

A futuristic city street at night, characterized by motion blur and a strong blue color palette. The scene is filled with streaks of light from buildings and traffic, creating a sense of high speed and advanced technology. The perspective is from a low angle, looking down a long, straight road that recedes into the distance.

PLUTON

TURN ON
THE FUTURE



ABOUT COMPANY

PLUTON GROUP OF COMPANIES



PLUTON GROUP OF COMPANIES. MAIN OFFICE



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 +380 61 239-79-01
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GENERAL INFORMATION



Location of Mother Company LLC Pluton IC

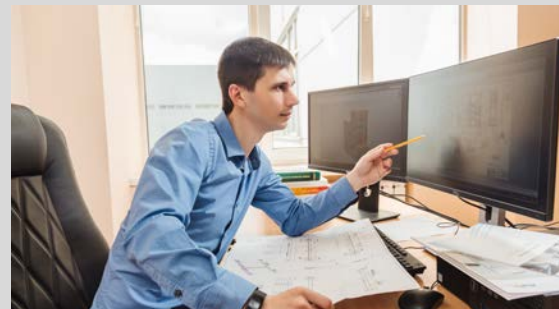
4-B Lukasha M. st.,
Lviv, 79026 Ukraine



8 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



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

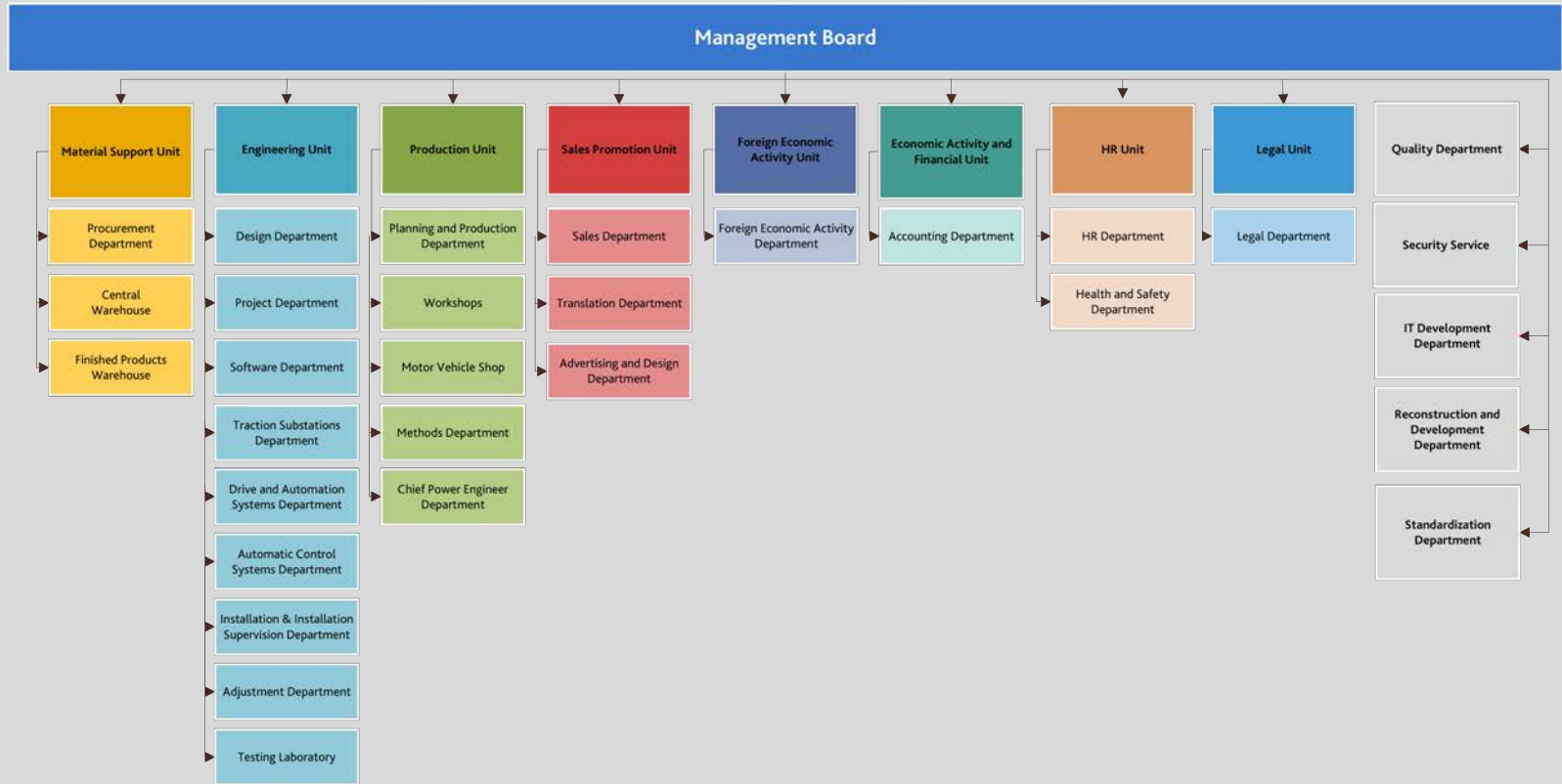


PRODUCTION AREA

(PLUTON POLSKA, WARSAW)



ORGANIZATION CHART



CONFORMITY CERTIFICATES




Quality Management System



Environmental Quality System



Occupational Health and Safety Management System



TURN-KEY
TRACTION
SUBSTATIONS

TRACTION SUBSTATIONS. EQUIPMENT



Medium voltage
switchgear
6 kV... 40.5 kV



Rectifier units
600...3300 V DC:

- rectifiers;
- transformers.



