes
- PCIR – Optical Terminal Boxes

This diagram illustrates the connectivity and distribution of various subsystems within the TPTS-SB platform, emphasizing the safety and control aspects of the NPP system.
The figure shows TPTS-SB architecture based on 4-channel safety I&C system of NPP. Wired connections

RCPS EE – Reactor Control and Protection System Electrical Equipment
MCR – Main Control Room
ECR – Emergency Control Room
ES – Engineering Station
Safety I&C – Safety Instrumentation & Control System
**PURPOSE**

*Information and Measurement Multifunctional Controller KIUM* is a hardware and software complex of automation tools designed to build automated process control systems (I&C) of medium and high complexity level, Automated Systems for Power Fiscal Metering System as well as telemetry systems. Modular principle of building controller’s software & hardware tools allows to establish on its basis various telemetry and automation systems with a design-based structure for a wide area of application and implementation of various control algorithms.

**MAIN FUNCTIONS**

- Remote measurement of the current parameters of monitored facilities;
- Remote alarm on discrete states of facilities;
- Remote control over control devices of the controlled facilities;
- Remote measurement of integral parameters values.
- Output of remote adjustment signals;
- Establishing operation modes, process setpoints and parameters from UL;
- Maintaining communication with external devices and systems;
- Process presentation in the form of a mimic diagram, parameter tables, trends, graphs and diagrams;
- Automatic testing up to the level of a functional module.
KEY FEATURES

- **Architectural and system solutions developed in Russia**
- **Completely Russian production: from printed circuit boards to a cabinet design**
- **Modern component framework meeting highest requirements for performance and reliability**
- **Modular design of the architectural solution, flexibility and scalability of the configuration**
- **Redundant / parallel operation of processor modules**
- **Automatic testing up to the level of functional modules**
- **Connection of external devices by UART, CAN, Ethernet buses; support of any RTU with standard protocols**
- **Possibility for users to develop their own SW and drivers for non-standard devices**
- **Embedded operating system Linux, open application program interface**
- **Web-configurator, user Web-interface**

APPLICATION AREAS

**Electric power industry facilities**
- Electric power transmission and distribution facilities: power supply centres, opened and closed distribution and transformer substations
- CHPP and TPP of small and average power

**Oil and gas industry**
- Oil pumping and gas compressor stations
- Telemetry of main gas pipelines and oil pipelines
- Gas control and distribution units
- Tank batteries, oil product terminals
KIUM ARCHITECTURE

**Process Sensors, Technological Parameters Transducers, Actuators**

**Main Control Unit**

- **CPM** – Central Processor Module
- **PLM** – Process Link Module
- **PSCIM** – Power Supply Connection and Indication Module
- **ESCM** – External Signals Connection Module

**Extension Unit**

**Gateways**

**Upper level (ULS) bus**

**Signals of sensors and control commands: analog and digital**

**Bus 1 of CAN 2.0 Standard**

**Bus 2 of CAN 2.0 Standard**

**CPM** – Central Processor Module  
**PLM** – Process Link Module  
**PSCIM** – Power Supply Connection and Indication Module  
**ESCM** – External Signals Connection Module  
**MM** – Mezzanine Module  
**MP** – Marshalling Panel  
**ULS** – Upper Level System
KIUM
Multifunctional Measuring Controller

MAIN CONTROL UNIT

CENTRAL PROCESSOR MODULE

CONTROL & COMMUNICATION MODULE OF PLM MODULE

PROCESS LINK MODULE

PLM MEZZANINE MODULE
EXAMPLE OF IMPLEMENTED PROJECT: 
TELEMETRY SYSTEM OF LLC GAZPROM TRANSGAZ MAKHACHKALA

GAS PIPELINE LINE OPERATION SECTION (GPLOS)
- Control Engineer's AWS
- Instrumentation and Control equipment engineers AWS
- AWS of Remote Terminal Units
- AWS of pipeline electrochemical protection

Communication Server of CCR
- AWS of line maintenance service

Radio modem

Control Engineer's AWS

Instrumentation and Control equipment engineers AWS

AWS of pipeline electrochemical protection

AWS of line maintenance service

Communication Server of CCR

Video wall

Data Acquisition Server

PJSC Gazprom

CCC – CENTRAL CONTROL ROOM

Tarum line operation section of the main gas pipeline
Controlled facilities: 57
Controlled facilities: 72

Tarum line operation section of the main gas pipeline
Controlled facilities: 86

Tarum line operation section of the main gas pipeline
Controlled facilities: 96

Izberbash line operation section of the main gas pipeline
Controlled facilities: 30
Controlled facilities: 35

Derbent line operation section of the main gas pipeline
Controlled facilities: 25
Controlled facilities: 49

CONTROLLED STATION OF GAS DISTRIBUTION FACILITY
Automation controller: CS-GDS-56

CONTROLLED STATION OF LINE VALVE
Automation controller: CS-GDS-65

CONTROLLED STATION OF CATHODIC PROTECTION FACILITY
Automation controller: CS-UK/GKZ-46
## TECHNICAL FEATURES

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>• Redundant; • Non-redundant</td>
<td></td>
</tr>
<tr>
<td><strong>Base Controller</strong></td>
<td>• Central Processor Module; Object Communication Module; Number of Mezzanine Modules in Object Communication Module; Performance</td>
<td>2; 8; 4; 19&quot;; 3U</td>
</tr>
<tr>
<td><strong>Central Processor Module</strong></td>
<td>• Processor Freescale i.MX257, core; Frequency; DDR2 Memory; Input-Output</td>
<td>ARM926EJ-S; 400 MHz; 256 MB</td>
</tr>
<tr>
<td></td>
<td>– CAN; – Ethernet 10/100; – USB 2.0; – UART (232, 485, 422)</td>
<td></td>
</tr>
<tr>
<td><strong>Process Link Module</strong></td>
<td>• Microcontroller; Number of Mezzanine Modules; CAN; Operating System</td>
<td>AT91SAM7A3; 4; 2; FreeRTOS</td>
</tr>
<tr>
<td></td>
<td>• Types of mezzanine modules: – analog input of remote measurement of the current parameters; – discrete input of remote alarm; – discrete output of remote control; – pulse input of remote measurement of integral parameters values; – analog output of remote adjustment</td>
<td>4; 4; 4; 4; 1</td>
</tr>
<tr>
<td></td>
<td>• Input signals: – unified current signals, mA; – unified signals of resistance thermometers of Platinum and Copper type with standard scaling according to GOST R 8.625 via three-wire or four-wire connection circuit</td>
<td>0-5; 0-20; 4-20</td>
</tr>
<tr>
<td></td>
<td>• Output signals: – unified analog signals, mA; – control signals of process facility actuators: “relay”, switching voltage; – control signals of process facility actuators: “open collector”, switching voltage</td>
<td>0–20; 220 V at 1 A; 48 V at 0,5 A</td>
</tr>
<tr>
<td></td>
<td>• Basic reduced error of instrument channels transformation; Acceptable value limits of basic reduced error for process parameters instrument channels in the form of percentage to measurement range shall be the following:</td>
<td>0,1%</td>
</tr>
<tr>
<td></td>
<td>– in case of using primary transducers of accuracy class 0,1; – in case of using primary transducers of accuracy class 0,15; – in case of using primary transducers of accuracy class 0,25; – in case of using primary transducers of accuracy class 0,5</td>
<td>± 0.20%; ± 0.25%; ± 0.35%; ± 0.60%</td>
</tr>
<tr>
<td><strong>Communications</strong></td>
<td>• Data communication interfaces; Data communication protocols</td>
<td>RS232 / RD422 / RS485; MODBUS / CAN/ Ethernet</td>
</tr>
<tr>
<td><strong>External factors, design parameters, reliability</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Factors</strong></td>
<td>• Operating temperature range; Cabinet Dimensions LxWxH, mm; Weight, not more; Protection according to GOST 14254</td>
<td>from -40 to +75°C; 1 000 x 570 x 600; 100 kg; IP43</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
<td>• Mean time between failures of a channel; Mean lifetime; Mean time to operability recovery</td>
<td>0,18*10^10h; 15 years; 1 h</td>
</tr>
</tbody>
</table>
APPLICATION WITHIN SYSTEM SCOPE

**Electric power industry facilities**
- Automated Systems for Power Fiscal Metering System
- Automated Systems of Power Technical Metering
- I&C telemetry and automation of electrical substations

**Oil and gas industry**
- Telemetry and automation systems of gas distribution stations
- Control and monitoring systems of gas control and distribution stations
- Telemetry systems of main gas pipelines
- Automated systems of pumping stations etc.

**REFERENCE**
- LLC Gazprom Transgaz Nizhny Novgorod
- LLC Gazprom Transgaz Makhachkala
- OJSC Mostransnefteproduct (Moscow)
- OJSC Yugo-Zapad Transnefteproduct (Samara)
- CJSC BaltNafta (Kaliningrad)
- OJSC Metan (Penza)

**MANUFACTURER**

JSC Federal Scientific and Production Centre
Start Production Association named after M. Protsenko
(JSC FSPC Start Production Association named after M. Protsenko)
startatom.ru
EE I&C
Software and Hardware Tools of Electrical Equipment Instrumentation and Control Systems

PURPOSE

Software and hardware tools of Electrical Equipment Instrumentation and Control Systems are a hardware and software package of automation tools which is a basic platform for building:

- Common Plant Electrical Equipment Instrumentation and Control Systems (CP EE I&C) for control of Common Plant electrical equipment of power generation circuits (outdoor switchgear) and electrical equipment of Common Plant auxiliaries (indoor switchgear);
- Electrical Equipment Instrumentation and Control Systems (EE I&C) of power unit / company for control of electrical equipment: unit transformers, switches, auxiliary power supply system, emergency power supply system of the power unit / enterprise.

