

ELECTRICAL ENGINEERING SOLUTIONS FOR HIGH VOLTAGE NETWORKS

CONTRACT:	TPPS-11
SCOPE OF WORK:	Failure Analysis & Transformer Supply
END CLIENT:	Pahlawan Power Sdn Bhd
LOCATION:	UK based services
DURATION:	9 weeks
VALUE:	£ 1,031,000 GBP



SUMMARY:

Following consultation on previous projects, the Technical Services Manager at TPPS Ltd was contracted to complete a failure analysis and provide an investigation report for the failure of a 155 MVA Steam Generator Transformer at Tanjung Kling Power Station in Melaka, Malaysia, owned by Pahlawan Power Sdn Bhd. Consultation with the client, insurers and loss adjusters, Cunningham Lindsey, led to the quick decision to source a temporary unit for replacement to restart generation and minimise severe financial losses.

TPPS Ltd was requested to source a suitable transformer that would allow the station to restart generation, and using our industry contacts found a 90 MVA unit in the UK which was being held as a strategic spare by a generation company. The unit would need to be re-engineered and updated to a 117 MVA unit in order to be suitable. Once all parties agreed this was the most efficient option for re-generation, TPPS Ltd immediately started design studies for direct interchangeability with existing installations. Here began the task of testing, dismantling, re-engineering and shipping the replacement 115 tonne unit in the shortest possible time to the contractor installing the transformer in Malaysia in place of the failed unit.

FAILURE INVESTIGATION:

TPPS Ltd's Technical Services Manager and Senior Test Engineer flew to Malaysia at the earliest opportunity to complete physical studies, tests and inspections and analyse any data given by the client from other sources. The stresses caused by the fault had been so severe that the side walls had deformed and separated from the stiffening beams at the bottom of the tank, the HV bushings of the 'B' and 'C' phases, and the surge arrester bushing on the 'A' phase had been broken by the internal forces when the fault occurred. Engineers reviewed data from a series of tests completed on the unit, including Turns Ratio & Winding Resistance, Voltage Ratio & Magnetising Current, Insulation Resistance, Frequency Response Analysis (FRA), On Load Tap Changer tap selector tests and Dissolved Gas Analysis of oil samples. The review of all data surmised that an internal discharge had occurred due to an insulation fault between 2 of the windings and subsequently caused arcing with enough force to deform the main transformer tank. Once the initial diagnosis had been given it was clear that any replacement or rewind option from the OEM under warranty would take too long, and the loss adjusters and insurers requested TPPS Ltd use its industry contacts to source a replacement unit that could be sourced and procured sooner. A detailed investigation report was issued to the client to be used for insurance and legal purposes.

SOURCING:

No units could be found that were of the same size as that failed as not many companies hold this size of unit as a strategic spare, however TPPS Ltd found a generation company that had a Ferranti 90 MVA, 132/11kV, OFAN, Yd1 transformer at its central stores within the UK. Although only 90 MVA compared to the 155 MVA that failed, the option was proposed and accepted that it could be updated and re-engineered to a 117 MVA OFAF unit that would allow the power station to generate. The transformer was sanctioned for a series of tests to ensure its integrity, and once approved the unit was procured and dismantled.



RE-ENGINEERING & UPRATING:

As the replacement unit was OFAN cooled the most effective method of uprating was to use cooling fans to force air over the radiators increasing the cooling efficiency of the insulating mineral oil and turn the unit into an OFAF cooled unit. The decision was approved to utilise the cooling fans from the failed unit and support frameworks were designed and fabricated to secure 8 cooling fans under the 16 radiators on each of the 2 cooler banks. Design and interchangeability studies between the failed and replacement unit, and its interface with existing installations, identified critical functions that would also need re-engineering. It was imperative that internal, control and protection components be modified or added in order to accommodate the increased rating. Whilst the ancillary components of the cooling system and tank were being dismantled for transport the following modifications were designed, materials and components procured, and brought back to the company's premises for modification.

- Identify and source Current Transformers to meet the station's protection system
- Procurement and supply of Oil and Winding Temperature Indicators for increased protection
- Re-engineering and replacement of HV line ends to carry the increased Amps
- Modification to LV & HV turrets to allow mounting and installation of additional CT's
- Design, fabrication and mounting of CT connection boxes for termination of new CT's
- Major re-wiring of the marshalling kiosks to include additional control and protection circuits

DISMANTLING & LOGISTICS:

TPPS Ltd were challenged to dismantle the transformer's ancillary equipment and secure them for air freight within 18 days of the replacement unit being procured. The sizes of 17 packing crates for ancillary equipment such as radiators, pipework, control and marshalling kiosks, bushings and the conservator had to be estimated, confirmed by the shipping company, made and delivered whilst the transformer was still being dismantled in order to meet the deadline. Even faced with below freezing temperatures that stopped work, engineers completed the dismantling and packing of the transformers on schedule and TPPS Ltd engineers secured and loaded the crates onto 3 articulated vehicles for transport to Heathrow Airport for commercial air freight to Kuala Lumpur. The 85 tonne mass of the main transformer tank would take 85 days to get to Malaysia by boat, so the Antinov AH-124, the third largest air freight carrier in the world, had only one flight available and was chartered to fly the transformer from East Midlands Airport.



LOADING & TRANSPORT:

TPPS Ltd sought the services of approved subcontractors to supply a 500 tonne crane to load the 85 tonne main tank onto a heavy haulage low loader the day before the Antinov AH-124 departed. Once loaded the tank was taken to our factory for final modification and testing overnight, before being escorted to the freight area at East Midlands Airport. The tank was loaded onto the Antinov's entry ramp by two 250 tonne cranes, and winched into the centre of the plane with millimetres to spare, along with the crates containing the cooler bank framework. After the 6 hour loading operation the Antinov made 2 refuelling stops over its 60 hour journey to get the transformer to Kuala Lumpur where it was received by the installation contractor. The majority of remaining ancillary equipment for mechanical erection was dispatched in order of installation over the next week on the first available commercial flights.

TECHNICAL SUPPORT:

As part of the contract agreement TPPS Ltd continued to offer technical support to the client and the installation contractor after delivery of the replacement transformer and through the final testing and commissioning stages of the project. The transformer was successfully commissioned and energised to allow the power station to generate once again.