DC Switchgear
600...3300 V



LV Switchgears:

- DC and AC Switchgears
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 systems:

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



Reactive power compensation units



Microclimate control systems



Catenary system equipment:

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



Modular traction substations

MEDIUM VOLTAGE SWITCHGEAR 27.5 KV



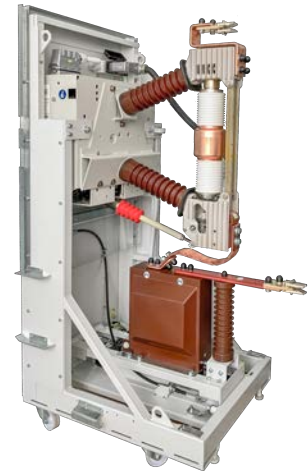
27.5 kV switchgears manufactured by PLUTON are meant for reception and distribution of AC electric energy of 50 Hz power frequency, with rated voltage of 27.5 kV at AC railway traction substations.

We have created 27.5 kV switchgears 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.



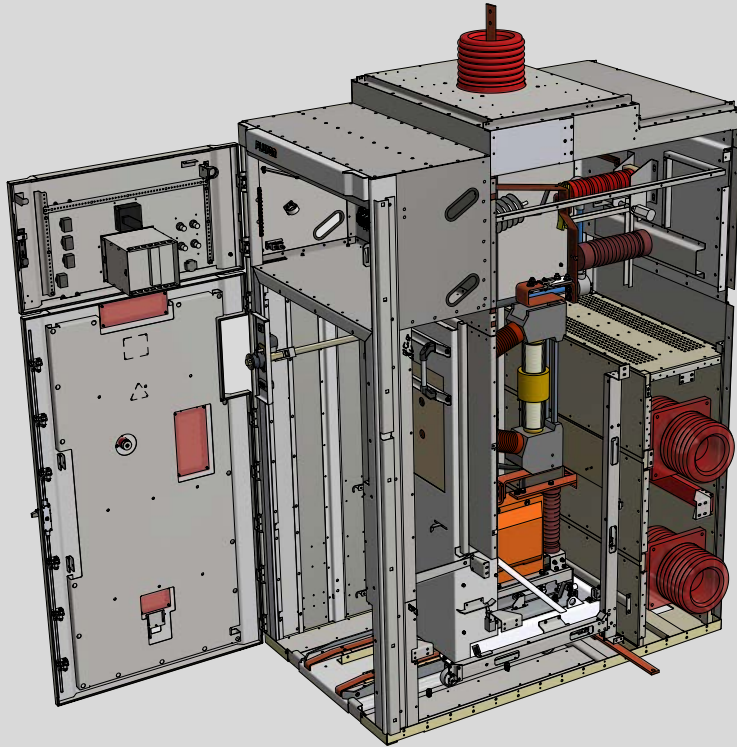
MEDIUM VOLTAGE SWITCHGEAR 27.5 KV

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.

MEDIUM VOLTAGE SWITCHGEAR 6 (10) KV

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.

MEDIUM VOLTAGE SWITCHGEAR 6 (10) KV

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.



MEDIUM VOLTAGE SWITCHGEAR 6 (10) KV

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.

MEDIUM VOLTAGE SWITCHGEAR 6 (10) KV

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.

RECTIFIERS

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®).

RECTIFIERS

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®).

RECTIFIERS

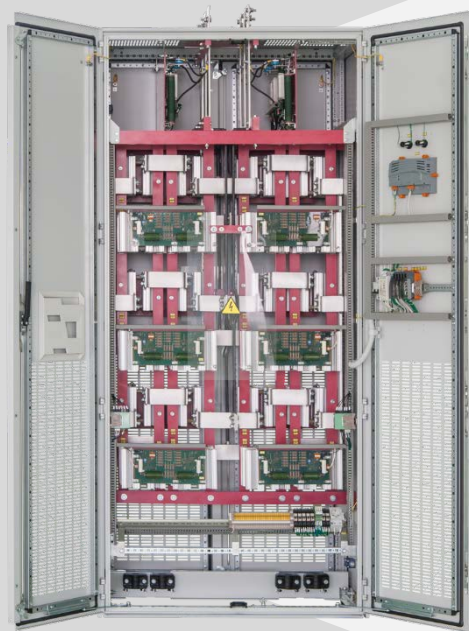
Advantages

- 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.



RECTIFIERS

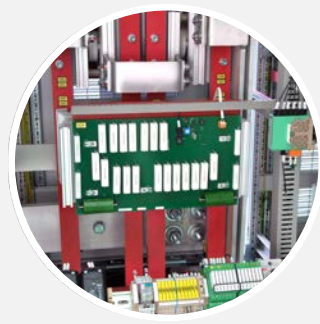
Main components



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.