MAIN FUNCTIONS

- Monitoring and control of high-voltage switches of 500 / 220 kV outdoor switchgear, electric power transmission lines, coupling autotransformer, generator-transformer units, shunt reactors.
- Monitoring and control of 220 kV and 6 kV switches of redundant auxiliary transformers.
- Monitoring and control of 6 kV and 0,4 kV switches of emergency power supply lines, common plan auxiliary transformers and common plant consumers.
- Monitoring and control of switches of voltage control devices under load of 500/220 kV coupling autotransformer, 220/6,3 kV redundant auxiliary transformers.
- Implementation of semi-automatic synchronization algorithms during actuation of 500 kV and 220 kV high-voltage switches according to operating personnel commands from AWS.
- Monitoring of EE I&C software & hardware tools and reconfiguration of the system in case of redundant components failure.
- Reception, generation and display of analog parameter values, synchronization parameters, state of switching devices and relay protection and automation devices, event registration and archiving.
KEY FEATURES

- Possibility to ensure redundant monitoring and control from mosaic panels
- Building a duplex architecture based on star topology, server duplication, redundancy
- Modern component framework meeting the highest requirements for performance and reliability
- Support of all electrical and the majority of general purpose industrial data exchange protocols
- Possibility to develop I&C subsystem as a unified fully functional information component of I&C system
- Protection from unauthorized access at the hardware and software levels
- Complete integration of EE I&C with the modern devices of microprocessor relay protection and automation
- Remote programming of all the modules using the unified software development kit according to IEC 61131-3
- Interfacing with standard components of primary equipment level: Digital current transformers and voltage transformers, smart switching devices, RPMD, as well as conventional discrete and analog sensors
- Response time of EE I&C does not exceed 1.5 s
- Logging and archiving of events and control commands with the resolution (with assignment of time tag) not less than 10 ms

Standard scope of CP EE I&C:
- Remote Terminal Unit (RTU)
- Telecommunication device (TD)
- Unified Server (US)
- Synchronism Check Relay (SCR)
- Time Synchronization Unit (TSU)
- AWS of operating personnel (WS-2)
- AWS of technical maintenance (WS-1)

Standard scope of unit/enterprise EE I&C:
- Unified Server (E-US)
- Telecommunication device (E-TD)
- Workstation (WS-E)
- Interfacing Gateway (IG)
- Central Coordinating Device (CCD)
- Remote Terminal Unit (RTU)

APPLICATION AREAS

Electric power industry facilities
- Electric power transmission and distribution facilities: power supply centres, outdoor and indoor distribution and transformer substations
- Nuclear power plants, thermal power plants and heat-and-power plants, hydro power plants

Oil and gas industry
- Power supply facilities of oil & gas refining and petroleum chemical plants
CP EE I&C PLATFORM SCOPE

UNIFIED SERVER

Unified Server (US) is aimed at ensuring information exchange with devices united into a Local Area Network (LAN) as a center for information reception, processing, storage and output.

US Technical Features:
- Configurable computer system based on dual-core processor Intel Xeon Silver/Gold;
- RAID array 0,1,5,6 with capacity up to 10 TB;
- Connection to LAN – up to 10 optical Ethernet communication lines;
- US diagnostic system;
- 2 power inputs with automatic switching of inputs;
- Time of autonomous operation when power supply is off shall be at least 30 minutes;
- Power consumption shall not exceed 2000 VA.
- US overall dimensions shall not exceed 612х1112х2112 mm;
- SSW based on Windows/Linux OS.

REMOTE TERMINAL UNIT

Remote Terminal Unit (RTU) ensures:
- Reception of remote control commands generated at automated workstations and sections with mosaic monitoring and control panels (MMCP sections) via digital communication channel 100BaseFX;
- Connection with electrical equipment of the main power generation circuit and auxiliaries;
- Generation and transfer of remote control commands to electrical equipment control logic via wired circuits;
- Reception of discrete and analog signals on state of electrical equipment, central and fire alarms, control components of MMCP sections;
- Transfer of information on state of electrical equipment, central and fire alarms via digital communication channel 100BaseFX;
- Output of discrete and analog signals for MMCP sections via wired circuits;
- Channels: Input 4-20 mA up to 64, input =220 V up to 368, output =220 V up to 80, output ~220 V up to 16, input 24 V up to 96, output 24 V up to 160.
SYNCHRONISM CHECK RELAY – SCR

Synchronism Check Relay (SCR) ensures:

- Synchronism checking of two three-phase AC power lines connected to SCR via auxiliary circuits of synchronization;
- Execution of semi-automatic synchronization algorithms and issue of command for actuation of high-voltage switches;
- Reception of commands for control of synchronism check via wired circuits;
- Monitoring of electrical equipment synchronization parameters;
- Transfer of electrical equipment synchronization parameter values via digital interface;
- Transfer of signals on synchronization function state via wired communication lines;
- Issue of actuation command into control logic by switch when there are conditions for actuation;
- Display of information on current SCR parameters and synchronization function state by Web-server;
- Configuration and parameterization using DIGSI Software;
- Based on SIPROTEC 4 7VE63 and operates together with RTU;
- Mean time between failures - 80,000 hours minimum.

TELECOMMUNICATION DEVICE – TD

Telecommunication device (TD) is aimed at establishment of Local Area Network (LAN), ensuring information interaction between the components of systems and subsystems within I&C

TD Technical Features:

- Configurable communication system;
- Connection to LAN – up to 40 optical Ethernet communication lines;
- Support of network redundancy functions;
- TD diagnostic system;
- 2 power inputs with automatic switching;
- Time of autonomous operation when power supply is off shall be at least 30 minutes;
- Power consumption shall not exceed 400 VA;
- TD overall dimensions shall not exceed 610 x 1 710 x 870 mm;
- Weight of TD shall not exceed 300 kg.
**SCOPE OF POWER UNIT / ENTERPRISE EE I&C PLATFORM**

**CENTRAL COORDINATING DEVICE – CCD**

Central Coordinating Device (CCD) ensures:
- Exchange of data and remote control commands between RTU, EE I&C server and interfacing gateway;
- Centralized processing of data and remote control commands, including logic processing;
- Reception of standard time signals from upper level system and their retranslation into the system devices (via interfacing gateway);
- Automated diagnostics of the device, monitoring of temperature and power supply in the cabinet, protection against unauthorized access.

**CCD Technical Features:**
- Up to 16 simultaneously operating data processing modules according to IEC 61850, IEC 60870-5-104, IEC 60870-5-101 protocols with data exchange via internal bus, CCD controller – SICAM AK 1703;
- Remote programming of all the modules using the unified software development kit according to IEC 61131-3;
- Power consumption shall not exceed 850 VA;
- Overall dimensions (WxDxH) shall not exceed 600 x 800 x 2 200 mm.

**REMOTE TERMINAL UNIT – RTU**

Remote Terminal Unit (RTU) ensures:
- Input of signals received from electrical equipment;
- Output of remote control commands to electrical equipment;
- Exchange of data and remote control commands from CCD (via network equipment set).

**RTU Technical Features:**
- Contains from one to four devices for control of high-voltage connection SIPROTEC 6MD6645;
- Has channels for connection of the following signal types:
  - Input discrete =220 V;
  - Output discrete =220 V;
  - Input analog 4..20 mA;
  - Input analog ~0..170 V;
  - Input analog 0..5 A.
- Connection to CCD is provided via fiber optic communication channel 100Base-FX. Data communication protocol according to IEC61850.
UNIFIED SERVER – E-US
Unified Server (E-US) ensures:
• Data acquisition, processing, generation and archiving;
• Collection of registration results of current processes, including oscillograms, their storage and transfer during performance within EE I&C;
• Monitoring of power supply and temperature in the cabinet, protection against unauthorized access, automated diagnostics of the device.

US Technical Features:
• Dual-processor configurable computer system based on triple-core processors Intel Xeon L5410;
• HDD memory capacity up to 6 x 300 GB;
• Channels for connection to LAN – 100Base FX (24), 100Base TX (20);
• Power consumption shall not exceed 1000 VA;
• Overall dimensions shall not exceed 605 x 895 x 2120 mm.
• SSW based on Windows Server Standard OS.

TELECOMMUNICATION DEVICE – E-TD
Telecommunication device (E-TD) ensures:
• Integration of functionally connected information segments (nodes) into a single local area network.
• Automated diagnostics of the device.
• Monitoring of power supply and temperature in the cabinet, protection against unauthorized access.

E-TD Technical Features:
• Specification of communication channels: 100Base-TX (96 channels), 100Base-FX (36 channels);
• Power consumption shall not exceed 400 VA;
• Overall dimensions shall not exceed 605 x 895 x 2120 mm.

INTERFACING GATEWAY – IG
Interfacing Gateway (IG) ensures:
• Conversion of formats of retranslated data, remote control commands and their logic processing;
• Monitoring of power supply and temperature in the cabinet, protection against unauthorized access, automated diagnostics of the device.

