Artificial Lift R&D Council

Challenges in PCP wells Optimization in South of Oman.

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Background

- In a field in South Oman, with more than 600 wells producing with progressive cavity pump (PCP) systems, it was realized that monthly gains from pump parameters adjustments to well changing conditions could account for 5 to 10 % increased net production, at practically no cost.
- Due to logistic issues and manpower availability, this cannot be done as frequent as desired, so the well optimization process takes longer than the planned 2-months period.
- Failures due to **“pump-off”** conditions, improper **sand handling**, over speed on certain pump models, electric shut-downs, lack of monitoring due to SCADA communication issues and continuous trips are considered operational and produced an important deferment that affects overall production targets in the Company.

Historical Approaches - Manual

Objective:

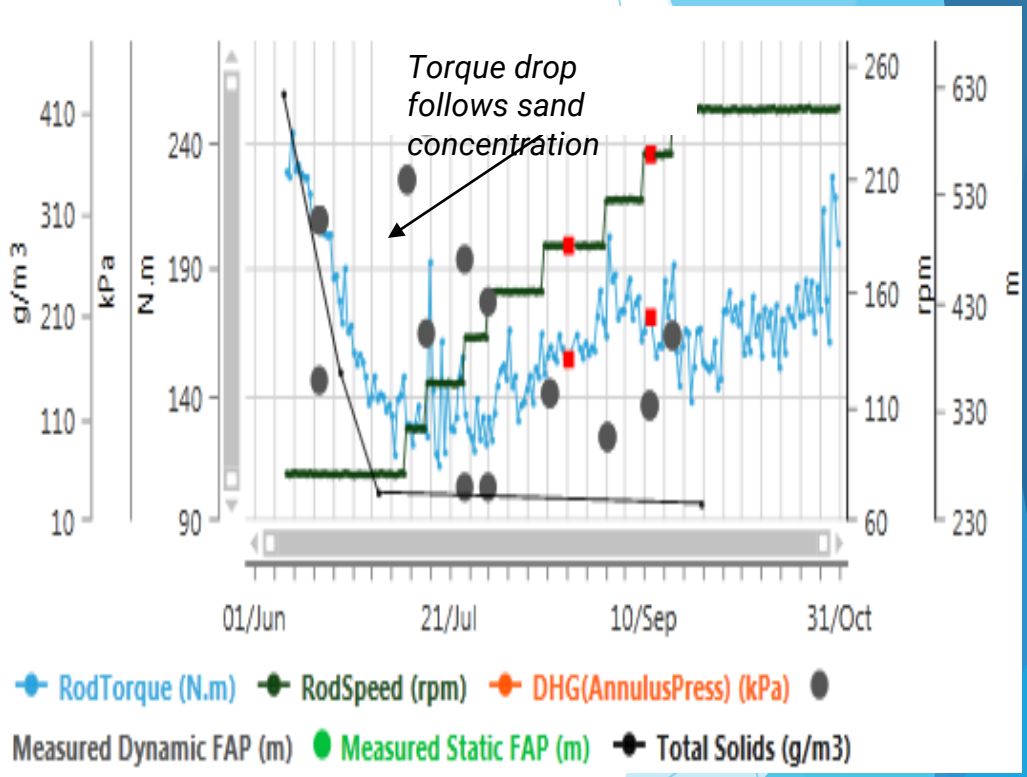
- Well ramp-up trials to find best compromise between failure prevention and production optimization.

Results:

- 20 to 30rpm incremental every week, depending on sand content.
- 2 – 3 months acceleration or bean-up process.
- No failures during bean-up at 20-rpm.

Challenges:

- > 200 well visits per month,
- Long time to restore production,
- High variation in annulus fluid levels,
- Blind-spots & slow response time to lack of pressure support.



