

# Multi-Cycle Sleeves Allow Multiple Restimulations and Interventions in a High-Value Offshore Well

**i-Valve multi-open-close (MOC) sleeves provide water shut-off and re-stimulation capabilities**

## Background

Due to the large investment in offshore wells, it is desirable to select lower completions equipment that can remain operational for many years and can be subjected to production and completion stimulations. In 2009, Aker BP selected our innovative i-Valve™ sleeves for the lower completion in a new project. These sleeves offer multiple open/close cycles and have premium ISO 14998 V0-qualified seals, materials, and anti-scale coatings. This allowed the i-Valve to be used throughout the lifetime of the well to enhance production.

In 2009, the well was initially completed but did not require stimulation and was flowing naturally. At the end of 2010, a high water cut (over 70%) was detected and the well was stimulated with acid through the i-Valve sleeves to enhance production. This intervention was successful, and the well was brought back online with reduced water cuts and higher productivity. The customer performed other interventions in the well to selectively close i-Valve sleeves and shut off water producing zones.

The well was produced and in 2014 oil production rates began declining. Between 2014 and 2016, the water cut began increasing and oil production continued to decline. Production logging confirmed only three zones were contributing to production.



## Case study facts

**Location:** North Sea

**Customer:** Aker BP

### Products

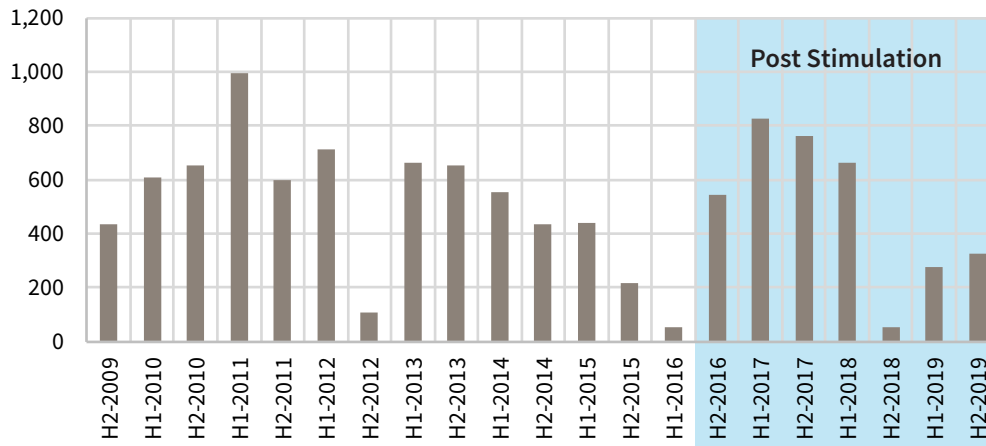
- i-Valve
- i-Shift
- i-Stroke

### General well information

- Total depth: 16,853 ft (5,137 m)
- Horizontal section: 4,593 ft (1,400 m)
- Lower completion included ten zones



## Semi-Annual Average Daily Oil Production (bbl/day)



Average oil rate throughout the life of the well. The effects of the initial acid stimulation (2011) and proppant re-stimulation (2017) are clearly seen.

## Solution

The i-Valve sleeves are operated by using either coiled tubing or wireline shifting tools. Our solution for Aker BP used the coiled tubing deployed i-Shift™ shifting tools and the i-Stroke™ hammer system. Using these tools, each i-Valve can be selectively shifted into the closed or open positions as required.

The i-Shift is a flow activated hydro-mechanical shifting tool. To activate the i-Shift, the operator increases flow, causing the shifting keys are allowed to expand. The shifting keys are designed to latch into a matching profile in the i-Valve sleeves.

The i-Stroke hammer system allows the appropriate shifting force to be applied through the i-Shift into the i-Valves, allowing the sleeves to be shifted even in extended reach and highly deviated wellbores where there is insufficient string weight available. Again, the hammer system is activated by increasing the flow rate which drives the piston until it is released. The release of the piston applies an axial load to the string.

## Results

In the second half of 2016, seven years after the initial installation of the i-Valve sleeves, Aker BP decided to close all the i-Valve sleeves so a new plug-and-perf operation could be performed in between the initial zones. Without full pressure integrity and all the i-Valve sleeves re-closed, the re-stimulation could not be performed. Our team assisted Aker BP in the pre-planning of this operation to ensure that appropriate contingencies were outlined.

Each i-Valve sleeve was closed successfully, which allowed a five-zone plug-and-perf operation to proceed. After performing the re-stimulation and cleaning out the wellbore, the three productive i-Valve zones were re-opened before restarting the well.

The results in 2017 show a dramatic increase in oil and gas production from this well. The oil rates returned to pre-2012 levels, and the well has produced well since. The i-Valve sleeves were an integral part of the success of this well. Through collaborative efforts and long-term design thinking, Aker BP successfully treated and produced this well for ten years with excellent results.

