TURNKEY SOLUTIONS IN POWER ENGINEERING
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About Company

BUSINESS AREAS

SVEL Group JSC is a leader among national manufacturers of the electrotechnical equipment. It is a producer of power dry-type and oil-immersed transformers, provider of solutions in electric power quality improvement and electric network protection. SVEL Group is also taking advantage of its cutting edge technologies to be a reliable provider in such products as switchgears, packaged transformer substations, instrument transformers, circuit breakers and disconnectors.

SVEL specialists solutions allow to produce the equipment that assists enterprises in the reduction of energy consumption up to 45%. Going forward, SVEL Group will continue to make big steps in other MV, HV and UHV equipment.

PRODUCTION OF PREFABRICATED HV AIR-INSULATED SUBSTATIONS (KTPB)

Year of production startup – 2009
Production capacity – 88 substations per year
Personnel – 450 employees.

Substations sales department:
Phone +7(343)253-50-20
Fax +7(343)253-50-18
substations@svel.ru

PRODUCTION OF OIL TRANSFORMERS

Year of production startup – 2009
Production capacity under full load – 24,000 MVA per year
Personnel – 450 employees

Oil transformers sales department
Phone +7(343)253-50-22
Fax +7(343)253-50-18
oil-immersed@svel.ru

PRODUCTION OF REACTOR EQUIPMENT

Year of production startup – 2004
Production capacity – 960 phases per year
Personnel – 380 employees

Reactor equipment sales department
Phone +7(343)253-50-19
Fax +7(343)253-20-12
reactors@svel.ru

PRODUCTION OF CIRCUITBREAKERS, GAS-INSULATED TRANSFORMERS AND DISCONNECTORS

Year of production startup – 2011
Production capacity – 1,000 units per year
Personnel – 150 employees

Substation sales department
Phone +7(343)253-50-20
Fax +7(343)253-50-18
substations@svel.ru

PRODUCTION OF DRY-TYPE TRANSFORMERS

Year of production startup – 2003
Production capacity – 8,000 units per year
Personnel – 350 employees

Dry-type transformer sales department
Phone +7(343)253-50-21
Fax +7(343)253-50-12
dry-type@svel.ru

PRODUCTION OF INSTRUMENT TRANSFORMERS

Year of production startup – 2016
Production capacity – 1,000 units per year
Personnel – 450 employees

Instrument transformers sales department
Phone +7(343)253-50-66
Fax +7(343)253-50-18
instrument@svel.ru

PRODUCTION OF MEDIUM VOLTAGE SWITCHGEARS

Year of production startup – 2009
Production capacity – 2,000 units per year
Personnel – 450 employees

Substation sales department
Phone +7(343)253-50-20
Fax +7(343)253-50-18
substations@svel.ru

PRODUCTION OF PREFABRICATED MV/LV TRANSFORMER SUBSTATIONS

Year of production startup – 2009
Production capacity – 500 units per year
Personnel – 450 employees

PRODUCTION OF LOW-VOLTAGE SWITCHBOARDS

Year of production startup – 2016
Production capacity – 1,000 units per year

Substation sales department
Phone +7(343)253-50-20
Fax +7(343)253-50-18
substations@svel.ru
KTPB
COMPACT PREFabricated HV AIR-INSULATED SUBSTATIONS

RATED VOLTAGE – from 35 to 220 kV

ADVANTAGES:

Reduction of project design period
Use of typical products catalogues.

Convenient procedure of ordering
Use of code designation for prime KTPB items. That decreases procedures of order clearing.

Versatility
Modular versatility makes it possible to implement any type of high-voltage equipment tailored to individual project requirements.

Reconstruction of existing switchgears
• Modules are adapted for any type of equipment;
• Rigid busbar can be arranged on wide spectrum of supporting insulators and disconnecting devices;
• Open switchgears configuration design with the consideration of individual project requirement.

Decrease of terms of delivery
Availability of developed design documents.

Decrease of terms of assembly
• Use of bolting instead of welding both in modules with equipment and in rigid busbars;
• Fit-up assembly test at the manufacturing facility allows to exclude incompleteness of delivery to the site and to check assemblability of parts.

Decrease of installation area for switchgear
• Block-modular design allows to decrease amount of foundations comparing to block constructions;
• Use of suspended cable constructions allows to cut additional expenditures for on-ground cable laying;
• Placement of cabinets of secondary control wiring directly on supporting metal construction allows to exclude expenditures on arrangement of separate foundations for these cabinets.

Use of rigid busbar
It allows not to use bus portals, to avoid necessity of making foundations for them, it allows to exclude laying of flexible busbar; and that leads to decrease of land allocation for switchgear, to decrease construction-and-assembling operations, it leads to material saving.

