Manage Side Loading & Reduce Failures

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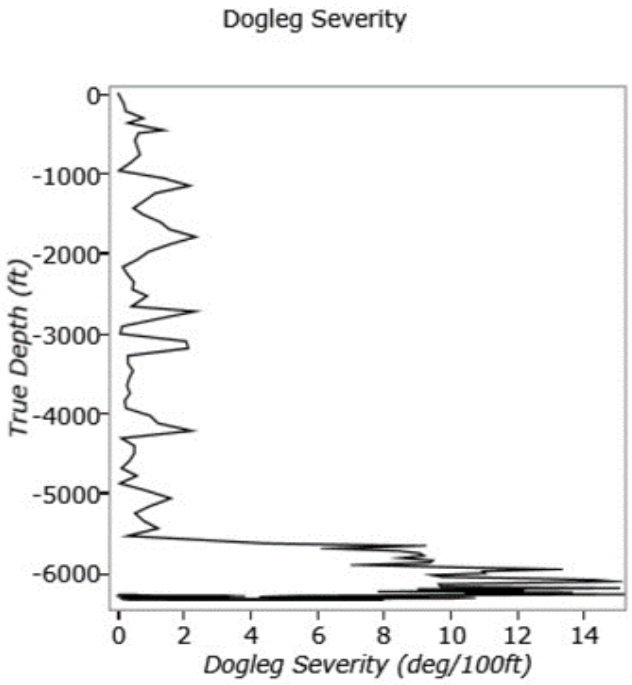
Background

In this case study, five high failure rate wells producing from the Middle and Upper Wolfcamp formations, were converted from conventional sucker rod to continuous rod. These wells were experiencing failures from rod on tubing wear due to deviation.

Well Design and Production

The standard design for these wells involved setting the pump at a depth between 5,000 to 6,000 ft, utilizing a 1.75-inch insert pump with a C912-427-192 unit. Production ranged from 200 to 350 bfpd at the time of conversion to continuous rod. In the figure below, the dogleg severity for one of these wells is displayed below. The graph illustrates multiple instances where the dogleg severity exceeds 2 degrees throughout the wellbore. It should be noted that the dogleg severity calculation shown below is based on data collected at 100-foot intervals using a MWD survey. Typically, when using an in-tubing gyro with 25-foot intervals, the dogleg severity calculation increases by approximately 1.5 to 2 times. This increase in dogleg severity is crucial to consider in the design process.



Typical dogleg severity plot for Case Study

Detailed Analysis of Well No. 5

After conversion to continuous rod, Well No. 5 had a rod string taper consisting of 5,347 ft of .875-inch D41 rod and 200 ft of 1.5-inch sinker bars, with a C912-427-192 pumping unit. The targeted production rate post-conversion was 220 bfpd. Before installing continuous rod, this well experienced two holes in tubing per year. However, after the switch to continuous rod, the well ran for 670 days without a failure. This well never failed but was converted to gas lift due to its high GOR. This installation of continuous rod proves that through increased contact area, continuous rod reduces the pressure between the rod and the tubing string, reducing tubing failures.

Failure Rate Reduction

Well	Rod Failure Rate	Tubing Failure Rate	Total Failure Rate
Well No. 1	1.0	1.0	2.0
Well No. 2	2.0	0.0	2.0
Well No. 3	1.0	1.0	2.0
Well No. 4	1.0	0.0	1.0
Well No. 5	0.0	2.0	2.0

Case Study Failure Rate on Conventional Sucker Rods

All wells, except for Well No. 4, had a failure rate of 2.00 failures per year with conventional sucker rods. These failures were either due to a hole in tubing or rod part. After the conversion to continuous rod, no failures were reported.

For instance, Well No. 1, which previously had a failure rate of 2.00 failures per year, ran for 907 days post-conversion, avoiding five failures. Similarly, Wells No. 2, No. 3, No. 4, and No. 5 avoided eight, five, two, and three failures respectively. The average number of failures avoided across these wells was 4.6.

Well	Days in Operation	Yrs. in Operation	Rod Failures	Tubing Failures	Failures Avoided
Well No. 1	907	2.48	0.0	0.0	5
Well No. 2	1,585	4.34	0.0	0.0	8
Well No. 3	968	2.65	0.0	0.0	5
Well No. 4	765	2.09	0.0	0.0	3
Well No. 5	670	1.83	0.0	0.0	2
Average					4.6

Case Study Runtimes and Avoided Failures Since Conversion to Continuous Rod

Economic Implications

The repair costs for these wells averaged $41,500 for a tubing leak and $35,000 for a rod part. Despite an initial cost difference of $8,000 for installing a continuous rod string compared to a conventional one, the savings from avoided failures amounted to $161,000 to $190,900 per well depending on the failure type. This means that an upfront investment of $8,000 in continuous rod led to savings ranging from $161,000 to $190,900 in repair costs per well.

LPS CASE STUDY: WOLFCAMP FIELD Sucker to Continuous Rod Conv.

Failure Type	Failures Avoided	Avg. Repair Cost	Cost Savings	Initial Cost (SR)	Initial Cost (CR)	Initial Cost Diff.
Tubing	4.6	$41,500	$190,900	$24,000	$24,000	$0
Rod	4.6	$35,000	$161,000	$18,000	$26,000	$8,000

*Case Study **Average Savings per Well** After Conversion to Continuous Rod*

Seeing the significant reduction in failure rates and the associated economic benefits, the operator began converting similar wells from ESP to rod lift with continuous rod instead of conventional rod.

Conclusions

Continuous rod offers multiple advantages:

- Reduces wear and failures by eliminating couplings and removing the need for rod guides.
- Distributes side loading over a larger contact area, reducing stress on rods and tubing strings.
- Reduces friction through the elimination of rod guides
- Significant reduction in failure rates, as demonstrated in the case study.

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