

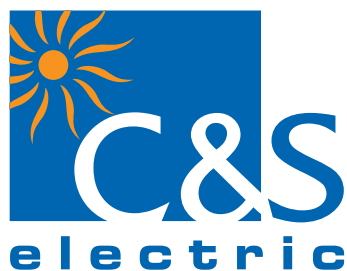
## GLOBAL SPECIALIST FOR POWER BUSBARS



ISOLATED PHASE BUSDUCT



SEGREGATED PHASE BUSDUCT



isobar

We touch your electricity everyday!

C&S Electric Ltd. is a leading manufacturer of electrical and electronic equipment in India. It is India's largest exporter of industrial switchgear & power busbar products. C&S Electric products are used in applications ranging from power generation, transmission and distribution, protection and final consumption.

C&S Electric has the following product verticals:

- Switchgear - LV & MV
- Power Busbars - LV & MV
- Packaged Sub Station (PSS)
- Protection & Measurement Devices
- Lighting
- Diesel Generator

## MARKET LEADER

C&S is amongst the top 4 players in the switchgear business segment and a market leader in the busbar business with more than 50% share in Indian market.

## 18 MANUFACTURING PLANTS

C&S Electric have 18 state-of-the-art manufacturing facilities equipped with latest tools and systems to ensure highest level of quality and services.

A dedicated network of channel partners, ensuring access to the farthest corners of India, with an obsession for customer services. In addition C&S products are available in 7500+ retail counters nationally.

## 600+ STOCKISTS

C&S has 5 international sales offices at London, The Netherlands, Dubai, Germany & USA. C&S exports the entire range of products across all 7 continents, thus reaffirming its position as India's largest exporter of industrial electrical products. Our new subsidiary C&S Electric UK Limited will enhance our coverage and customer service for the international market.

## EXPORTS TO OVER 80 COUNTRIES

## 5000+ EMPLOYEES

5000+ Employees including over 600 engineers, dedicated sales team of 350 people & millions of satisfied customers.

## 2% OF REVENUE INVESTED IN R&D

Over 20,000 sqft. space dedicated to R&D, 70 R&D engineers, state of the art testing & design facilities ...& most of the all a passion for innovation & excellence.

Power Busbar division of C&S Electric Ltd has evolved by continuously addressing the market needs over past 40 year. With the acquisition of Eta-com, Belgium having specialization in cast resin insulated Busway, the merger between the two companies resulted in making C&S as “Global Power Busbar specialist.”

C&S Power Busbars products comply with relevant national & International standards and proven with the Installation references available throughout the continents finding its applications in Power generating stations, Process & manufacturing industries, Commercial & residential Buildings, Infrastructure establishment - Airports, Metros, Railways, Hospitals, Tunnels, Ports, Shopping centers, Exhibition centers, Warehouses IT Parks, Data centers solutions, Solar farms, Oil & Gas and Chemical Industry.

C&S Power Busbar Division with combination of supreme range, vast experience in R&D, engineering, state of art manufacturing plants, in-house testing facilities and strong project management is aimed to provide one stop solutions to user.



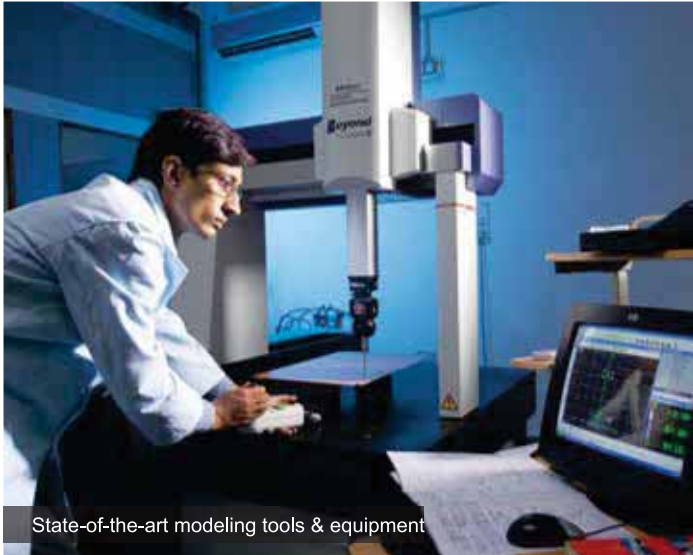
C&S Electric, India



Eta-com, Belgium



## R&D and Testing Facilities



State-of-the-art modeling tools & equipment



Research Center



Impulse Testing Facilities at BD Plant

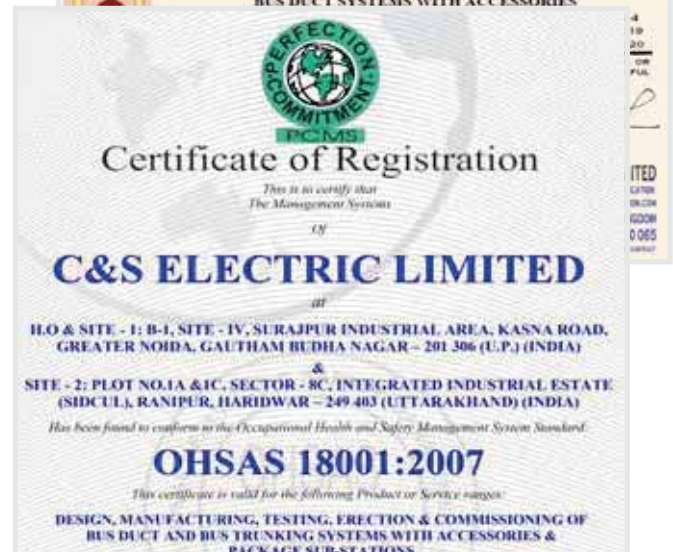
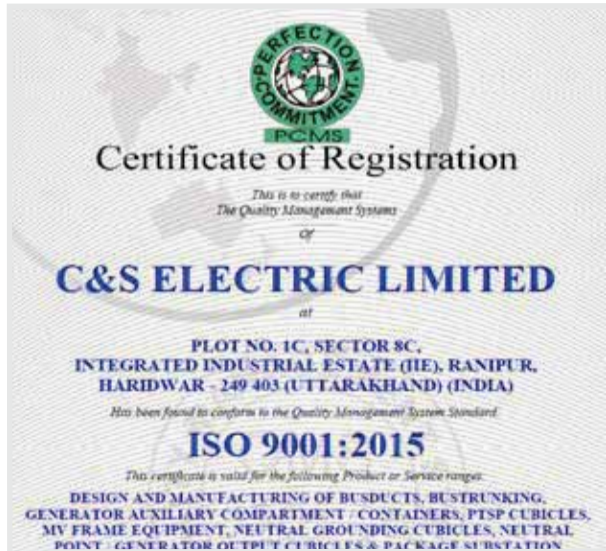


Dedicated team of engineers for development & value engineering



India's only 30,000A power busbar test center

## Quality Assurance



14001:2015



9001:2015



18001:2017



**metabar** Range offers Low Voltage Busbar Trunking System – Lighting Trunking, Compact Air Bustrunking, Track Busway & Sandwich Bustrunking ranging from 25A to 6300A.

Metabar bustrunking is a low impedance, compact size, safe and reliable power distribution system with flexibility in distribution, ease of Installation, reusability & better aesthetics – makes a preferred choice for user.

Metabar bustrunking offers highest safety features - short circuit withstand capacity, resistance to flame propagation, fire penetration, circuit Integrity during fire, seismic resistance & corrosion resistance etc.

### Sandwich Bustrunking (SB)-LV

|                                        |                                               |
|----------------------------------------|-----------------------------------------------|
| Compliance of standard                 | IEC 61439 (1&6)                               |
| Conductor Material & Ratings           | Copper 630A - 6300A<br>Aluminium 400A - 5000A |
| Rated Operational Voltage (Ue)         | 1000V                                         |
| Rated Impulse Withstand Voltage (Uimp) | 12kV (1.2/50µs)                               |
| Enclosure Material                     | G.I.                                          |
| Degree Of Protection                   | IP54 / IP55*                                  |
| Plug In Box                            | 32A-630A                                      |

\*IP65 & IP66 available on request



### Compact Air Bustrunking (CB)-LV

|                                        |                                              |
|----------------------------------------|----------------------------------------------|
| Compliance of standard                 | IEC 61439 (1&6)                              |
| Conductor Material & Ratings           | Copper 125A - 1250A<br>Aluminium 200A - 800A |
| Rated Operational Voltage (Ue)         | 1000V                                        |
| Rated Impulse Withstand Voltage (Uimp) | 12kV (1.2/50µs)                              |
| Enclosure Material                     | G.I.                                         |
| Degree Of Protection                   | IP54                                         |
| Plug In Box                            | 32A-400A                                     |



### Lighting Trunking (LB)-LV

|                                |                 |
|--------------------------------|-----------------|
| Compliance of standard         | IEC 61439 (1&6) |
| Conductor Material & Ratings   | Copper 25A, 40A |
| Rated Operational Voltage (Ue) | 500V            |
| Enclosure Material             | Aluminium       |
| Degree Of Protection           | IP54 / IP55     |
| Plug In Box                    | Upto 16A        |



### Track Busway (MB)-LV

|                                |                    |
|--------------------------------|--------------------|
| Compliance of standard         | IEC 61439 (1&6)    |
| Conductor Material & Ratings   | Copper 250A - 400A |
| Rated Operational Voltage (Ue) | 690V               |
| Enclosure Material             | Aluminium          |
| Degree Of Protection           | IP42               |
| Plug In Box                    | Upto 63A           |



**betobar** Range offers - Low Voltage and Medium Voltage cast resin Insulated Busway system ranging from 1000V to 17.5KV and 630A to 6300A.

