Modular integrated transformer substations

Voltage class:
6 (10), 35, 132, 230 kV
HISTORY
Start-up of SVEL RosEnergoTrans plant – 1st plant of SVEL Group, specialized in manufacturing of the cast resin dry-type transformers, voltage classes are 6-10 kV, rated power is from 25 to 2500 kVA.

Start-up production of dry-type current limiting reactors, 4000 A, voltage classes are up to 20 kV, inductive resistance is up to 2.0 ohm;
Realization of the first project on design and construction of unitized transformer substation.

Designed and manufactured dry-type converter transformers ТРСЗП-3200/6 for zones with moderate cold climate outdoor installation (possibility of exploitation at the ambient temperature up to minus 60°C);
Obtained patent on dry-type current limiting reactors;
Obtained certificates of compliance of SVEL power equipment to Federal norms of industrial safety and working conditions for objects of JSC Gazprom and JSC Transneft.

Obtained certificate of compliance of the quality management system to ISO 9001:2000;
Start-up of the project on the construction of a new plant SVEL Power Transformers, manufacturing oil-immersed transformers, voltage classes are from 10 to 220 kV, rated power is from 2 500 to 250 000 kVA.

Branch Offices were opened in the following cities: Moscow, St-Petersburg, Krasnoyarsk, Krasnodar and Kiev.

Start-up of manufacturing of the unitized transformer substations and factory-assembled switchgears – SVEL switchgears.
Start-up of manufacturing of SVEL Instrument transformers;
Branch Offices were opened in Astana, Kazan and Novosibirsk;
Plant of metal structures was integrated into SVEL Group.

Designed and manufactured АПДЦТН – 250 000/220- the most powerful oil-immersed transformer manufactured by SVEL Group before 2011.
Branch Office was opened in Khabarovsk.
SVEL Group 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.

BUSINESS ACTIVITY

Manufacture of dry-type transformers and current-limiting reactors;
Manufacture of power oil immersed transformers;
Manufacture of integrated switchgears, transformer substations, complete block transformer substations;
Manufacture of current and voltage transformers;
Manufacture of transmission angle and pipe towers, special distribution steel towers;
Design and installation;
Manufacture of circuit breakers and disconnectors.
SCOPe OF APPLICATION

SVEL Group makes modular integrated transformer substations, voltage classes: 6 (10), 35, 132, 230 kV (Tech.conditions 3412-001-63920658-2009), carrying out functions of a general contractor (ready-to-operate).

Modular integrated transformer substations (MITS) is designed to receive, convert and distribute electric power of three-phase alternating current, 50Hz power frequency. MITS can be used on the territory of the Russian Federation and abroad to provide energy to the industrial objects of oil and gas industry, mining industry, the machine-building enterprises, railway transport, urban and utility facilities, agricultural zones and big construction sites.

Type variants of modular integrated transformer substations are designed on the base of the book Type principle electric diagrams of distribution equipment with voltage 6-750 kV, substations and application notes №14198тм-т1, ENERGOPROEKT Institute, Moscow city – 1993.

Modular integrated transformer substations are designed for outdoor installation on the height nor more than 1000m above the sea level and operating conditions, corresponding to versions tropical, moderate cold, cold climatic zones, placement category 1 according to GOST standard 15150.

Modular integrated transformer substations, voltage classes 6 (10) – 230 kV, designed by specialists of SVEL Group, are modern layout solutions, corresponding to The rules on design of power electric installations, and also requirements and recommendations of JSC FSK EES.

The main parameters and characteristics of modular integrated transformer substations correspond to the values, indicated in the table Technical parameters of modular integrated transformer substations.

The present catalog contains the description, main characteristics, diagrams and other technical information concerning modular integrated transformer substations and its component parts.

Designation:

MITS – XXX – XX – XX – XXX

- Climatic modification of the placement category 1 is according to GOST 15150;
- Power transformer capacity, MVA;
- Number of the switchgear diagram;
- Voltage class, kV;
- Modular integrated transformer substation.