KTPB TECHNICAL DATA

<table>
<thead>
<tr>
<th>No.</th>
<th>Data</th>
<th>AIS 220 kV</th>
<th>AIS 110 kV</th>
<th>AIS 35 kV</th>
<th>Notes</th>
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<tbody>
<tr>
<td>1</td>
<td>Rated Voltage, kV</td>
<td>220</td>
<td>110</td>
<td>35</td>
<td></td>
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<tr>
<td></td>
<td>Highest</td>
<td>220</td>
<td>110</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>35;110</td>
<td>35</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lowest</td>
<td>6;10;35</td>
<td>6;10</td>
<td>6;10</td>
<td></td>
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<tr>
<td>2</td>
<td>Power of transformer</td>
<td>125000*</td>
<td>63000*</td>
<td>16000*</td>
<td>* According to substation project requirements</td>
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<tr>
<td>3</td>
<td>Rated current, A</td>
<td>630;1000;1600</td>
<td>630;1000;1600</td>
<td>630;1000;1600</td>
<td>According to single-line diagram 110-12…13, 220-7…14</td>
</tr>
<tr>
<td></td>
<td>• AIS bay</td>
<td>to 4000</td>
<td>to 4000</td>
<td>to 4000</td>
<td>See Switchgears Catalogue</td>
</tr>
<tr>
<td></td>
<td>• incoming switchgear</td>
<td>630</td>
<td>630</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• power transformer circuits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• busbars</td>
<td>1000;2000;3150</td>
<td>1000;2000</td>
<td>1000;2000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Rated peak withstand current, kA</td>
<td>65;81;102;128</td>
<td>65;81;102;128</td>
<td>65;81;102;128</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Rated short-time withstand current (during 3 sec), kA</td>
<td>25;31,5;40;50</td>
<td>25;31,5;40;50</td>
<td>24;31,5;40;50</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Temperature range, °C</td>
<td>-60 up to +40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Seismic sensity</td>
<td>7-9*</td>
<td></td>
<td></td>
<td>*According to MKS-64 scale; reinforced supporting metal frame</td>
</tr>
<tr>
<td>8</td>
<td>KTPB lifetime, years</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
KTPB
MODULAR INTEGRATED TRANSFORMER SUBSTATIONS

KTPB SET CAN INCLUDE:

- Power transformers (autotransformers);
- Compact Prefabricated HV Air-insulated Substations 220, 110, 35 kV;
- Rigid busbar system 35-220 kV and busbar bridge 6(10) kV;
- Cable constructions;
- Local control cabinets;
- Closed switchgear ZRU 6(10) kV, 35 kV;
- Substation control building (ORU);
- Portals;
- Lighting;
- Earthing switches.
OIL TRANSFORMERS
(POWER AND RECTIFIER)

VOLTAGE CLASSES: up to 500 kV
POWER: from 2,500 to 267,000 kVA

STRUCTURAL FEATURES

Magnetic core
• Coiled grain-oriented electrical steel with low specific losses is used;
• Assembly of steel sheets is performed with complete chamfered joint using Step-Lap technology.

Coils
• Winding technology allows to stabilize dimensions of coils during whole operating life;
• Use of transposed wire allows to increase electrodynamic firmness of transformer coils at short-cuts, and to decrease extra losses in coils.

Active part
Structure of active part allows to decrease extra losses in its metal structures by half.

System of test assembly of dismantled units of metal structures with part marking
• Design mistakes are excluded;
• Installation of transformers becomes easier.

Transformer monitoring system
At the customer’s request, additional functions of control, monitoring and diagnostics of transformers are installed. They increase safety of power facilities used in the production of power transformers of the SVEL Group:

• Control of condition of coolers and effectiveness of cooling system;
• Computation of time in operation for each oil pump and fan;
• Ambient temperature control;
• Oil temperature control in input/output of cooling system;
• Humidity-in-oil analysis;
• Analysis of gases dissolved in oil;
• Control of LTC current condition by analog sensors or through angular deflection of drive;
• Command generation and execution control for transformer tap changing in the mode of LTC manual control;
• Control of LTC drive current;
• Evaluation of real LTC resource depending on transformer load and time of inspections;
• Detection of such failures as creep, rejection of switching, crawling, and lack of synchronization;
• Oil temperature control and evaluation of thermal wear of insulation;
• Control of partial discharges and insulation of inputs.

Transformer monitoring system can include sensors for prime parameters measuring, prime parameters processing unit, archivation and visualization unit, control unit, unit for data exchange with a system of higher level, and integration unit for connection with automated controlling system.

