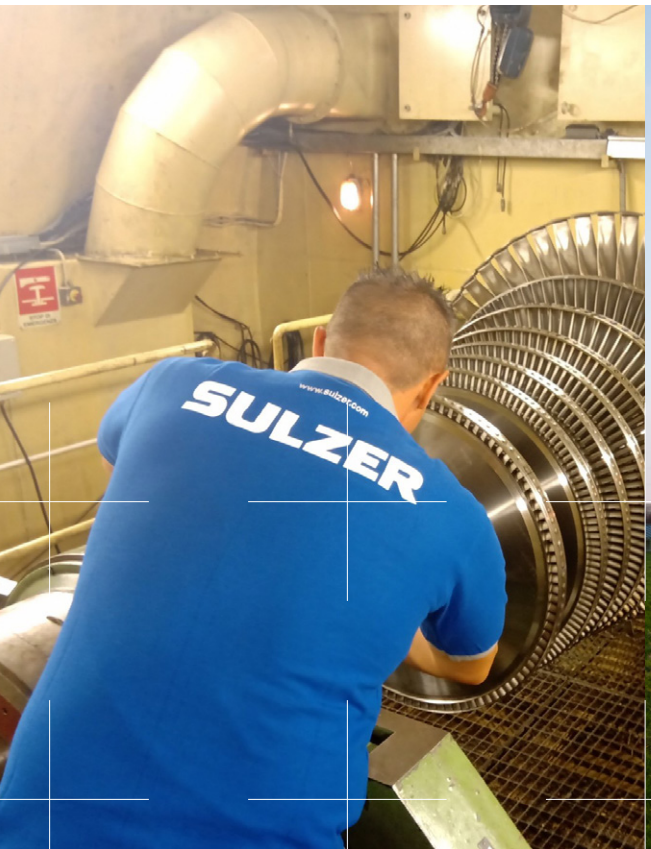
Efficiency enhancement for reverse engineered rotor

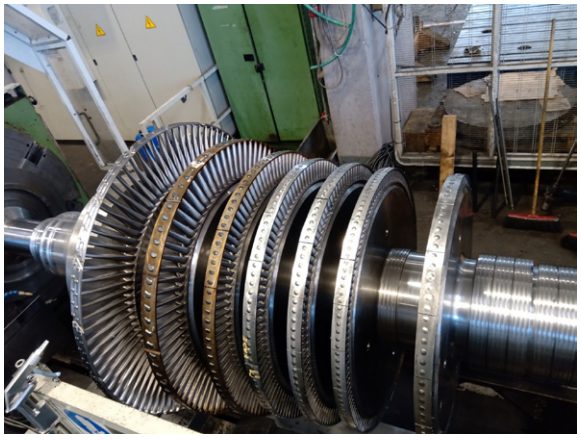
CUSTOMER	Biowaste power plant
LOCATION	Taiwan
INDUSTRY	Power Generation
KEY SERVICES	1. Reverse engineering
	2. Steam turbine re-rate
	3. Machining
	4. High speed balancing

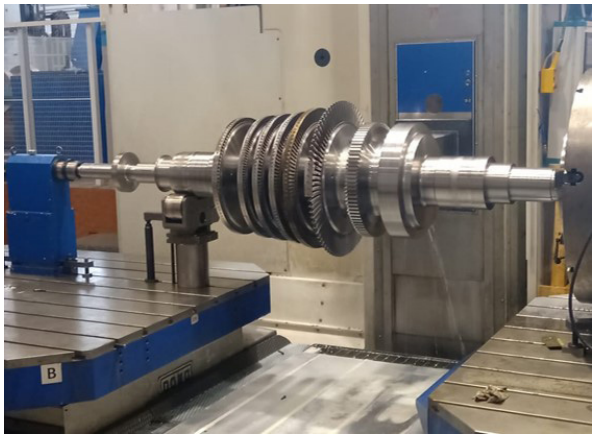


THE CHALLENGE

Pushing the envelope for energy efficiency & operational continuity

- The biowaste power plant has a power purchase agreement (PPA) with the local grid while supplying biowaste generated power
- Its trusty 20MW steam turbine operated without hiccups for since commissioning
- Operators decided that it would be prudent to source a spare rotor for the turbine for operational continuity and to prepare for any unexpected contingencies
- The maintenance and engineering teams had lofty ambitions and to push the envelope further, they desire a 2% efficiency enhancement, through a re-rate
- The OEM and a few other turbomachinery service providers were engaged for this endeavor
- The OEM could only deliver the spare with a re-rate in 16months, due to a production backlog - the lead-time wasn't ideal.
- The other turbomachinery service providers were either not able to offer a re-rate or could not commit to the tight timeline
- Sulzer was eventually appointed to deliver as our offer ticked all requirements from timeline, expertise and offer.
- There was only a 5 days window period during the plant's scheduled shutdown, to conduct all necessary scanning, data gathering and analysis as part of the project.
- All work were to be done on the operational rotor
- To add complexity, none of the existing turbine blades could be dismantled from the rotor during the shutdown



