General interface-free overhaul of the 110-MW railway power turboset at STEAG power plant Lünen

Dipl.-Ing. Harald Fink, STEAG power plant Lünen

Dipl.-Ing. Stephan Frense, E.ON Anlagenservice GmbH

VGB conference "Maintenance of power plants 2006"
on 15/16 February 2006 in Leipzig

Abstract

In addition to a certain reservation with view to the upcoming building projects within German power plant fleets, the time and cost factor is the main reason for performing overhauls at longer intervals than it used to be common in the past. This issue is opposed by the operator's expectations regarding uninterrupted availability. Therefore he is confronted with the question: What is more beneficial? The safety of scheduled outages at regular intervals or stretching the intervals and risking that the plant might suffer breakdowns leading to the necessity of an unscheduled outage? In both cases, time and money will have to be invested, in the latter case however, the investment will be clearly higher.

During a scheduled overhaul, additional damage might be diagnosed which could affect the prescribed time frame and budget negatively. Yet there are possibilities left to reduce the costs. It does, however, call for prompt and feasible solutions to be presented by the service teams onsite and the possibility to coordinate and implement these suggestions flexibly and without any further delay.

Regarding the optimisation of its plant's performance, STEAG AG's power plant Lünen has chosen the tried and tested overhaul cycle, in line with the unit's operating mode which is continuously monitored by the plant staff.

The general turboset overhaul from 1 April to 5 August illustrates how the teamwork between the customer and the service supply company including all specialist divisions can ensure a smooth and interface-free performance – from planning to commissioning and documentation.

Initial situation

Not too long ago, it was common to carry out self-directed overhauls, i.e. with in-company staff and the support of the manufacturer. The entire organisational and monitoring process, the involvement of specialist firms, suppliers, etc. demanded a great deal of efforts from the management and the staff.

Today the situation has completely changed. A new era dawned with the liberalisation of the energy market and the subsequent streamlining of power plant crews, which, among other issues, required a process of rethinking in view of maintenance organisation.

The purpose of this presentation is not to portray an overhaul. Although some details will be referred to, this presentation does not focus on **WHAT** exactly the order comprised, but on **HOW** it was processed. It should be clearly pointed out that, in this context, great importance was attached to the cost value ratio by both parties.

General facts about railway power

In Germany, the railway-owned grid, a single-phase alternating current system, is separated from the regular power supply grid and operated at 16.7 Hz.

The power is generated by thermal power plants (including nuclear power plants) and hydroelectric power plants, or furnished by the 50 Hz grid via centralised and decentralised transformer stations and converters.

The thermal power plants, with an installed capacity of approximately 42 % and an output of approximately 66 %, are the dynamos of the railway power.

STEAG power plant Lünen

Lünen power plant, which is owned by STEAG AG, has two hard coal-fired units with a total installed capacity of 500 MWel. About 2.2 billion kWh of electrical energy and 70 million kWh of district heat are generated annually. The German railway company Deutsche Bahn is supplied with 110-MW of railway power.

The 110-MW railway turboset at Lünen power plant was commissioned in 1984. The turbine (T 7328) is designed for a rotational speed of 1,000. The low pressure turbine and the generator rotor are connected by a torsion shaft.

Due to the necessity of cost management, the overhaul cycle intervals have become longer at STEAG power plant Lünen, just as in other power plants. However, special attention is always paid to the operating mode of the unit, which is continuously monitored by the plant staff. In addition, measurements and assessments of the plant condition are performed, e.g. the efficiency of the inner turbine.

Successfully, it seems. After all, 14 years and 73,000 operating hours have passed with a total output of approximately 5.1 million MWh since the last major overhaul of the 110-MW railway turboset.

In 2005, the company decided to award this contract as a complete package for the first time. The aim was to secure a competitive advantage and to minimise internal costs.

The bidding and awarding process was aimed at finding **ONE** single supplier in charge of flawlessly performing all advertised services.

The objective was an interface-free, cost-efficient and on schedule general overhaul.

General turboset overhaul 2005

The contract was awarded following an EU invitation for bids. Only two bidders qualified for this contract due to the special design of the turbine and the required relevant references.

Lünen power plant decided in favour of (EAS) although the manufacturer had the required expertise for this type of contract. The reason was that E.ON Anlagenservice GmbH's bid was more competitive and the overall price/performance ratio more favourable.

The operative word here is performance without any intentions to underrate the manufacturer's expertise. It is rather a question of having the perspective of a power plant operator. A service supply company with longstanding operator's experience sets different standards and is able to contribute its knowledge and capabilities. EAS is familiar with the special features of the railway power grid and with similar type turbines and generators. This is not a surprising fact since EAS has carried out assignments on two thirds of approximately one dozen railway power turbines in Germany.

The turbine and generator overhaul had to be executed within a timeframe from 1 April to 12 June. The contract comprised the overall settlement of the project – from planning, organisation and performance to commissioning and documentation.

One of the reasons for the overhaul was a defect on the insulation of the inductor. This defect was scheduled to be remedied at the manufacturer's plant. EAS was responsible for the dis- and reassembly as well as the organisation of the transportation. In addition, special regard had to be paid to the excessive heat consumption and the running behaviour of the low-pressure turbine.

"Time bomb" diagnostic findings

A planned overhaul with a set time schedule should not be a problem for an experienced service supply company when it comes to planning and executing the individual contract items in a timely manner.

This should also apply when, in addition to the usual overhaul tasks, an extensive testing program, including the examination and assessment of all areas of the turbine and valve housings with a propensity to cracking and an inspection of individual plant components, as e.g. the overhaul of gates, water injection valves, gland steam valves and the main oil pump have to be carried out.

