



20 kV SWITCHGEAR AND CONTROL GEARS

K-131 "PROGRESS"

TECHNICAL DESCRIPTION

1. K-131 SERIES SCG "PROGRESS"



1.1 PURPOSE AND APPLICATION

Switchgear and control gears (SCG) K-131 are designed to receive and distribute electric energy in three-phase 50 and 60 Hz AC networks with maximum voltage of up to 24 kV.

They are used at all types of power plants, distribution substations of power systems, substations of industrial enterprises, transport electrification and other power supply facilities.

The switchgear K-131 consists of separate cabinets or coupled units, which are assembled in the switchgear sections on site.

1.2 MAIN ADVANTAGES

- Possibility to use domestic vacuum circuit breakers BB/TEL-20/.
- Metal casing made of galvanized steel with separated compartments.
- The cabinets can accommodate CTs with flexible secondary winding leads of required length for installation of a sealed terminal block in the relay compartment in a place convenient for maintenance.
- Reliable arc protection can be implemented using microprocessor devices with sensors based on fiber optic which feature high speed and high sensitivity.
- Up-to-date microprocessor-based units with advanced communication interfaces.
- Active mimic diagram and high voltage indicator.
- Operability under seismic actions up to 9 points of MSK-64 scale.
- Protection class at least IP 40.
- High maintainability.
- Personnel safety ensured through:
 - Isolated compartments allowing to localize an arc within one compartment;
 - Use of reliable high-speed arc protection systems with emergency pressure relief valves;
 - Availability of screw-type mechanism to move drawout element with the front door closed from the working position to the reference position and back;
 - Availability of circuit breaker trip mechanism with the front door closed;
 - Separate drive of upper and lower shutter of the shutter mechanism;
 - Availability of field grounding bus;
 - Availability of a set of interlocks that prevent personnel's faults while operating the equipment.
- Circuit breakers-equipped cabinets can accommodate the second drawout element with voltage transformers to monitor input voltage.
- Service life is at least 30 years.

1.3 OPERATION CONDITIONS

- In terms of environmental exposure, K-131 cabinets comply with climatic version U3 according to GOST 15150-69 and according to GOST 15543.1-89.
- Lower ambient air temperature is assumed to be -25°C. At a temperature of -25°C or below, the switchgear room must be heated. To ensure equipment proper operation in the relay cabinet heating should be provided.
- Altitude above the sea level is no more than 1,000 m (installation at an altitude exceeding 1,000 m is permissible provided that the requirements of GOST 15150-69, GOST 1516.3-96 and GOST 8024-90 are complied with).
- The environment is non-explosive, containing no gases saturated with current-conducting dust, vapors and chemical deposits detrimental for insulation of conducting parts which would impair characteristics of SCG cabinets beyond the permissible limits (atmosphere II according to GOST 15150-69).
- In terms of the effect of environmental mechanical factors, the SCG cabinets comply with group M6 according to GOST 17516-1-90. Seismic-resistant version K-131 cabinets ensure operability under seismic actions up to 9 points of MSK-64 scale at installation level above over datum up to 25 m according to GOST 30546.1-98, GOST 30546.2-98, GOST 30546.3-98.
- The ingress protection degree according to GOST is 14254-96 - IP40, IP00 (with opened doors of the cabinet).
- K-131 cabinets comply with the requirements of Specs 3414-033-00110496-2009.

1.4 BASIC TECHNICAL PARAMETERS

Table 1.1 Basic technical parameters of K-131 series SCG

Parameter name	Value
Rated voltage, kV	20
Maximum operating voltage, kV	24
Rated current of the main circuits, A	630; 1250; 1600; 2000; 2500; 3150 ¹
Rated current of busbars, A	1250; 2000; 2500; 3150
Rated trip current of circuit breakers built into the cabinets, kA	16; 20; 25
Short-time thermal current (3 s for main circuits; 1 s for grounding blades), kA	16; 20; 25
Rated current of electrodynamic resistance of the main circuits, kA	40; 51; 64
Rated voltage of DC and AD auxiliary circuits, V	220
Types of applied vacuum circuit breakers	VD4, SION, BB/TEL, 3AH4
Insulation level according to GOST 1516.3-96	standard insulation (level "b")
Insulation type	composite
Availability of insulation of conducting parts	with non-insulated buses; with partial insulation of buses
Availability of drawout elements in the cabinets	with drawout elements; without drawout elements
Type of line high-voltage junctions	cable
Servicing conditions	single-side/double-side
Availability of door in the cabinet drawout element compartment	door-equipped
Types of cabinets depending on built-in electric equipment	– with high-voltage circuit breakers; – with detachable contact joints; – with voltage transformers; – with power fuses; – with auxiliary transformers
Control type	local, remote, telecontrol
Overall dimensions of cabinets, mm: – width – depth – height	800; 1000 ² 1700 ³ / 2190 ⁴ / 2440 ⁵ 2362
Cabinet weight, kg	no more than 1,250 (depending on the version)

1 – with forced ventilation system; 2 – for the cabinets with AT and cabinets for 2000, 2500 and 3150 A rated currents; 3 – for cable entry cabinets; 4 – for busbar entry cabinets; 5 – for busbar entry cabinets of 3150 A current.