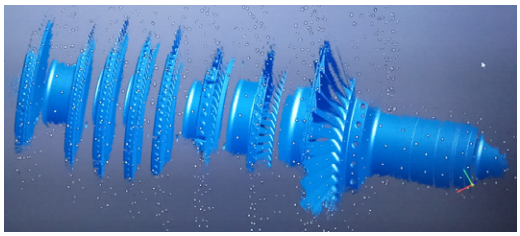


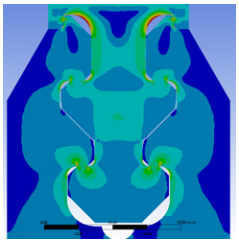
THE SOLUTION

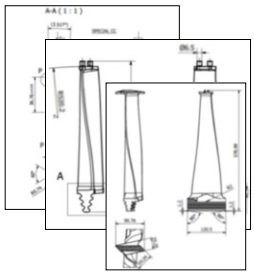
Methodological expertise for re-rate & reverse engineering

- Our technical experts got on to work round the clock for all the necessary work during the turnaround
- Combining absolute precision with expediency, the team completed the process within the shutdown period
- The re-rate strategy which was to re-design the turbine blade airfoils to modify and expand the surface and angle
- This approach was the most practical on a timeline and cost perspective which negated the need to overhaul the structural design of the rotor extensively such as diameter, stages and flow
- The entire reverse engineering and re-rate endeavor comprised of:
  - On-site scanning, measurements and materials analysis
  - Multi-faceted feasibility study comprising of aerodynamics, structural & modal analysis, creation of virtual model of the proposed turbine re-rate
  - Re-design of required components- blade attachments and airfoil
  - 826 new blades were engineered and manufactured for the project
  - Inspection: mechanical, hardness, ultrasonic, magnetic particle, dimension and heat stability testing
  - Assembly and high-speed balancing

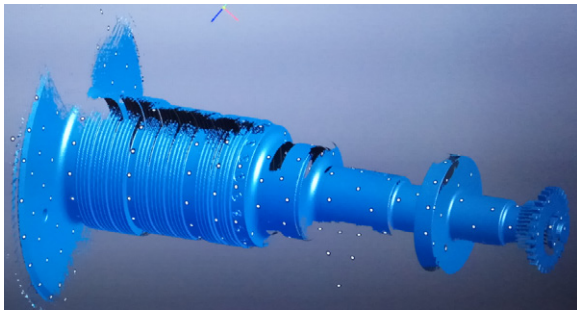
Develop Manufacture Drawing

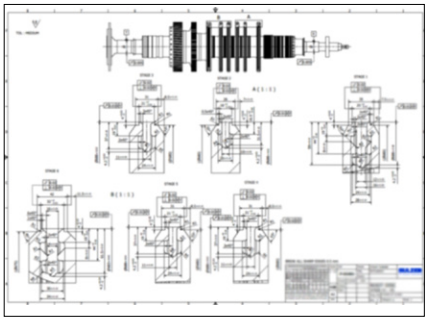




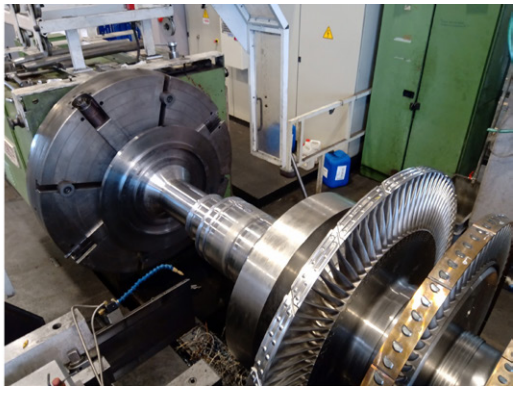


Blades Redesign





Develop Rotor Drawing



Manufacturing Process – Shaft Machining

CUSTOMER BENEFIT

Spare rotor project that ticked all boxes

- The entire project fulfilled all criteria set out by the operator, from technical, timeline to outcome and costs.
- OEMs are typically set-up and geared towards for new equipment development and production as its core business strategy which might undermine its post-sales support.
- Sulzer's extensive experience with different turbomachinery models and brands offered technical breadth and depth with flexibility to apply innovative engineering solution with no compromises in quality and effectiveness
- The project was delivered in 12 months, 4 months faster than what the OEM could deliver.
- The key benefit had to be the 2% efficiency enhancement as desired by the operator with expected OPEX savings to be gained in time to come.

PROJECT KEY FACTS

EFFICIENCY INCREASED

2%

PROJECT LEAD-TIME

12 months

NEW BLADES SUPPLIED

826

STEAM TURBINE CAPACITY

20MW

THE IMPACT

Breadth and depth of varied turbomachinery expertise and database offers operators an excellent option for technical-demanding projects with no compromise on quality

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