



PLUTON GROUP OF COMPANIES





PLUTON GROUP OF COMPANIES. MAIN OFFICE



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PLUTGT



GENERAL INFORMATION



Location of Mother Company LLC Pluton IC

4-B Lukasha M. st., Lviv, 79026 Ukraine



9 representative offices around the globe

30 years of experience

in electrical equipment manufacturing

515 implemented projects

in 99 cities of the world



Number of employees

- in Ukraine more than 320 persons;
- other countries more than 100 persons.

Share of exports

• over 80 %.



SCOPE OF ACTIVITIES



Turn-key substations for power industry, metro, city electric transport, railway



Electric equipment packages for different mechanisms and systems



Automatic control systems of technological processes at iron and steel works, power and mining enterprises, transport



HISTORY

1970 1980 1990 2000 2010 2020

1970



All-Union Production Association "Preobrazovatel" — leading manufacturer of electrical industry

1992



PLUTON — leading manufacturer of equipment for traction substations of public electric transport, metro and railway

PRODUCTION AREA





PRODUCTION AREA





PRODUCTION AREA

(PLUTON POLSKA, WARSAW)









ORGANIZATION CHART





CONFORMITY CERTIFICATES





Quality Management System





Environmental Quality System





Occupational Health and Safety
Management System





TRACTION SUBSTATIONS. EQUIPMENT









Medium voltage switchgear 6 kV... 40.5 kV

600...3300 V DC:

- rectifiers;
- transformers.

DC Switchgear 600...3300 V

LV Switchgear:

- DC and AC Switchgear 0.4 kV and 0.23 kV;
- auxiliaries.

SCADA System:

- lower level including duty operator's automated workplace;
- power operator's upper level control system (SCADA).



TRACTION SUBSTATIONS. EQUIPMENT









Uninterrupted power supply systems:

- charging and rectifying units;
- accumulator batteries;
- UPS.

Reactive power compensation units

Microclimate control systems

Catenary system equipment:

- cabinets with line disconnectors;
- switchgear for dead-end rail power supply;
- cable connection points, tunnel equipment for depot, etc.

Modular traction substations



MEDIUM VOLTAGE SWITCHGEAR 27.5 KV



27.5 kV switchgear manufactured by PLUTON are meant for reception and distribution of AC electric energy of 50 Hz power frequency, with rated voltage of 27.5 kV at AC railway traction substations.

We have created 27.5 kV switchgear which provide reliability and uninterrupted power supply, safety of operation and convenience of service.



MEDIUM VOLTAGE SWITCHGEAR 27.5 KV Advantages

- application of vacuum circuit breaker produced by Siemens;
- maximum protection against accidental touch to live parts due to the fact that all switchgear components are located in metal enclosure;
- optimal maintenance safety owing to interlocking system that prevent faulty actions of personnel;
- resistance to emergency arc owing to interlocks and protected enclosure;
- cubicles were **tested** for the influence of arc in the independent testing facility;
- protected closed enclosure is resistant to environmental influence.



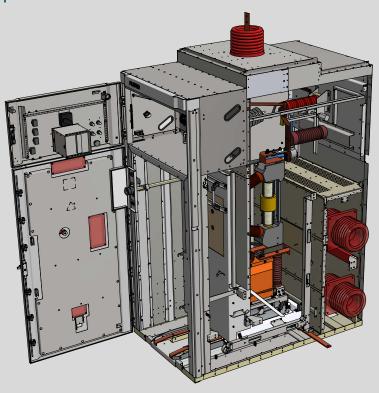


MEDIUM VOLTAGE SWITCHGEAR 27.5 KV Design





MEDIUM VOLTAGE SWITCHGEAR 27.5 KV Design



Design features:

- **free access** to all functional groups of equipment;
- possibility of switchgear built-on equipment manual control when compartments doors are closed;
- single-sided maintenance;
- vacuum circuit breaker is installed on trolley;
- **sliding shutter** for maintenance safety.



Main advantages



Benefits of X10 Evolution medium voltage switchgear:

- **internal arc resistance** (IAC classification AFLR), verified by type tests for localization in an accredited test center;
- gas exhaust duct with pressure relief valve for each compartment (except relay protection compartment);
- **protection** against operating personnel mistakes due to built-in mechanical and electromagnetic interlocks;
- ensuring an increased level of operational safety;
- digital relay protection;
- medium voltage switchgear complies with IEC 62271-1 and IEC 62271-200 standards requirements.