THREE MAIN REASONS TO CHOOSE OIL IMMERSION TRANSFORMERS OF SVEL:

1. Reduced no-load and load losses
2. Less operating costs
3. Higher electrodynamic firmness of transformer coils

PRODUCTS
AIR-CORE CURRENT-LIMITING REACTORS

**Purpose**

SVEL develops and produces air-core reactors designed and suitable for electric power systems up to 330 kV with a purpose to limit short-circuit currents in electrical networks and to keep voltage level in electricity-generating equipment in case of short-circuit:

- current ranges from 50 to 10,000 A;
- non-standard implementation of reactor with angles between outputs different from 0, 90, 180 and 270° is possible;
- vertical, horizontal and stairstep placement of reactor phases is possible;
- climatic categories according to GOST and IEC standards.

Constructive innovations allow decrease weight and overall dimensions of reactors comparing to concrete reactors as well as with other kinds of air-core reactors.

**Basic Elements of Construction**

The reactor windings are made of multiple-core aluminum cable specially designed for SVEL reactors. Winding is designed to be multilayer to provide unattenuated current distribution across parallel wires without transposition between them (this construction is patented). As a result, reactors, though having rather small overall dimensions, have high electrodynamic firmness and thermal resistance.

Mechanical strength of reactors is provided by winding pressing design composed of a system of insulating ledges and vertical tension pins.

**Benefits**

- Wide range of air-core current-limiting reactors with current range from 50 to 10,000 A and voltage up to 330 kV;
- Production based on own patent;
- Small overall dimensions and weight;
- Versatility of output implementation;
- Manufacture of air-core current-limiting reactors takes from 45 to 60 days;
- Manufacture of reactors with reduced losses.

SHELL-TYPE CURRENT-LIMITING REACTORS

**Voltage Classes:** up to 20 kV  
**Nominal Current:** up to 9,000 A

Major advantage of shell-type current-limiting reactors is a possibility of compact placement in reaction chambers because of decreased area of stray fields.

DAMPING REACTORS

**Voltage Classes:** 6 – 10 kV  
**Nominal Current:** 20 – 250 A

Damping reactors with cast-insulation are designed to limit commutation current of capacitor bank appearing at switching of capacitor bank (or some stages of capacitor bank) into electric network. Damping reactors are installed in a capacitor bank in series with power factor high-voltage capacitors.

SMOOTHING REACTORS

**Voltage Classes:** up to 10 kV  
**Nominal Current:** up to 9,000 A

Smoothing reactors are static electromagnetic devices designed to reduce content of ultraharmonics (ripple) in inverted current using its inductivity in electric network.

FILTER REACTORS

**Voltage Classes:** 6 – 10 kV  
**Nominal Current:** up to 4,000 A

Filter reactors are series connected with filter capacitor bank to form resonant circuit, which can filter specified harmonic currents.

LINE TRAP

**Nominal Current:** from 100 to 4,000 A  
**Minimum Active Resistance:** from 400 to 650 ohm  
**Barrier Frequency Coverage:** from 24 to 1,000 kHz

Line trap are designed to provide transmission of signals of automatic emergency response system, as well as signals of relay protection, telephone lines, telemechanics and others.

SVEL-REACTOR EQUIPMENT
**HIGH-VOLTAGE PRODUCTS**

**VOLTAGE RANGE:** from 110 up to 500 kV

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**LIVE TANK SF6 CIRCUIT BREAKERS FOR 110 AND 220 kV**

Circuit-breakers are designed for operation under rated and short-circuit current conditions in three-phase AC networks. The circuit-breaker covers the whole temperature range from -60°C to +40°C, which makes it suitable almost for all climate zones.

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**DEAD TANK SF6 CIRCUIT BREAKERS FOR 110 AND 220 kV**

Circuit-breakers are designed for operation under rated and short-circuit current conditions in three-phase AC networks. Characteristics of built-in current transformers can vary depending on customer's requirements.

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### TYPE OF CIRCUIT BREAKER | ВГКТ-110 | ВГКТ-220
---|---|---
Voltage class, kV | 110 | 220
Rated current, A | 2500 |
Rated short-circuit breaking current, kA | 40 |
Temperature range, °C | -60...+40 |
Drive mechanism | Stored-energy spring PPrA |

### TYPE OF CIRCUIT BREAKER | ВГСТ-110 | ВГСТ-220
---|---|---
Voltage class, kV | 110 | 220
Nominal current, A | 2500 |
Rated current, kA | 40 |
Rated short-circuit breaking current, °C | -60...+40 |
Mechanism | Stored-energy spring PPr |

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**SF6 CURRENT AND VOLTAGE INSTRUMENT TRANSFORMERS**

SF6 current and voltage instrument transformers are designed for outdoor and indoor installation. Instrument transformers transform high currents and voltages into standardized low and easily measurable values that are isolated from the high voltage. Instrument transformers provide current and voltage signals for measuring, protection and control devices.

