UP TO 17,5 kV
LSC 2B PM (METAL-CLAD)
WITHDRAWABLE VACUUM CIRCUIT BREAKER
MEDIUM VOLTAGE CUBICLES
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1. **SCOPE**

This technical document describes switchgears used in medium voltage cubicles up to 17.5 kV METAL-CLAD, WITHDRAWABLE VACUUM CIRCUIT BREAKER and electrical materials used in these switchgears. Medium voltage switchgears ensure conditions and features described in the following sections of this document are manufactured in accordance with the single-line diagrams and projects.

Service continuity category: LSC 2B (metal-clad design, i.e. compartmentalisation into separate busbar, switching-device and connection compartments)

Partition class: PM

Internal arc classification: IAC A FLR

Metal-clad, withdrawable switchgears according to following technical features and single-line schematics 3-phase bus bars and gap isolators, medium voltage cable connection for external connections, vacuum circuit breakers, earthing switches, current and voltage transformers, protection control measurement equipment and interconnections between them, earthing system, interlocking mechanisms and by mounting and connecting of other auxiliary materials shall be delivered as a complete unit.

2. **GENERAL**

All switchgears shall be produced under system warranty of manufacturing company as factory product. On condition informing earlier in any stage of the factory manufacturing, switchgears can be checked by the customer.

Design of medium voltage panels as being original design of manufacturer have to be in accordance with safety of staff when repairing equipment and maintenance, service reliability, ease of maintenance, mechanical protection of equipments, equipment mobility and additional load properties.

Medium voltage switchgears shall provide operating and service continuity at high level as well as complete human and goods safety.

NXAIR ≤ 17.5 kV and NXAIR 24 kV switchgear is tested in accordance with the following internationally accepted requirements: IEC 62271-210 (Draft), IEC 68-3-3, IEC 68-2-6, IEEE 693, UBC Division IV

Switchgears shall be indoor and modular type. Switchgears having similar structure shall maintain following criteria:

- Extention of cubicle from left or right side
- Easy mounting
- Safe and easy operating
- Compact and standard dimensions
- Minimum maintenance necessity
- An interlocking mechanism working with forceless concealment system
2.1 STANDARDS AND REGULATIONS

The switchgears and equipments used in them to be used in medium voltage panels being designed, and electrically type tested shall be produced by panel groups complies with the following latest valid international standards and they shall be produced in accordance with relevant standards and project specific conditions. In the view of management safety switchgears are in accordance with related standards and valid regulations.

Standards

<table>
<thead>
<tr>
<th></th>
<th>IEC standard</th>
<th>VDE standard</th>
<th>EN standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>NXAIR</td>
<td>IEC 62271-1</td>
<td>VDE 0671-1</td>
<td>EN 62 271-1</td>
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<td></td>
<td>IEC 62271-200</td>
<td>VDE 0671-200</td>
<td>EN 62 271-200</td>
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<tr>
<td>Devices</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Circuit-breakers</td>
<td>IEC 62271-100</td>
<td>VDE 0671-100</td>
<td>EN 62 271-100</td>
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<tr>
<td>Vacuum contactors</td>
<td>IEC 60470</td>
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<tr>
<td>Disconnectors and earthing switches</td>
<td>IEC 62271-102</td>
<td>VDE 0671-102</td>
<td>EN 62 271-102</td>
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<tr>
<td>HV HRC fuses</td>
<td>IEC 60282</td>
<td>VDE 0670-4</td>
<td>EN 60 282</td>
</tr>
<tr>
<td>Voltage detecting systems</td>
<td>IEC 61243-5</td>
<td>VDE 0682-415</td>
<td>EN 61 243-5</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>–</td>
<td>IEC 60529</td>
<td>VDE 0470-1</td>
</tr>
<tr>
<td>Insulation</td>
<td>–</td>
<td>IEC 60071</td>
<td>VDE 0111</td>
</tr>
<tr>
<td>Instrument transformers</td>
<td></td>
<td>IEC 61869-2</td>
<td>EN 60 071</td>
</tr>
<tr>
<td>Current transformers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage transformers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation, erection</td>
<td></td>
<td>IEC 61936-1</td>
<td>VDE 0101</td>
</tr>
</tbody>
</table>

2.2 OPERATING CONDITIONS

Medium voltage panels suitable for using in buildings (indoor) have to operate with nominal values in the defined ambient conditions without any negative effects and changes.

