Clever: The use of torque flanges in power generation plants

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Energy consumption is growing globally. In parallel, power generation plants need to be economical with valuable fuels and meet the increasing requirements posed by environmental protection. Aims that need completely new technologies for the operation of such systems.

A short history of uncertainty in the determination of torque…

Power and degree of efficiency are the most important value pair for determining the efficiency of plants for energy production: Effective power can be very easily measured at the generator output. However, measuring the degree of efficiency - the ratio between the effective power generated by the generator within a specific time and the drive power supplied to the drive in the form of fuel - is significantly more difficult.

A widespread method is the determination of the fuel mass flow. However, direct measurement of mass flow is very inaccurate. A series of difficult to influence parameters and the type of fuel used result here in strong uncertainty. In practice, the mass flow of the fuel is indirectly established with the help of previously determined calibration values and simulation programs.

Another method for determining the drive power is to record the torque in the shaft train between drive and generator. This allows the drive output to be calculated dependent on the speed. To do this, the torsion of the drive shaft, which is generated by the drive torque, can be determined. A series of methods is available for this purpose. However, they all have one thing in common: They do not determine the torque directly. Instead, the determination is indirect via a parameter related to torque and subsequent calculation. The parameters to be considered in this calculation (e.g. material, shaft geometry) are subject to tolerances which ultimately lead to a relatively large uncertainty in the torque parameter.

A good compromise can be found in measuring the drive shaft torsion via the strain on the surface. Strain gages are installed onto the shaft for this purpose, then connected into a measuring bridge. The measuring bridge power supply and the measurement signal are transferred contactless via a telemetry system from a stator to the rotating shaft and vice versa. This method delivers very precise measurement values for strain, depending on the quality of the application and the components used. However, the subsequently calculated torque value has an uncertainty of approx. 3 to 5%. The reason: The above-mentioned tolerances of the parameters that are taken into account here. The method has a series of advantages - for example, existing systems can be retrofitted at any time with this system. But: The achievable uncertainty for the torque parameter is no longer sufficient for the current requirements set for new plants.

The uncertainty of the above method can nevertheless be decisively improved by calibrating the drive shaft or parts of it directly for the parameter torque. The part being calibrated is incrementally loaded here in a calibration machine with defined torques. The corresponding output signals are then measured and documented. Calibration can be implemented on site. But it will then be subject to the difficulties inherent in the complicated and costly load application and the local conditions. Calibration in a calibration laboratory

instead provides optimal conditions and high accuracy. This needs costly and, in some circumstances, different mounting parts for the installation of the component to be calibrated in the calibration machine. In addition, in some cases there may not be any suitable calibration machine available due to the dimensions of the component to be calibrated or the maximum torque.

… and the happy end: No more uncertainty – torque really can be measured simply and accurately today

The difficulties described above can be avoided relatively easily. By taking into account the torque measurements in the drive chain during plant design. All that is needed for this is: A component that can be directly mounted in the drive chain, rotating with it or even taking over the function of the drive chain. This component is already calibrated to the required torque and appropriately certified. It can be easily installed, removed, replaced and recalibrated.

Figure 1 shows a torque flange that is available as a standard version up to 300kNm and which can also be delivered with a nominal measuring range of up to 2MNm. The measurement flange is available as a non-rotating version for the measurement of reaction torques or as a reference transducer, and as a rotating version with a telemetry system.