### TECHNICAL DATA OF CURRENT TRANSFORMER; TYPE T6-SVEL

**DATA** | **VALUE**
---|---
Rated voltage, kV | up to 500
Rated primary current, A | up to 5000
Rated secondary current, A | 100
Number of secondary windings | to 6
Metering accuracy class | 0.25; 0.2; 0.5; 0.5; 1P; 10P
Ambient air temperature, °C | -60...+40

### TECHNICAL DATA OF VOLTAGE TRANSFORMER; TYPE ZNG-SVEL

**DATA** | **VALUE**
---|---
Rated voltage of primary winding, kV | 110/3
Rated voltage of main secondary winding, V | 110/3
Rated voltage of additional secondary winding, V | 100
Number of secondary windings | up to 3
Ambient air temperature, °C | -60...+40

---

**DISCONNECTORS FOR 110 AND 220 kV OUTDOOR INSTALLATION**

Disconnectors are used to connect the circuit and indicate a visible isolating distance in an air isolated gap. They are designed for operation in three-phase AC networks.

Disconnectors can be equipped with earthing switches. A built-in mechanical Interlocks guarantee that the disconnector can't be operated when the earthing switch is in switched on position and vice-versa. Disconnectors may have manual and motor drive system equipped with the electro-magnetic interlock, witch guarantees the correct operation sequence. Disconnectors cover the whole temperature range from -60°C to +40°C.

### TYPE OF DISCONNECTOR | R6-110 | R6-220
---|---|---
Rated voltage, kV | 110 | 220
Rated current, A | up to 5000 | up to 5000
Rated peak withstand current, kA | 102; 128 | 102; 128
Rated short-time withstand current (during 3 sec), kA | 40; 50 | 40; 50
Number of operating cycles | 10000 | 10000
Drive: Motor Manual | NS080 NR080 | NS080 NR080
Seismic intensity (MSK-64) | 7 - 9 points | 7 - 9 points
MEDIUM VOLTAGE SWITCHGEARS

VOLTAGE CLASSES: 6(10), 35 kV

PURPOSE AND SCOPE:
Air-insulated switchgears produced by SVEL are intended for operation in three-phase distribution networks up to 35 kV, rated frequency 50 Hz.

Switchgears passed all type tests at official laboratories according to Russian standards.

TECHNICAL DATA

<table>
<thead>
<tr>
<th>DATA</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear type</td>
<td>KRU-SVEL</td>
</tr>
<tr>
<td></td>
<td>KRU-SVEL-K-3.1</td>
</tr>
<tr>
<td>Rated voltage, kV</td>
<td>6; 10</td>
</tr>
<tr>
<td></td>
<td>35</td>
</tr>
<tr>
<td>Maximum operating voltage, kV</td>
<td>7.2; 12</td>
</tr>
<tr>
<td></td>
<td>40.5</td>
</tr>
<tr>
<td>Rated busbar current, A</td>
<td>1000; 1600; 2000; 3150; 4000</td>
</tr>
<tr>
<td></td>
<td>1250; 2500</td>
</tr>
<tr>
<td>Rated main circuits current, A</td>
<td>630; 1000; 1250; 1600; 2000; 2500; 3150; 4000</td>
</tr>
<tr>
<td></td>
<td>1250; 2500</td>
</tr>
<tr>
<td>Rated short-circuit breaking current of circuit breakers installed in switchgear, kA</td>
<td>20; 25; 31.5; 40</td>
</tr>
<tr>
<td></td>
<td>25; 31.5</td>
</tr>
<tr>
<td>Rated peak withstand current, kA</td>
<td>51; 64; 81; 102</td>
</tr>
<tr>
<td></td>
<td>63; 81</td>
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<tr>
<td>Rated thermal current, kV</td>
<td>20; 25; 31.5; 40</td>
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<tr>
<td></td>
<td>25; 31.5</td>
</tr>
<tr>
<td>Rated short-time withstand current, sec for switchgear unit for earthing switch</td>
<td>3 1</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated voltage of secondary circuits, V</td>
<td>330</td>
</tr>
<tr>
<td></td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>42 (360) 12</td>
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<tr>
<td>Type of incoming/outgoing high-voltage connections</td>
<td>cables, busbars</td>
</tr>
<tr>
<td>Service side</td>
<td>front/front and rear</td>
</tr>
<tr>
<td>Protection class</td>
<td>up to IP4X</td>
</tr>
<tr>
<td>Type of units built-in equipment and connections</td>
<td>circuits breaker, busbar-disconnector, surge arrester, voltage transformers with bus inputs incoming/outgoing from the top with cable inputs incoming/outgoing from below in cabinet with power fuses with auxiliary equipment and apparatus hardware, combined</td>
</tr>
<tr>
<td>Type of control</td>
<td>local, remote</td>
</tr>
<tr>
<td>Type of delivery</td>
<td>by separated units</td>
</tr>
</tbody>
</table>

