# Cahora Bassa HVDC line emergency restoration

by Mike Rycroft, features editor, EE Publishers

**During the recent floods in Mozambique a section of the Cahora Bassa HVDC line was damaged. This had a huge impact on the transfer of power between Mozambique and South Africa with one of the 533 kV DC lines out of service. Quanta Services Africa was awarded the contract in February for the short term emergency restoration of this line.**

The line was restored using the Aluminium Composite Core Conductor (ACCC) conductors from CTC/ARB to replace the damaged 5,3 km section. This conductor consists of a composite core technology allowing for the use at high mechanical and electrical loading and the low resistance aluminium stranding reduces the line losses. This allowed the team to cross the 812 m section.

The engineering effort was a combination between Trans Africa Projects, CTC and ARB. TGC (Transmission Grid Consulting) acted as the owner's consultant. Mechem was the demining contractor and Chopperworx provided the aerial support for the duration of the project. Quanta Serivces Africa was the full wrap EPC contractor.

The original plan was to replicate the existing four bundle Zambezi configuration but the 812 m section caused some concerns. The team simulated and engineered a plan to restring the damaged section with the new ACCC conductor from strain tower (T2047) to strain tower (T2060), a distance of about 5,3 km. Due to the expected electrical loading on the line, it was found

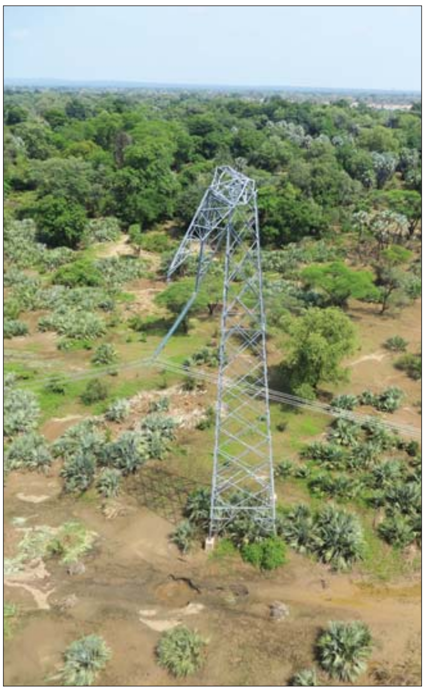

*Fig. 1: Damaged towers which had to be repaired.*

*Fig. 2: Fitting spacers on the new section.*

that a 3 bundle ACCC Lisbon conductor (315,5 mm$^2$) would suffice, taking corona into account. Tests on the conductor were done at the CSIR which yielded a breaking strength of 109 kN.

The biggest engineering challenge was the 812 m span. The flooding and the time constraints on the project made it impossible to construct a new tower. The use of any conductor over that span length resulted in an increase of mechanical loading on the existing structures, which had to be reinforced.

The ACCC being lighter than the conventional conductor per sg mm was another benefit as it allowed the contractor, in this case, to reach the required clearances under the allowable tower loadings. The 5,3 km section of the route was strung under higher than normal tensions than the rest of the route, and it was necessary to counter stay the strain towers at either both ends.

## Site access

The client supplied the insulators, hardware and replacement towers, which had to be transported from Chamoy in Mozambique. The rain and floods washed away some of the access roads, which meant the trucks could not reach the site. QSA had to establish a secure off-loading area, about 20 km away and everything had to be air lifted by helicopters. Two helicopters were on site for the duration of the project.

## Line suspension

The change from a three-bundle to a four bundle affected the configuration. A four bundle spacer was used with one conductor left out as the required number of spacers could not be manufactured in time. Due to the extensive damage to some of the towers; the conductors, still attached to the towers, were under excessive tension and had to be removed prior to the commencement of any work.

Even though one less conductor results in less wind-loading, vibration had to be taken into account he , especially in the long unprotected span. It was therefore decided to over-damp the line by putting spacers every 30 to 50 m along the span. It was also necessary to install armour-rods to protect the ACCC conductor where the spacers were installed.

## Site and logistics

The biggest challenge on this project was the logistics and secondly the possibility of old land mines. It was necessary to sweep and clear the site, which took about two weeks. This is a standard procedure after floods. Part of the logistical issues were clearance and permits for helicopter over the parks, clearances for fuel, getting fuel

*Fig. 3: ACCC Lisbon conductor was used in the repair of the section.*

*Fig. 4 : Using ACCC conductors made it possible to utilise a three-bundle configuration.*

*Fig. 5: The robotic arm in use during the restoration.*

*Fig. 6: Helicopters were used extensively for transport and other purposes.*

to site, getting material to site, getting material through customs on short notice, temp import permits, building roads and infrastructure. The nearest source of fuel was Polokwane or Louis Trichardt. Fuel had to be transported on a daily basis due to environmental issue of having a 30 kl bowser on site. The project received continuous support from the Mozambican government.

*Fig. 7: The 812 m span.*

The team was originally based at Punda Maria. Traveling times to and from site were hampered by the roads and closing of the border gates. It was decided to move closer to the job, to a tented bush camp, approximately 2 km away from site. A catering company was engaged to provide food, water and supplies. The only means of communication were satellite phones as there was no cellular network in that region. The satellite network was also used for emails etc. The team spent about four weeks and worked around the clock.

The total project duration was about seven weeks from NOA (notification of acceptance) to handover. Some of the existing structures had to be strenghthened before the stringing of the new conductor. Two towers had to be repaired by replacing critical sections. Due to the tight time constraints, only two weeks were available for preparation, mobilisation and permitting. Bulldozers had to be hired to make roads to gain access to site line. Theft was a concern and the sites had to be fenced off with 24 hour security.❖