Ambient temperature

- Short duration max.value: +40°C
- 24 hour period mean max.value: +35°C
- Min.value: -5°C

Atmospheric conditions: Normal Climatic Conditions (IEC 62271-200)
Relative Humidity: 85% at 40°C
Site altitude above sea level: up to 1000m, +1000m (with correction factor)

2.3 DOCUMENTATION

The following documents will be given along with the offer:

a) Layout plans and front side views for offered panels
b) Technical brochure for the offered panels and for all products
c) Type test reports belongs to the offered panels and main products (circuit breakers, earthing switches, relays, contactors, etc.)

The following documents will be given with the delivery:

a) Layout plans and front side views belongs to the delivered panels
b) Operating and maintenance manuals belong to all delivered products

c) Circuit terminal diagrams

3. TESTS

3.1 TYPE TESTS

Type Tests: (according to IEC 62271-200)

- Short time and peak withstand current test
  Peak and short-time withstand current tests to verify the dynamic and thermal current carrying capacity of the main and earth circuits; the tests are performed with rated peak short-circuit current or rated short-circuit making current or rated short time current or rated short-circuit breaking current.
- Temperature rise test,
  Temperature rise tests to verify the current carrying capacity with rated normal currents.
- Dielectric tests
  Dielectric test to verify the insulation level of the switchgear (tests with rated lightning impulse withstand voltage and rated short-duration power frequency withstand voltage with the specified values depending on the respective rated voltage).
- Mechanical Function Tests
  Mechanical function test to verify the mechanical functions and interlocks.
- IP Protection Tests
  Degree of protection tests to verify the protection against electric shock and foreign objects.
  - Short Circuit Withstand Test (for Circuit Breaker in Panel)
  - Internal Arc Tests and Withstand Capacity of Other Internal Arc Tests
  Protection of operating personnel by means of tests for verifying the internal arc classification

Internal Arc Capacity of Panels shall be proved with tests. Type tests reports of Medium Voltage Switchgears manufactured according to standards above are handed with proposal attachment.

3.2 ROUTINE TESTS

Having completed of panels by the manufacturer company following routine tests defined below are performed. The user, if necessary, may participate in the routine tests performed in the manufacturing site as an observer when he informed manufacturer before his visit.

Routine Tests: (according to IEC 62271-200)

- Voltage withstand in the main circuit at power frequency voltage
- Voltage withstand in the auxiliary circuit at line frequency voltage
- Checking of proper operation of functional locks, interlockings, signaling devices and auxiliary equipments
- Functional checking of the circuit breaker operation mechanism and control instruments.
- Mechanical operating tests
- Measurement of main circuit resistance
- Checking of control wiring circuit
- Visual checking
4. **STRUCTURAL PROPERTIES**

4.1 **DESIGN AND MANUFACTURING**

Whole system is consists of panel groups with single busbar, air insulated, copper busbar, withdrawable circuit-breakers having vacuum technology along with complete sealed type that includes numeric protection relays, modular construction, having construction made of sheet steel, suitable for working up to 17.5 kV nominal voltage, metal compartment, free-standing type, wall standing type floor mounted, controlled by front.

The main frame of switchgear is made of cold rolled of galvanized sheet steel construction.

The back and top surfaces of the switchgears are made of entirely bolted lid and for each switchgear they have independently detachable structures.

Each switchgear, if necessary, is equipped with a heater controlled by a thermostat against condensation.