DATA VALUE

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>VERSION</th>
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</thead>
<tbody>
<tr>
<td>Insulation type</td>
<td>air</td>
</tr>
<tr>
<td>Busbar insulation</td>
<td>insulated busbars/busbars without insulation</td>
</tr>
<tr>
<td>Type of incoming/outgoing high-voltage connections</td>
<td>cables, busbars</td>
</tr>
<tr>
<td>Service side</td>
<td>front/front and rear</td>
</tr>
<tr>
<td>Protection class</td>
<td>up to IP4X</td>
</tr>
<tr>
<td>Type of units built-in equipment and connections</td>
<td>circuits breaker, busbar-disconnector, surge arrester, voltage transformers with bus inputs incoming/outgoing from the top with cable inputs incoming/outgoing from below in cabinet with power fuses with auxiliary equipment and apparatus hardware, combined</td>
</tr>
<tr>
<td>Type of control</td>
<td>local, remote</td>
</tr>
<tr>
<td>Type of delivery</td>
<td>by separated units</td>
</tr>
</tbody>
</table>

TECHNICAL DATA

- Construction does not have welded joints, bolting or riveting only. That allows to use galvanized sheets in all switchgear elements;
- Double metal powder coating of metal constructions allows to avoid corrosion within 30 years;
- Any type of equipment build in a unit;
- Construction of switchgear is modular; that conduces fast realization of customer’s requests (it is enough to change the block);
- During the complete cycle of production each equipment is submitted to electrical and mechanical tests until the final test;
- Small dimensions allows optimal using of inner space;
- Possibility of switchgear installation into block-modular building.

* Depth 1400 mm and 1500 mm to be increased by 200mm for a unit with busbar bridges and junctions.
** Single-line diagram
PREFabricATED MV/LV TRANSFORMER SUBSTATIONS

VOLTAGE CLASSES: 6 (10)/0.4
RATED POWER: up to 2,500 kVA

ADVANTAGES:
- Pre-fabricated assembly;
- Minimum amount of welding seals, galvanized steel sheets;
- Design flexibility and quick changes;
- Any substation configuration;
- Maximum factory readiness;
- Possibility to use in for outdoor installation in block-modular building;
- Installation with dry-type transformer allows to avoid oil facilities;
- KTP-SVEL conform with permissible shipping dimensions;
- Possibility of installation on foundation of any type;
- Seismic sensity is up to 9 points (MSK-64).

TECHNICAL DATA

<table>
<thead>
<tr>
<th>DATA</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power transformer capacity, kVA</td>
<td>250; 400</td>
</tr>
<tr>
<td>Rated voltage on HV side, kV</td>
<td>6; 10</td>
</tr>
<tr>
<td>Maximum operating voltage on HV side, kV</td>
<td>7,2; 12</td>
</tr>
<tr>
<td>I rated voltage on LV side, kV</td>
<td>0,4; 0,69</td>
</tr>
<tr>
<td>Rated short-time withstand current on HV side in 1 sec, kA</td>
<td>20</td>
</tr>
<tr>
<td>Rated peak withstand current on HV side, kA</td>
<td>51</td>
</tr>
<tr>
<td>Rated short-time withstand current on LV side in 1 sec, kA</td>
<td>10</td>
</tr>
<tr>
<td>Rated peak withstand current on LV side, kA</td>
<td>25</td>
</tr>
<tr>
<td>Insulation level according to GOST1516.3-96 with oil transformer</td>
<td>standard insulation</td>
</tr>
<tr>
<td>with dry-type transformer</td>
<td>reduced insulation</td>
</tr>
<tr>
<td>Seismic sensity according to MSK-64</td>
<td>9 points</td>
</tr>
</tbody>
</table>

Types of Equipment Used in Prefabricated MV/LV Transformer Substations

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>TYPE, PART NO.</th>
<th>MANUFACTURER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power transformers</td>
<td>TS,TMZ,TSZ,TSZD,TMG,TMGF</td>
<td>SVEL, METZ n.a. V.I.Kozlov Russky Transformato</td>
</tr>
<tr>
<td>Load-break switch</td>
<td>SL12</td>
<td>Elektrospolti TM Samara Group of Companies Electrichka</td>
</tr>
<tr>
<td>Fuse</td>
<td>PKT, VVT-D</td>
<td>any</td>
</tr>
<tr>
<td>Automatic circuit breaker</td>
<td>BA, BASO-45Tpio TS, AH, AN, AS 3VT, 3VL, 3WL, 3WT CVS, NSX, MVS, Ns, NT</td>
<td>Kontaktor LSIS Siemens Schneider Electric</td>
</tr>
<tr>
<td>Current transformers</td>
<td>TOP-0,66 TSHP-0,66 TTI</td>
<td>different</td>
</tr>
</tbody>
</table>

