

Case Study

A New Life for a 96 MW Steam Turbine Generator Set

After 40 years in retirement, a 96 MW condensing steam turbine from a power plant in Lünen, Germany will again be put into operation in Santa Cruz, Bolivia. Originally the turbine was operating as part of an experiment together with a gas turbine, (exhaust) boiler and all necessary auxiliaries. After a couple of years with a run-time of only 15,000 hours the gas turbine exploded and the experiment was stopped. No direct harm was done to the steam turbine which was finally sold in 2007.

Inspection

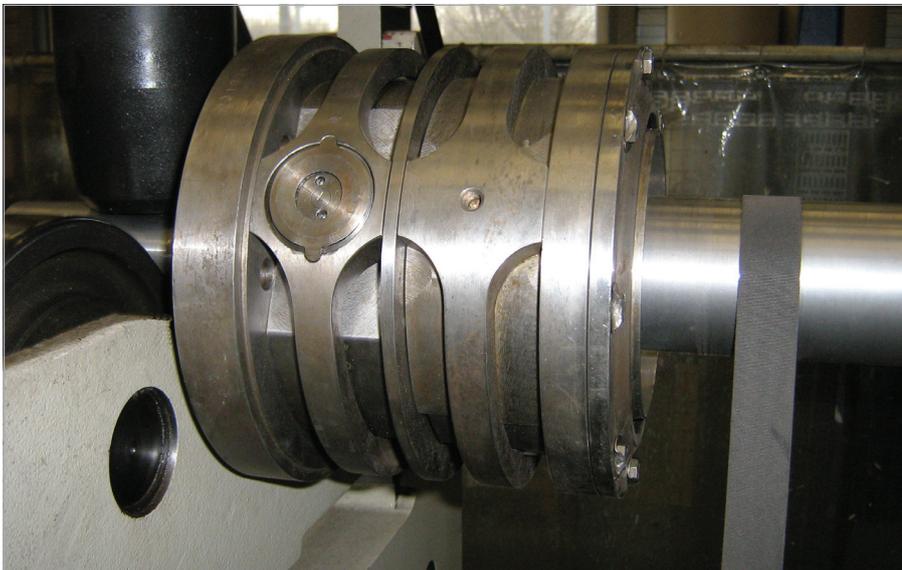
Sulzer Turbo Services Rotterdam became involved in this relocation project as the customer required a steam turbine specialist to determine the status of the turbine. In contrast to the other bidders, Sulzer Turbo Services Rotterdam proposed a disassembling, inspecting, reporting, repair proposal strategy instead of rejecting parts based on age. All parts were disassembled and complete inventory charts were made. Some parts were sent to our workshop for further inspection.

Inspection of rotor

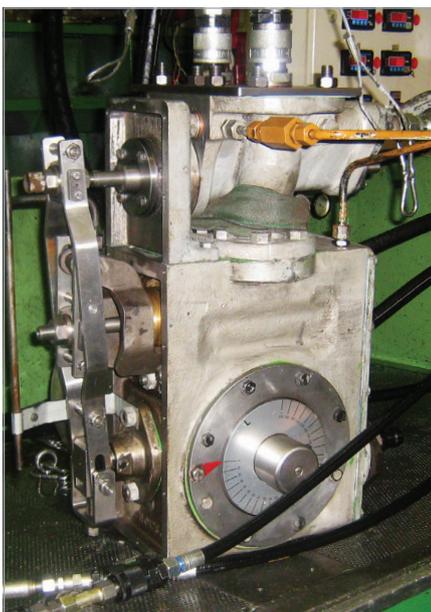




Overview in Lünen



Readjustment of mechanical trip



Testing of the hydraulic actuator

Repairs

Based on the inspections, reports were provided to the customer with advice regarding required repairs. Most parts were in a good condition but additional orders were obtained for replacements and spares for:

- wear and tear parts
- repair/replacement/testing steam valve parts
- radial/axial bearings, including complete set of new radial bearings and set of axial pads
- inspection and testing of the hydraulic trip unit
- start-up spares

Spin off

Whilst working on the disassembly of the turbine, we discussed with the customer how the turbine has to be operated in Bolivia. These discussions resulted in the customer asking us to join them as a partner in assisting with engineering the best solutions for the plant set up in Bolivia. This resulted in additional orders for:

