

# Technical Paper

## One Stop Shop for the Rehabilitation of Seven Frame 5001 Gas Turbines in Libya

A power generating company in Libya awarded Sulzer Elbar the contract for the rehabilitation of seven Frame 5001 units built in the early seventies. Out of the seven units four are built into containers and three units are designed with heat recovery boilers for the production of potable water and located in a power house. Some of the units had not run for several years due to lack of replacement parts and a qualified maintenance system.

The rehabilitation project was quite substantial. As well as the complete overhaul of the gas turbine, main gear box and associated generator, the turbine controls were subject to a complete renewal. The replacement of the existing and outdated turbine controls additionally involved the improvement of the supervision level of the turbine. Furthermore the generator AVR (automatic voltage regulator) and GP (generator protection systems) had to be renewed. As replacement for the old turbine control system, an up-to-date

digital controller with a triple redundant system was chosen. Software designing and implementation was done by Sulzer engineers followed by a factory acceptance testing of the turbine controller, AVR and GP.

An overall assessment made during the project evaluation and quoting phase had to be completed. Data available at the three power stations,

tune and confirm the initial project planning.

Designing the new turbine controls and the adaptation of the fuel system was one of the first tasks. Meanwhile the field service group started the disassembly of the units. The supervising engineers were assisted by the customer's qualified staff. Sulzer



*Removing the old turbine controls*

in English and Japanese, had to be gathered and the engineering groups started the challenging task to fine

Elbar being one of the largest repair companies, understood that the major target was salvaging components for



*Generator before and after cleaning*

repair instead of replacing the capital parts. The capital parts and turbines rotors were shipped for refurbishment to Sulzer Elbar workshops in Lomm in the Netherlands. Timing was a crucial but achievable factor for the project flow.

The instrumentation and control crew started with the renewal of the field wiring, labeling and adding of all



*Old wiring around junction boxes*

the crucial monitoring and alarm connection points. The old control systems for turbine and generator had to be removed and new control cabinets put in place.

Site for site was rewired and tested in accordance with the new engineered specifications and drawings.

Parallel to all these activities, the generators, HV transformers, breakers and measuring transformers had to be cleaned and tested in the field. A group of specialists consisting of Sulzer Elbar engineers and the customer's high voltage and generator engineers, supported by the maintenance staff completed this extensive job. It was a big challenge, as the units were subjected to extremely high pollution. Fortunately the stator windings of all units were found in a repairable condition. Cleaning, re-vernishing and drying were done on site. The same applied to most of the rotors. As the existing slip rings were beyond repair, new generator slip rings had to be manufactured based on reverse engineering. Only one rotor was completely replaced with a spare unit.

To safeguard the fire protection in the containerized units, the old system had to be completely replaced. The high humidity had done its work over the years and many valves, sensors and even the CO<sup>2</sup> bottles were severely corroded.

All the units were successfully commissioned, synchronized and handed over to the customer. The project will be considered complete after the training of the customer's engineers in the Netherlands. Furthermore, for a period of two months, Sulzer Elbar will provide on-site training and support to familiarize the maintenance and operations crew with the new control and supervision systems provided.

The project has been a great opportunity and leverage for obtaining large scale rehabilitation projects and provided Sulzer Elbar with even more experience on total plant maintenance

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