IG Technical Features:
• Specification of communication channels: 100Base-TX (32), 100Base-FX (8);
• Interfaces: RS-232, USB, PS/2.
ARCHITECTURE OF POWER UNIT / ENTERPRISE EE I&C

OC SHT – operator control software & hardware tools
EE I&C AWS – automated workstation of Electrical Equipment Instrumentation and Control System
ULS – Upper Level System
CCD – Central Coordinating Device
E-US – Unified Server
E-TD – Telecommunication Device
RTU – Remote Terminal Unit
IG – Interfacing Gateway

Communication lines according to IEC 60870-5-101 protocol
Communication lines according to IEC 60870-5-104 protocol
Local area network Ethernet with IEC 61850 protocol
EE I&C system boundaries
APPLICATION WITHIN THE SYSTEMS

Electric Power Facilities

• Common plant electrical equipment instrumentation & control systems of power generation facilities (CP EE I&C and CP EE I&C)
• Common plant electrical equipment instrumentation & control systems of power generation facilities (Power Unit EE I&C)
• Electrical Equipment Instrumentation and Control systems of power transmission & distribution facilities

Oil and Gas Industry

• Electrical equipment instrumentation & control systems of the main step-down substations, distribution and transformer substations, emergency power supply system of oil & gas processing plants and petrochemical plants

REFERENCE

• CP EE I&C of Rostov NPP
• EE I&C of Beloyarsk NPP, Unit 4
• EE I&C of Novovoronezh NPP 2, Units 1, 2
• EE I&C of Kalinin NPP
• EE I&C of Rostov NPP
• EE I&C of Belarusian NPP

MANUFACTURER

Sedakov Scientific Research Institute of Measuring Systems
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**DA SHP**

Data Acquisition Software and Hardware Tools for Electrical Equipment

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**PURPOSE**

Data Acquisition Software and Hardware Tools refer to software & hardware package of automation tools. It is a basic platform for building the systems of data collection, storage, visualization and transmission from electrical equipment of the power supply system (DA SHP) to the following equipment: "generator-transformer" unit, operational and redundant auxiliary transformers, 6/10 kV switchgears, low-voltage 0.4 kV switchgear, DC boards, inverters, AC/DC converters, voltage controllers of operational auxiliary transformers, current and voltage measurement transformers, instrument transducers with unified current input etc.

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**MAIN FUNCTIONS**

- Input of discrete signals on the state of switching devices according to protocol of IEC 61850-8-1 (MMS) from microprocessor relay protection and automation devices, smart switching devices and other external controllers.
- Input of digitized sampled values of current and voltage from digital current & voltage transformers according to protocol of IEC 61850-9-2 (Sampled Values) and oscillography in COMTRADE format.
- Collection of analog and discrete signals from secondary transducers of sensors and annunciators via remote terminal unit.
- "Horizontal" exchange of discrete messages and control commands between controllers and RPMD (GOOSE messages).
- Time synchronization of equipment and built-in digital devices with high accuracy (less than 1 ms).
- Generating and maintaining the archive of process messages, analog signals and oscillograms.
- Visualization of process data and oscillograms on AWS of electrical engineering personnel.
- Transmitting data to the upper level system.
- Diagnostics of hardware & software tools.
KEY FEATURES

- Building a duplex architecture based on star topology, server duplication, redundancy
- Modern component framework meeting the highest requirements for performance and reliability
- Support of standard communication interfaces: RS-232/422/485, Ethernet 10/100 Base-Tx
- Self-checking of software and hardware
- Full integration with various upper level systems, possibility of further development
- Remote programming of all the modules using the unified software development kit according to IEC 61131-3
- Interfacing with standard components of primary equipment level: Digital current transformers and voltage transformers, smart switching devices, RPMD, as well as conventional discrete and analog sensors
- Protection from unauthorized access on hardware and software levels

APPLICATION AREAS

Electric Power Facilities
- Electric power transmission and distribution facilities: Power supply centres, opened and closed distribution and transformer substations
- Nuclear power plants, thermal power plants and heat-and-power plants, hydro power plants

Oil and Gas Industry
- Power supply facilities of oil & gas refining and petroleum chemical plants
SCAPE OF DA SHP PLATFORM

SERVER COMMUNICATION DEVICE

**Server communication device** is aimed at ensuring collection, processing and storage of process and diagnostic data of electrical equipment, reception and transmission of standard time signals via PTP and NTP protocol for synchronization of internal clock of electrical equipment.

**Structure of server communication device:**
- system unit - 2 pcs;
- switching controller;
- cross connect equipment;
- uninterruptable power supply source;
- multi-controller unit;
- switching device for power supply networks;
- KVM console.

**Technical features of server communication device:**
- Configured multiprocessor computer system based on Intel Xeon Silver/Gold.
- RAID 0,1,5 with capacity up to 10 TB.
- Connection to LAN – up to 48 optical Ethernet communication lines.
- Communication controller:
  - Interfaces: RS-232, RS-422, RS-485, Ethernet 10/100 Base-Tx.
  - Processing up to 50 000 tags/s;
  - Time synchronization via NTP, PPS, PTP;
  - Support of PRP redundancy protocol;
  - QNX 6.5 operating system;
  - Transmission of independent data sets in 10 directions.
- Diagnostic system for server communication device, 2 power inputs with automatic switching.
- The system shall have 30 minutes run time in case the power supply is off.
- Power consumption shall not exceed 2000 VA.
- Overall dimensions of server communication device (W x D x H) shall not exceed 1 110 x 612 x 2 110 mm.
- SSW based on Windows/Linux OS.
REMOTE TERMINAL UNITS RTU

Remote Terminal Unit (RTU) is aimed at interfacing the Data Acquisition Software & Hardware Package (DA SHP) with the following equipment:

- Relay circuits of equipment condition monitoring;
- Instrument transducers of electrical equipment;
- Microprocessor relay protection and automation devices;
- Microprocessor controllers;
- Voltage controllers for transformers;
- Instrument transformers of current and voltage.

RTU structure:

- Controllers (PLC);
- Main and backup switches;
- Converters (PTP/PPS), converters (TTL(PPS)/FO);
- Optical distribution frames;
- Power supply units;
- T-splitter, clip connectors.

RTU shall perform the following functions:

- Reception of signal via wired electrical communication lines from the "dry contact" sensors with assignment of time stamps and ensuring +24 V power supply of the contacts;

- Receiving signals from three phases (2 channels) of alternating current and voltage (with zero sequence input) with direct connection to the instrument current transformers, the current of secondary winding from 0 A to 5 A and instrument voltage transformers with nominal voltage of winding from 0 V to 100 V. Oscillograms are recorded in the Comtrade format with a resolution of at least 20 points for network frequency of 50 Hz and recording duration from 1 s to 11 s in emergency mode and 0.3 s in pre-emergency mode (emergency mode is determined based on exceeding the threshold values by one or a group of measured values (upper or lower) set during configuring);

- Receiving data from external EE controllers via RS-485 (Modbus RTU protocol).

- Collection of digital data according to protocols of IEC 61850-8-1, GOST R IEC 61870-5-104 and Modbus/TCP in one or two pairs of Ethernet interface channels (100Base-FX) from 32 external relay protection and automation devices according to topology of the ring bus;

- Collection of digital data according to protocols of IEC 61850-8-1, GOST R IEC 61870-5-104 and Modbus/TCP in 12 Ethernet interface channels (100Base-FX) from external microprocessor controllers relay protection and automation devices according to the star topology;

- Transmission of collected digital data through switches via two Ethernet channels (100Base-FX) to server communication device;

- Recording discrete signals (events) to PLC with 1 ms resolution. Volume of RTU PLC archive is at least 1000 events.
APPLICATION WITHIN SYSTEM SCOPE

Electric power industry facilities

- Common plant electrical equipment instrumentation & control systems of power generation facilities (CP EE I&C)
- Common plant electrical equipment instrumentation & control systems of power generation facilities (Power Unit EE I&C)
- Electrical Equipment Instrumentation and Control systems of power transmission & distribution facilities
- Data acquisition systems of electrical equipment (DA SHP)

Oil and gas industry

- Electrical equipment instrumentation & control systems of the main step-down substations, distribution and transformer substations, emergency power supply system of oil & gas processing plants and petrochemical plants
- Data acquisition systems of electrical equipment (DA SHP)

REFERENCE

- Leningrad NPP Units 1 and 2;
- Beloyarsk NPP Unit 4;
- Belarusian NPP (Units 1, 2).

