EFFECTIVE USED TUBING STRING PROFILE WELLCHEK DATA BASE WITH WEB ACCESS

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ABSTRACT

WellChek Database has been developed to provide a well specific, tubing string profile from an on-site used tubing inspection unit. Tubing is classified as it is pulled from the well, providing sequential information on a per joint basis within the string. Before being returned to production a detailed report of the tubing string is provided online, which can be viewed together with previous inspection results, containing critical information to the well management program. Routine well maintenance provides the opportunity for inspection data to be easily obtained. Field engineers find it beneficial to track wear and corrosion patterns, propensity, failure causes and success of mitigation techniques. Tubing issues make up a high proportion of production costs - rig time, lost production, tubular replacement and transportation. Working together with production engineering groups to analyze this data has yielded information to assist in making practical tubing management policies to reduce these costs.

INTRODUCTION

The majority of today's oil is still produced from conventional rod pumped wells. Tubing and rod failures make up one of the highest proportion of maintenance services. The combined price of downtime and servicing wells being so costly it is critical to mitigate risk of repeat failures. A number of different services and tools are available in the industry to production engineers for assisting them with maintaining the highest production rates of their wells. Commercial items such as special tubing, internal coatings, rod designs, rod guides, special practices and new methods are all available to improve artificial lift systems including chemical treatments and many other technologies reducing the risk of tubing and rod failures. Unfortunately every well is unique and a specific combination of any of these applications may work for one well but not for the next. Additionally, many of these services or products are implemented with little or no information and far too often improper combinations end up costing as much as the original well failure. The knowledge of downhole conditions becomes very valuable when resolving critical production problems. While millions of dollars are spent each year for improving and maintaining production levels, the on-site sequential tubing inspection is the most economical component to build an effective risk management program. This associated database has already played major rolls in providing real time data solving the seemingly impossible problem and decreasing unnecessary costs.

ON-SITE SEQUENTIAL INSPECTION

Originally on-site tubing inspection was designed and marketed as an alternative for in-plant reclamation centers where pipe is transported and received for servicing. In the beginning on-site inspection reports simply stated the total amount of tubing rejected or failed according to API specifications for classifying used tubing and casing. The leading major benefit of on-site inspections is all acceptable lengths of tubing are available at the well site for immediate reuse. Once the well maintenance is complete the rig crew will be able to begin running tubing back into the hole without delay. All replacement pipes new or used will be transported to the location from either a pipe distributor yard or it may be from a storage area or straight from a service center. Inspections performed at the site offers many advantages the main one is putting the well to back on production in a quick and economical fashion. The field engineer realizes the value associated with knowing the sequential locations of each length as it pertains to each well. The use of a tubular maintenance program will coordinate all unacceptable tubes identified on-site by color code as they are laid down and made ready for transportation to the reclamation service centers. Tubular service facilities offers detailed inspections along with re-threading, re-coupling, re-coating as the case may be since there are so many reasons tubing may be downgraded. Most material management programs will return the reclaimed tubing to location ready for use. Used Tubing is refurbished to an "as new" condition, when tubes are verified as having almost new elements like acceptable wall thickness and no detectable flaws makes it very economical to reuse the tubes quickly realizing a large amount of savings when compared to buying new pipe.

Beware of new tubing, it should be known all new tubing is not always defect free, in recent years "post mill inspections" of new pipe have increased, finding greater amounts of defective pipes by inspections performed prior to the tubing being run downhole such as damaged connections, thin walls and internal defects all causes for premature workovers.

ON-SITE SEQUENTIAL REPORTS

Knowledge of failure patterns and depths has become very significant in tubing and rod string designs, rod guiding decisions and material considerations. In a slow industry a greater emphasis is put on each well to increase savings and extend well run times. The sequential position of tubing as it was used downhole allows for specific knowledge to the approximate locations for failures, extensive rod wear, corrosion and pitting relating to troubled areas found within the tubing string. This unique and critical piece of data is yielded during on-site tubing inspections it was noticed as early as the 1980's while trying to solve very low well run times. The first on-site printed inspection reports were developed to show the breakout of the tubing classifications using a graphical representation relating to the important sequential position of all tubes specially the downgrades illustrated vertically on a page. Production groups now can easily recall the well profile (sequential positions) to help identify the area and possible root cause for continuous problems or failures.

