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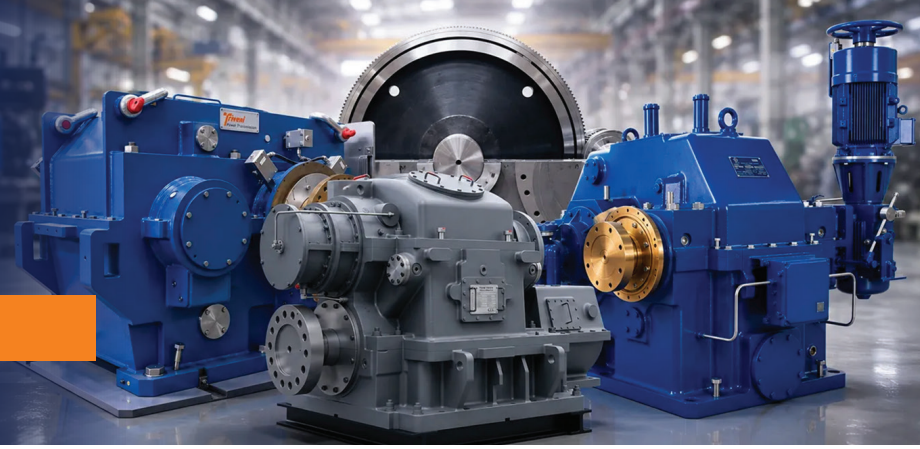
POWER TRANSMISSION LTD.



STEAM TURBINE DRIVE GEARBOX (PAPER MILL)

1 TECHNICAL DATA:

Equipment	Steam Turbine Drive Gearbox
Original Power	16,022 KW
Upgraded Power	18,705 KW
Type	Speed Reducer
Input/Output Speed	7554 / 1500 RPM
Ratio	1: 5.036
Centre Distance	720 mm
Driving Equipment	Steam Turbine
Driven Equipment	Alternator
Year of Commissioning	2006

2 PREAMBLE / PROBLEM REPORTED

The paper industry customer planned to utilize the spare generation capability available in the alternator and therefore sought enhancement of gearbox power transmission capacity without any change in existing footprint or centre distance. The original gearbox supplier did not recommend uprating within the existing envelope, making detailed engineering evaluation necessary. TPTL was approached for solution.

3 DIAGNOSTICS STEPS UNDERTAKEN / OBSERVATIONS MADE:

- Detailed technical due diligence was conducted to gather critical operating and design data relevant to the proposed uprating.
- Existing gear tooth bending strength, pitting resistance and bearing load carrying capability were evaluated for enhanced power conditions.
- Multiple gear tooth geometry permutations and combinations were analysed while maintaining the centre distance at 720 mm.
- The effect of increased transmitted load on bearing performance and operating reliability was assessed.
- Alternative bearing arrangements were investigated to ensure reliable operation at the higher power rating.

4 ANALYSIS:

- The study confirmed the feasibility of increasing transmitted power from 16.022 MW to 18.705 MW while retaining the existing gearbox footprint.
- Gear tooth geometry was optimized through several design iterations to achieve the required bending strength and pitting resistance.

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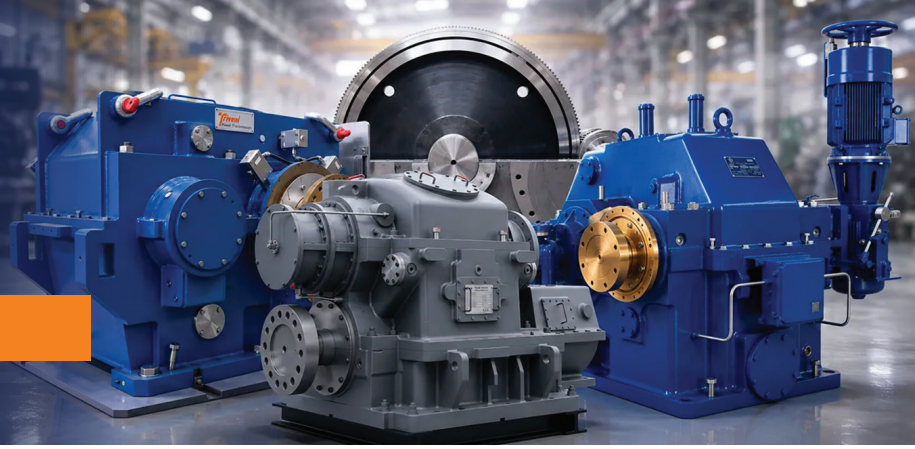

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- The tooth pressure angle was optimized to enhance tooth-root bending strength, thereby improving load carrying capability at the enhanced rating.
- As the centre distance remained unchanged, bearing specific loads increased with the higher transmitted power.
- To minimize this impact, the existing offset bearing arrangement was replaced with a pressure dam bearing configuration.
- The optimized gear and bearing design enabled reliable power transmission without any change to installation dimensions.

5 CONCLUSION:

- The gearbox was successfully uprated by approximately 16.7% while maintaining the original installation footprint and centre distance.
- The successful power enhancement was achieved through optimization of tooth geometry, pressure angle refinement for higher bending strength, validation of pitting resistance and implementation of pressure dam bearings.
- A newly designed gearbox incorporating these enhancements was manufactured, supplied and commissioned successfully and has been operating reliably in service.