

Exception Signal Improvement for More-Accurate Identification of High Tubing Pressure Well in Delta Field

Nancy Maulirany^{*1}, Sevtyan Nugraha Masri^{*2}, Ramdhan Ari Wibawa^{*3},
Rosyadi^{*4}, Meita Silaban^{*5}

¹IATMI, ^{2,3}SKK MIGAS, ^{3,4,5}PERTAMINA HULU ROKAN

* Email: nancy.maulirany@pertamina.com

Abstract. IEMS (Integrated Exception Management System) is integrated solution for exception management which applies data science process to organize large amount of data and automatically generate exception signals that are prioritized for review and actions. The scope is currently focused on reduce Lost Production Opportunities (LPO), optimizing wells by reducing time taken for abnormal conditions to be identified and anticipated. One of problems in Delta field is high tubing pressure that occurs due to upset of fluid to flow caused by restriction from pipeline. Exception signal to identify anomaly tubing pressure using data tubing pressure from dynamometer is mostly end up as “no further action” or false signal. Which mean, criteria or data science process in IEMS to captured high tubing pressure is not robust enough. For more accurate identification of high tubing pressure wells, team has applied to alter the maximum tubing pressure to average tubing pressure to capture fluctuation tubing pressure. Additional criteria added to strengthen the criteria is using Artificial Intelligent. Machine learning will be labeling and classification the dyno card to identify high tubing pressure identic with dyno shape with hump. The combination of these data, we expect to reduce false signal that related to resource’s manning hour and reduce potential hidden wells down. Recommendation for wells after high tubing pressure exception signal is flushing the pipeline with water. Several flushing requests are rejected by operation team due to normal tubing pressure. To avoid discrepancy data tubing pressure, we recommend for regular calibration pressure gauge or pressure transmitter.

Keyword(s): high pressure, database, artificial intelligent, dynamometer

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1 Introduction

Artificial pump used In Delta field are sucker rod pumps due to their multiple advantages including relatively low-cost, well-established technology, availability, and wide applicability range. The surface dynamometer card has been used routinely as an aid in analyzing the performance of sucker rod pump equipment. IEMS is integrated solution as framework for exception management which applies data science process to organize large amount of data (about ~6,500 active wells), digitize SME knowledge to identify abnormal well/facility performance by creating exception modules which automatically generate signals that are prioritized for review and actions. Each signal generated from the database as per criteria to be identified. One of problems in Delta field is high tubing pressure that occurs due to upset of fluid to flowing

caused by restriction from pipeline, that may occur due to congeal well, sand, temperature drop or reduced flowline size due to impurities. Data tubing pressure from dynamometer are used to identified high tubing pressure.

2 Exception Signal High Tubing Pressure identification

2.1 Current Exception Signal High Tubing Pressure identification

Signal high tubing pressure is designed and created in 2016 with data retrieved from dynamometer pressure database combined with certain criteria and condition. The criteria are;

1. Median tubing pressure ≤ 80 and last tubing pressure maximum $> 2.5 * \text{median tubing pressure}$ and last tubing pressure maximum > 150
2. Median tubing pressure > 80 and last tubing pressure maximum $> 1.5 * \text{median tubing pressure}$ and last tubing pressure maximum > 200

With these current criteria, exception signal “high tubing pressure” is then reviewed with other information of wells then followed up with operation team for flushing the pipeline to reduce backpressure to the wellbore. But there are exception signals are false, it was only data fluctuation and become the highest contributor to NFA (No Further Action) – 62%.

