

ELECTRICAL ENGINEERING SOLUTIONS FOR HIGH VOLTAGE NETWORKS

CONTRACT: TPPS-13
 SCOPE OF WORK: Transformer & LNER Refurbishment
 END CLIENT: British Energy Generation Limited (now EDF Energy)
 LOCATION: Dungeness B Power Station, Kent
 DURATION: 29 weeks
 VALUE: £ 355,000 GBP

SUMMARY:

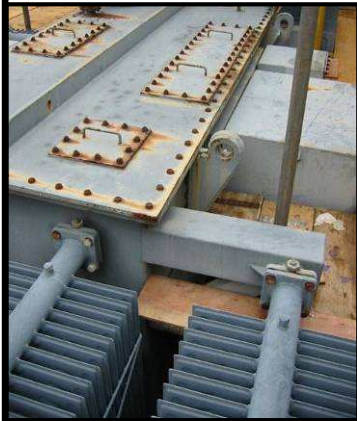
TPPS Ltd won the tender to complete the refurbishment of four auxiliary transformers up to 12 MVA at EDF Energy's Dungeness B power station in Kent in May 2011, and was subsequently awarded the contract in January 2012 to overhaul the 775 MVA generator and 32 MVA unit transformers as part of the stations statutory three yearly outage. TPPS Ltd completed strategic maintenance works on another three units to make a total of ten units overhauled within ten months. Each unit was inspected and a strategic overhaul plan agreed with the client to support the generic inspection, maintenance and testing procedures already in place. With units bombarded by coastal conditions for over 30 years there was a multitude of components to be reverse engineered, fabricated and replaced; from small bore cooling pipework to cable boxes and conservators.

During the 29 weeks engineers removed over 70,000 litres of insulating mineral oil from units so that some 150 components could be replaced, and once invasive works completed; over 3,000 litres of a triple coat marine paint system was applied to transformers, Liquid Neutral Earth Resistors (LNER's) and fire system pipework for protection against the elements for at least another 10 years.



TPPS Ltd completed maintenance, refurbishment and overhaul services on 10 units of various sizes over 29 weeks within a ten month period:

1 x 200 kVA	3300/433V ONAN Services TX
1 x 2.5 MVA	3300/433V ONAN Services TX
1 x 7 MVA	11/3.3kV ONAN Station Auxiliary TX
3 x 12 MVA	11/3.3kV ONAN Station Auxiliary TX
2 x 32 MVA	23.5/11 kV ONAN Unit TX
1 x 57 MVA	275/11.8 kV OFAF Station TX
1 x 775 MVA	432/23.5 kV OFWF Generator TX



REFURBISHMENT WORKS:

Located directly on the southern most shores of Kent, plant at Dungeness B power station has been bombarded by the harsh coastal elements for 30 years; slowly corroding away any protective coatings until bare metal had been left exposed and components degraded. Although all plant was safe for operation, strategic overhaul packages were agreed on each transformer compound to ensure continued operation for another 10 years.

Different orientation and locations around site meant some units were more degraded than others and a wide variety of components had to be reverse engineered as nuclear regulations dictate replacement components need to be exactly like-for-like to those removed. TPPS Ltd reverse engineered, fabricated and replaced over 150 items including cooling pipework, termination boxes, control kiosks, cable boxes, access covers and brackets, as well as three conservators for 2.5 MVA, 7 MVA and 12 MVA power transformers.

Some components were standard and could be sourced through approved suppliers to replace oil gauges, valves, expansion couplings and winding and oil temperature indicators. Whilst new gaskets were made at the factory ready for installing new components on site, engineers had to cut new gaskets on site for existing components to be re-used, which included the removal and re-installation of numerous valves, cable boxes and pipework flanges.

Over 70,000 litres of mineral oil were removed to complete invasive works, such as the removal of 60 cooling radiators to replace upper and lower gaskets to cure leaks, and meant that over 150,000 litres within the units were processed to remove any moisture; oil samples taken throughout the process and full DGA reports given to the client for records.

