1 The generator was transported for repair and back with one of the largest cargo planes in existence.

Flying Generators for Fast Repair

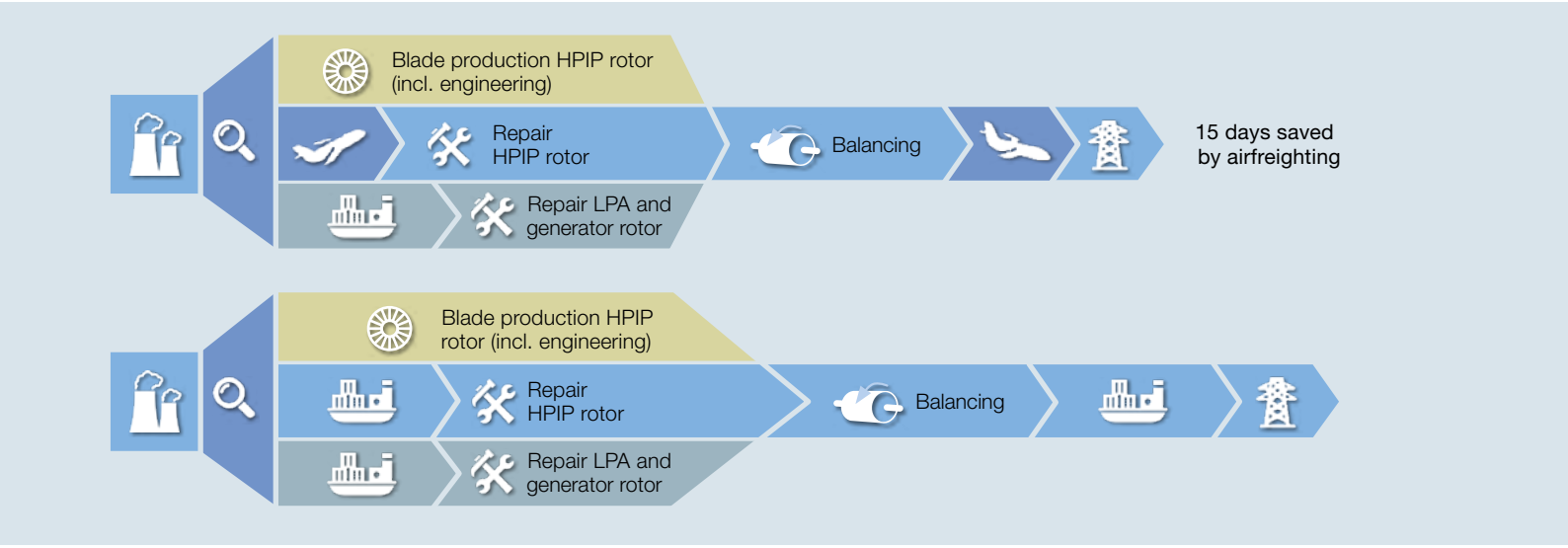
Power generation companies rely on turbines and generators to deliver vital power to customers. Repairs are usually required urgently when an unexpected failure occurs. To save time, a Malaysian power generation company even sent a 500 MW turbine and generator rotors via airfreight to Sulzer in Indonesia for repair.

A 500 MW turbine and generator in a power plant in Malaysia broke down during the festive season, shortly before New Year. The Sulzer engineers headed out from the service center in Indonesia on the first available flight to assess the situation. Whoever has tried to get a last minute flight at the end of December knows it is not an easy task to get a seat during this extended holiday period.

A breakdown during New Year

The initial on-site inspection of the turbine generator showed that a lubrication failure had occurred. The result was seriously damaged bearing journals and blades on the high-pressure / intermediate-pressure (HPIP) turbine rotor. It was immediately clear that the drive train of the generator would require extensive repairs. The customer as well as the insurance company were very keen to minimize the downtime, primarily due to financial losses incurred for each day of non-operation.

The most urgent of the large component repairs, the HPIP turbine rotor, was flown to the service center in Purwakarta, Indonesia, using a Boeing 747 airplane. The generator and low-pressure rotor followed via sea freight because repairing them would take less time. Once repaired, all three items were transported back using an Antonov An-124 and a Boeing 747, some of the largest cargo planes, to ensure the fastest possible turnaround.



2 The repair with parallel workflows and rapid transport took 85 days only – 15 days were saved by airfreighting.

Parallel workflows for fast repair

Sulzer's field service team helped to dismantle the generator drive train, which weighed 22 tons (84 500 lbs.). They made all arrangements for the HPIP rotor to be airfreighted to the service center in Purwakarta, Indonesia. Compared with sea freight, this air-freight saved approximately 15 days (Fig. 2).