1.5 MAIN BUILT-IN EQUIPMENT

Table 1.2 Main equipment built into K-131 series SCG cabinets

High-voltage circuit breakers		I nom, A	I break, kA	Short-time electrodyn. current, kA
1	Vacuum circuit breaker BB/TEL – 20 (Tavrida Electric, Russian Federation)	800	16	40
2	Vacuum circuit breaker Sion – 24 (Siemens, Germany)	800; 1250; 2000; 2500	16; 20; 25	40; 50; 63
3	Vacuum circuit breaker VD4-24 (ABB, Italy)	630; 1250; 1600; 2000; 2500	16; 20; 25	40; 50; 63
4	Vacuum circuit breaker 3AH4 (Siemens, Germany)	3150	40	102
Current transformers		Transformation ratio	Short-time thermal current (1s), kA	
5	TOL 20 UHL2 (2, 3, 4 windings) (SZTT OJSC, Yekaterinburg city, the Russian Federation)	5-2500/5	0,4-40	
6	TLO-24 U3 (2, 3, 4 windings) (Electroshield-K LLC, Kaluga Region, Babynino village, the Russian Federation)	5-1500, 2000 ² -3000 ²	2,5-40	
Voltage transformers		Rated voltage:		
7	GSES 24D (RITZ Instrument Transformers GmbH, Germany)	- primary winding, kV – 20,000/√3 - secondary winding, V – 100/√3 - additional secondary winding, V – 100/3		
Excess-voltage suppressors		Network voltage rating, kV – 20 Maximum admissible continuous voltage, kV – 24		
8	OPN-Siemens 3EK7-300-4CF-M11 (Siemens, Germany)			
9	OPN-P/ZEU 20/24 UHL1 (ZEU, St. Petersburg, the Russian Federation)			
Zero-sequence current transformers		Rated voltage is 0.66 kV Diameter of opening for cable transit is 70 mm, 200 mm.		
10	TZLK-0,66 U3, T3. TZRL-70 U3, TZRL-200 U3 (Electroshield-K LLC, Kaluga Region, Babynino village, the Russian Federation)			
11	TZLE-125 UHL2, T2. TZRL-125 U3 (SZTT OJSC, Yekaterinburg city, the Russian Federation)	Rated voltage is 0.66 kV. Diameter of opening for cable transit is 125 mm		

1 – detailed specifications of the listed equipment are provided on manufacturer plants' web sites;
 2 – manufacture of transformers with these specifications is subject to additional agreement with the manufacturer when ordering. On agreement with manufacturer plant other equipment type with other parameters can be used.

1.6 TYPICAL CIRCUIT DIAGRAMS OF THE MAIN CIRCUITS

Table 1.3 Typical circuits of the main circuits of K-131 SCG cabinets

Circuit diag. No.	101	102	110	111	116	117	647	647-1	203
Electric connections diagram									
Rated current	630; 1250; 1600; 2000; 2500		2000; 2500						-
Maximum quantity and cross section area of power cables	up to 9 (1x500) ¹		-						

Circuit diag. No.	255	501	501-1	648	648-1	648-2	177	177-1	177-2	
Electric connections diagram										
Rated current	-	630; 1250; 1600; 2000; 2500						3150	2000; 2500	
Maximum quantity and cross section area of power cables	-	up to 9 (1x500) ¹						-	-	

1 – connection with the use of three-core insulated cables is allowed provided that they are terminated and secured outside the cabinet. NOTE. On preliminary agreement with the manufacturer plant, cabinets for particular facilities can be manufactured based on customized main circuit diagrams

1.7 AUXILIARY CONNECTIONS DIAGRAMS

SCG cabinets auxiliary connections diagrams are implemented in accordance with orders of design organizations agreed with the manufacturer plant.

They may be based both on microprocessor devices: Sirius, MRZ, BE, TOR, BEMP, BMRZ, MR, RS80, Siprotec, REF, SEPAM, GE, Micom and other protection, control, alarm, measurement and metering systems complete with a circuit breaker ensuring operation reliability and stability.

For particular facilities, on preliminary agreement, the manufacturer plant can develop customized circuit diagrams of RPA devices.

Typical circuit diagrams of secondary connections are provided on web site www.moselectroshield.ru or may be provided on request.

1.8 CABINET DESIGN

DESIGN FEATURES AND GENERAL INFORMATION

The K-131 cabinets have a rigid galvanized metal sheet design consisting of a drawout element compartment, line compartment, busbar compartment and relay cabinet. The compartments are separated by metal bulkheads and

connected with bolted hardware. A design feature of the cabinets is arrangement of busbars at the top of the cabinets, line (cable) compartment under them and central position of DE in the cabinet.

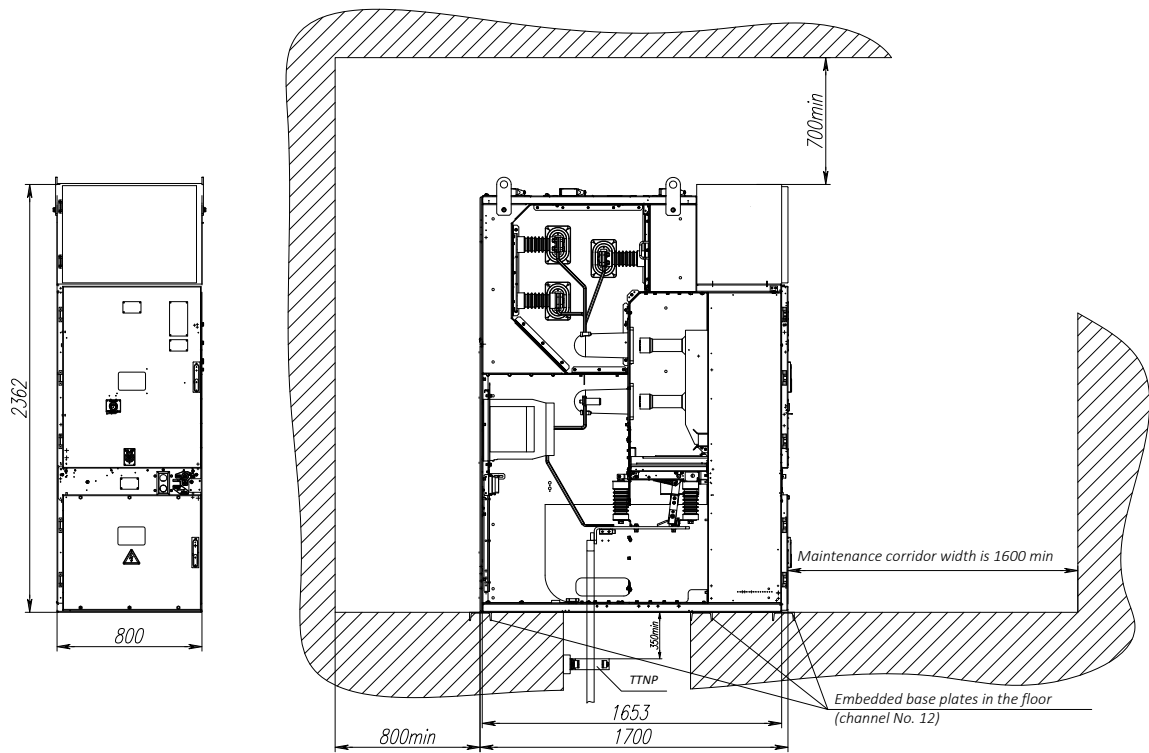


Fig. 1.1 General appearance and overall dimensions of K-131 SCG cable entry for up to 1600 A rated currents