Main advantages

Benefits of X10 Evolution medium voltage switchgear:

- withdrawable elements with electric drive option;
- due to compact size of the switchgear, they can be placed in a substation with minimum of space, contributing to a more efficient use of area.





Main components



EasyPact EXE circuit breaker

- rated current: 630 A, 1250 A, 1600 A, 2000 A, 2500 A;
- rated breaking current: 25 kA-31,5 kA;
- mechanical life: 10,000 operations;
- new withdrawable trolley with the circuit breaker motorized draw-in and –out option;
- secure interlocking system;
- possibility of the circuit breaker remote draw-in/-out;
- reliable vacuum chambers, drive mechanism and withdrawable trolley.



Main components



EasyPact EXE circuit breaker

An important benefit of EasyPact EXE vacuum circuit breakers is their compactness and relative lightweight. They occupy less space and weight than standard circuit breakers, making them easy to install and maintain.

EasyPact EXE vacuum circuit breakers offer long service life and minimal maintenance requirements, reducing total cost of mastering them.



for city electric transport and metro



Rectifiers are produced both with "zero" and "bridge" 6- and 12-pulse rectification circuits.

Rectifier arm can be made with "diode-diode" or "diode-fuse" structure.

Rectified current 800 A, 1000 A, 1250 A, 1600 A, 2000 A, 2500 A, 3000 A, 4000 A, 5000 A, 8000 A.

Rectifiers are equipped with oil and dry transformers (Resibloc®).



for railways





Rectifiers are produced both with "bridge" 12-pulse rectification circuits.

Rectified current 2000 A, 3150 A, 4000 A.

Rectifiers are equipped with oil and dry transformers (Resibloc®).



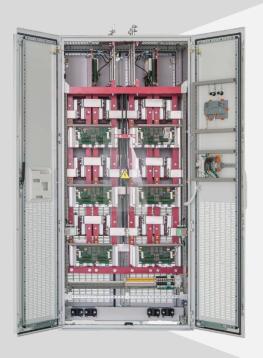
Advantages

- forced current division in parallel branches;
- two diodes connected in series provides longer service life due to decrease of cyclic-repeated loads, double reserve in class;
- diodes diagnostics in four parameters;
- diodes heating temperature supervision;
- protection against overvoltage;
- support of IEC 61850 protocol;
- WEB interface;
- events protocol.





Main components





Diodes

Pill diodes class 25 manufactured by VISHAY.

For better reliability, longer service life, each rectifier arm has 2 diodes connected in series.



Galvanic isolation boards

Protection against internal switching surge voltage.

Information acquisition on diode condition and temperature for the analysis of diodes condition by diagnostics system.



Protection panels

Protection of power semiconductors against external switching surge.



Main components

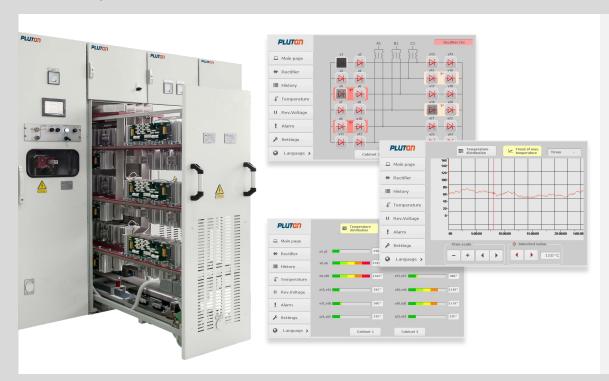
Protection, diagnostics and control system:

- built on the basis of industrial controller SOTA® manufactured by PLUTON;
- support of IEC 61850 protocol for power systems;
- continuous monitoring of each diode parameters in dynamic mode;
- visualization of temperature distribution, reverse voltage distribution;
- protection of rectifier and converting transformer;
- communication with SCADA system.





Main components



The following information is displayed on visualization panel of SOTA® controller:

- · rectifier single-line diagram;
- events log;
- · diodes temperature;
- diodes temperature variation diagram;
- reverse voltage distribution between two diodes in series;
- signals:
 - transformer overheating;
 - doors condition;
 - rectifier overheating;
 - diode parameters derating;
 - diode breakdown;
 - diode fault.



Withdrawable rectifiers

PLUTON offers withdrawable rectifiers.

