IATMI22-019

Digitalization Application on Pump Stuck Identification Procedure an Effort to Support Pump Failure Reduction in Mature Steam Flood Field

Rinaldi Pasaribu[*1], Hengky Darma Satria[2], Rizky Hadi[3], Josua Firdaus[4]
[1,2,3]PT. PERTAMINA HULU ROKAN, [4]PT. Mitra Integrasi Informatika
* Email: rinaldi.pasaribu@pertamina.com

Abstract.
Pump stuck and floating rod are one of the main contributors to pump failure in mature steam flood field. In total there are ~1000 pump stuck and floating rod events per year occurs in D field, resulting in an oil loss of ~200 MBO. The main cause of those issue is sand problem that triggered by degrading well bore screen liner integrity over time.
One of the initiatives to overcome the problem is the pump stuck identification (PSI) procedure which is troubleshooting procedure that conducted by field operator before the well finally declared as pump stuck and scheduled for rig work. The procedure includes several steps based on historical best practices which include surface facility and well head equipment adjustment and down hole pump trouble shooting.
However, in practice this PSI troubleshooting procedure was not standardized and properly recorded. This situation results in difficulties to ensure the work is carried out according to standard procedures and miss the opportunity to do lookbacks for future improvements. This situation triggered initiatives to improved success rate of PSI troubleshooting.
This paper demonstrates the use of digitalization to maximize the PSI impact. Field operators required to input the results of the PSI procedure through a loader which automatically sends the information to the database where the PSI input compliance data is tracked regularly and evaluated for future improvement. In addition, several steps of the PSI procedure have been added to improve the current PSI troubleshooting procedure.
This initiative has been fully started since the beginning of 2022 and is currently successful in maintaining the PSI compliance above 97% and successfully put back on production 87 pump stuck/floating rod wells correspond to 10,718 bbl. Oil loss avoidance and is expected to continue to increase in line with implementation consistency and continuous improvement procedures.
This initiative can be adopted in other fields in maximizing the value of troubleshooting procedure

Keyword(s): Digitalization; Pump Stuck; Floating Rod; Troubleshoot

1 Introduction

D field has a massive Sucker Rod Pump (SRP) operation with total more than 6,000 SRP wells running every day. In total there are ~1000 pump stuck and floating rod events per year resulting in an oil loss of ~200 MBO.

The biggest Sub Surface pump problem faced is produce sand which causes pump stuck and not pumping, those problems were a dominant contributor to Loss Production Opportunity (LPO) and has an impact on increasing well service costs.
Based on the DIFA (Dismantle Inspection Failure Analysis) data, most of the findings is a lot of fine sand inside of pump.

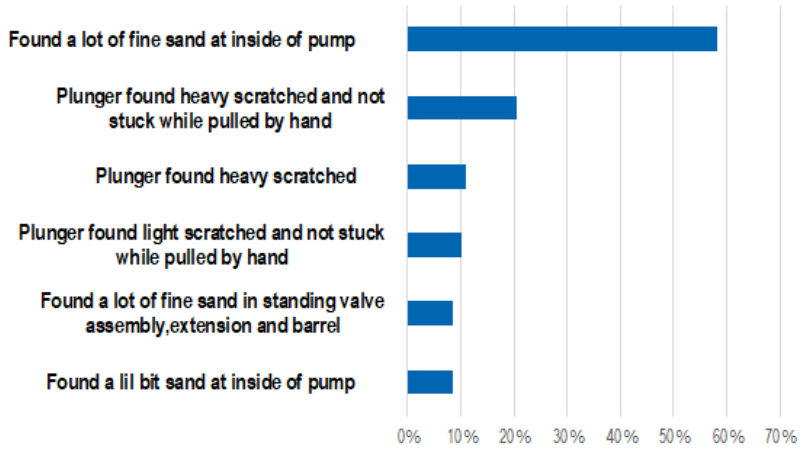

Figure 1. DIFA findings (IODSC AL team, 2021)

There are two dominant factors causing the sand problem in well bore:

1. Formation type, reservoir type D field is sandstone with unconsolidated sand characteristics
2. Completion type, most of the wells in D field are open hole gravel packs. Gravel packs and screen liners will be damaged over time, especially with a steam flood operation.

