CASE STUDY

OLEUM TECHNOLOGY

SIP

W. TEXAS OPERATOR EXTENDS ESP RUN LIFE, ENDS PUMP-OFFS & INCREASES OIL 92% & 33% WITH NEW AI ANNULAR VALVE

Oleum Technology's SIP Also increased Gas 33% and 23%; Results Leads to Production Contract

THE CHALLENGE

An American major in Midland wanted to improve ROI on its unconventional ESP wells. It wanted to lower deferred production and OPEX by increasing the pump's efficiency and run life. More broadly, it wanted to slow the decline rate.

Unconventional wells in West Texas are known for a steep initial decline. This is associated with early gas breakthrough and a high gas-to-oil ratio. The operator tried common mitigation tools such as gas separators, gas turbines and gas shrouds, with VSD and other smart pump controllers. Currently most of its wells are controlled by a PID system. But these tactics only partially worked. Gas interference and gas lock were still causing the ESP's to pump-off for as much as 12 hours a day.

Major amounts of oil and gas production were being lost, field labor costs were high and the resulting wear on the pumps meant that the average well was running through 3 ESP's before moving to a rod pump. The total event and replacement cost was hundreds of thousands of dollars.

So, when Oleum Technology presented its System of Integrated Production (SIP), a totally new technology to significantly reduce those costs and increase production, the major decided to try a pilot. It set the following KPI's:

1) pump run times of or close to 24 hours;
2) constant pump speeds aligned with design;
3) lower fluid levels above the pump;
4) increased oil production.

SIP'S NEW TECHNOLOGY

SIP increases production primarily by managing annular gas pressure. It also recommends the best complimentary pump speed and tubing pressure.

SIP is fully automated and controlled from the cloud by proprietary Artificial Intelligence (AI) algorithms developed over 20 years of research and field experimentation. Using more than 30 data points per well, the algorithms control an annular back pressure valve at the wellhead, constantly adjusting casing pressure in real time. .

Manual changes in tubing pressure and pump speed are infrequent and done by the operator — or Oleum's field engineers can do if agreed. The optimal speed on ESP's with SIP is often fixed. The AI plays on the mobility of oil and the impact of gas at the bottom hole and up into the pump. It

manages annular pressure so that more free gas stays in solution. This increases the oil's mobility and eliminates, or largely eliminates, gas interference in the pump. Gasification & gas lock are a problem on any well, but especially in pumps on unconventional wells.

For heavy and mid-API oils, SIP counter-intuitively increases bottom hole pressure. This holds more water back, but also keeps more free gas in solution. The well's oil, unlike water, becomes more mobile. As a result, more oil comes into the well despite the higher pressure at the bottom.

New Pemex contract awarded, too try-and-buy beginning in Kuwait, Oman, Austria and Colombia.

On light oils such as West Texas crude, less additional casing pressure is needed and applied to keep the gas in solution. Initially, both the pump intake and and bottom hole pressures rise after SIP is installed, but then drop significantly as the newly steady and empowered pumps pull down the liquid column and pull up more liquid from below. In the pump's new equilibrium, both the intake and bottom hole pressures are lower than originally, but higher than they would be without SIP, which is still keeping the gas in solution.

The production impact is especially great on ESP's because of their powerful suction on the bottom hole when freed by SIP. The liquid level over the pump is also pushed and pulled down.

The recommended adjustments in tubing pressure, meanwhile, add to the increased pump efficiency by creating a coordinated sandwich effect of pressures above and below the pump.

Production Impact

	Before SIP			With SIP			IMPACT		
	Oil bbls	Water Cut %	Gas, mcf	Oil bbls	Water Cut %	Gas, mcf	Oil % Change	Water Cut %	Gas % Change
Well 1	90	80%	265	173	80%	384	+93%	0%	+33%
Well 2	100	84%	206	133	80%	254	+33%	-4%	+23%

THE RESULTS

SIP was first installed for 10 months on two, extended reach, horizontal rod pump wells in the Lower Spraberry Trend. The operator declared sucess and extended the pilot to two of its higher priority ESP's. SIP was tested six weeks on each. The full test lasted 13 months.