Betobar-Cast Resin bustrunking consists of copper or aluminum busbars casted in homogeneous Insulating compound BIM, made of Epoxy resin mixed with special fillers under vacuum. This insulating compound has class "F" insulation with high mechanical and electrical strength, excellent resistance to atmospheric pollution & chemicals, resistance to fungi, Insects and rodents. Bustrunking section Joints are also casted with B.I.M at site, resulting in homogeneous insulation over the full run of bustrunking.

Betobar-Cast Resin bustrunking with low impedance, compact size, better aesthetics offers - highest degree of Ingress protection (IP68), high short circuit withstand capacity, resistance to flame propagation, resistance to fire penetration, circuit Integrity during fire, seismic resistance & UV resistance etc.

Betobar- Cast Resin bustrunking is highly safe and most reliable power distribution system for critical applications such as - Oil & Gas industry, explosive areas, humid and coastal area, chemical & dusty atmosphere and outdoor installations.

### Cast Resin Insulated Busway (LA)-LV

|                                        |                                               |
|----------------------------------------|-----------------------------------------------|
| Compliance of standard                 | IEC 61439 (1&6)                               |
| Conductor Material & Ratings           | Copper 800A - 6300A<br>Aluminium 630A - 5000A |
| Rated Operational Voltage (Ue)         | 1000V                                         |
| Rated Impulse Withstand Voltage (Uimp) | 12kV (1.2/50µs)                               |
| Degree of Protection                   | IP68                                          |
| Mechanical Resistance                  | IK10                                          |



### Cast Resin Insulated Busway (SH)-MV

|                                        |                                                 |
|----------------------------------------|-------------------------------------------------|
| Compliance of standard                 | IEC 62271 (1&201)                               |
| Conductor Material & Ratings           | Copper 1300A - 1850A<br>Aluminium 1350A - 1500A |
| Rated Operational Voltage (Ue)         | 3.6 kV - 7.2kV                                  |
| Rated Impulse Withstand Voltage (Uimp) | 12kV (1.2/50µs)                                 |
| Degree of Protection                   | IP66 / IP67                                     |
| Mechanical Resistance                  | IK10                                            |



### Cast Resin Insulated Busway (PH)-MV

|                                        |                                                 |
|----------------------------------------|-------------------------------------------------|
| Compliance of standard                 | IEC 62271 (1&201)                               |
| Conductor Material & Ratings           | Copper 1750A - 6100A<br>Aluminium 1350A - 5000A |
| Rated Operational Voltage (Ue)         | 3.6 kV - 17.5kV                                 |
| Rated Impulse Withstand Voltage (Uimp) | 12kV (1.2/50µs)                                 |
| Degree Of Protection                   | IP66 / IP67                                     |
| Mechanical resistance                  | IK10                                            |



**isobar** Range offers - Isolated Phase busduct (IPB), segregated phase busduct (SPB) and Non-Segregated phase busduct (NSPB) ranging from 415V, 630A to 38KV, 30000A.

C&S is one of the global leaders in design, manufacturing, erection & commissioning of all variants of busducts for power generation and distribution upto 1000MW.

C&S has supplied more than 500 sets of isolated phase busducts with generating capacities of more than 150GW ranging from 80MW to 800MW.

Isobar busducts have been successfully type tested from renowned laboratories – KEMA-Netherlands / Czech Republic, EDF-France, CPRI-India.

### Isolated Phase Busduct (IPB)-MV

|                                        |                                              |
|----------------------------------------|----------------------------------------------|
| Compliance of standard                 | IEC 62271 (1 & 200) / IS 8084<br>IEEE C37.23 |
| Rated Continuous Current               | 100A-30,000A                                 |
| Conductor                              | Aluminium*                                   |
| Rated Operational Voltage (Ue)         | 11kV – 38kV                                  |
| Enclosure Material                     | Aluminum Alloy                               |
| Rated Impulse Withstand Voltage (Uimp) | 75kV - 170kV (1.2/50µs)                      |
| Degree of Protection                   | IP55 / IP65                                  |

\*Copper Conductor available on request



### Segregated Phase Busduct (SPB)\*\*-MV

|                                        |                                                |
|----------------------------------------|------------------------------------------------|
| Compliance of standard                 | IEC 62271 (1 & 200) / IS 8084 /<br>IEEE C37.23 |
| Rated Continuous Current               | 630A - 5000A                                   |
| Conductor                              | Aluminium / Copper                             |
| Rated Operational Voltage (Ue)         | 3.3kV - 33kV                                   |
| Enclosure Material                     | Aluminum Alloy                                 |
| Rated Impulse Withstand Voltage (Uimp) | 40kV - 170kV (1.2/50µs)                        |
| Degree of Protection                   | IP55 / IP65                                    |

\*\*Non-Segregated Phase Busduct (NSPB) - MV design available on request

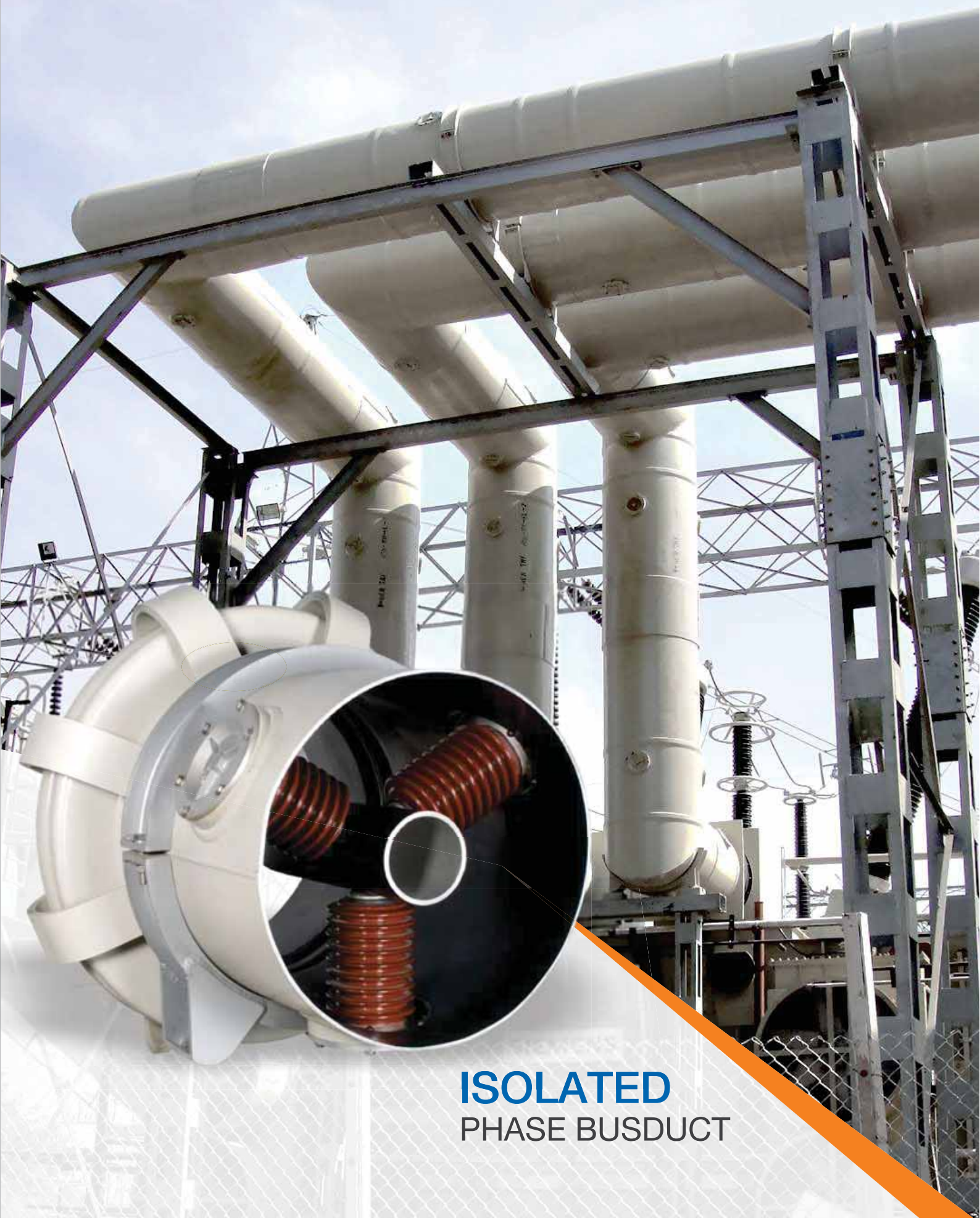


### Non Segregated Phase Busduct (NSPB)-LV

|                                        |                                 |
|----------------------------------------|---------------------------------|
| Compliance of standard                 | IEC 61439 (1&6) / IS 8623 (1&2) |
| Rated Continuous Current               | 630A - 6500A                    |
| Conductor                              | Aluminium / Copper              |
| Rated Operational Voltage (Ue)         | 415V                            |
| Enclosure Material                     | Aluminum Alloy                  |
| Rated Impulse Withstand Voltage (Uimp) | 12kV (1.2/50µs)                 |
| Degree of Protection                   | IP55 / IP65                     |