While the most common sand problems that occur in D field are pump stuck and floating rods. Pump stuck is a condition where the rod is unable to move due to the accumulation of sand that holds the plunger while floating rod is a condition where the rod move slowly downward due to restricted by solid interference in the barrel. This can be seen from the movement of the horse head that precedes the movement of the rod.

In the last 2 years there is a trend of increasing case of floating rod in D field and pump stuck case also increasing significantly since Oct-21.

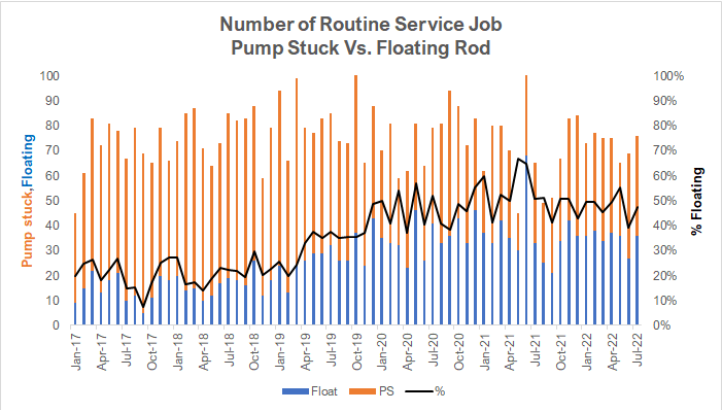

Figure 2. Floating rods occurrence in D field (IODSC AL team, 2021)

The previous workflow used in D field for handling pump stuck and floating rod wells is as follows,

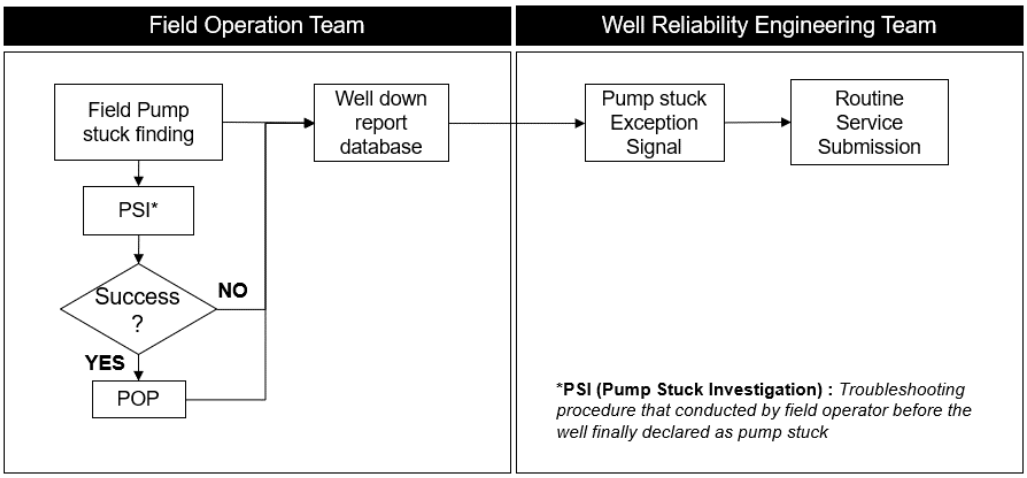

Figure 3. Pump Stuck/Floating Rod Recovery Workflow (IODSC AL team, 2021)

From the workflow above, PSI is the most important procedure to overcome pump problems due to sand, so it needs to be ensured that it is performed properly.
However, in the workflow there is no step to record the PSI result. Challenges by not having the PSI record:

- There is no clarity on whether PSI procedures have been properly performed.
- In the absence of PSI records, we lose the opportunity to analyze the data for future improvements.

2 Methodology

In an effort to reduce the number of pump stuck and floating rod cases, the project team proposed the following solutions:

- Improve PSI procedure by adopting historical best practices.
- Improve pump stuck and floating rod workflow with additional steps to input PSI result. This process is carried out digitally so that the data can be used for well down confirmation and lookback purposes.
- Develop monitoring dashboard

2.1 Improving PSI procedure

Based on the workshop conducted with the FOD team, it was agreed that several steps were proven to be effective in overcoming the sand pump problem and would be added to the existing procedure. The steps are as follows:

- Release tubing or casing pressure.
- Dump hot water through casing annulus until return to surface.
- Try to re-start pumping unit and reciprocate stuck or floated plunger several times.