MANUFACTURER

Branch of FSUE RFNC-VNIIEF
Scientific-Research Institute of Measuring Systems named after Y.E. Sedakov
niis.nnov.ru
DA SHP ARCHITECTURE

Communication channels:
- Mbit/s
- Gbit/s

Main SCD CP01

Server

Upper Level switch

Communication controller

RTU switch

NPP LAN AWS
main channel

UULLS
main channel

from UPLS
PTP-synchronization

RTU № 1 СРВ11

RTU № 2 СРВ21

RTU № 3 СРВ31

RTU № 4 СРВ41

RTU № 5 СРВ51

RTU № 6 СРВ61

RTU № 8 СРВ81

Main channel

Redundant channel

RPMD Switch, redundant

RPMD Switch main

RPMD

RTU controller

RA RM VT CT

RPMD

RPMD

RPMD

RPMD

RPMD

RPMD
Data Acquisition Software and Hardware Tools for Electrical Equipment

- Communication channels:
  - Mbit/s
  - Gbit/s

- NPP LAN AWS
  - Main channel
  - Redundant channel

- Upper Level switch
- Communication controller
- RTU switch
- DA SHP AWS
  - CPB03
- Printer CPB04

- RTU switch
- RTU controller
- RPMD Switch
- RPMD Switch, redundant
- RPMD

- RTU № 1 СРВ11
- RA VT
- RM CT

- RTU № 2 СРВ21
- RA VT
- RM CT

- RTU № 3 СРВ31
- RA VT
- RM CT

- RTU № 4 СРВ41
- RA VT
- RM CT

- RTU № 5 СРВ54
- RA VT
- RM CT

- RTU № 6 СРВ61
- RA VT
- RM CT

- RTU № 7 СРВ64
- RA VT
- RM CT

- RTU № 8 СРВ50
- RA VT
- RM CT

- RPMD Switch,
- redundant

- RA VT
- RM CT

- RPMD

- Server
- IG

- AWS of RPAD Engineer
- Server IG
- Upper Level switch
- Communication controller
- RTU switch

- Redundant SCD CPB02
- Server
- IG

- Upper Level switch
- Communication controller
- RTU switch
- DA SHP AWS
  - CPB03
- Printer CPB04

- RTU switch
- RTU controller
- RPMD Switch
- RPMD Switch, redundant
- RPMD

- RTU № 1 СРВ11
- RA VT
- RM CT

- RTU № 2 СРВ21
- RA VT
- RM CT

- RTU № 3 СРВ31
- RA VT
- RM CT

- RTU № 4 СРВ41
- RA VT
- RM CT

- RTU № 5 СРВ54
- RA VT
- RM CT

- RTU № 6 СРВ61
- RA VT
- RM CT

- RTU № 7 СРВ64
- RA VT
- RM CT

- RTU № 8 СРВ50
- RA VT
- RM CT

- RPMD Switch,
- redundant

- RA VT
- RM CT

- RPMD

- NPP LAN AWS
- Redundant channel
- UULS
- Redundant channel
UNK TM
Software and Hardware Tools of Unified Telemetry Complex

PURPOSE
Software & hardware tools of a telemetry complex are a software & hardware complex of automation tools which is a basic platform for construction of automated control systems for distributed technological processes and equipment of the trunk line section, gas distribution stations (GDS), gas pressure reduction sites (GPRS), gas metering stations (GMS), inter-field trunk pipelines of gas fields and other objects of the fuel & power sector.

Software & hardware tools of a telemetry complex can be used both as an independent telemetry system (the UNK TM system) and as in an upper level I&C system.

MAIN FUNCTIONS
- Remote measurement of the current parameters of monitored facilities.
- Remote alarm on discrete states of facilities.
- Remote control over control devices of the controlled facilities.
- Output of remote adjustment signals.
- Establishing operation modes, process setpoints and parameters from the Upper Level System.
- Maintaining communication with external devices and systems.
- Process presentation in the form of a mimic diagram, parameter tables, trends, graphs and diagrams on the operator AWS.
- Automatic testing up to the level of a functional module.
KEY FEATURES

- Control and monitoring of both lump controlled objects and territorially distributed objects
- Modern component framework meeting the highest requirements for performance and reliability
- Full integration with various upper level systems, possibility of further development
- The minimum time for detection of unauthorized parameter changes
- The working temperature range of the monitored station is from –55 to +55°C (special design)
- Maximum quantity of controlled objects in the system shall not exceed 255
- +24V Independent backup power with remote battery charging
- Availability of a simulator of linear production control manager

APPLICATION AREAS

Oil and gas industry
- Process facilities of the gas pipeline section, products pipelines, gas distribution stations (GDS), gas pressure reduction sites (GPRS), gas metering stations (GMS), electrochemical protection units, etc.

Infrastructure
- Heat distribution networks: centralized online operational monitoring and control over supplying consumers with heating energy and hot water
PLATFORM SCOPE

CONTROL ROOM (CR)

A control room (CR) is a rack made based on an industrial computer with installed software that provides the following:

- Automatic data collection (of process parameters) coming from controlled stations (CS);
- Processing the data obtained in accordance with the set algorithms;
- The results and tracking the stages of remote control of process (objects) and adjustment commands;
- The functions for changing configuration settings.
- Control of access to control functions and changing the configuration parameters;
- On/off polling mode of both specific sensors, and the entire controlled station;
- Time synchronization of the control room and the controlled station;
- Transfer of information to the upper level (to the SCADA system).

CONTROLLED STATION CS

The controlled station (CS) consists of a cabinet including data acquisition and processing devices (DAPD) based on a microprocessor device, communication device and uninterrupted power supply unit. The microprocessor device contains a controlled by the QNX real-time operating system microprocessor controller, a power supply board, a port extension board and functional modules of analog and discrete I/O connected by the passive control/data bus. The scope also includes application software.

A controlled station ensures the following:

- Remote measurements of analog current and voltage signals, their primary processing by the analog input/output module;
- Remote adjustment by the standardized current signal from 0 to 20 mA supplied by the analog input/output module to the input of the controlled object;
- Remote alarm by input of discrete signals from dry contacts via polling with a current signal of 5 mA;
- Remote control by output of discrete signals as DC voltage commutation of 24±3 V or 110±11 V;
- Reading signals from turbine and rotary gas flow meters;
- Connecting to satellite (non-volatile) controlled stations (NVCS) and the video-surveillance and protection system.
NON-VOLATILE CONTROLLED STATION

A satellite non-volatile controlled station (NVCS) is designed for use as a remotely controlled station to monitor and control distributed process facilities located in remote power dependent areas including explosion hazardous areas remote from the base controlled station at a distance of up to 2 km.

A satellite non-volatile controlled station shall be connected to the control station CS and provide the same functions as the controlled station.

TECHNICAL FEATURES

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control room (CR)</td>
<td>• The basis of control room is an Advantech industrial computer</td>
<td>QNX 6.5.0</td>
</tr>
<tr>
<td></td>
<td>• A data hub based on Fastwel CPC150 controller</td>
<td>PB Cascade DataHub</td>
</tr>
<tr>
<td></td>
<td>• Operating System</td>
<td>50,000</td>
</tr>
<tr>
<td></td>
<td>• The database control system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Maximum volume of points in the real-time database</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Multi-channel data communication to the upper level control and the control automated system via standard data exchange protocols</td>
<td></td>
</tr>
<tr>
<td>Controlled station CS</td>
<td>• CPC-108 controllers and Fastwel I/O modules.</td>
<td>QNX 6.5.0</td>
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<tr>
<td></td>
<td>• The real-time operating system</td>
<td>Cascade DataHub</td>
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<tr>
<td></td>
<td>• The database control system</td>
<td>12</td>
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<td></td>
<td>• RS232/RS485 port number</td>
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<td></td>
<td>• Number of remote measurement channels</td>
<td>256</td>
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<tr>
<td></td>
<td>• Number of remote alarm channels</td>
<td>256</td>
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<tr>
<td></td>
<td>• Number of remote control channels</td>
<td>20</td>
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<td></td>
<td>• Number of remote adjustment channels</td>
<td>4-20; 4-20; 0-5</td>
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<td></td>
<td>• The range of input signals of telemetry links</td>
<td>Minus 5(10)-0; 0-5</td>
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<td></td>
<td>• Current signals, mA</td>
<td></td>
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<tr>
<td></td>
<td>• Level signals, V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Operating as a data re-translator to other controlled stations</td>
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<tr>
<td></td>
<td>• Communication with more than 10 types of gas and electricity meters</td>
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<tr>
<td>A non-volatile controlled station NVCS</td>
<td>• Performance</td>
<td>Explosion-proof design</td>
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<td>• Number of remote measurement channels</td>
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<tr>
<td></td>
<td>• The range of input signals of remote measurement channels</td>
<td>4-20</td>
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<tr>
<td></td>
<td>• Current signals, mA</td>
<td>Minus 10-10</td>
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<tr>
<td></td>
<td>• Level signals, V</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>• Number of remote alarm channels (dry contact)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>• Number of remote control channels (+24V)</td>
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TECHNICAL FEATURES  (CONTINUATION)

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional</strong></td>
<td></td>
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</tr>
<tr>
<td>A complex based on control rooms, control loops, NVCS</td>
<td>Maximum number of CR-CS communication directions</td>
<td>8</td>
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<td></td>
<td>Maximum number of CS in one communication direction</td>
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<tr>
<td></td>
<td>Maximum number of CS in the complex</td>
<td>255</td>
</tr>
<tr>
<td></td>
<td>Maximum number of NVCS connected to the base controlled station</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Maximum quantity of the following types of channels:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Remote measurement</td>
<td>2576</td>
</tr>
<tr>
<td></td>
<td>– Remote alarm</td>
<td>5120</td>
</tr>
<tr>
<td></td>
<td>– Remote control</td>
<td>2048</td>
</tr>
<tr>
<td></td>
<td>– Remote adjustment</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>• Structure of communication channels between control rooms and controlled stations</td>
<td>Star, linear, mixed type</td>
</tr>
<tr>
<td></td>
<td>• Communication channel type applied for data exchange</td>
<td>Cable, VHF channel, FOCL, satellite</td>
</tr>
<tr>
<td></td>
<td>• Data communication speed (depending on the communication channel), Mbit/s</td>
<td>1.2 - 100</td>
</tr>
<tr>
<td></td>
<td>• The time for detection of unauthorized parameter changes:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– With 63 CS on one communication direction, at most, s</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>– With 30 CS on one communication direction, at most, s</td>
<td>2.35</td>
</tr>
<tr>
<td><strong>Operational</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Operating temperature range</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– CR</td>
<td>from +5 to +40 °C</td>
</tr>
<tr>
<td></td>
<td>– CS (NVCS)</td>
<td>from minus 40 to +55 °C</td>
</tr>
<tr>
<td></td>
<td>– CS (NVCS) customized</td>
<td>from minus 55 to +55 °C</td>
</tr>
<tr>
<td></td>
<td>• Mean lifetime</td>
<td>12 years</td>
</tr>
<tr>
<td></td>
<td>• Main power supply for equipment</td>
<td>220 V AC</td>
</tr>
<tr>
<td></td>
<td>• Backup power supply for equipment</td>
<td>24 V DC</td>
</tr>
</tbody>
</table>