RECTIFIERS

Main components

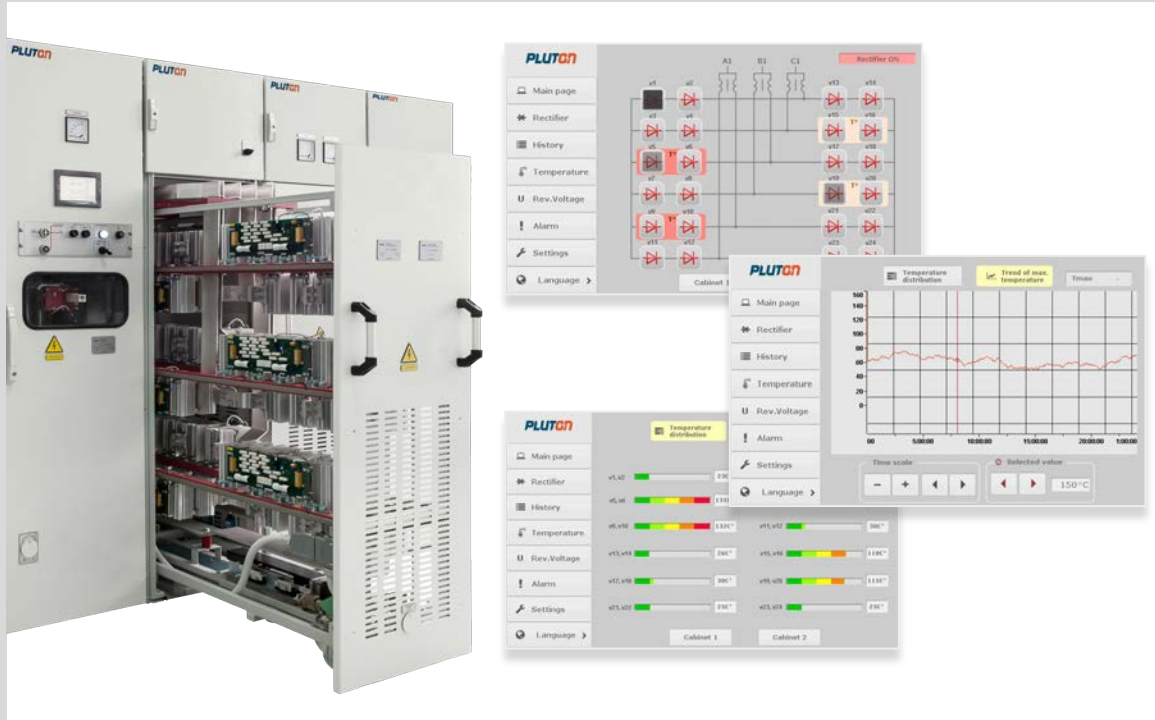
Protection, diagnostics and control system:

- 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.



RECTIFIERS

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.

RECTIFIERS

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.



RECTIFIERS

Withdrawable rectifiers



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).

TYPE TEST REPORT

Independent, accredited testing facility. Member laboratory of IEC, and CEMIS.
NO: 3059/21/2010/0000
CSC Name: 5-technique of
December 6/0/0
URNANE
CSC Model:
Line-commutated semiconductor converter
Rectifier Line V-THD 2/3kV-750A 2P
Test sample:
Rated voltage on the line side: U_{line} 550 V
Minimum rated voltage on the line side: U_{line} 450 V
Maximum rated voltage on the line side: U_{line} 650 V
Rated direct voltage: U_{dc} 750 V
Rated current on the line side: I_n 1500 A
Rated direct current: I_n 2500 A
Rated frequency: f_n 50 Hz
Duty class: VI

IEC 60746-1:1-2009-04

Standard document

Lightning and functional test

Controlled test sample temperature rise and load test

Controlled test sample for commissioning and shipment

Checking of safety devices

Checking of the protection device

Temperature rise test at 125% load for 2 hours

16 to 24 February 2012

The scope of the test does not include the scope of test has been

checked. The test has been PASSED.

Ullrich

REINOLD SCHNEIDER

Test program manager

16.02.2012

IPH INSTITUT FÜR PRÜFUNG UND ZERTIFIZIERUNG

www.iph-berlin.de

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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.



Resibloc® transformer

DC SWITCHGEARS



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

DC SWITCHGEARS

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 SWITCHGEARS

Main components

DC high speed circuit breaker (Sécheron, Switzerland):

- design providing minimum maintenance;
- high switching capacity;
- minimum tripping time;
- уменьшенное перенапряжение во время отключения.



DC SWITCHGEARS

Main components

DC high speed circuit breaker (Sécheron, Switzerland):

- automatic setting of contact tightness;
- long lifetime;
- insulation material wiping under arc;
- stepless regulation of trip setting;
- high mechanical resistance — 8x25000 cycles.



DC SWITCHGEARS

Main components



AFB ARC-FREE
CIRCUIT
BREAKER



AFB40

AFB25

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.

DC SWITCHGEARS

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.