RETRIEVING ON-SITE REPORTS

Analyses of these reports were hindered by a number of issues, often many reports were printed on-site and not stored in an electronic format. As wells would go for long run times between well workovers or until a failure occurs the last inspection reports seem to get buried in a file cabinet inside very thick well files costing precious time attempting to retrieve these reports. An online database was built simply to recover these files and store them in the widely accepted format Microsoft Excel. The original pilot program was developed in California in early 2000 making several well snap-shots viewable in a short period of time. It was quickly realized the strength of a database holding all the spreadsheets would be a very user friendly way to search for past sequential well inspections. This was accomplished with a full integration of stored information into a single database where the data was made available by well name and location.

FIRST CASE STUDY

A major California oil field was experiencing severe problems, a number of wells failed just months or in some cases as quick as weeks after having been pulled and inspected. The initial reaction was perhaps bad tubing was being allowed back downhole so the validity of the on-site inspections performed came into question even though defective tubes were identified and removed from service during the inspection. The resulting research showed compared to other wells inspected on that lease these particular wells had a history of a much higher tubing rejection rate than the overall average of the lease. Well #545, (Figure 1.1) a snap-shot of the total tubing string on February 2005 showed length #152 with a tubing split. Additionally 25 of the 26 lengths just above the split were downgraded and all the tubing just below the split was classified as red. It is very noticeable on this sequential report no corrosion was detected or found on left side of the well profile (fig 1.1) only rod wear conditions were detected and existed as illustrated on the right side of the well profile (fig 1.1).

In less than four months on June 2005 this well failed again. The inspection revealed a very similar pattern of wear (Fig 1.2) detecting another split tube (length #149) within 100ft of the February tube failure. Certainly having the inspection report showing the tubing string's classifications in sequential order enables a clear picture to be drawn of for persistent problems. Each of these inspections identified several hundred feet of tubing as being a potential to fail just above and below the location where the two split tubes were rejected. It was noted by the inspector as he pulled away from the well-site; the pulling crew began to run the just inspected tubing back into hole long before the replacement tubing began to arrive.

MATERIAL POLICY

Since tubing replacement cost can become extremely expensive the material policy at the time of this well followed re-running tubing with up to 40% wall loss as cost-saving policy a reflection of the 1980's market. It was apparent the pulling crew had continued to follow these policies running highly worn tubing back into the well that was prone to failures. As the bigger picture became clearer the sub par tubing string was found to be the major contributing facture for such a deteriorating well run-life. It is typical for pipe returning downhole to be almost in the same position as it was when pulled (last out – first in). Based on the reviewed sequential inspections this policy was quickly revised helping to verify over used tubulars as a major part of the problem. This knowledge changed the practice to where only new tubing or yellow band tubing would be allowed in this well for future use. Also this applied to all replacement tubing and in conjunction with this new focus sucker rods and rod guide were specifically designed to complement the well habits.

RESULTS

This well stayed in production for 14 months representing a 350% increase from its previous two workovers. When the next failure occurred in August 2006, the inspection results depicted side-load wear caused from long time running with corrosion and pitting evidence closer to typical tubing life estimations (Fig 1.3). On-site inspection results were validated putting critical pieces of the root cause failure analysis puzzle together making the well conditions and habits controllable. This lease property has continued the new tubular re-run policy with a few additional communication tasks. The inspection results are now being shared with the whole subsurface team playing a major part of their risk management program. A new inspection report retrieval method now includes an online database searchable by well name and location. Today's technology makes it possible for real time inspection results to be emailed as notifications made possible by standardizing each inspection unit with the same capability. A team effort was given by all parties with measurable results by revising some practices and a few policies the risk management team of tubular materials realize the small but very important part tubing inspection plays in a successful completion.

SECOND CASE STUDY

A small field tucked away in a dense urban location in Southern California had a handful of wells prone to tubing related failures. For a three year period, these wells were tracked in the attempt to determine the root cause for unusual workover rates. Three wells were targeted for having 21 workovers in a short 3 year period. Due to the great record keeping of on-site reports the failure analysis narrowed down the potential problem to two pockets of deviation. Further reviews revealed these areas were susceptible to rod wear, being resilient to guides and to other known possible preventative measures. One particular well consistently failed every 3 to 4 months with finally a parting of the string in August of 2006 (Fig. 2.1) requiring an extensive focus into failure mitigation. A new longer well life solution had been tried in Canada, where it was discovered a much tougher pipe surface should be applied in the known problem areas. The tubing manufacturers and tubing users agreed on the process of boronized pipe to withstand such an aggressive troubled zone. The attempted solution to extend the well re-working periods was successful far beyond predicted. Boronized tubing has a robust surface toughness useful in preventing tubing wear meeting the severe downhole conditions. The inspection company verified boronized tubing can be properly inspected even with the extreme hard surface. It was also determined the wall thickness can be measured correctly with the large change in surface hardness. Normal workover inspections with the gamma-ray / electromagnetic unit were successful.