Historical Approaches – Automatic Protection

Objective:

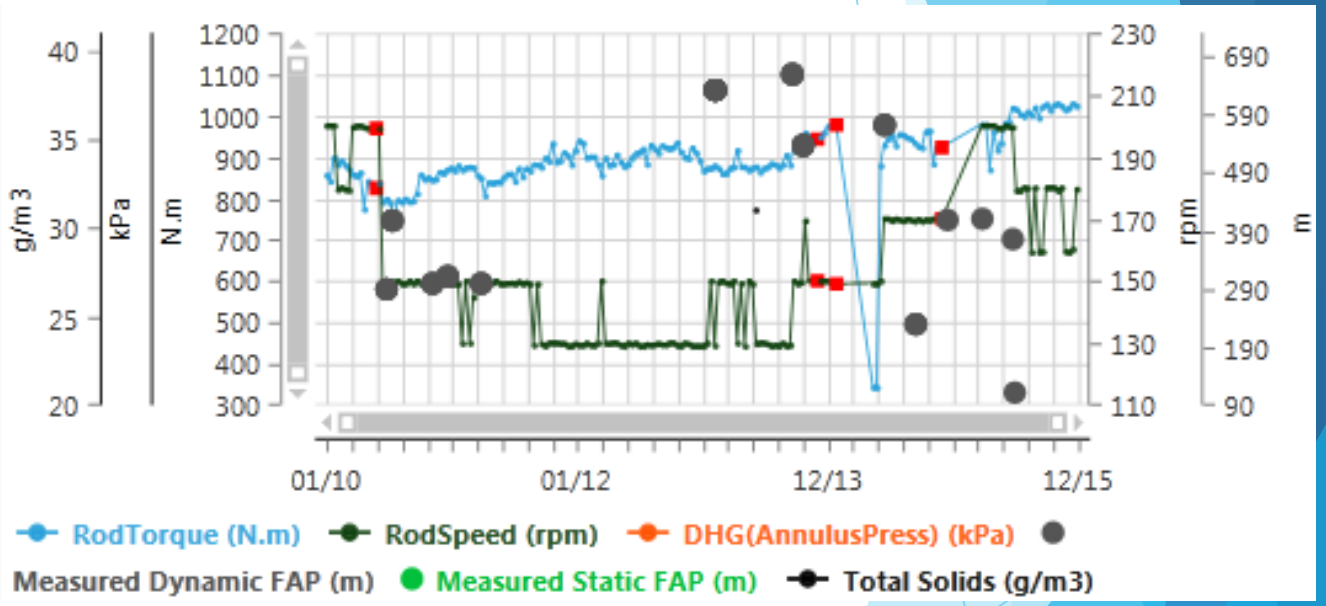
- Automatic adjustment of speed based on max torque limit to protect from running dry.

Results:

- Up to 5-years run life achieved in some wells,
- Protection activated very frequently in sandy wells.

Challenges:

- Well not optimized when protection activated, despite high fluid levels.
- In sandy wells, reducing speed affects solids settling above pump.



Historical Approaches - Automatic Optimization*

Objective:

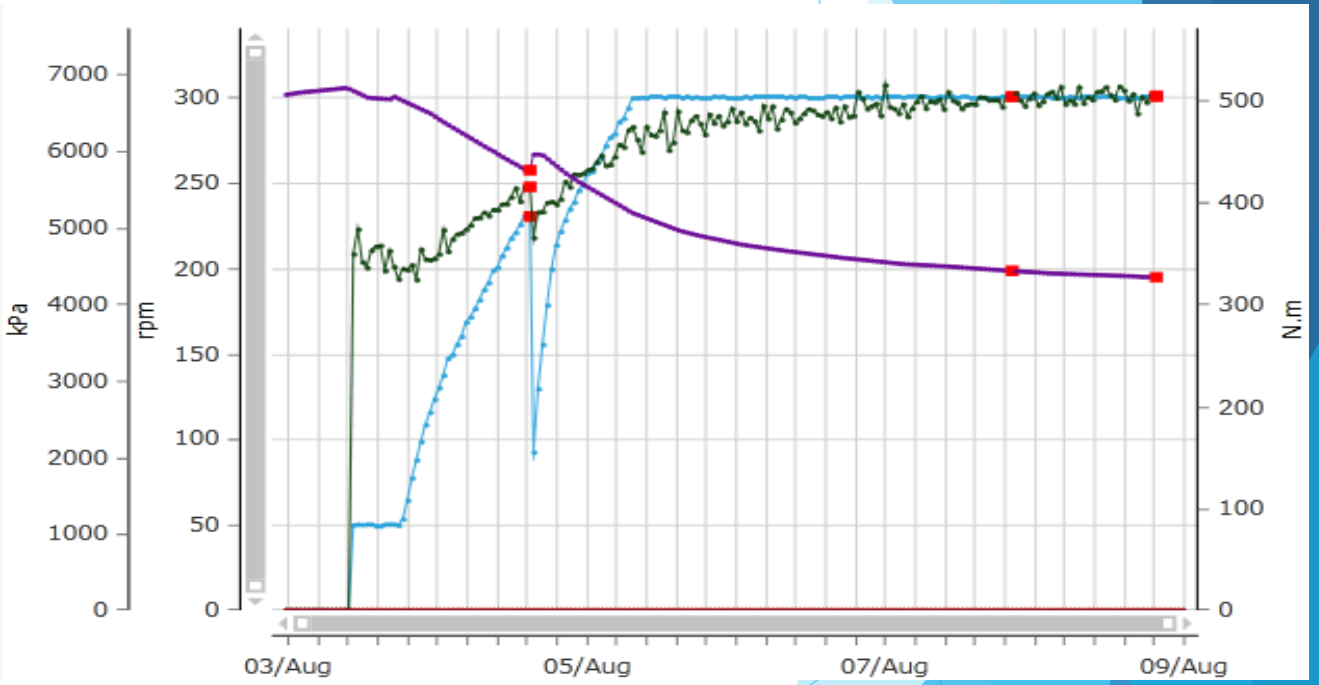
- Adjust speed automatically with slow ramp-up to meet an intake pressure target.

