Rigless, through-tubing wireline-retrievable ESP lowers operating costs

As the complexity associated with producing hydrocarbons increases, operators continue to seek improved pumping systems for bringing fluids to surface at lower costs.

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The relatively high cost and long lead times associated with rig workovers—in offshore and remote operations—motivate operators to explore other economical alternatives to pulling and replacing low-performing or failed electric submersible pump (ESP) pumps.

To help mitigate these issues, AccessESP has developed a retrievable ESP system that delivers a high degree of flexibility and ease of operation (Fig. 1) that has not been possible with previous ESP applications and technologies. Slickline-retrievable ESP systems are now a commercially viable technology, proven in a range of challenging environments and operating successfully in fields all around the world. The application of this technology significantly reduces operating costs, capex and cost-per-barrel for operators in a large segment of the global ESP market, while actively increasing well productivity.

In 2014, the company commercialized an innovative, rigless, through-tubing retrievable ESP system, where pump deployment and changeout operations can be performed on a live well, fully compliant with industry well barrier policies. This differentiating technology eliminates the need for costly heavy workovers and well interventions related to replacing ESPs, and largely improves well production uptime.

For very demanding well environments, AccessESP also provides their installations with optional proprietary ESP power delivery system, including an innovative encapsulated power cable (EPC) further enhancing the permanent system reliability and total system life.

AccessESP system is an evolution of the initial technology introduced in the 1990s to solve ESP challenges identified by operators in the Alaskan North Slope. Then, the ESP pump could be replaced with a standard slickline operation, without the need of pulling the tubing or well completion. Over 300 rigless ESP replacements were performed successfully with this previous generation, with a record 96% success rate.

THROUGH-TUBING WIRELINE-RETRIEVABLE ESP

The new system consists of an outer, permanent completion and a retrievable assembly. The permanent completion is deployed with the tubing string (run with a rig) and is intended to remain in the well for an extended period (10+ years). The retrievable assembly contains the ESP components, and is designed to be removed and redeployed through tubing with conventional, light intervention equipment on a live well.

Key benefits are:
1. Maximizing well production uptime.
2. Live-well ESP change-out operation, eliminating reservoir damages, due to kill fluid.
3. Eliminates the need to pull the tubing string, to replace an ESP.
4. Lower operating costs, thanks to...
a rapid ESP change-out through a standard slick line operation on a live well.
5. Full-bore access to lower completion and reservoir for remediation and measurements (sidetracks, logging, setting plugs, stimulation, perforating, etc.).
6. Versatile ESP components change-out, allowing adjustment of the ESP components to match reservoir changes.
7. High-efficiency permanent magnet motor (PMM) – prime mover in the ESP system.
8. Compatibility with most industry ESP pumps, also qualified to operate with most VSDs in the market.

PERMANENT COMPLETION SYSTEM

Run with the production tubing, the permanent completion is the “landing string” for the retrievable assembly ESP system and has two main components: 1) the side-pocket-mounted downhole wet connector; and 2) the connector orientation and latching system, Fig. 2. The side pocket wet connect system provides an electrical connection between the retrievable ESP assembly and the ESP power cable to surface, that is installed outside of the tubing, similar to a standard ESP.

There is at least 3.8-in. full-bore access to the lower completion (production zone), once the ESP is retrieved (thru-tubing) from a well. An optional isolation sleeve is also available to protect the permanent completion wet connector dock from mechanical damage during well work and lower completion operations.

THRU-TUBING SLICELINE RETRIEVABLE ASSEMBLY

The retrievable assembly integrates the plug arm / wet connect system, permanent magnet motor, seal / protector, and downhole sensor with industry-standard components available from any ESP provider, Fig. 3.

The retrievable assembly system is installed and retrieved thru-tubing on a live well with a standard slickline operation in four individual runs. This proven deployment methodology is intentionally proposed, to ensure ease of deployment using conventional slickline in live wells and enhances the retrievability success when a component needs to be changed, as well as allowing for partial system changeout.

