

## ELECTRICAL ENGINEERING SOLUTIONS FOR HIGH VOLTAGE NETWORKS

CONTRACT:	TPPS-14
SCOPE OF WORK:	Isolated Phase Busbar Refurbishment
END CLIENT:	EDF Energy
LOCATION:	Dungeness B Power Station, Kent
DURATION:	11 weeks
VALUE:	£ 204,250 GBP



### SUMMARY:

Following the delivery of multiple transformer refurbishments at site TPPS Ltd were requested to submit a tender for the mid-life refurbishment of a 23.5 kV Isolated-Phase Bus Bar System (IBS) at EDF's Dungeness B Power Station as part of their 72 day statutory outage in spring 2012. The IBS system interconnects the 775 MVA generator transformer and two 32 MVA unit transformers, which TPPS Ltd were already contracted to refurbish during the outage, and with the client seeing advantages in one contractor completing both projects simultaneously, the company was awarded the contract.

The system was designed and installed almost forty years previously and had received little refurbishment over its lifetime, and TPPS Ltd were required to complete a full reverse engineering study of the system as detailed information from the OEM was not available. Mechanical refurbishment would include design, supply and installation of steelwork sections, clamp assembly sets, electromechanical insulation and anti-vibration components supporting the busbar sheath, as well as the insulator mounting sets holding the main 23.5 kV conductor within the sheath. The electrical refurbishment included the inspection and testing of bolted connections, earthing, control and protection systems associated with system. Due to the harsh coastal conditions the main structure needed to be grit-blasted and a triple coat epoxy marine paint system applied, and all new components had to be supplied with either a hot dip galvanised or zinc plated finish for protection against the elements, and all fixings were stainless steel with anti-corrosive insulating washers. TPPS created, supplied and installed a number of unplanned design modifications in order to allow old components to be removed, and completed numerous additional works requests to ensure system integrity, such as replacing fire system support brackets and rubber expansion bellows.

Once all works had been completed the unit was energised to half load and TPPS engineers completed a thermographic survey of the busbar system to check for hotspots, which was repeated a week later when the unit was at a full load of 470 MW. As part of the contract package TPPS Ltd provided a full works report including QA documentation, fabrication drawings, general arrangement drawings and material specifications for all tasks completed. Following reverse engineering and fabrication lead times the site works were delivered within 6 weeks to meet the stations outage programme.

### QUALITY CONTROL:

The client requested that each steelwork assembly, expansion bellow or conductor support insulator was given a specific identification code that would clearly identify the assembly type, phase and numerical location within that phase; and gave TPPS Ltd the challenge of designing and implementing an effective QA system as there was no existing system in place. General arrangement and location maps were issued and approved for reference and task specific control documents implemented to record every aspect of the works including the reverse engineering and fabrication of replacement components; all including a variety of inspection, hold, test and witness points for the client to review works completed. The design and implementation of location specific codes proved invaluable for clearly communicating works progress, corrective actions, remedial works and design modifications.



### MECHANICAL ENGINEERING:

The supporting steelwork, mounting plates and clamp assemblies had to be reverse engineered for fabrication and all fixing holes had to be pre-drilled and punched so that the integrity of the hot dip galvanised finish would not be compromised. The project called for the supply of 30 sections of steelwork, 240 mounting and packing plates, 22 insulated clamp assembly sets and 70 ant-vibration bush mount sets. All these items would replace 35 sets of the assembly seen in the adjacent picture, and the client required that all components were secured using stainless steel fixings, which required insulating washers to avoid galvanic corrosion occurring if the galvanised components came in direct contact with the stainless steel fixings.

## CONDITIONING AIR SYSTEM:

The busbar system operates under a constant pressure by air being purged through to stop the build up of moisture within each phase of the busbar sheathing. Each of the 27 access covers and 15 expansion bellows had to be removed to access to the main conductor supports, and TPPS Ltd had to replace 210 metres of seals on the access covers, and replaced the expansion bellows at the client's request. The conditioning air system itself also needed minor refurbishment with a number of valves, support brackets, glands and tubing replaced, and then the system tested as part of the works.



## WORKS DELIVERY:

The delivery of works had to follow a strict regime in order to protect the system, with external steelwork replacement and refurbishment first, followed by internal refurbishment and sealing of the system before final inspection and testing of the earthing, control and protection systems and handover. An integral part of the works was the reverse engineering and supply of the electromechanical components to replace the upper and lower insulator support assemblies that held the main 23.5 kV conductor within the sheath on each phase, the integrity of which would be tested by a thermographic inspection after the unit was commissioned and energised.

- Reverse engineering, fabrication, supply and replacement of steelwork sets and insulating components
- Grit blasting, degreasing, jet washing and application of triple coat epoxy marine paint system to main steelwork
- Design and replacement of insulated anti-vibration assembly between new steelwork and busbar sheath
- Replacement of lower mounting assembly for each of the conductor insulator support sets
- Inspection, replacement of components and cleaning of conductor support insulator sets and replacement of seals
- Replacement of expansion bellows assembly at 5 points across all 3 phases
- Overhaul of bolted joints and flexible connections along the main conductor and connection to two 32 MVA unit transformers
- Inspection, overhaul and testing of the CT earth link connections to the two 32 MVA unit transformers
- Design, supply and replacement of support brackets and over-slung fixings for the fire protection system pipework
- External refurbishment and painting of the main deluge system interconnecting pipework
- Reverse engineering and supply of upper and lower insulator assembly support sets
- Inspection, testing and replacement of components on conditioning air system
- Inspection and testing of earthing, control and protection systems
- Thermovisual inspection of Isolated Busbar System after energisation – Half Load @ approx. 200 MW
- Thermovisual inspection of Isolated Busbar System after energisation – Full Load @ approx. 470 MW

In order to maintain system integrity TPPS Ltd designed specialist lifting frames to support the sheaths as steelwork was replaced. The safe working access took 2 weeks to implement due to the requirement for multiple working platforms, lifting points for these support frames, and tenting of the entire system to protect against the elements whilst access covers were open. This left TPPS Ltd just over 6 weeks to complete all the works before access had to be removed to meet the stations commissioning schedule.

## ELECTRICAL INTEGRITY:

The system needed to be protected against circulating currents between the sheath and the supporting steelwork, meaning that every mechanical assembly needed to be insulated; however material specifications were not available in OEM documents. TPPS Ltd had to identify six different materials to insulate the steelwork, clamps and bush assembly sets, and these had to be passed to EDF's central technical support for approval which delayed supply. Suppliers were put on standby and once materials were approved the components were ordered, cut to size and delivered directly to site within 4 days ready for installation by TPPS engineers.