Example:

MITS – 132 – 4Н – 16 – УХЛ1

MITS – Modular integrated transformer substation;
132 – Nominal voltage = 132 kV;
4Н – Diagram of the switchgear electrical connections;
16 – Transformer capacity = 16000 kVA;
УХЛ1 – For zones with moderate cold climate the placement category 1 according to GOST 15150.
BENEFITS OF SVEL MODULAR INTEGRATED TRANSFORMER SUBSTATIONS

Reduction of term for project designing
Use of catalogs with typified product.

Easy ordering process
Use of symbols for the main component parts of MITS, that reduces the time to approve an order.

Universality
Universality of modules – possibility to install any type of high voltage equipment taking into account individual requirements of a project.

Possibility to modernize the existing switchgears
- Modules are adaptable to any type of equipment.
- Rigid busbars can be installed on a wide range of support insulators and disconnectors.
- Layout design of the outdoor switchgear takes into account the individual requirements of a project.

Reduced delivery time
Presence of the developed design documentation.

Reduced period of mounting
- Application of bolt connections instead of welded ones in modules with equipment and in rigid busbars.
- Check assembly at the manufacturer allows: to exclude incomplete supply; to check assembling of the equipment.
- Application of rigid busbars allows to refuse from the busbars portals, making foundations under them and laying of flexible connections.

Reduced floor space to arrange the switchgears
- Application of rigid busbars allows to refuse from the busbars portals, as a result it reduces the distance between the switchgear cubicles.
- Application of the modular integrated design allows to reduce the number of foundations in comparison with the design of separate units.
- Application of the suspended cable arrangement allows to refuse from the expenses on the additional works of laying the ground cables.
- Position of cabinets of the secondary control wiring directly on the supporting metal structure of modules allows to refuse from the expenses on making foundations under them.
### Technical parameters of the factory-assembled switchgears

<table>
<thead>
<tr>
<th>№</th>
<th>Parameter</th>
<th>Characteristics</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Outdoor switchgear</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>230 kV</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Nominal voltage, kV</td>
<td>132 kV</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>highest</td>
<td>35 kV</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>medium</td>
<td>35 kV</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>lowest</td>
<td>6, 10, 35</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Power transformer capacity, kVA</td>
<td>Up to 250000*</td>
<td>*to be approved according to the requirements of the substation project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Up to 63000*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Up to 16000*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Nominal current, A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>the switchgear cubicles</td>
<td>1000, 2000</td>
<td>According to the diagrams: 132-12...13; 230-7...14.</td>
</tr>
<tr>
<td>-</td>
<td>cabinet of the switchgear input</td>
<td>-</td>
<td>630, 1000, 1600, 2500, 3150</td>
</tr>
<tr>
<td>-</td>
<td>circuits of lines and electrical jumpers</td>
<td>max 1000</td>
<td>See the catalog Factory-assembled switchgears</td>
</tr>
<tr>
<td>-</td>
<td>circuits of power transformers</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>circuits of the assembled busbars</td>
<td>1000, 2000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Through current of short circuit</td>
<td>65, 81*</td>
<td>*For switchgear cubicles and assembled busbars with In=2000A</td>
</tr>
<tr>
<td></td>
<td>(amplitude), kA</td>
<td>65, 81*</td>
<td></td>
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<td></td>
<td></td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3 sec withstand thermal current, kA</td>
<td>25, 31,5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Climatic modification and the</td>
<td>for zones with tropical, moderate,</td>
<td>GOST 15150</td>
</tr>
<tr>
<td></td>
<td>placement category</td>
<td>moderate cold climate</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>The wind speed grade</td>
<td>I – V</td>
<td>PUE (the 7th edition)</td>
</tr>
<tr>
<td>8</td>
<td>The ice-covered ground grade</td>
<td>I - VII</td>
<td>PUE (the 7th edition)</td>
</tr>
<tr>
<td>9</td>
<td>The air pollution concentration</td>
<td>I – IV</td>
<td>GOST 28856</td>
</tr>
<tr>
<td>10</td>
<td>Seismicity of the construction site,</td>
<td>7 – 9*</td>
<td>According to MSK-64 scale; *reinforced supporting metal structures</td>
</tr>
<tr>
<td></td>
<td>points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Average lifetime of MITS, years</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>
CONSTRUCTION

Completeness

Modular integrated transformer substations may consist of:

- Power transformers (autotransformer);
- Outdoor switchgears 230, 132, 35, 6(10) kV;
- Rigid and flexible busbars;
- Cable structures;
- Cabinets of the secondary control wiring;
- Contact-stretching accessories;
- Outdoor factory-assembled switchgears (10) 6 kV;
- Substation control house (SCH);
- Portals;
- Lighting mast and lightning;
- Earthing;
- Foundations;
- Lightning protection (lightning rods etc);
- Safety fence of the substation.

