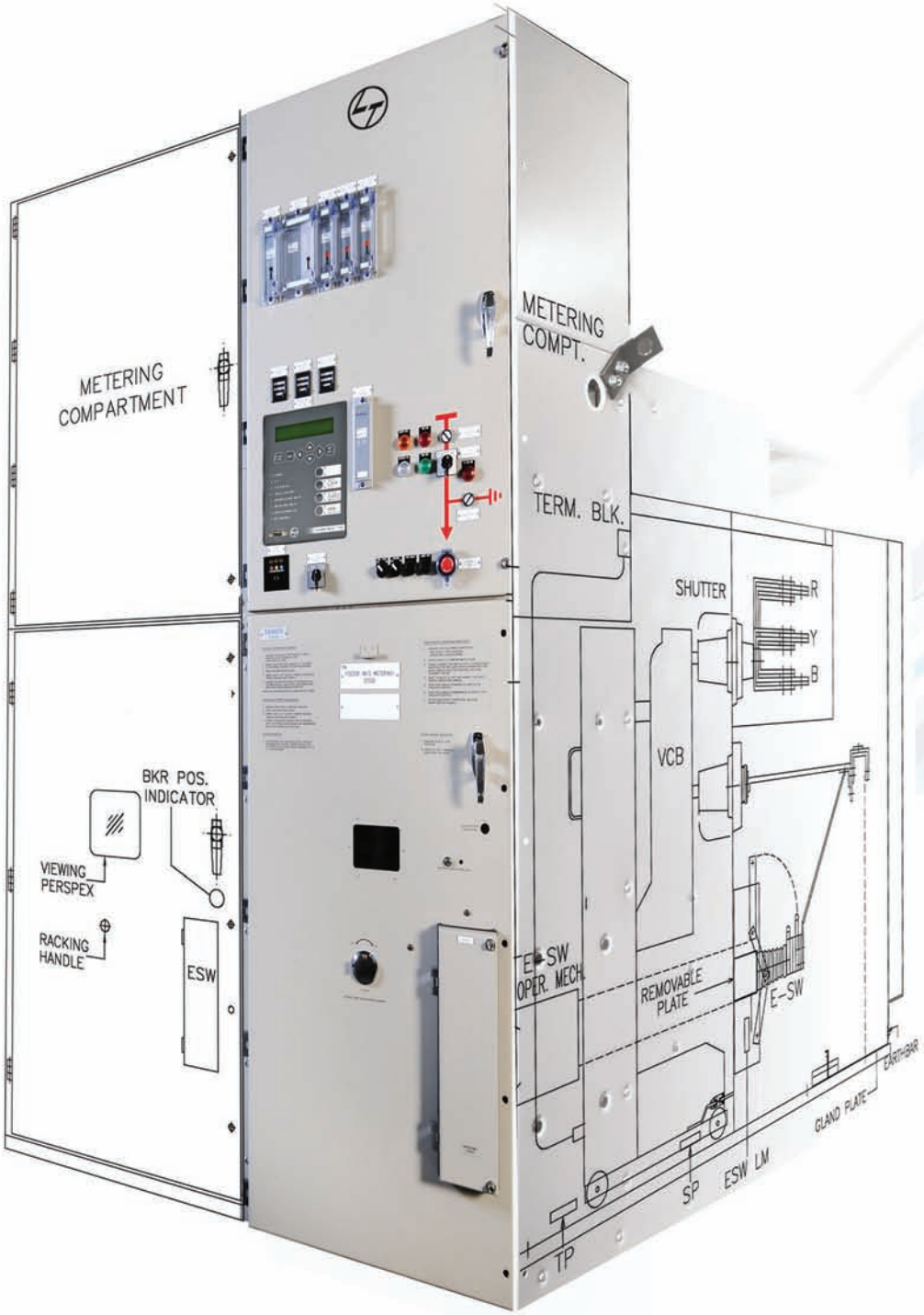
AIR INSULATED SWITCHGEAR



LARSEN & TOUBRO

Medium Voltage Manufacturing Facility
at Ahmednagar, Maharashtra (INDIA)

Larsen & Toubro (L&T) is a technology-driven company that infuses engineering with imagination. We offer a wide range of advanced solutions, services and products. We provide state-of-the-art products & solutions to a large and diverse customer base.

Air Insulated Switchgear (AIS) type VHIH has been in operation for 4 decades. It is a time tested product which has the endorsement of customers all over the world. It has worldwide acceptance in sectors like Metals, Power, Oil and Gas, Petrochemicals, Infrastructure etc.

Our range of medium voltage products is manufactured at state-of-the-art facilities across the world. We have manufacturing facilities at Australia, India, Indonesia, Malaysia and Saudi Arabia.

Air Insulated Switchgear (AIS) by L&T is used for control and protection of electrical distribution in any industry, utility or residential area. The AIS cubicle has Vacuum Circuit Breakers (VCB) as the switching device and the control can be offered through numerical or electromechanical relays.

