DEFENDING ELECTRIC DRIVES

RECENT IMPROVEMENTS DISPEL ANY DOUBTS ABOUT THEIR SUITABILITY

Barry Dick
TMEIC GE

Myth Busters in the May/June, 2009 issue (p. 36) discussed replacing gas turbines with electric motors to drive variable-speed compressors, and lists benefits including superior efficiency, lower emissions for better environmental performance, and reliability and availability. A number of factors to consider in evaluating this retrofit are then discussed. The following is a different look at the same issues.

Beyond dispute

Electric drives and motors of high capacity have been applied with great success in many industries over the past decades. Prominent among these are steel-making rolling mills, power generation, and compressor drives for gas transmission and refinery applications. The technology has progressed over the years and the newer types of drives have characteristics that are friendly to the power system and the motor.

Replacing a turbine with a drive and motor may require additional electrical service to be brought to the compressor site. The complexity and cost of getting sufficient power to the compressor site depends on its location. Refinery applications are usually located where power is readily available; pipeline applications are usually more isolated, but arrangements can usually be made to obtain adequate power.

Starting a large motor with a drive does not stress the power system because the drive does not allow inrush currents. The maximum current draw is no more than rated motor current. Large capacity Pulse Width Modulated drives can be applied on "relatively weak" power systems because they operate at high input power factor and do not depress the system voltage while starting and operating the motor.

Problems with motors powered by drives have largely been solved. Problems that may have occurred in the past with motor bearing currents, and motor harmonic heating have been studied and effective measures have been implemented to solve them.

The bearing currents are eliminated by properly insulating at least one of the motor bearings (which is standard practice for medium voltage motors) and by using the correct cables between the motor and drive. These cables provide a path for common mode currents to return to the drive without passing through the motor bearings. There are also effective ways to ground the motor shaft using brushes or other means that ensure any voltages are drained off the shaft.

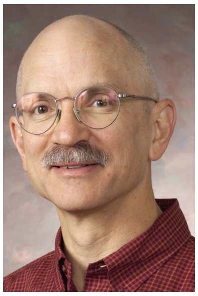
Harmonic currents imposed on motors are quite low in magnitude due to multi-pulse techniques or low harmonic output drives. Generally, these low-level harmonic currents are high-frequency in relation to the mechanical torsional vibration frequencies. When torsional excitations from a drive occur, it most likely is from a regulator problem or tuning problem. These can be fixed in the design or tuning of the drive system, and are not inherent to the use of an electric drive on a motor.

The adverse effects on the power system of recent drive system designs are insignificant. Harmonic currents have been reduced to low levels by multi-pulse (18-pulse or higher) systems or with the use of active front-end converters. The drives also exhibit high power factor operation (0.95 or higher) over the useful operating speed range, so voltage sag is almost never a problem.

An electric drive and motor can be applied to any defined load on a compressor application. Electric drives have been applied to loads with high overload requirements, such as metal rolling mills, for many years. With a defined torque-versus-speed envelope for the compressor, an appropriate drive and motor can be designed. If higher torques are required at speeds below the rated speed, the drive can be selected for that capacity and the motor cooling and torque capacity can be matched to the load.

Electric drives and motors can be effectively applied in varied conditions and can meet the desired goals. For a retrofit application, the goals might include reduced noise, emissions at a specific location, and reduced maintenance frequency and costs. Anytime one or more of these goals must be addressed for an existing compressor site, an electric drive option should be considered. The drive system and motor can be configured to deliver the proper torque and speed to the compressor, while overcoming some of the most bothersome aspects of operating a turbine as a mechanical driver. TI

Author
Barry Dick is a Senior Drive Application Engineer with TMEIC GE in Roanoke, VA.

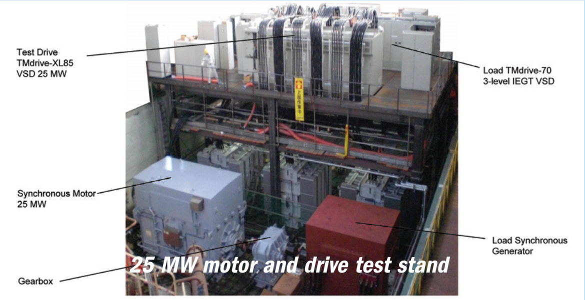


DRIVING HEAVY-DUTY COMPRESSORS

In 2008 TMEIC introduced the XL series of electric drives for compressor applications. These drives are sized to drive the high-power compressors used in Liquefied Natural Gas (LNG) plants and on pipelines. These drives extend the capabilities of the TMdrive-MV series, now updated as the TMdrive-MVG. Voltages range from 3 kV up to 11 kV with the TMdrive-MVG, and power levels of over 100 MW are supported by the TMdrive-XL85 in its multi-bank configuration. In the TMdrive-XL85, 30 MVA of power is provided through 24 output devices.

While most of the applications for the new TM-XL drives are in LNG plants and on pipelines, they can also be used on large compressors and fans in refineries, petrochemical plants, and electric utilities. To verify the design and construction, TMdrive-XL has been factory-tested under full-load conditions and a wide speed range, which helps to give assurance for use in high-power compressors.

Figure shows the actual large drive test stand used for the TMdrive-XL series performance tests. The arrangement used a back-to-back configuration where the motor drives a generator whose power output is circulated back to the supply to recover the majority of the system energy.



25 MW motor and drive test stand