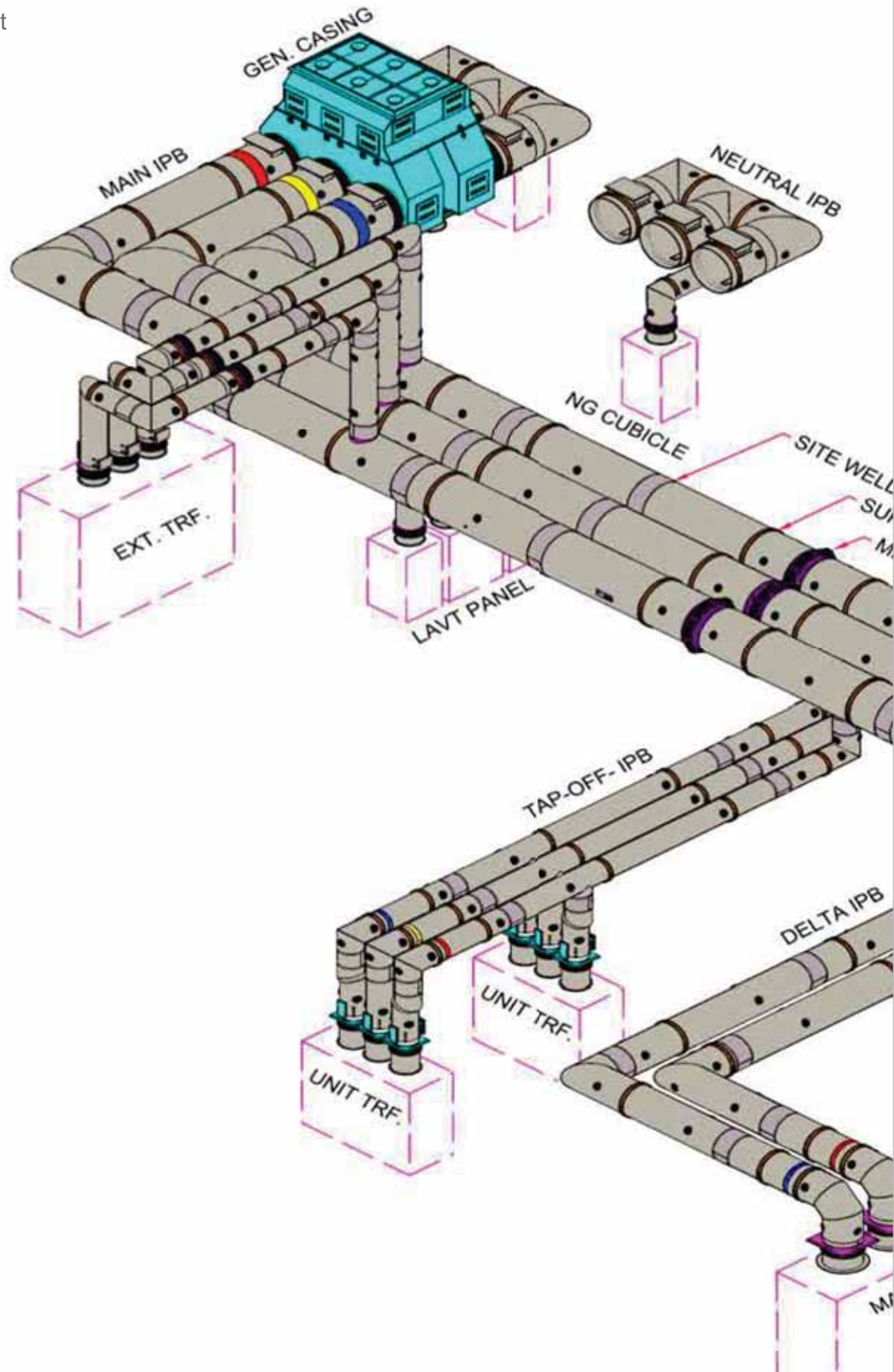




## ISOLATED PHASE BUSDUCT

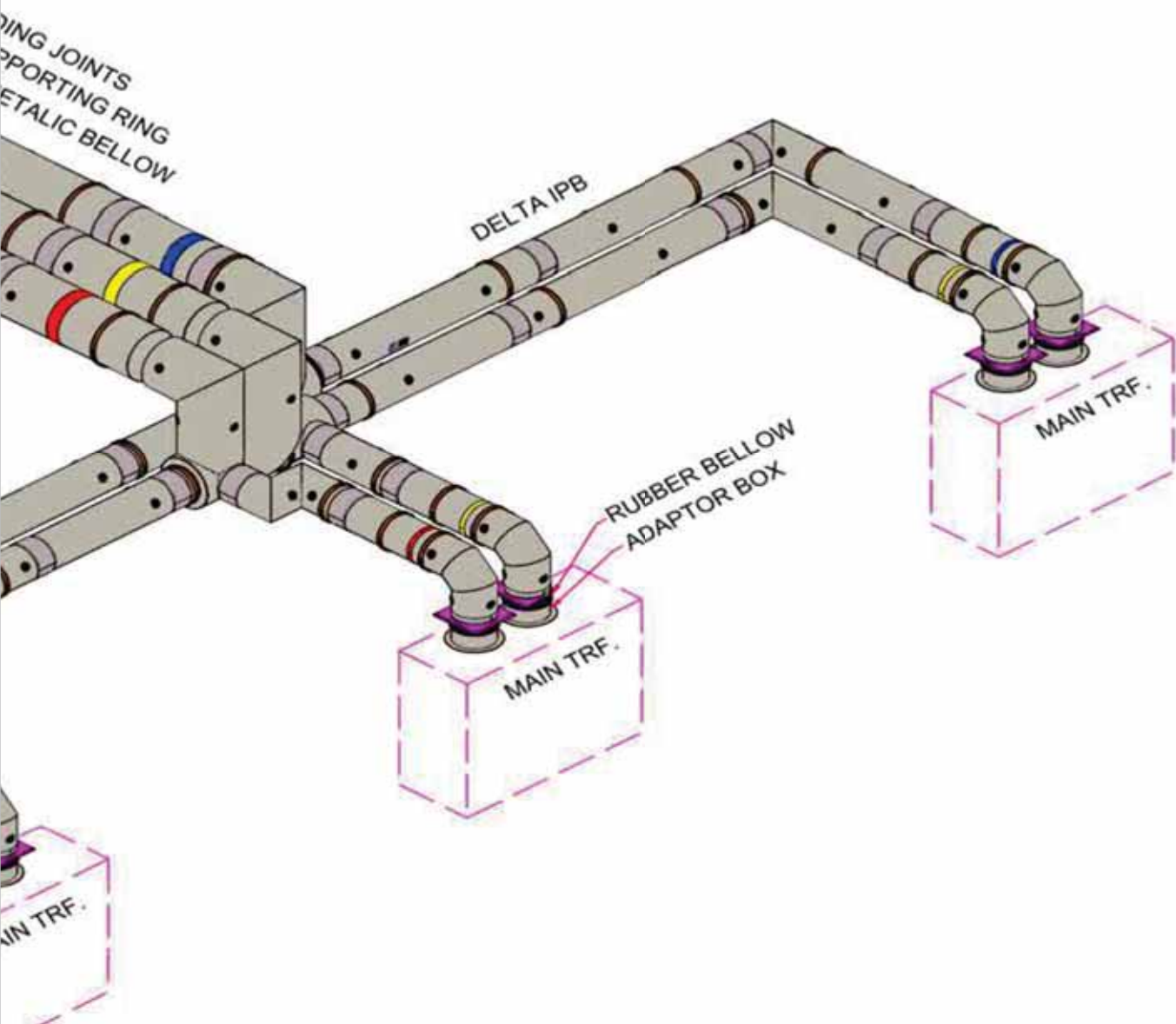
## Typical Layout Arrangement

Isolated Phase Busduct





*C&S has Supplied 500+ sets of Isolated Phase Busduct with Generating Capacity of 150+ GW, ranging from 80 MW to 800 MW Plants.*





C&S offers a wide range of Isolated Phase Busduct from 11kV to 38kV upto 30000A.

#### APPLICATIONS:

Isolated Phase Busduct (IPB) finds application in Power Generating Units between

- Generator Phase terminals to Generator Transformers with Tap off Connections & Generator Transformers with Tap off Connections to Unit Auxiliary Transformer (UAT), Neutral Grounding Cubicles (NGC), Excitation Transformers and Lightning Arrester Voltage Transformer (LAVT) Cubicles
- Generator Phase terminals to Generator Circuit Breakers (GCB) & Generator Circuit Breakers (GCB) to Transformer with Tap off Connections to Unit Auxiliary Transformer (UAT), Neutral Grounding Cubicles (NGC), Excitation Transformers and Lightning Arrester Voltage Transformer (LAVT) Cubicles
- Generator Transformer Delta formation for three single phase transformers.
- Above applications will find Power Transmission solutions in power generating stations - Thermal, Hydro, Gas based, Nuclear & Combined cycle

#### ■ PRODUCT HIGHLIGHTS:

- Excellent shielding under Short Circuit Conditions, near elimination of forces.
- Eliminates phase to phase faults.
- Reduces proximity effect between the main current carrying conductors of the adjacent phase to almost zero due to magnetic shielding, on the one hand.
- It provides complete protection for operating personnel from touch and high step voltages across the enclosures and the metallic structure.
- Best suited for adverse climatic and polluted atmospheric conditions.
- The busduct system is easy to handle and Install.
- Provides excellent degree of protection-IP65.
- Seismic compliant.



