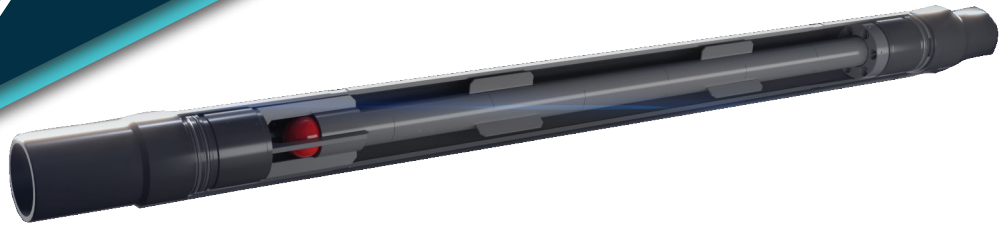


CASE STUDY



SandGuard™

ELIMINATING SAND FALLBACK IN THE PERMIAN BASIN

► SUMMARY

FET | Multilift Solutions partnered with a major O&G operator in the Permian Basin to provide technology which eliminate ESP failures as well as issues with efficiency caused by sand fallback.

This study is ongoing, and already several of the ESPs have had their run life increased by as much as 800%, resulting in a potential cost savings of millions of dollars.

► BACKGROUND

An ESP (electrical submersible pump) is commonly placed 8,000 feet or more below surface. Sand is one of the major issues that leads to ESP failure, wear and loss of efficiency. Improvements in handling sand and de-sander technologies help, but are often not enough to keep the system running efficiently. Restarts are an especially high-risk time for ESPs. That risk is amplified when sand is present in the production fluid.

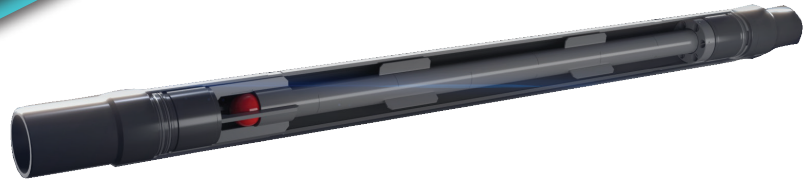
What is sand fallback and how does it cause ESP wear/failures?

There are a number of reasons why an ESP will shut down. Common causes are inconsistent power, surges in power, gas slugging. It can also be caused by pre-set safety precautions that cease ESP operations for self-preservation when key markers are outside the safe running zone. When oil is produced from a reservoir, the production fluid often contains large amounts of sand, water and gas. After shutdown, all solids within the thousands of feet of production fluid in the tubing above the ESP will fall and come to rest on top of the system. This results in multiple tubing joints full of sand settling directly on top of the ESP internals. When an ESP is restarted with large amounts of sand resting above it, a hard start/rock start occurs. Hard starts are the best-case scenario in this situation, but these types of starts increase wear and damage the ESP. Over time, the hard starts will make the ESP less efficient and shorten its run life. Often this best-case scenario does not happen and a catastrophic failure occurs. Examples of a catastrophic failure due to sand fallback can include a broken shaft or an electrical failure due to high amperage while trying to start the ESP.

► SOLUTION

A major oil and gas producer in the Permian basin was facing a series of short ESP runs caused by sand fallback. This led to increased NPT (None Productive Time), workovers and costly ESP purchases. Forum Energy Technologies approached the customer offering the SandGuard as a solution to eliminate issues related to sand fallback. There have been positive results, with the elimination of broken shafts, and elimination of electrical failure during restart – all of which result in longer lasting ESPs. This customer has seen a large value added thanks to the SandGuard. Before and after data from the ESP wells currently running with SandGuard show this solution has saved the customer millions of dollars in both ESP failures and deferred production.

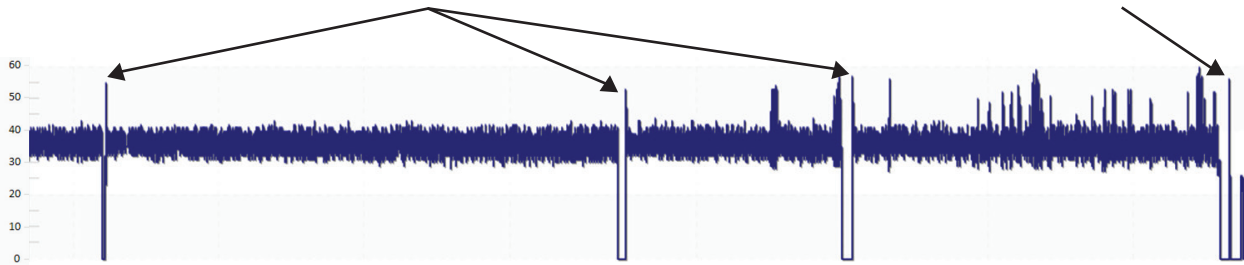
CASE STUDY



BEFORE SANDGUARD

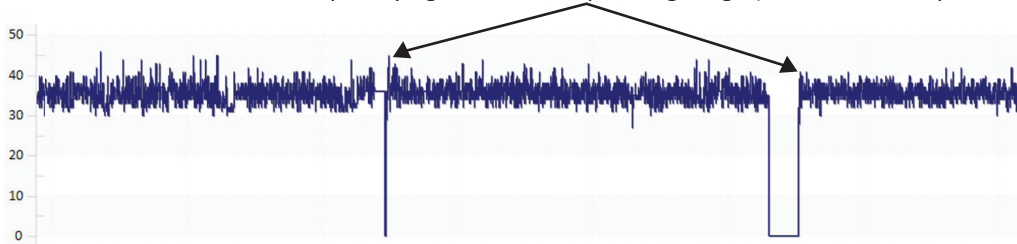
Hard starts - jumped to 55-60 amps on start on 3 restarts.

Hard start leading to failure - broken shaft.



AFTER SANDGUARD

Two starts with amps staying in standard operating range (40 & 45 max amps during restart).



WORKOVER AND DEFERRED PRODUCTION COST

New ESP	\$150,000
Cost of Rig & Misc. Rig Costs (Pump truck, BOP rental, electrician)	\$15,000
Workover Cost	\$165,000.00
\$/BBL of Oil	\$25
Daily Fluid Production	1500
Oil per BBL	40%
Daily Revenue	\$15,000
Deferred Production Days	9
Total Deferred Production Revenue Per Workover	\$135,000.00
 Total Cost and Lost Revenue Per Workover	 \$300,000.00

WORKOVER AND DEFERRED PRODUCTION SAVINGS *

Well No.	Previous ESP Run Days	Current ESP + SandGuard Run Days (All Still Running)	% Increase in Run Life	Notes
1	41	346	744%	8x previous run; 3 previous sand failures
2	54	712	1,219%	12x previous run; 2 previous sand failures
3	128	637	398%	3x previous run; 1 previous sand failure
4	29	559	1,828%	18x previous run; 1 previous sand failure

*BASED ON LAST ESP RUN AT \$300,000 PER WORKOVER