OPERATIONAL OPTIMIZATION THRU FAILURE ANALYSIS MEETINGS

Dan Phillips, Mike Brock, Rob Vincent
PL Tech LLC

ABSTRACT

Failure meetings are a proven optimization tool to reduce failures, cut costs, and increase production. However, many companies don't utilize this tool or don't properly optimize it. This paper will cover the basics of preparing for and holding a failure meeting along with a brief explanation of root cause analysis.

INTRODUCTION

Failures of artificial lift equipment is a normal part of oilfield operations. The failures raise operational costs and the subsequent downtime results in lost production. Just repairing the equipment without attempting to solve the root cause of the failure will typically result in more failures and can result in further increasing repair costs. Over the years, numerous papers on various failure tracking systems and root cause analysis result in longer equipment life, reduced failures, decreased costs, and a related increase in production. However, a critical part of the process is failure meetings.

Every form of artificial lift has failures and can benefit from failure meetings, but for brevity we will focus on rod pump installations though most of the following recommendations can be applied to all wells. This paper will briefly discuss what data should be gathered and how trending that data can be effective in identifying root causes. What is a root cause and how to identify them. Finally, we will review how failure meetings can be set up, who to invite, and how they should be directed.

DATA

There is an abundance of data that can be collected to help track failures and determine the root cause of the failure. A tracking system is essential in gathering the data in a format that can ultimately be displayed in formats that the operator finds useful. Some operators are using programs such as OpenWells or WellView while some use an Excel spreadsheet and others in house programs. (Figures 1, 2, 3, and 4) Spot Fire can be utilized to help bring data from multiple programs to present in different format to facilitate using more than one program. The biggest issue is gathering the information you need in a consistent format.

The use of drop down lists helps with formatting, but sometimes just getting the data from the field can be difficult. A form or spreadsheet can greatly assist by reminding the rig supervisor what information is required and help drive consistency in reporting. However, all the data needs to be entered into a program by the rig supervisor, engineer, and/or other designated personnel. Ideally, the person doing the work should enter the necessary information.

At a bare minimum, the information that can be helpful to analyze and derive a root cause is: 1) dates of when the well failed, the repair job started, and well put back on production, 2) what is the actual failure versus why a well was pulled, 3) the depth of the failure, 4) what was observed as the well was pulled, 5) what was run back into the hole, 6) location of new, used, and rerun equipment, 7) location of all equipment related to the bottomhole assembly, and 8) details such as was the plunger stuck prior to attempting to unseat the pump, was the TAC set, what was laid down and why, description of solids in the mud joint, etc.

Other information such as pictures, chemical analysis, tubing scans, pump inspection reports, and gyros greatly add to the data collected. These should be attached to programs if possible or placed in an electronic file to ensure their availability for the failure meeting.

Trending failure data is instrumental in recognizing progress, detecting problems, and/or identifying areas of concern. Trending failures in terms of failures/well/year or meantime between failures will show an operator if they are making progress in resolving failures (Figure 1). Trends showing the percentage of rod, tubing, and pump failures will help determine which area might need more focus in making changes to reduce failures and if progress is being made in reducing those failures. Trending root causes also helps to identify areas that need attention and direct activities in that direction (Figures 3 and 4). Without these trends it is difficult to establish target goals. They are an important key performance indicator.

A critical component of any failure tracking system is a champion. Without a champion or someone that is motivated to stay on top of the program, ensure that data is getting properly input, fixes any problem, and helps keep the program moving forward, the overall failure tracking system will experience a slow death spiral. The challenge is often in finding successors when the initial champion moves on.