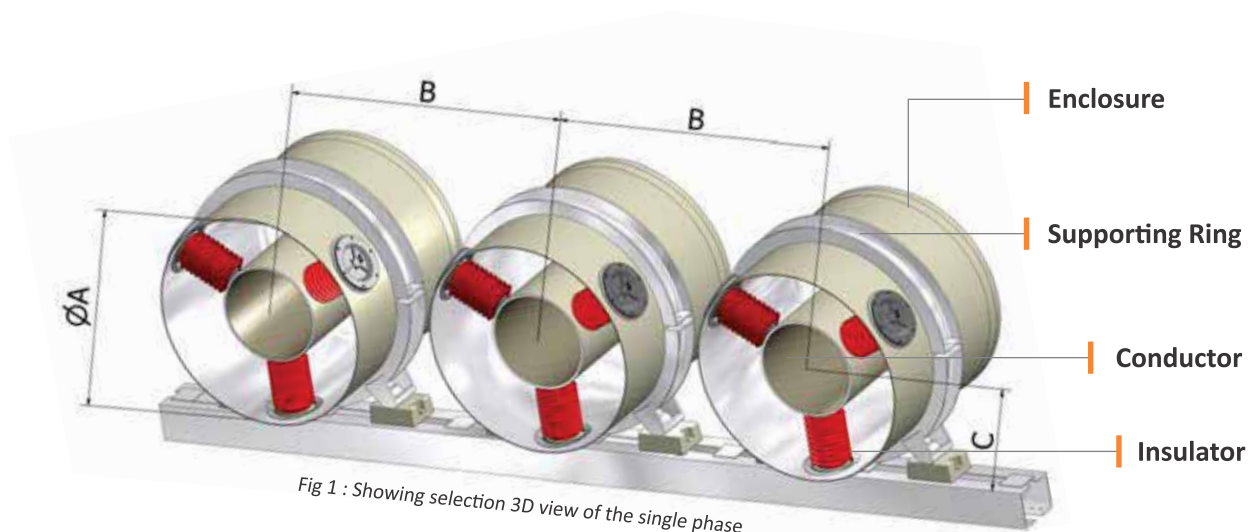
## Technical Specifications

|                                          |                                             |
|------------------------------------------|---------------------------------------------|
| Compliance of standard                   | IEC 62271 (1 & 200) / IS 8084 / IEEE C37.23 |
| Rated Continuous Current                 | 100A-30,000A                                |
| Configuration                            | 3P                                          |
| Conductor                                | Aluminium*                                  |
| Rated Operational Voltage (Ue)           | 11kV – 38kV                                 |
| Rated Short Time Withstand Current (Icw) | 80KA -309KA (for 1 Sec.)                    |
| Enclosure Material                       | Aluminum Alloy                              |
| Rated Impulse Withstand Voltage (Uimp)   | 75kV - 170kV (1.2/50 µSec)                  |
| Degree of Protection                     | IP55 / IP65                                 |

\*Copper conductor range available on request



## Technical Data



| Rated Voltage | Basic Insulation Level | Rated Current | Enclosure size |      |     |
|---------------|------------------------|---------------|----------------|------|-----|
| kV            | kV                     | Amps          | A              | B    | C   |
| 17.5          | 38/95                  | 2000          | 450            | 750  | 396 |
|               |                        | 4000          | 500            | 900  | 410 |
|               |                        | 5000          | 520            | 900  | 410 |
|               |                        | 6000          | 585            | 1000 | 425 |
|               |                        | 8000          | 675            | 1000 | 465 |
|               |                        | 10000         | 750            | 1100 | 490 |
| 24            | 55/125                 | 2000          | 570            | 900  | 420 |
|               |                        | 4000          | 620            | 1000 | 445 |
|               |                        | 6000          | 700            | 1000 | 480 |
|               |                        | 8000          | 795            | 1100 | 510 |
|               |                        | 10000         | 870            | 1200 | 535 |
|               |                        | 12500         | 970            | 1300 | 580 |
|               |                        | 14000         | 1070           | 1400 | 671 |
| 27            | 60/125                 | 19000         | 1270           | 1600 | 751 |
|               |                        | 4000          | 670            | 1000 | 465 |
|               |                        | 15000         | 1070           | 1750 | 671 |
|               |                        | 22000         | 1420           | 1750 | 830 |
|               |                        | 24000         | 1520           | 1850 | 850 |
| 38            | 80/150                 | 26000         | 1620           | 1950 | 890 |
|               |                        | 4000          | 750            | 1100 | 490 |
|               |                        | 15000         | 1120           | 1800 | 690 |
|               |                        | 23000         | 1450           | 1800 | 820 |
|               |                        | 26000         | 1620           | 1950 | 890 |

**Note:**

All dimensions in mm

1. Declared sizes are tentative and are subject to changes according to site ambient temperature and technical specifications.
2. Shipping sections maximum length is 10m. Adjacent sections are welded with bonding enclosures at site.



## Conductor

The conductors are normally made of aluminium (Al - 99.5%) rolled and welded to one another so as to have tubular form.

### Benefits of Tubular Busbars

1. Skin effect factor is minimum resulting in less losses.
2. Uniform heat dissipation over entire surface.
3. Shapes facilitates the effect of self-centering during short circuit forces and hence uniform dielectric is maintained relieving both enclosure and conductor from any undue stresses. The thermal effects in busbars are taken care of by the expansion joints.
4. Symmetry simplifies calculations & precision.
5. From manufacturing point of view, welding of bend / Tap offs in tubular design is simpler than other.

In some cases conductor can be copper 99.9% also.

External surfaces of conductors are painted matt black paint in order to increase the heat-dissipating capacity by radiation and reduce the temperature rise of the conductors.



## Enclosure (Continuous Enclosure Type)

The enclosure is made of aluminum alloy sheets rolled and welded to form a tubular form of standard lengths. The successive standard lengths of enclosures are welded together by means of welding enclosures at site. This system is called as electrically continuous housing. In case of three phase system, each phase enclosure is then cross-connected with the enclosure of the other phases at the extreme ends of the installed bus duct. The welded bonding permits longitudinal flow of induced currents through the length of the enclosure and return through the enclosure of the other phases. One end of the shorting plate is grounded for safety of personnel. Enclosures are supported at the location with the help of supporting rings in two halves clamped to the enclosure.

The enclosure is designed to carry longitudinal electromagnetic currents up to 90–95% of the rated current of the main bus and also accountable for the dissipation of heat of the main conductors, unless an additional forced cooling system is adopted.

### Some of the prominent features of the enclosure design are –

1. Continuous enclosure provides a high degree of magnetic shielding for metallic objects and structures located in the vicinity.
2. Magnetic shielding also significantly reduces the electrodynamic stresses caused by short-circuits on the structures and between the enclosures of the other phases. The thermal effects of the enclosure are taken care of by the bellows.
3. The electrical bonding of enclosures thus nullifies the proximity effect and helps to reduce the heating in supporting beams/ Structures.
4. Voltage rise in enclosures is low due to its resistive origin hence ensuring personnel safety.
5. Aluminum housings are inherently corrosion-resistant, lighter in weight and easier to handle. The continuous housing design simplifies installation and reduces construction time by keeping joints to a minimum.

Sometimes canopy arrangement is also provided to nullify the effect of solar radiations.

## Insulators

Insulators are used to support the conductors inside the enclosures. Their main purpose is to bear the weight of the conductors, stresses due to conductor expansion and short circuit faults. The insulators are positioned at 120° apart and this design has many benefits.

### Benefits of Insulator design

- Bus to get aligned at its magnetic center and therefore uniform dielectric strength is maintained between bus and enclosure.
- Free Movement of conductor during expansion.
- Eliminates the effect of cantilever forces.
- Easy maintenance as insulators can be easily removed from outside.
- No access door is required thus enhancing the efficiency of air pressurization system.

## Accessories

### Metallic Expansion Joints

Metallic expansion joints are provided to allow expansion and contraction on conductors and enclosures due to temperature variations.

Metallic expansion joints with double compensator made of aluminium alloy, same as that of enclosure, is installed along the route and location is established by proper designing and calculations. This joint also permits the path for the longitudinal enclosure circulating current thus achieving “continuous design” of Isolated Phase Busduct (IPB).



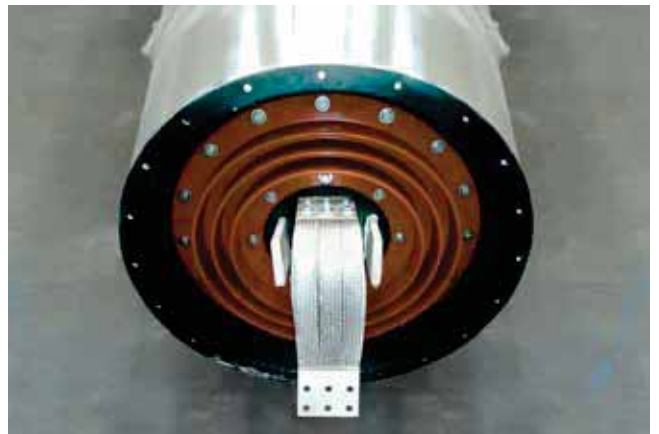
### Rubber Bellows

EPDM Rubber Bellows are provided at equipment termination end to prevent transmission of vibrations to busduct and also to prevent flow of enclosure longitudinal currents to equipment. They also facilitates easy alignment with equipment flanges and equipment/Civil foundation tolerances.