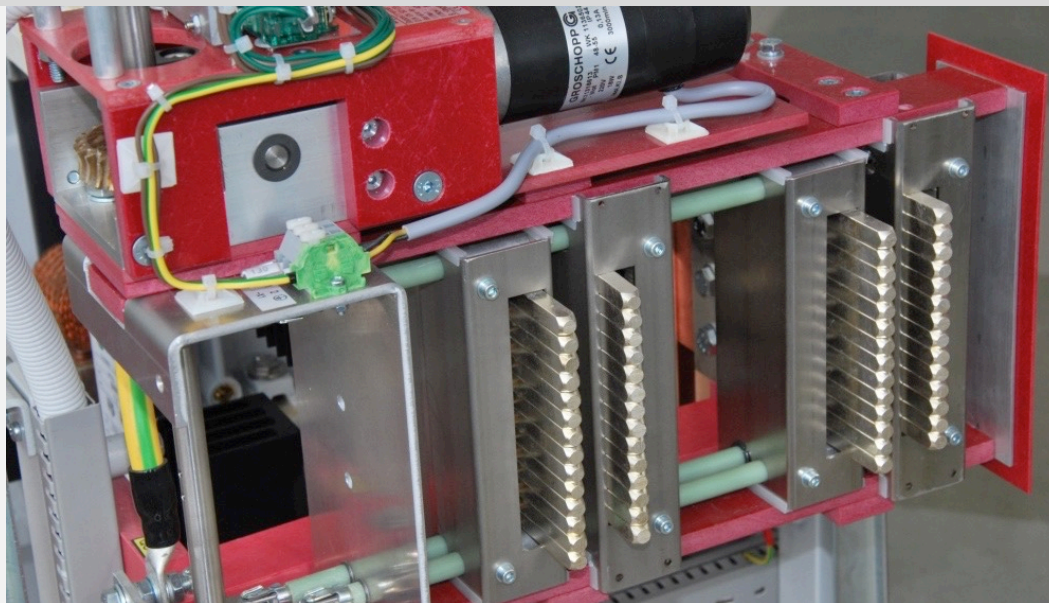
DC SWITCHGEARS

Main components

Service busbar double-pole disconnector

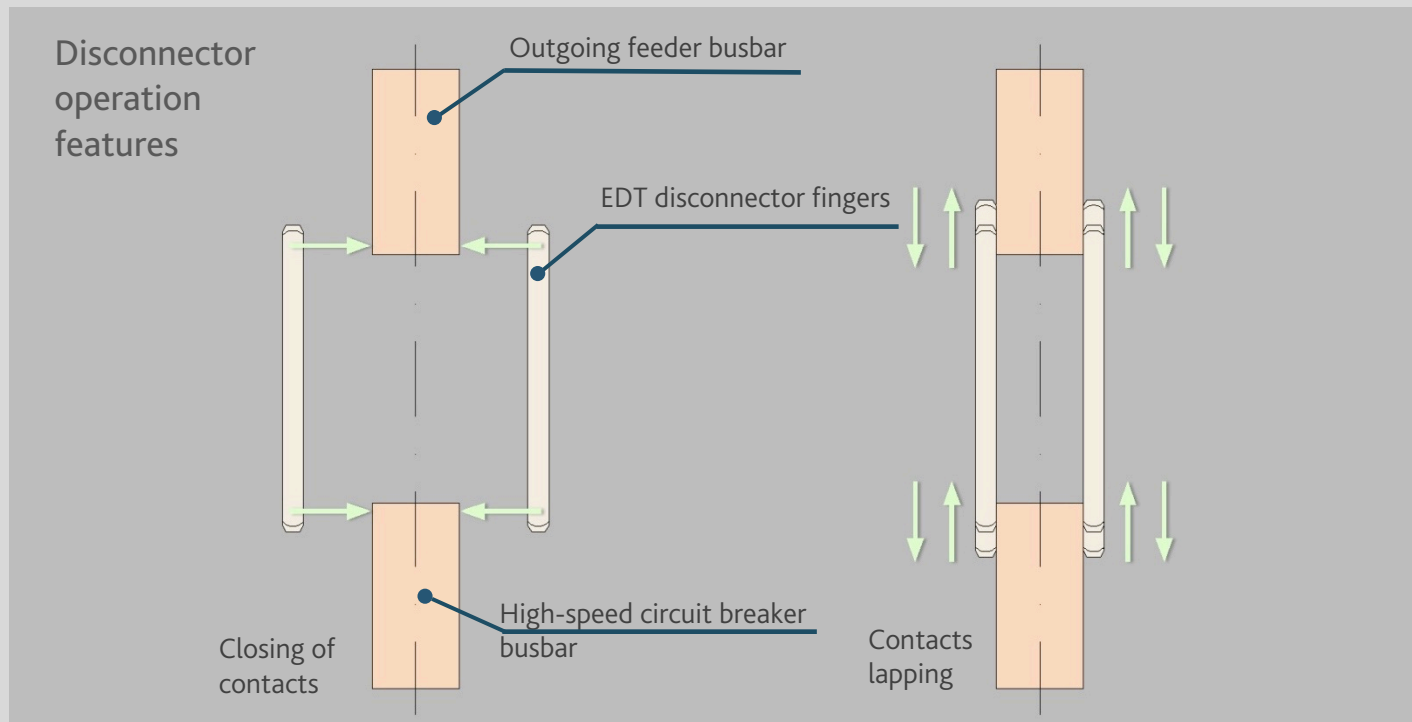
Disconnectors have unique design of contact system. The contacts move during operation and crimp the busbar.

