CG Systems Division supplies turnkey integrated Transmission & Distribution (T&D) solutions. It is a division of CG Holdings Belgium, formerly Pauwels International Belgium, a world leader in the design and manufacture of innovative three-phase distribution and power transformers, and integrated T&D solutions.

Our core business

- CG Systems Division specializes in electrical turnkey projects such as:
  - Air-Insulated Switchgear (AIS) and Gas-Insulated Switchgear (GIS) substations up to 500 kV
  - Mobile substations and mobile transformers up to 100 MVA / 245 kV
  - Compact substation designs:
    - WindSubs (onshore and offshore)
    - Modular substations
  - Transformer Switch Units (TSUs)
  - High Voltage transmission lines up to 245 kV
  - Rural electrification projects

Our comprehensive services

Our success is based on the skilled, consistent application of a complete range of professional project management services:

- Design and engineering
- Project management
- Equipment supply
- Erection and commissioning
- Turnkey delivery
- Financial engineering
- Substation repair, maintenance and exploitation (CG Services Division).

Our global coverage

CG Systems Division has operated a branch office in Indonesia since 1988, on the premises of PT CG Power Systems Indonesia in Bogor, near Jakarta. It has successfully completed numerous substation and transmission line projects in the Malay Archipelago.

In 1995 we extended our mobile substation activities to North America, operating from the premises of CG Power Systems Canada in Winnipeg, Manitoba.

In 2006 CG completed the acquisition of the former Ganz Transelektrica (now CG Electric Systems Hungary Zrt) and its main contracting activity together with its engineering company Transverticum (TV), engaged in the design, erection and commissioning of fully integrated substations.

In 2010 CG acquired UK based Power Technology Solutions Ltd. PTS is an Electrical Engineering company providing a comprehensive range of engineering services to blue chip clients in the UK high voltage electrical power systems industries – including the major utilities/Distribution Network Operators (DNOs), heavy industrial users, major switchgear manufacturers and ESI approved contractors.

CG Systems Division has an extensive list of references in nearly 50 countries ranging from Albania to Zimbabwe, including large contracts in Algeria, Bahrain, Canada, Ecuador, Indonesia, Saudi Arabia, Tunisia, Venezuela and the United States.
150 kV transmission line in Indonesia

30 MVA mobile substation

80 MVA; 10.5/110 kV step-up substation in The Netherlands
CG Systems Division is a specialist in turnkey substation projects up to 500 kV. These projects are carried out for large industrial customers as well as for major electricity utilities.

**Indonesia**

CG Systems Division has commissioned many major turnkey projects in Indonesia. The photo shows a 150 kV AIS substation with double infeed and an output of twice 80 MVA, for a polyethylene plant.

**Tunisia**

Another clear example of our expertise is this utility AIS substation in the north of Tunisia. The 225 kV incoming overhead line, which is part of the North African interconnection grid, is equipped with measuring transformers, circuit breakers and disconnectors. It is connected to a 100 MVA step-down auto-transformer. The transformer is linked to a 90 kV double-bus substation via an underground cable and the appropriate switching devices. The control and protection scheme of this substation fully complies with the stringent EDF standards.

**Kuwait**

Over the last 10 years the CG Electric Systems, Systems Division has built several 132/11 kV indoor GIS substations for Kuwait’s Ministry of Electricity and Water. These substation projects were full turnkey and included the civil works.

**Abu Dhabi**

CG Electric Systems has realized 33/11 kV indoor substation projects over the past few years. In offering full turnkey projects with civil works included, great attention is always given to local architecture.

**Ecuador**

This substation in Pomasqui, near the city of Quito, is a typical example of rehabilitation involving about 80 projects throughout Ecuador. CG Systems Division manufactured and dispatched the components of this 138/23 kV, 33 (66) MVA substation. Design, erection and commissioning was supervised by Transelectric S.A. (formerly Inecel) and the regional utility Empresa Electrica Quito S.A.

