Well Completion

Once the design well depth is reached, the formation must be tested and evaluated to determine whether the well will be completed for production, or plugged and abandoned.

To complete the well production, casing is installed and cemented and the drilling rig is dismantled and moved to the next site.

A service rig is brought in to perforate the production casing and run production tubing. If no further pre-production servicing is needed, the christmas tree is installed and production begins.

Well completion activities include:

- Conducting Drill Stem Test
- Setting Production Casing
- Installing Production Tubing
- Starting Production Flow
- Beam Pumping Units

After production starts, the well may need further servicing.

If it's decided that the well will not be completed, then it will be plugged and abandoned.

Fig. 1. Completed well

Fig 2. Well completion service rig

Conducting Drill Stem Test ^ TOP

To determine the potential of a producing formation, the operator may order a drill stem test (DST). The DST crew makes up the test tool on the bottom of the drill stem, then lowers it to the bottom of the hole. Weight is applied to the tool to expand a hard rubber sealer called a packer. Opening the tool ports allows the formation pressure to be tested. This process enables workers to determine whether the well can be produced.

Potential Hazards:

- Being pinched or struck by the drill stem test tools during floor operations.
- Swabbing the hole on the way out with the test tool could cause a kick to occur, which could result in a blowout leading to injuries and deaths.
- Being exposed to unexpected release of H_2S or other gases or liquids.
- A packer seat failure or fluid loss to an upper formation could cause a kick that might result in a blowout causing injuries and deaths.
- Other hazards are similar to those encountered during trippingout/in.

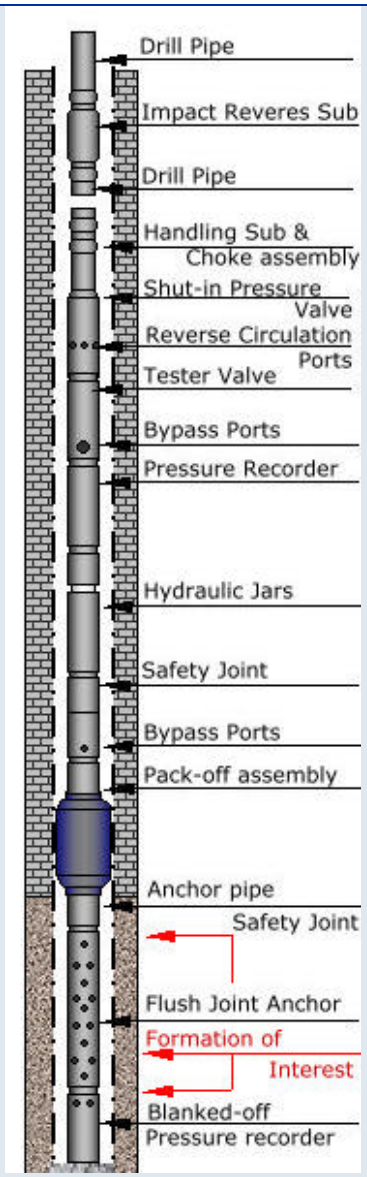

Fig. 3. Drill stem test assembly

Possible Solutions:

- Wear appropriate PPE.
- Instruct workers in handling and using the special tools required during drill stem testing.
- Keep a method for filling the hole in place at all times. Before any test starts, the rig management must ensure that the blow-out prevention system includes a kill system that is capable of pumping fluid into the well below the annular preventer and at least on-set of pipe rams.
- Run a pump-out-sub or downhole circulating device in the test string to to enable the system to be reversed.
- Ensure all workers on the location understand the dangers before starting any drill stem test. They should be fully informed of and trained in appropriate safety procedures, including the use of safety equipment and breathing apparatus. If in an H_2S area, post a sign indicating the test in full view for the general public to see. Post reliable people to stop them from coming to the location. Define a minimum of two muster points with all vehicles parked in an appointed area.

Setting Production Casing

∧ TOP

Production casing is the final casing in a well. It can be set from the bottom to the top. Sometimes a production liner is installed.

This casing is set the same as other casings, then cemented in place.

See Casing Operations and Cementing for more information on specific hazards and solutions.