There will be ventilation holes without having negative effect on degree of protection mechanism but sufficient to ventilate inside the switchgear. Precaution must be taken to prevent mouse and bug intrusion into the switchgear.

The internal volume of each switchgear separated by metallic shutter shall be comprised of following individual compartments:

- Circuit-breaker compartment (withdrawable circuit-breaker section)
- Cable compartment (the section connecting of power cables)
- Busbar compartment (accommodating main busbar section)

Panels are in a robust structure against excessive pressure increase inside and external mechanical shocks without having been damaged. For the safety of operating personals each compartment except low voltage compartment should have discharging bolted plates against the high-pressure gases inside the switchgear caused by internal arcs.

Withdrawable circuit-breaker compartment door along with low voltage compartment door, which are hinged, can be unlocked by special key or mechanism.

On metal shutter among circuit-breaker compartment, busbar compartment and cable compartment upper and lower mating contacts fixed in cup type bushings. Enforced operated metal shutters for opening or closing the cup type bushings are used while moving the withdrawable part.

In the circuit-breaker compartment, there shall be automatic metal shutters which are opened and closed by sliding circuit-breaker mechanically. These metal shutters operated by circuit-breaker movement contain a shutter mechanism that opens when sliding inward and vice versa.

4.2 **PARTITIONING**

Bolted galvanised steel sheets subdivide the panel into;

- Circuit breaker compartment (withdrawable part compartment)
- Cable compartment
- Busbar compartment

4.2.1 **Circuit-breaker Compartment**

This compartment contains withdrawable vacuum circuit-breaker and all auxiliary equipments related to its operation. In this compartment:

- Withdrawer with Vacuum circuit-breaker
- Insulated bushings for the connection of upper and lower poles of the circuit-breaker
- Metal shutters, which are opened and closed when circuit-breaker inserted to and removed from its socket, separates busbar and circuit-breaker compartments.
- Position contacts
- Sockets for control and command circuits
- Interlocking mechanism between circuit-breaker and earthing switch.
- As optional, cast resin and block type voltage transformer shall be provided on withdrawer

### 4.2.1.1 Circuit-breakers

Circuit-breakers shall be vacuum type and withdrawable.

Moving contact fingers of the circuit-breaker shall be silver plated copper elements, spring mounted tulip shape for the sake of maintaining low contact resistance and good ventilation.

Circuit-breakers operating at the same nominal value shall be in interchangeable construction. Circuit-breaker shall be detachable without disassembling any compartment.

Vacuum circuit-breakers shall maintain minimum 10.000 open/close at nominal current and minimum 25 times at short circuit current.

Circuit-breaker must provide following positions:

- **Service position (Operation Position)**
  - Main and auxiliary circuits are connected. Circuit breaker can be energised. In this position circuit-breaker withdrawer shall be earthed.

- **Test position**
  - Main circuits are disconnected and auxiliary circuits are connected. When the circuit-breaker is in test position it will be disconnected and entirely within the system and also metal shutters in the main circuit and the front door of the compartment shall be closed. Low voltage connection for control and command of circuit breaker in the test position should be plugged in.

Each circuit-breaker shall include following basic elements:

- Opening coil
- Closing coil
- Drive mechanism including closing release, motor unit
- 64-pole plug-socket connection
- Operating counter
- 12NO+12NC auxiliary contact
- 2-position switch for closing spring charge signal

Opening spring will be energised automatically when circuit breaker closed.

Closing spring shall be charged electrically as well as allowing independent manual operation.

Circuit breaker shall contain spring operation indicator.

Spring charging motor shall be designed to operate orderly 85% and 110% of nominal supply voltage.

Operation mechanism shall have a locking mechanism to prevent circuit-breaker from closing in the case of incomplete charging of the closing spring and to load sufficient energy for an open-close procedure cycle without requiring any further action.

Circuit breaker shall have a display unit switching position and a mechanical operation counter in mechanical operation mode.

