



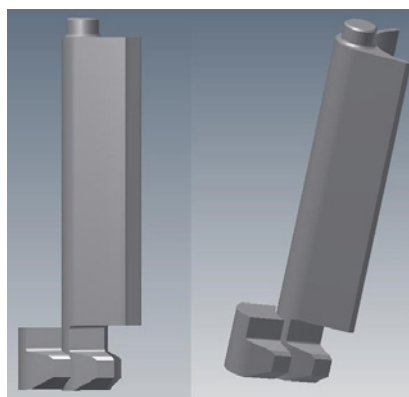
- Higher efficiency and reliability
- Increase time between outages

## Technical upgrades – Blade design improvements

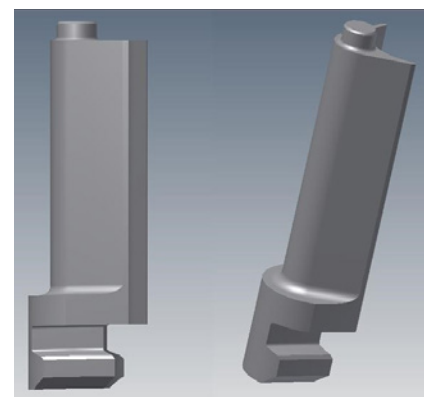
Sulzer is your global partner with reliable and sustainable solutions for your key operations. We offer repair and maintenance services for turbines, compressors, pumps, generators and motors. We also offer OEM and aftermarket parts. With one of the largest service networks in the industry, we are close to our customers with over 180 production facilities and service centers worldwide. Our cutting-edge engineering services provide unique and innovative solutions customized to your equipment needs.

During inspection performed by Sulzer a steam turbine showed signs of heavy erosion to the outside diameter faces of the rows four and five disks. The disks need to be weld repaired to return it to the original shape. Sulzer proposed to change the blade design in order to prevent erosion damage to the disk and improve overall reliability and durability of the design.

As it can be seen from the pictures provided, the platform is added underneath of the airfoil to eliminate the overhanging edges and spacer is made integral. The airfoil height and radial position remained unchanged, while the overall blade height increased due to addition of the platform. This is achieved by machining the root section of the disk at a new (smaller) radius after performing the weld repair.



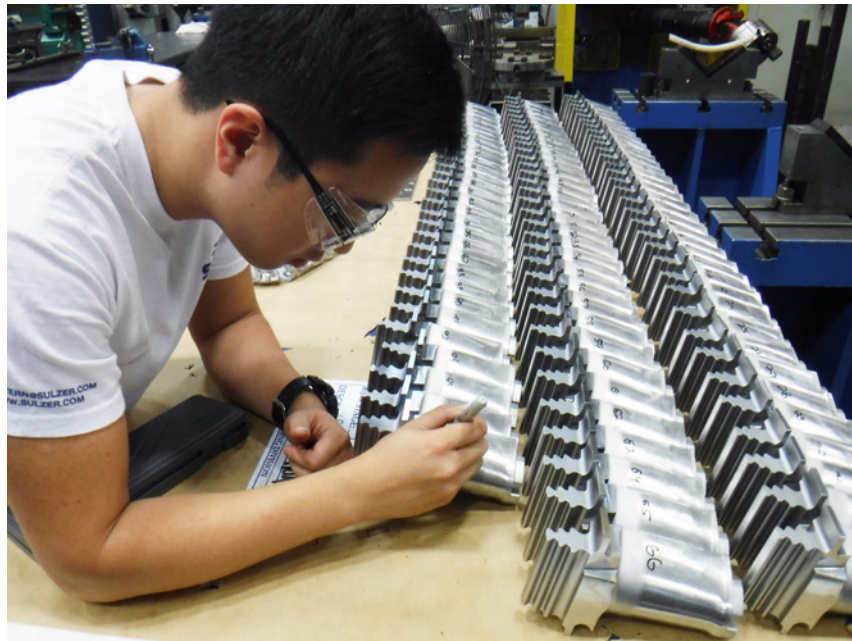
Original blade design



Sulzer upgraded blade design

In addition to addressing the disk erosion problem, this design change provides the following improvements:

- Increased circumferential pitch and therefore contact area at the root.
- One piece design reduces total number of pieces in the blade pack, therefore increasing the rigidity of the blade row. A good blade pack is essential in radially loaded blades.
- Added platform helps reduce steam entrance to the blade root as well as adds a generous transition fillet between airfoil and root. The edge between the overhanging airfoil and root in the original blade is a location known for its possibility for fatigue crack initiation due to its sharp geometry and direct exposure to steam.



Sulzer provides cutting-edge services and solutions for rotating equipment dedicated to improving customers' processes and business performances. When pumps, turbines, compressors, generators and motors are essential to operations, customers need a service partner they can trust. With our technically advanced and innovative solutions, we give our customers the assurance they need to focus on their operations.



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#### Engineering Services capabilities/service offering:

- Alignment tracking
- Machinery diagnosis
- Field balancing
- Performance rerates
- Technical upgrades (blade design improvements)
- Root cause failure analysis
- Rotordynamic analysis
- Turbomachinery engineering seminar series