The VCB and switchboard complies to the latest international standard. The VCB is type tested in accordance to IEC 62271-100, whereas the cubicle is type tested as per IEC62271-200. Further to meet stringent safety norms, the cubicle is subjected to internal arc test at 40kA, 1 sec.

All operations are behind closed door thus enhancing the safety of operating personnel.

The AIS panel is available from 3.3kV upto 36kV and for current ratings upto 3150A with natural cooling. The short circuit rating available is upto 50kA for 3 sec. To prove its suitability for service in severe climatic conditions, the switchgear has been subjected to climatic aging tests according to IEC 60932, and proven to Design Class 2 (the highest class). The switchgear has been designed and tested to ensure the safety of the operator in the event of an internal-arc fault. Arc vents are provided in the busbar, cable and VCB compartments.

The switchgear has also been successfully tested to withstand seismic forces of 5-7 on the Richter scale, in accordance with IEC 60068-3-3.

KEY FEATURES

- Metalclad, fully compartmentalized
- Horizontal isolation, horizontal drawout
- Fully insulated design
- Internal arc fault-proven
- All operations behind closed doors
- Interlocked for safety
- Fully rated fault-make earthing switch
- Earthquake-proven
- Simple installation
- Readily extensible
- Minimal maintenance

12kV - SINGLE BUSBAR

The 12kV Single busbar design is a fully compartmentalized metal clad design. This design is suitable for 3.3kV, 6.6kV & 12kV. The different parts of this design are described below.

CUBICLE

Made of high-grade pickled-&-oiled mild steel sheets, cut and folded on numerically controlled machines, the cubicle parts are painted by an advanced Cathodic Electro-Deposition (CED) process which provides optimum protection against corrosion and weathering. The paintwork is tested to withstand 1000 hours in a 5% salt spray.

The cubicle parts are riveted/bolted together to form a rigid enclosure with fully segregated busbar compartment, circuit compartment, VCB compartment and low voltage compartment. The construction complies fully with the requirements of a metal-clad enclosure as defined in IEC62271-200.

Standard ingress protection is IP4X as per IEC 60529. Higher IP ratings are available on request.

BUSBAR CHAMBER

The bus bar chamber consists of the main busbar system. The bus bars are provided with insulation along its complete length and the joints are provided with removable shrouds.

Since all parts of the bus bar system are well insulated, the safety of the device as a whole and of operating personnel is enhanced.

VCB CHAMBER

The VCB chamber houses the VCB truck. The movement of the VCB truck is interlocked with the VCB and the VCB door to provide complete safety.

Automatic metal shutters are provided to prevent access to live parts when the VCB is isolated or withdrawn. These metallic shutters are spring operated and the mechanism is, in turn, linked to the movement of the circuit breaker truck. This mechanism is more reliable than gravity operated shutters. The shutters can be padlocked independently.

The VCB compartment is fitted with a padlockable front door which not only provides a flush frontage to the switchboard line-up, but also upholds the integrity of the ingress protection (IP) rating even when the VCB is isolated or withdrawn. The operation of the VCB and the earthing switch can be carried out with the door closed.

The following interlocks are provided in the panel:

- All operations are behind closed door.
- VCB cannot be engaged or withdrawn unless it is in open position.
- VCB cannot be operated unless it is in the engaged or in test position.
- Earthing switch cannot be closed when the VCB is engaged.
- VCB cannot be engaged when the earthing switch is closed.
- Rear door interlock (Optional): The rear door cannot be opened unless the breaker is in test position and the earthing switch is closed.
- VCB cannot be racked in unless the plug is fitted.

Any other interlock can be provided as per requirement.

VACUUM CIRCUIT BREAKER

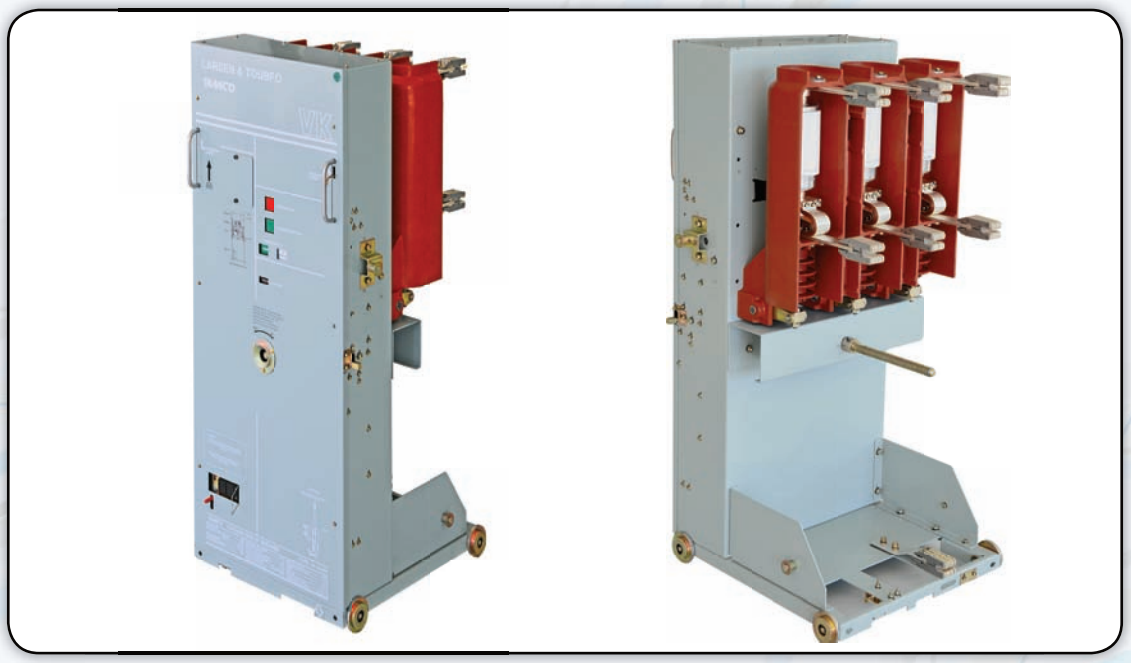
At the heart of the switchgear is the vacuum circuit breaker. The VCB is truck-mounted, and adopts the proven horizontal isolation / horizontal drawout principle. The VCB is tested as per the latest international standard IEC62271-100.