REFERENCE PROJECTS

- LLC Gazprom Transgaz Yugorsk
- LLC Gazprom Transgaz Ukhta
- LLC Gazprom Transgaz Nizhny Novgorod
- LLC Gazprom Transgaz Surgut
- LLC Gazprom Transgaz Yekaterinburg

MANUFACTURER

Branch of FSUE RFNC-VNIIEF
Scientific-Research Institute of Measuring Systems named after Y.E. Sedakov
niis.nnov.ru
TELEMETRY COMPLEX ARCHITECTURE

GPMD – Gas Pipeline Management Directorate
CCR – Central control room
CR – Control Room
RTD – receiving-transmitting device (Modem, radiomodem, etc.)
CS – controlled station
NVCS – non-volatile controlled station
ACS for GDS – automated control system for gas distribution station
AFCS – automatic flow control system
PVS – protection and video surveillance system
CMS – corrosion monitoring system
CPS – cathodic protection system
PO – process equipment

Data transferring channels: metric waves, radio relay link, fibre optics, GPRS/EDGE, satellite.
Important Operation Parameters Registration System

**PURPOSE**

*Important Operation Parameters Registration System (IOPRS)* is aimed at registration, storage and output of the information on the power unit state before, during and after the accident in the amount sufficient for subsequent analysis of the emergency situation and determining its cause and propagation, and for analysis of the personnel actions on its localization, response and prevention.

IOPRS is a two-channel system for registration of information on the power unit state, which is recorded on non-volatile media protected against external effects.

**MAIN FUNCTIONS**

- Collection of data from all provided sources of information.
- Registration and storage of data (archiving).
- Entry of accident archive, output of archive information, monitoring integrity of archived data.
- Archive reading, output and recording of archive information on IOPRS WS.
- Configuration of IOPRS servers.
- Information access control.
- Transfer of information on IOPRS hardware and software malfunction to upper level system LAN.
- Self-diagnostics of hardware & software tools.
- Diagnostics of an attempt of unauthorized access.
- Registration of system information.
- Maintenance of the unified time with I&C.
**KEY FEATURES**

- **IOPRS** is assigned to safety-related normal operation systems (3N class in accordance with NP-001-15).
- IOPRS servers comply with the requirements for I seismic category in accordance with NP-031-01.
- IOPRS servers comply with the requirements for resistance to seismic effects up to 7 MSK scale.
- Recording of the information is performed at the same time on the drive in the system unit and on the drive in the steel shelter.
- Possibility to save accident archives on non-volatile media (BD-RW, streamer).
- IOPRS servers comply with the requirements for III design group of interference immunity in accordance with GOST 32137-2013.
- Support of standard communication interfaces: Ethernet 10Base-T / 100Base-TX / 1000Base-T.
- Software and Hardware Self-diagnostics.

**TECHNICAL FEATURES**

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum volume of registered signals</td>
<td>250 000</td>
</tr>
<tr>
<td>Number of information sources</td>
<td>10</td>
</tr>
<tr>
<td>Recording speed of changing signals in normal operation, signal per sec:</td>
<td></td>
</tr>
<tr>
<td>• analog signals</td>
<td>1 000</td>
</tr>
<tr>
<td>• discrete signals</td>
<td>500</td>
</tr>
<tr>
<td>Recording speed of changing signals in extreme mode, signal per sec:</td>
<td></td>
</tr>
<tr>
<td>• analog signals</td>
<td>10 000</td>
</tr>
<tr>
<td>• discrete signals</td>
<td>1 000</td>
</tr>
<tr>
<td>Long-term functioning in extreme mode</td>
<td>1 min</td>
</tr>
<tr>
<td>Archive depth during nominal flow of signals</td>
<td>96 h</td>
</tr>
<tr>
<td>Operability time in case of common cause failure (power loss)</td>
<td>30 min</td>
</tr>
<tr>
<td>Accuracy of synchronization of internal clocks of servers</td>
<td>±5 ms</td>
</tr>
<tr>
<td>Mean time between failures of registration and storage function</td>
<td>50 000 h</td>
</tr>
<tr>
<td>Service life, years</td>
<td>At least 30</td>
</tr>
<tr>
<td>Mean time to recovery</td>
<td>2 h max</td>
</tr>
</tbody>
</table>
IOPRS
Important Operation Parameters Registration System

CONNECTION STRUCTURE

APPLICATION AREAS

Power generation facilities
- Nuclear power plants
- Thermal power plants and heat-and-power plants
- Hydro power plants

REFERENCE
- Bushehr-1 NPP
- Kudankulam NPP
- Beloyarsk NPP (Unit 4)

MANUFACTURER
Branch of FSUE RFNC-VNIIEF
Scientific-Research Institute of Measuring Systems named after Y.E. Sedakov
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**OC HW**
Operator Control Software and Hardware Tools

**PURPOSE**

Operator control software and hardware tools (OC HW) are software and hardware complex of automation tools, which is a base platform for building mimic diagram system and emergency area of monitoring and control of normal operation equipment to the extent necessary and sufficient for monitoring and control of equipment in case of loss of connection with upper level system.

Operator control hardware of Main Control Room and Emergency Control Room (OC HW of MCR, ECR) are intended for:

- providing MCR and ECR with monitoring and control tools of safety systems;
- providing MCR with emergency area of monitoring and control of normal operation equipment to the extent necessary for control of equipment without upper level system;
- providing MCR and ECR with safety systems which include indicators of Safety I&C control rods and data banners indicating the malfunction of Reactor Rod Control System (RRCS) equipment.
MAIN FUNCTIONS

- Transmission of remote control commands from Safety Panel (SP) sections, general mimic diagram (GMD), indication panel of Control and Protection System (CPS), post-accident monitoring, Electrical Equipment (EE) board, Normal Operation system sections via wired communication lines;
- Transmission and reception of analog and discrete signals on the state of the process equipment of SP, GMD, CPS, PAM, NOS section, EE board via wired circuits;
- Transmission of remote control commands from EE sections via digital interface;
- Displaying information on the state of the process equipment to personnel using digital and discrete-analog instruments, single indicators, emergency and preventive alarm board, passive mimic symbols and sound alarm;
- Transmission and reception of analog and discrete signals on the state of the process equipment of EE section.

APPLICATION AREAS

Electric power industry facilities
- Electric power transmission and distribution facilities: Common plant control rooms of power supply centers, opened and closed distribution and transformer substations; operator control centers of electrical grids.
- Nuclear power plants, thermal power plants and heat-and-power plants, hydro power plants

Oil and gas industry
- Oil refineries and petroleum chemical companies
- Gas processing companies
- Condensate stabilization plants and condensate pre-transportation preparation plants
SCOPE OF OC SHT PLATFORM

LARGE SCREEN DISPLAY

Large screen display (LSD) is intended for processing and display of information on the process at display cube screens of Main Control Room.

LSD includes:
- Up to 8 projection modules;
- Power supply and control rack;
- Cable set;
- Software tools, including tools for LSD testing in operation conditions: System SW (operating system, drivers); application SW within SCADA-system, remote control SW, test SW.

LSD TECHNICAL FEATURES

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional</strong></td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>DLP</td>
</tr>
<tr>
<td>DVI ports</td>
<td>2</td>
</tr>
<tr>
<td>Resolution of one display cube, pixels</td>
<td>1 400 x 1 500</td>
</tr>
<tr>
<td>Lighting</td>
<td>LED</td>
</tr>
<tr>
<td>Diagonal, inches</td>
<td>50</td>
</tr>
<tr>
<td>Projector brightness, lm, min</td>
<td>1 000</td>
</tr>
<tr>
<td>Contrast, min</td>
<td>1 500:1</td>
</tr>
<tr>
<td>Color rendering, number of colors / bit, min</td>
<td>16,7 mln / 24</td>
</tr>
<tr>
<td>Brightness uniformity, min</td>
<td>95%</td>
</tr>
<tr>
<td>Viewing angle from the normal vector in vertical and horizontal directions, degrees, min</td>
<td>-45 to +45</td>
</tr>
<tr>
<td>Average operation time of light sources (LED elements), h, min</td>
<td>50,000</td>
</tr>
<tr>
<td>Operability time when power supply is off, min</td>
<td>20</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td></td>
</tr>
<tr>
<td>Connection of control rack with projector modules</td>
<td>FOCL</td>
</tr>
<tr>
<td>Distance between control rack and projector modules, m, max</td>
<td>500</td>
</tr>
<tr>
<td>Power supply</td>
<td>187–242 V / 47–51 Hz</td>
</tr>
<tr>
<td>Maximum power consumption, kVA</td>
<td>2.5</td>
</tr>
<tr>
<td>Overall dimensions of power supply and control rack (WxHxD), mm</td>
<td>610 x 1800 x 870</td>
</tr>
<tr>
<td>Overall dimensions of display cube (WxHxD), mm, max</td>
<td>1 000 x 980 x 620</td>
</tr>
<tr>
<td>Weight of LSD, kg, max:</td>
<td></td>
</tr>
<tr>
<td>- Power supply and control cabinet</td>
<td>300</td>
</tr>
<tr>
<td>- One display cube</td>
<td>75</td>
</tr>
</tbody>
</table>
SP SECTION. SAFETY PANEL SECTION

Safety Panel section “SP section” is used within OC HW and intended for:

• Generation of remote control commands by actuators of safety channels from the scope of Engineered safety features actuation system (ESFAS);
• Display of information on the process equipment state via standard signals generated by devices of other I&C subsystems;
• Process alarm.