There will be mechanical open/close buttons on front surface of each circuit breaker.

Circuit breakers shall be locked mechanically and featured as tripped by electrically and mechanically. Operation mechanism will be “trip-free” and contain an “anti pumping” device.
Control and command circuit connections on the withdrawable circuit breakers will be multi-conductor flexible cable and have plug and socket system.

4.2.2 Cable Compartment

This compartment shall include following equipments:

- Earthing switch with auxiliary contact (indicated on single-line diagram)
- Current transformers
- Voltage transformers
- Cable connection terminals

Accessing to this compartment for Front-access type panel shall be possible to remove intermediary plate bolted to main body. Accessing to this compartment for Rear-Access type panel shall be possible to remove rear plate bolted to main body.

To prevent accessing live parts from under the switchgear, cable entry shall be over bottom plate with glands.

4.2.2.1 Earthing Switch

Earthing switch shall be fixed and rapid type.

It has short-circuit closing feature that it is as much as short-circuit withstand current of the switchgear.

Earthing switch position display can be viewed in the front of panel. In the front side of the switchgear there shall be an indicator showing earthing switch position.

The earthing switch will be operated by driving mechanism on the front of the panel. Earthing switch will be chosen according to single-line diagram values.

4.2.2.2 Current Transformers

All current transformers shall be in accordance with IEC 61869-2.

Current transformers shall be in values and rates as stated in single line schematics and shall be dry type.

The burden of current transformers shall not be less than total of all relays, measurement equipments and relevant loads connected.

Current transformers shall be placed at cable compartment.

Nominal current, ratio, knee point voltage, secondary winding resistance (compensated for maximum service voltage) shall be submitted for approval.

All current transformers shall be cast resin insulated, block and toroid type.

It shall be designed according to accuracy of limit factor, accuracy classification, specification of measurement and protection device that will be used.

4.2.2.3 Voltage Transformers

All voltage transformers will be in accordance with IEC 61869-3. Voltage transformers will be cast resin type and same as ratios and values defined in the single-line diagrams.
Secondary coils of the voltage transformers are protected by MCB’s. Appropriate protection, control, measurement and auxiliary circuits shall be coordinated optionally.

Burden of voltage transformers shall not be less than total of all relays, measurement equipments and relevant loads connected.

Voltage transformers used in measurement cubicles shall be withdrawable type and shall have primary current limiting fuses.

Voltage transformers can be mounted at circuit breaker withdrawer and under this circumstance it shall be designed that can be protected by current limiting fuses.

When voltage transformers are used in cable or busbar compartment of incoming/outgoing feeders, current limiting fuses can be omitted.

In general, accuracy classification of voltage transformer will be determined according to properties of protection/measurement devices.

4.2.3 Busbar Compartment

Busbar compartment, on the panel, is separated from other sections with metal separation and contains 3 single-phase copper busbar supported by cast resin bushing and the connections of circuit-breaker and on request current transformers.

Busbars shall be 3-phased and it shall endure all dynamic, thermal and dielectric stresses through switchgear.

Busbars are made of solid, high conductivity coefficient electrolytic copper. The interconnection between vertical busbars and main busbar maintained by busbars, on the other hand flexible connection equipments shall not be accepted.

For busbars and their interconnections there shall be provided enough support and reinforcement to withdraw thermal and magnetic force caused by nominal short circuit current.

Busbar system shall be suitable for extension at the both sides of the panels.

Insulation in the busbar compartment is maintained by air. Busbar can be insulated by PVC and heat-shrinking macaron until contacts.

Main busbars of the busbar compartment are made from plain copper in rectangular cross-section.

Bottom of each cubicle must have earthing terminal for the connection to earthing busbar. Earthing busbar shall be connected to the earthing system of control building at both sides.

4.2.4 Low Voltage Compartment

This compartment shall be top-front section of medium voltage switchgear and shall be in separated structure that is sealed completely and will be in each of the cubicle.