The trend in the interrupter design is to continuously reduce the vacuum envelope size and enhance short circuit capability at the same time. Our VCB designs are continuously reviewed and upgraded to keep up with the latest developments in vacuum technology.

Two options of operating mechanisms are offered:

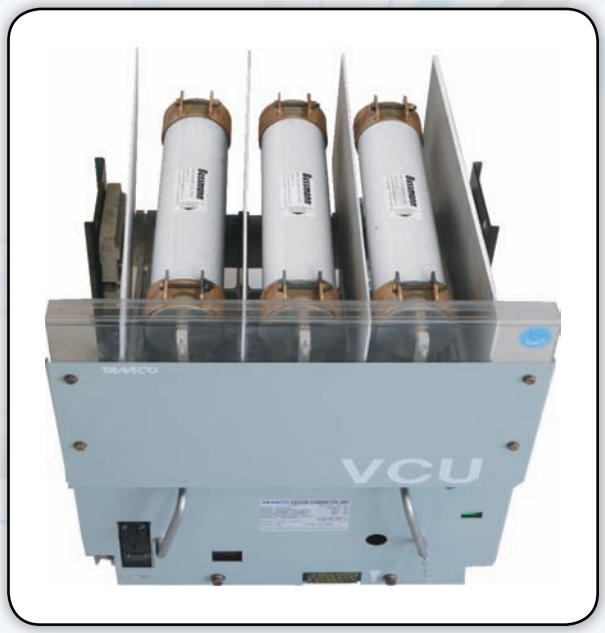
- Hand-charged spring, stored energy mechanism with manual and/or electrical release
- Motor-charged spring, stored energy mechanism with manual and electrical release

The VCB mechanism requires minimal maintenance. Its design lifespan is 20 years or 10,000 operations.

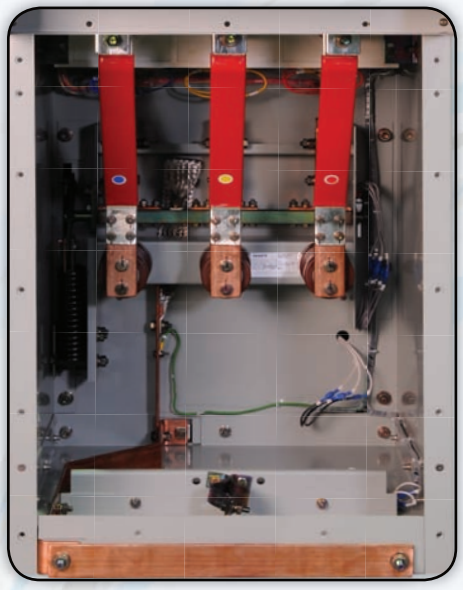


VACUUM CONTACTORS

For specific application of motor switching, vacuum contactors are offered. These Vacuum contactors are available upto 6.6kV with current rating of 400A and short circuit level upto 50kA. Vacuum contactors are fitted with HT fuses for short circuit protection.