2.2 Improving pump stuck and floating rod recovery workflow with additional steps to input PSI result

The field operation team will consistently input the PSI result and its compliance will be monitored regularly, with following improvement workflows

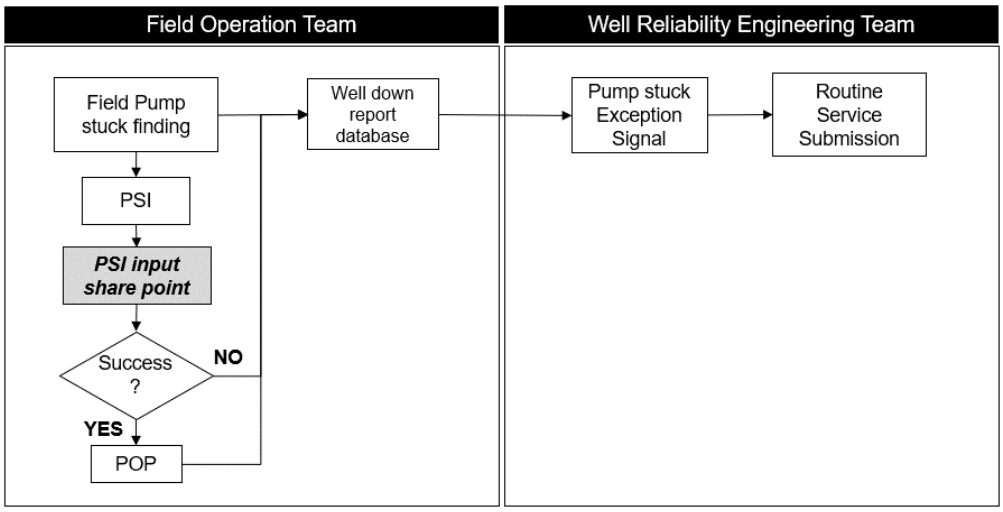

Figure 4. Improved Pump Stuck/Floating Rod Recovery Workflow (IODSC AL team, 2021)

The project team also prepares a table to store the PSI results in the database. So that PSI results can be evaluated and monitored in real time basis.

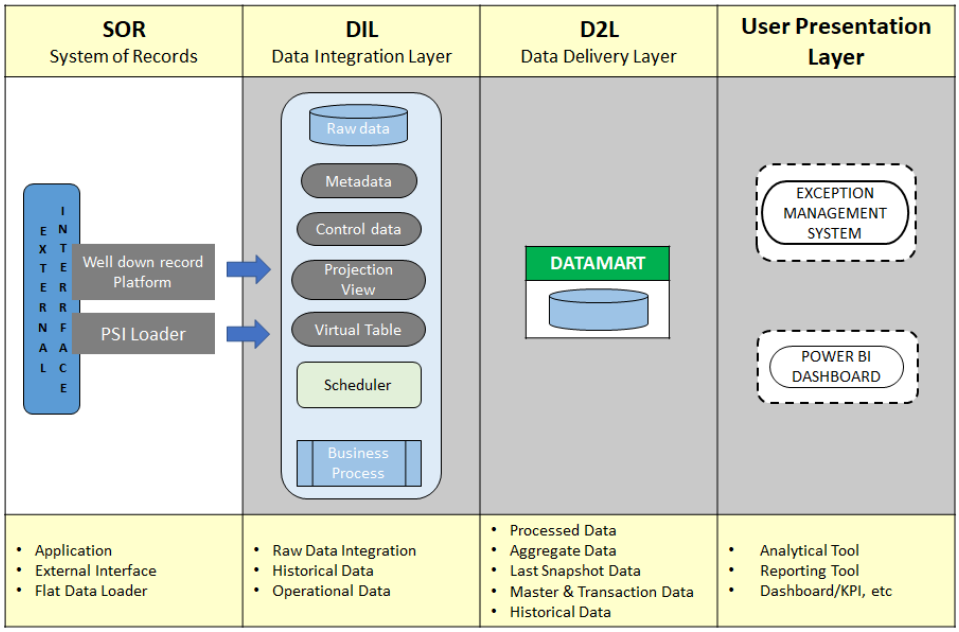

Figure 5. PSI Loader data integration Architecture (IODSC AL team, 2021)

2.3 Developing Monitoring Dashboard

To ensure that the PSI data input process was carried out consistently, the project team developed a compliance dashboard which is monitored regularly,

