

HYDEL GEARBOX (TURKEY)

1 TECHNICAL DATA:

Equipment	Turbo Generator Gearbox
Power	3200 KW
Type	Speed Increaser
Input/Output Speed	130/750 RPM.
Ratio	1 : 5.77
Oil recommended	ISO-VG-320
Teeth Design	Single Helical
Offset Type	Horizontal
Driving Equipment	Hydel Turbine
Driven Equipment	Alternator
Input Coupling	Rigid Coupling
Output Coupling	Gear coupling

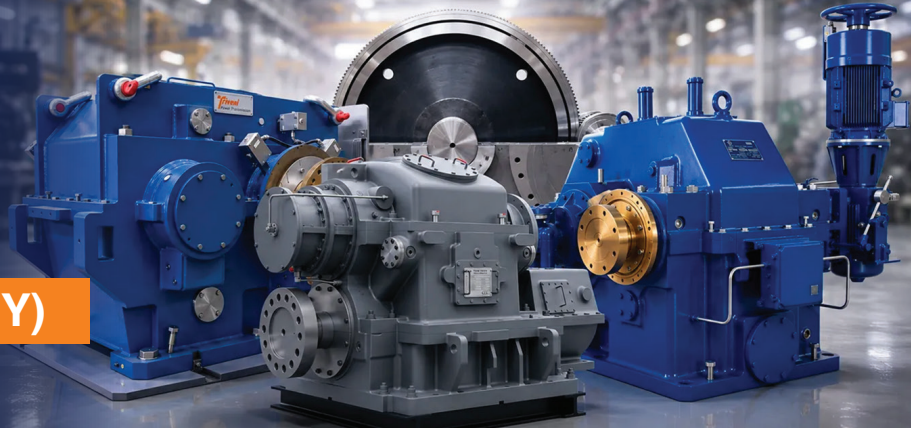
2 PREAMBLE / PROBLEM REPORTED

The OEM-made gearboxes were commissioned in 2009. The first breakdown occurred after 850 hours of operation in Unit 1, with a maximum load of 2900 kW. High vibration and noise were observed during operation. Upon inspection, deep cracks were found in the pinion teeth. Due to urgency, the end user manufactured a new pinion locally, and the set was recommissioned. However, noise and vibration were again detected in the gearbox, and misalignment was observed in the pinion bearing during operation.

Casing bore skew was suspected, and the casing bore was rebuilt and machined. The set was recommissioned. Unit 2 at the same plant was also commissioned at the same time, but the gearbox started failing after 1690 hours, exhibiting the same problems and observations as Unit 1.

Another two units were commissioned in the next year and within 1040 running hours, both gearboxes experienced similar problems to the first two units. The customer manufactured a new pinion in two years, which again failed within a short period of time.

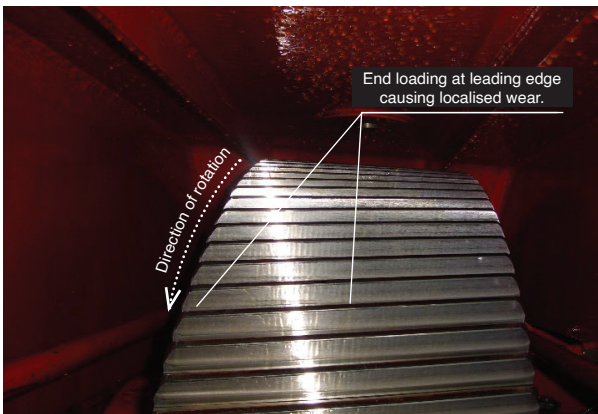
Since all four gearboxes in the plant experienced similar failures, and the gearbox OEM could not identify the root cause, the customer approached TPTL. TPTL deployed their design and service team.



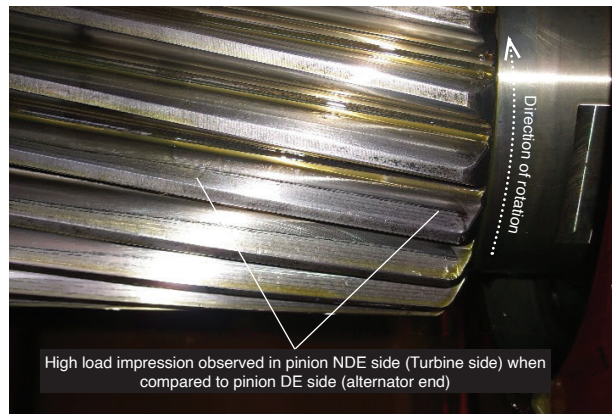
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3 DIAGNOSTICS STEPS UNDERTAKEN / OBSERVATIONS MADE:

The tooth impression in all four gearboxes found identical.



