# High Quality Laser Weld Repair Solutions at Elbar

The drive to high efficiency in gas turbines asks for new materials for the hot section components followed by the demand for high technical repair solutions. To satisfy these demands, Elbar introduced a high flexible 5-axis laser-machining center. It combines the ability to rebuild removed substrate by laser metal forming or cladding. Furthermore the laser cutting and welding process are integrated.

The main advantage of the laser technique is the low but highly controllable heat input into the substrate. This leads to a small Heat Affected Zone (HAZ), limited dilution of the substrate with the weld filler material and no distortion of the components. This offers a higher quality repair compared to the standard processes. Typical components, which already have been repaired at Elbar, are rotor blades and transition pieces.

### Trailing Edge Patch Blade Repair

During service, rotor blades suffer different types of corrosion/oxidation attack which can lead to the complete loss of the wall thickness. The standard repair procedure includes the removal of the degenerated regions and rebuilding them by Gas Tungsten Arc Welding (GTAW). This method has some inherent disadvantages mainly linked to the high-energy input.

Laser keyhole welding offers a high-quality repair solution. During the repair process a patch is butt welded to the remaining substrate. The controlled process reduces the HAZ and limits the dilution of the substrate. No distortion of the components will be found since welding stresses are reduced as a result of the low energy input.

*Laser workstation at Elbar*

### Tip Repair

Rotor blades typically suffer from tip rubbing during service. This wear damage has to be rebuilt, for which the laser cladding process offers new possibilities. During the process, superalloy powder with a composition comparable to the substrate is injected into the liquid pool, which is created by the laser beam on the substrate. The powder melts and forms a new layer on the surface of the component. The ability to better control the material deposition offers a near net shape build-up minimizing machining and the substrate/filler material can be matched with the actual conditions in the turbine.

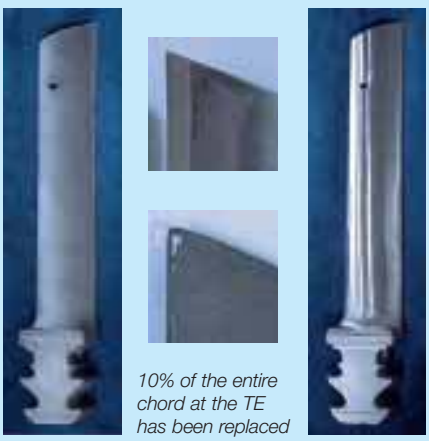
The low heat input during the laser cladding process reduces the stresses during solidification. These stresses have to be minimized since they are responsible for the recrystallization behavior of the fusion zone, which would be disastrous for future repair of single crystal components.

### Combustion Chambers and Assembly Welding

Combustion components guide the hot gas stream from the combustion chambers to the turbine guide vanes. They are typically machined from preformed sheet metal and joined in different weld assembly steps.

The typically used welding process leads to high heat inputs with wide weld beds and large HAZ's. The laser keyhole welding process, which is applied at Elbar, reduces the impact on the microstructure leading to a higher quality weld joint.

In all the applications the laser as a machining tool leads to a higher quality repair and joint quality at a much higher process reliability and accuracy with a reduction in processing time.



*10% of the entire chord at the TE has been replaced*

*Laser cladding of rotor blades*

*Gas tungsten arc weld*

*Autogenous laser weld*

### Future

Especially DS and SX components offer limited possibilities for conventional repair welding. Currently, after successful laboratory testing, laser metal forming techniques will be implemented in the actual repair process for these components.

*Stefan Krause*
*Elbar*

*55 MW steam turbine rotor on PT Hickham Indonesia's new lathe*

# Large Lathe Installed and Commissioned at PT Hickham Indonesia

### "Just in Time" Inauguration

With the realization of the big bay project in 1998, a strategic commitment had been made to upgrade the service capabilities of PT Hickham Indonesia in order to be able to enter the high-end heavy-duty power generation equipment service market. The key requirements for the establishment of the necessary infrastructure to perform comprehensive services for large-capacity power generation equipment were identified to be the following:

**Key Requirements**

1. High bay assembly building with total bridge crane lifting capacity of 100 tons
2. Large scale rotor unstacking and restacking platform
3. Large balancing machine with a minimum capacity of 60 tons
4. Large swing and high load capacity horizontal lathe

By the end of the year 1999, items 1 and 2 had been accomplished successfully and a reliable outsourcing solution had been found for item 3. In March 2000 the approval for extraordinary capital expenditure was received to implement the acquisition of the last element on our list. With the help of Sulzer STS senior consultant, Hugo Herde, an extensive search was launched on the international machine tool equipment market. By September 2000, a suitable candidate had been found in Germany and following final negotiations a purchase contract was signed in November. In January 2001, the equipment arrived at our service center in Indonesia for minor refurbishment work and preparation for the installation phase of the project. Over the next 5 months 90 tons of machinery components were assembled and installed under the supervision of the retired Sulzer machine tool service manager Erwin Burch. With the benefit of the exceptional level of experience and skill of our Swiss expert, all the pertinent manufacturer's installation and alignment tolerances were either achieved or exceeded, resulting in high reliability and precision machinery performance. Project schedule and work completion timing was perfect and by the end of June the first job was already waiting to go into the lathe.

A 55 MW double-flow steam turbine rotor was received from a geothermal power plant. The rotor, which had 2.2 meters tip diameter and weighed 18 tons, was successfully processed.

**Technical Data Zerbst Lathe**

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|---|---|
| Swing over bed plates | 3 500 mm |
| Total bed length | 12 500 mm |
| Distance betw. centers | 8 200 mm |
| Max. rotor weight betw. cent | 63 ton |
| Steady rest | 2 |
| Special features | Flexible bed way arrangements |

With the official inauguration on July 2, 2001, the achievements of our team were celebrated in traditional Javanese style in the presence of all Hickham Indonesia co-workers and our Swiss expert. By popular demand the newest member of our equipment family was named Bima. Bima, the legendary Pandava prince of the Mahabharata epic signifies courage, strength and determination.

PT Hickham Indonesia's management would like to thank everyone whose support and contribution has made it possible to make things happen. We look forward to reporting on many important Bima projects in the future.

*Hans W. Strickler*
*PT Hickham Indonesia*