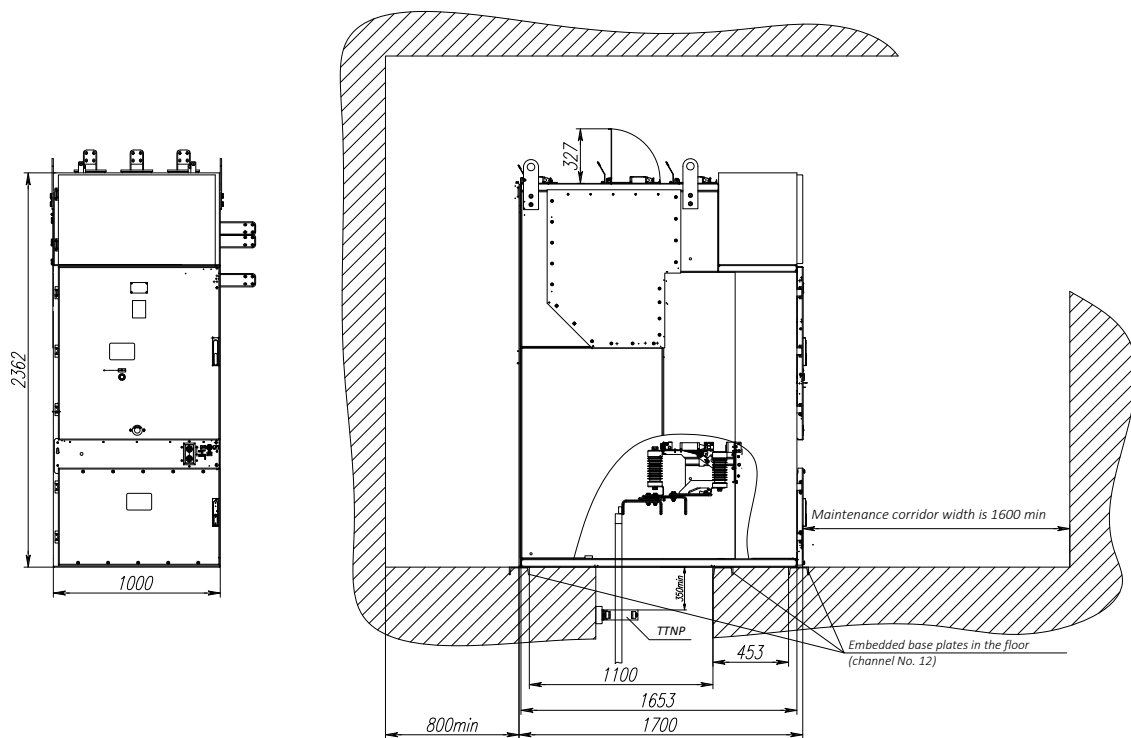


Fig. 1.2 General appearance and overall dimensions of K-131 SCG bus entry cabinet for up to 2000-2500 A rated currents

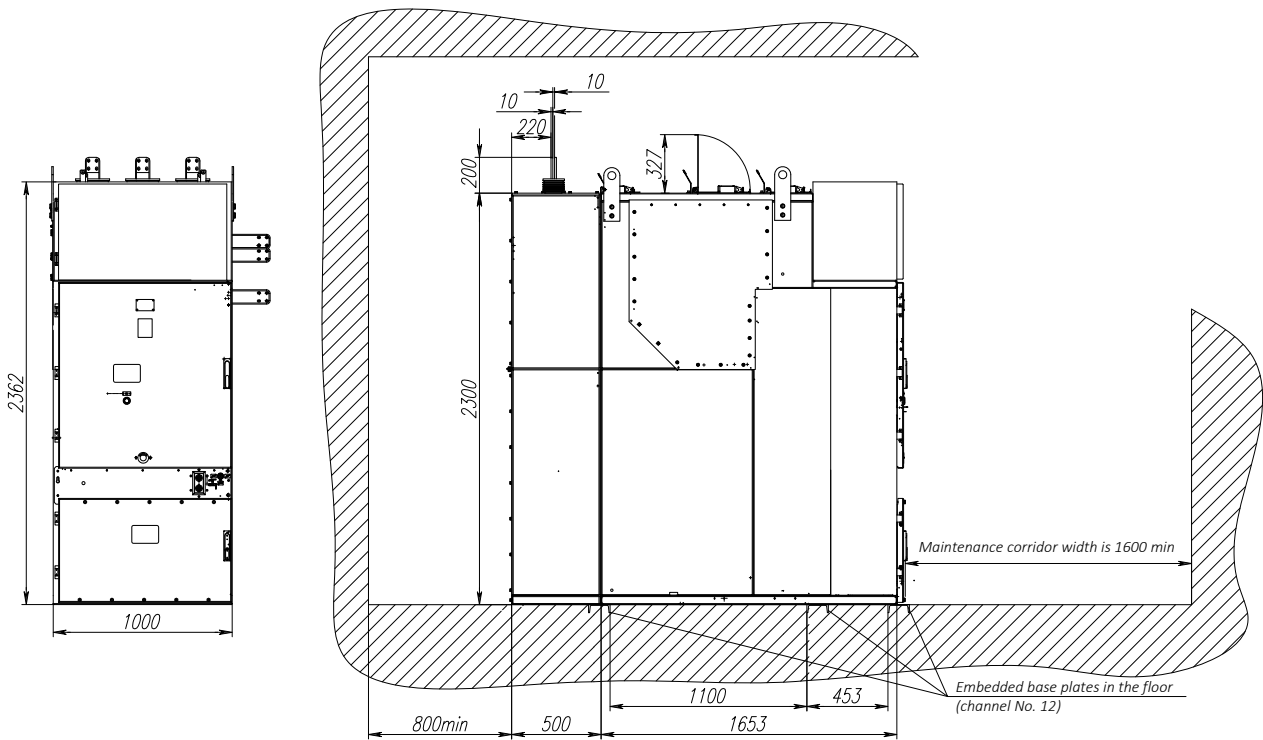


Fig. 1.3 General appearance and overall dimensions of K-131 SCG busbar for up to 2000-2500 A rated currents

The busbar compartment is unified for all cabinets for up to 3150 A currents. The K-131 cabinets are coupled directly without adapter cabinets for up to 3150 A currents. When cabinets are coupled they are aligned on front panels.