Safety Panel section includes:

• Digital and discrete-analog instrument devices;
• Single indicators;
• Banners of emergency & warning alarm messages;
• Passive mimic symbols and piezo-oscillators.

NOS SECTION. NORMAL OPERATION SYSTEM

Normal Operation system section “NOS section” is used within OC HW and intended for:

• Generation of remote control commands by actuators of normal operation (NO) process systems;
• Display of actuators state of normal operation process systems at mimic diagrams.

CPS SECTION. CONTROL AND PROTECTION SYSTEM

Control and Protection System section “CPS section” shall operate together with CPS equipment and is used within OC HW and intended for:

• Implementation of information functions of CPS electrical equipment;
• Control of CPS control rods position.
GMD SECTION. GENERAL MIMIC DIAGRAM
SECTION GMD SECTION

General Mimic Diagram section “GMD section” is used within OC HW and intended for:

- Generation of remote control commands by actuators of normal operation (NO) process systems;
- Display of information on state of actuators from the scope of Engineered safety features actuation systems (ESFAS).

EE SECTION. ELECTRICAL EQUIPMENT SECTION

Electrical Equipment section “EE section” is used within OC HW and intended for:

- Generation of remote control commands by actuators of normal operation (NO) power supply systems;
- Display of information on state of the process equipment of normal operation (NO) power supply system;
- Display of information on state of actuators from the scope of Engineered Safety Features Actuation System (ESFAS).

OPERATOR CONTROL TOUCHSCREEN PANEL

Operator Control touchscreen panel (OC TP) ensures:

- display of formats and control of process by touchscreen displays;
- reception of data from Ethernet-bus or digital interface of GOST R IEC 60870- 5-104 protocol and its conversion into videosignal for touchscreen displays;
- conversion and transmission of control signals sent to data packets in accordance with communication protocols via Ethernet-bus or digital interface of GOST R IEC 60870- 5-104 protocols;
- transmission of diagnostic signals on equipment state of OC panels and reception of standard time signals from Upper Level System via a separate digital interface 100Base-FX;
- mean time to failure, 250 000 h min.
### Functional
- Control channels of SP, NOS, CPS, GMD, EE sections
- Control channels of SP section ensure switching of DC voltage circuits
  - from 3.8 to 5.25 V with current from 0.2 to 100 mA
  - from 3.8 to 27.6 V with current from 0.2 to 250 mA
  - from 3.8 to 27.6 V with current from 0.2 to 2000 mA
  - from 3.8 to 27.6 V with current from 10 to 2000 mA
- Control channels of NOS section ensure switching of DC voltage circuits
  - from 21 to 27.6 V with current from 0.2 to 100 mA
  - from 21 to 27.6 V with current from 0.2 to 2000 mA
  - from 21 to 27.6 V with current from 10 to 2000 mA
- Control channels of CPS section ensure switching of DC voltage circuits
  - from 21 to 27.6 V with current from 0.2 to 100 mA
  - from 21 to 27.6 V with current from 0.2 to 2000 mA
  - from 21 to 27.6 V with current from 10 to 2000 mA
- Control channels of GMD section ensure switching of DC voltage circuits
  - from 3.8 to 27.6 V with current from 0.2 to 100 mA
  - from 3.8 to 27.6 V with current from 0.2 to 2000 mA
- Control channels of EE section ensure switching of DC voltage circuits
  - from 21 to 27.6 V with current from 0.2 to 100 mA
  - from 21 to 27.6 V with current from 0.2 to 2000 mA
  - from 187 to 242 V with current from 10 to 2000 mA
- Discrete information display channels include:
  - channels consisting of one single indicator;
  - channels consisting of group indicator (banner)
- Analog information display and instrument channels measure uniform signals of DC voltage and convert them into values of the main process parameters.
  - from 2 to 10 V (from 4 to 20 mA)
- Sound alarm channels ensure two signal types of the possible seven types with the priority of the first (second, third, fourth) one over the fifth (sixth, seventh) channel.

### Design, reliability
- Overall dimensions (W x H x D), mm:
  - SP section, EE section: 1306 x 2305 x 805
  - CPS section: 805 x 2305 x 605
  - NOS section, CPS section, GMD section: 1285 x 2365 x 800
- Weight, kg, max: 350
- Service life, years: 30
- Specified operation time, h: 250,000
- Mean time to failure, h:
  - for one control or discrete information display channel: $5.0 \times 10^5$
  - for one instrument and analog information display channel: $1.5 \times 10^5$

### Reference
- Bushehr NPP, Unit 1;
- Kudankulam NPP, Units 1, 2, 3, 4;
- Beloyarsk NPP, Unit 4;
- Belarusian NPP, Units 1, 2;
- Novovoronezh NPP-2, Units 1, 2;
- Rostov NPP, Units 3, 4.

### Manufacturer
Branch of FSUE RFNC-VNIIEF
Sedakov Scientific Research Institute of Measuring Systems
nniiis.nnov.ru
JSC RASU is a subsidiary of Rosatom State Atomic Energy Corporation and since 2015 has been a general and exclusive system integrator and supplier of ROSATOM for instrumentation and control systems (I&C) of nuclear facilities. The company has designed the comprehensive and balanced product proposal of state-of-the-art end-to-end solutions that includes design, engineering, commissioning, maintenance, modernization and decommissioning of NPP I&C systems. JSC RASU has successfully implemented and continues implementing various projects on automation of nuclear power plants on the territory of Russian Federation as well as in Europe, Asia and Africa.

The latest realized projects in Nuclear power industry

- **Novovoronezhskaya NPP-2**
  Turn-key solution of I&C system for power unit №6 with VVER-1200 reactor of 3+ generation (see notes).

- **Leningradskaya NPP-2**
  Turn-key solution of I&C system for power unit №1 with VVER-1200 reactor of 3+ generation (see notes).

- **Rostovskaya NPP**
  I&C system installation and commissioning for power unit №4.

Notes:
1. NPP design with VVER-1200 reactor of 3+ generation is the main export product/solution of Rosatom that is being fully engineered with digital design instruments.
2. There is a new concept of active 4 independent channel safety system that is used in new design with 3+ VVER-1200 reactor.
3. Hardware and software tools comply to local and international standards for purposes of redundancy, independence and diversity principles.
4. I&C system implemented on Leningradskaya NPP-2 is going to be considered as a reference project for Finland, Hungary and Turkey NPP projects.
Distribution of I&C Subsystems
(based on the standard NPP design)
Distribution of I&C Subsystems (based on the standard NPP design)
Distribution of I&C Subsystems
(based on the block diagram of the Leningrad NPP I&C)
Distribution of I&C subsystems (based on the block diagram of the Leningrad NPP I&C)
I&C Functional Systems

NUCLEAR POWER

UPPER UNIT/PLANT LEVEL SYSTEM (UULS/UPLS)

Purpose:
- Centralized monitoring and displaying information on the process state to the maintenance personnel, and ensuring control of the I&C equipment.

Manufacturers of system components:

OPERATOR CONTROL HARDWARE (OC HW)

Purpose:
- Displaying information on the process equipment state, alarm, monitoring and control of normal operation systems in the scope required to ensure control in case of the Upper Unit Level System failure, monitoring and recording parameters, qualifying a post-accident state.

Manufacturers of system components:
IMPORTANT OPERATION PARAMETERS REGISTRATION SYSTEM (IOPRS)

Purpose:
- Recording, storing and output of information on the power unit state before, during and after the accident in the amount sufficient for subsequent analysis of the emergency situation, for determining its cause and propagation, and for analysis of the personnel actions on localization, response and prevention of the accident.

Manufacturers of system components:

REACTOR CONTROL & PROTECTION SYSTEM — ENGINEERED SAFETY FEATURES ACTUATION SYSTEM (RCPS-ESFAS)

Purpose:
- Automatic and manual control of power, reactivity and power distribution in the reactor core, ensuring control of thermal, hydraulic and neutronic parameters of the reactor plant, control of CPS control rods, recording of events and interchange of signals with the adjacent I&C subsystems.

INITIATING PART OF EMERGENCY AND PREVENTIVE PROTECTION SUBSYSTEM OF ENGINEERED SAFETY FEATURES ACTUATION SYSTEM (EP/PP ESFAS)

Purpose:
- Generation of initiating EP/PP signals, monitoring of neutronic and process parameters, monitoring discrete signals on the state of equipment and subsystems, generation of required data on the controlled parameters and alarm.