Results:

- ~ 20 wells connected.
- Good follow-up of pressure with speed.
- No pump failures due to pump-off conditions.

Challenges:

- Frequent surface trips caused wells to be under bean-up frequently.
- Wells could run less time optimized compared to manual process.
- Conservative intake pressure values taken due to uncertainty on gas content.



** Pressure Control Setup, Mahrooqi, Velazco, Vargas, Oct-2013*

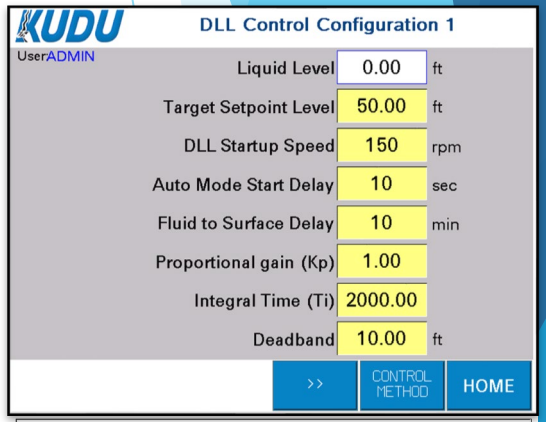
Operating Envelop Limitations

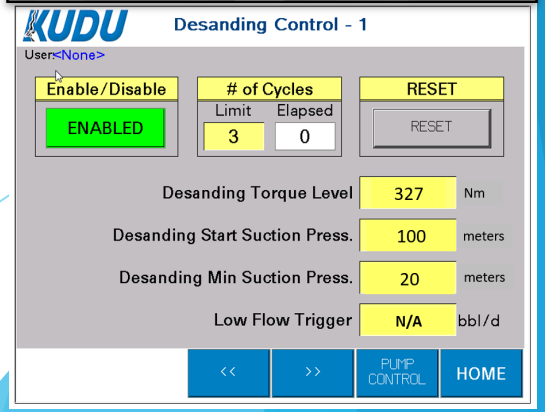
- Surface/station trips caused wells to restart the optimization process keeping wells running at optimized conditions for less than 50% of the time. (See Figure 1).

Figure 1—Well operating under automated optimization process.