Classification of Prefabricated MV/LV Transformer Substations

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>VERSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of power transformer</td>
<td>dry-type transformer/ oil transformer</td>
</tr>
<tr>
<td>Type of neutral on LV side</td>
<td>solid-grounded neutral insulated neutral</td>
</tr>
<tr>
<td>Mutual alignment</td>
<td>one-row/two-row</td>
</tr>
<tr>
<td>Number of power transformers</td>
<td>with one transformer/with two and more transformers</td>
</tr>
<tr>
<td>Protection degree</td>
<td>IP20, IP23, IP34</td>
</tr>
<tr>
<td>HV incoming connection</td>
<td>cable/air</td>
</tr>
<tr>
<td>Outgoing arrangement in low-voltage panel</td>
<td>top</td>
</tr>
<tr>
<td>bus cable</td>
<td>top and bottom</td>
</tr>
<tr>
<td>Circuit breaker installation</td>
<td>plug-in withdrawable / fixed-mounted</td>
</tr>
<tr>
<td>Designation</td>
<td>incoming, outgoing, coupling, secondary wiring</td>
</tr>
<tr>
<td>Service conditions</td>
<td>front and rear side</td>
</tr>
<tr>
<td>Control</td>
<td>local, remote</td>
</tr>
</tbody>
</table>

DELIVERY SET

Depending on customer’s request, delivery set can include:
1. HV switchgear
2. LV distribution panel
3. Power transformer
4. SUNN, SUVN specified by design of KTP and power transformer
5. Block-modular buildings
6. Busbar trunking system
7. Truck for circuit breaker transportation with weight exceeding 30 kg
8. Spare parts and accessories
9. Set of operating documentation

Guaranteed service life is 2 years, guaranteed storage life is 3 years in original packaging provided the transportation and storage conditions are observed.
**PURPOSE**

NKU-SVEL low-voltage switchboard is designed for low-voltage distribution at three-phase systems.

**APPLICATION**

The demands on power distribution are extremely diverse. At present days customers require reliability and safety of the power supply. NKU-SVEL complies with high demands on the power supply and can be used in oil and gas industry:

- Chemical industry;
- Metallurgy;
- Manufacturing industry;
- Infrastructure and transport;
- Nuclear power industry.

**ADVANTAGES**

- Modular structure allows to perform LV switchboard for wide range of application;
- Changing of configuration and functional blocks without supply switching off;
- Possibility of extension by adding sections as the number of receivers of electric power is increased;
- Highest operating personnel safety;
- Motor control.

---

### LOW-VOLTAGE SWITCHBOARDS SPECIFICATIONS

<table>
<thead>
<tr>
<th>DATA</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage, kV</td>
<td>0.4; 0.69</td>
</tr>
<tr>
<td>Rated frequency, Hz</td>
<td>50</td>
</tr>
<tr>
<td>Rated busbar current, A</td>
<td>up to 6300</td>
</tr>
<tr>
<td>Rated peak withstand current, kA</td>
<td>up to 220</td>
</tr>
<tr>
<td>Rated short-time withstand current 1sec, kA</td>
<td>up to 100</td>
</tr>
<tr>
<td>Type of connection to earth</td>
<td>TN-C, TN-C-S, TN-S, IT</td>
</tr>
<tr>
<td>Internal division</td>
<td>1, 2a, 2b, 3a, 3b, 4a, 4b</td>
</tr>
<tr>
<td>Panel</td>
<td>incoming feeders coupling outgoing feeders universal mounting design compensation of reactive power</td>
</tr>
<tr>
<td>Mounting design</td>
<td>Fixed-mounted withdrawable</td>
</tr>
<tr>
<td>Configuration of functional units</td>
<td>circuit breakers installation fuse installation motor softstarter and smooth braking device frequency converter</td>
</tr>
<tr>
<td>Panel Over-all dimensions, mm</td>
<td>2200</td>
</tr>
<tr>
<td>height</td>
<td>600-1200</td>
</tr>
<tr>
<td>depth</td>
<td>200-1200</td>
</tr>
<tr>
<td>width</td>
<td></td>
</tr>
<tr>
<td>protection degree</td>
<td>IP30, IP31, IP40, IP41, IP42, IP54</td>
</tr>
<tr>
<td>Seismic sensity MSK-64 scale</td>
<td>9 points</td>
</tr>
<tr>
<td>Life time (not less), years</td>
<td>30</td>
</tr>
<tr>
<td>Operational altitude above sea, up to</td>
<td>1000</td>
</tr>
<tr>
<td>elevation (no more), m</td>
<td></td>
</tr>
<tr>
<td>Warranty since placed in operation</td>
<td>3 years</td>
</tr>
<tr>
<td>Accordance to</td>
<td>GOST, IEC</td>
</tr>
</tbody>
</table>
CAST RESIN DRY-TYPE TRANSFORMERS