The completeness of modular integrated transformer substations can be modified according to the individual requirements of the project and the Customer and shall be indicated in the questionnaire of a substation (see Annex: Questionnaire).

Power transformers

Power transformers installed in modular integrated transformer substation, designed and made by SVEL Power transformers, are used for energetic objects, electrified transport and substations of the industrial enterprises rated up to 250 MVA, voltage classes are up to 230 kV (of ТДН, ТРДН, ТДТН types) according to the range of GOST 12965-85. Power transformers, made by domestic and foreign manufacturers also can be applied.

Converter transformers are used for plants of nonferrous metal electrolysis and chemical factories, electric drive of rolling mills and electric-arc furnaces in metallurgy, electrified railway and industrial transport, specific electro-physical research installations. Transformers meet all the requirements of GOST 16772-77.
OUTDOOR SWITCHGEARS

Outdoor switchgears 6 (10), 35, 132, 230, as a part of MITS, are switchgears with supporting metal structures, having high voltage equipment installed on them, also rigid busbars, the elements of flexible busbars, cable structures, cabinets of the secondary control wiring, earthing elements. Supporting metal structures for the high voltage equipment are made for modular integrated and separate units versions. (Technical conditions №5264-002-63920658-2009 Metal structures for modular integrated transformer substations of 6(10) – 230 kV).

Supporting metal structures are certified according to the system of GOST, their quality and carrying capacity are confirmed with calculations and test reports:

Test report №19-10 dated 16.03.2010 of the Test center Stavan-test of JSC The Ural Institute of Metals, reg. № РОСС RU. 0001.22ЭФ05 dated 28.05.2007

Test report №15.04.10 dated 05.04.2010 of the Test center UralNIIAS of JSC The Ural research institute of architecture and construction, reg. № РОСС RU.0001.22СЛ07 dated 04.12.2009

Outdoor switchgears 132 kV (Diagram 132-4H)
1. Supporting blocks
2. High voltage equipment, including equipment of the high-frequency communication
3. Rigid busbars
4. Contact-stretching accessories
5. Cable structures
6. Cabinets of the secondary control wiring
7. Support insulators
8. Portals
9. Elements of earthing and lightning protection
10. Service platform
Supporting metal structures depending on the design are designed for seismic load, corresponding to the seismicity of the construction site up to 9 points inclusive according to МSK-64 scale. Metal structures have an anticorrosive coating to protect against external impact sources (hot-dip galvanized coating or cold galvanizing or varnish-and-paint coating.

On the outdoor switchgear we install domestic and foreign high voltage equipment, certified by JSC FSK EES, that is provided in the electrical connections diagrams of the main circuits (see the section Diagrams of the main circuits). Modules with high voltage equipment 132, 230 kV are supplied as disassembled. Modules with high voltage equipment of 35 kV can be supplied as assembled or disassembled of the appropriate height ready-to-use (supporting metal structures, high voltage equipment, rigid busbars, cabinets of the secondary control wiring, secondary control wiring, cable trays etc.).

Metal structures can be designed for any type of high voltage equipment, domestic or foreign, taking into account the individual requirements of the project. Modules with the equipment, that are applied as the main solution at the design and reconstruction of the switchgears 6(10) – 230 kV, are easy to install due to the application of bolt connections instead of welded ones.

Modules with the equipment to be incorporated in the outdoor switchgear of different voltage classes, have a wide range of the designed module types (see below), that is constantly renewed.