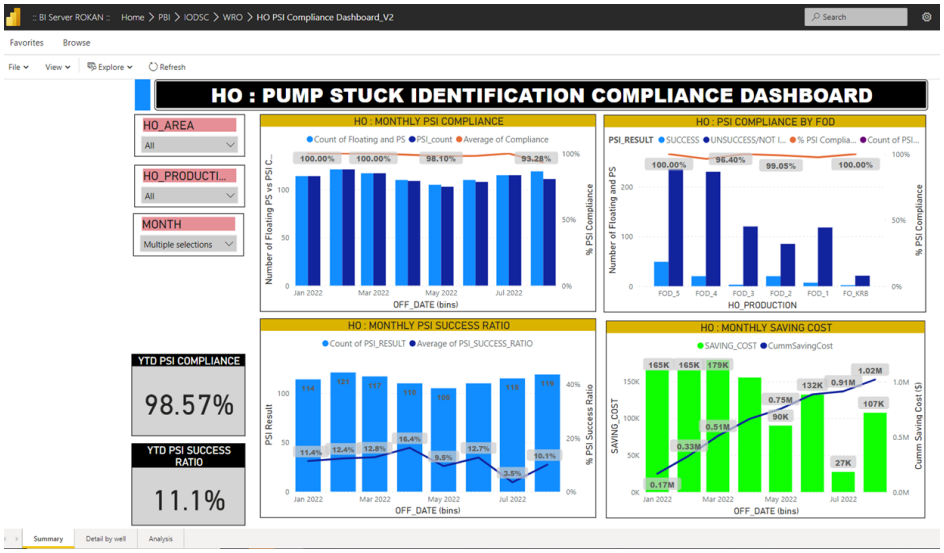

Figure 6. PSI Compliance Dashboard (IODSC AL team, 2021)

Results

The PSI process improvement and digitalization solution has been implemented since November 2020 and was fully implemented in January 2021. As per July'22, the PSI input compliance status has reached 98.5% exceeding the target of 95% which can be seen on **Figure 6**.
Before the initiative, PSI execution result was not tracked since there is no table in database for data storage. Based on newly developed PSI database, in 2022 there were total 87 pump stuck and floating rod wells has been successfully put back on production, correspond to 10,718 bbl Oil loss avoidance
PSI is the first step in pump stuck and floating rod mitigation procedure in D Field. Rig and rig less recommendation to recover pump stuck and floating rod must be based on PSI finding result. **Figure 4.** Therefore, the solution has important role to improve rig less success ratio, since its first implementation in Q4-2020, rig less job success rate to recover pump stuck and floating rod improve from 18% to 28%.

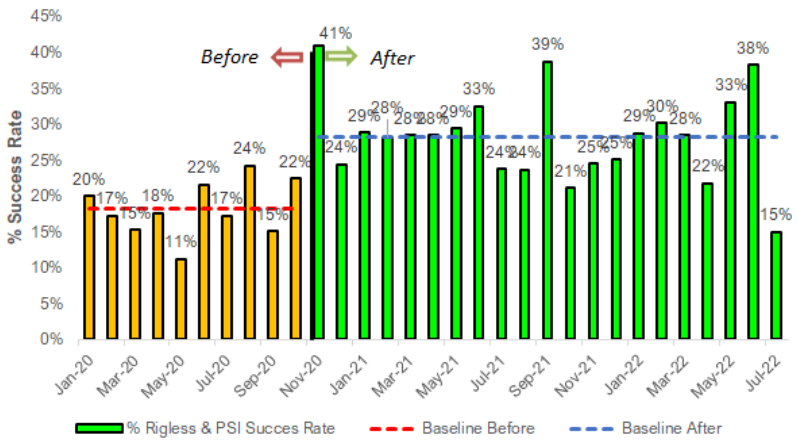

Figure 7. Rig less pump stuck and floating rod recovery success rate (IODSC AL team, 2021)

Conclusions

The proposed solution is considered easy to implement and can be adopted in other fields in maximizing the value of troubleshooting procedure. By simply improving existing processes and digitizing the data, it can give a significant positive impact to overall field operations.

References

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Acknowledgments

We would like to thank Pertamina Hulu Rokan, SKK Migas, and Dirjen Migas for their permission to publish this paper.