Disconnectors require lowest maintenance, once every 10 years.



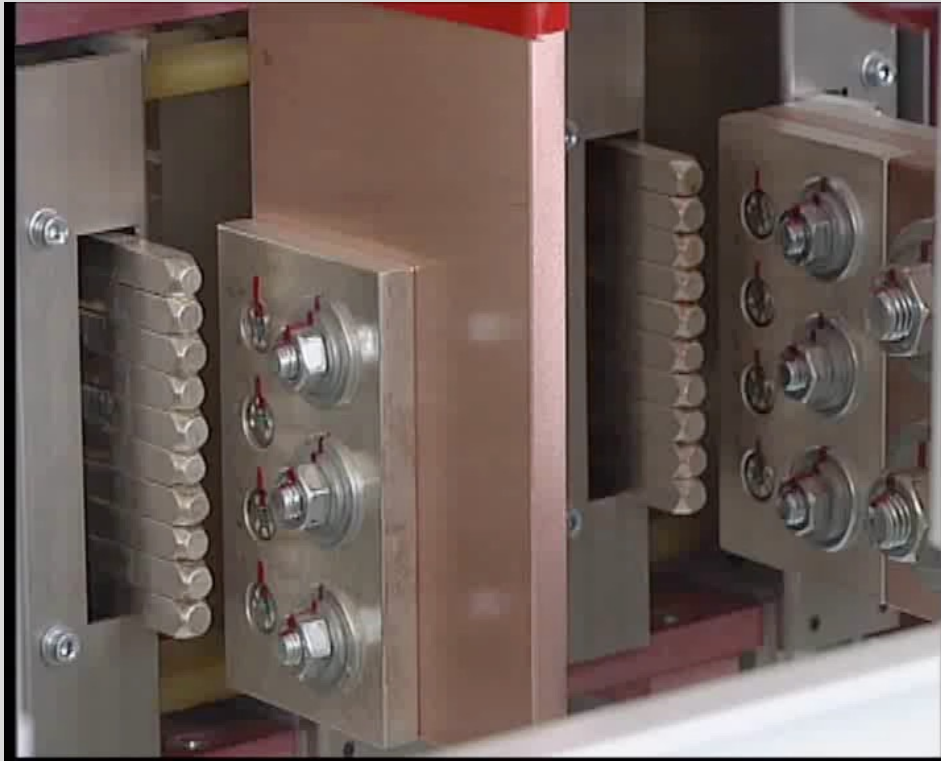
DC SWITCHGEARS

Main components



DC SWITCHGEARS

Main components



DC SWITCHGEARS



DC SWITCHGEARS



DC SWITCHGEARS

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.

DC SWITCHGEARS

Main components



Line tester (short circuits tester SCT):

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

DC SWITCHGEARS

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:

I_o instantaneous overcurrent (ANSI 50)

I_{max} time overcurrent protection (ANSI 76)

di/dt current rate of rise protection

ΔI current increment directional protection

I(t) time/current protection (ANSI 49)

U_{min} undervoltage protection(ANSI 27)

U_{max} 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

Visualization
panel

SOTA®

Measuring and recording functions

SOTA® generates and stores the following records:



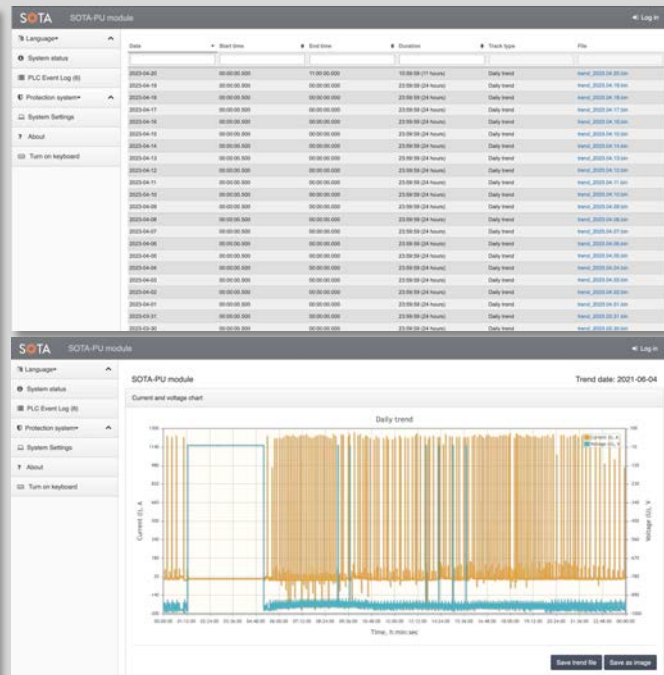
events log;
failures log;



emergency oscillograph
records (Fast track, Slow
track);