Control cable with 64 pin socket for circuit breaker shall be in a spiral tube.

In this section, all materials shall be assembled as required connections made and ready to operate.

- Numeric type multifunctional relays for protection and measurement
- Other equipments for protection, control measurement and metering
- Fuses
- Terminal blocks
- Miniature circuit breakers
- Instruments
- Auxiliary relays etc.
- Optionally pressure switch, to trip circuit-breaker in the case of arc occurs,

Low voltage compartment may be accessible while the system under voltage. All connection wires shall be marked and indicating its terminal.
Cable output holes for external connection are equipped with cable connection. In low voltage compartment there shall be a cable cut outs containing auxiliary cable connections between switchgears. Cable connection between switchgears shall be implemented by sockets.

4.2.4.1 Protection Relays

Each circuit-breaker shall be controlled by a relay. Relays shall be door-assembled in low voltage compartment of the panel and have following features.

Relays shall be equipped with microprocessor technology and shall compatible with energy automation system.

Protection relays shall be of numeric type and have features such as fault recording, measuring provided by numeric technique.

Protection relays, shall be convenient for data transmission through a computer system or a communication system as well as they can be used individually. Software to be used on computer system, which is considered to be installed, shall be compatible with Windows operating system and shall maintain user-friendly operation. Through this software all operations such as fault analysis, configuration, and control shall be done.

Relays shall includes following features:

- For 3-phase and earthing it shall feature reserve timed and/or over current with stable characteristics, short circuit, earth fault protection.
- Inverse time overcurrent curve option and at least one break curve defined by the user shall be included
- As a standard, the equipment can provide 3-phase true RMS currents, neutral current, current demand (for each phase separately and average) measurements.
- It shall provide 3-phase true RMS voltages and average RMS voltages, active power, reactive power, appearing power, active power demand, reactive power demand, active and reactive energies, power factor and frequency measurements
- As a standard, the equipment shall have overcurrent protections (50/51), earth fault protections (50N/51N), overload protection (with two time constants), reverse component protection (46), circuit-breaker fault protection (50BF), opening circuit control (74TC) lock out (86) functions, inrush blocking and built-in optional 4 parameter configuration groups.
- It shall provide optionally over and/or low voltage protection (59/27), directional overcurrent and directional earth fault protection (67/67N), high and/or low frequency protection (810/U), phase sequence protection for voltage (47), directional sensitive earth fault protection (67Ns), residual voltage protection (64), underrcurrent protection (37), startup time monitoring (48), autoreclose (79) and also fault location functions.
- As fault recording function, it shall have minimum 5 seconds of memory unit in which at least 8 faults can be stored. Storing detailed current and voltage curves via these fault curves shall allow fault analysis and harmonic monitoring on the computer.
- It shall store last eight faults in fault memory including pick-up and fault recovery times, pick-up times and fault recovery voltage and current values etc. to enable fault analyzing.
- As an event recorder, it shall record position changes, relay functions achieved in these events and other related information and minimum last 200 event records in the relay shall be stored
- It shall record minimum and maximum values of current, voltage, power, and frequency etc. measurements with time-stamped.
- The relay shall have an RS-232 port which shall enable a computer to connect relay directly and collecting all sorts of configuration and measurement data, and shall enable the equipment to parameterize with the computer.

4.3 OPERATION SAFETY AND INTERLOCKING

All open/close operations shall be made only when HV door is closed.
Capacitive detector shall be used for controlling indication of busbar and cable voltage.
Circuit breaker can be withdrawn by one personnel without any extra force.
Bolted Plate shall be mounted at ceiling of panel for facilitating discharging of pressure.
Viewing window shall be mounted such that it will withstand the pressure of internal arc.