Advantages of withdrawable rectifiers:

- easy access to components for convenient maintenance;
- compact design;
- operating safety;
- increased concentration of power per unit volume of rectifier.







Withdrawable rectifiers







IEC, EN conformity tests



Rectifiers manufactured by PLUTON were successfully type-tested for the conformity to the International standards (IEC) and the European standards (EN) in test center IPH Institut (Berlin, Germany).



TRANSFORMERS Advantages

- reliable operation under conditions of high pollution density, high humidity, low temperature;
- **dynamic stability** of the winding 650-750 N/mm²;
- all the materials are flame-resistant and do not sustain combustion process;
- vibration-absorbing units;
- windings and core temperature supervision;
- "cold" start with maximum load;
- minimum technical maintenance;
- increased resistance to overvoltage and short-circuit currents.







DC SWITCHGEAR



DC switchgear include components from world-leading manufacturers with high switching capacity, high dynamic resistance to short-circuit currents, and sufficient mechanical durability.



DC SWITCHGEAR

Advantages

- smaller overall dimensions;
- application of maintenance-free components;
- high reliability;
- convenient maintenance and personnel safety;
- microprocessor monitoring and traction network protection system;
- high level of automation that excludes human factor;
- long service life (30 years);
- protection against dust and humidity (protection level IP43).





DC SWITCHGEAR

Main components

DC high speed circuit breaker (Sécheron, Switzerland):

- design providing minimum maintenance;
- high switching capacity;
- minimum tripping time;
- automatic setting of contact tightness;
- long lifetime;
- insulation material wiping under arc;
- stepless regulation of trip setting;
- high mechanical resistance 8x25000 cycles.





Main components



AFB® arc-free ultra high-speed DC circuit breaker (PLUTON):

- arc-free commutation principle, high wear resistance, the lowest maintenance;
- ultra high speed of short circuit currents interruption;
- safety and environmental friendliness, no damaging effect of arc.



Main components



Service busbar double-pole disconnector:

- wiping contacts;
- long time without maintenance (once every 10 years);
- silent economic electric drive (18 W);
- high electrodynamic resistance;
- high mechanical resistance (30 000 cycles);
- allows to install trolley into service position without mechanical effort.



Main components

Service busbar double-pole disconnector

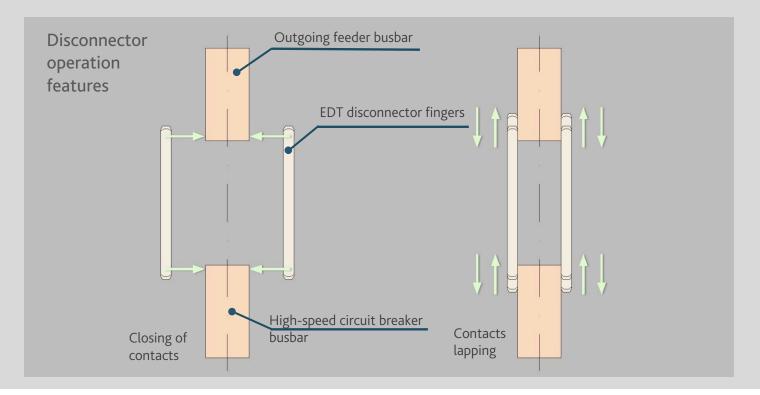
Disconnectors have unique design of contact system. The contacts move during operation and crimp the busbar.

Disconnectors require lowest maintenance, once every 10 years.





Main components





DC SWITCHGEAR Main components













Main components



Cable control system:

- resistance measurement range of external cable insulation — 50-500 kOhm, of internal cable insulation — 200-2000 kOhm;
- operating line power supply;
- 3 pairs of discrete failure signals;
- galvanic isolation from processing module (SMTN-3 system) by means of optic fiber.



Main components



Line tester (short circuits tester SCT):

- line resistance measurement;
- high speed circuit breaker tripping interlock.



Main components

SOTA® system is a combined microprocessor-based relay protection device. This solution combines relay protection and PLC systems into a single modular system for performing a wide range of tasks.

Modular architecture of SOTA® system, combined with modern surface mount technology, ensures high reliability, high processing power, and fast response.

SOTA® provides high precision measurement of electrical values and time intervals to improve performance of processing operations and response of protection functions.