### Seal Off Bushing

These bushings are used to prevent hydrogen leakage from generator terminals from entering the IPB enclosure and also when a pressurization system is used. These seal-off bushings are made of epoxy cast resin.



### Wall Frame Assembly

These are used to close the opening location where bus is passing through the wall. These plates are made of Aluminium along with silicone sealing to seal the resultant interface gap. wall frames can be supplied with fire barriers both inside and outside of the IPB. Wall passages are fully insulated from the busduct.



## Auxiliary Systems

### Pressurization System

Pressurization system is used to maintain a positive pressure above atmospheric pressure by few millibars of dry and clean air inside the enclosures, in order to prevent any entry of outside air into the busduct thus eliminating any dust or moisture into the busduct

It helps in maintaining good dielectric characteristics of the insulator during continuous operation and eliminates condensation.



### Hot Air Blowing System

The hot air blowing system is required for blowing hot air into the busduct to evacuate moisture content inside the busduct during first time energizing or starting after maintenance.

This system is open loop circuit with hot air supplied through inlet valve until the interior of enclosure is completely dry. The unit is a low voltage equipment comprising axial flow fan, a heater, an inlet filter, pressure damper and can be customized with required controls and Interlocks.



### Forced Air Cooling System

For higher ratings (usually 25 000A and above), heat dissipation through natural cooling alone may not be sufficient. It may require a larger enclosure. But this may become too large to terminate at the generator end and be a limiting factor, besides becoming more expensive. Hence this system is adopted to maintain & control temperature rise limits as per specification or customer needs.

This is the closed loop circuit, the air blown into two phases is drawn into the third, cooled when passing through the heat exchanger and returned to the circuit. As the warm air flows out of the return phase(s) into the heat exchanger, it is passed on to the cooling coils. The air then passes through a water eliminator before re-entering the enclosure(s) to be re-circulated.





## Auxiliary Equipments

C&S manufactures and supply Auxiliary Equipment as per customer requirements.

### 1. Potential Transformer (PT) & Surge Protection (SP) Cubicles / Lightning Arrester Voltage Transformer Cubicles (LAVT)

PT & SP Cubicles or LAVT cubicles are used for generator voltage measurement and generator protection from over voltages due to surges.

Cubicle houses Potential Transformers, Lightning arrester, Surge arrester along with its associated assembly.



### 2. Neutral Grounding Cubicles

Generator Neutral Grounding Cubicles are designed to minimize fault damage incurred by generators, maintain sufficient fault detection and improve power system reliability.

Cubicle houses Neutral Grounding Transformer and Neutral Grounding Resistor along with its associated assembly.

- It is free standing floor mounted type cubicle made up of powdered coated mild steel CRCA or Galvanized sheets with IP54 ingress protection for NGT and IP23 for NGR compartments.



### 3. Generator Terminal Enclosures (GTE) & Generator Auxiliary Compartment (GAC)

GTE or GAC is mounted on Generator top is used for monitoring & protection system components in a large housing. The enclosure includes both line-side and neutral-side bus systems.

It is basically combination of PT & SP Cubicle and Neutral Grounding Cubicle with some extra features



### 4. DC Busbar Systems / Excitation Transformer

DC Busbar System are generally used for generator excitation system and in smelter plants for furnace connections.



### 5. Other Panels are also available on request

1. Neutral Point Cubicle (NPC)
2. Generator Auxiliary Box (GAB)
3. Generator Terminal Box (GTB)

## SEGREGATED PHASE BUSDUCT





C&S offers a wide range of Segregated Phase Busducts for medium voltage applications ranging from 3.3kV to 33kV upto 5000A

#### APPLICATIONS:

Segregated phase Busducts (SPB) finds application in small Power Generating Units & Utilities

- Generator Phase terminals to Generator Transformers with Tap off Connections & Generator Transformers with Tap off Connections to Unit Auxiliary Transformer (UAT), Neutral Grounding Cubicles (NGC), Excitation Transformers and Lightning Arrester Voltage Transformer (LAVT) Cubicles
- Generator Phase terminals to Generator Circuit Breakers (GCB) & Generator Circuit Breakers (GCB) to Transformer with Tap off Connections to Unit Auxiliary Transformer (UAT), Neutral Grounding Cubicles (NGC), Excitation Transformers and Lightning Arrester Voltage Transformer (LAVT) Cubicles
- Transformer to Switchgear Panel.
- Interconnection between Switchgear Panels.

Above applications will find power transmission solutions in following segments

- Power generating stations ( Captive Power Plants , Hydro & Solar )
- Process plants, manufacturing industries & Industrial buildings
- Infrastructure establishment - Airports, Metros, Railways, Tunnels, Ports

#### PRODUCT HIGHLIGHTS

- Good shielding under short circuit conditions by virtue of non-magnetic metal barriers between phases.
- Minimizes phase to phase faults.
- Conformity to International standards.





## Technical Specifications

|                                    |                                      |
|------------------------------------|--------------------------------------|
| Compliance of standard             | IEC 62271, ANSI/IEEE C37.23, IS 8084 |
| Rated Continuous Current           | 630A-5000A                           |
| Configuration                      | 3P                                   |
| Conductor                          | Aluminium*                           |
| Rated Operational Voltage (Ue)     | 3.3kV - 33kV (AC)                    |
| Rated Short Time Withstand Current | Up to 50kA (for 3 Sec.)              |
| Rated Impulse Withstand Voltage    | 40kV - 170kV (1.2/50 $\mu$ s)        |
| Enclosure Material                 | Aluminium Alloy                      |
| Integral Earth                     | Aluminium Alloy Enclosure**          |
| Degree of Protection               | IP55 / IP65                          |

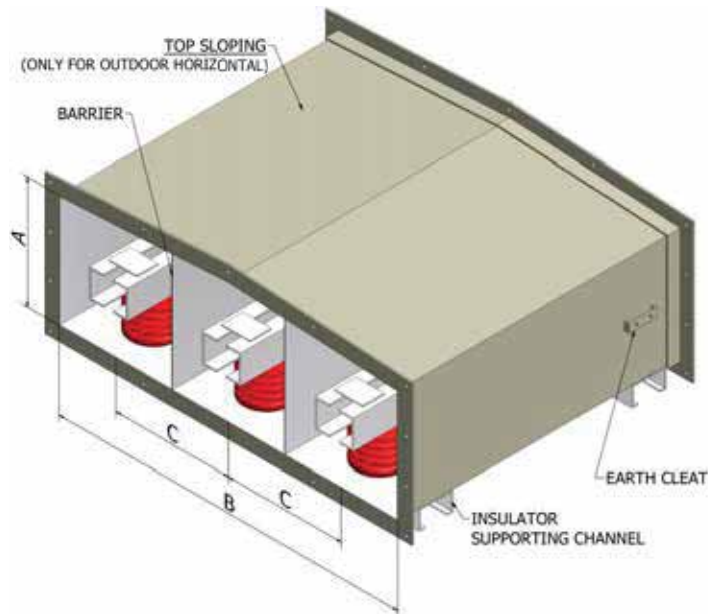
Non- Segregated Phase Busduct (NSPB ) design for MV are also available on request.

\*\*Separate External earthing available on request

\* Copper on request



## Technical Data



| Rated Voltage | Basic Insulation Level | Rated Current | Enclosure size |      |     |
|---------------|------------------------|---------------|----------------|------|-----|
| kV            | kV                     | Amps          | A              | B    | C   |
| Up to 7.2     | 28/60                  | 1250 to 2000A | 350            | 1000 | 330 |
|               |                        | 2500 to 3200A | 400            | 1200 | 400 |
|               |                        | 3500 to 4000A | 450            | 1400 | 470 |
| 12            | 35/75                  | 1250 to 2000A | 400            | 1200 | 400 |
|               |                        | 2500 to 3500A | 450            | 1400 | 470 |
|               |                        | 4000A         | 500            | 1500 | 500 |
| 17.5          | 38/95                  | 1250 to 2000A | 450            | 1400 | 470 |
|               |                        | 2500 to 3200A | 500            | 1650 | 550 |
|               |                        | 3500 to 4000A | 550            | 1700 | 570 |

All dimensions in mm

## Construction

In Segregated Phase Busduct (SPB) construction the conductors of all phases from each other are housed in a common non –magnetic metallic enclosure separated by metal barriers between adjacent phases. The busduct is natural air cooled.

### Conductor

The conductors are normally made of aluminium alloy designed as bar, single channel or double channels assembled in a hollow square as per current rating. Conductor can be insulated on request.

In some cases conductor can be Copper also.

### Enclosure

The enclosure is made of aluminum alloy sheets welded to form a rectangular form of standard lengths. The successive standard lengths of enclosures are bolted at site.

Enclosures are painted with uniform thickness makes it suitable for harsh environment. Special paint colors are available upon request.

Enclosure acts as Integral earth and separate external earth can also be provided on request.