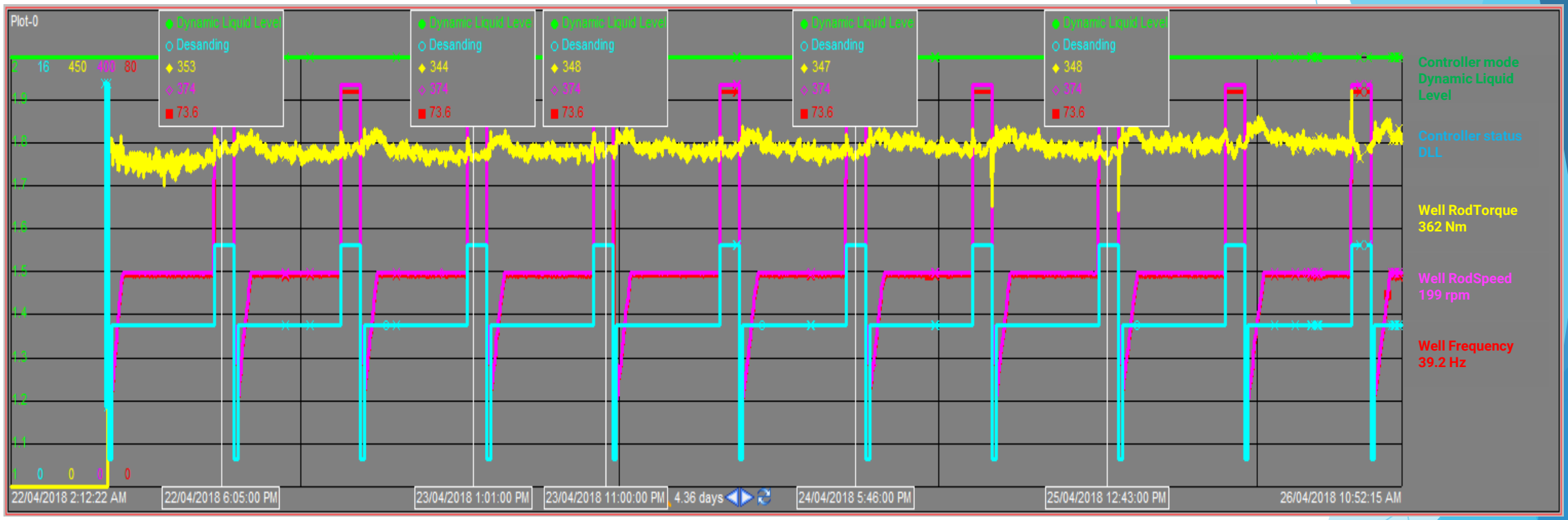
Improved Automated Optimization

- To address these concerns, an automated PCP motor controller (Kudu Well Manager) was installed in 5-wells for a period of 1-year. Well optimization, uptime and resource utilization were monitored and compared to previous performance to assess impact and propose a more efficient way forward.
- To increase the running time at optimized conditions, the ramp up of speed from minimum to target speed was programmed for completion within 1-day. Special consideration was given to prevent sand accumulation. This was done through an additional automated function: Desanding.





Desanding



The desanding function verifies that there is enough liquid available at the well bore and then runs the pump in a high-speed burst to remove the excess sand. This action helped to prevent the pump from becoming stuck.