**Malaysia**

Another illustration of our turnkey capabilities is this 132 kV main intake GIS substation for a large cement factory in Malaysia. Two 48/30 MVA power transformers are connected to the 132 kV grid of the utility company. The GIS assembly is composed of two incoming line bays, two transformer bays, and one bus-coupler. Downstream, an 11 kV switchgear board, consisting of 13 panels, distributes the electrical energy. Relay and protection panels designed by CG Systems Division monitor all equipment.
CG Systems Division is a full-line supplier to the renewable energy sector. We therefore recognize that space and time are at a premium in wind farms, while economics dictate that grid connections are installed on the smallest possible footprint within the shortest possible delay and at the lowest possible price. CG Systems Division meets these challenges by building modular substations ideally suited to the needs of the wind energy industry. Our WindSub substation (AIS or GIS type), allows multiple turbines to be connected to the electricity grid within the shortest possible time.

**Reduced installation times**

Our modular design reduces installation times. The substation is constructed and tested in our facilities and delivered to your site in separate modules. Pre-installation only involves pouring the concrete and connecting the substation to the electricity grid. Your substation will be ready to go with a minimum of time and effort.

**Competitive pricing**

Standardized WindSub development reduces manufacturing costs. Consequently, our WindSub is priced very competitively. Furthermore, our modular approach results in less elaborate on-site construction work, further reducing costs. An optimized power transformer design, aligning the rated power with the wind park’s estimated annual output by using hybrid insulation systems, reduces the power transformer’s rated power and cost price, while ensuring the same reliability and performance over a long lifetime.

**Customer input**

Our standardized WindSub design allows for very short delivery times. However, the customer’s requirements are discussed at every stage, so the project can be efficiently completed in the most ideal circumstances and within the agreed deadlines.

**Unmatched benefits**

- Short delivery times
- Rapid installation
- Reduced installation costs because of minimal civil construction works
- Optimized transformer design thanks to the use of hybrid insulation systems
- Improved flexibility in terms of equipment exchangeability
- Substantial reduction of on-site testing procedures, thanks to complete substation unit testing at our factory
- Limited maintenance requirements.
Reliability and reduced offshore maintenance are important factors to take into account when designing offshore wind farms. The CG Systems Division meets these challenges by introducing a new concept: an AC-connection to link an offshore wind park to the electricity grid (patent pending). Systems Division offers you a turn-key solution for connecting your offshore wind park to our onshore utility grid. CG Systems Division selects the most suitable partners, each expert in the different specific fields which are applicable in the offshore industry.

An Innovative design

The main objective is to reduce significantly the need of offshore equipment to the most essential components by:

> taking out the tap regulation of the main power transformer and move it to the mainland in the form of a booster transformer combined with a soft closing device;
> making a direct connection of the HV submarine power cable with the offshore main power transformer without the use of a HV GIS circuit breaker;
> making maximum use of the regulation of the wind turbine generators (WTG) for VAR compensation.

Advantages

> Increases reliability and availability by shifting a number of maintenance critical components to the mainland; by applying hybrid transformer designs in combination with on-line monitoring systems;
> The onshore booster reduces the short circuit currents for the submarine cable and offshore platform HV equipment and allows for smaller installed reactive power on the offshore platform;
> No need for a separate SVC, as the wind turbine generators will be used as a VAR compensator;
> Reduction of weight on the offshore platform, due to the lower oil volume of the main power transformer and reactors;
> Integrated switching design without switching transients;
> Integrated design with regard to the compensation of the reactive power, in full compliance with the grid operator’s requirements;
> Maintenance of and interventions on the most maintenance critical components are mainly shifted to the mainland (accessible 7/7 days and 24/24 hours).