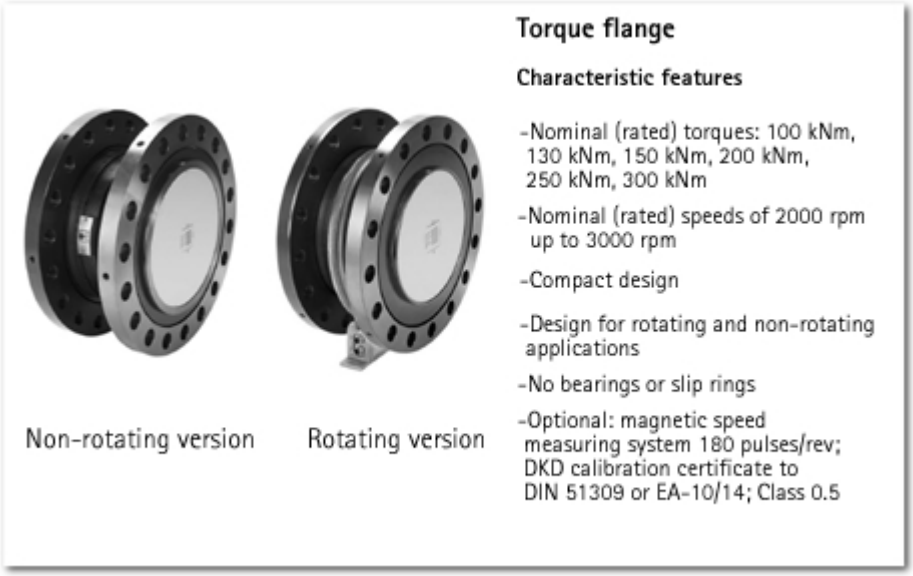

Fig. 2: Measuring body of a 2MNm torque flange

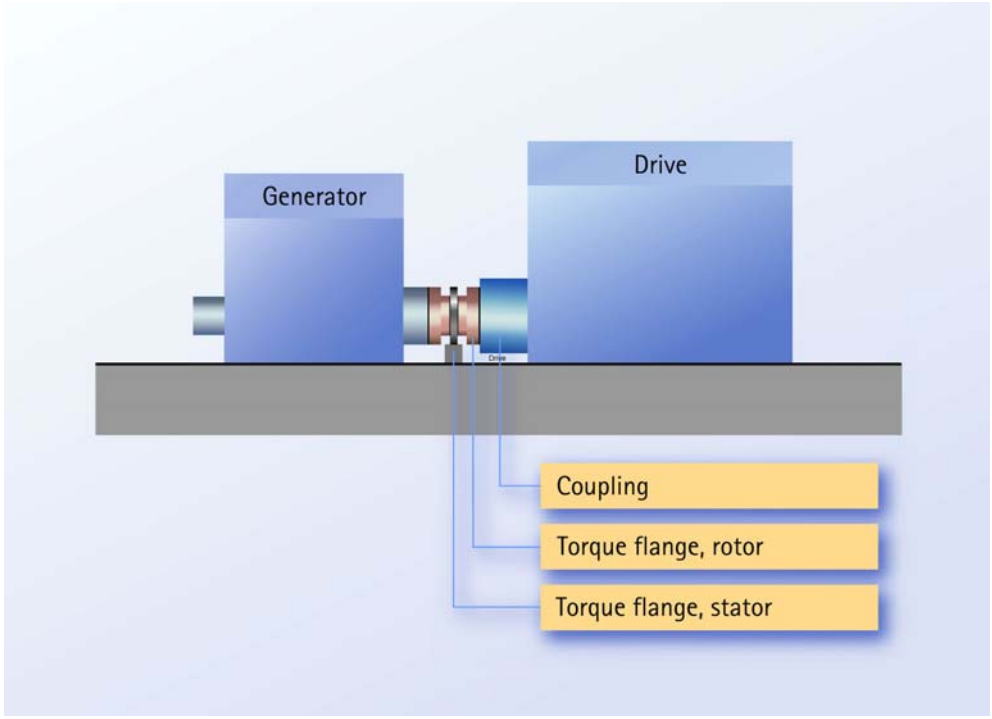

Fig. 3: Installation of a torque flange in a generator set

Depending on the telemetry system type, the torque flange provides the dynamic torque signal in high quality up to a bandwidth of 6kHz. This results in numerous advantages for the operation of plants for power generation:

- Constantly accurate efficiency measurements (monitoring)
- Fuel consumption analysis and optimization
- Torsion vibration analysis possible without additional sensors
- Detection of changes in characteristic torque curve
  → Conclusions for repairs or modification of service intervals
- Short signal propagation delay→ Rapid regulation and limitation during overload
- Easy mounting
- Easy recalibration, incl. calibration certificate
- ATEX certificate for use in potentially explosive atmospheres
- ABS or equivalent certificate for use on ships
- Wear and maintenance free

As the biggest manufacturer worldwide of torques flanges for torque measurements, HBM has decades of experience in this sector. Even during continuous use, the high quality of our products ensures high-precision torque measurements for many years. The global presence of HBM also ensures short reaction times for the clarification of technical or commercial questions.