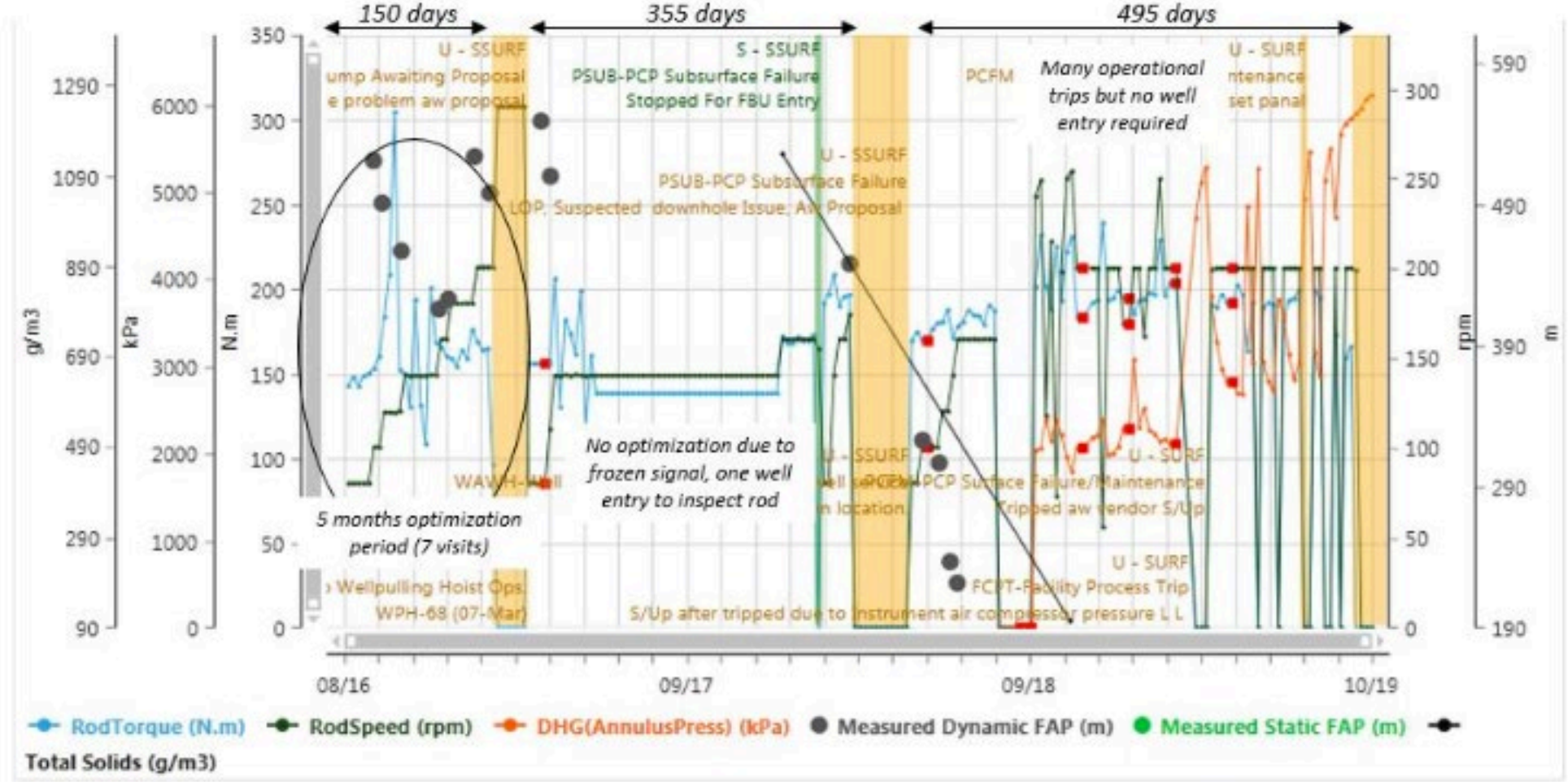
Results after Controllers deployment

- Four sandy wells and one depleted well were selected to test the new optimization loop. Table 1 shows the changes in the four parameters monitored during the trial from before to after implementation of the optimization.

