Dual Drives Always Work Better!

Dual drivers—a combination of an electric motor and a gas turbine to power a centrifugal compressor—play on the individual strengths of each driver in a single package.

BY KLAUS BRUN & RAINER KURZ

Over the years, we have seen requests to drive centrifugal compressors with a combination of gas turbines and electric motors in various configurations. These are often referred to as hybrid drives or dual drives, or in many cases, the electric motor is seen as a helper drive. Some of the confusion comes from the fact that these combinations vary and therefore so does the architecture of such drives. The combination of electric motor and gas turbine drivers to power a centrifugal compressor offers opportunities to take advantage of the individual strengths of each drive in a single package.

In these combinations, the gas turbines can be single shaft, offering very little operating-speed flexibility, or two shaft. On the electric side, we see variable speed motors (as variable frequency drives, although variable speed gearboxes are feasible), as well as electric machines that can be operated as motors or generators. The drivers can also be rated for similar or different power. For certain applications, constant-speed electric motors could be used. The architecture of these drives usually, but not always, requires a clutch between the respective drivers and the compressor.

WHY CONFIGURE A DUAL DRIVE?

The reasons for employing a dual-drive configuration are just as numerous as the different configurations. Single-shaft gas turbines, when driving compressor trains in LNG applications, for example, require sizeable starter motors because the starter not only has to accelerate the gas turbine but also the entire compressor train. The starter motor needs to have variable speed capability while also using 25% of the driver power. (That does not sound like a lot, but it would be a 25 MW motor for a 100 MW gas turbine) These motors can also be used to augment the gas turbine power on hot days, and a clutch allows the motor to disengage when it's not needed. In similar applications, with two-shaft gas turbines, an electric motor can augment the power of the gas turbine, or it can be used as a generator to use surplus power for the generation of electricity. This looks attractive, but often the added complexity cannot be justified economically.

Other uses of hybrid trains seek to take advantage of low-cost electricity during certain times, operating the electric motor (with a disengaged gas turbine) when operating costs would be lower than gas-fired operation. Similar arguments can be made if emissions avoidance, together with high supply security in case of electric grid problems, are sought. In cases like this, the electric motor would be sized for similar power as the gas turbine, and the operation would see either the gas turbine or the electric motor but not both in operation. Therefore, one or two clutches are needed. Generally, to avoid tremendous windage losses, the power turbine of a gas turbine should not spin if the gas turbine does not make power. This means a minimum of one clutch is required.

For certain applications, constant-speed electric motors could be used. The architecture of these drives usually, but not always, requires a clutch between the respective drivers and the compressor.

In this circumstance, like in many other applications where the opportunity is to only use one of the drivers at a time, a centrifugal compressor that can be driven from both shaft ends is advantageous.

Economically, the case for dual drives is often difficult to make because essentially the project carries the cost of an extra driver, and the clutches and train become very complex, including control systems, lube oil control, and the torsional train behavior. Creating electricity to feed into a grid is not often financially rewarding. If the train is part of a facility that can consume the extra electricity, the economics change. The goal of supply security for predominantly electric applications can also be met by electric-only drives with a gas -turbine-driven generator. This can include mobile, deployable gas-turbine-driven power generation systems.

There are other possible turbomachinery train combinations, including steam turbine drivers, but these are usually only employed in applications where excess steam is available, such as refineries or olefin plants. Similarly, combinations of steam turbines with motor drivers have been successfully employed in petrochemical applications where plant steam is abundant.

So, there are potential benefits to dual drives, but the decision needs to be carefully measured about the goals the operator wants to achieve, and how much added complexity is acceptable. ■

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