(DISTRIBUTION AND RECIFIER)

VOLTAGE CLASSES: up to 36 kV
POWER: from 25 to 25,000 kVA

- Reduced no-load and load losses
- Reduced noise level
- Ambient temperature from minus 60 °C up to 55 °C.
- High level of fire-resistance allowing to locate transformer sites as close as possible to electric power consumers, which will significantly reduce losses in course of electric power transmission in LV mains
- Ecological cleanliness. As there is no oil in the transformer, threat of environment pollution because of oil leakage will not be possible
- Operation security. Transformer windings are not flammable and cannot be a source of fire
- Minimum operational costs, as there is not necessity in periodic check and replacement of dielectric fluid
- Small overall sizes, which provides possibility to install a more powerful transformer in the existing transformer compartment in course of reconstruction of the substation
- High dynamic strength at short circuit currents
- Windings are not subjected to wetting and polluting
- Increased reliability. High pulse strength of dry-type transformers allows omitting installation of surge arresters.

TECHNICAL PARAMETERS OF CAST DRY-TYPE TRANSFORMERS

<table>
<thead>
<tr>
<th>TRANSFORMER TYPE</th>
<th>DISTRIBUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated power, kVA</td>
<td>10-6300*</td>
</tr>
<tr>
<td>HV insulation level, kV*</td>
<td>12</td>
</tr>
<tr>
<td>HV tapping range</td>
<td>Off load tap changer +2x2.5%</td>
</tr>
<tr>
<td>Frequency, Hz</td>
<td>50, 60</td>
</tr>
<tr>
<td>Vector group</td>
<td>DYN-11, DYN-5, YYN-0 (and other)</td>
</tr>
<tr>
<td>Thermal class</td>
<td>F, H</td>
</tr>
<tr>
<td>Environmental, Climatic and Fire behaviour class (according to IEC 60076-11)</td>
<td>E2</td>
</tr>
<tr>
<td>Enclosure</td>
<td>Without enclosure (IP00). With metal enclosure (IP21-IP54)</td>
</tr>
<tr>
<td>Earthquake activity of the installation site per MSK-64 scale</td>
<td>Up to 9 points</td>
</tr>
<tr>
<td>Service life</td>
<td>30 years at least</td>
</tr>
</tbody>
</table>

* Note: basic characteristics of transformers of insulation classes 17.5-36 kV and power over 6300 kVA are to be agreed by individual requests of customers.

The company has an efficient quality control of the products in accordance with ISO 9001:2008. The Quality System covers all production stages from the offer to the after sale service.

SVEL follows the current trends and the highest quality standards. That is why we certify management systems and products from leaders in their field.

SVEL Group produce follow dry-type transformers:

- Distribution transformers
- Earthing transformers
- Transformers for 6-12-18-24 pulse converter
- HV-HV transformers
- Scott type transformers
- Autotransformers
- Marine transformers
- Transformers for Urban electric transport
- Transformers for renewable energy
- Amorphous cast resin dry-type transformers
SPECIAL FEATURES OF DEVELOPMENT AND MANUFACTURE

When developing instrument transformers, SVEL Group uses innovative approaches and experiences of leading manufacturers of this equipment, which allows to make transformers with high level of reliability and measuring accuracy.

Reliability and long serviceable life of cast coil instrument transformers are based on the technology of epoxy compound pouring-in. SVEL instrument transformers are poured in open molds under deep vacuum. Probability of occurrence of hidden internal defects of insulation of transformers is excluded as a result of special construction of the mold with open upper part and individual selection pouring-in modes for each type of transformer.

 Specialists of SVEL Group, in cooperation with German manufacturers of casting equipment for instrument transformers of highest voltage class from 7.2 to 40.5 kV, developed design of outdoor instrument transformer. It has following features:

• Manufacturing through one pouring-in by epoxy compound;
• High ultraviolet radiation resistance;
• Acceleration of the process of transformer manufacturing through exclusion of second pouring-in;
• Reduced heating factors of transformer;
• Lower equipment cost because of refusal of polyurethane resin.

