

## ELECTRICAL ENGINEERING SOLUTIONS FOR HIGH VOLTAGE NETWORKS

CONTRACT:	TPPS-02
SCOPE OF WORK:	33kV Substation Design, Supply & Installation
END CLIENT:	Cemex UK Limited
LOCATION:	Tilbury Port, Essex
DURATION:	estimated 48 weeks
VALUE:	£ 967,300 GBP

### SUMMARY:

TPPS Ltd were awarded the contract by Cemex UK Ltd for the supply, installation and commissioning of the main 33 kV to 6.6 kV step down substation at their Tilbury Port site in Essex in January 2007 as part of a £ 20 million development project. The scope of supply included plant and equipment for the main 33kV incoming transformer compound and adjacent substation building, and the electrical plant room on another part of the site.

The 33kV incoming feed was connected to a 10/12.5MVA, 33/6.3 KV Oil immersed power transformer supported by a neutral earthing resistor in a purpose built transformer compound, with the outgoing LV feeding into Power Factor Correction equipment housed within the main substation building, before being split into two incoming feeds for new 6.3KV Siemens Simoprime Switchgear. The main substation building had installed the first 6.3kV switchgear set, UPS systems, battery racks and charger, AC distribution panel, marshalling kiosks, voltage regulator panel and 400/110V transformer panel, which would then feed the DC panels in the electrical plant room for the control and protection systems for the second 6.3kV switchgear set, with signals and controls sent to the control room via SCADA systems. As the project was essentially a turnkey solution without the civil works, TPPS Ltd had to complete all MV and LV cable management, substation earthing, station lighting, energy management and control and protection systems for the project. The system was fully commissioned and handed over to the client in October 2008.

### DESIGN & MANUFACTURE:

Supplying the transformer was a major part of TPPS Ltd being awarded the competitive tender as we would design and manufacture the unit ourselves. Specified by the client to be oil cooled and suitable for outdoor installation and comply with IEC 60076, the transformer was a 33/6.3kV, Delta Wye (DYN11), 3 phase, 50 Hz unit with a continuous primary to secondary loading of 10 MVA under natural cooling conditions (ONAN) and an increased loading of 12.5 MVA under forced cooling conditions (ONAF). The varying load requirements for plant on site called for HV taps at +/- 15% over 18 steps to be automatically controlled by an ABB On Load Tap Changer (OLTC), type UZE, in order to maximise energy efficiency. The design was supported with a variety of auxiliary equipment for operation, monitoring, control and protection.

The LV, HV and HV tapping coils and windings were all manufactured by TPPS Ltd, oven dried for 72 hours before being mounted to the 3 limb core, clamped, positioned within the main tank at our factory, and filled with mineral insulating oil to BS 148 before going through a series of tests. The unit went through a rigorous programme of ratio, polarity, no load loss, load loss, winding resistance, impedance, insulation power factor, HV induced potential, noise and temperature tests to IEC 60076, 60137, 60214, & 60289 standards to prove integrity for operation. Following the successful testing the unit was transported to site for positioning on the plinth, erection of auxiliary components, installation and commissioning. The transformer weighed a total of 26 tonnes including 7.8 tonnes of mineral oil with a total lead time of 16 weeks from manufacture to installation.



### TRANSFORMER INSTALLATION:

Once delivered and positioned on the plinth, the main tank would have radiators, cooling fans, the conservator, marshalling kiosks, and monitoring equipment and tap changer control kiosks installed, with additional mineral oil added and processed to IEC standards. Auxiliary cables and support systems were installed and tested to ensure the control, monitoring and protection equipment to the control room through SCADA.

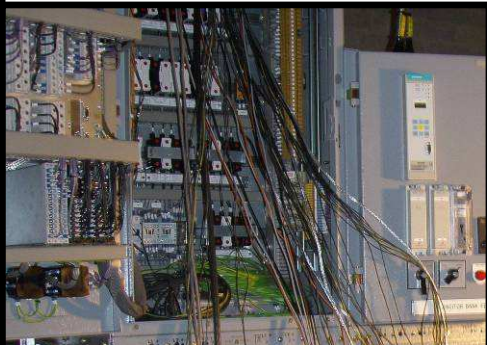


### 6.3kV MV SWITCHGEAR:

The contract required the design and supply of 2 sets of 3 phase 6.3kV medium voltage metal clad switchgear complying with IEC 60694 & 62271. TPPS Ltd contracted Siemens to supply their Simoprime MV switchgear sets encompassing draw-out magnetic vacuum type circuit breakers with a basic impulse (BIL) rating of 60 kV and 31.5 kA interrupting capacity at 7.2 kV. Each of the switchgear sets for the main substation and electrical plant room consisted of 4 equipment panels incorporating a variety of protection relays, overcurrent relays, ION monitoring meters, MCB's, earth switches, motors, heaters, test blocks and disconnectors to control and protect incoming and feeder circuits. Changes to the client's electrical design required a number of component and wiring modifications to be completed on site by TPPS engineers and sets re-commissioned.

### MV & LV CABLE INSTALLATION:

The contract included the supply, installation, termination and testing of all MV interconnecting cables between plant, LV cables for AC and DC distribution panels and auxiliary control and protection system wiring. Specifications included 120 metres of 6.3kV 500 mm<sup>2</sup> single core XLPE/PVC/AWA/PVC for connection between the transformers, NER, MV switchgear and panels, and 30 metres of 120 mm<sup>2</sup> three core XLPE/PVC/SWA/PVC for connection to PFC equipment. A substantial amount of wall, floor and ceiling mounted cable trays and conduits were required between the plant and within the substation building to manage all the auxiliary wiring. TPPS Ltd spent a total of 3 weeks completing the cable laying and termination works for these systems as well as substation lighting, earthing and SCADA systems.



### SUPPORT SYSTEMS:

UPS systems, battery rack and charger, MV Power Factor Correction Panel, AC distribution panel, marshalling kiosks, voltage regulator panel and transformer panel were installed in the main substation building which would then feed the DC panels in the electrical plant room for the control and protection systems, with the auxiliary AC and DC distribution panels including lighting control, emergency lighting, panel heater control and power socket protection. These systems would ensure all switchgear tripping and closing duties, alarm and indications required for safely operating the electrical network. Specification for these systems included:

Voltage Regulator Panel	- ABB SPAU 341 C Voltage Regulator
Battery Pack & Charger	- Switch tripping battery chargers 110V, 16A, 71Ah to IEC 60623
Lighting System	- 230 VAC industrial fluorescent and metal Halide (HV Switchyard)
Transformer Panel	- 400/110V transformer to feed DC distribution panel
Lightning Arrestors	- Gapless metal-oxide heavy-duty type to IEC 60099
DC Distribution Panel	- Control of 110V DC systems to IEC 60439
AC Distribution Panel	- containing MCB's and fuse switches for AC control and protection
Current Transformers	- rated at 300/5A and 100/1A complying to IEC 60044



### SUBSTATION EARTH SYSTEM & NER:

All major plant and equipment including the transformer tank, switchgear, CT's and disconnect switches required earthing with 50 mm x 6 mm copper earth bar or 150 mm<sup>2</sup> single core PVC/PVC earthing cable; this was fed from a 4 point earthing grid 3 metre by 2 metre with 200 mm<sup>2</sup> grid pattern meeting BS 7430 requirements, and giving an earth resistivity value of 150 ohm-m. TPPS Ltd also supplied, installed and connected within the transformer compound a 6.6/3.81 kV neutral earth resistor (NER) from Cressall rated at 400A with 10 second delay.