Every switchgear shall be interlocked against unavailable condition:

- To withdraw or engage of a circuit breaker shall be impossible unless it is in the open.
- Locking to prevent the circuit-breaker for closing when circuit-breaker is between connected or disconnected positions
- Locking to prevent inserting the circuit-breaker when earthing switch is closed or to prevent closing the earthing switch when the circuit-breaker inserted into and main contacts are connected positions
- Locking circuit-breaker compartment door can not be opened as long as circuit-breaker is energized.
- Locking for closing earthing switch manually when circuit-breaker withdrawer in operation mode.
- Locking to prevent closing circuit-breaker when withdrawable unit is between operation and test positions.
- Also circuit-breaker withdrawable unit could be on test position without circuit-breaker compartment door is opened.

To earth the medium voltage switchboard installation, main frame, shutters, and all other non current carrier metal parts shall be connected each other and shall be connected externally to an appropriate copper made earthing busbar through switchboard.

4.4 PROTECTION

Medium voltage switchgears shall have following degrees of protection according to IEC 62271-200, IEC 60529, VDE 0470-1, VDE 0671-200 standards and requirements.

For external surface of the panel (when medium voltage door closed):

<table>
<thead>
<tr>
<th>Switchgear panel</th>
<th>Degree of protection for the enclosure, optionally</th>
<th>Degree of protection for the enclosure, with ventilation</th>
<th>Degree of protection for the partitions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IP3XD, IP4X, IP50, IP51</td>
<td>IP3XD, IP4X</td>
<td>IP2X</td>
</tr>
</tbody>
</table>

4.5 LABELING

The front of the panel shall be labeled using engraved black labels or replaceable transparent capped labels. There shall be definitions like manufacturer’s name, type and serial number, applicable nominal values, description of switchgear on the label.
4.6 PAINT AND PROTECTION AGAINST RUST

All kinds of materials such as bolts, washers, nuts etc. used in panels shall be made of corrosion and rust proof metals.

Front closure plates and doors shall be electrostatic powder painted; paint color standard is RAL 7035, and paint thickness is 75+25 micron. Other metal parts shall be hot dripping galvanize or yellow color passived electro-galvanized.

4.7 PACKAGING AND SHIPPING

The following factors should be taken into account when deciding on the size of transport units to be employed:

- Transport facilities on site
- Transport dimensions and weights
- Size of building doorways

All panels are fixed to wooden palettes and have open packing by polyethylene sheets covering the panels for the transportation in native country or abroad by road and rail.

All panels are on palettes in sealed crates with upper and lower polyethylene sheets, welded together, with desiccant bags and sealed wooded floor for overseas by ship.

Panels shall be conveyed on the palettes until the destination. In this case, drawers are removed from the panel and switchgears are shifted into the cable channel.

When panel groups consist of a number of panels, loading groups shall not exceed 3 panels.
4.8 **DIMENSIONS:**

Dimension of the medium voltage switchgears to be manufactured shall not exceed following values.

<table>
<thead>
<tr>
<th>Width (mm)</th>
<th>Dimensions</th>
<th>in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Circuit-breaker panel</td>
<td></td>
</tr>
<tr>
<td>≤ 1000 A</td>
<td>≤ 4000 A</td>
<td>600 / 800/1000</td>
</tr>
<tr>
<td>≤ 400 A</td>
<td></td>
<td>800 / 800/1000</td>
</tr>
<tr>
<td>Contactor</td>
<td></td>
<td>435</td>
</tr>
<tr>
<td>panel</td>
<td>Disconnecting panel</td>
<td>≤ 1000 A</td>
</tr>
<tr>
<td>≤ 400 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bus</td>
<td>sectionalsizer</td>
<td>≤ 1000 A</td>
</tr>
<tr>
<td>≤ 400 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metering</td>
<td>panel</td>
<td>≤ 1000 A</td>
</tr>
<tr>
<td>Busbar</td>
<td>connection panel</td>
<td>≤ 400 A</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>H1 Standard panel or standard panel with natural ventilation</td>
<td>2300 / 2500</td>
</tr>
<tr>
<td></td>
<td>H2 With high low-voltage compartment or additional compartment for busbar components</td>
<td>2350 / 2550</td>
</tr>
<tr>
<td></td>
<td>H3 With forced ventilation for 4000 A</td>
<td>2450 / 2650</td>
</tr>
<tr>
<td></td>
<td>H4 With optional arc absorber², for 12 kV, &gt; 25 kA or generally for 17.5 kV</td>
<td>2500 / 2680</td>
</tr>
<tr>
<td>Depth (mm)</td>
<td>T Single busbar, all panel types (except contactor panel)</td>
<td>1350 / 1500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1650 / 1650</td>
</tr>
<tr>
<td></td>
<td>Contactor panel</td>
<td>1400 / 1500</td>
</tr>
</tbody>
</table>

