ELECTRICAL BOPS POINT TO THE FUTURE

A raft of challenging regulations in the wake of the Deepwater Horizon tragedy in the Gulf of Mexico has led to new innovations in blowout prevention, writes Magne Rød, chairman of the board and commercial manager of Electrical Subsea & Drilling.

Following the Deepwater Horizon tragedy, new regulatory requirements are being imposed internationally, phased in over time. Many requirements are difficult to meet with today’s blowout preventer (BOP) technology. This includes cutting, maintenance, testing requirements, increased reserve energy, monitoring, underwater vehicle override, remotely operated vehicles etc. In addition to improvement of BOP well barrier devices, development of all-electric BOP control systems has begun, in order to satisfy new requirements.

Electrical BOPs may be used in surface and subsea applications. There is potential here for efficiency gains – there will be time to save on fast mobilisation and demobilisation for land drilling. A general benefit is enhanced control and monitoring capabilities during operation and condition based maintenance functionality.

The volume of surface equipment, with the elimination of the hydraulic power unit, hydraulic operation panels, pipework/hoses, will be greatly reduced. For subsea applications, there are additional benefits related to reduced BOP stack height and weight, which is beneficial with respect to handling and wellhead fatigue challenges. Another aspect is the huge economic potential of reducing downtime/time between operations and elimination of water depth limitations related to subsea hydraulics.

Reliability studies have identified BOP control systems as the most likely source of failure on a BOP stack. Improved reliability and operational efficiency will be obtained through a reduction of the sources of fault in the control system compared with today’s electro-hydraulic control system as well as reduced system
complexity and elimination of hydraulic leakage points. Other critical components are the annular and ram preventers. Exact control over applied force and operation cycle monitoring, so that repairs or replacement of critical components can be performed before they turn into major failures, will also reduce downtime.

There will be full controls redundancy to the actuators - as opposed to shuttle valves between pods on today’s electro hydraulic control systems. A new standard of continuous condition monitoring of actuator controls will be enabled, with system condition monitoring, (various instrumentation and insulation resistance monitoring of electrical distribution with electrical battery bank monitoring,) feedback from actuator power controls with exact actuator position and applied force.

This will enable advanced diagnostics during operations and condition based monitoring and maintenance. Electric batteries will offer much higher energy density than hydraulic accumulators and will be more space and weight efficient. Reserve energy and battery condition can be continuously monitored at battery cell level.

Electro-mechanical actuators and control systems can be interfaced with existing BOP designs, but the greatest improvement will be integration of all-electric controls with improved well barrier technology, to fully satisfy statutory requirements. During shearing operations, it will be possible to control the actuator speed, so that speed is maximized across the unloaded distance, before the cutting blades touch the pipe. “Soft stop” of rams may be implemented; this should increase the seal life compared with ‘on/off’, high-pressure hydraulics.

There are no electrical BOPs in operation today, but subsea production systems have been moving towards all-electrical controls with electro-mechanical actuators since the turn of the century. Electrical BOP development has been held back by a mixture of commercial and technical circumstances.

Incentives for funding of research and development programmes have been overshadowed by a general contentment with the status quo of electro-hydraulic control systems and cost of development. Subsea BOP suppliers and operators are reluctant to change, since these systems are proven technologies and are familiar to users across the industry. Efforts tend to be focused on continuous improvement of existing systems, rather than enabling technologies that may be disruptive to current business models.

The electrical BOP development is currently being pioneered by technology companies outside the established BOP supplier industry, funded by operators and drilling companies which are supporting the development. Electrification of BOP controls is not only driven by the safety policies of the operators, but the technology also fits well with a general trend of increased onshore/offshore “digitalisation”, to reduce life cycle costs through performance analytics and asset optimisation.

The development has so far consisted of prototyping and testing of the electro-mechanical actuator technology. The next step will be BOP system engineering and further prototyping and testing of core technologies. A first electrical BOP may be field proven some time during 2020. The qualification scope for actuators and new well barrier technology will be relatively similar, whether the BOP will be for a subsea or a dry application, but the total development scope of a surface BOP will be less demanding, compared with a subsea electrical BOP.

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