CAMEROON

TURBINE REHABILITATION AT THE SONG LOULOU HYDROELECTRIC POWER PLANT

With a rated 398 MW, the Song Loulou hydroelectric power plant produces 57% of the electric power available on the Southern grid of Cameroon. It was commissioned in two phases in 1981 and 1988. It is equipped with 8 Francis turbines units with 4.5 m diameter runners operating under 39.2 m of head.

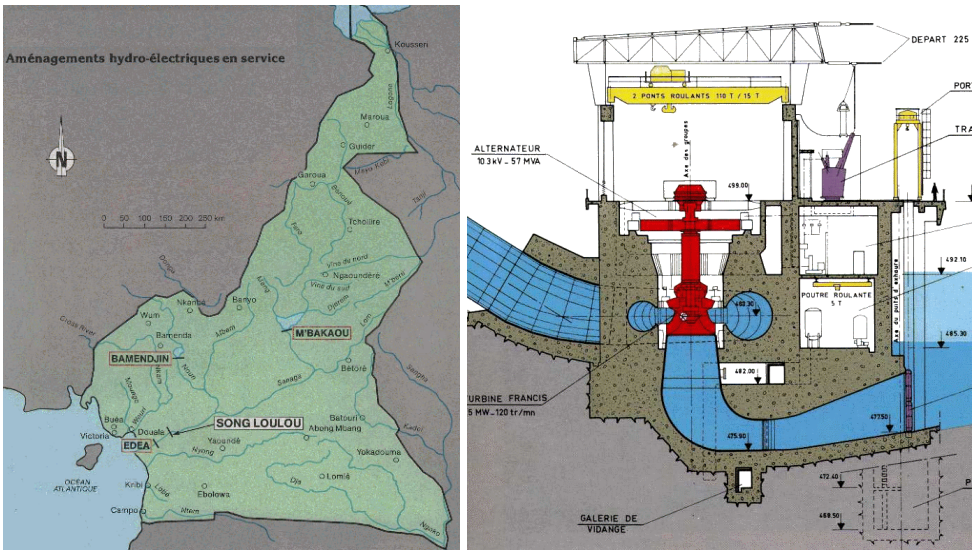

figure 1 : Cameroon, Song Loulou hydroelectric power plant (SONEL document)

The concrete used for the construction of the Song Loulou dam and power house expands by chemical effect. Deformations are transmitted to embedded hydromechanical elements such as turbines and inlet gates. The deformation of turbine labyrinth seals already caused contact with the runners on some units. The reliability of this essential part of Cameroon's infrastructure is threatened, with hazards to industrial production (Alucam aluminum plant in Edea), and making such comforts as lights, fans and refrigeration precarious to millions.

After years of unsatisfying repairs, the Société Nationale d'Electricité du Cameroun (SONEL) funded the rehabilitation of stranded unit n°6. The works started in 1995 and were completed in 1998.

At the end of 1997, SONEL obtained a commitment of the Swiss Government to fund the rehabilitation of the seven remaining units for 8 million Swiss Francs (4.6 million USD / October 2000). A project review assessed the work to be done and resulted in substantial changes in design with regard to the modifications of unit n°6.

unit	lower seal clearance, mm		contact	with
	right shore	left shore	prediction	realignment
1	0.30	1.65	2001	2006
2	0.45	1.85	2002	2007
3	0.75	0.40	2002	2003
4	0.95	1.10	2005	2006
5	0.35	0.65	under works	
6	(2.00)	(2.00)	repaired	
7	0.55	0.50	2003	2003
8	not available		?	?

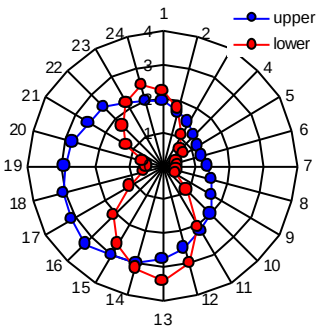

figure 2 : Reduction of clearances on lower runner seal, detail of deformations for unit 5

The steel structure of a turbine embedded in expanding concrete behaves like an empty soda can pressed in the hand. Tremendous pressures exerted on the stay ring squeeze the guide vane rings and reduce the clearance of the runner seals. The table in figure 2 summarizes the extent of the damage at the beginning of 2000. We estimate that if no action is taken, four units will be stranded in three years. The orbit diagram of figure 2 shows details of the radial clearances on the upper and lower seals of unit 5 at the start of works. The main deformations develop along the right shore – left shore axis. Clearances were reduced from the rated 2 mm down to 0.35 mm. There were traces of contact on the runner band. The adopted solution is to remove the radial assembly between the stay ring and the guide vane rings and to create new axial face-to-face sealing surfaces, figure 2.

The upward movement of the concrete block around the spiral case damaged the assembly flange between the draft tube cone and the lower guide vane ring. There, the bolted flange assembly is replaced by a sliding radial seal. Another damage due to the expanding concrete was the ripping of the draft tube lining around the access door. The door structure is modified to allow elastic deformation of the surrounding plates and the lining is reinforced.

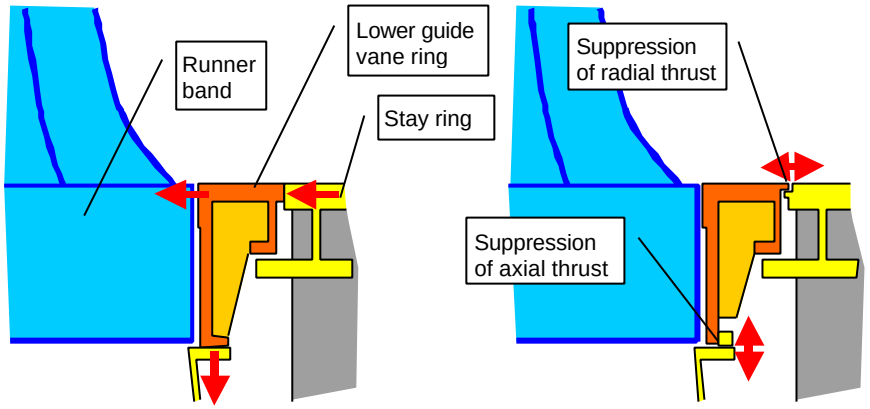

figure 3 : Schematic representation of modification on turbine parts

Work on unit n°5 started in January 2000. This unit will be re-commissioned before the end of the year. Considering the experience gained on the implementation of the repair procedure, the rehabilitation of the six remaining units is expected to be significantly shorter. The program is expected to be completed in 2004.

The main project actors are:

- Société Nationale d'Electricité du Cameroun (SONEL) owns and operates the Song Loulou power plant. SONEL produces 700 MW of hydro power on the Southern grid.

- VA Tech Hydro Vevey obtained the rehabilitation contract at the outcome of an international call for tenders on a short list of eight leading hydro turbine manufacturers. VA Tech Hydro Vevey produced the final design and is presently performing the rehabilitation works.

- The Swiss State Secretariat for Economic Affairs (seco), Project financing Division, funds the project.

- Stucky Consulting Engineers, Ltd. was appointed for project review, procurement and the supervision of contract execution.