The unscheduled assignments, which might come up during the overhaul, definitely pose a risk for a contract this size. Depending on their scope and the additional amount of work, they might unhinge the entire schedule and boost the costs. In this case, flexibility is required on sides, the customer's and the supplier's. The supplier must be able to develop the best solutions on a short-term basis, whereas the customer is expected to come to fast decisions.

At Lünen power plant, this cooperation worked perfectly. All diagnostic findings were discussed during the overhaul without any delay, and decisions regarding the solutions proposed by the service team were promptly made.

Here is one example in connection with the above-mentioned running behaviour of the low pressure turbine: When the connection between the low pressure turbine and the generator was inspected, it became obvious that there were excessive deviations from the alignment specifications. Normally the generator would have simply required to be lowered. This, however, was not possible because alignment measures had been taken during previous overhauls during which all base plates had been removed due to changes in the foundation.

At the time the defect was detected, everyone involved still expected an on-time return of the inductor. Therefore the solution, from a logistical point of view, comprised raising the complete turboset. Customer and supplier both agreed on this method.

Subsequently, the turboset was raised by 5 mm, the connection of the inductor was prepared, and, after the inductor had been returned, the fine alignment was carried out. The generator was furnished with base plates of > 2 mm, which will allow a further alignment at a later date.

During the commissioning phase, the customer ordered a specialist company to perform vibration measurements. The measurements were carried out during the warming-up operation and the results showed that the vibration rate was below 1 mm/s and therefore remained within the limit values (0 to 2.8 mm), in line with ISO 10816-2. This was an indication for a satisfactory running behaviour of the turbine.

Above that, the turboset alignment did not affect the overall schedule because the service team carried out the additional assignments during night and weekend shifts.

It shall not be failed to mention that the excellent teamwork between the service supply company and the power plant staff, as well as the continuous exchange of information, greatly contributed to a prompt and efficient overhaul process. For example, the workshop at Lünen power plant was available for minor drilling and lathe jobs. Major reworking tasks and the manufacturing of spare parts were performed in the supplier's central workshop in Gelsenkirchen.

"Just in time" repairs and spare part supply

Prior to the start of the overhaul, a team comprising power plant and service supplier staff obtained a general overview of available spare parts in the power plant warehouse to prevent delays due to missing component parts. The parts that would be needed due to diagnostic findings could, of course, not be taken into account. However, the process of procurement, which is known to be time-consuming, was, in many cases, not necessary. Repair measures and a short-term supply (and modification, if needed) could be ensured thanks to the spare part warehouses of the E.ON power plant fleet.

During the overhaul, comprehensive repair work, e.g. on steam inlets and hydraulic turbine valve drives, mechanical reworking of the components to achieve design valve clearances, a modification of the speed monitor bolt centres and a re-adjustment of the triggering speed were carried out by the EAS central workshop.

In addition, the main oil pump was overhauled, a wear protection was installed on the H_2-gasket retainer assembly, and welding and stress-relieving measures were performed.

The EAS-owned electro-laboratory reworked parts of the generator synchronisation system, as well as defective exciter parts which the manufacturer was unable to provide.

Standby service

In spite of various diagnostic findings, the overhaul was completed within the prescribed time. But the commissioning process was delayed. The reason was the prolonged repair time for the inductor at the manufacturer's plant. Originally, a period of about six weeks had been scheduled. After four weeks, the manufacturer stated that twice as much time was required due to unexpected severe diagnostic findings.

Normally this interruption would have resulted in additional costs since the service team had been planned in for this project. The supplier displayed great flexibility and assigned the crew to other tasks. The equipment remained onsite. One week prior to the return of the inductor, the overhaul team arrived at the power plant to perform final tasks and to reassemble the turboset.

After performing mechanical and electrical adjustments on the valves and turbine control units, the EAS team and the power plant crew, in a joint effort, carried out the safety tests and the commissioning and subsequently reconnected the railway power turbine to the grid.

Conclusion:

In summary, it can be ascertained that:

- the service supply company completed all assignments required for the general overhaul of the 110-MW railway power turboset within the prescribed time and budget, thus answering all customer's expectations,

- the overall contract was performed in an optimal and reliable manner and without any accidents,

- solutions to arising problems were instantly and competently presented and decisions were made promptly and without any delay,

- the utilisation of the supplier-owned central workshop and electro-laboratory for the reworking, supply and manufacturing of urgently needed components substantially contributed to the prevention of bottlenecks,

- the calculation of prices for additional work was carried out in a fair manner,

- the teamwork between the power plant and service supplier's staff was excellent throughout,

- Lünen power plant experienced almost no interfaces because the supplier's specialist teams worked hand in hand.

A power plant operator is, of course, not able to hand over all responsibilities when a contract of this scope is awarded. He is still faced with the task of making decisions in connection with measures arising from the results of diagnostic findings.

However, prompt decision-making is greatly facilitated when the service supply company is experienced in plant operational issues and therefore considerably contributes to saving time and costs by repairing and supplying urgently needed components.

Due to the positive experience with the EAS central workshop, another order was placed for reconditioning spare parts intended for storage in the warehouse.

One should not fail to mention that after completion of the overhaul work another vibration measurement was performed under full load conditions. It was targeted at achieving a further optimisation of the running behaviour.

Overall, the result confirmed the decision made by STEAG power plant Lünen. In the future, contracts for major general overhauls will be primarily advertised as complete packages, which will offer favourable chances to producer-independent service supply companies.