CABLE CHAMBER



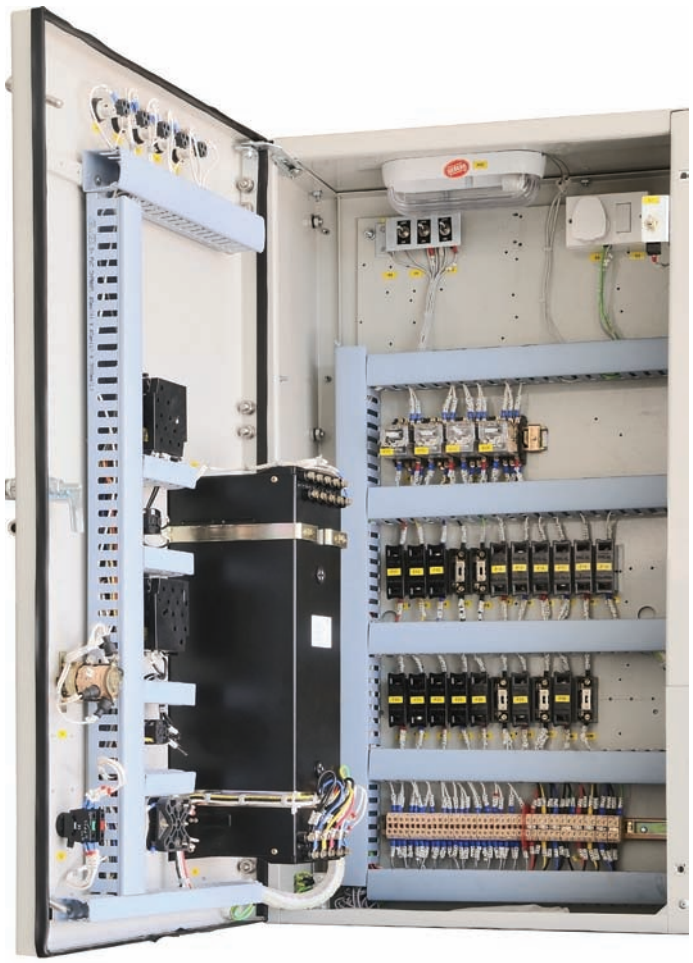
No live parts are located less than 300mm above floor level.

The cable termination height is more than 750mm above floor level, and generous space is provided for terminating the power cable. This ensures a higher bending radius as well as reduces tension on terminals.

The cable chamber also houses the CT and the earthing switch.

LOW VOLTAGE COMPARTMENT

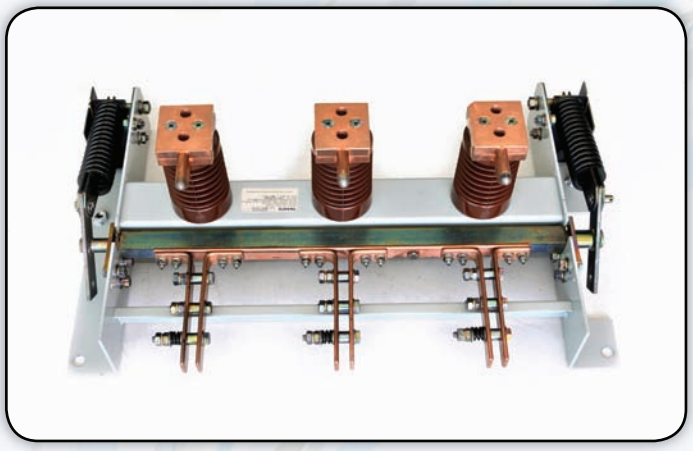
The dimensions provided offer ample space for mounting of terminals, fuses, MCB, relays. meters etc. for any standard scheme. An additional chamber can be mounted on top, if necessary, for more complex protection and control schemes. Wire bunches are routed through horizontal and vertical wire ways which provide support and order.



EARTHING SWITCH

Circuit earthing is effected by a fault-make earthing switch interlocked with the VCB. The switch is tested to make and carry the rated short-circuit current for 3 seconds, in accordance with latest IEC standards. Earthing by means of an integral earthing switch is proven to be safe, simple and reliable.

Busbar earthing is effected by a busbar earthing switch usually mounted at the bus-section panel. Option of cable earthing and bus earthing trucks are also available.