CURRENT TRANSFORMERS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>VOLTAGE CLASS, kV</th>
<th>ACCURACY CLASS OF MEASURING WINDINGS</th>
<th>ACCURACY CLASS OF PROTECTION WINDINGS</th>
<th>NUMBER OF SECONDARY WINDINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOL-SVEL</td>
<td>7.2 – 40.5</td>
<td>0.2; 0.25; 0.5; 0.55; 1; 3; 5</td>
<td>SP, 10P</td>
<td>up to 4</td>
</tr>
<tr>
<td>TPOL-SVEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPL-SVEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TV-SVEL</td>
<td>40.5 – 252</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSNL-SVEL</td>
<td>0.72 – 24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VOLTAGE TRANSFORMERS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>VOLTAGE CLASS, kV</th>
<th>ACCURACY CLASS</th>
<th>SECONDARY VOLTAGE, V</th>
<th>NUMBER OF SECONDARY WINDINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOL-SVEL</td>
<td>3.6 – 40.5</td>
<td>from 0.2 and below</td>
<td>100 or 110</td>
<td>2</td>
</tr>
<tr>
<td>2NOL(P)-SVEL</td>
<td></td>
<td></td>
<td>100/√3 or 110/√3</td>
<td></td>
</tr>
<tr>
<td>3XNOL-SVEL</td>
<td></td>
<td></td>
<td>100 or 110</td>
<td></td>
</tr>
</tbody>
</table>

POWER TRANSFORMERS

<table>
<thead>
<tr>
<th>TYPE</th>
<th>VOLTAGE CLASS, kV</th>
<th>RATED POWER, VA</th>
<th>RATED PRIMARY VOLTAGE, V</th>
</tr>
</thead>
<tbody>
<tr>
<td>OL-SVEL</td>
<td>7.2 – 40.5</td>
<td>630; 1250</td>
<td>6300; 6600; 10500; 11000</td>
</tr>
<tr>
<td>OLS-SVEL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OLS-P-SVEL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**HISTORY**

- **2003**: Start-up of dry-type transformers production.
- **2005**: Development and production of TRSZP-320/0.6 outdoor dry-type rectifier transformer.
- **2009**: Start-up of Medium voltage switchgear and Prefabricated MV/LV TRANSFORMER SUBSTATIONS production.
- **2010**: Development and production of ATDCIN-200/0.01/220 voltage transformer with the highest capacity in the world.
- **2012**: Development and production of KSO-SVEL, 10 multi-elm electro-magnetic unit/units, protecting device for over voltage protection of voltage transformers.
- **2016**: Development of SVEL Group's lab and plant for equipment testing and production of equipment for nuclear power stations.

**No1 IN RUSSIA**

- **2003**: Start-up of Air-GDHE current limiting reactors production.
- **2004**: Development and production of SVEL-SVEL, 10 multi-elm electro-magnetic unit/units, protecting device for over voltage protection of voltage transformers.
- **2005**: Development and production of KSO-SVEL, 10 multi-elm electro-magnetic unit/units, protecting device for over voltage protection of voltage transformers.
- **2007**: Development and production of KSO-SVEL, 10 multi-elm electro-magnetic unit/units, protecting device for over voltage protection of voltage transformers.
- **2009**: Operation tests of KSO-SVEL, 1.1, 1.2, single-ended service 
  assembled chamber. Certificate of Conformity and Declaration of Compliance.
- **2013**: Operation tests of KSO-SVEL, 1.1, 1.2, single-ended service 
  assembled chamber. Certificate of Conformity and Declaration of Compliance.
- **2014**: Operation tests of KSO-SVEL, 1.1, 1.2, single-ended service 
  assembled chamber. Certificate of Conformity and Declaration of Compliance.
- **2015**: Operation tests of KSO-SVEL, 1.1, 1.2, single-ended service 
  assembled chamber. Certificate of Conformity and Declaration of Compliance.
- **2016**: Development and production of KSO-SVEL, 1.1, 1.2, single-ended service 
  assembled chamber. Certificate of Conformity and Declaration of Compliance.

**SVEL GROUP**

- **2003**: SVEL Group accredited own test center for checking whole line of equipment.
- **2004**: Test in DAD NTC-RBS VLS, Certificate of Conformity and Declaration of Compliance.
- **2005**: Test in DAD NTC-RBS VLS, Certificate of Conformity and Declaration of Compliance.
- **2007**: Test in DAD NTC-RBS VLS, Certificate of Conformity and Declaration of Compliance.
- **2009**: Test in DAD NTC-RBS VLS, Certificate of Conformity and Declaration of Compliance.
- **2012**: Test in DAD NTC-RBS VLS, Certificate of Conformity and Declaration of Compliance.
- **2016**: Test in DAD NTC-RBS VLS, Certificate of Conformity and Declaration of Compliance.