A NEW TOOL FOR THE PRECISE MAKE UP OF THE "NASTY" TWO ELEMENT SUCKER ROD CONNECTION

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ABSTRACT
The sucker rod connection poses several problems to rig crews as well as the oil companies. The first issue the crews have to deal with is the fact that there are two elements to a rod connection: The lower and the upper rod interfaces. Making up both elements to precise circumferential displacements at the same time is almost impossible.

This paper will deal with these issues and will illustrate a new tool that solves the makeup problems and at the same time, gives the crews a method to remove or replace a coupling. The tool can be instructed to make up either both or only one element of the connection to the precise desired CD. The two CDs are measured independently.

SUPPOSITIONS
This paper discusses how rods are assembled or disassembled in the field and it is only appropriate that the first sentence should read something like this: There is a huge difference between "what we should do" and "what we actually do." Problem solving should always start with the known facts.

Fact number one: If properly assembled and properly used, the sucker rod pin should not fail under a load.

Fact number two: The correct tightness of a rod connection is based on the proper use of "The Card." API 11-BR is the rule book. Circumferential Displacement or CD is the standard. The tightness standard is not applied torque.

Fact number three: Rod tongs, although identical in appearance, have vastly different pressure-torque relationships. Allowing the crew to set the pressure to an "experienced based known" is asking for problems. (See slides 1 and 2)

Based on observation, the current field practice for the majority of crews is very simple.
They:

- Place a backup wrench or some other rigid object in the tongs between the tong case and the rotating table.
- Turn the table and let the tongs stall when the table engages the wrench.
- Set the pressure relief valve at some pre-known pressure based on experience.
- Remove the wrench and run the rods.

When asked why he does it that way, the operator's normal response is: "I know my tongs and this is the pressure that it takes to make up the rods correctly. I have done this thousands of times."

Fact number four: Spray metal couplings might solve a lot of the abrasion problems and coupling wear issues, but they offer unique problems to the well service company as it is very difficult to grasp the coupling in the field without inflecting damage at the same time. Hammering the connection is never allowed. Example: If a crew discovers a pit or worn place in a rod body and needs to replace the rod, it is most difficult to break off a spray metal

coupling with the current tools available to the crew. Moreover: Asking a crew to warehouse the rods is practically asking for the impossible.

Fact number five: The service rig operator may have his company's name on his shirt and he knows whose name is on his paycheck, but rest assured he is working for and answers to the company man at the wellsite. He will react to the company man's wishes. The bottom line here is: One should not hold the service company responsible for properly running the rods if the company man does not insist that the service crew do so. Assuming can be very expensive.

Fact number six: Some humans like shortcuts and will often take the easy path where available. If the crew does not fully understand and appreciate the absolute necessity to follow API 11 BR, they will find the short cuts. This problem is magnified when no one is looking or they are being pushed for time.

- Fact number 6A is a corollary to fact six: The harder the company man pushes for time, the quicker the crew will resort to short cuts.

Fact number seven: When a crew is installing a new coupling using conventional rod tongs, the odds of obtaining the proper CD on both ends of the new coupling is not in favor of the operator.

Fact number eight: Crews and Customers alike often feel that it is only necessary to "card" the rods on the last run….the run when the well is to be hung on the unit. They downplay the need to card on intermediate runs such as fishing or running paraffin knifes. Clearly this is not a good practice as fishing with rods can often place higher loads on the pins than the normal pumping operation. Remember…once the pin or coupling is damaged, the rod is history. It should end up in a fence somewhere or maybe sold to some poor unsuspecting poor boy operator.

Fact number nine: While using conventional tongs, if a crew is allowed to pre-set the pressure "to a known or preconceived" value (the stalled wrench system) and if that pressure is too high, permanent damage can occur to the pin and a premature failure will occur. If the pressure is set too low, a loose under a load failure might occur.

Fact number ten: Machines and computers do really well with tasks that are repeatable and predictable. Machines, when well designed and maintained, are precise. Humans are not predictable. Humans are different. Humans are not precise. Imprecise humans operating precise machines produce imprecise results.

With the above facts in mind, possibly, the service industry is being asked to do something that realistically cannot be done with the current tools in the field. Certainly, the opportunity door is opened for new technology.