OTHER AUXILIARIES

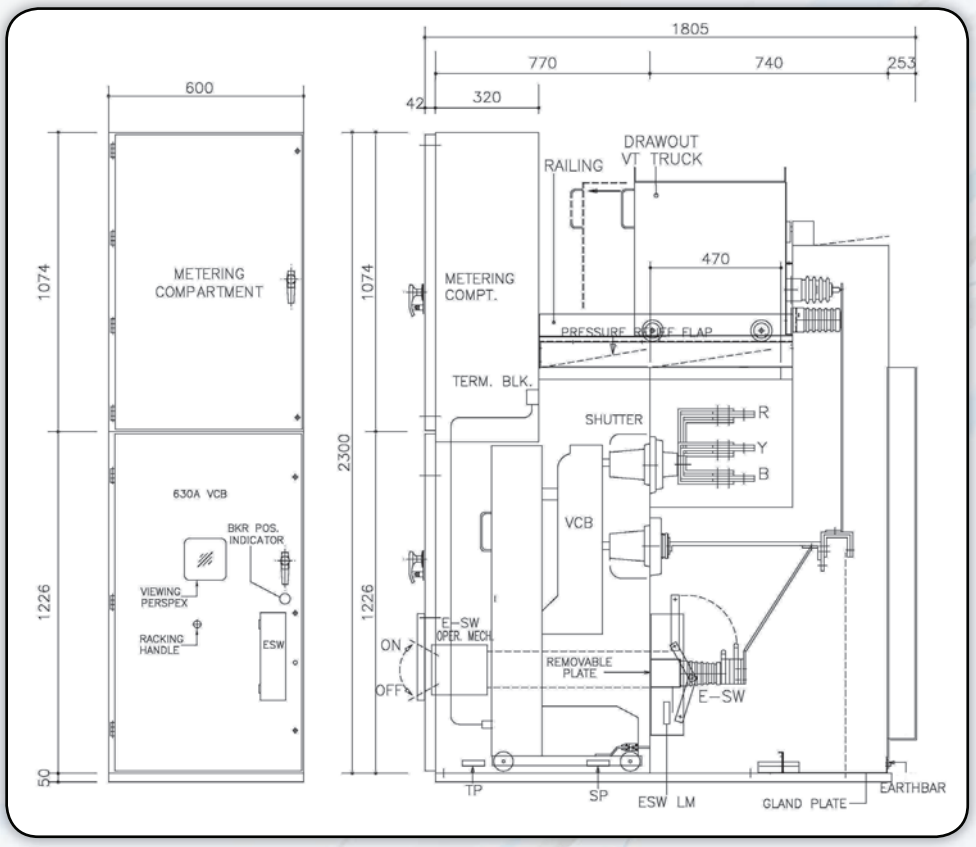
CURRENT TRANSFORMERS

Current transformers can be mounted in the cable chamber of the panel. While wound type and ring type of CTs are in popular usage and can be offered, we recommend using bushing type CTs. These CTs are mounted on earthed condenser bushings. This mounting arrangement ensures higher degree of safety. Current transformers are supplied by reputed manufacturers with expertise in CT design.

POTENTIAL TRANSFORMERS

Potential Transformers are usually mounted on the rear of the cubicle, in the upper part of the circuit compartment. The PTs are fuse protected on both primary and secondary sides. We can also offer front draw-out VTs.
Three mounting options are offered: fixed, isolatable and drawout. The isolatable design offers the advantages of isolation without having to put up with the inconvenience of a conventional drawout PT.

CROSS SECTIONAL DRAWING



DATA SHEET

Voltage	12kV				
Impulse withstand voltage	75, 95kVp				
One minute power frequency withstand voltage	28kV				
Transient recovery voltage	20.6kVp				
Frequency	50 Hz				
Normal current	630A – 3150A				
Short circuit breaking current	20kA	25kA	31.5kA	40kA	50kA
Short circuit making current	50kA	63kA	80kA	100kA	125kA
Duration of short circuit	3 secs				
Degree of protection	IP4X (Higher IP can be offered on request)				
Width (in mm)	600/ 700/ 800/ 1000 (depending on current and short circuit rating)				
Depth (in mm)	1805/2065/2160 (depending on current and short circuit rating)				
Height (in mm)	2300				

Fault Level (kA) / Normal Current (A)	25	31.5	40	50
630A				
1250A				
2000A				
3150A				

VCB	
Operating sequence	O-0.3 sec-CO-3 min-CO
Opening time (in msec)	35
Break time	< 3 cycles
Full load switching life (No. of operations)	10,000
Closing voltage/Tripping voltage	24V - 220V DC
Spring charging voltage	24V-220V DC / 110V-230V AC
Auxiliary contacts	6 NO+ 6 NC

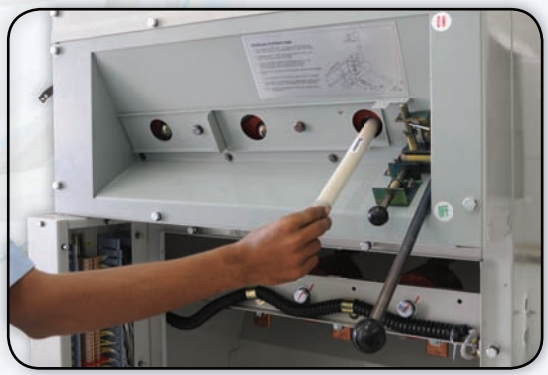
36KV - SINGLE BUSBAR

The 36kV AIS panel offered is similar in features to the 12kV AIS panel. The 36kV AIS panel is a fully compartmentalised metal clad design. The switchboard has all protective features of the 12kV panel including all the safety interlocks, integral earth switch, complete insulation etc. The switchboard is type tested as per the latest international design and is very easy to operate and maintain.