daily trends



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

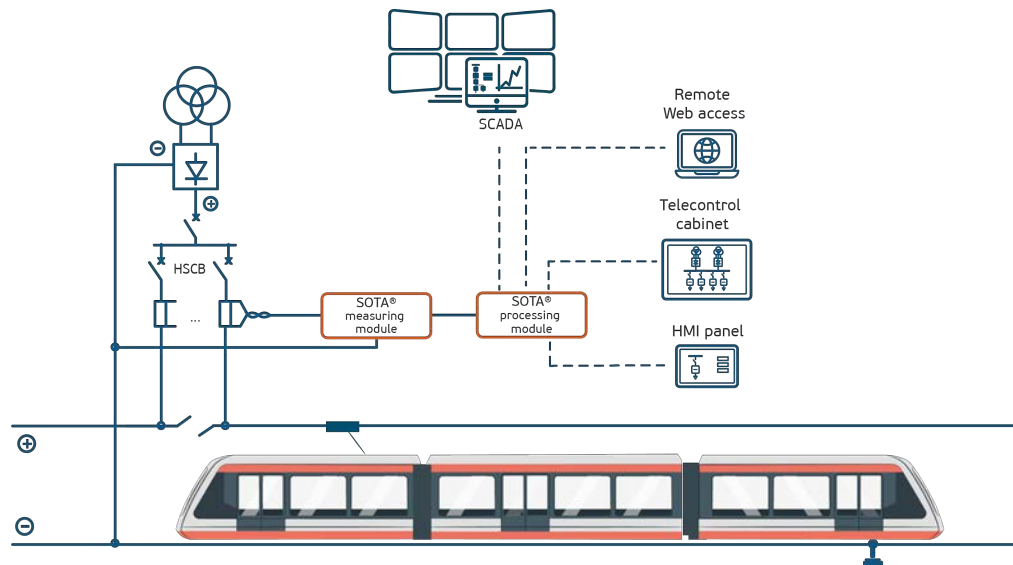


SOTA®

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,
-2, -32
- IEC 61131-1,2
- IEC 60255-26 EMC
mechanical and climatic resistance

COMMUNICATION PROTOCOLS SUPPORT

- IEC 61850
- IEC 60870-5-101
- IEC 60870-5-103
- IEC 60870-5-104
- Modbus
- DNP 3.0
- CANopen
- SNTIP client



SOTA®

IEC 61850



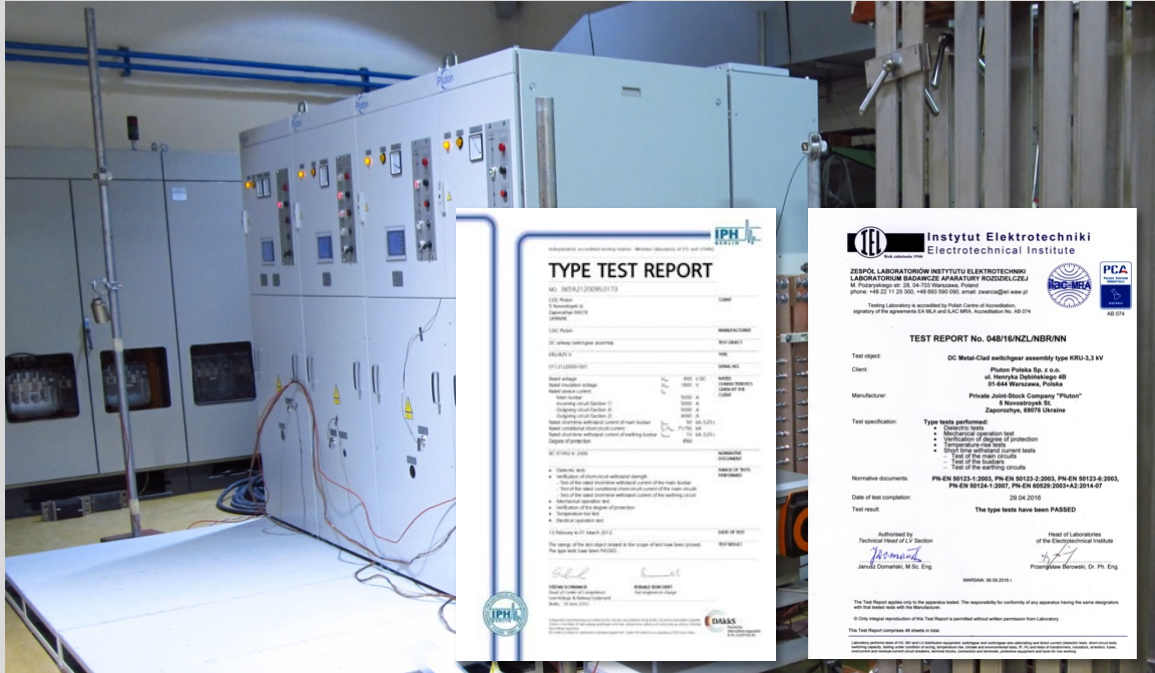
IEC 61850 is a universally applicable international standard that allows to arrange unrelated solutions produced by different manufacturers of relay protection equipment and data transfer systems that are applied at the substations.

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 SWITCHGEARS

IEC, EN conformity tests



DC switchgears 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.