The straight lengths (max. lengths of 4.5 meters) are supplied with all necessary elements like Bends, tees, rubber bellows, flexibles and adaptor boxes etc. as required to complete the route. Inspection covers are provided to allow access for assembly or removal of current transformers, expansion joints, space heaters, thermostat, flexible joints and other such equipment.

### Insulators and Bushings

The insulators are usually of high strength porcelain or epoxy and bushings are in epoxy. Conductor supports are spaced at such intervals to ensure adequate mechanical strength to withstand forces due to fault conditions as specified.



## Support Structures

Support Structures are designed and fabricated as per customer and site needs. These structures are manufactured from mild steel and are hot dip galvanized

Structural support is required to withstand the resultant static and dynamic loadings that the system will experience during fault & electromagnetic vibrations as they may have natural frequencies that coincide with the natural frequency or a harmonic of the current.





## Design & Engineering Excellence

Our in-house skilled engineering team help users to select, specify & design complete solutions with full installation drawings.

- 3D Drawings with corresponding equipment
- 2D Drawings for Termination connections and equipment with dimensions
- 3D Complete Model drawings

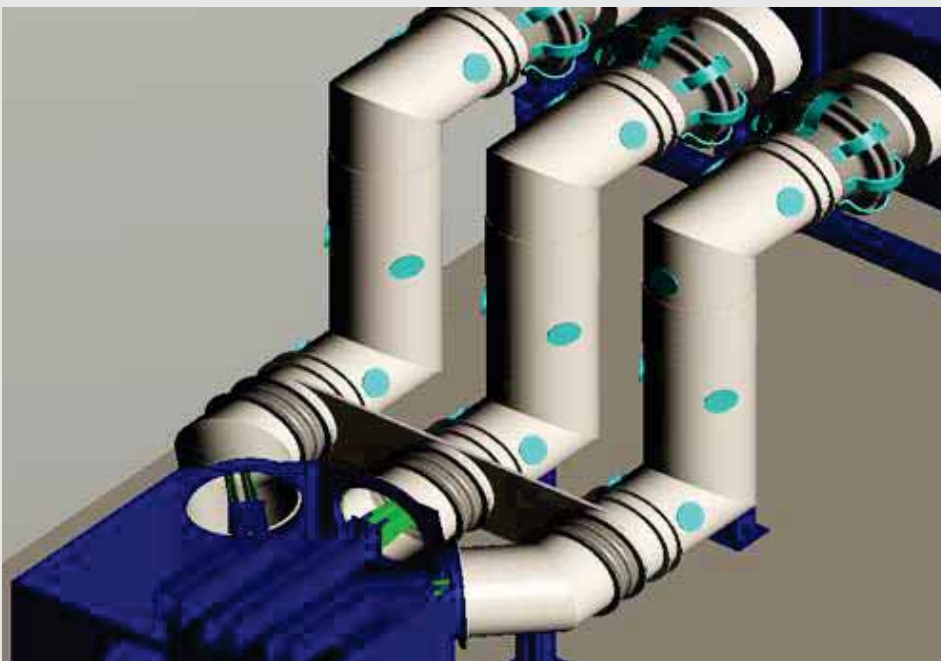
### Connection & Terminations

Termination connections between IPB and Generator, Main Transformer, Generator Circuit Breaker (GCB), Neutral Ground Cubicle, Auxiliary Unit Transformer (UAT) etc respectively becomes critical due to limited space availability & very high forces on the bushing connections. As the generator size increases, a large number of flexible connections between the Isolated Phase bus-duct palms & auxiliary equipment are required to carry continuous rated currents. Following points are need to be taken care for designing of termination connections:-

1. Short circuit forces on bushing connections,
2. Design of connection piece assembly,
3. Orientation of bushing connection plates/piece,
4. HV clearances,
5. IPB termination arrangement on generator (It is advisable to fully involve the generator manufacturing during design stages).



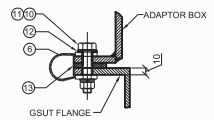
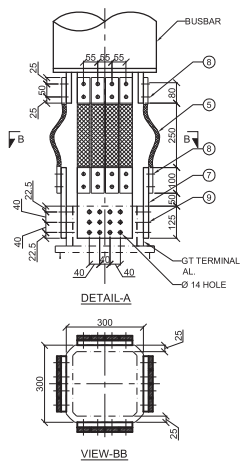
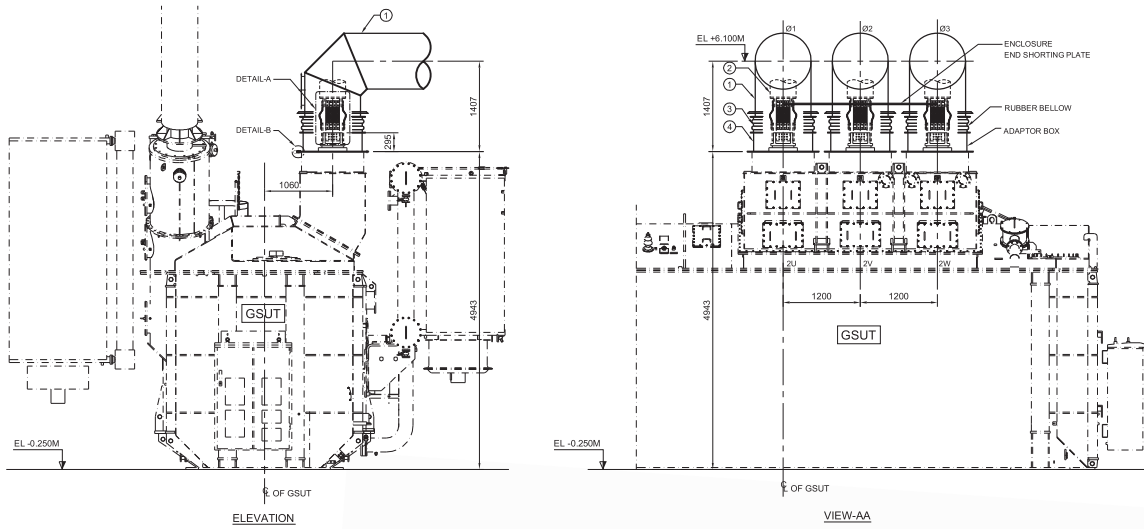
Typical Generator Connection



