Product and Service Innovation

The challenge in the successful development of optical sensing systems has been integrating non-oil field optical competance with established completion technologies.

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Weatherford International Ltd.'s acquisition of CiDRA OSS (optical sensing systems) in late 2001 was part of a strategic initiative to expand its completion systems division and continue bringing innovative technologies into the oil and gas industry. The move positioned Weatherford at the forefront of the trend toward permanent optical reservoir-monitoring systems. By integrating optical surveillance techniques into existing interventionless flow-control hardware, Weatherford is creating the next generation of intelligent wells.

The development of fiber optic permanent monitoring systems merged optical and completion disciplines to produce oilfield equipment utilizing non-oil field technology.

Technological collaboration

To expedite the integration of fiber optic technology and skills into the established culture of the oil and gas industry, Weatherford has worked closely with its client base. With its acquisition of CiDRA OSS, Weatherford added to its existing technology development steering relationship with BP Corp. an alliance to qualify and introduce permanent optical reservoir-monitoring systems. Acceptance of downhole fiber optic technology by BP assets and the industry in general has been helped by ensuring the products and systems being developed matched the requirements of customers (i.e.: developing solutions to real problems as opposed to solutions looking for problems). With numerous deployments successfully completed, fiber optics have gained a reputation as a robust, reliable and functionally superior alternative to electronic sensing technology for permanent reservoir-monitoring applications.

Applying established technologies

Although advances in optical technology in the telecommunications and other industries have enabled the development of permanent in-well fiber optic sensing systems, successfully adapting and deploying proven data communications technologies in the oil field has required close cooperation and communication between fiber optic specialists and experienced oil field professionals. The challenge has been to successfully focus knowledge and expertise from two fundamentally different technical disciplines in an energetic, efficient and creative manner.

For example, a fiber optic cable and connector system provides for light transmission to and from the downhole sensors. fiber optic specialists in cooperation with completion product specialists have specifically designed the cable and connector system for mechanical and environmental robustness, as well as optical functionality. They have incorporated multiple protective barriers between wellbore fluids and the optical fiber. Every attempt has been made to give the cable a look and feel similar to its electrical counterpart. Mechanical strength and protection of the cable is provided by a metal capillary tube, encapsulated in a polymeric buffer. The tubing encases a specially coated, small-diameter stainless steel fiber-in-metal-tube (FIMT) surrounded by a buffering material. The optical fibers are packaged in the FIMT with hydrogen-gettering gel, which provides high striction forces for holding the fiber in place. Together with the cable, high-reliability optical connectors and cable fusion splicing techniques also have been developed for long-term survival in harsh downhole environments. To complete the in-well system, the cable is connected to the optical sensor, whether a pressure/temperature transducer, an optical flowmeter or a seismic sensor. These sensors are then integrated as an assembly into the production tubing string. ●