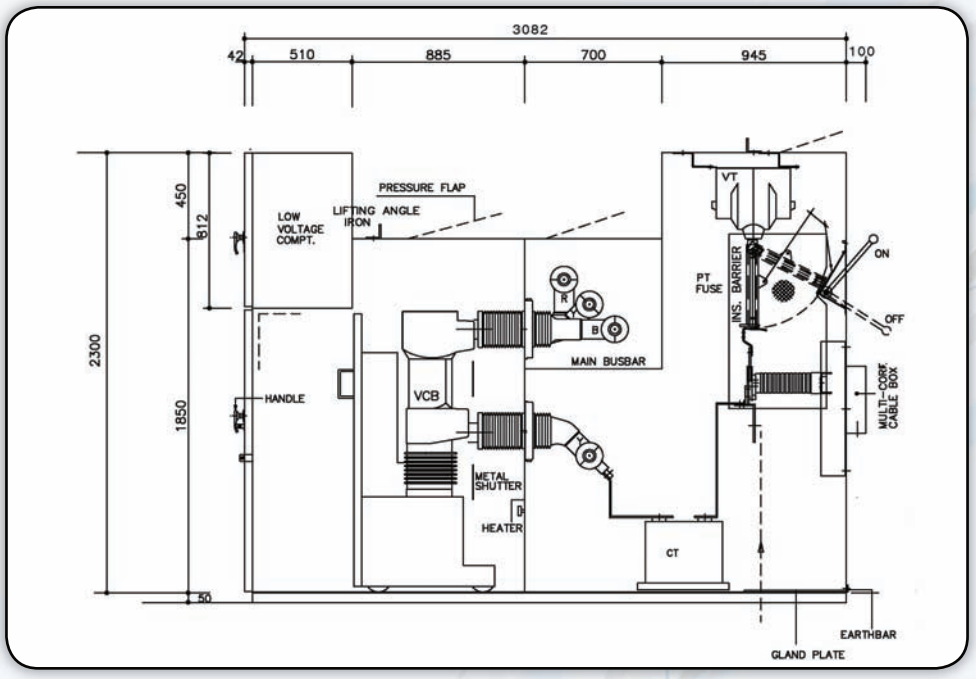
This switchboard has 4 chambers:

1. Busbar chamber: The bus bars in this switchboard are circular in shape. They are completely insulated and the joints are provided with shrouds.
2. VCB chamber: The VCB chamber houses the VCB truck. It has spring operated safety shutters and padlockable front door. Interlocks are provided to ensure complete safety of operating personnel.
3. Cable chamber: The cable chamber has a liberal volume for ease of cable termination.
4. Low voltage compartment: The low voltage compartment has a generous space for mounting relays and meters.

The PT is mounted on the rear of panel and is a special execution. It is an isolatable type of arrangement with a swing out fuse assembly. The PT does not have to be withdrawn completely for replacement of fuse or for isolation purpose. By means of a lever, the fuses can be easily accessed and replaced. This reduces the maintenance time.



CROSS SECTIONAL DRAWING



DATA SHEET

Voltage	24kV	36kV
Impulse withstand voltage	125kVp	170kVp
One minute power frequency withstand voltage	50kV	70kV
Transient recovery voltage	41kVp	62kVp
Frequency	50 Hz	50 Hz
Normal current	630A - 2000A	
Short circuit breaking current	25kA	31.5kA
Short circuit making current	63kA	80kA
Duration of short circuit	3 secs	3 secs
Degree of protection	IP4X (Higher IP can be offered on request)	IP4X (Higher IP can be offered on request)
Width (in mm)	900	1200
Depth (in mm)	2372	3082
Height (in mm)	2300	2300

For 24kV	
Fault Level (kA) / Normal Current (A)	25
630A	
1250A	
2000A	

For 36kV		
Fault Level (kA) / Normal Current (A)	25	31.5
630A		
1250A		
2000A		

VCB		
Voltage	24kV	36kV
Operating sequence	O-0.3 sec-CO-3 min-CO	
Opening time (in msec)	25	20
Break time	< 3 cycles	< 3 cycles
Full load switching life (No. of operations)	10,000	10,000
Closing voltage/Tripping voltage	24V-220V DC	
Spring charging voltage	24V-220V DC / 110V-230V AC	
Auxiliary contacts	6 NO + 6 NC	6 NO + 6 NC

TWO TIER DESIGN

For motors upto 3000kW, 6.6kV, a unique two tier design can be offered which leads to lesser footprint of the switchboard and hence lesser footprint for the substation.

The design is fully compartmentalised and metal clad. Like the 12kV panel, there are 4 compartments offering the same level of safety and ease of use. The two tier can be used for Vacuum contactor (VCU) feeder or for Vacuum circuit breaker upto 630A. The vacuum contactor or VCB is completely withdrawable and fully interlocked ensuring safety of operating personnel.

The VCU incorporates reliable vacuum switching technology with higher life of contactors. The short circuit protection is provided by high voltage fuses mounted on the same truck.