Each module type has its own designation, indicating information about its composition and arrangement of the equipment, installed on the metal structures, the height of the module and distance between phases of the equipment. Application of such designation is convenient to choose the required module type and to place an order without wasting time on additional approval.

Metal structure with the installed high voltage equipment has the following designation:

**Modular version:**

\[
B. \text{XXX. } XX - XX / XX - XXX
\]

- Climatic modification;
- Interphase distance, dm;
- Height of the supporting metal structure, dm;
- Type of the installed equipment;
- Nominal voltage, kV;
- Supporting block.

**Abbreviation for the high voltage equipment:**

- ВЗ – high-frequency choke
- ВК – Breaker
- ЗЗ – earthing lead
- КЗ – short-circuit
- КМ – cable coupling sleeve
- КС – coupling capacitor
- ОД – isolating switch
- ОИ – supporting insulator
- ШО – busbar support
- ОПН – overvoltage limiter
- ОПНн – overvoltage limiter of the neutral
- ПР – fuse
- РЗ – disconnector
- СИ – pulse counter
- ТН – voltage transformer
- TT – current transformer
- ТСН – service transformer
- ΦП – coupling filter
Rigid busbars

Rigid busbars, designed by specialists of SVEL Group are designed to transfer and distribute the electric power between the high voltage equipment in outdoor and indoor switchgears of Modular integrated transformer substations. Rigid busbars are made according to the technical conditions 03Т.538.002. Rigid busbars for outdoor switchgears of voltage classes 6 (10) – 230 kV. Application of rigid busbars allows to refuse from the busbars portals, making foundations under them and laying of flexible connections, this leads to the floor space reduction of the switchgear, the reduction of mounting works and materials saving.

Rigid busbars according to the diagram 110-4H

Designation of the rigid busbars:

**RB. XXX. XXXX**

- Rated current, A;
- Rated voltage, kV;
- Rigid busbars.

Parameters of the rigid busbars

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current, A</td>
<td>1000 2000</td>
</tr>
<tr>
<td>Short-time thermal current (3 sec.), kA</td>
<td>31,5</td>
</tr>
<tr>
<td>Short time electrodynamic current (impact value, &lt;0,1 sec.) kA</td>
<td>80</td>
</tr>
<tr>
<td>Climatic modification and the placement category according to GOST 15150-69</td>
<td>From tropical to cold climate zone</td>
</tr>
</tbody>
</table>
Design of the rigid busbars consists of the following elements and units:

- Busbars of tubular and plane section are made of aluminum alloy 1915.T, having good electrical conductivity and rather high strength;

- Connections of the busbars are made as steel clamps of round or plane section and they are located on a support plate. The connection elements allow to make a rigid fixation of the busbar (console), or free fixing, that gives possibility for lengthwise movement of the busbar if the temperature deformations occur (joint-hinge);

- Compensators of the temperature deformations are made of aluminum wire, grade A, acc.to GOST 839-80. The wire section is chosen depending on the rated current value. The compensators also play the role of a current-carrying flexible connection between the busbars.

Connections of the busbars:

Connections of the busbars 132 kV
Fixing of the horizontal busbar and a support plate is done with steel clamps of round section with thread.

Connections of the busbars 230 kV
Fixing of the horizontal busbar is done with bent clamps of sheet steel.
Rigid busbars are designed for rated currents from 1000 А to 2000 А.

From the outside the busbar surface can have a varnish-and-paint coating, or color marking done with ring markers that are made of a heat shrink tube. Colors depend on phases according to PUE.

Rigid busbars are designed for outdoor installation at the height of nor more than 1000 м above the sea level and operating conditions, corresponding to versions tropical, moderate cold and cold climatic zones, placement category 1 according to GOST standard 15150.

At present the rigid busbars using cast supports are being designed.

**Design of the cast busbar supports:**

Rigid busbars on the cast supports:
FACTORY-ASSEMBLED SWITCHGEARS 10 (6) KV

Factory-assembled switchgears 10 (6) kV, designed by specialists of SVEL Group, are applied as distribution points of the modular integrated transformer substation. Factory-assembled switchgear by SVEL consists of separate cabinets and the equipment in each has the same type of connection to the collecting busbars.

