

PCL

Production composite log service

APPLICATIONS

- All ESP wells equipped with downhole gauges measuring both intake and discharge, particularly
 - wells where conventional testing cannot be performed, such as subsea wells, unmanned platforms, and remote locations
 - wells with flow rates too low for testing with a physical meter
 - fields with large well populations that preclude testing monthly
 - wells dominated by transient conditions such as intermittent production, low mobility, or unconventional shale oil production

BENEFITS

- Extends ESP run life by enabling optimization of pump operating point, motor current, and pump degradation in real time using pump health indicator (PHI)
- Optimizes drawdown by analyzing real-time rate change measurements resulting from small choke and frequency changes
- Reduces testing costs by extending intervals between physical tests
- Measures productivity index (PI), skin, depletion, and reserves without buildups

FEATURES

- High-frequency rate measurement, typically 1/min
- High repeatability
- High resolution, typically 20 bbl/d for rate and 0.5% for water cut
- Liquid rate features:
 - Validity in transient condition
 - Independence from fluid specific gravity and therefore auto-calibrating with changing water cut
 - Validity across full pump flow range

PCL* production composite log service improves well production and ESP run life by providing real-time high-frequency liquid flow rate and water cut measurements. The high resolution and repeatability enables inflow characterization with techniques such as transient analysis in drawdown, single-well simulation, and fracture flow regime visualization.

PCL service also provides a comprehensive method of tracking the operating stress endured by an ESP throughout its life, which contributes to subsequent failure analysis and enables run life improvements.

Real-time deliverables (online)

PCL service can read and write data to and from any historian, making it flexible enough to work with most SCADA systems. For operators already using the Schlumberger Lift IQ* production life cycle management service, a well can be connected to the PCL service engine within a few days. The service delivers 8 parameters directly to the operator's historian and the production or reservoir engineer's desk:

- Downhole liquid rate
- Operating point
- Data quality indicator
- Water cut[†]

- Surface liquid rate[†]
- PHI, which can be used for initial calibration of rates and real-time detection of ESP performance degradation[†]
- Recommended voltage to minimize current[‡]
- Expected minimum current[‡]

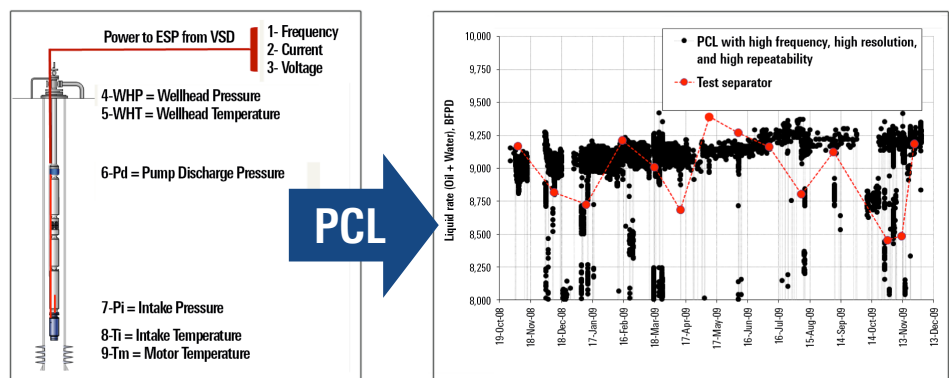
Maximizing ESP run life

The proprietary real-time pump health indicator monitors real-time pump performance degradation caused by wear, gas, viscosity, and scale. It also enables initial flow rate calibration when a test separator or multiphase flowmeter are not available. Optimal motor voltage is also calculated in real time to minimize power consumption and motor temperature.

Reservoir characterization reports (offline)

The high frequency, high resolution, and high repeatability of PCL service enables five types of reports:

- Inflow performance relationship (IPR) curve is available either a few days after ESP installation with a managed frequency ramp-up, or by creating a multirate test with small variations of choke, frequency, or both. It does not require measurement of reservoir pressure, thereby avoiding buildups.



PCL service uses ESP gauge data to generate high-frequency, high-resolution, and high-repeatability flow rates that enable reservoir characterization — without additional testing.

[†]requires real-time wellhead pressure
[‡]provides real-time power optimization

- Skin measurement with pressure transient analysis (PTA) can be performed in drawdown—for example, during ESP startup—thereby avoiding buildups. This is enabled by PCL service high-frequency downhole liquid rate, which captures transients.
- Log-log plots of $(P_i - P_{wf}) / Q$ over time identify reservoir flow regimes. This enables fracture characterization and is particularly valuable on multiple-fractured horizontal wells.
- Single-well simulation can be performed to obtain evolution of reservoir pressure and skin over time.
- Hydrocarbon pore volume (HCPV), a proxy for drainage area, can be calculated using flowing material balance calculation for undersaturated reservoirs.