Line compartment, DE compartment and busbar compartment have relief valves and end switches which ensure excessive pressure release when an electric arc short circuit occurs. Pressure from all compartments is released upwards into the non-operating zone. Some openings are provided in the sheet base of the cabinet for welding the cabinets to embedded channel beams and passage of power and control cables from two sides.

To provide single-side servicing, the cabinet design is equipped with removable bulkheads in DE compartment ensuring access for scheduled maintenance in the line compartment and busbar compartment.

The space in the cable connection compartments of K-131 cabinets is designed for connection of power cables with insulation made of cross linked polyethylene using the following sleeve types:

- POLT-24D/1XI-L12 manufactured by Raychem, for single conductor cables with up to 240 sq. mm cross-section area.
- POLT-24E/1XI-L12 manufactured by Raychem, for single conductor cables with 240 to 400 sq. mm cross-section area.
- POLT-24F/1XI-L20 manufactured by Raychem, for single conductor cables with 500 sq. mm cross-section area.

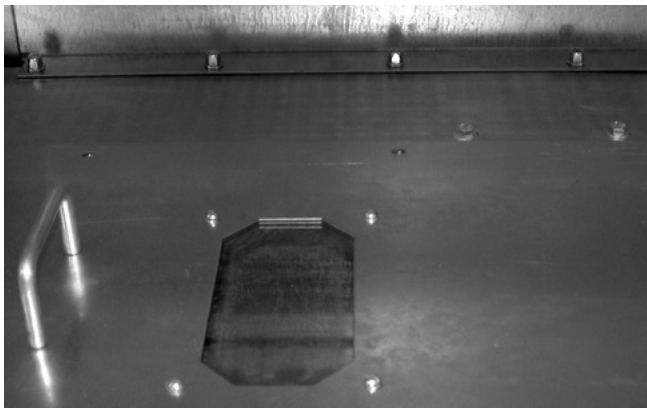


Fig. 1.4 Removable bulkheads with inspection windows in the busbar compartment

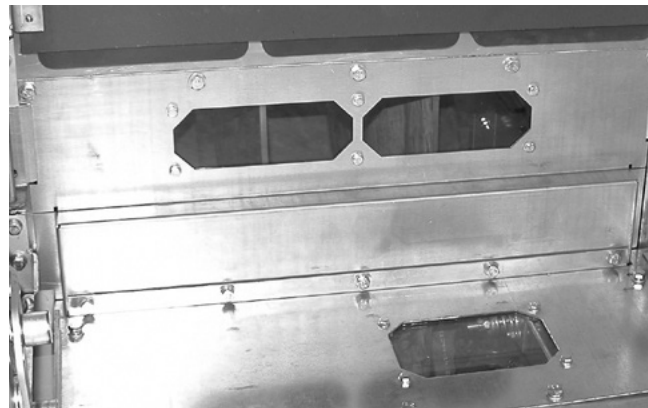


Fig. 1.5 Removable bulkheads with inspection windows in the DE compartment

To provide double-side servicing:

- the line compartment from the rear side is closed with a removable cap equipped with inspection windows;
- the busbar compartment from the rear side is closed with a removable cap that can be removed together with vertical posts, thus opening free access to the busbar compartments of the entire section.

The auxiliary circuit wires in high-voltage cabinet compartments are closed with protective enclosures.

Operating buses from cabinet to cabinet are laid via openings in the relay cabinet. If customer desires so, control cables and power supply buses can be laid in cable trays on the top of relay cabinets.

The drawout element (DE) compartment is closed with a front door which has an inspection window for visual inspection of the circuit breaker state. When the front door is closed, the drawout element can be located in operating or reference positions. The fixing device ensures attachment of DE precluding its self-movement inside the cabinet housing during operation, both in normal mode and at short circuits and during transportation.

There is an opening in the front door of DE compartment through which the shaft of the mechanism for DE element movement from reference position to operating position and back at opened front door is inserted.

Circuit breaker is tripped in the working position using a button with the front door closed.

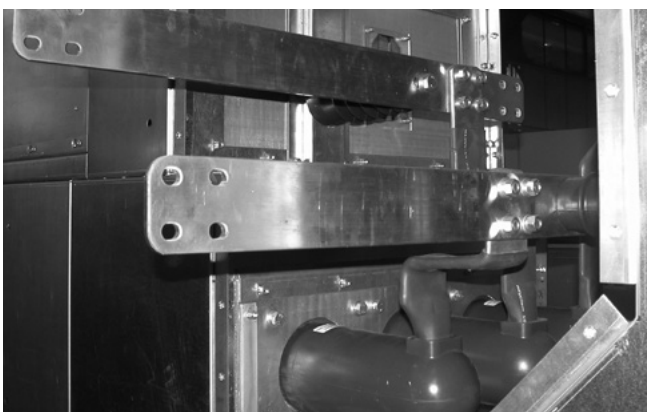


Fig. 1.6 Copper busbars in the busbar compartment

The K-131 cabinets use copper busbars in all compartments, in the entire range of cabinet rated currents.

For convenience of servicing the voltage transformers are installed on guides to provide possibility to draw them out from the cabinet for works or replacement, the secondary winding leads are located on the front side.

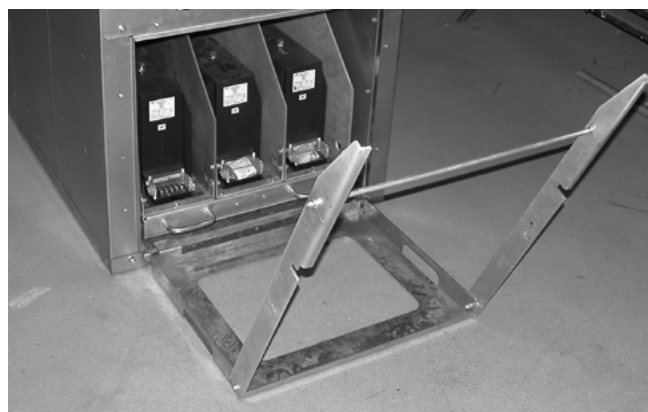


Fig. 1.7 Guides for DE with VT

Voltage transformers with a built-in fuse are installed on the drawout element providing the maximum reliability, minimum dimensions and absence of transformer oil.