The designed factory-assembled switchgears have the following advantages:

- Possibility to install any type of equipment inside the cubicles;
- Factory-assembled switchgears by SVEL consist of blocks, it leads to the quick realization of the customer wishes (it’s enough just to change a block);
- Small dimensions due to the maximum use of the inside space;
- The structure doesn’t have welded seams, the connections are either bolt or riveted, and it allows to apply a galvanized sheet for all elements of the factory-assembled switchgears by SVEL;
- The double metal-particle coating of metal structures allows to avoid corrosion during 25 – 30 years.
EARTHING

Earthing of the metal structures with the high voltage equipment, of the power transformers tanks, of the cabinets of factory-assembled switchgears and of the other metal parts is carried out with steel strips 4х40 GOST 103-76, one end of which is connected with the equipment using the earthing bolts and another end is welded with beams or frames of the support structure for the electrical equipment. The support structure is earthened directly to the earthing loop of the substation by welding. The earthing strip is covered in black color in its location. The earthing loop of the substation is calculated by the project organization.

FOUNDATIONS

The elements of BKTP can be installed on different foundation types. The type and its location is defined by the project organization basing on the geological engineering survey.

The following foundations are applied:

- underground;
- half-underground;
- slightly underground;
- monolith foundation post;
- piled (stands, screw piles, drilled piles, drive piles);
- single foundation beam;
- double foundation beam.

When the supporting metal structures are installed on the piled foundations and foundation beams it’s necessary to apply some adapter elements (grillage) that are screwed with the support plates of the metal structure columns.

For other types of foundations the columns of metal structures are installed directly on the foundations using the anchor bolts. The support plates of columns have width 35 mm holes for the anchor bolts М30 of the square 400х400 mm.

It’s possible to install the supporting metal structures on the foundations according to the individual requirements of the project.

LIGHTNING PROTECTION

The function of the outside lightning protection at the object is performed with lightning rod and lightning conductors, which provide protection from direct lightning strokes. Lightning rods are installed on the busbar portals 35-230 kV and supports of power lines 35-230 kV.

The system of the outside lightning protection, based on the lightning protection grid, is designed individually for each object.

SAFETY FENCE

The Safety fence of modular integrated transformer substations is made according to our own design documentation. The fence consists of the welded mesh panels, which are assembled directly at the object by welding with stand supports from steel tube. On the top of the fence all around there is a spiral barbed-wire fence OKC 54/10 acc.to TV-1470-001-39919268-2004.
FILLING-IN OF THE QUESTIONNAIRE

The questionnaire is filled-in according to the set form. Changing of the form, its dimensions and content is not admissible. The questionnaire forms for the factory-assembled switchgears and the SCH are filled-in according to the catalogs of this type of products.

The questionnaire form, signed and stamped by the Customer, shall be sent to the Manufacturer in 1 (one) copy.

All columns of the questionnaire form shall be filled-in, in case of the data absence in columns it’s necessary to make a line.

In the part Installed equipment it’s necessary to indicate the type and all parameters of the equipment indicating in the column additional requirements the conditions that influence on the completeness and design of the equipment incorporated in MITS.

In the part Requirements to the rigid busbars, it’s necessary to indicate the values of the short-time thermal current and electrodynamic withstand current, the admissible continuous current of the rigid busbars. It’s also necessary to indicate the type of rigid busbars (welded or on the cast supports) and variant of marking (ring markers or continuous covering).

In the part Climatic conditions of the construction site it’s necessary to fill-in all columns, excluding Additional requirements. The material and the type of the supporting metal structures as well as the design and diameter of the busbars in the rigid busbars depend on correct filling-in of this part.

In the part Additional requirements it’s necessary to indicate the type and the height of the foundation above the layout level (+0.000), and also this part is important if you order suspended cable structures.

In the part Scope of supply blocks shall be indicated according to the above indicated designation (see the part Outdoor switchgears). If you order portals and lightning masts you should indicate their complete designation according to the type catalogs of this product. (see the part Portals).

The questionnaire shall have the following attachments: a single-line diagram, the layout and dimensions of the substation, the foundations and supports.