Gear Wheel



Pinion Shaft

Wear was found on both the pinion and gear wheel towards the turbine side, despite the customer achieving a blue contact of over 80% during gearbox assembly/repair.

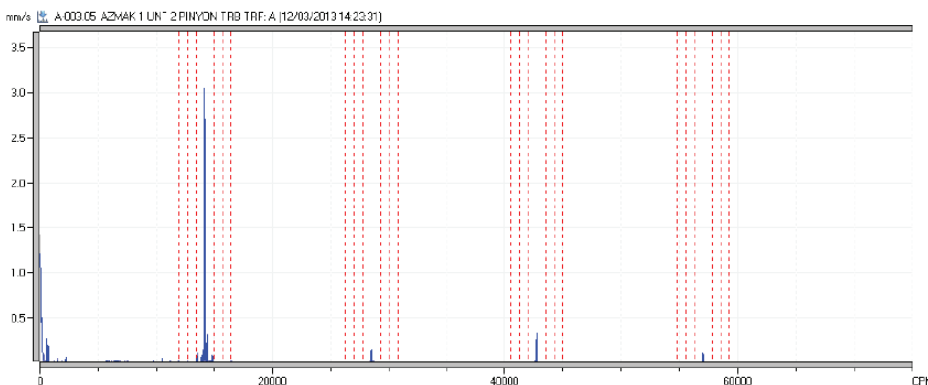
Gearbox input shaft runout was measured from no load to full load, revealing that the gear shaft had lifted by 0.10mm under load compared to no load.

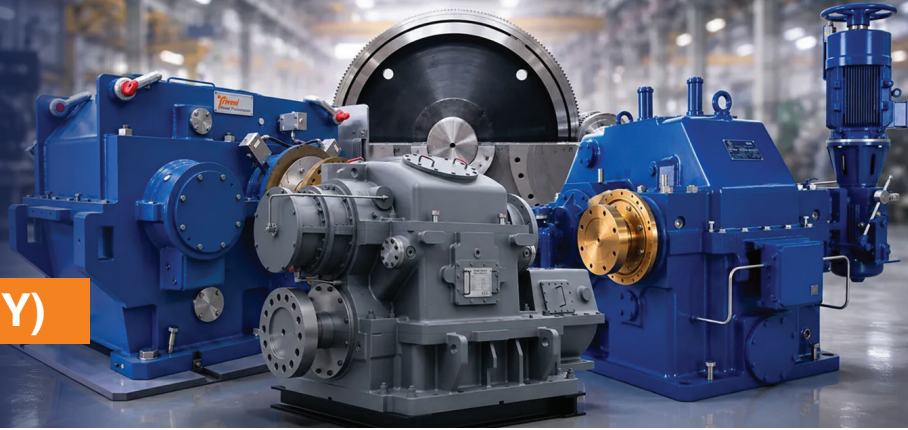
4 ANALYSIS:

The load contact in the gearbox was found to be 30% of the face width when compared to the 80% contact observed during no-load conditions.

The input shaft lift of 0.10mm at full load was identified as the most probable reason for the loss of contact under load.

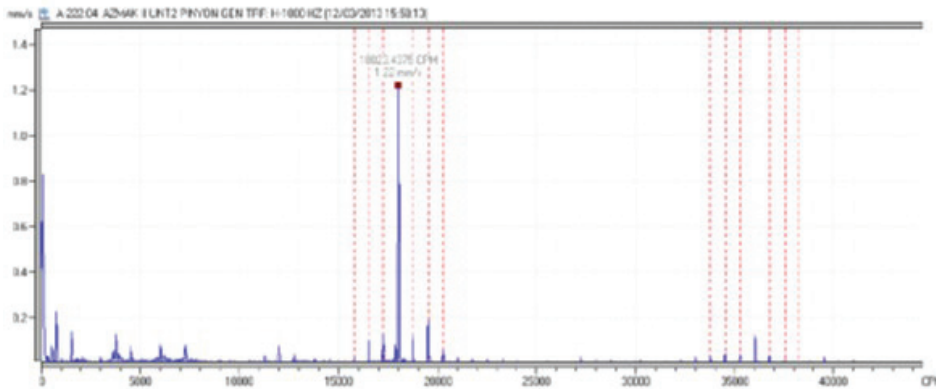
Spectrum analysis of the casing indicated the presence of gear mesh frequency (GMF) with sidebands, along with GMF harmonics at higher loads. Additionally, no GMF harmonics were observed during no-load running. Vibration readings indicated the presence of gear misalignment during load operation.