With invasive repair works completed the transformers, LNER's and fire system pipework needed protecting from the elements once again, and a triple coat marine paint system was implemented with over 3,000 litres of two-part epoxy paint. Once all oil handling and painting works had been completed the galvanised supports, clamps and tray for HV, LV and auxiliary cables were replaced along with cable markers, and labels for other auxiliary equipment.



EQUIPMENT REFURBISHMENT:

As shown by the photographs the radiators on two 12 MVA transformers were highly corroded. Engineers removed the 24 radiators from the two units in stages before being transported to TPPS's factory for refurbishment. The first task was to purge the radiators with dry air to undergo a 12 hour pressure drop-test to ensure no leaks would occur when filled with oil. As the walls of the radiators are only about 2 mm thick, any shot or grit blasting would risk damaging them; so high pressure water was used to remove loose paint, and then finished to a smooth firm surface by hand. Once prepared, the radiators had a triple coat marine mastic paint system applied using two-part epoxy paint that would match that being applied to the transformers at site.

A similar system was implemented on a number of ancillary components such as HV and LV cable and wiring termination boxes, except these were able to be shot-blasted. In some circumstances repair had been chosen over fabricating new components to ensure the planned outage time for each unit was achieved. Whether new or repaired, all components underwent QA inspection, pressure testing and painting before being installed at site.



INSPECTION, MAINTENANCE & TESTING:

Strict maintenance procedures were followed for the inspection, maintenance and testing of transformers and Liquid Neutral Earth Resistors (LNER's) to ensure equipment was safe for operation. General assembly inspections were completed to identify the refurbishment package for each unit, and once these were completed engineers set about maintaining and testing control, protection and monitoring equipment, such as oil and winding temperature indicators, buchholz relays and control kiosks, and proving the alarm and trip settings back to the stations main control room, and commission the unit ready for energisation. Procedures included:

TRANSFORMERS:

- Oil Sampling - testing insulating oil for moisture, dielectric strength and dissolved gases
- Buchholz Relay - Inspection & test to ensure trip and alarm settings
- PRD inspection - Manual operation of tank mounted pressure release devices
- Oil Integrity - Replacement of TRANSEC drier cylinders and particulate filters
- Operational Assembly - Ensuring oil levels, valve positions, oil temperature, etc are suitable for operation
- Breather Assembly - inspect dessicant condition and replace as necessary
- Marshalling Kiosks - inspecting, cleaning and testing of alarm and trip settings to control room
- Temperature Indicators - inspection, test and calibration of winding and oil temperature indicator settings

LIQUID NEUTRAL EARTH RESISTORS:

As part of the fault protection system for 3 phase transformers, each of the LNER's was inspected, maintained and tested as part of the contracts. As well as general inspections for assembly, wiring checks and changing of the electrolyte fluid; the units were tested for insulation resistance of the contactor coil and heater elements, continuity resistance, current injection test of the Current Transformers and final resistance test of the LNER for operation.



775 MVA GENERATOR TRANSFORMER:

Manufactured by GEC Alstom in the 1970's, the transformer consists of 3 main tanks each holding one winding of the three phase unit, which is oil and water cooled, each with their own conservator, diverter and selector switch, protection and monitoring devices. This design means there was triple the amount of auxiliary components to inspect, maintain and test. Engineers spent 2 weeks completing maintenance instructions and implementing corrective actions, with works including:

- Overhaul of bolted / flexible connections to 23.5 kV Isolated Phase Bus Bar
- Overhaul of 23.5kV Voltage Transformer Cubicles and Cells
- Overhaul of Diverter and Selector switches and full range testing
- Testing of oil and water cooling control kiosks and temperature indicators
- Inspection and function tests of forced oil & water cooling system
- Tap changer Control Maintenance – manual, local, remote and alarm tests
- Drycol breather wiring and cubicle inspection and testing