The most complete and correct filling of the questionnaire significantly reduces time for additional approvals and development of the design documentation for modular integrated transformer substation.
Questionnaire

**MODULAR INTEGRATED TRANSFORMER SUBSTATION – SVEL**

<table>
<thead>
<tr>
<th>Requested data</th>
<th>The substation name</th>
<th>The diagram number</th>
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</thead>
<tbody>
<tr>
<td><strong>Requirements to the Outdoor switchgear</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Installed equipment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Designation</td>
<td>Manufacturer</td>
</tr>
<tr>
<td>Power transformer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disconnector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breaker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current transformer</td>
<td></td>
<td></td>
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<tr>
<td>Voltage transformer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overvoltage limiter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coupling capacitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-frequency line trap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coupling filter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-pole disconnector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overvoltage limiter of the neutral of the power transformer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earthing lead of the neutral of the power transformer</td>
<td></td>
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</tr>
</tbody>
</table>

**Requirements to the rigid busbars**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
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<tbody>
<tr>
<td>The short-time thermal current of the rigid busbars, kА</td>
<td>Admissible continuous current of the rigid busbars, kА</td>
</tr>
<tr>
<td>The electrodynamic withstand current of the rigid busbars, kА</td>
<td>Color marking (ring markers or continuous paint covering)</td>
</tr>
<tr>
<td>Type of the rigid busbars (welded; with the cast supports)</td>
<td>Additional requirements</td>
</tr>
</tbody>
</table>

**Climatic conditions of the construction site**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>The wind speed grade (PUE the 7th edition)</td>
<td>Climatic modification according to GOST 15150</td>
</tr>
<tr>
<td>The ice-covered ground grade (PUE the 7th edition)</td>
<td>Seismicity of the area (acc. to MSK-64 scale)</td>
</tr>
<tr>
<td>The air pollution concentration GOST 9920</td>
<td>Temperature of the coldest week, °C</td>
</tr>
<tr>
<td>Additional requirements</td>
<td></td>
</tr>
</tbody>
</table>

**Additional requirements**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of foundation (foundation beams, piles, others)</td>
<td>Foundation height</td>
</tr>
<tr>
<td>Number of levels of the suspended cable structures (1 or 2)</td>
<td>Width of the cable tray (200, 300, 400)</td>
</tr>
<tr>
<td>Presence of the separating profile in trays</td>
<td>Add. requirements</td>
</tr>
</tbody>
</table>

The questionnaire is to be sent by fax: +7 (343) 253-50-12
## Scope of supply

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Number</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module of disconnector</td>
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<td></td>
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</tr>
<tr>
<td>Add. requirements</td>
<td>Module of breaker</td>
<td></td>
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<tr>
<td></td>
<td>Module of the current transformers</td>
<td></td>
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<tr>
<td></td>
<td>Module of the voltage transformers</td>
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<tr>
<td></td>
<td>Module of the SCH</td>
<td></td>
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<tr>
<td></td>
<td>Module, receiving the power line wire</td>
<td></td>
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<td>Module of the SCH of neutral</td>
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<tr>
<td></td>
<td>Module of the support insulators</td>
<td></td>
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<tr>
<td></td>
<td>110 kV</td>
<td></td>
<td>Type of support insulators</td>
</tr>
<tr>
<td></td>
<td>Service platforms for the breaker drives</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Portals</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Lightning masts</td>
<td></td>
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<tr>
<td></td>
<td>Lightning installation</td>
<td>2x500 Wt</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>2x1000 Wt</td>
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</tr>
<tr>
<td></td>
<td>Grillage for supporting metal structures for the equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Set of rigid busbars</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cabinets of the secondary control wiring (yes/no)</td>
<td>Please indicate the type of cabinets of the secondary control wiring</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contact-stretching accessories (yes/no)</td>
<td>Please indicate the wire type</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Set of brackets for the cover of the power transformer</td>
<td>Type of support insulators</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SCH (Substation control house) (yes/no)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indoor switchgears 35, 6 (10) kV (yes/no)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Please indicate the N number of cubicles and phases with high-frequency treatment.**

---

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For detailed information please contact our experts.