Zero-sequence current transformers are installed in the cable compartment or in the cable channel outside the cabinet, depending on the power cables cross section and type.

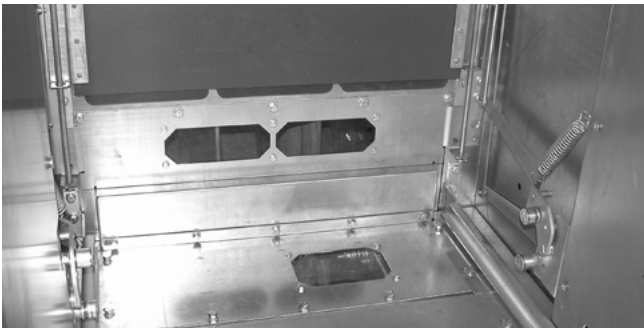
For convenience of installation and servicing an aluminum clamp is installed for holding the cable, and detachable zero-sequence current transformers. The cabinet design provides for access to connect the cable on the front side for single-side servicing.

A junctor grounding bus is located in the lower part of the cabinet.

In terms of design the cabinets are classified as:

- cabinets with drawout elements (with circuit breakers, with voltage transformers, with auxiliary transformers, with disconnectors, etc.);
- without drawout elements (blind entry, cable harnesses, etc.).

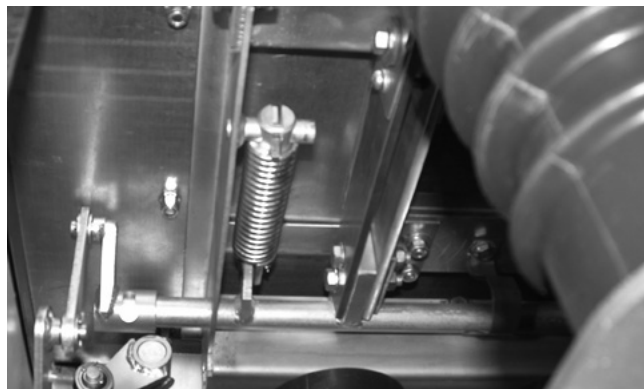
SHUTTER MECHANISM



Safe operation in the DE compartment is ensured by protective shutters which close automatically when the drawout element moves to repair position, eliminating access to fixed live terminals. The shutter mechanism design precludes any self-opening of the shutters when the DE is in repair position.

The shutter mechanism has a separate drive of upper and lower shutters. To ensure safe operation in the DE compartment, the shutters are locked with padlock.

GROUNDING DISCONNECTOR



The cabinet grounding disconnector (Fig. 1.8) consists of the following components: grounding mechanism, mobile contacts, fixed contacts, GD drive shaft, GD interlock flag, ground-wire drive and GD position indicator. The grounding disconnector (GD) is mounted in the linear compartment, under the drawout element compartment.

Rigidly fixed to the grounding case with supporting insulators. Mobile and fixed terminals of the grounding disconnector are made of copper. The grounding disconnector can only be closed when the DE is in reference position.

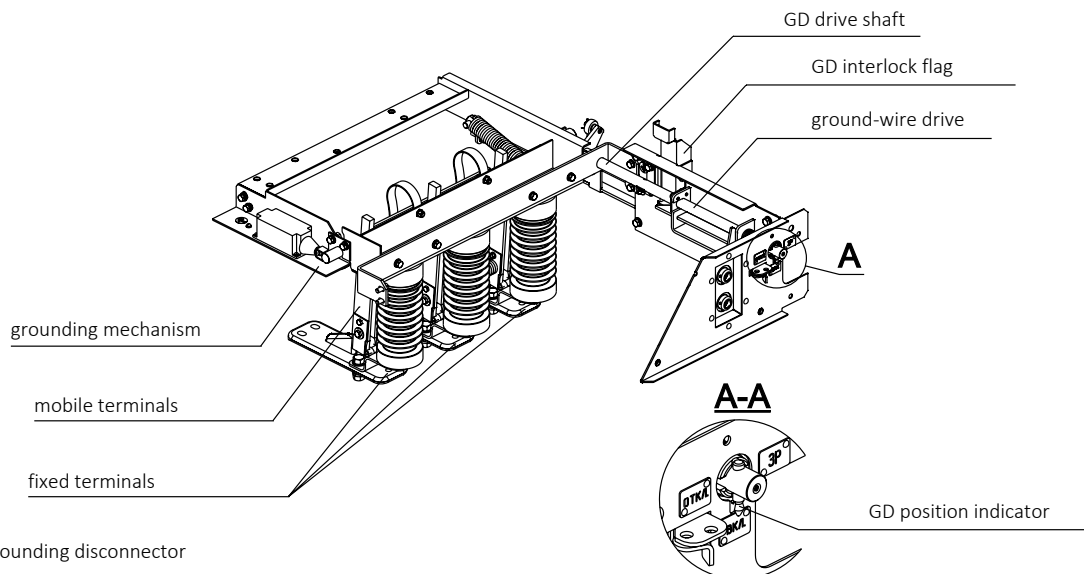
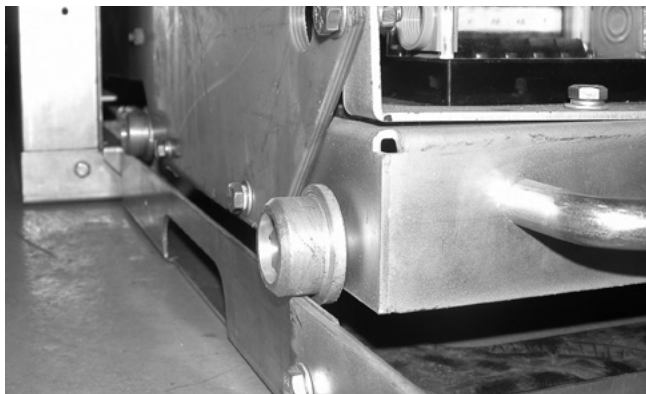


Fig. 1.8 Grounding disconnector

DRAWOUT ELEMENTS

The drawout elements (DE) are a wheel base with cross arm on which the high-voltage equipment determined by the electric connection diagram of the main cabinet circuits (with circuit breakers, voltage transformers, auxiliary transformers, etc.) and disconnecting terminals is installed.