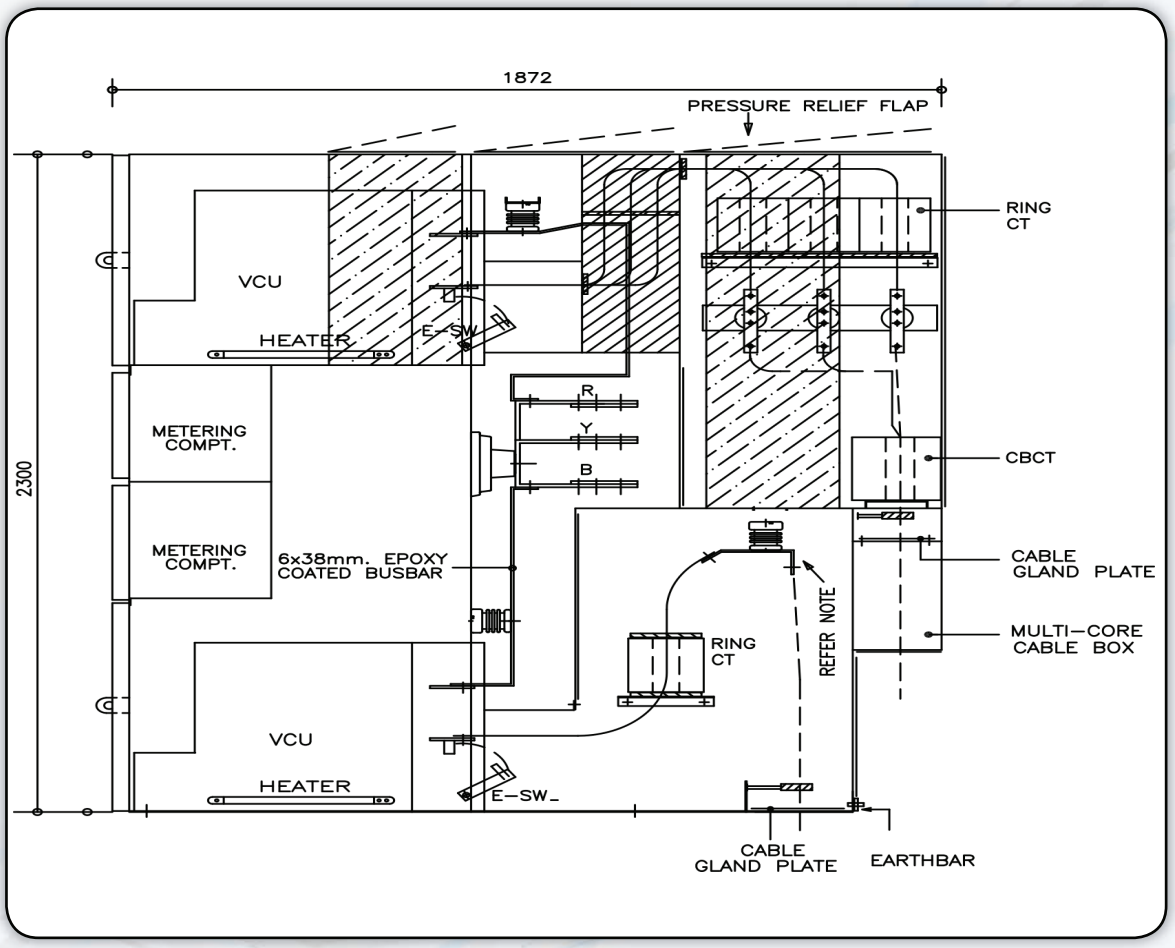
This panel can be lined up with other L&T AIS panel without need for an adaptor panel. The busbars are capable of carrying current upto 2000A and are completely insulated. The boards are provided with arc vents for internal arc faults ensuring operator safety even in case of severe fault. The other safety features include shutters that prevent access to live parts when VCU is disconnected.

Each feeder has its own low voltage compartment for mounting of relays and meters and for has generous space even for complex wiring schemes. The cable compartment situated in the rear is suitable for both top cable and bottom cable entry and has a large volume required for HV cable termination. CTs can be mounted comfortably in this space. Integral earthing switch can also be provided.

Various safety interlocks are provided in accordance to IEC 62271-200. These are:

- Doors can only be opened when VCU is disconnected.
- VCU can be connected or disconnected only contactor is open.
- VCU cannot be connected if the door is open.
- Contactor cannot be closed if VCU is in intermediated position.
- Operating handle cannot be removed in intermediate position.
- Contactor opens if operating handle is inserted.
- VCU padlockable is connected and disconnected position.

CROSS SECTIONAL DRAWING



DATA SHEET

	Latched	Non latched
Voltage	7.2kV	
Impulse withstand voltage	60kVp	
One minute power frequency withstand voltage	20kV	
Frequency	50 Hz	
Normal current	200A	400A
Short circuit breaking current	63kA (fused)	
Making current (100 operations)	2000A	4000A
Breaking current (25 operations)	1600A	3200A
Peak current (10msec)	55kA	85kA
Degree of protection	IP4X (Higher IP can be offered on request)	
Width (in mm)	700	700
Depth (in mm)	1872	1872
Height (in mm)	2300	2300
VCU		
Opening time (in msec)	15-25	
Closing time at no load (in msec)	60-80	
Full load switching life (No. of operations)	2,50,000	
Closing voltage	110V-220V DC	110V-220V AC/DC
Tripping voltage	110V-220V DC	-
Auxiliary contacts	6 NO+ 6 NC	6 NO+ 6 NC

DOUBLE BUSBAR

Most of the executions in medium voltage consists of single bus bar system. But in cases where a reliable power supply is required or when the maintenance downtime for the whole system needs to be low, a double busbar system can be used. Typically such a system requires two busbar systems that operate independently of each other. Single circuit breaker can operate on either bus. While most double busbar system use expensive isolators for switching between the busbars, L&T offers a solution without isolators that increases the reliability of the system as well as reduces the volume occupied by the switchboard.