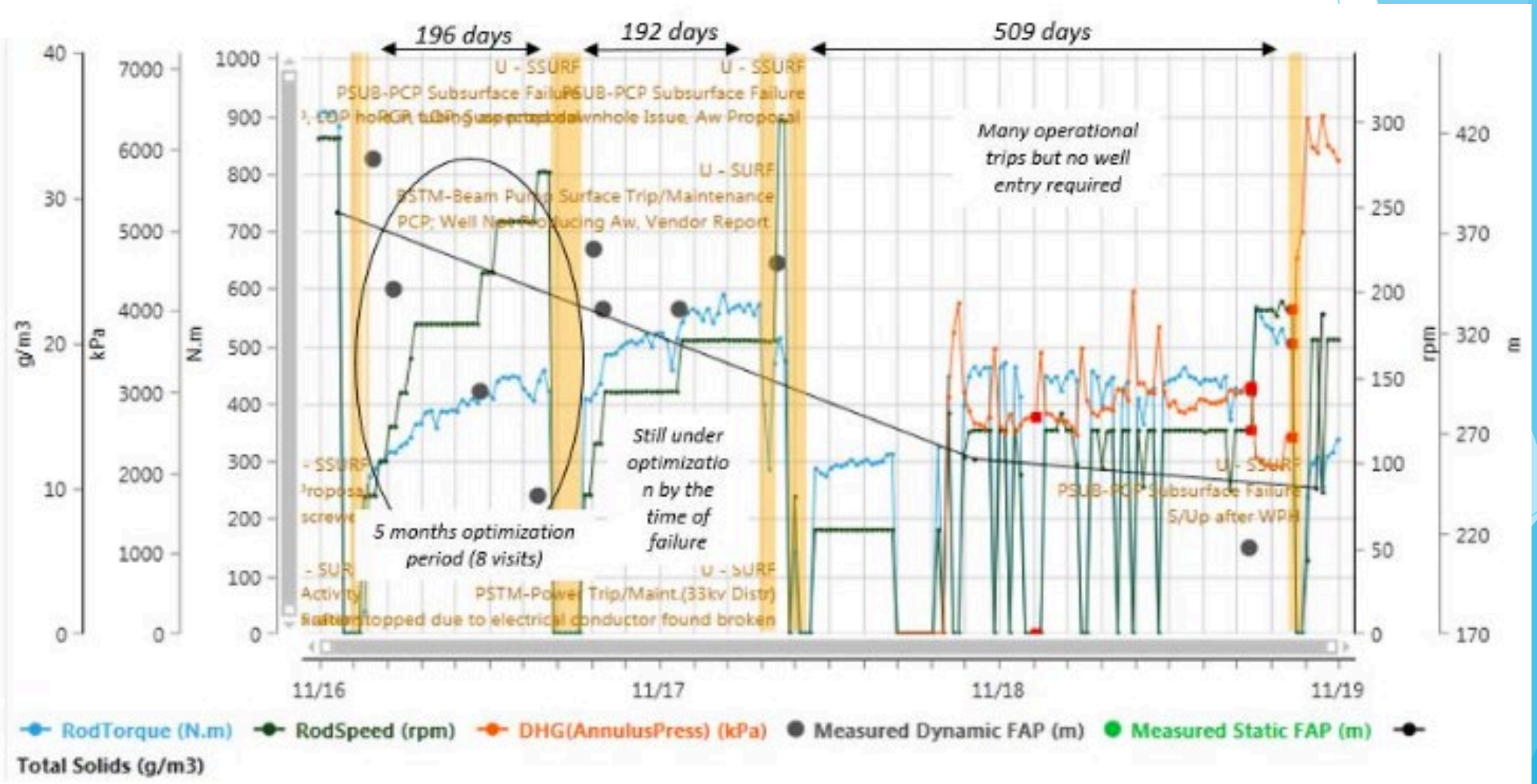
Well	Well Uptime Incremental (%)	Reduction in Time to Optimize	Incremental Well Capacity (%)	Reduction in Well Interventions/Visits
A	40%	**5 months to 2 days**	**47%**	**5 to 2**
B	25%	**3 months to 2 days**	**< 5%**	**8 to 2**
C	40%	**5 months to 2 days**	**30%**	**8 to 2**
D	160%	**6 months to 2 days**	**25%**	**9 to 2**
E	n/a	No change	−60%	0

Table 1—Changes in the parameters monitored before and after implementation. Major improvements in running time at optimized conditions and well deliverability were observed.

Typical case. Well “C”. Enhanced performance

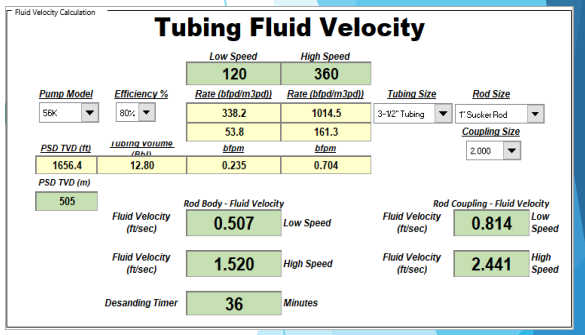


Typical case. Well “D”. Enhanced performance



Conclusions/Lessons Learned

- Desanding was programmed for a 0.501 ft/sec fluid velocity to ensure prevention of solids accumulation above the pump. There are good indications that sand accumulation was being addressed.
- High fluid velocity in the rod-tubing string could potentially cause erosion to the internal walls of the pipe. Modeling evaluation is required before setting system maximum speed for the desanding function, reducing premature wear.
- The PCP well controller (Kudu Well Manager) has proven to be a successful and viable well manager for PCPs. Overall productivity has been increased by eliminating the need to continuously monitor fluid levels. Control features such as desanding allows protection from overpressure, high torque, and sand plugging.



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