DECISION TIME

The team decided August 2006 to use only 15 joints of boronized tubing in the troubled zone as a test. When the next workover for this well occurred in May 2007 it was related to a sucker rod parting from wearing on the new boronized tube and not a tubing failure. The inspection report showed the tubing near the rod failure was re-classified as predominately yellow band pipe. Further review of several inspection sequential reports (tubing string profiles) identified two other potential problem areas in this well. April 2007 the team made a decision to use 9 joints of boronized tubing in the new potential troubled location. After nine months in January 2008 the next workover was required, the on-site inspection reveled only 2 joints of boronized tubing were downgraded to blue band (Figure 2.1). The production time for this well was doubled, while the amount of replacement tubing was cut on average by one third. Before the boronized tubing was considered typically fifteen percent of tubing would be rejected and laid down for replacement. The next two pulls on this well averaged only a ten percent tubing rejection with replacement required. This new technique was applied to two additional wells with similar results.

CAPABILITIES AND APPLICATIONS

Statistical studies can now be performed on a per well basis or location or area by the lease company allowing records to be accessed from their thousands of inspection jobs and literally millions of tubing lengths. When sorted by well name and field location inspection results may be used for determining recovery rates and rejected types. In beta, each well can have a rod string design assigned to it with dates correlating before or after inspection runs and can be viewed historically together with customizable viewing options. The ability to query by partial or full well names, reject rates, date ranges, and reject type offers a vast amount of data to the production team while sitting at your own computer.

INTO THE FUTURE

An upcoming feature will include the ability to pull numbers by depth and position within a tubing string. That data, combined with the section and lease queries, can provide subsurface tubing conditions across an entire field in ways never before realized. The ability to put hard numbers behind the rates of failure and wear to tubing from results of subsidence, corrosion or deviation will have vast implication for well maintenance and greatly help making the tough economical decisions. Moving forward is two ongoing studies to measure the usefulness of different mitigation techniques. The first is applying the unique capable of the Gamma-ray inspection to distinguish the difference between a singular rod stroke and an even body erosion with a few proposed report modifications and database tweaking this becomes very useful in quantifying the effectiveness of tubing rotators when applied to particular wells based on tubing reject rates.

A second field is using a beta version of the database to track rod string designs that correlate with tubing inspection reports and deviation surveys. When known starting values are available such as drift angle, tubing class, rod type and rod guides are matched to consecutive inspection reports the ability to measure the success of new implementations for guiding and design applications will help in creating easy to apply basic monitoring practices. With the strength of accessing and tracking thousands of lengths from traceable changes to performing studies on the effects of tubing rotators, well deviation, rod guides and other possible solutions that may have been difficult to quantify and therefore justify.

CONCLUSION

As more data is collected and shared by applying inspection services production groups will have a greater understanding of tubing life and its conditions. This will lead the risk maintenance programs with material considerations, new tubing vs. used refurbished tubing and other practices and policies. The ability to monitor well changes and know tubing sequential classifications on a joint-by-joint basis with depth position has made this a game changer in preventative maintenance tools. Cost-effectiveness becomes the main driver in a number of scenarios and applications that can now be attempted and measured for true value added. The case studies used showed the commitment to solving critical problems is very possible with very practical policies.

In the case of Well #545, the old policy to only replace tubing with greater than 40% wall loss and no regard to failure patterns or inspection data was a major contributor to repeat failures always near the same hole depth. Subsequent inspections verified the longer run times allowed side-loading to become the new problem with good tubing strings. The correlation can be made with the predictive rod analysis showing a proper and longer run-time is achievable for each well’s unique situation. To maintain this level of risk management a consistent inspection program is the key. The performance of a well can be closely monitored with an inspection during the pulling of the tubing string, it will also yield downhole knowledge on the why’s and how’s of that particular well’s producing data and the rapid changing conditions of the string. When multiple inspection techniques are applied such as sometimes gamma-ray inspection and sometimes hydrostatic testing and sometimes electromagnetic inspection the upfront control of these costs will only appear to be a good cost saving plan, but in fact as the gap of incomplete data continues to grow along with the downhole unknowns it doesn’t very take long for the well run-times to shorten back to the 3 to 4 month period.