The wells were removed from their PID system and put on SIP's automated system at a fixed pump speed. The operator, nonetheless, added certain constraints as a precaution. These included set points placed on motor temperature, flow line pressure, and other parameters to shut the pump if reached. The set points were never reached.

The ESP performances were monitored by tracking motor temperature, pump intake pressure (PIP), and pump-off occurrences. A portable tester measured production.

During the time the two wells ran on SIP, there were no pump-off events. After SIP was removed, pump-offs regularly returned. Similarly, overheating disappeared under SIP, but came back to cause multiple shutdowns after SIP was bypassed at the end.

Under SIP, frequency was steady at 50 Hz on one pump and 52 Hz on the other. The pumps clearly operated more efficiently. Before and after SIP, however, frequency swung considerably — between 45 Hz and 65 on one pump, and between 45 Hz and 55 Hz on the other. Field engineers were unable to stabilize the units.

The change in PIP was dramatic, too. On one well with SIP, it reached a minimum of 620 psig. After SIP, it could not be lowered below 790 psig despite the re-activation of PID control. On the other well, PIP dropped so much that pump speed was increased midway through the test to exploit it.

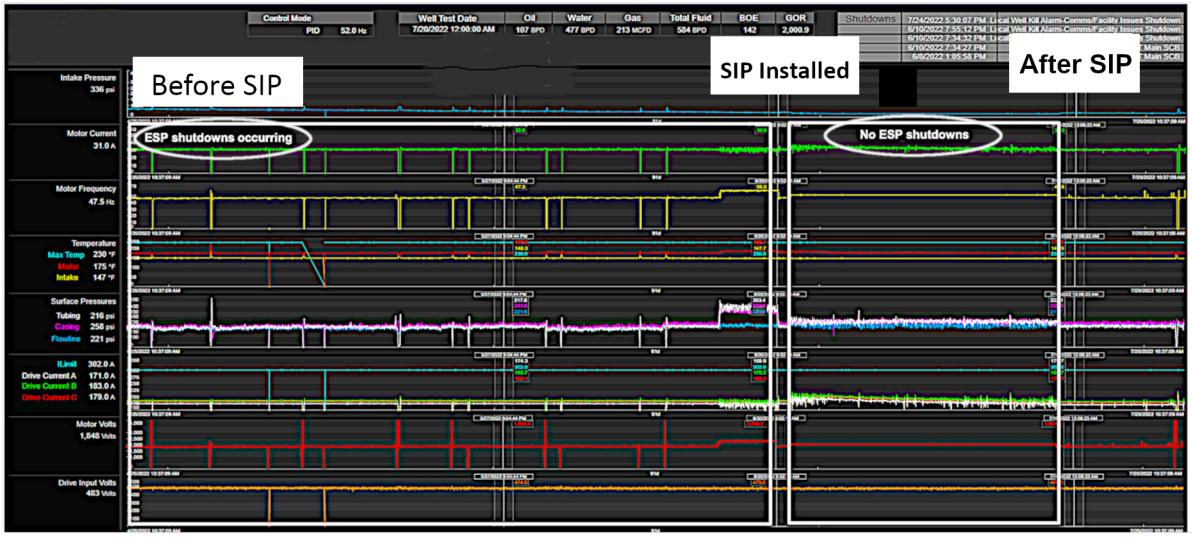
Frequent Echometer shots confirmed the drop in the dynamic fluid level over the pump.

The upshot of all this is that oil production increased fully 92% on one well and 33% on the other. Gas production—not considered in the original KPI's—emerged as a significant benefit, too. It went up 33% on one well and 23% on the other.

Production rates dropped to pre-pilot levels within days after SIP was bypassed and PID systems returned. As a result, the operator re-connected SIP to both wells and will add a number of new units under a production contract that has just been concluded. The contract is designed to scale up the number of wells in West Texas and other fields the operator has in the U.S. and the world.

Outside Texas, Oleum has done successful SIP pilots on conventional wells, with both rod pumps and ESP's. PEMEX in Mexico has issued a production contract to put SIP on 150 conventional wells. Agreed try-and-buy pilots will begin soon on wells in Kuwait, Oman, Austria and Colombia.

Pump Monitor Screenshot: Instability Before/After SIP



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