DC SWITCHGEARS

IEC, EN conformity tests



DC SWITCHGEARS

IEC, EN conformity tests



INNOVATIONS

DC switchgear with arc-free circuit breaker

AFB ARC-FREE
CIRCUIT
BREAKER

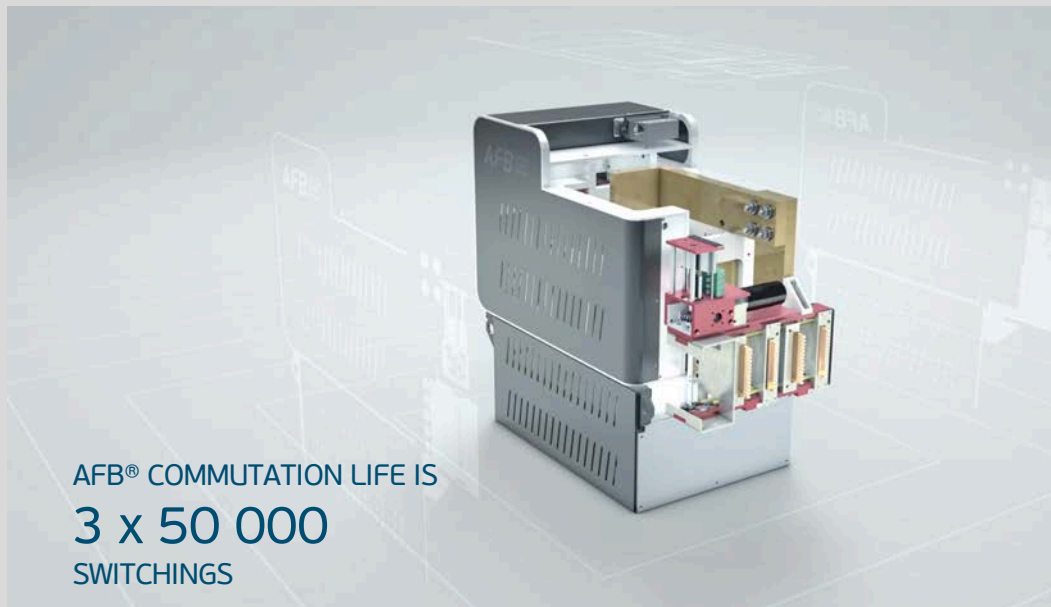


Arc-free ultra high-speed
DC circuit breaker



INNOVATIONS

DC switchgear with arc-free circuit breaker



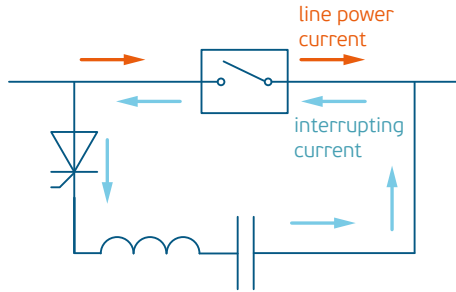
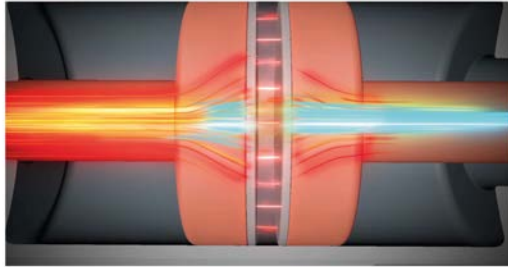
AFB® COMMUTATION LIFE IS
3 x 50 000
SWITCHINGS

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.

INNOVATIONS

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.

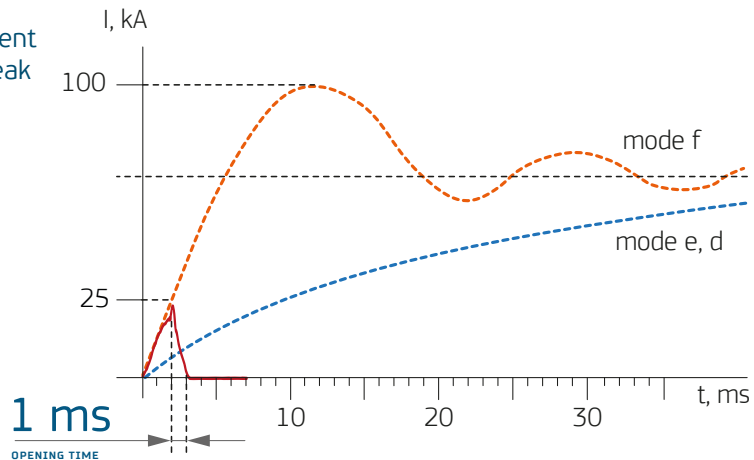
INNOVATIONS

DC switchgear with arc-free circuit breaker

<25 kA

short circuit current
limitation with peak
calculated value

100 kA



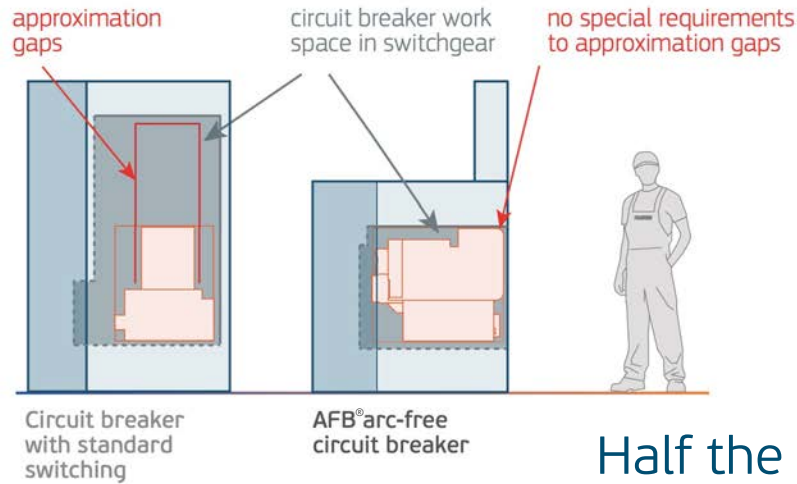
AFB® provides high-speed power contact opening and circuit breaker di/dt tripping before short-circuit setting reaching.