The drawout and fixing mechanisms are mounted on the DE wheel base. It fixes the DE in reference and operating positions. The DE base plate is equipped with a mechanism interlocking in case of movement of DE into DE compartment when the grounding disconnector is closed.

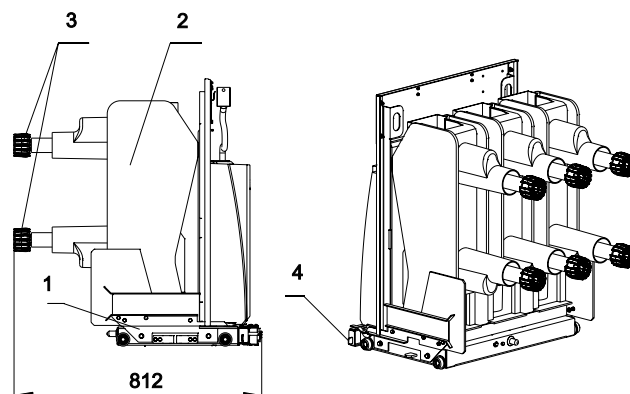


Fig. 1.9 Drawout element (DE) with SION circuit breaker
1 – base plate; 2 – circuit breaker; 3 – socket contact; 4 – lock

INTERLOCKS

To prevent any incorrect operations during routine maintenance and other works the cabinets are provided with the following mechanical interlocks:

- precluding any movement of DE from operating position to reference position and back when the circuit breaker is closed;
- precluding any possibility of the closing of the circuit breaker when it is in the intermediate position;
- precluding any closing of the grounding disconnector in operating and intermediate positions of DE;
- precluding any movement of DE from reference position to operating position when the grounding disconnector is in closed position;
- electrical interlocks (electromagnetic locks with keys) between the elements located in different cabinets, or a cabinet circuit breaker with an element outside this cabinet (for example, between circuit breaker and busbar grounding disconnector, between intersection disconnector and intersection circuit breaker, etc.);
- precluding opening of the drawout element compartment door in the circuit breaker operating and intermediate position.

RELAY CABINET

Relay cabinet (RC) is a metal design with a door. It is installed on the SCG cabinet housing. The distribution cabinet door is equipped with lock mechanism which is locked and unlocked with a key supplied with SPTA.

The relay protection and automatic (RPA) devices in SCG cabinet are located on the rear wall of RC on DIN rails. The control, measurement and alarm devices and manual control devices are located on the front doors; terminal rows are located in the base plate and on the rear wall of RC.

The auxiliary circuits of RC are connected with drawout

element circuits by means of plug-and-socket connectors and wires laid in flexible plastic hoses. Electric coupling between RCs is provided via operating circuit buses passing through openings in side walls of RC.

Configuration and connections of the auxiliary circuit devices are determined by the respective diagrams.

The control cable entry is from the left or right of RC, bottom or top (specified in the datasheet). There are two channels in the right and left side plates. They are covered

with caps when cables are to other distribution cabinet are laid. The RC can accommodate a heating device ensuring normal operation of the relay equipment at ambient temperatures in the switchgear rooms of below -5°C .

The relay cabinets can be manufactured outside the SCG

cabinets for deploying the plant devices of auxiliary circuits, for example, automatic frequency load shedders (AFLS), central alarm (CA), arc protection, metering devices, etc. Such cabinets are manufactured as wall hanging and floor designs.

STANDARD TRUCK

A standard truck is designed to draw DE in (out) and to move it outside the cabinet. Such truck is also designed for drawing DE from reference position to repair position and for moving it in the room.

The truck consists of a frame 4 and a lifting platform 5, on which a drawout element 1 is attached. The platform 5 is lifted together with the DE 1 by turning the handle 3. The DE is fixed on the lifting platform.

To draw the DE out from and into the cabinet, the standard truck is attached to the cabinet using the side rotary locks 6. This increases reliability and simplifies its use. To draw the DE out from the K-131 cabinets with 3150 A rated current, no standard truck is required. In these cabinets the DE is drawn out directly onto the floor.

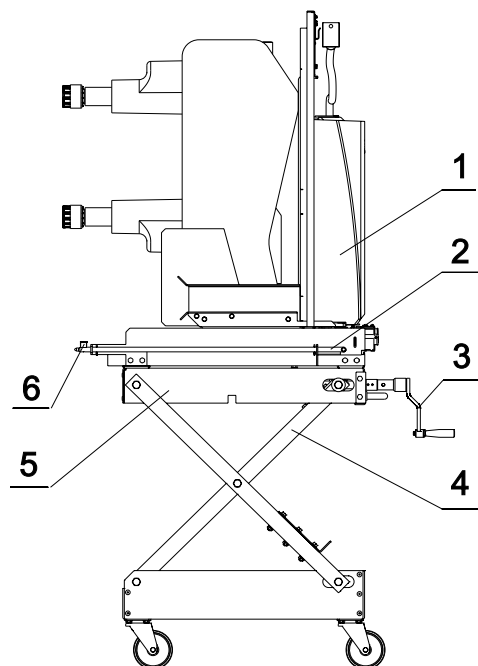


Fig. 1.10 Standard truck

1 – drawout element; 2 – lock handle; 3 – platform moving handle; 4 – frame; 5 – lifting platform; 6 – lock.

1.9 VARIANTS OF SWITCHGEAR LAYOUT IN SWITCHGEAR ROOMS

The cabinets can be located in switchgear room in one or two rows (Fig. 1.11). The maintenance corridor width shall be selected in accordance with the operational code for electrical installations. The recommended width of the maintenance corridor shall be no less than 1600 mm.