The benefits

> An innovative design concept (patent pending) focusing on improved reliability and efficiency both in operation and maintenance;
> An offshore wind park AC grid connection at a lower total cost compared to conventional AC grid connection solutions;
> A combination of CG Systems Division’s extensive experience in the field of wind energy and the expertise of well-selected partners in specialist offshore technologies;
> Attractive delivery times.
**HV grid connection substation:**
For alternative generation projects

**The Netherlands**

Another illustration of CG Systems Division’s capabilities in turnkey projects is this 110 kV, 80 MVA grid connection substation for an important farming project in The Netherlands (JV with Alfen).

Our modular substation concept consists of three separate modules: high voltage equipment, power transformer and medium voltage equipment. Each module is mounted on skids.

The modules are designed to allow easy transportation and quick installation times. They are pre-assembled and, before leaving the factory, the entire substation is subjected to an exhaustive series of tests. At the site, besides some fairly simple foundation works, the customer only has to provide the necessary power, control and ground connections. Pre-assembled control cables with multi-plug connectors further reduce the installation time.

**Multiple benefits**

- Short delivery times
- Rapid installation (compared to AIS & GIS substations)
- Reduced installation costs because of minimal civil construction works
- Improved flexibility in terms of equipment exchangeability
- Reduced installation costs because of reduced installation times
- Easily removable and reusable
- Substantially reduced on-site testing procedures, thanks to complete substation unit testing at our factory
- Limited maintenance requirements
The CG Transformer Switch Unit (TSU) is one of the most compact modular substations available, and is ideally suited to meet the stringent demands of the industry. Significantly smaller than standard substations, our TSU is uniquely compact because both the HV and MV equipment are mounted on a specially designed power transformer that drastically reduces the overall dimensions of the substation.

A full range of components

The TSU developed by CG Systems Division consists of the following components:

- **HV components (ideal configuration):**
  - Circuit-breaker equipped with a three-pole mechanical drive
  - Disconnector (in accordance with the customer’s specifications)
  - Voltage transformers (inductive or capacitive type)
  - Current transformers (as bushing CTs in the power transformer)
  - Lightning arresters
- **MV components**
  - A simple and compact busbar system, connected directly to the secondary windings of the transformer by means of bushing terminals
  - A number of outgoing feeders, based upon customer requirements
- **Power transformer**
  - Up to approximately 60 MVA / 170 kV
- **Control and protection equipment**
- **AC and DC auxiliaries**
When conventional solutions – such as AIS and GIS substations – can’t meet urgency and flexibility requirements, mobile substations are the appropriate solution.

**Rapid integration, easy re-use**

Mobile substations are fully equipped electrical substations mounted on semi-trailers. Rapid integration into the network and the ability to reuse them afterwards at other locations are the most important advantages of these mobile units. An additional advantage is that the erection and commissioning time of the substation and civil construction works are reduced to a minimum, because the mobile substations are completely pre-assembled and tested in our factory.

**A variety of applications**

Mobile substations are used in three principle applications:

**Emergency units**
- When equipment fails, mobile substations can be installed as emergency units for substations without spare transformer capacity.
- When maintenance or repair activities have to be carried out in existing substations, mobile substations ensure continuation of services.
- In the event of natural disasters (such as floods, earthquakes or hurricanes), mobile substations supply vital energy needed for assistance and recovery programs.
- When electricity breakdowns threaten to paralyze industrial production, mobile substations assure continuing power supply.
- When power lines freeze, mobile substations can be used for de-icing.

**Temporary electric power supply solutions**
- As they can be assembled (manufactured) and commissioned within a relatively short period of time, mobile substations are often used as a temporary solution while permanent installations are being built.
- Mobile substations can be used as standby units for peak load periods. For example, they can supply the extra power needed for special events such as concerts, large sporting events and other mass meetings.
- Mobile substations serve as sources of electric power in isolated areas. A typical application is energy supply to large infrastructure projects.