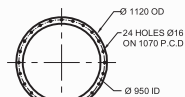




## Typical 2D & 3D Connection Modeling

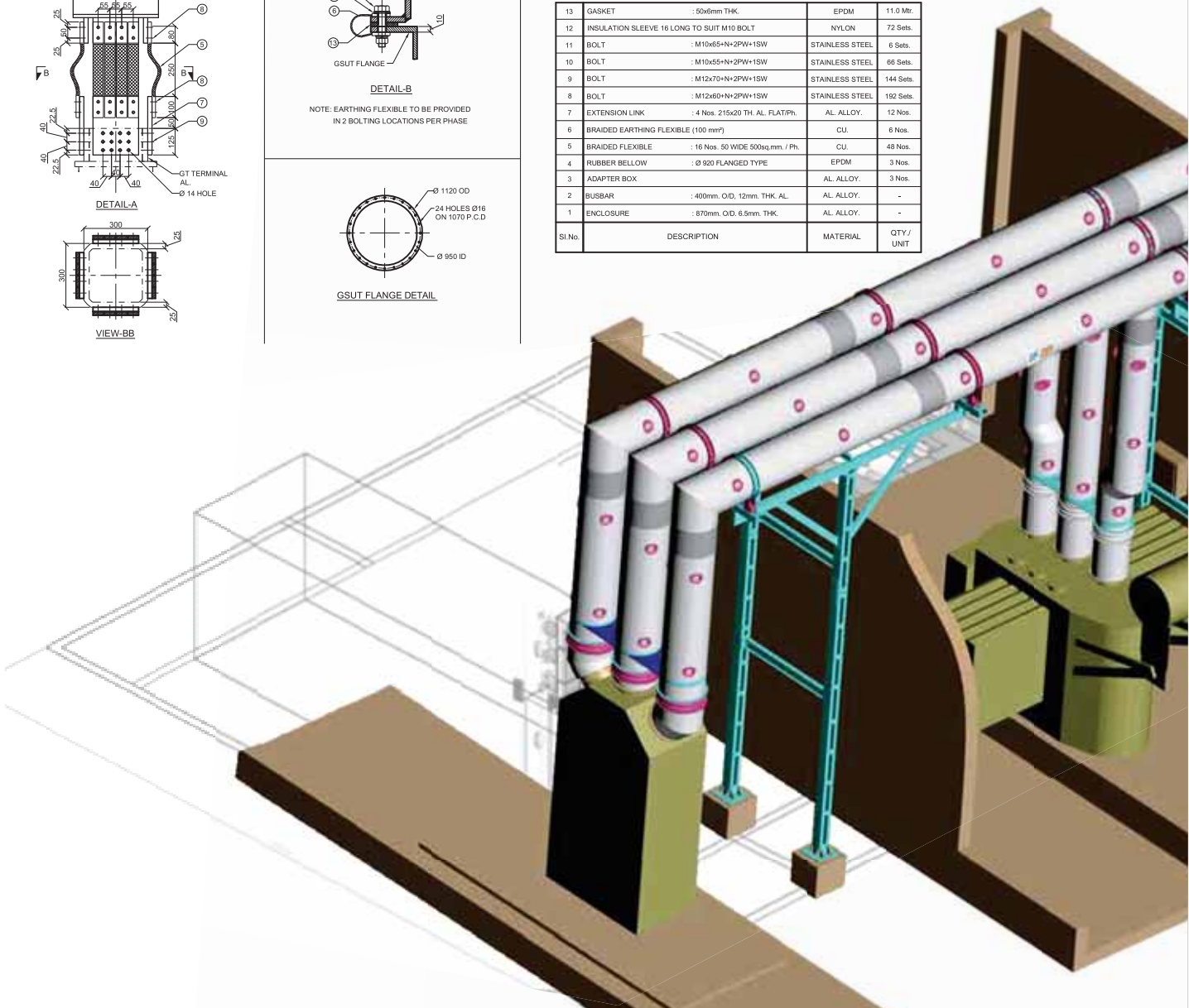


NOTE: EARTHING FLEXIBLE TO BE PROVIDED IN 2 BOLTING LOCATIONS PER PHASE



### BILL OF MATERIAL :-

| Sl.No. | DESCRIPTION                                        | MATERIAL        | QTY / UNIT |
|--------|----------------------------------------------------|-----------------|------------|
| 13     | GASKET : 50x6mm THK.                               | EPDM            | 11.0 Mtr.  |
| 12     | INSULATION SLEEVE 16 LONG TO SUIT M10 BOLT         | NYLON           | 72 Sets.   |
| 11     | BOLT : M10x65-N+2PW+1SW                            | STAINLESS STEEL | 6 Sets.    |
| 10     | BOLT : M10x55-N+2PW+1SW                            | STAINLESS STEEL | 66 Sets.   |
| 9      | BOLT : M12x70-N+2PW+1SW                            | STAINLESS STEEL | 144 Sets.  |
| 8      | BOLT : M12x60-N+2PW+1SW                            | STAINLESS STEEL | 192 Sets.  |
| 7      | EXTENSION LINK : 4 Nos. 215x20 TH. AL. FLAT/Ph.    | AL. ALLOY.      | 12 Nos.    |
| 6      | BRAIDED EARTHING FLEXIBLE (100 mm <sup>2</sup> )   | CU.             | 8 Nos.     |
| 5      | BRAIDED FLEXIBLE : 16 Nos. 50 WIDE 500sq.mm. / Ph. | CU.             | 48 Nos.    |
| 4      | RUBBER BELLOWS : Ø 920 FLANGED TYPE                | EPDM            | 3 Nos.     |
| 3      | ADAPTOR BOX                                        | AL. ALLOY.      | 3 Nos.     |
| 2      | BUSBAR : 400mm. O.D, 12mm. THK. AL.                | AL. ALLOY.      | -          |
| 1      | ENCLOSURE : 870mm. O.D, 6.5mm. THK.                | AL. ALLOY.      | -          |





## Typical Terminations

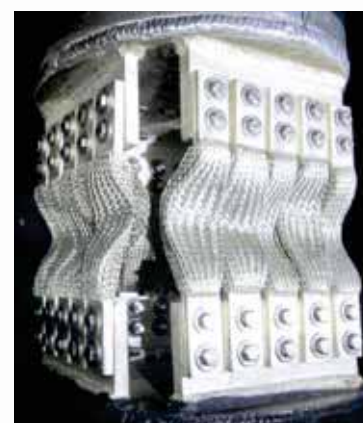
Copper laminates or copper braided flexibles are provided at all the terminals to connect the bus conductor for easy alignment /assembly with the equipment terminals besides preventing any stress at the joints on the equipment and terminals due to nullification of Vibrations.

Flexibles can be fixed or dismantled easily without disturbing equipment position.

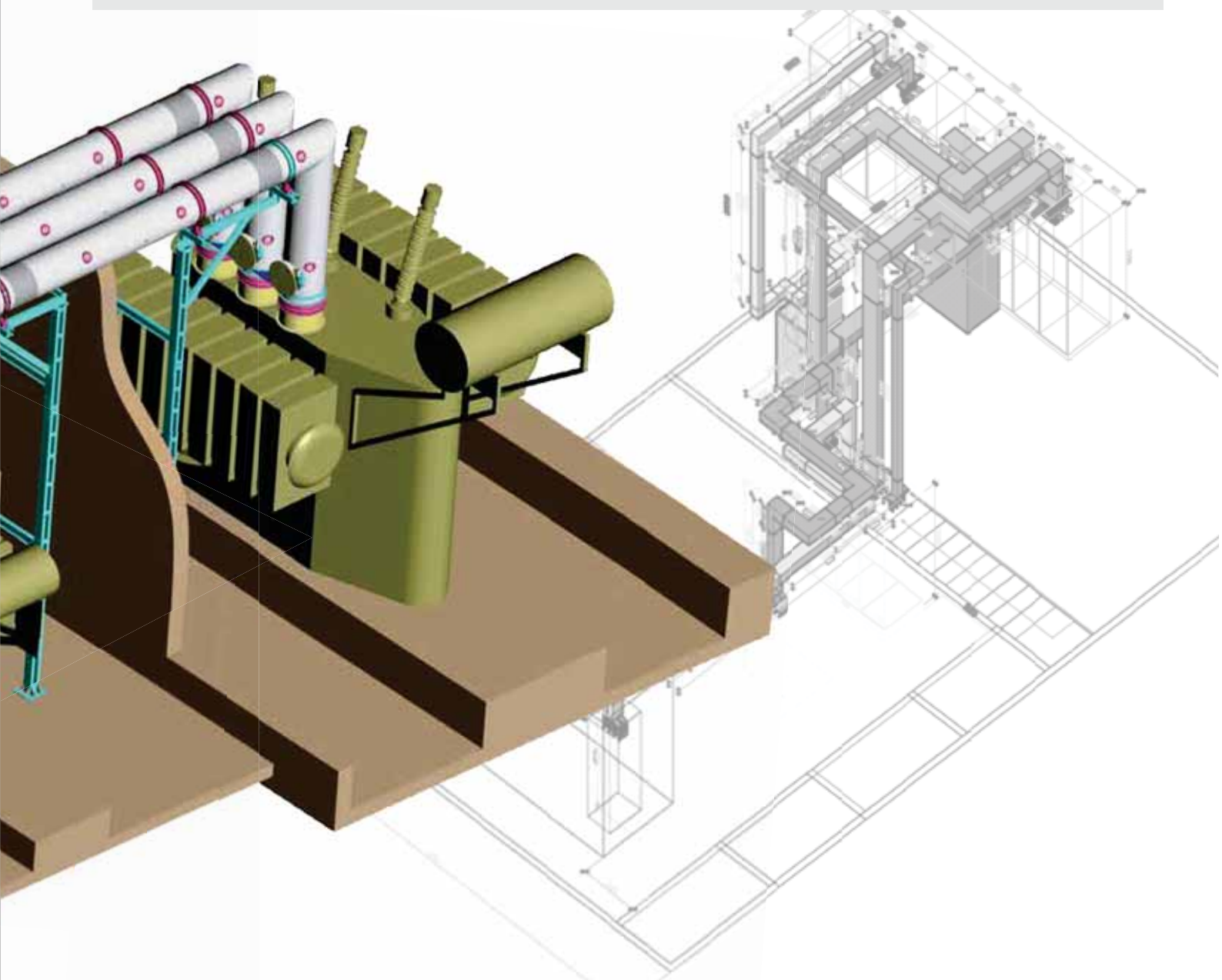
All contact surfaces of busbar are Tinned or silver plated based on specification.



Laminated Flexible Connection



Braided Flexible Connection



## Installation & Supervision Service

C&S in-house experienced and skilled team carry out Installations and supervision services worldwide.





## REFERENCE LIST OF SOME OF THE MAJOR DOMESTIC PROJECTS FOR IPB & SPB

| S.No. | Name of the Power Station        | Location       |
|-------|----------------------------------|----------------|
| 1     | 2 x 600 MW Anpara 'C' TPP        | Uttar Pradesh  |
| 2     | 3 x 660 MW Prayagraj TPP         | Uttar Pradesh  |
| 3     | 2 x 660 MW Meja TPP              | Uttar Pradesh  |
| 4     | 2 x 500 MW Rihand STPP           | Uttar Pradesh  |
| 5     | 3 x 660 MW Barh STPP             | Bihar          |
| 6     | 2 x 660 MW Barh STPP             | Bihar          |
| 7     | 3 x 500 MW Kahalgaon STPP        | Bihar          |
| 8     | 2 x 800 MW Lara STPP             | Chhattisgarh   |
| 9     | 3 x 660 MW Sipat STPP            | Chhattisgarh   |
| 10    | 2 x 685 MW GMR STPP              | Chhattisgarh   |
| 11    | 2 x 600 MW Singhitarai TPP       | Chhattisgarh   |
| 12    | 3 x 500 MW Korba STPP            | Chhattisgarh   |
| 13    | 2 x 500 MW Sipat STPP            | Chhattisgarh   |
| 14    | 2 x 600 MW DVC, Raghunathpur TPP | West Bengal    |
| 15    | 2 x 800 MW Darlipalli STPP       | Odisha         |
| 16    | 2 x 660 MW Babandh TPP           | Odisha         |
| 17    | 2 x 800 MW Sri Damodaram S TPP   | Andhra Pradesh |
| 18    | 2 x 660 MW Krishnapatnam STPP    | Andhra Pradesh |
| 19    | "2 x 660 MW Bhavanapadu TPP"     | Andhra Pradesh |
| 20    | 2 x 500 MW Simhadri STPP         | Andhra Pradesh |
| 21    | 2 x 800 MW Ramanagundam STPP     | Telangana      |
| 22    | 1 x 660 MW Ennore TPP            | Tamil Nadu     |
| 23    | 3 x 500 MW Vallur TPP            | Tamil Nadu     |
| 24    | 2 x 500 MW Nagarjuna TPP         | Karnataka      |
| 25    | 5 x 660 MW Tiroda TPP            | Maharashtra    |
| 26    | 3 x 660 MW Koradi TPP            | Maharashtra    |
| 27    | 2 x 660 MW Vidarbha TPP          | Maharashtra    |
| 28    | 2 x 660 MW Chhabra STPP          | Maharashtra    |
| 29    | 2 x 660 MW Amarkantak TPP        | Maharashtra    |
| 30    | 1 x 500 MW Chandrapur STPP       | Maharashtra    |
| 31    | 2 x 500 MW Tarapur NPP           | Maharashtra    |