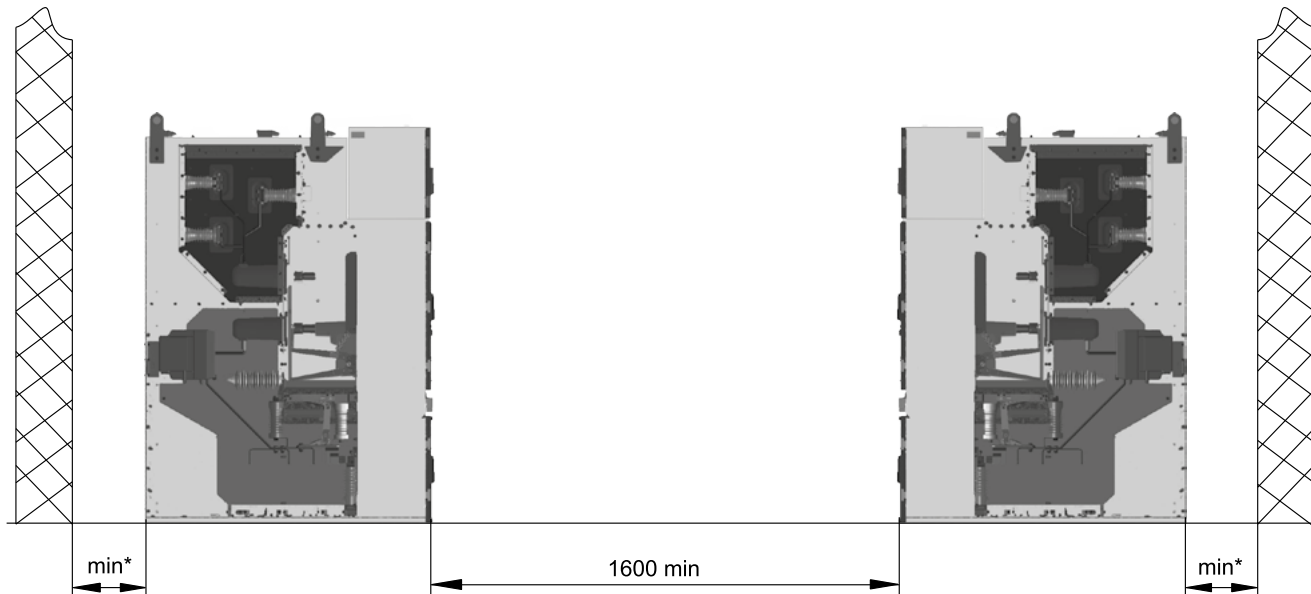


Fig. 1.11 Double-row layout of cabinets in the switchgear room
*min distance of the maintenance corridor is determined by cabinet maintenance condition

The K-131 SCG cabinets are coupled and installed in switchgear rooms on at least No. 12 embedded channels which shall be connected with the room grounding circuit at least in two locations.

Fig. 1.12 illustrates floor openings for power and control

cables, and distances for placing embedded channels. The cabinets are designed for connection of maximum nine single-core multi-ampere cables with cross-section of up to 9 (1x500) mm² or four power cables with cross-section of 4 (3x240) mm².

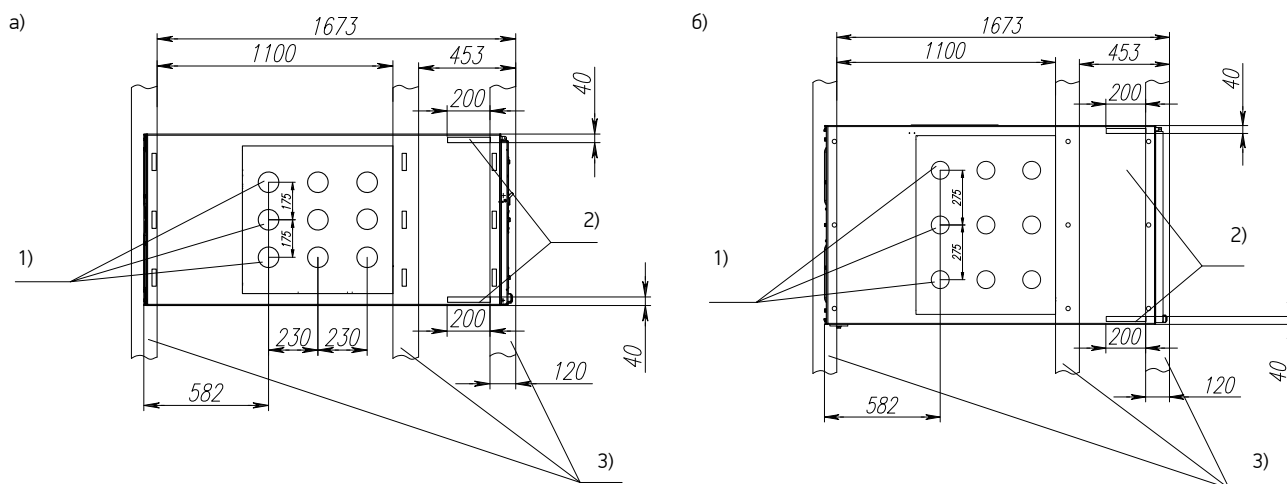


Fig.1.12 Layout of embedded channels and openings for single-core power and control cables in cabinets
a) for cabinets of up to 1600 A rated currents; b) for cabinets of up to 2000-2500 A rated currents
1 – power cables entry points; 2 – control cables entry point; 3 – embedded base plates in the floor (channel No. 12)

1.10 BUSBAR ENTRIES AND BUSBAR BRIDGES

The plant manufactures busbar entries from the switchgear wall to the nearest and furthers SCG section rows, busbar bridges and busbar links as component of K-131 cabinet set for switchgear cabinets sectioning.

Busbar bridges, entries and inserts are manufactured to meet the requirements of a specific project and their overall dimensions and configurations are specified at the stage of requirements specification approval.

1.11 ARC PROTECTION

Installation of quick-operating arc protection activated in case of electric arc short circuits (SC) is provided for installation in the SCG cabinets:

- using relief valves and end switches (arc arresters or excessive pressure relief units shall be provided for busbar compartment);
- using optical sensors (light-activated silicon-controlled rectifiers, fiber-optic sensors);
- both above mentioned variants can be used with mutual redundancy.