Fig. 4. Installing production casing

Installing Production Tubing

^ TOP

A well is usually produced through tubing inserted down the production casing. Oil and gas is produced more effectively through this smaller-diameter tubing than through the large-diameter production casing.

Fig. 5. Tubing on rack

Joints of tubing are joined together with couplings to make up a tubing string. Tubing is run into the well much the same as casing, but tubing is smaller in diameter and is removable.

The steps for this activity are:

- Tubing elevators are used to lift tubing from the rack to the rig floor.
- The joint is stabbed into the string, which is suspended in the well, with air slips.
- Power tongs are used to make-up tubing.
- This process is repeated until tubing installation is complete.
- The tubing hanger is installed at the wellhead.

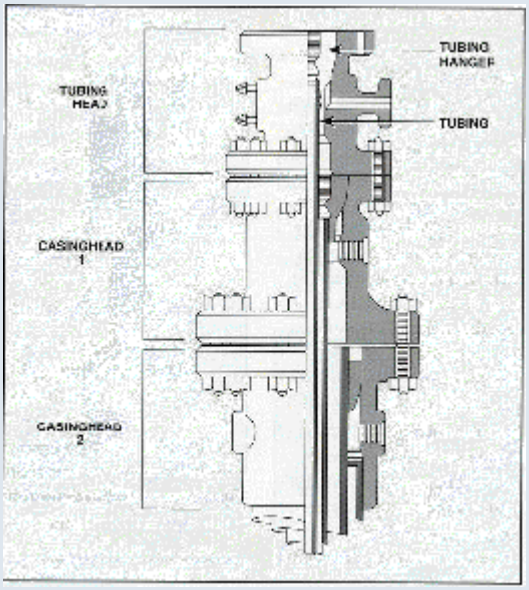

Fig. 6. Tubing head

New technology allows tubing to be manufactured in a continuous coil, without joints. Coiled tubing is inserted into the well down the production casing without the need for tongs, slips, or elevators, which takes considerably less time to run.

Fig. 7. Installing coil tubing

Potential Hazards:

- Getting pinched fingers and hands from tongs and slips.
- Being struck by swinging tubing and tubing elevators.
- Getting caught between the joint and tongs or stump.
- Being struck by the tubing hanger wrench if it should slip.
- Getting fingers and hands pinched and caught between tubing hanger and tubing head.

Possible Solutions:

- Keep all fingers and hands away from pinch points.
- Instruct workers to be on alert when on the rig floor and pipe racking area.
- Avoid placing hands on the end of the tubing stump.
- Use the correct tools for each task.
- Inspect the tools before use.
- Use coiled tubing.

Starting Production Flow

∧ TOP

Production flow is started by washing in the well and setting the packer. Washing in means to pump in water or brine to flush out the drilling fluid. Usually this is enough to start the well flowing. If not, then the well may need to be unloaded. This means to swab the well to remove some of the brine. If this does not work the flow might be started by pumping high-pressure gas into the well before setting the packer.

If the well does not flow on its own, well stimulation or artificial lift may need to be considered.

Fig. 8. Starting production flow

Potential Hazards:

- A blowout may be possible whenever well pressures are changed.

Possible Solutions:

- Monitoring of well pressures and working blow out preventers (BOP's) are the best way to prevent blowouts.

Beam Pumping Units

∧ TOP

If the well doesn't produce adequately, a beam pumping unit may be installed.

There are four basic types of beam pumping units. Three involve a walking beam, which seesaws to provide the up and down reciprocating motion to power the pump. The fourth reciprocates by winding a cable on and off a rotating drum. The job of all four types is to change the circular motion of an engine to the reciprocating motion of the pump.

Fig. 9. Beam pumping units

The pump units are brought in disassembled on trucks and off-loaded onsite. The many parts of the pump unit include large heavy metal pieces that need to be assembled.

Potential Hazard:

- Being pinched, struck, or crushed by falling or swinging parts during assembly.

Possible Solutions:

- Ensure that the work crew understands the assembly procedures and hazards involved in the tasks.
- Wear appropriate PPE.

Fig. 10. Assembling beam pumping unit