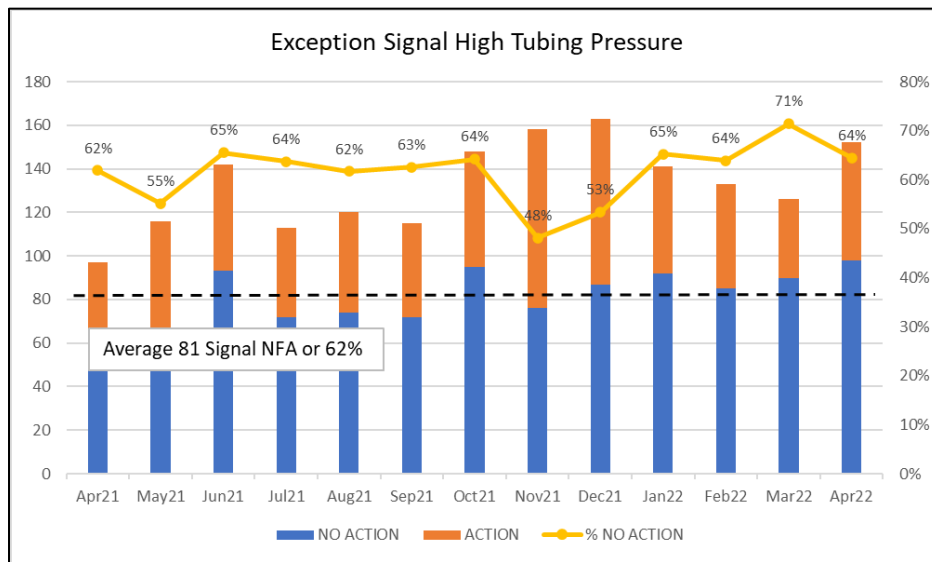


Figure 1. Exception signal high tubing pressure response

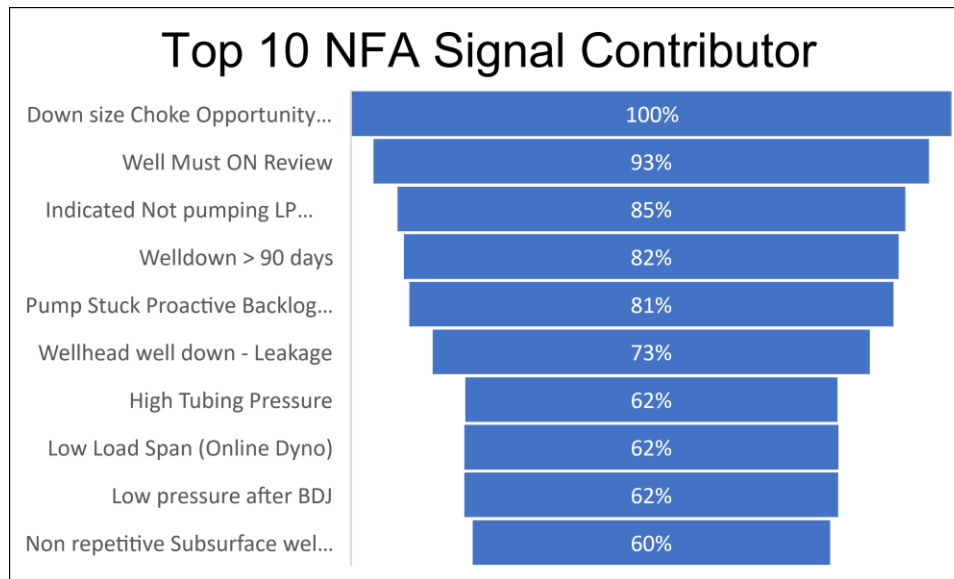


Figure 2. Top 10 No Further Action (NFA) contributor

Based on above charts, top 10 no further action (NFA) contributor or false exception signals for wells down and anomaly pump performance are being review for criteria improvement to reduce false signals

2.2 Exception Signal High Tubing Pressure identification improvement

Based on review and analysis, criteria exception signal to identify high tubing pressure is inappropriate due to last tubing pressure used for criteria is maximum tubing pressure. Dynamometer is device to record pump performance in several data and times, one of data is tubing pressure. Tubing pressure data is recorded several times in a day. So, data maximum tubing pressure is maximum pressure data recorded in a day data. While in fluid dynamics, turbulent flow is fluid motion characterized by chaotic changes in pressure and flow velocity.

It is recommended to rejuvenate high tubing pressure indication with statistic approach and combination with Artificial Intelligent for improvement criteria;

1. Median tubing pressure ≤ 80 and last tubing pressure average > 200 and last1, last2 and last3 > 180
2. Median tubing pressure > 80 and last tubing pressure average > 250 and last1, last2 and last3 > 200
3. Last 3 predict class Artificial Intelligent (AI): high pressure based on dyna shape

Last tubing pressure used are average tubing pressure based on calculation data tubing pressure certain time per day and static in last 4 day. Additional criteria added to strengthen the criteria and reduce wrong interpretation is Artificial Intelligent. With much of active wells and massive numbers of dynamometer cards, machine learning labeling and classification the dyna shape. The model can be used to help the engineers in identifying the problems of sucker rod pumps that are commonly found in Delta Field

Sample Date / Time	Data Value	Sample Date / Time	Data Value
09/15/2022 12:03:16 PM	21.00	09/14/2022 10:02:49 AM	26.40
09/15/2022 10:02:59 AM	3.90	09/14/2022 08:03:30 AM	4.90
09/15/2022 08:04:34 AM	140.40	09/14/2022 06:02:40 AM	120.70
09/15/2022 06:03:21 AM	1.00	09/14/2022 04:05:18 AM	8.40
09/15/2022 04:08:46 AM	19.20	09/14/2022 02:02:48 AM	9.00
09/15/2022 02:02:31 AM	0.60	09/14/2022 12:03:21 AM	15.90
09/15/2022 12:03:20 AM	85.30	09/13/2022 10:03:10 PM	15.00
09/14/2022 10:02:27 PM	4.90	09/13/2022 08:02:51 PM	49.30
09/14/2022 08:03:18 PM	114.60	09/13/2022 06:03:06 PM	18.70
09/14/2022 06:02:33 PM	172.20	09/13/2022 04:03:01 PM	21.30
09/14/2022 04:02:45 PM	152.70	09/13/2022 02:03:38 PM	33.70
09/14/2022 02:02:58 PM	74.80	09/13/2022 12:03:16 PM	4.90
09/14/2022 12:04:10 PM	81.40	09/13/2022 10:02:51 AM	0.90
		09/13/2022 08:02:19 AM	120.40
		09/13/2022 06:02:22 AM	7.50