To save additional time, samples were taken from 12 rows of HPIP turbine rotor blades before the rotor was removed from the site. The blades were sent for immediate reverse engineering and manufacturing to Indonesia. The leadtime for new blades was going to be the most time-consuming part of the repair, so it was important to produce these samples as fast as possible.

Once the rotor was in the Sulzer Indonesia workshop, the full extent of the damage became apparent. A fluoroscopic inspection revealed a significant amount of cracking in the active thrust collar. Rebuilding the active thrust collar to its nominal dimensions required extensive machining, weld buildup, and a final heat treatment (Fig. 3).

Sailing in LPA and generator rotor

The generator rotor and the low-pressure rotor (LPA) were carefully packaged. They were shipped to Indonesia by sea freight because the damage to these two components required less time to repair. The aim of the Sulzer engineers was to minimize the rebuild time and complete the repairs of the three rotors at the same time.

The LPA rotor showed significant wear and high hardness readings on both bearing journals. In each case, the journals were undercut and prepared for welding. After that, they were encased with special ovens to deliver the correct heat treatment prior to final machining.

3 The HPIP rotor required extensive weld buildup and machining to deliver nominal dimensions.

4 Final assembly of the generator rotor.

At the same time, the service engineers inspected the generator rotor. The findings were: damaged bearing journals, a significant bow at the coupling end of the rotor, and oil contamination under both retaining rings (Fig. 4).

One damaged bearing journal was repaired in a similar way to the LPA rotor. The bow was removed using heat treatment and stress relief. Both retaining rings were removed for non-destructive testing to confirm that there were no defects before they were reinstalled with new insulation material. After the repair, all rotating equipment needs a dynamic balancing procedure and quality tests to guarantee reliable, concentric operation. The Sulzer service center in Purwakarta, Indonesia, is equipped with a large balancing machine to complete this task before rotors were transported back to Malaysia (Fig. 5).

Sulzer's Service Center in Indonesia

Agus Susena, Manager of Sulzer South East Asia concludes: "Thanks to our previous partnership, the customer was confident that Sulzer would complete the repair in the shortest possible time, even over the New Year period. In fact, between arrival and departure of the HPIP turbine rotor, we stayed on schedule to complete the reblading, machining, and balancing as committed.

Our engineers delivered a very high level of professionalism and workmanship during this tight time frame. After this refurbishment, the rotors should have many more years of reliable operation ahead. As a service center, we are committed to providing an immediate and positive response to ensure customer satisfaction. This is why we are available 24 hours a day and 7 days a week."

Two teams of specialists involved

While the LPA and generator rotors were being repaired, the HPIP rotor required a considerable amount of work. The suppliers of the new blades had worked around the clock to manufacture all components in the shortest possible time. Now, it was the turn of the specialists in Purwakarta. All available hands were needed — two blading teams were involved in removing and replacing the blades.

Once the new blades were in place, the teams started the process of attaching the blade shroud. This involves a hot peening process: The blade tenons are heated to a specific temperature before deforming the ends, thus binding the blades and shrouds together. This process is similar to the creation of a steel rivet (Fig. 6). Both blading teams worked in parallel to complete the task as quickly as possible. This ensured that the work on the HPIP rotor was completed at the same time as the other two rotors. The customer was regularly updated on the work progress, to be able to arrange transport efficiently for the return trip of the rotors.

Fast return to Malaysia

The customer booked air transport for all rotors. Because of the size and weight of the cargo, they required the services of both an Antonov An-124 and a Boeing 747. The refurbished rotors, which had been carefully packaged and loaded, were all airfreighted back to Malaysia, where the Sulzer field service team awaited them. All generator components were repaired in just 85 days, which would have been about 100 days without the use of airfreight. An alternative option for the customer would have been to replace the generator with a new unit, which would have taken much more time than the repair done by the Sulzer Service Center in Indonesia.

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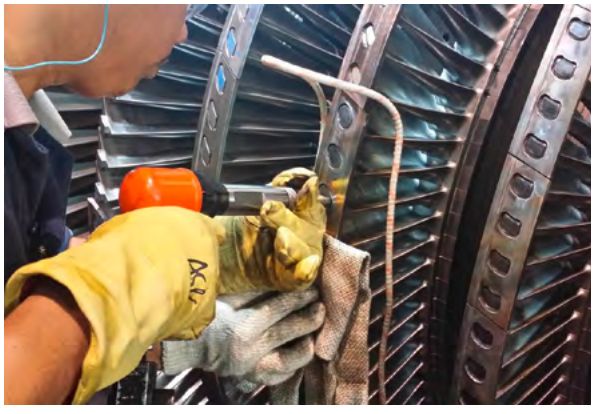
5 Low-speed balancing of all components before shipping.



6 New HPIP rotor blades were installed and secured with a hot peening process.

7 The generator was transported with an Antonov An-124.