The double bus bar design of L&T is similar in features to the single bus bar execution: it complies to the IEC62271-100 and IEC 62271-200.

The double bus bar design is available at 3.3kV to 12kV and for 36kV. The double bus bar panel is fully compartmentalised. The different compartments are separated by metal partitions complying to "metal clad" design as per IEC62271-200. The boards are internal arc fault tested and ensure operator safety by safely discharging gases through the vents on the top.

This specific design has 5 chambers:

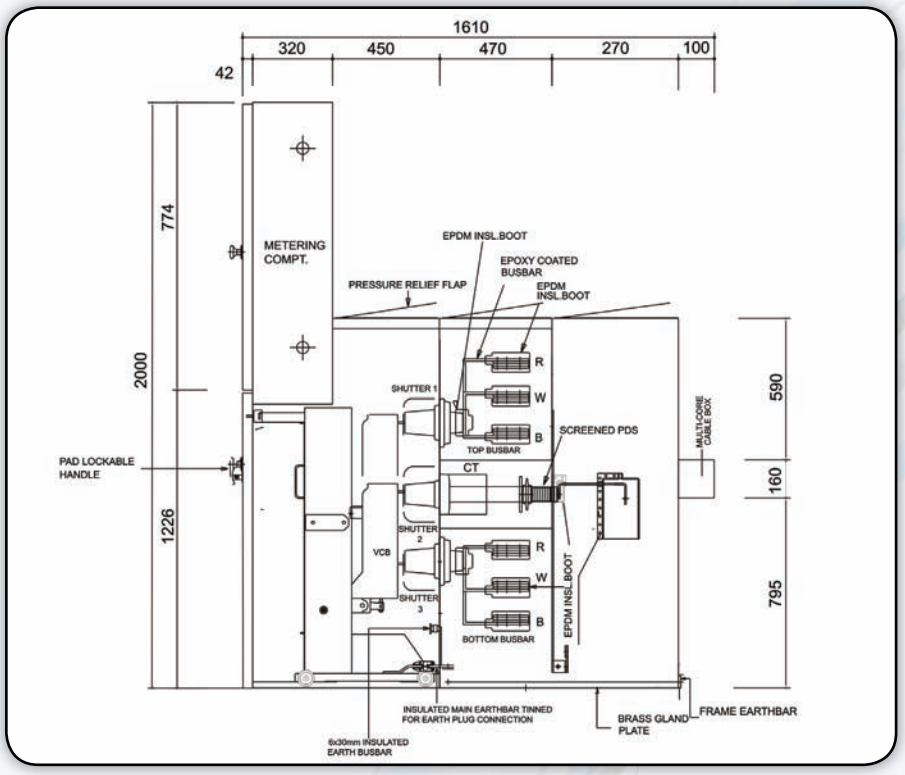
1. VCB chamber: This houses a special VCB.
2. The low voltage compartment: This houses the relays, meters, fuses, terminals, etc.
3. The cable chamber: Contains the CT and the cable termination.
4. Main bus bar chamber: This is the main busbar compartment.
5. Reserve busbar chamber: This is the reserve busbar compartment to be used when the main bus bar is unavailable.

This execution has a special VCB execution. While the VCB switching mechanism and bottle position is unchanged, a jackscrew is built in the truck to raise or lower the circuit breaker arms such that the arms either engage the main busbar or reserve busbar. This means of busbar selection offers the following advantages:

1. Minimum height
2. Minimum footprint
3. Error free reliable operation

This design maintains all the safety features of the single bus design like the shutters to prevent access to the bus bars when VCB is withdrawn; the safety interlocks as per IEC62271-200, padlocks, etc.

CROSS SECTIONAL DRAWING



DATA SHEET

Voltage	12kV		36kV
Impulse withstand voltage	75kVp		170kVp
One minute power frequency withstand voltage	28kV		70kV
Transient recovery voltage	20.6kVp		62kVp
Frequency	50 Hz		
Normal current	630A – 2000A		1250A-2000A
Short circuit breaking current	20kA	25kA	25kA
Short circuit making current	50kA	63kA	63kA
Duration of short circuit	3 secs	3 secs	3 secs
Degree of protection	IP4X (Higher IP can be offered on request)		
Width (in mm)	700/800 (depending on current and short circuit rating)		1200
Depth (in mm)	1610/1870		3160
Height (in mm)	2000		2400

VCB		
Operating sequence	0-0.3 sec-CO-3 min-CO	
Opening time (in msec)	35	20
Break time	< 3 cycles	< 3 cycles
Full load switching life (No. of operations)	10,000	10,000
Closing voltage/Tripping voltage	24V-220V DC	
Spring charging voltage	24V-220V DC / 110V-230V AC	
Auxiliary contacts	6 NO+ 6 NC	6 NO + 6 NC

Current rating		
Normal Current (A)	**Fault Level (kA)**	**25**
630A		12kV
1250A		12kV/36kV
2000A		12kV/36kV

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