A proprietary permanent magnet motor is, by design, one-fifth the weight and length of a conventional ESP induction motor. This is a key enabler to support the ESP changeout through a standard slickline or wireline operation. In wells with high deviation and installation depths beyond reach of typical slickline operations, the system has been deployed successfully, using coiled tubing, wireline tractor or pump-down to reach the target installation depth.

CASE STUDIES

Pump-only replacement. A major operator challenge was how to produce a field economically with very difficult reservoir conditions, in particular unconsolidated sands producing viscous low-temperature oil with fines. Standard ESPs typically wear out in about a year. In addition, produced sand often accumulates in the wellbore and completion string, requiring frequent well clean-outs.

The company’s thru-tubing wireline retrievable ESP system was installed in various wells enabling the operator to perform pump-only replacements on a standard slickline, a cost-effective live-well rigless operation. Wells are brought back to the desired production in about 36 hr. For cases were the well is sanded up, the entire retrievable ESP system is removed from the well on a similar live-well rigless through-tubing operation, allowing a clean-up operation at a fraction of the time and cost of a conventional well workover.

Rigless ESP resizing offshore. ESPs are the preferred option for producing wells offshore West Africa. However, the operator did not have reliable reservoir information to properly size the initial ESP, engineers used data from a nearby area to complete the application design.

The well was completed with the new ESP system. However, after various tests, more accurate reservoir data were captured, and the operator elected to resize the ESP to a higher horsepower unit, to help achieve the required drawdown. The ESP was replaced on a live well rigless intervention, obtaining the desired production, which was an effective long-term solution that otherwise would have sacrificed production or required a heavy workover operation.
ESP rigless live-well clean-out. A highly deviated multi-lateral well had a history of producing significant amounts of sand that accumulated in the production string, restricting the flow to the ESP and requiring frequent fill clean-out interventions. The well was equipped with an AccessESP system. To perform the lower completion and multi-lateral clean-out required removing the ESP from the well with a combination of slickline and coiled tubing operations.

The operator elected to perform a complete fill clean-out below the ESP, removing and clearing any sand accumulation in the upper and lower completion laterals. After removing the ESP and retrievable assembly through the tubing, the protection sleeve was installed across the downhole wet-connect to minimize debris settling during the clean-up operation or during re-installation of the ESP.

Following the successful well clean-out, a retrievable assembly with the ESP was reinstalled, bringing the well back to desired production. This successful operation included the combination of CT and slickline. Significant cost-savings were realized, due to expedited execution time, minimizing disruption to oil production while reducing HSE risks.

ESP horizontal, live-well rigless change-out. A major operator offshore West Africa, with producers on ESPs, needed to address the high cost from frequent workover operations and deferred production from well downtime. The ultimate objective was to lower the total cost of ownership while extending the economic life of its fields.

The fields were approaching the end of their productive lives and were, therefore, of limited future financial value. The operator was looking for a solution, in which ESPs in the wells could be retrieved and replaced economically, thus extending the field’s economic life. The company’s research concluded that installing the through-tubing wireline-retrievable ESP system was the most viable option, considering the small platform footprint and the benefit of performing ESP change-outs with slickline on a live well.

Because the ESP was placed in the well’s horizontal section, to safely and effectively perform this operation, engineers elected to combine the use of a live-well wireline operation with support from a well tractor with a stroker. The operation facilitated an optimized ESP change-out combination and eliminated the need of a coiled tubing operation. With this technology and methodology, ESPs can now be changed out with 25-30% of the cost compared to rig intervention operations, with significantly reduced HSE risk compared with using a workover rig.

VALUE ADDED BENEFITS

Rigless thru-tubing retrievable ESP systems significantly reduce the impact of deferred production and rig costs on prolific wells. The new ESP system eliminates, or minimizes, logistical challenges, including availability of intervention rigs, lack of on-board accommodations, limited lifting capacity of platform cranes and small deck space for workover operations.

This technology also has been considered for well flowback / clean-out and well testing, where retrieving the ESP through-tubing offers a meaningful benefit, compared with standard ESP runs. It enables operators to move away from costly and inefficient run-to-failure systems, with a business model that grows and favorably scales with a producer’s changing business objectives.

Fields being pumped with gas lift now have an economically viable lift alternative with the new ESP technology, which increases well productivity while extending the field’s economic life.

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