**Substitutes for AIS/GIS substations**
- When the demand for electricity rapidly expands beyond the scheduled increase in main-system capacity, mobile substations can be permanently installed as substitutes for AIS/GIS substations. They can be delivered within a very short delivery time, while the completion of a permanent installation may take several years.
**Completely equipped and fully compliant**

Our mobile substations have the same electrical equipment as AIS/GIS substations, and fully comply with IEC, ANSI, or any other standard.

Standard units consist of the high voltage equipment, the main transformer, the medium voltage equipment and the typical secondary systems found in AIS/GIS substations. All measuring, monitoring and safety systems are mounted in a control panel. Autonomous operation of the mobile substation is guaranteed by the use of an auxiliary transformer and batteries.

Mobile substations can be equipped with state-of-the-art telecommunication systems. We can provide the complete SCADA package (Supervisory Control and Data Acquisition), or any other customer-preferred system.

Our mobile substations are designed, assembled and tested at four different Systems locations (Mechelen, Budapest, Jakarta and Winnipeg). This assures quality and reliability. Test procedures include the testing of the power transformer, mechanical inspection tests, functional testing, energization test and a road test.
With transformers up to 100 MVA or 245 kV (*), CG Systems Division paves the way for a rapid deployment of considerable power. For the transformer’s design and construction, our R&D department works closely with various production facilities. In the case of the mobile substation shown in picture 1, this resulted in a complex three-winding transformer: 45 MVA, 132 kV, with double mid-voltage windings of 13.8 and 33 kV respectively and an installation altitude of 3,000 m.

Easily maneuverable units

The trailers are designed to facilitate short installation times and good maneuverability. For larger and heavier units, steerable rear wheel axles are often provided. These optimize the maneuverability of the unit and minimize the turning radius.

Comply with all local road transport regulations

Road transport regulations and local road infrastructure are important factors to take into account when designing mobile substations. This is done to comply with stringent regional substation dimension and weight restrictions. Especially in the case of emergency units, the mobile substations have to be designed so that they can be moved anytime, anywhere throughout the territory that the utility wants to cover.

Obliquely mounted HV-insulators and a specially shaped conservator make the transformer portion of the substation so compact that it can be transported over long distances without the need to dismount components.

The high voltage switchgear satisfies the most stringent requirements. The disconnecting switches and circuit breakers are often mounted on extendible supports. This allows the trailer and the substation to be kept within the maximum permissible width for road transport. When the substation arrives at its destination, these roll-out racks guarantee a quick set-up of the high voltage equipment at the phase-to-phase clearances required for safe operation.

(*) To comply with the commonly-prevailing road transport regulations (weight and dimensional restrictions), the rating of the transformer is limited to max. 100 MVA. The same road transport regulations (dimensional constraints) limit the HV level to a maximum of 245 kV with a BIL level of 1050 kV. To maintain a compact design, lower BIL levels are applied for the higher voltage levels, both for the power transformer and the HV equipment (e.g. 900 kV instead of 1050 kV in case of 245 kV). Lower BIL levels result into a more compact transformer and reduced phase-to-phase clearances.

45 MVA, 117.5/21.6 x 12.47 kV mobile hybrid substation for a US utility with hybrid insulation system for the transformer windings.
45 MVA; 132/33/13.8 kV 3-winding transformer
Mobile hybrid substations

More power for less space

Combining high power ratings with stringent dimensional limitations is of the utmost importance. When designing mobile substations, the transformer is not only the main component of a mobile substation; it is also the biggest and heaviest part of the unit. Therefore, a compact and lightweight transformer design contributes significantly to the mobility of mobile substations.

State-of-the-art insulation

In a growing number of transformer designs for mobile substations, NOMEX® high temperature conductor insulating material is used in combination with conventional cellulose insulation, permitting a temperature rise up to 95 or 115 K. This hybrid insulation system is combined with a specially designed cooling system to ensure that the oil temperature does not exceed the maximum allowable temperature values. The use of NOMEX® as an insulating material for the transformer windings allows power ratings to increase substantially while meeting stringent dimensional restrictions. In the case of severe weight limitations, aluminum tanks can assist in meeting regulations.

