Planning for successful electrified fracturing

A single AC induction motor directly connected to the pump input shaft can now replace the diesel engine, transmission and associated auxiliary equipment in a hydraulic fracturing operation.

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Recent socioeconomic and regulatory changes are placing pressure on hydraulic fracturing apparatus to become cleaner, quieter and more efficient. This in turn is driving the development of a new breed of hydraulic fracturing platforms—the electric fracturing skid.

Conventional formation fracturing requires a fluid slurry source that can accommodate a broad range of pressures and flows during the critical stages of formation development. The current state of the art has relied upon several massive diesel engines, each mechanically coupled to multiple-piston positive displacement pumps through a multispeed transmission—an integrated system solution that has endured for the past several decades.

The success of the diesel solution is due in large part to:

- Component reliability;
- Prime mover durability;
- System flexibility; and
- Operation simplicity.

The constraints placed on the range of fluid pressures and flows necessary to successfully fracture a well require enormous total bulk pumping power capability. Additionally, the site operator must have very fine control of all of the available power. Cost-effective electric solutions that could provide the required power, precise speed and torque control in a lightweight and small footprint have been beyond the reach of technology—until now.

Advances lead to transition

With recent advances in electric motor analysis, design optimization techniques and variable frequency drive (VFD) software, it is possible to remove the diesel engine, transmission and associated auxiliary equipment from the pumping platform and replace it with a single alternating current (AC) induction motor directly connected to the pump input shaft. The electric power delivered to the AC motor is then controlled and supplied through a VFD that may be located at any convenient location onsite and connected to the motor with only a few power cables.

When using closed-loop vector control methods with an integrated high-resolution motor shaft encoder, the pump operator has the ability to apply full torque from the motor to the pump over a wide range of speeds. This translates into the ability to have full pumping pressure available with very fine control from 0% to about 40% of full flow. When exceeding 40% flow, available pressure will decrease with increases in flow. These aggregate characteristics are ideal for the critical stages of formation development.

Technical partners critical to success

Whether developing a new design skid platform from the ground up or converting existing hardware to use newer technology, the technical skills required will be vastly different from those required for "conventional" diesel fracturing. Owners and operators need to partner with leaders in the industry that will not only provide the technical support required to select the right motor, VFD and power sources but that also must have the technical ability and innovative spirit required to help the customer develop its "niche" in the market.

And given that each electric frack site will require between 25,000 hp and 60,000 hp of power vs. up to 4,000 hp for a traditional electric drilling site, it also is critical to partner with a dedicated technical motor design and manufacturing company to help plan, develop and implement a custom program that uses a range of powerful, lightweight and smaller volumetric envelope motors and drives that specifically meet the challenges this market segment presents. Traditional motor repair shops are generally not equipped to properly evaluate the applied physics and system-level tradeoffs required.

There is no doubt that this new era of electrohydraulic fracturing will be intensely competitive. Only those organizations that select the right key partners will be able to provide solutions that:

- Deliver greater mobility and portability;
- Are less expensive to transport;
- Occupy less of the total site footprint;
- Provide superior fluid power control;
- Remain quieter and cleaner than the incumbent diesel solutions; and
- Reduce recurring maintenance. E&P