Manufacturers of system components:
SAFETY INSTRUMENTATION & CONTROL SYSTEM (SAFETY I&C)

Purpose:
- Automation in anticipated operational occurrences during processes of removing the heat from reactor core, protection of the primary and secondary circuits against overpressure, containment localization, bringing the reactor into subcritical state, monitoring and control of the safety systems while they perform their functions.

Manufacturers of system components:

SUPPLEMENTARY (DIVERSE) PROTECTION SYSTEM (DPS)

Purpose:
- Control of beyond design basis accidents when initiating events, defined in design of the NPP reactor plant, overlap and when there is a common cause failure of emergency and preventive protection of initiating part of the safety I&C system (IP of Safety I&C EP-PP).

Manufacturers of system components:

NEUTRON FLUX MONITORING EQUIPMENT (NFME)

- Monitoring the physical power, reactor period, reactivity, local parameters of the reactor core according to neutron flux density and its change rate.

Manufacturers of system components:
INDUSTRIAL SEISMIC PROTECTION SYSTEM (ISPS))

Purpose:
• Ensuring monitoring and automatic recording of seismic impact on the reactor plant and generating a signal on exceeding of the emergency protection threshold with regard to seismic impact level to shut down the reactor when the earthquake magnitude exceeds the design values.

Manufacturers of system components:

WATER CHEMISTRY INSTRUMENTATION AND CONTROL SYSTEM (CWC I&C)

• Ensuring automated acquisition, processing, documenting and storage of data in the scope, sufficient for timely detection of breaches of standard WCH indicators, generation and implementation of the control signals.

Manufacturers of system components:

NORMAL OPERATION INSTRUMENTATION & CONTROL SYSTEMS (NO I&C)

Purpose:
• Monitoring and control of normal operation system processes in all NPP design basis modes of the power unit operation, and continuous diagnostics of the system hardware operability.

Manufacturers of system components:
MONITORING, CONTROL AND DIAGNOSTIC SYSTEM (MCDS)

Purpose:
• Monitoring, control and diagnostics of the reactor plant equipment, including monitoring of chain fission reaction in the reactor core.

IN-CORE INSTRUMENTATION SYSTEM (ICIS)

Purpose:
• Monitoring of neutronic, thermal and hydraulic parameters and indicators of the reactor core state, parameters of the primary and secondary cooling circuits, generation and transmission of emergency and preventive protection signals on the in-core local parameters, monitoring of operational limits and safe operation limits.

Manufacturers of system components:

INTEGRATED ANALYSIS SYSTEM (IAS);

Purpose:
• Displaying information on reactivity, current state of reactor core, power distribution in the reactor core and required boric acid concentration.

Manufacturers of system components:
ONLINE DIAGNOSTIC SYSTEM (ODS)

Purpose:
- Integrated assessment of equipment integrity based on information from Leak Detection System, Radiation and Process Monitoring System, output of information and alarm on detected malfunctions.

Manufacturers of system components:

FATIGUE MONITORING SYSTEM (FMS)

Purpose:
- Assessment of the remaining lifetime of the main equipment of the reactor plant based on continuous monitoring of thermal parameters in various operating modes of the reactor plant.

Manufacturers of system components:

HARDWARE & SOFTWARE MEASUREMENT SYSTEM [HW/SW MEASUREMENT SYSTEM]

Purpose:
- Measurement and display of data on reactivity required to monitor the neutronic properties of the reactor core when putting the unit into operation, during commissioning activities, low power operation and routine measurements performed after refueling.

Manufacturers of system components:
AUTOMATED RADIATION MONITORING SYSTEM (ARMS)

Purpose:
• Radiation and process monitoring of the power unit, and radiation monitoring in premises, storage facilities, filters, emissions and discharges.

Manufacturers of system components:

AUTOMATED RADIATION SITUATION MONITORING SYSTEM (ARSMS)

Purpose:
• Continuous monitoring of radiation and meteorological conditions in the area of radiation hazardous facility.

Manufacturers of system components:

MONITORING SYSTEM FOR VIBRATION AND MECHANICAL VALUES (VMMS)

Purpose:
• Monitoring of vibration characteristics of the process equipment components, generation of emergency signals when exceeding the set vibration parameters, transmission of these values to the upper level system, diagnostic of equipment vibration state, detecting the origin and development of specific defects in equipment components.

Manufacturers of system components:
FIRE PROTECTION INSTRUMENTATION AND CONTROL SYSTEM (FP I&C)

Purpose:
• Automatic fire detection, control of fire automation system and process equipment of the protected facility.

Manufacturers of system components:

ELECTRICAL EQUIPMENT INSTRUMENTATION AND CONTROL (EE I&C)

Purpose:
• Monitoring and control of electrical equipment and informing the operating personnel on the current operating and switching mode of electrical equipment, anticipated operational occurrences and malfunctions of the electrical equipment by displaying the relevant information.

Manufacturers of system components:
COMMON PLANT AND LOCAL NPP I&C SUBSYSTEMS

Purpose:
Performing specific functions of the NPP I&C.
List of systems:
• Common Plant Instrumentation and Control Systems for Local Control Stations (CP LCR I&C)
• Defective Assembly Detection System (DADS)
• Transport Complex Control System (TCCS)
• Polar Crane Control System (PCCS)
• Refueling Machine Control System (RMCS)
• Transformer Equipment Monitoring and Diagnostics System (TEMDS)
• Reactor Coolant Pump Process Diagnostics System (RCPPDS)
• Unit Diesel Power Station Instrumentation and Control System (UDPS I&C)
• Emergency Diesel Power Station Instrumentation and Control System (EDPS I&C)
• Decontamination Equipment Instrumentation & Control System (DE I&C)
• Oil & Diesel Pump Station I&C (ODPS I&C)
• Pre-operational Cleaning Facility I&C (POCF I&C)
• Control System for Solid Radioactive Waste Treatment Equipment
• Control System for Liquid Radioactive Waste Consolidation Facility
• SW & HW Package for Drain Water Treatment System
• LCS of Instrumentation and Control System for Cementation Plant
• LCS of Instrumentation and Control System for NZK-150-1,5P Handling Equipment
• LCS for Laundry Water Treatment I&C
• SF6 Concentration Monitoring System in rooms of 330 kV gas-insulated switchgear building
• Automated Engineered Structure Monitoring System
• Integrated Valves Diagnostic System
• Containment Prestress and Reinforced Cable Strain Monitoring System
• Leak Monitoring System for Containment Leak Tight Enclosure during Strength & Leak Tests

Manufacturers of system components:
SAFETY PARAMETERS DISPLAY SYSTEM (SPDS)

Purpose:
- Information support of operating personnel actions when making decisions on control of design basis and beyond design basis accidents and mitigating their consequences.

Manufacturers of system components:

TECHNICAL AND ECONOMIC INDICATORS CALCULATION SYSTEM

Purpose:
- Automated calculation and analysis of technical and economic indicators for efficiency of the main and auxiliary equipment of the power unit.

Manufacturers of system components:
JSC RASU relies on more than 25 years of experience gained by Rosatom companies in implementing various projects in the oil and gas sector and together with their partners JSC RASU is ready to provide solutions on any tasks of the client: from automation of individual local process facilities to design of distributed systems for control of the company's process chain.

In the past quarter of a century, I&C systems for oil and gas companies of various scale and complexity have been developed: from simple telemetry systems to I&C for both local facilities and territorially distributed enterprises. Our joint solutions are based on the principles of development of reliable, failure-free, safe and efficient I&C systems:

- Client orientation
- Engineering capabilities and many years of experience in I&C design and development
- Quality Management System at all levels: from development to support of systems during operation
- Modern process solutions and industrial infrastructure

**Recent projects:**

**Modernization of I&C for GCS-1 of South-Balyk gas field**

**Customer:** PJSC Rosneft Oil Company  
**Project Duration:** 2 years

As a result of modernization, Allen Bradley's foreign equipment was replaced with domestic TPTS tools. At the same time, the amount of automation equipment with the maintained scope of the existing functionality and implementation of new one has been significantly reduced.

**Modernization of I&C for OPP-2 in Nizhnevartovsk oil refining facility**

The customer noted the advantages of Russian development and components:
- The possibility of building both centralized and distributed control systems;
- High accuracy of measurements;
- High resistance to cyber-threats.

**Modernization of I&C for CS-4 of Nadum LPU MG "Gazprom Transgaz Yugorsk"**

The automatic control system of GPA GTK-10 and automatic control system of CS-4 were implemented at the facility.

**Number of signals** – 20 000.
I&C Functional Systems

OIL & GAS

MANUFACTURING EXECUTION SYSTEM (MES)
FOR GAS PRODUCTION ENTERPRISE

Purpose:
- Centralized management and control of the main and additional processes of gas producing plant.

System Manufacturer:

SOFTWARE AND HARDWARE TOOLS
FOR TELEMETRY AND AUTOMATION

Purpose:
- Operational monitoring and control of distributed remote terminal units, automation controllers, other devices and equipment of I&C systems based on these tools for information, control and metering of power consumption purposes.

System Manufacturer:
ABNORMAL EVENTS DETECTION SYSTEM FOR MULTILINE GAS PIPELINES

Purpose:
• Early real-time detection of abnormal events on multiline gas pipelines, determining type and location of event and generation of messages for control engineer.