SOTA® Main functions



Traction network parameters monitoring



Emergency processes waveforms recording



Data collection for further analysis



Traction network protection against short-circuit current and overloads



Events logging



System remote control



Cubicle operation control (PLC)



Daily trends storage



Communications protocols support

SOTA® Protection functions



SOTA® provides the following protections:

lo	instantaneous overcurrent (ANSI 50)
lmax	time overcurrent protection (ANSI 76)
di/dt	current rate of rise protection
ΔΙ	current increment directional protection
I(t)	time/current protection (ANSI 49)

Umin	undervoltage protection(ANSI 27)
Umax	overvoltage protection (ANSI 59)
BF	breaker failure
DDL	DDL protection
R-prot.	impedance protection



SOTA® Control functions



- displaying the required information on visualization panel with liquid crystal graphic display;
- switching units control in convenient intuitive form;
- PLC operation algorithms programming using IEC 61131-3 standard languages (ST, IL, LD, FBD, SFC).



SOTA® processing module



SOTA®

Measuring and recording functions

SOTA® generates and stores the following records:



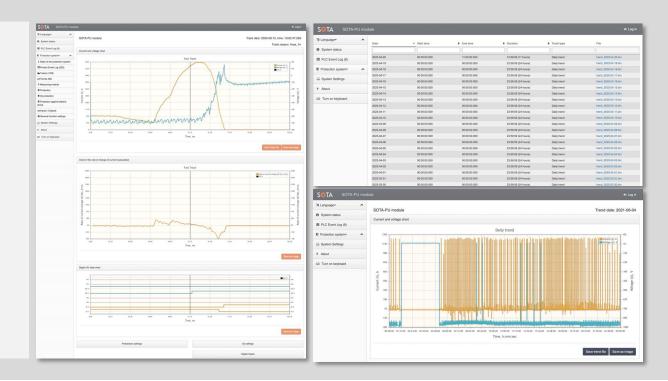
events log; failures log;



emergency oscillograph records (Fast track, Slow track);



daily trend





SOTA®

Measuring and recording functions

Emergency records can be:

- viewed using Web-interface,
- read by upper level system via **Ethernet interface**,
- saved on external USB disc for later analysis using PC.





SOTA® Data storage functions



SOTA® stores emergency processes data for further analysis:

up to 200 emergency records

(Fast track, Slow track)

up to 200 days in events log

up to 60 days daily trends



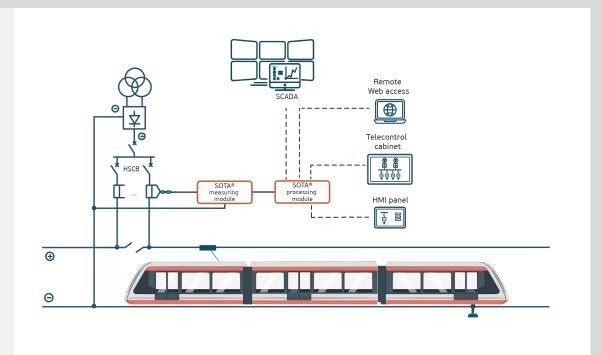


SOTA®

Communication functions



- reading of traction network actual electrical parameters by the upper level system from SOTA® (or their independent transfer when using IEC 61850 protocol);
- two-way data transfer between SOTA® and ACS, PC via standard communication channels.





SOTA® Advantages

COMPLIANCE WITH INTERNATIONAL STANDARDS

- IEC 60068-2-1, -2. -6. -14. -27. -30. -31. -78
- IEC 60255-21-1,
- IEC 61131-1,2
- IEC 60255-26 EMC
- COMMUNICATION
 - SOTA **PROTECTION**