KEY'S SMART TONG TECHNOLOGY

Rod pin failures for the most part are avoidable as the pin is up to the task when properly tightened and properly used. Most likely, the best proof of this statement comes from Key's Smart Tong®. These tongs were introduced several years ago and have for the most part been used in fields and wells that had a history of high pin failures. "Without exception, on wells where Smart Tong® was used to run a new rod string, the historical high pin failure rates was reduced to zero on all wells. On wells that used Smart Tong® to re-run rods using existing materials, the failure rate dropped significantly." (5 failures on more than 100,000 connections. See Steve Concrogood's Paper)

Those few re-run failures were attributable to excess fatigue damage, which was already built up in the connections due to previous improper makeup. This data points to another fact: Once a rod is tighten past yield, it is destroyed.

CIRCUMFERENTIAL DISPLACEMENT TOOL

The CDT has taken a uniquely different approach and has several defining features such as:

- The tool grasps all three components (both rods as well as the coupling) of the two element rod connection enabling the device to deal with each of the two connections separately.

- The CDT divides the make up of a rod connection into two distinct processes:
  (1) From the initial spin up the threaded region to the shoulder point (SP), and
  (2) The final tightening from SP to the desired CD.

- The tool sets the CD of each element in separate processes.

- The tool does not require "head reversal" when switching from pulling or running rods. Safety feature.

- The tool gives the crew the ability to remove a coupling without friction wrenches and hammers.

With a device that can grasp all three elements of a rod connection, a whole new world is opened up.

- **How Does It Work?:**

RIH with rods: The CDT operator has a display screen and a series of buttons that allows him/her to make certain selections that control the device. Select “RIH” and choose from a pick lists of options.

1. The size, grade?
2. New-rerun?
3. CD to what standard...Norris, Trico, API?
4. On Break rods….The coupling…(Break and re-make) or (check tightness) or (nothing)?
5. Off Break rods….(Break and re-make) or (check tightness) or (nothing)?
6. Is the coupling looking up or down?

Step 4 deals with the rod connection that is being made up and run from the derrick where spin up is required. The CDT can break the coupling that remained on one rod and re-make it to a known CD, or it can check the tightness based on torque, or it can do nothing. It then spins up the rod from the derrick to the SP and then brings the new connection to the prescribed CD.

Step 5 tells the CDT how to deal with the off break connection. This is the two connections that were hung in the derrick and not dismembered when triples are being pulled. The difference in these two connections and the break connection is: No rod spinning involved. It is a tightness check either by torque or the break and re-make method.

The CDT software will sound an audible alarm indicating a successful or defective connection.

Changing out a defective coupling. If the tong operator detects a worn or defective coupling, the CDT will “buck” the coupling off but not spin it off. After it is broken from both rods, he hand screws on a new coupling and instructs the CDT to “make” the coupling which is done to the correct CD on both ends.

POOH with rods: The operator selects POOH on the screen and the PLC prompts the following:

1. The size, grade?
2. New-rerun?
3. Leave the coupling looking up or down?
4. Remove the coupling?

The size and grade information is needed because the software is looking for over tight or loose rods and it will alarm the operator of any anomalies.

CLOSING COMMENTS

Who: The question of who really needs to worry about making up rods to absolute precision is often discussed. At first pass, it would appear that beam pumping well operators with lightly loaded wells might not have an interest in this subject. Maybe only the deep-highly loaded operators should be concerned. But, if one considers that the metal gurus of the world really do not understand the cumulative effect of fatigue of the threads or rod faces and that most rods are recycled during their life, one should pay more attention to how that asset is treated.

Development Stages: The CDT was actually developed with the new auto-robotic rig in mind however, it is clear that the tool has wide spread applications for the existing well service industry. The CDT will be developed and introduced to the field in three stages.

1. A stand alone mechanical tool for existing rigs.
2. A semi-automatic tool for existing rigs
3. A completely automated tool associated with the auto-robotic rig.

The system disclosed in this paper is patent pending.

Mark IV Rod Tongs

Mark V Rod Tongs

The Mark IV and V Rod Tongs are Identical in Appearance.
The only difference is the internal gear ratio.