A combination of benefits

- Reduced overall capital costs
- Increased flexibility in scheduling maintenance, repair and construction works
- A reduced substation downtime, resulting in lower revenue losses
- Enhanced adaptability to meet the needs of rapidly expanding electricity networks
- Reduced peak time overloads
- Optimization of the utilities’ operational flexibility and reliability

NOMEX® is a registered trademark of E.I. du Pont de Nemours and Company
Professionalism you can rely on

Our dedicated team of experienced engineers guarantees flawless technical implementation of turnkey projects. Project engineers use state-of-the-art CAD systems to design and visualize substation concepts. From negotiations to project completion, the document flow is completely automated. This guarantees short communication lines and rapid response times between sales, design, production, administration and logistics departments. Customers can count on a total quality commitment from the substation’s design and testing to its shipment. And for after-sales service, CG Systems Division guarantees flawless performance.

Valuable financial advice

Years of experience with projects worldwide enable our specialists to provide practical, effective financial advice along with informative and accurate technical and logistical assistance. Consequently, CG Systems Division has a reputation as a reliable partner with the world’s major financial institutions, including the World Bank, the European Bank for Reconstruction and Development, the European Investment Bank, the Inter-American Development Bank, and the Asian Development Bank.

Total quality commitment

Customers can count on a total quality commitment from the substation’s design to its testing and shipment. As a consistent guarantee of the highest quality, CG Systems Division conforms to ISO 9000 standards, and has achieved ISO 9001:2000 certification for all its activities. Regular internal and external quality audits ensure full and continuous conformity with this international standard. The company’s materials and components suppliers are also required to meet these stringent ISO standards.

When roll-on, roll-off shipment is not possible, the mobile substation is loaded with special lifting equipment. The picture shows the shipment of a 22.4 MVA, 110 kV/12.5 kV mobile substation in the port of Antwerp, Belgium.
Power Technology Solutions is an Electrical Engineering company providing a comprehensive range of engineering services to blue chip clients in the UK high voltage electrical power systems industries – including: Distribution Network Operators (DNOs), T&D Equipment Manufacturers, Major Switchgear Manufacturers, Heavy Industrial Users and ESI approved contractors.

Transmission sector

PTS has operated successfully within the Electricity Transmission Sector for over ten years; we have a breadth of experience that is second to none. Operating closely with National Grid, Scottish Power and the OEMs, PTS can undertake any aspect of a transmission project, whether this is a switchgear bay extension, Nicap protection & control change or SGT replacement, at all voltage levels up to and including 400kV.

Distribution sector

Within the Electricity Distribution Sector, PTS works very closely with the UK Distribution Network Operators (DNOs) in assisting to deliver all aspects of their projects. We have various framework contracts with many of the DNOs which allows us to ensure understanding of our clients’ requirements.

Generation sector

In addition to the work we undertake in the transmission and distribution sectors, PTS also operates in the generation and power station arena. Building upon our vast experience allows us to provide services for customers and developers who require to interface with point of connection providers.

Renewables sector

The rapid expansion of the renewable energy market of the electrical power industry has provided PTS with another arena for the supply of our specialist design, installation and commissioning services. Our range of capabilities within the Transmission and Distribution networks allow us to provide a complete solution for the connection of onshore and offshore windfarms, tidal systems, waste to energy and other renewable sources to the electrical network.

Panel manufacture sector

A recent addition to the extensive portfolio of PTS services is the manufacture of panels; including protection and control relay panels, marshalling kiosks, pilot termination boxes, metering panels etc. Utilising a well appointed workshop facility in Glasgow, PTS can define and supply our clients’ complete requirements. All panels are fully tested to rigorous procedures before being delivered to site.