ROOT CAUSES

There are multiple methodologies to determine the root cause of a failure. The most commonly used is the "Why" process where one keeps asking the question "why" until one cannot drill down any further. By getting down to the root cause, then one can address that issue rather than applying a band-aid that only fixes the symptom. For example a hole in the tubing is caused by tubing wear, but what caused the wear. It was due to buckling, but what caused the buckling? The plunger was dragging during the downstroke, but what caused that? It was iron sulfide found between the plunger and barrel, but where did the iron sulfide come from? It was a lack of chemical downhole, but why wasn't the chemical reaching the pump inlet? The chemical did not reach the pump inlet because the slip stream had been closed, but why? It had been closed because the pumper had closed it after determining production was down.

Having a clearly defined, reasonable, and finite list of Root Causes to choose from helps teams reach agreement. List that are too long make it difficult to focus. Lists that are too short impede proper analysis and ultimate failure mitigation.

Too often, we want to quickly settle on the easy answer or we don't have the data to adequately evaluate the potential answers. This can be offset somewhat by a solid list of root causes and a diligent effort to not settle on the all too common "unknown".

FAILURE MEETINGS

Failure meetings are critical to determining root causes and developing fixes. While there is a tendency to rush to an answer when the well is first pulled and is often required to get the well back on in a timely manner, this can lead to misdiagnoses and repeated failures. Failure meetings provide an opportunity to systematically assess failures, determine root causes, and ultimately determine changes that will help reduce future failures.

Many cringe at another meeting so the importance of the meetings should be stressed and they should be prescheduled to ensure that they are held periodically. The idea is to have them often enough to adequately cover the failures. Shorter meetings tend to be more productive. Limiting meetings to review a manageable number of failures ensures all cases are reviewed with the same level of interest and objectivity. Weekly meetings may be necessary in larger areas or high failure rate areas. Monthly meetings are common, but in some cases, they may be required more frequently while in other situations there may be an extended amount of time. Only those wells for which all the data is available to should be reviewed.

Let's step back a moment and discuss the definition of failures. The simplistic definition is whenever downhole equipment fails, but did it become a failure when the equipment failed or when the well was repaired. Additionally, what about jobs performed to upsize equipment, execute workovers, prepare for an offset fracturing, or anytime a service rig is required? While all of these jobs as well as related tasks should be documented as they can contribute to a failure and/or explain skew failure data, each operator should determine how they are going to categorize all of these actions. Additionally, most operators classify a failure at the point it is repaired as there are many instances when wells are down for months if

not years before being repaired. This can create difficulties when calculating the failure rate, but consistency often minimizes that issue over time. Good failure definitions can help direct teams to correct Root Cause determination.

Just as the tracking system needs a champion, one should be selected for the failure meetings as well. A meeting facilitator. Then someone should be selected to lead the discussion on each failure. Many times, this is the production engineer, but it can be a champion, ~~or~~ production supervisor, production specialist, or someone else. Their primary duty is to ensure that all the data is gathered and placed in an appropriate format to facilitate the conversation. These can be the same person. However, there is a benefit when the meeting facilitator is not part of the production team that operated the well at time of failure. An impartial facilitator can offer objectivity.

The remaining personnel should be those personnel that can contribute information about the well, its operation, and the resultant repair. This should include: production engineer, operations supervisor, service rig supervisor, fluid tech or optimizer, pumper/operator, pump shop technician, and chemical company representative. Other personnel that might be considered are rod manufacturing rep and other technical personnel. Each should come prepared to contribute to the conversation and bring relevant data and/or failed parts.

Data should include that gathered during the failure mentioned earlier plus production data, fluid levels, dynagraphs (live, shutdown, startup, malfunction, failure, etc.), available production information (SPM, runtime, cycles, pump fillage, etc.), design program output, past failure information, and failed parts.

Failed parts from the pull are instrumental in determining root causes. It is recommended that failed parts be cut a minimum of one foot each side of the failure and that a process be implemented to ensure the parts get picked up, properly handled, and brought to the meeting. Many companies have the chemical company pick up failed samples to bring to the meeting, but they will often clean up the samples to make it easier to see any pitting. This can prevent a good analysis of a rod failure so this should be discussed with the rod manufacturer. Tubing should be split to allow an internal visual inspection and additional samples should be gathered if they could contribute to the analysis. Finally, failed pump parts should be brought if they were the reason for the failure plus any other parts that will contribute to the analysis. A standard suite of pictures can suffice as the next best option to handling the actual parts. Pump inspection reports often provide clues of how the well was operated. Metallurgy or failed equipment (rod or tubing) inspection reports are valuable in providing objective input and analysis.

