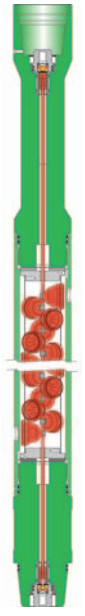
Quick Torque connector improves rig floor safety, TCP efficiency for operations

By Justin Mason and Allison Novak, Halliburton

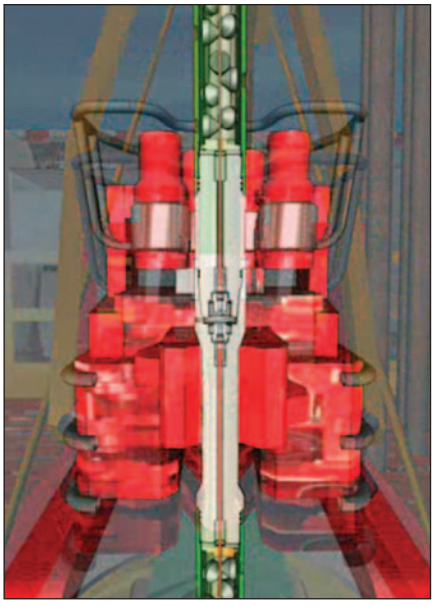
TODAY, TUBING-CONVEYED perforating (TCP) is a technique that is employed worldwide for perforating producing zones in oil and gas wells. It was first introduced more than 30 years ago, and since that time, numerous challenges have been overcome to improve well control at the time the zone of interest is perforated and brought on production.

However, until recently, a challenge remained — the inability to utilize automatic rig-handling equipment in the make-up of the multiple segments of TCP guns on the rig floor. Instead, rig hands were tasked with making up the TCP segments to ensure that the exposed explosives on each end of the perforating gun module are properly aligned for both operational and safety reasons.



This final challenge was overcome with the recent introduction of Halliburton's Quick Torque™ Connector system. Because the new system allows TCP segments to be remotely handled by automatic pipe-handling equipment during make-up on offshore installations, the safety of rig personnel and the efficiency of TCP operations have been dramatically improved.

Many wells have perforating zones in excess of 3,000 ft from the top to the bottom of the producing interval. Because TCP guns are separated into segments for transportation and operational purposes, lengths of up to approximately 28 ft must be connected (made up) on the rig floor and conveyed into the well, one at a time. Now, operators employing the QTC connectors can pick up perforating assemblies with existing automatic rig pipe-handling systems and properly make them up using iron roughneck equipment without any need for direct human intervention. While significantly increasing personnel safety, it saves valuable rig time by eliminating the assembly of components on the rig floor.



Above: Gun module in rotary and gun module being handled by automatic rig handling equipment. Below: Iron roughneck making up 2 gun modules, with bottom of the gun connector stabbing into top of gun connector. Left: Quick Torque Connector Sub-Assembly.

SAFER EXPLOSIVES HANDLING

The system consists of connectors that cover both ends of each gun section to enclose the assembly. The connectors have a common, self-aligning drillpipe thread that allows automatic or manual make-up. Explosive transfer occurs through a web, making the system safe and self-contained.

In operation, either before or after connecting and deploying the gun segments into the wellbore, a firing head of choice can be attached, further deployed into the well and operated in the same manner as a standard TCP job. Once the zone of interest is perforated, the TCP guns can either be left in the wellbore or pulled back to surface for redeployment. The process to disconnect can be performed by reversing the connecting process, and the gun modules can be laid out with the automatic rig equipment.

The QTC system can be used on any rig with automatic pipe-handling equipment. It can be used with 4 ⅝-in. standard or 4-⅝-in. self-orienting TCP gun systems with 3 ⅜-in.-OD or smaller firing heads. The drill string must be capable of crossing over to NC38 threads. There are 3 different styles of connectors—one that connects a firing head to the top of the string, one for a firing head attached to the bottom of the string, and one that only screws onto the guns.

The connector system was developed for a closed gun system using current field-proven technology. Once the thread protectors are removed, all subsequent steps can be automated. If needed, there are environmental kits for extreme conditions such as high temperatures or high pressures.

OPERATORS BENEFIT

In addition to increased personnel safety on the rig floor from no human intervention, operators enjoy a standard NC38 thread make-up procedure, a considerable reduction in the need for back-up guns offshore and a reduction in rig time due to increased efficiency from being able to use an automated pipe-handling system.

The connectors are made from Q125 material that can be used in sour service > 175°F and are redressable. Also, firing heads can be run on the top or bottom, the configuration of the connectors allows for venting of any built-up pressure during shipping and guns can be

doubled up prior to being shipped offshore.

The QTC system lowers the back-up requirements for tubing-conveyed perforating guns. As opposed to a standard gun system, only 1 section between each connector has to be replaced in the event of a leakage, caused mechanically or by a stop fire into the gun body. The distance between each connector in a long perforating string is typically 39 ft. Because each connector pressure seals between each gun section, 118 ft of extra perforating guns is approximately a triple back-up of perforating guns available.

In fact, the QTC system is the first of its kind in the industry to satisfy the Norwegian Petroleum Directorate's (NPD) and the Norwegian Oil Industry Association Recommended Guidelines with regard to facilities regulation section 55 and activities regulation section 80 for remote pipe handling.

DEVELOPMENT TESTING

Prior to releasing the QTC system for field use, function testing, detonation testing and pressure testing were accomplished. The connector size and make-up worked well. The transfer of explosives through these components is a method that has been successfully used in other tools.

Detonation transfer through the connectors was successful as verified by the witness plates. To ensure connectors are reliable after use, quality assurance /quality control best practices require pressure testing of each used connector.

An external pressure test of 29,000 psi was done on the connectors after detonation testing had been performed. This verified both the strength of the connectors and the seal bore integrity after use. All tested connectors held the applied pressure. Additionally, a test was done on the box connector to ensure that the insert would move to allow venting of any trapped pressure behind the insert. Once filled with water, the insert was vented by adding a small amount of water (no additional pressure was added). It vented at approximately 70 psi water pressure, indicating that any trapped pressure would cause the insert to shift, preventing injury.

NORTH SEA DEPLOYMENT

The QTC system was used for the first time at **Statoil**'s Kristin field in the Haltenbanken area off Norway. It was used in combination with Halliburton's patented G-Force® internal oriented perforating system to perforate the P-3H well.

"Our plan is to use the QTC system to perforate at least 6 of the 11 wells in this subsea field from the drilling and completion rig Scarabeo V," stated **Inge Myhre**, Statoil's drilling and completion manager. "The experience from this first operation demonstrated improved safety by remote handling of the TCP system. The trip time was reduced by more than 4.5 hours, or approximately 30% using the QTC system."

"By eliminating manual handling of TCP assemblies and with no personnel on the drill floor while running in and pulling out of the hole, our new system creates a much larger zone of safety than was possible before," added **Jorunn Saetre**, Halliburton Energy Services Group vice president for Scandinavia.