SSDE promote green future by manufacturing turbine blades for supercritical power generators

Following the Indian government's push for a green future and economic development, the manufacturing of supercritical components in power generation is vital. SSDE using the Nikon ALTERA CMM have helped to increase energy efficiency by 40% with the production of super-critical turbine blades.

With over 15 years of experience in precision machining, Sri Sai Durga Engineering (SSDE) has expertise in CNC turning and CNC milling to wire erosion, weld cladding and mechanical assembly. SSDE has had a vast amount of success, particularly throughout the power generation industry which is in-part attributed to the "customer focused" approach. With its main focus on customer satisfaction, the team has strived to reduce lead times, manufacture products with outstanding quality and innovate cost-effective solutions for components with challenging specifications.

Accuracy, reliability and attention to detail are the three main factors in the success of the customer oriented approach for SSDE. Alongside experience of the dedicated and flexible staff, the quality department plays a very important role to ensure that every component produced meets the geometrical specification, "right on time, every time".

Within recent years, the quality department, based in Patancheru, Hyderabad has played an even more important role due to the government demand for more environmentally friendly power generation. This has seen a shift in the production of components for sub-critical power generators to components for super-critical power systems that have tighter tolerances, different dimensions and more complex shapes. A wide range of measurement equipment has helped SSDE to develop an exceptional reputation. However, to maintain the desired levels of quality assurance and cope with demand, new metrology equipment that combines speed, accuracy and automation was required. As a result, SSDE now relies on the Nikon Metrology equipment to continue satisfying its customers' needs by delivering consistent, accurate and defect-free products.

SSDE look to invest in the latest metrology equipment

Naveen explains that components such as the turbine blades SSDE manufacture are vital in maintaining the efficiency of these generators, so the quality and integrity of these parts are of the utmost importance. The turbine blades are required to be much stronger and a more complex design is required to optimize the steam flow. A variety of custom alloys as well as X20, a composite material often used for high temperature steam piping are used to meet the required specifications. They are manufactured to much tighter specifications, hence the geometrical inspection tools needed to offer micron accuracy to measure the complex shapes.

Previously, when manufacturing the basic blades for subcritical turbines, manual methods were viable for inspecting the straight forward designs. Basic templates or callipers were sufficient for the inspection of blades

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> *Naveen Reddy, SSDE.*

A tricone rock drill bit - used for rock abrasion to extract ground water, oil and gas.

with a fixed section geometry. Comparatively, the new turbine blades for use in supercritical power generators comprise of increasingly complex designs with twisted foil sections. The aerofoil in particular would pose difficulties for any manual method with a varying geometry from root to shroud, which -if possible to measure- would be extremely time consuming.

As a company that is continuously looking to improve, Naveen knew that SSDE needed a new inspection system capable of achieving the highest level of accuracy possible, with the turbine efficiency largely depending on the quality and integrity of its blades.

SSDE consulted multiple CMM suppliers before opting for the Nikon Metrology solution. They wanted a CMM capable of fast and accurate inspections, therefore selecting the 8.7.6 ALTERA with the SP25 continuous scanning probe and Digigraph blade analysis package, part of CAMIO.

With over 50 years of metrology experience, the ceramic Nikon Metrology CMMs are made with the latest technology to ensure ultimate quality for every application. The accuracy and repeatability of this system has been a major bonus for SSDE to inspect the components for supercritical generators. The SP25 is the ideal tool for measuring the blades with its ability to follow the complex shapes and contours – proving to be a major advantage for this application. The software package CAMIO enables straightforward programming for such inspections. Not only does CAMIO make this an easy-to-use system, but it also provides a dedicated system functionality with the right reporting capabilities in Digigraph. Profile reporting with blade analysis in Digigraph displays, manipulates and analyses scanned data. Naveen highlighted the Best Fit feature to be of importance to SSDE as the QA team can be certain that the inspected components conform to their specifications. Automatic best fitting can be calculated with both text and graphical outputs for the direct comparison of measured and nominal profiles.

The micron accuracy and increased repeatability of the Nikon system has made it possible for SSDE to progress into the production of supercritical components but also, the speed has offered significant benefits too, as the use of the ALTERA has reduced inspection cycle times by at least 30%.

Whilst the turbine blade industry has peaked, SSDE have diversified, looking into other industries. Turbine blades still remain a major portion of day-to-day work for SSDE, but it has also started to offer their expertise in in the production of components in other industries. With the reduced inspection cycle times, SSDE has been able to slowly introduce the additional line of work for the production of tricone rock bits. Tricone bits are used in well drilling (or borehole drilling) and consist of three rollers which are used for the abrasion of the rock to extract ground water, oil and gas.

Faster cycles, more certainty and new possibilities

The team at Sri Sai Durga Engineering are very pleased with their new system, its capabilities and the new possibilities it has introduced. They are fully equipped and able to deal with the complex designs for the supercritical components in the shift towards more environmentally friendly procedures and play their part in reducing emissions in India. The Nikon solution has enabled a much higher level of confidence in the components produced by SSDE, helping to maintain the company values of quality and customer satisfaction.

Subcritical and supercritical power generators

Supercritical generators have several benefits in the power industry, primarily for cutting emissions, enabling power plants to stick to the ever tightening regulations as well as lower running costs.

The difference between subcritical and supercritical generators is defined at which pressure they operate. Sub-critical generators will operate at a pressure below 220 atm (3,200 psi), whilst supercritical generators operate above 220 atm. At a temperature and pressure above the critical point, gaseous and liquid phase properties become very similar and the resulting substance is known as supercritical fluid (SCF).

Both the temperature and pressure must reach the critical requirements in order to create supercritical water. By operating at these conditions the water in the system is transferred directly to steam which can power the turbines. Operating below these conditions in a subcritical generator involves an energy loss from latent heat, which is needed for the phase change from liquid to gas. Therefore the energy loss from a system running above the critical point is much smaller. The increased efficiency means fewer fossil fuels are burnt to power the generator, also resulting in fewer CO_2 emissions.