

Subsea Tree Actuator Valve Permanent Reinstatement System (PCOL Tool)

Engineering, manufacture and qualification testing of diver /ROV-installed XT valve linear override tools and subsea auxiliary valve skids, to reinstate the functionality of production and wing valve actuators. The system allows for remote SCM and well intervention system control, and 20-year design life. Structural, pressure vessel, fatigue analysis and splash zone deployment assessment were conducted by **Neptune**. In-house manufacture and qualification were completed to API 6A & 17D.

Client: Undisclosed

Time: 2013 – 2015

Location: UK Continental Shelf

Problem description

There have been several identical seal failures on Subsea Valve actuators in the North Sea and other global subsea installations. When the valves are actuated open, excessive hydraulic fluid is leaked to sea. To allow these wells to continue producing, inherently mechanical lock-out devices (LAOT's) have been installed as a temporary measure. Unfortunately, this removes the functionality from the platform to open and close the valves and will no longer respond to an emergency shut-down situation meaning that the valves are not operable without costly ROV intervention.

Three subsea Tree valves developed hydraulic leaks on the actuator stem seals. Root cause investigations indicated a seal failure due to loss of elasticity caused by low temperatures and long periods of dormant, unpressurised activity.

Temporary solution

LAOT's are typically used to mechanically hold open the failed actuator such that hydraulic pressure is no longer required to open the valve. Therefore, all the subsea Tree actuators with this failure had a temporary LAOT installed to lock open the valve and reinstate production with no hydraulic leaks.

Like for other temporary LAOT's, the ones installed were not designed to be subsea for an extended period of time. They were typically used for well interventions and were usually subsea only for a few days at a time. The LAOT's were installed for a prolonged period of time and required change out due to bolt and body corrosion, and loss of pressure in the cavity.

The LAOT's were reinstalled with modifications such as Inconel 718 bolts or an additional ball valve to lock in pressure. These modifications along with regular inspection and integrity tests allowed the tools to remain subsea and allowed production to continue. However, these recurring activities were costly. Therefore, a permanent solution was required to reinstate the original valve capability.

Permanent solution – PCOL System (Platform Controlled Override Linear System)

The PCOL System was developed by **Neptune** to overcome all of the above problems. Key features of the system include:

- ✚ Designed and manufactured by **Neptune** Subsea Engineering
- ✚ Designed for permanent installation and full reinstatement of leaking actuator valves and hence permanent Tree reinstatement
- ✚ Over 20-year design life
- ✚ Powered supplied from XT SCM (Subsea Control Module) with 3000 psi working pressure
- ✚ Compatible with all bayonet type actuators

- ✚ All components made of Super Duplex, Inconel 625 & Inconel 718
- ✚ For use with 5" and 2" actuators
- ✚ Dual redundancy on all seals
- ✚ Zero compression set on seals
- ✚ Advanced surface treatments on key surfaces
- ✚ Contamination tolerant
- ✚ Diver installed (ROV deployable version also been developed)
- ✚ Restores full valve and Tree functionality
- ✚ Valve controlled by same SCM directional control valve and software as host (failed) actuator
- ✚ Closure time of the valves are designed to meet emergency subsea disconnect (ESD) criteria
- ✚ Included in the regular subsea IRM campaign
- ✚ Auxiliary Skid provide multiple modes of intervention and compensation
- ✚ Qualified in accordance with API 17D internal and hyperbaric pressure testing