ANALYSIS

DIAGNOSTICS CONTROL

> PLC PROGRAMMING **LANGUAGES SUPPORT**

MONITORING

- IEC 61131-3



COMMUNICATION PROTOCOLS SUPPORT

Modbus

- DNP 3.0

- CANopen SNTP client

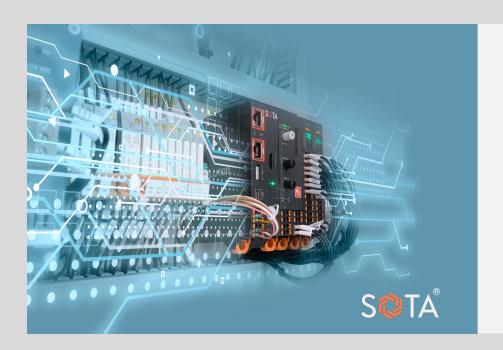
IEC 61850

IEC 60870-5-101

IEC 60870-5-103

IEC 60870-5-104

SOTA® IEC 61850



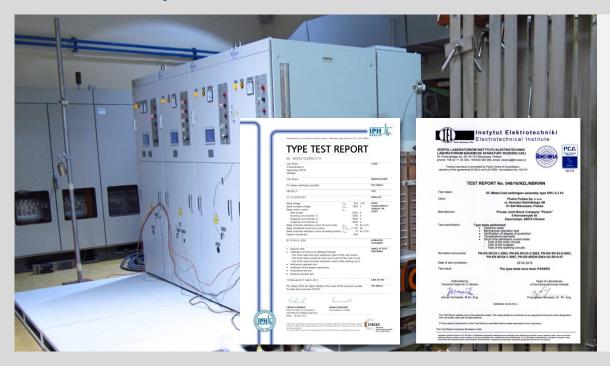
IEC 61850 is a universally applicable international standard that allows to arrange unrelated solutions produced by different manufacturers of relay protection equipment and data transfer systems that are applied at the substations.

IEC 61850 provides:

- signal transfer reliability increase;
- compatibility and interchangeability of equipment in case of substation expansion (modernization);
- application of IEC 61850 standard opens up opportunities for future transition from traditional to digital substation, i.e. to a qualitatively new level of power facilities automation and control.



DC SWITCHGEAR IEC, EN conformity tests



DC switchgear manufactured by PLUTON were successfully type-tested for compliance with International Electrotechnical Commission (IEC) standards and European standards (EN) in such test centers as IPH Institut (Berlin, Germany) and IEL (Warsaw, Poland) including internal arc testing.



IEC, EN conformity tests





IEC, EN conformity tests





DC switchgear with arc-free circuit breaker





DC switchgear with arc-free circuit breaker

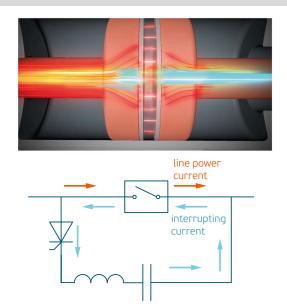


Lowest maintenance:

- number of emergency current interruptions is much greater in comparison with circuit breaker with standard switching and arc interruption;
- no arc interruption contacts, and as a result, no need for their periodic replacement;
- no main contacts wear;
- no need of contacts inspection after emergency currents interruption with unlimited number of trippings.



DC switchgear with arc-free circuit breaker



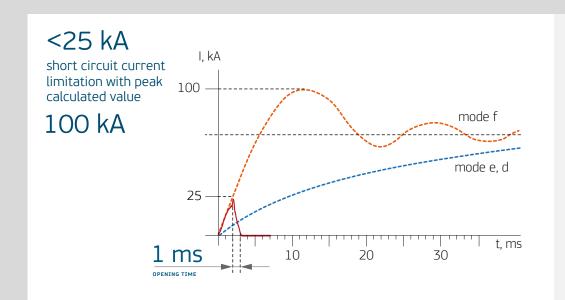
Operating principle

The main innovation of AFB® circuit breaker is operation of main contact in vacuum. Pre-charged high-voltage capacitor generates current to interrupt short-circuit current in antiphase to the main circuit current. The contact opens in vacuum interrupter, when currents algebraic sum is zero.

Thus, the main contact opens with a current value close to zero.



DC switchgear with arc-free circuit breaker



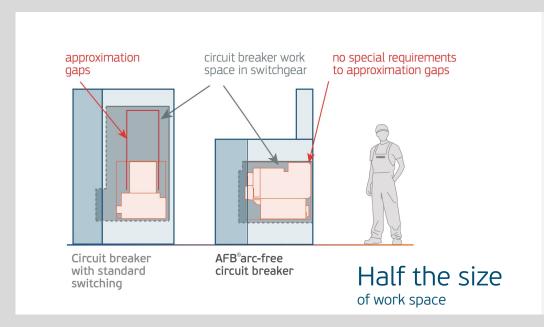
AFB® provides high-speed power contact opening and circuit breaker di/dt tripping before short-circuit setting reaching.

Opening time is <1 ms, with minimum level of overloads ejected into contact network (max. 2 kV).

AFB® circuit breaker provides secure low current interruption, and as a result, circuit breaker contacts damage prevention.