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During prolonged operation, significant sidebands were observed around the gear mesh frequency (GMF), primarily due to the initiation of gear wear.

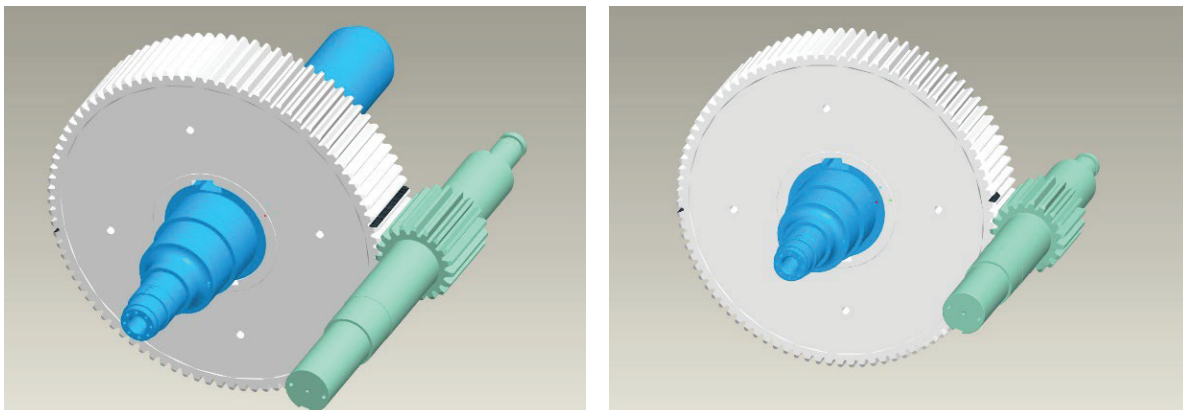


5 CONCLUSION:

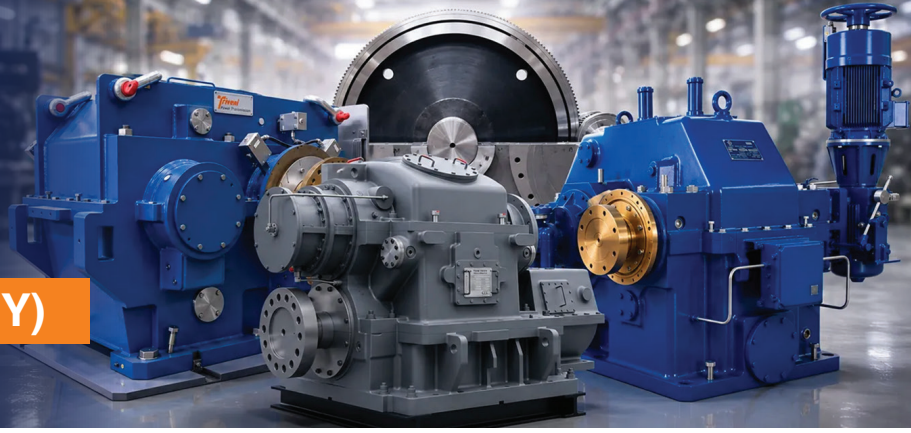
The change in contact pattern and GMF harmonics indicated the following.

- Deflection of gear shaft in the gearbox.
- Deflection of pinion shaft under load.
- Change of mode shape of turbine rotor shaft under load.

Since all four gearboxes exhibited identical behavior, it was found that the existing configuration of the turbine had axis shift during load operation.



The way forward would be to select a gearbox configuration where tooth contact is not affected under load. A vertical offset gearbox is one such configuration, where any change in the slope of the input shaft axis does not affect the tooth contact pattern. This is because the shaft axis moves parallel to the tooth contact, rather than away from it.



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6 COMPREHENSIVE SOLUTIONS PROVIDED BY TPTL

Horizontal offset gearboxes have been replaced with vertical offset Gearboxes, resulting in improved stability and competence. This solution has been successfully implemented and operational since then, ensuring enhanced performance and reliability.