The champion should keep the team on track and moving forward. They should also keep the group asking “why” until a root cause and any actions forward are determined. Lastly, the data should be recorded in a place where it will be reviewed when the well next fails. Overall action items with responsible and accountable personnel identified are useful to review at each meeting to ensure necessary work is not overlooked.

CONCLUSION

Failure meetings are a proven tool in reducing failures. To make them effective, programs to document and track the failure data are required, data must be trended to help spot related issues, and participation by multiple personnel to drill down through the data to determine a root cause.

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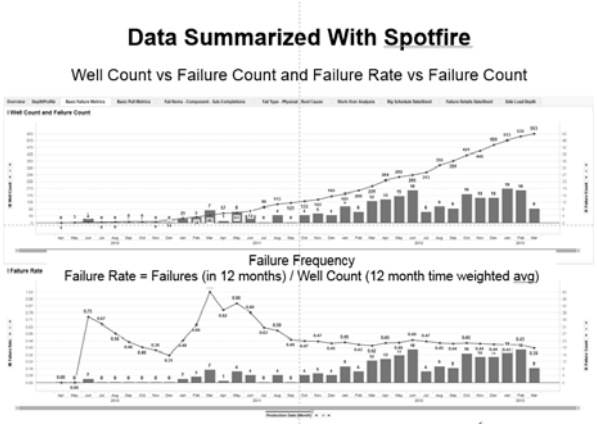

Figure 1- Failure rate summarized using Spotfire

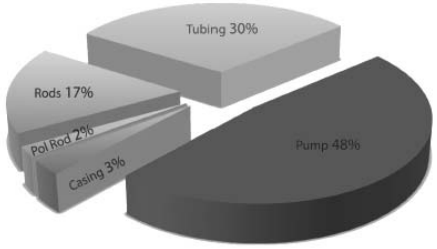

Figure 2 - Failed equipment summary using EXCEL

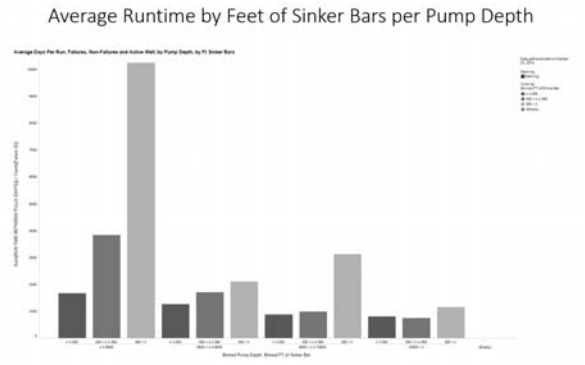

Figure 3 - Failure analysis example using Spotfire

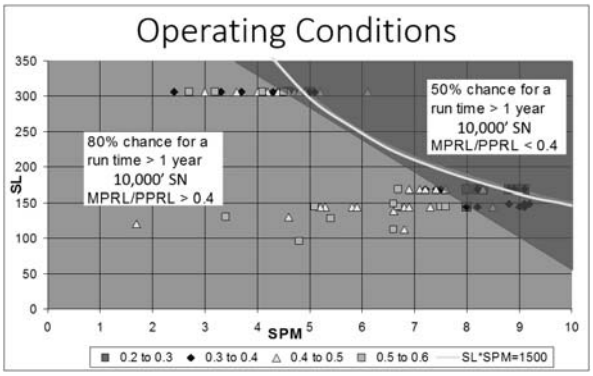

Figure 4 - Failure analysis example using EXCEL