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Single-row arrangement (plan view) for single-busbar switchgear
Dimensions B (width) and T (depth)
For back-to-back and face-to-face arrangement, the room dimensions apply accordingly to those for single-row arrangement.
For back-to-back arrangement, a 1200-mm wide control aisle is required on the left or on the right of the switchgear.

5. **ELECTRICAL FEATURES**

<table>
<thead>
<tr>
<th>Rated values</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>kV</td>
<td>7.2</td>
<td>12</td>
</tr>
<tr>
<td>Frequency</td>
<td>Hz</td>
<td>50/60</td>
<td>50/60</td>
</tr>
<tr>
<td>Short duration power frequency withstand voltage (phase-to-phase, phase-to-earth)</td>
<td>kV</td>
<td>20 **</td>
<td>28 **</td>
</tr>
<tr>
<td>Lightning impulse withstand voltage (phase-to-phase, phase-to-earth)</td>
<td>kV</td>
<td>60</td>
<td>75</td>
</tr>
<tr>
<td>Short-circuit breaking current</td>
<td>max. kA</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Short-time withstand current, 3 s</td>
<td>max. kA</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Short-circuit making current <strong>²</strong></td>
<td>max. kA</td>
<td>125/130</td>
<td>125/130</td>
</tr>
<tr>
<td>Peak withstand current <strong>²</strong></td>
<td>max. kA</td>
<td>125/130</td>
<td>125/130</td>
</tr>
<tr>
<td>Normal current of busbar</td>
<td>max. A</td>
<td>4000</td>
<td>4000</td>
</tr>
<tr>
<td>Normal current of feeders:</td>
<td>max. A</td>
<td>4000</td>
<td>4000</td>
</tr>
<tr>
<td>With circuit-breaker</td>
<td>max. A</td>
<td>4000</td>
<td>4000</td>
</tr>
<tr>
<td>With contactor <strong>³</strong></td>
<td>max. A</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>With disconnector link</td>
<td>max. A</td>
<td>4000</td>
<td>4000</td>
</tr>
<tr>
<td>Bus sectionalizer</td>
<td>max. A</td>
<td>4000</td>
<td>4000</td>
</tr>
<tr>
<td>Busbar connection panel</td>
<td>max. A</td>
<td>4000</td>
<td>4000</td>
</tr>
</tbody>
</table>

**¹** 32 kV or 42 kV optional for GOST standard
**²** Values for 50 Hz: 125 kA
60 Hz: 130 kA
**³** Current values dependent on HV HRC fuses, for GOST standard max. 32 kV short-duration power-frequency withstand voltage. Lightning impulse withstand voltage across open contact gap of contactor: 40 kV at 7.2 kV, 60 kV at 12 kV

**⁴** Values for 50kA

Control Voltage: 24 VDC or 110 VDC

6. **SPARES AND ACCESSORIES**

Following spares along with the proposed switchgears shall be presented in order to provide convenience in management and maintenance.

ACCESSORIES
- Control lever to provide circuit-breaker movement
- Charging crank for the circuit-breaker spring
- Keys to lock and unlock the doors
- If available, earthing switch lever