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.

INNOVATIONS

DC switchgear with arc-free circuit breaker



Half the size
of work space

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.

INNOVATIONS

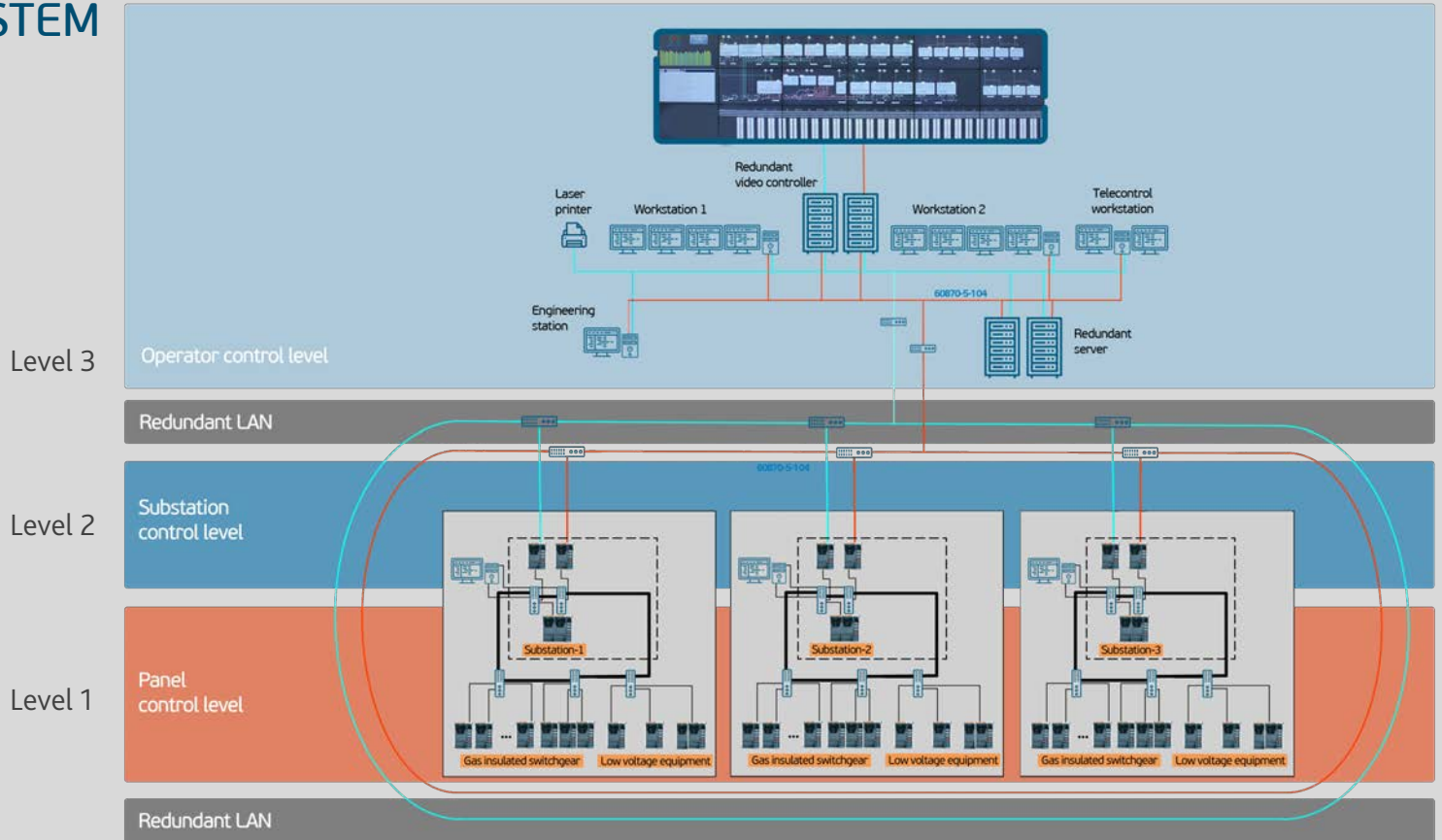
DC switchgear with arc-free circuit breaker



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.

SCADA SYSTEM



SCADA SYSTEM



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.**

SCADA SYSTEM



2nd level. Substation control

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.

SCADA SYSTEM



3rd level. Operator control

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.

SCADA SYSTEM



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.

3.3 KV DC CONTACT NETWORK SECTIONALIZING POINT



3.3 KV DC CONTACT NETWORK SECTIONALIZING POINT



3.3 KV DC CONTACT NETWORK SECTIONALIZING POINT



3.3 KV DC CONTACT NETWORK SECTIONALIZING POINT



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)



A blurred high-speed train in a station with a bright light flare on the left.

Thank you for attention!

www.pluton.ua