DC switchgear with arc-free circuit breaker



Compact design

In contrast to standard contact circuit breaker, which requires additional work space for plasma ejection in its operation, AFB® circuit breaker applies principle of power circuit interruption in vacuum, thereby leading to reduction of switchgear work space.



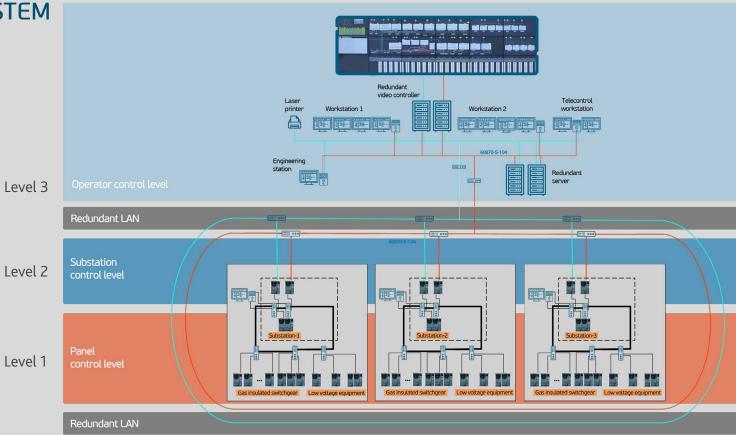
DC switchgear with arc-free circuit breaker



Operational and environmental safety:

- no arc plasma emission upon interruption;
- no combustion products and their deposits on circuit breaker components and switchgear units;
- no arc plasma overpressure in switchgear during switching;
- fire risk reduction.









1st level. Panel control

Traction substation equipment (switchgear, rectifiers, auxiliary equipment, etc.) is controlled at the first level.

The first level of control is implemented on the basis of modern industrial controllers built into the equipment.

Controllers monitor and control equipment, as well as perform protection functions.





Second level provides general substation control.

Substation control level provides:

- **supervision** of current mode and status of the main circuit of the substation from the automatic workplace of operation personnel;
- control of switching units in normal and emergency modes;
- registration of emergency messages;
- · events logging;
- display of current status of traction substation equipment, operation of hardware and software, etc. on mimic diagrams of the monitor.





3rd level. Operator contro

The third level of control combines dispersed traction substations into a single system, which provides remote control and monitoring using software and hardware of operations control center.

Modern backup servers are applied for collecting and processing of data from substation controllers. Power operators workstations, as well as video wall displaying the state of all substations electrical equipment is provided for substations operational control.







MODULAR TRACTION SUBSTATIONS



Modular traction substation is an **integrated solution** for reliable power supply of electric transport catenary.

Modular traction substation can be used as **transportable or fixed** electric power distribution point.

Modular traction substation is designed for operation in automatic mode being an unattended installation.



MODULAR TRACTION SUBSTATIONS Advantages

- minimum of construction works on installation site;
- · high readiness for commissioning;
- rapid mounting (simple connection of primary and secondary circuits);
- possibility to configure different circuits;
- antiburglar protection and disassembling;
- easy access to equipment;
- **mobility** and possibility to move to the new operation place.





MODULAR TRACTION SUBSTATIONS



Modular traction substation is a functionally finished product with organization of power and secondary circuits connections.

Modular traction substation can be of single-, double- or triple-unit type.

Manufacturing of modular traction substation for a more number of units is possible on case of necessity.

Modules are mechanically unrelated, and are installed in accordance with the design solution.



MODULAR TRACTION SUBSTATIONS









Reliable power supply is provided by modern traction equipment system, **automatically** controlled by SCADA system.

Modular traction substation is equipped with:

- operating and emergency lighting system;
- heating, ventilation, air conditioning system;
- intruder alarm;
- fire extinguishing system.



















CUSTOMER CARE

PACKAGED APPROACH TO THE PROJECTS OF ANY COMPLEXITY







DESIGN WORKS

- project audit;
- recommendations for equipment selection;
- engineering surveys;
- development of design documentation;
- field supervision.

PRODUCTION AND ENGINEERING

- · manufacturing;
- delivery to the site
- full-scale tests;
- installation and commissioning;
- start-up.

AFTER-SALES SERVICE

- training of the Customer's personnel;
- providing operational support;
- warranty and after-sales service.



INNOTRANS 2022 (BERLIN, GERMANY)





TRAKO 2023 (GDANSK, POLAND)





Thank you for attention!

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