The results in these two case studies and the many similar ones not mentioned attest to the importance of the sequential inspection results as a major part of a successful preventative maintenance tool. This web-based program will be moving forward into its next generation under the WellTrak system name continuing to collect data on a world wide base for sequential on-site tubing inspection results from a fleet of inspection units.

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First Case Study

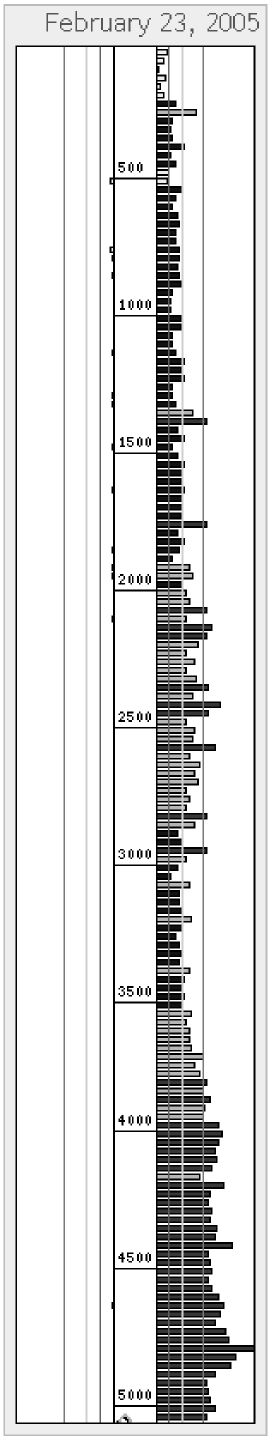

FIG 1.1

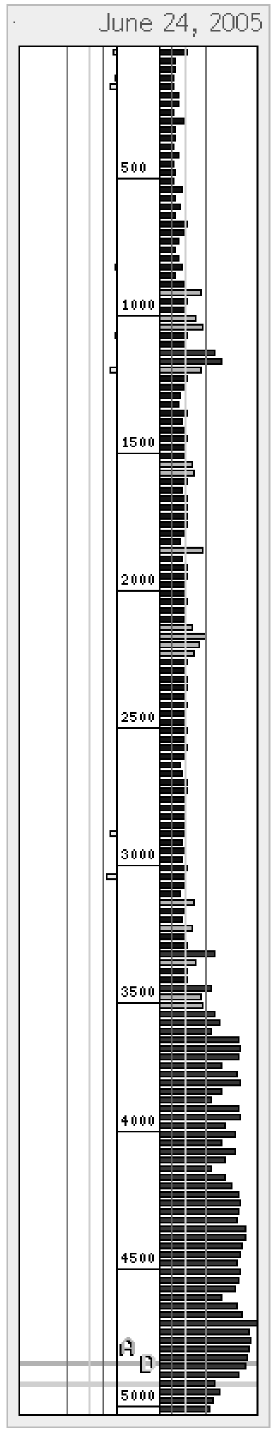

FIG 1.2

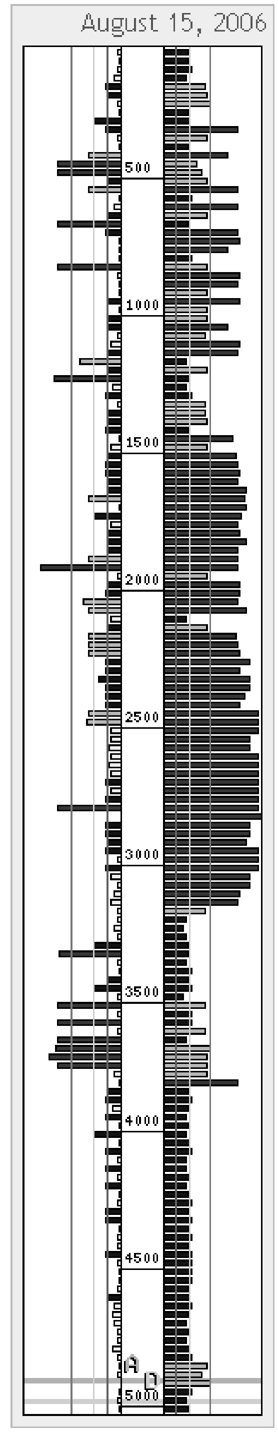

FIG 1.3

Second Case Study

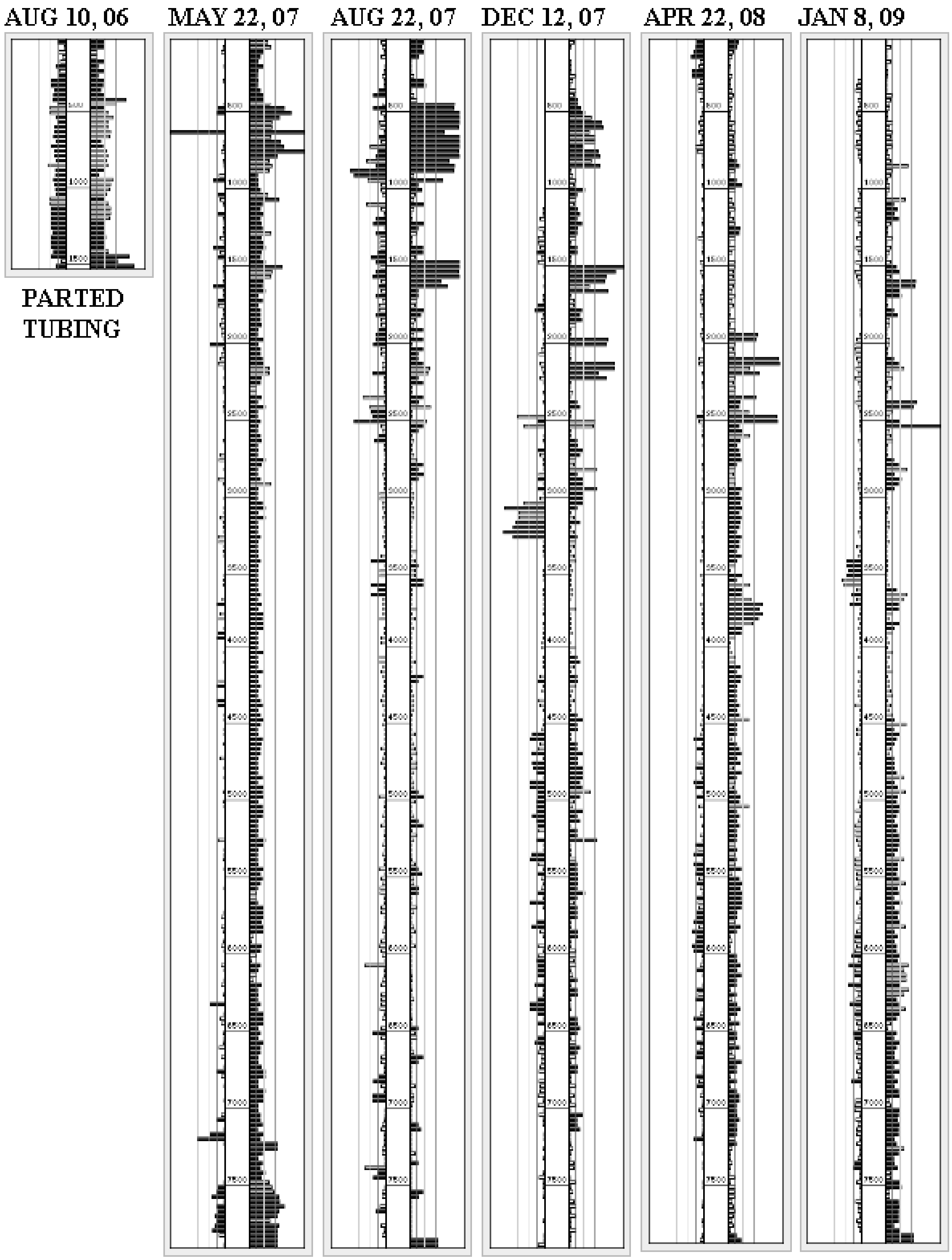

FIGURE 2.1