- delivery of turbine (control and safety) and generator (synchronizing, excitation, safety) controls systems, vibration monitoring system
- level measurement turbine-generator foundation
- inspection of condenser
- delivery of new fine filter unit
- tools and lifting equipment
- inspection generator stator, rotor, bearings (delivery of spare bearings), re-inspection of rotor after transport damage (rotor returned to workshop)
- replacement of H2 generator cooling system
- Hazard and operability (HAZOP) study assistance, erection, commissioning/start-up assistance of the turbine in Santa Cruz, Bolivia

State-of-the-art modification

Sulzer Turbo Services Rotterdam succeeded in upgrading the system to the current standard without changing the concept of the original design of the turbine. By engineering a state-of-the-art control system it was possible to have an up-to-date system as control and primary safety system, using the original safety system as back-up. This set up has many advantages.

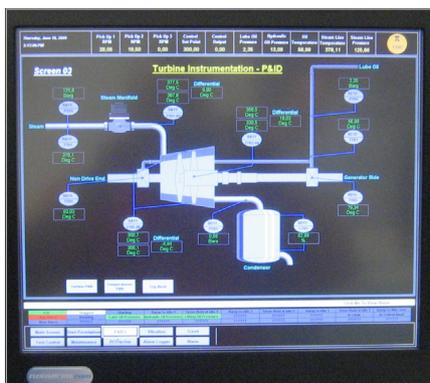
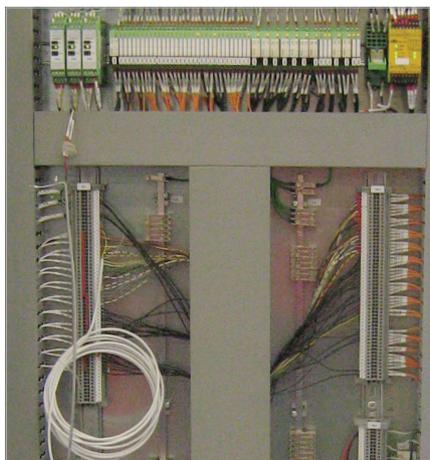
Operation and monitoring is completely automated and can easily be interfaced with other systems like DCS (Distributed Control System)..

1. Modification on the turbine itself was limited. The mechanical governor has been replaced by an electronic governor (integrated in the PLC) and new vibration/expansion probes have been supplied
2. Primary and back-up safety systems are based on different turbine controls cabinet philosophies i.e. electronic versus mechanical
3. Simultaneous progress of mechanical works and controls manufacturing

Although the manufacturing and programming of the controls are subcontracted, Sulzer Turbo Services has the lead in the set up of the application. By using software blocks, an application is engineered. If a software block is tested and approved it can be used many times and in other applications without the necessity of testing. If an application is engineered with only approved blocks an application test will be sufficient for testing the complete system, saving much testing time. Each software block will have its own description at different levels, such as only the features for sales purposes and a more dedicated description will be available for service.

Return on investment

Many questions were raised as to why the Bolivian customer wanted to invest so much money in an old steam turbine. The plant has only gas turbines and much energy is lost via the exhaust. Two of these gas turbines will be equipped with exhaust boilers for generating steam which will be used for the steam turbine.



Turbine control cabinet

The principal purpose for using a second-hand STG (steam turbine generator set) is to reduce the investment costs. The Bolivian company is looking for, and has the expertise in building cost effective plants.

Considering the very low gas price in Bolivia, a combined cycle installation (using exhaust of gas turbines to create steam for an STG unit) is not an obvious choice. However, to improve the efficiency of the plant they decided to invest in this project instead of installing a new gas turbine.

To achieve a good financial result, the project set up is based on following items:

1. Reduce the investment cost by using an STG
2. Get CER (Certified Emissions Reduction), from United Nations, according to the Kyoto protocol, and presale these ones as financial income for the project

This first CCGT project in Bolivia, requires a great deal of engineering effort from the Bolivian engineers because this is new science. To avoid mistakes and guarantee a successful project, expertise from dedicated companies is hired. The expertise for the steam turbine is provided by Sulzer Turbo Services Rotterdam.

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