Figure 3. Data tubing pressure from dynamometer

And dyna shape predicts high tubing pressure in last 3 days

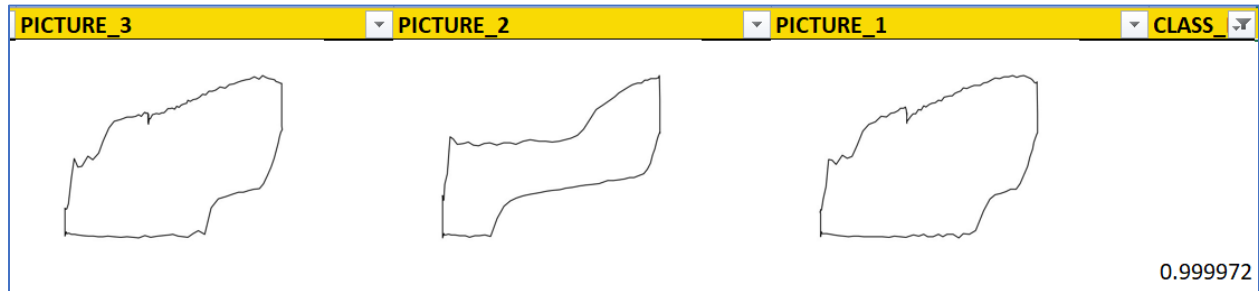


Figure 4. Dyna shape predicts high tubing pressure in last 3 days

3 Results

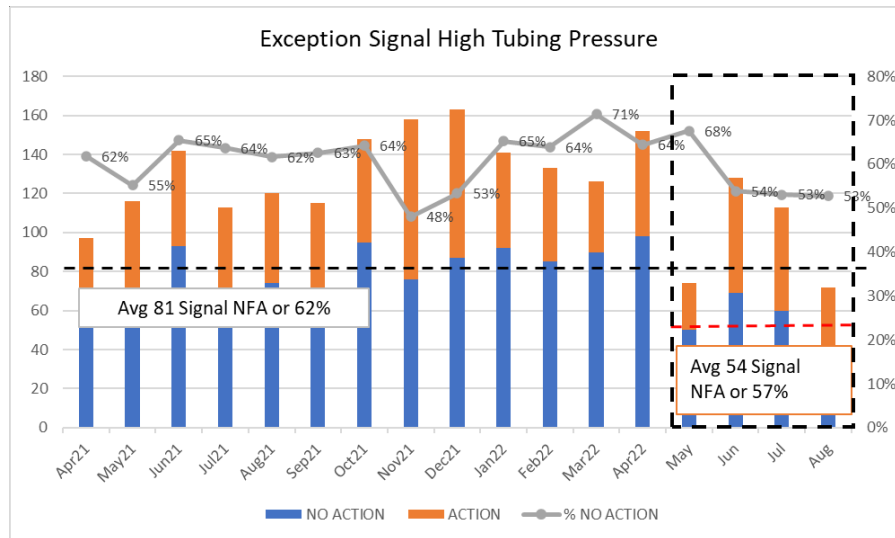


Figure 5. Exception signal result after criteria improvement

4 Conclusion

For more accurate Identification of high tubing pressure wells in Delta field, team proposed to alter the maximum tubing pressure to average tubing pressure to capture turbulent or fluctuation data tubing pressure instead of data maximum tubing pressure. In addition to that criteria exception signal in IEMS is combined with AI (Artificial Intelligent) for dyno card to identify high tubing pressure identic with dyno shape with hump. This dyno card condition shows an increase in load cell due to restriction of fluid to flow from wellbore due to back pressure from pipeline. With the combination of these data, we expect to reduce false signal that related to resource's manning hour and reduce potential hidden wells down

5 Challenges

Recommendation for wells after high tubing pressure exception signal is flushing the pipeline with water. Unfortunately, several requests are rejected by operation team due to different method to verify data tubing pressure. It is recommended to calibrate pressure gauge. Data tubing pressure or dyno card measured by dynamometer can only be transferred to database as daily data, not all measured data. A lot of data used more accurate data that IEMs process.



References

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