Lv contracting sector

Whilst PTS are proud of our experience and history within the Electricity T&D Industry, we consider ourselves a complete electrical solutions company and are equally at home in transferring our skills and experience into the LV Electrical Contracting Sector.
Engineering

> Feasibility studies & equipment specification along with protection single line diagrams.
> Technical reports as required for capital spend approval.
> Plant & equipment layout design including civil & electrical interfaces & earthing.
> Full design of protection & control equipment & relay panels including schematic & wiring, diagrams & general arrangements.
> Full construction design packages including multi-core cable schedules & termination details.
> System protection studies & settings reports.

Installation

> Highly experienced team of mechanical/electrical fitters & panel wiremen.
> Installation of all types of HV electrical equipment including circuit breakers, disconnectors, CT's & VT's, busbars, earthing, cables.
> Full site management & co-ordination of contractors & sub-contractors.
> Substation small power & lighting fit-out including LVAC & DC systems.
> Installation of full protection and control systems and refurbishment of existing schemes.

Client services

> Provision of highly experienced engineers to undertake the client engineer’s role.
> Design evaluation & tender appraisal, including full technical & financial review.
> Complete project management & delivery including site management & CDM.
> Expertise in finalising project scope documentation & provision of project sanction paperwork.
> Undertake Principal Contractor role with full co-ordination of project & site sub-contractors.

Project management

> PTS has successfully project managed and delivered significant design and build projects for a number of our clients within the transmission and distribution sector of the UK Electricity Industry.
> Our team has the necessary industry skills and experience to allow us to deliver on the expectations of our clients.
> Additional Best Practice experience from associated power systems roles within Petrochemical, Pharmaceutical, MOD and Nuclear Industries enables any PTS project to be coordinated and systematically controlled to high standards whether it is a simple undertaking, or a complex, high value multi-discipline scope.

Commissioning

> PTS provides highly experienced commissioning engineers with a comprehensive understanding of the generation, transmission & distribution schemes and equipment required for 6.6, 11, 33, 132, 275 and 400kV power systems.
> PTS has successfully completed test and commissioning works on significant projects within the Regional Electricity Companies (REC), DNO, National Grid and private industry sectors.

SAP operations

> PTS undertakes all operational (SAP) activities up to and including 132kV.
> Other activities include; the issue of safety documentation, switching schedules, system amendment notices, asset registration details, pressure testing & cable spiking, and updating site records.
> PTS operational engineers also undertake duties for project management and client liaison and representation where required.
> Decommissioning a substation can be as onerous as commissioning a substation with Health and Safety concerns. Power Technology Solutions can offer the full range of planning and return of control as required to any DNO including Project Management if required.
> Pre – Commissioning of contestable connection equipment i.e. private prepared networks. Power Technology Solutions completes all pre-com in support of civil engineering contractors, this may also include preparation of all associated documents for submission to DNO's.
Since its formation in 1977, CG Systems Division has built up a highly impressive reference list. Important projects have been carried out all over the world in the following countries:

**CG Systems Division**

- Albania
- Algeria
- Australia
- Azerbaijan
- Azores (Portugal)
- Bahamas
- Bahrain
- Bangladesh
- Belgium
- Brazil
- Canada
- Cape Verde Islands
- China
- Chile
- Columbia
- Congo
- Costa Rica
- Denmark
- Dominican Republic
- Ecuador
- Egypt
- El Salvador
- Germany
- Greece
- Guatemala
- Hungary
- Indonesia
- Iran
- Iraq
- Jordan
- Kuwait
- Malaysia
- Mali
- Morocco
- Mozambique
- Namibia
- Nigeria
- Panama
- Peru
- Philippines
- Puerto Rico
- Saudi Arabia
- Senegal
- Spain
- Suriname
- Syria
- Tanzania
- Thailand
- Tunisia
- UK
- United Arab Emirates
- United States of America
- Vietnam
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- Zimbabwe
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