

## eRED® Valves Maximize Efficiency During Upper Completion Deployment

Location: North Sea - Shell Norge Draugen E-4 Well

**Introduction** - In this operation two eRED® valves were used to successfully deploy the upper completion on the Shell Norge Draugen E-4 well while maintaining the highest level of safety.

**THE OPERATION** - The upper completion (from bottom to top) consisted of a hydrostatic-set production packer, two Permanent Downhole Gauge (PDG) mandrels, one subsurface safety valve, a gas lift mandrel (gas lift valve) and tubing hanger.

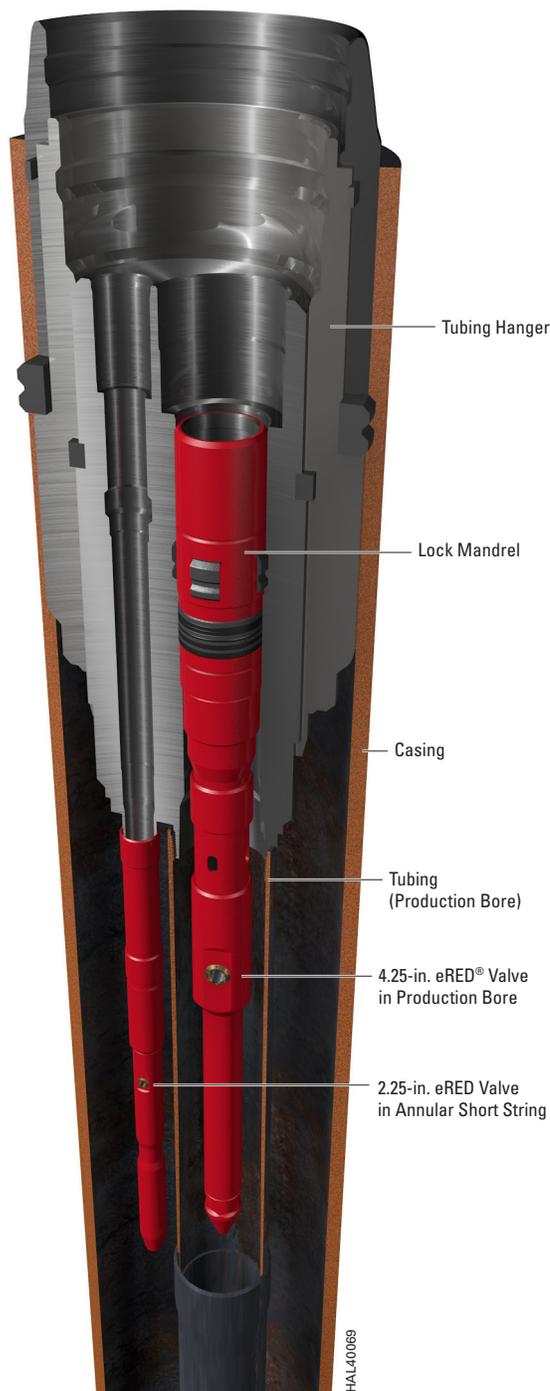
The two eRED valves were pre-installed onshore; one 4.25-in eRED valve was made-up to a 4.75-in QXT lock mandrel in the production bore of the tubing hanger; the second smaller 2.25-in eRED valve was made up to the annular short string. Both valves were tested to the maximum working pressure of the well and function tested prior to shipping offshore. The eRED valves were then run in the open position to allow the tubing to self-fill as it was lowered into the well.

With the completion at depth, the tubing hanger was locked into the wellhead. The completion brine was then circulated from the well by pumping base oil down through the open annulus valve. The returns were taken back up the production tubing through the 4.25-in eRED valve. At this stage, both eRED valves were inactive to avoid any possibility of actuating them during the circulation process.

With the circulation complete, the production packer was set by applying pressure at 3,000 psi. This pressure also served as the 'activate' command for both eRED valves. Once activated, each valve could be commanded to close at any time by applying its own unique pressure signal at surface: the annulus valve would close whenever it detected 1,250-1,750 psi for 33 minutes; the tubing-set valve when it detected 1,750-2,250 psi for 33 minutes.

The production tubing and production packer were then pressure-tested from below by applying pressure to the tubing string through the open tubing-set eRED valve. The annulus pressure was monitored as an indicator of any leaks.

The safety valve was closed, and the pressure above it bled to create a pressure differential for an inflow test. On completion of a successful test, pressure was reapplied to equalize the well before the safety valve was reopened.



*Both eRED® valves were deployed in the tubing hanger but could be independently operated without deploying a dual-bore riser*

At this stage, the tubing was still pressurized preventing the gas lift valve from shearing out while the packer was tested from above by pressurizing the annulus.

The gas lift valve was then sheared out by bleeding the tubing string pressure. Positive indication that the valve had sheared was confirmed by observing the annulus pressure drop.

The entire well was then pressurized by applying pressure to the annulus and through the gas lift valve. The applied pressure (1250-1750 psi for 33 minutes) was used as the command trigger to instruct the annulus eRED valve to close. During the programmed delay before the valve closed, the annulus pressure was increased so an inflow test of the eRED valve and tubing hanger seals could be performed by bleeding the pressure from the annulus when the valve had closed. The trapped pressure was released through the gas lift valve by bleeding off the production string after the successful test.

The tubing-set eRED valve was then commanded to close by applying 1750-2250 psi for 33 minutes, and then tested by applying pressure down the production tubing.

With both eRED valves and the tubing hanger tested, the BOP was then removed and the christmas tree installed.

Both the tubing-set eRED valve and the annulus eRED valve were then remotely opened by applying the relevant pressure signal at surface. The annulus eRED valve was left in hole as planned and the tubing-set eRED valve was retrieved with a single wireline run.

**RESULTS** - The eRED valves were used instead of traditional plug-and-prong type barriers to help increase the efficiency of the operation by removing all but one intervention.

By removing interventions from the operation Shell Norge was able to remove considerable cost, while at the same time reduce the amount of risk to both the operation and personnel.

In addition, the different pressure commands allowed each eRED valve to be independently instructed to close or open. This meant that there was no need to deploy a dual-bore riser saving a huge amount of time and removing significant risk from the operation.

### Project Highlights

- Two open activations and two close activations were carried out, removing a total of four wireline runs.
- The entire operation was successfully completed with only one wireline run.
- No requirement to deploy dual-bore riser.
- Reduced risk of waiting on weather.
- Each valve could be independently instructed to open or close – providing operational flexibility.

**For more information about the eRED® valve, contact your local Halliburton representative or email [completions@halliburton.com](mailto:completions@halliburton.com).**

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