System Manufacturer:

AUTOMATED FORCED DRAFT FAN CONTROL SYSTEM

Purpose:
• Control of draft fan system (air and gas type) that provide oxygen or another gas transportation in pipelines under the pressure.

System Manufacturer:

AUTOMATED GAS-COMPRESSOR PLANT CONTROL SYSTEM/COMPRESSOR STATION AUTOMATED CONTROL SYSTEM «SUPRA-NN»

Purpose:
• Automated control, adjustment of operating modes, monitoring and protection gas compressor units, main and additional equipment of compressor station.

System Manufacturer:
AUTOMATED GAS ODORIZING SYSTEM

Purpose:
• Pulsed supply of odorant in the flow of gas and generation of emergency and preventive alarms.

System Manufacturer:

AUTOMATED PROTECTION SYSTEM

Purpose:
• Automatic shutdown of the broken reduction lines or malfunction of Gas Distribution Station with uncontrolled increase of gas pressure, generation and transmission of information, preventive & emergency alarms on the state of reduction lines, overall reduction node, and pressure in the inlet and outlet of the reduction node to the operator and telemetry system.

System Manufacturer:
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Automation Controller</td>
</tr>
<tr>
<td>ACS for CS</td>
<td>Automated Control System for Compressor Shop</td>
</tr>
<tr>
<td>ACS for GDS</td>
<td>Automated Control System for Gas Distribution Station</td>
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<tr>
<td>ACS for GPU</td>
<td>Automated Control System for Gas Pumping Unit</td>
</tr>
<tr>
<td>AFCS</td>
<td>Automatic Flow Control System</td>
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<tr>
<td>AMCS</td>
<td>Automated Manage and Control System</td>
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<tr>
<td>AP</td>
<td>Automation Processor</td>
</tr>
<tr>
<td>APM</td>
<td>Automation Processor Module</td>
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<tr>
<td>APS</td>
<td>Automatic Protection System</td>
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<tr>
<td>ARMS</td>
<td>Automated Radiation Monitoring System</td>
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<td>ARSMS</td>
<td>Automated Radiation Situation Monitoring System</td>
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<td>ASCAPC</td>
<td>Automated Systems for Commercial Accounting of Power Consumption</td>
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<td>AWS</td>
<td>Automated Workstation</td>
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<td>BPS</td>
<td>Booster Pump Stations</td>
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<tr>
<td>CCD</td>
<td>Central Coordinating Device</td>
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<tr>
<td>CCR</td>
<td>Central Control Room</td>
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<tr>
<td>CHPP</td>
<td>Central Heating and Power Plant</td>
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<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>CMS</td>
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<td>CODP</td>
<td>Crude Oil Distillation Plants</td>
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<td>CP EE I&amp;C</td>
<td>Common Plant Electrical Equipment Instrumentation and Control</td>
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<td>CP LCR I&amp;C</td>
<td>Common Plant Instrumentation and Control Systems for Local Control Stations</td>
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<td>CS</td>
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<td>Water Chemistry Instrumentation and Control System</td>
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<td>CWT I&amp;C</td>
<td>Chemical Water Treatment I&amp;C</td>
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<tr>
<td>DA SHP</td>
<td>Data Acquisition Software and Hardware Tools</td>
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<tr>
<td>DADS</td>
<td>Defective Assembly Detection System</td>
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<td>Abbreviation</td>
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<td>DAPD</td>
<td>Data Acquisition and Processing Devices</td>
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<td>DB</td>
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<td>DE I&amp;C</td>
<td>Decontamination Equipment</td>
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<td>DPS</td>
<td>Additional (Diverse) Protection System</td>
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<td>DS</td>
<td>Diagnostic Station</td>
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<td>DSM</td>
<td>Input/output module for discrete signals</td>
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<td>ECR</td>
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<td>External Signals Connection Module</td>
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<td>Engineered Safety Features Actuation System</td>
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<td>MES</td>
<td>Manufacturing Execution System</td>
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<td>NO SR I&amp;C</td>
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<td>NOS</td>
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<td>NPP</td>
<td>Nuclear Power Plant</td>
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<td>NVCS</td>
<td>Satellite (Non-volatile) Controlled Stations</td>
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<td>OC HW</td>
<td>Operator Control Hardware</td>
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<td>OCM</td>
<td>Object Communication Module</td>
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<td>ODPS I&amp;C</td>
<td>Oil &amp; Diesel Pump Station I&amp;C</td>
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<td>ODS</td>
<td>Online Diagnostic System</td>
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<td>OS</td>
<td>Operation System</td>
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<td>PCCS</td>
<td>Polar Crane Control System</td>
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<td>PCS</td>
<td>Priority Control Stations</td>
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<td>PIM</td>
<td>Process Interface Modules</td>
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<td>Programmable Logical Controller</td>
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<td>PLU-CV</td>
<td>Priority Logic Unit for Control Valve</td>
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<td>PO</td>
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<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
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<tr>
<td>POCF I&amp;C</td>
<td>Pre-operational Cleaning Facility I&amp;C</td>
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<td>PP</td>
<td>Preventive Protection</td>
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<tr>
<td>PP IP</td>
<td>Initiating Part of Preventive Protection</td>
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<tr>
<td>PSCIM</td>
<td>Power supply connection and indication module</td>
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<tr>
<td>PSCIM</td>
<td>Power Supply Connection and Indication Module</td>
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<td>Power Supply Rack</td>
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<td>PVS</td>
<td>protection and video surveillance system</td>
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<td>RA</td>
<td>Remote Alarm</td>
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<td>RCPPDS</td>
<td>Reactor Coolant Pump Process Diagnostics System</td>
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<td>RCPS EE</td>
<td>Reactor Control and Protection System Electrical Equipment</td>
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<td>RCPS-ESFAS</td>
<td>Reactor Control &amp; Protection System - Engineered Safety Features Actuation System</td>
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<tr>
<td>RM</td>
<td>Remote Measurement of Current Parameters</td>
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<td>RM</td>
<td>Radio Modem</td>
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<td>RMCS</td>
<td>Refueling Machine Control System</td>
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<td>RPAD</td>
<td>Relay Protection and Automation Devices</td>
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<td>RPMD</td>
<td>Relay Protection Microprocessor Device</td>
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<td>RRCS</td>
<td>Reactor Rod Control System</td>
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<td>RSL</td>
<td>RS485 Data Exchange Module</td>
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<td>RTD</td>
<td>Receiving-transmitting Device</td>
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<td>RTDB</td>
<td>Real-time Database</td>
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<td>RTU</td>
<td>Remote Terminal Unit</td>
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<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<td>Safety I&amp;C</td>
<td>Safety Instrumentation &amp; Control System</td>
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<td>SAIR</td>
<td>Stand-alone Instrument Rack</td>
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<td>SCD</td>
<td>Server Communication Device</td>
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<td>Synchronism Check Relay</td>
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<td>Safety Parameters Display System</td>
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<td>Special Building I&amp;C</td>
<td>Special Building Instrumentation and Control System</td>
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<tr>
<td>SS</td>
<td>Safety System</td>
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<tr>
<td>SVM-A</td>
<td>Switch voting module for &quot;A&quot; diversity</td>
</tr>
<tr>
<td>SVM-B</td>
<td>Switch voting module for &quot;B&quot; diversity</td>
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<tr>
<td>SW</td>
<td>Software</td>
</tr>
<tr>
<td>SW</td>
<td>EN Bus Switch</td>
</tr>
<tr>
<td>SWL</td>
<td>ENL Bus Switch</td>
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<tr>
<td>SWT I&amp;C</td>
<td>Special Water Treatment I&amp;C</td>
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<tr>
<td>TCCS</td>
<td>Transport Complex Control System</td>
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<tr>
<td>TCS/TPS EE</td>
<td>Turbine Control and Protection System Electrical Equipment</td>
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<td>TD</td>
<td>Telecommunication Device</td>
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<td>TEMDS</td>
<td>Transformer Equipment Monitoring and Diagnostics System</td>
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<tr>
<td>TG I&amp;C</td>
<td>I&amp;C System for Turbine Generator Auxiliaries</td>
</tr>
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<td>TM SHT</td>
<td>Telemetry Software &amp; Hardware Tools</td>
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<td>TPP</td>
<td>Thermal Power Plant</td>
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<td>UDPS I&amp;C</td>
<td>Unit Diesel Power Station Instrumentation and Control System</td>
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<td>ULS</td>
<td>Upper Level System</td>
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<tr>
<td>UNK TM</td>
<td>Unified Telemetry Complex</td>
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<tr>
<td>UOPU</td>
<td>Unified Oil Processing Units</td>
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<tr>
<td>UPLS</td>
<td>Upper Plant Level System</td>
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<td>US</td>
<td>Unified Server</td>
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<td>UULS</td>
<td>Upper Unit Level System</td>
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<tr>
<td>VM-A</td>
<td>&quot;A&quot; diversity voting module</td>
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<tr>
<td>VM-B</td>
<td>&quot;B&quot; diversity voting module</td>
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<tr>
<td>VMMS</td>
<td>Monitoring System for Vibration and Mechanical Values</td>
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<tr>
<td>VT</td>
<td>Voltage Transformer</td>
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<tr>
<td>WT I&amp;C</td>
<td>Water Treatment Instrumentation and Control System</td>
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JSC RUSATOM AUTOMATED CONTROL SYSTEMS

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E-mail: info@rasu.ru  
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