The DE compartment, line (cable) compartment and busbar compartment are equipped with relief facing upwards. When an arc occurs, the excessive pressure acts on the relief valves and through them on end switches the contacts of which send command to RPA system with subsequent disconnection of generating sources – isolating switches of operating and redundant (section) switch. Connection of electric circuit from the end switch, relief valve is provided using a control cable.

Arc protection on light-activated silicon-controlled rectifiers is provided as follows. The arc protection light-activated silicon-controlled rectifiers are fixed on the SCG section in pairs receiving signal from opposite sides, on brackets installed in linear (cable) compartment and compartment of circuit breaker (of voltage transformer, etc.), depending on the SCG design in use.

Once an electric arc occurs, the light-activated silicon-controlled rectifiers send a signal for disconnecting the generating source, or own circuit breaker.

To protect the busbar compartment, the light-activated silicon-controlled rectifiers are installed in each cabinet. Once a short circuit in busbar compartment occurs, the light-activated silicon-controlled rectifiers are activated and send a signal for disconnection of isolating or section circuit breaker (according to the arc protection circuit diagram). All light-activated silicon-controlled rectifiers are connected to arc protection buses of the busbar compartment in parallel. The light-activated silicon-controlled rectifier operates on "dry contact" principle.

The busbar compartment, DE compartment and line compartment protection against electric arc short circuits can be implemented using microprocessor devices with sensors based on fiber optic which feature high speed and high sensitivity of optic sensors. Such protections can be based on modular design principle, for example, Orion DZ, Ovod-MD, Ovod-L, Duga, BSSDZ type devices, etc.

Three separate (autonomous) fiber-optic loops are implemented in the cabinet for each of three high-voltage compartments.

The arc optical protection central unit for systems Ovod-MD or Duga-M can be placed in a separate relay cabinet and be as wall hanging and floor designs or placed as part of the SCG cabinet with a small set of low-voltage equipment (usually SR cabinets or VTs).

1.12 MAKING-OUT OF AN ORDER

An order for manufacture and supply of the cabinets is carried out on datasheets agreed with the manufacturer plant. When SCG in operation are expanded, cabinets can be coupled with other cabinet series, both manufactured by the manufacturer plant and other producers:

- without adapter cabinets;
- with adapter cabinets. In this case the distance from the switchgear room wall to the rear wall of cabinets, and the switchgear type with connection dimensions shall be specified in the datasheet.

On Customer's request, the scope of supply of cabinets can include:

- busbar bridges, entry and links between cabinet rows;
- wall hanging or floor relay cabinets installed outside the cabinets (for deploying power supply devices, junctor buses, AFLS, meters, arc protection, etc.);

- adapter cabinets for coupling of newly manufactured cabinets with previously manufactured cabinet series;
- redundant drawout elements with circuit breakers;
- drawout elements with circuit breakers and new relay cabinets to replace the broken down ones;
- standard trucks.

Dimensions of busbar bridges between sections, as well as dimensions of installation thereof in the switchgear rooms shall be specified on particular orders.

Consultations on the equipment are provided by telephone +7 (495) 787-43-59 or by sending a query to e-mail address info@moselectro.ru

1.13 SCOPE OF SUPPLY

The scope of supply includes:

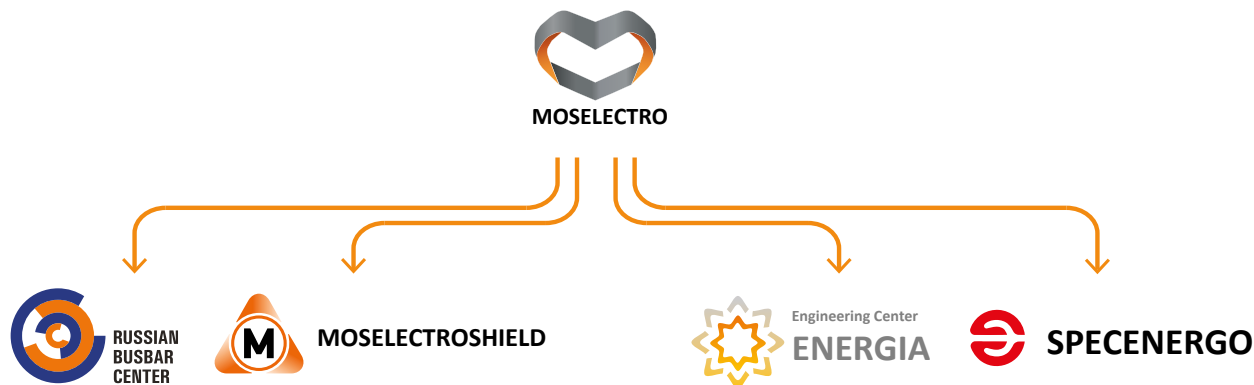
- cabinets with equipment and devices of the main and auxiliary circuits according to the order;
- a set of spare parts, tools and accessories (SPTA);
- operation documents.

Each particular order for cabinets is supplied with:

- manufacturer's certificate;
- technical description and cabinet operation manual;
- wiring schemes of auxiliary circuits for each cabinet type;
- electric schematic diagram;
- SPTA list.

MOSELECTRO GROUP

is a dynamically developing innovation company including Moselectroshield, RBC, IC Energia, and Specenergo companies.



- The market operation experience is over 70 years.
- Over 4000 completed projects.
- Over 422,000 SCG cabinets and over 376,000 linear meters of current-conducting wires in operation.
- A wide range of offered products and services

THE FOLLOWING PRODUCTS ARE ALSO ORDERED WITH OUR CUBICLES:



0.4 to 35 kV round current-conducting busbars with air insulation:

- generator voltage PCT (for generator voltage (TENE);
- complete PCT, closed type (TZK);
- closed bus duct (ShZK).



Low-voltage electrical switchboards (NKU):

- classical switchboards;
- protection automation switchboards for substations SchPT, SchSN;
- LCSG for PTS.



6/10 kV recloser with or without CMS:

- operating as a sectionalization point;
- in conjunction with revenue metering point.



Services:

- designing;
- installation, installation supervision;
- checkout, commissioning;
- warranty and service maintenance.

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