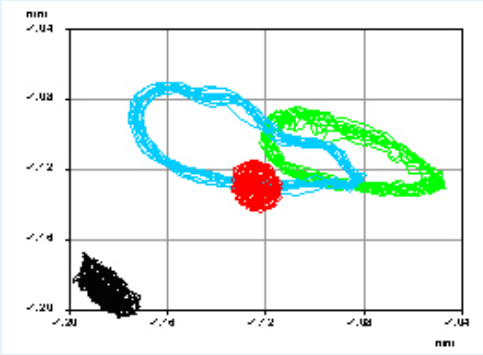
MACHINE DYNAMICS

8.5 MW generator string, stable or instable?

When commissioning a generator string in Austria, exceeded shaft vibrations were observed in part-load operation so that the operator refused the acceptance. As the cause for the vibrations increase was unclear, KCE was asked to carry out a comprehensive metrological investigation. From the steam turbine (rated power: 8.5 MW) with a high and low pressure part and a constant operating speed of 12,065 1/min, the torque was transferred via a 1-stage gear with pinion and gear wheel shaft to the slow-running generator shaft with 1,500 1/min. In part-load range (0.3 MW to 2 MW) increased bearing vibrations of v_{eff} = 5.2 mm/s at the gear as well as increased shaft vibrations of Smax = 95 µm at the pinion shaft were observed. Increased vibrations appeared primarily as subsynchronous single frequencies of about 60 Hz. For a more detailed analysis of the increased pinion shaft vibrations, the orbit displays of the fast-running shaft train were compared at different loads.

In part-load operation at 2 MW exceeded amplitudes appeared. The direction, the orbits run through, was parallel, i. e. in direction of the shaft rotation. The dominating vibration frequency was approx. 1/3 of the rotary frequency.

The mechanism of this increased sub-synchronous shaft vibration was based on the appearance of instability in connection with a bending natural frequency of the fast-running train (turbine shaft). The results of the investigation indicated instability at the slide bearings (oil-whip), although the detected subsynchronous vibration frequency occurred in an untypical range between the 0.28-fold and 0.31-fold of the rotary frequency. As especially the slide bearings of the pinion shaft operated on the limits of the pinion shaft regarding bearing play and the peripheral speed, KCE recommended a modification of the slide bearing system of the pinion shaft. Therefore, the radial bearing play of the pinion shaft was reduced.
After realising these measures, no instabilities of fast- running shafts could be detected. The critical load range now showed only radial pinion shaft vibrations of max. 14 µm ptp (before: 95 µm ptp) so that the operator could commission the plant without any problems regarding the vibration situation. operation without any problems.



Orbit display of shaft vibrations of the turbines (black and red) and pinion shaft (blue and green) at part-load – 2 MW

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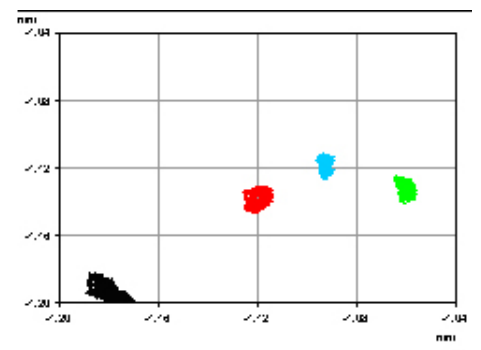

Orbit display of shaft vibrations of the turbines
(black and green) and pinion shaft (blue and green)
at part-load – 4 MW

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