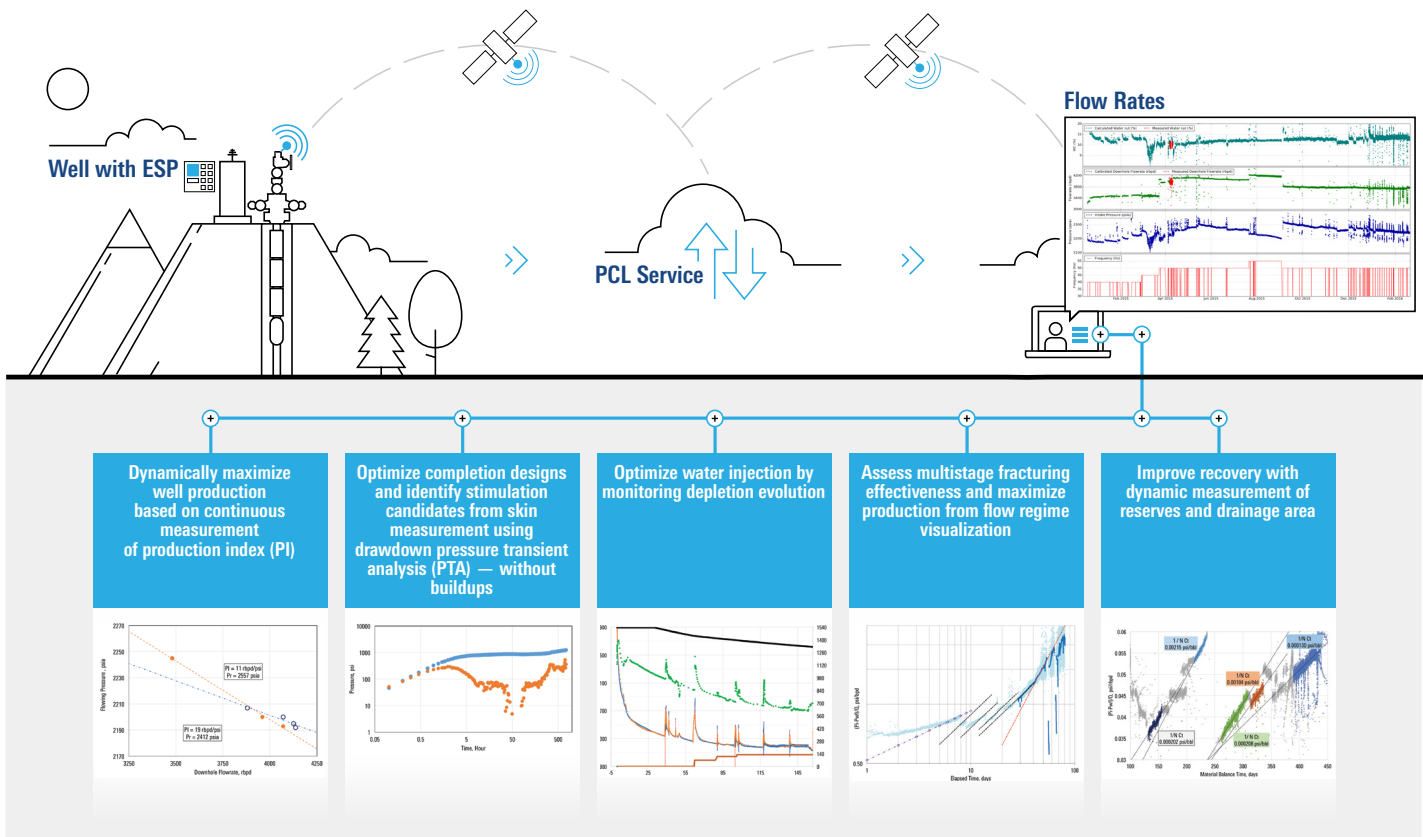
Back-allocation analysis (offline)

The PCL service can deliver type curves of liquid rate and water cut over time, which are ideal for back-allocation and in particular for wells commingling production into a single line (such as subsea and remote wells that cannot be tested separately) or where a dual-ESP completion means each layer is produced with a dedicated ESP.

Proven track record and case studies

The technology of PCL service is the culmination of many years of development and field trials, which are detailed in a series of seven technical papers available from the PCL service library.

Date	Paper number	Title
February 2010	SPE 127593	First Installation of Five ESPs Offshore Romania—A Case Study and Lessons Learned
September 2011	SPE 145542	Obtaining Real-Time Flowrate, Water Cut and Reservoir Diagnostics from ESP Gauge Data
September 2015	SPE 176780	Converting ESP Real-Time Data to Flow Rate and Reservoir Information for a Remote Oil Well
August 2016	URTEC 2471526	ESP Real-Time Data Enables Well Testing with High Frequency, High Resolution, and High Repeatability in an Unconventional Well
September 2016	SPE 181663	Providing Accurate ESP Flow Rate Measurement in the Absence of a Test Separator
November 2016	SPE 183337	Testing the Untestable... Delivering Flowrate Measurements with High Accuracy on a Remote ESP Well
April 2017	SPE 185144	Increasing Production with High-Frequency and High-Resolution Flow Rate Measurements from ESPs



ESP data is transmitted to the PCL service engine, which generates flow rates that form the basis of reservoir performance measurements that operators can use to improve well and field performance.

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