# A Fiber Optic Permanent Reservoir Monitoring System

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An entirely fiber optic system for the permanent installation and time-lapse (4-D) monitoring of producing reservoirs is presented. Several important advantages will be realized from an optical system: Zero in-sea electronics present no environmental risks, improved reliability, lighter weight construction, significantly reduced deployed system cost and improved operational safety.

A full field trial was pursued in 2003 using both conventional electronic and optical four-component (4C) cables in the North Sea. Data collected from the field tests proved that the prototype optical system met all the performance requirements required for operations in water depths up to 3,000 m. Several new generations of fiber optic sensor and telemetry design have been developed in the ensuing two years, including optical hydrophone, geophone and accelerometer designs. Both field and pressure chamber testing verify the integrity of all components up to water depths of 3,000 m, with equivalent sensitivity to conventional electrical components. By nature, fiber optic technology provides greater dynamic range than electrical technology. Therefore, the potential exists to build extremely sensitive systems, including pressure independence.

The fiber optic technology is particularly suited to permanent monitoring installations. Total channel count can be scaled to accommodate any three dimensional installation size, with receiver spacing between 6.25 and 500 m. System durability in harsh conditions is excellent, building upon decades of subsea fiber optic telecommunications technology. Given the apparent growth expected from permanent monitoring technology in the near future, the system presented here offers many exciting geophysical, cost and operational benefits.