| Sl.No. | Name of the Power Station      | Location         |
|--------|--------------------------------|------------------|
| 31     | 2 x 500 MW Tarapur NPP         | Maharashtra      |
| 32     | 1 x 500 MW Korba TPP           | Maharashtra      |
| 33     | 2 x 490 MW Dadri TPP           | Maharashtra      |
| 34     | 1 x 500 MW Farkka TPP          | Maharashtra      |
| 35     | 2 x 500 MW Mauda STPP          | Maharashtra      |
| 36     | 2 x 250 MW Dhanu TPP           | Maharashtra      |
| 37     | 4 x 660 MW Sasan UMPP          | Madhya Pradesh   |
| 38     | 2 x 660 MW Shri Singaji TPP    | Madhya Pradesh   |
| 39     | 2 x 660 MW Khargone STPP       | Madhya Pradesh   |
| 40     | 2 x 500 MW Vindhyachal STPP    | Madhya Pradesh   |
| 41     | 2 x 600 MW Kalisindh TPP       | Rajasthan        |
| 42     | 2 x 600 MW Hisar TPP           | Haryana          |
| 43     | 3 x 500 MW Indira Gandhi STPP  | Haryana          |
| 44     | 2 X 490 MW NTPC Dadri STPP     | Uttar Pradesh    |
| 45     | 4 x 70 MW Dhali Ganga HPP      | Uttaranchal      |
| 46     | 6 x 660 MW NTPC Nabinagar TPP  | Bihar            |
| 47     | 1 x 500 MW Farkka TPP          | West Bengal      |
| 48     | 3 x 170 MW Teesta HPP          | West Bengal      |
| 49     | 2 x 600 MW Jindal India TPP    | Odisha           |
| 50     | 3 X 250MW NTPC Bongaigoan TPP  | Assam            |
| 51     | 2 x 660MW TPCIL STPP           | Andhra Pradesh   |
| 52     | 2 x 500 MW Mauda STPP          | Maharashtra      |
| 53     | 4x 330 Adani Mundra TPP        | Gujarat          |
| 54     | 2 X 220 MW NPCIL Kakrapar APS  | Gujarat          |
| 55     | 2 x 700 MW NPCIL Rajasthan APS | Rajasthan        |
| 56     | 2 x 660MW RRVUNL Chhabra TPP   | Rajasthan        |
| 57     | 2 X 700 MW Nabha TPP           | Punjab           |
| 58     | 2 x 210 MW Roper TPP           | Punjab           |
| 59     | 6 x 250 MW Nathpa Jhakri HPP   | Himachal Pradesh |
| 60     | 3 x 350 MW Khalgaon TPP        | Bihar            |
| 61     | 2 x 500 MW Singrauli TPP       | Uttar Pradesh    |



## REFERENCE LIST OF SOME OF THE MAJOR INTERNATIONAL PROJECTS FOR IPB & SPB

| S.No. | Name of the Power Station         | Location           |
|-------|-----------------------------------|--------------------|
| 1     | 900MW Az-Zour Emergency PP        | Kuwait             |
| 2     | 50 MW OT-1086 Shagaya PP          | Kuwait             |
| 3     | 1 x 90MW Rusail PP                | Oman               |
| 4     | 20 MW Haima West CPP              | Oman               |
| 5     | 7 x 10 MW Aden PP                 | Yemen              |
| 6     | 1800 MW Hamriyah PP               | UAE                |
| 7     | 2x89.3 MW Shuakhevi Hydro PP      | Turkey             |
| 8     | 3 X 186 MW Yusufeli Hydro PP      | Turkey             |
| 9     | 2 x 650 MW Sokhna PP              | Egypt              |
| 10    | 1500 MW Sulaymaniyah PP           | Iraq               |
| 11    | 750MW DHI QAR & 432.8MW Samawa PP | Iraq               |
| 12    | 250 MW Deadsea works Gas PP       | Israel             |
| 13    | 2 x 150 MW, Gilboa Hydro PP       | Israel             |
| 14    | 259 MW Ashalim Solar TPP          | Israel             |
| 15    | 800 MW Kokhav Hayardent PP        | Israel             |
| 16    | 373 MW Al Qatrana PP              | Jordan             |
| 17    | 730 MW Takhiatash PP              | Uzbekistan         |
| 18    | 800 MW Talimardjan PP             | Uzbekistan         |
| 19    | 100 MW Kaxu -Solor PP             | South Africa       |
| 20    | 340 MW Kpone Independent PP       | Ghana              |
| 21    | 100 MW Xina Solar PP              | South Africa       |
| 22    | 100 MW Ilanga Solar PP            | South Africa       |
| 23    | 760 MW Kainji Hydro PP            | Nigeria            |
| 24    | 472 MW Abengoa ISCC AIN PP        | Morocco            |
| 25    | 2 x 271 MW Berrouaghia PP         | Algeria            |
| 26    | 114 MW Los Mina PP                | Dominican Republic |
| 27    | 138 MW Azito PP                   | Cote D Lvoire      |
| 28    | 2x136 MW+1x 46MW Angostura HEPP   | Chile              |
| 29    | 77 MW Aconcagua Cogeneration PP   | Chile              |
| 30    | 330 MW T6 PP                      | Argentina          |
| 31    | 185 MW Recka Gas Fired PP         | Peru               |

| S.No. | Name of the Power Station            | Location    |
|-------|--------------------------------------|-------------|
| 32    | 852 MW Chilca PP                     | Peru        |
| 33    | 3150 MW Substation Araraqura PP      | Brazil      |
| 34    | 5 x 50 MW Hrazdan PP                 | Armenia     |
| 35    | 230 MW MINSK TPP                     | Belarus     |
| 38    | 6 x 170 MW Tala Hydro PP             | Bhutan      |
| 39    | 82 MW Lower Solu Hydro PP            | Nepal       |
| 40    | 225 MW Sikalbaha PP                  | Bangladesh  |
| 41    | 163 MW Fenchuganj PP                 | Bangladesh  |
| 42    | 225 MW Bhola PP                      | Bangladesh  |
| 43    | 330 MW Sarulla Geo TPP               | Indonesia   |
| 44    | 1000 MW Tanjung PP                   | Indonesia   |
| 45    | 450 MW Grati PP                      | Indonesia   |
| 46    | 150 MW Pasuruan PP                   | Indonesia   |
| 47    | 3 x 110 MW Bengkanai2 PP             | Indonesia   |
| 48    | 650 MW Muara Tawar PP                | Indonesia   |
| 49    | 2 x 125 MW Hydro PP                  | Malaysia    |
| 50    | 2242 MW Melaka CCPP                  | Malaysia    |
| 51    | 2 x 150 MW Therma Visayas Energy PP  | Philippines |
| 36    | 3 x 205 MW Nam Ngum Hydro PP         | Laos        |
| 52    | 160 MW Da Nhim Hydro PP              | Vietnam     |
| 53    | 2 x 265 MW & 1 x 132 MW Nam Theun PP | Vietnam     |
| 54    | 667 MW Colongra PP                   | Australia   |
| 55    | 242 MW Yerevan PP                    | Australia   |
| 56    | 280 MW Mojave Gas PP                 | USA         |
| 57    | Morelos CCPP                         | Mexico      |
| 58    | 220 MW A3T PP                        | Mexico      |
| 59    | 791 MW Empalme PP                    | Mexico      |
| 60    | Alfa Co-Generation PP                | Mexico      |
| 61    | 874 MW Tierra Mojada CCPP            | Mexico      |
| 62    | 1875 MW Teeside PP                   | UK          |
| 63    | 900 MW Talimarjan PP                 | Uzbekistan  |
| 64    | 220 MW A3T Abengoa PP                | Mexico      |
| 65    | 330 MW Sarulla Geothermal PP         | Indonesia   |

## C&S Power Busbars

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C&S Power busbar division offers wide range of Power Busbars under one roof. Our skilled team help users to select, specify, design, order, Install and commission the products.

We are committed to provide you reliable and cost efficient Power Busbar solutions globally and partner you throughout the project cycle with our in-house services.

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- Product selection
- Technical compliances
- Bill of Quantity generation
- Offer Management

#### Post Order:

- Site Measurement
- Routing drawing preparation
- Bill of Quantity generation as per approved Drawings

#### After Sales (On-site service on request):

- Installation
- Commissioning
- Supervision
- Pre-commissioning audits
- Annual Maintenance



\*This Map is only for pictorial representation not to be scaled



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