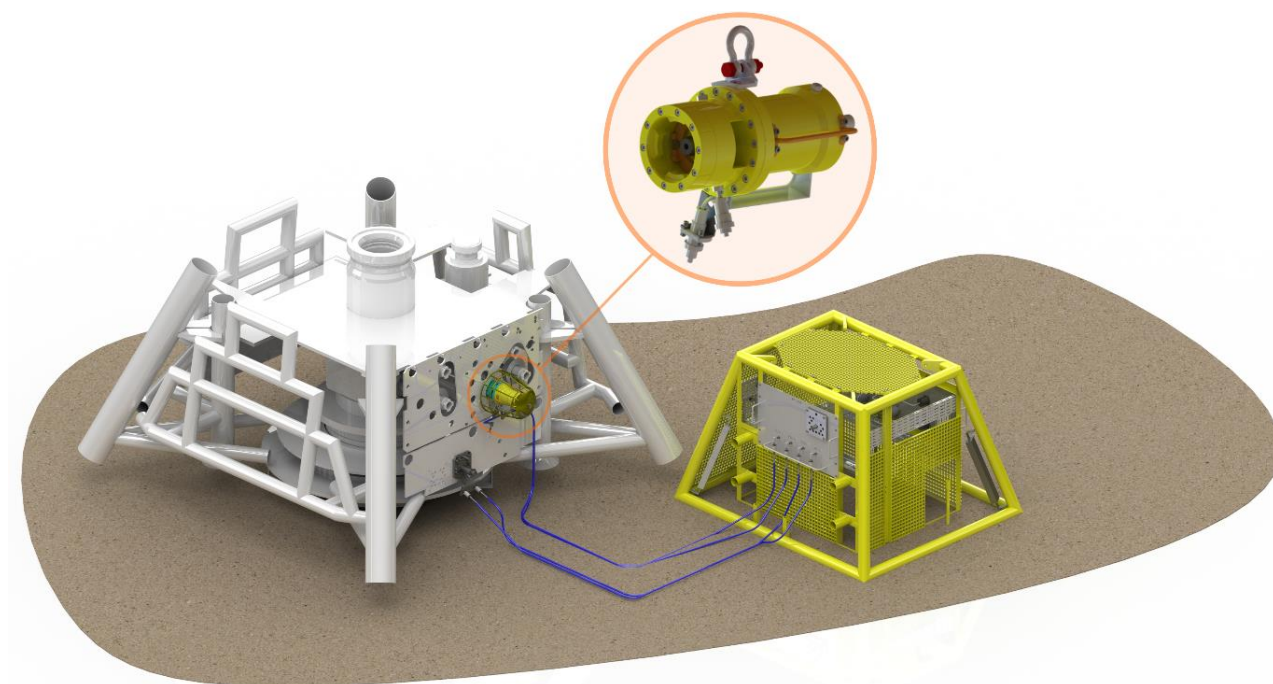


Figure 1: PCOL Tool and Auxiliary Skid installed to a subsea tree to reinstate its valve actuator function.

How PCOL System works

- ✚ **SCM control via Subsea Tree Bridge Plate:** A modified bridging plate reroutes the hydraulic supply pressure from the SCM to the PCOL Tool whilst simultaneously compensating the legacy actuator. This piece of kit can be installed or recovered by diver or ROV. This allows the platform to actuate the valve as normal.
- ✚ **Workover scenario:** The PCOL System is controlled by the intervention vessel/rig whilst maintaining compensation of the legacy actuator.
- ✚ **Workover control from platform:** This configuration presents a workover scenario whereby the PCOL Tool control remains with the platform whilst compensation of the legacy actuator remains with the Auxiliary Skid. All other tree valves are controlled by the intervention vessel/rig.

ROV-deployable version for deep-water applications

Following the successful deployment of the three PCOL Systems for a shallow-water field, **Neptune** Subsea Engineering were contracted to design and manufacture a ROV-deployable version of the permanent linear actuator override tool for a deep-water field. Detailed design and analysis of the tool were completed following API 17D, ASME Boiler Pressure Vessel Code (BPVC), DNV-RP-F112 and DNV-RP-C203. FMECA (Failure Mode, Effects and Criticality Analysis), TRAP (Technical Risk Assurance Process) and TRC (Technical Risk Categorisation) were carried out following API 17Q and API 17N.

Additional features of the ROV-deployable PCOL System include:

- ✚ Depth rating 3050 m
- ✚ Designed to be installed by ROV in high-current condition using Tool Deployment Unit (TDU)
- ✚ Design incorporating a novel engagement, locking and secondary locking functionality for quick installation in one seamless operation
- ✚ Up to four Override Tools can be installed on one XT. Two Override Tools can be controlled by one Auxiliary Skid.
- ✚ Powered supplied from XT SCM (Subsea Control Module) with 5000 psi working pressure

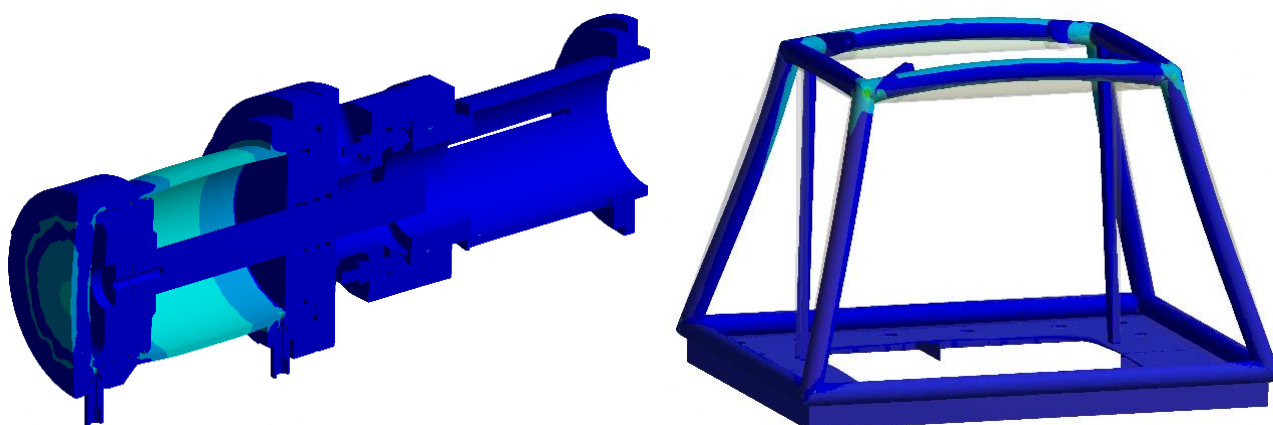


Figure 2: Left – FEA of Override Tool under internal pressure.
Right – FEA of Subsea Auxiliary Skid being deployed through splash zone.

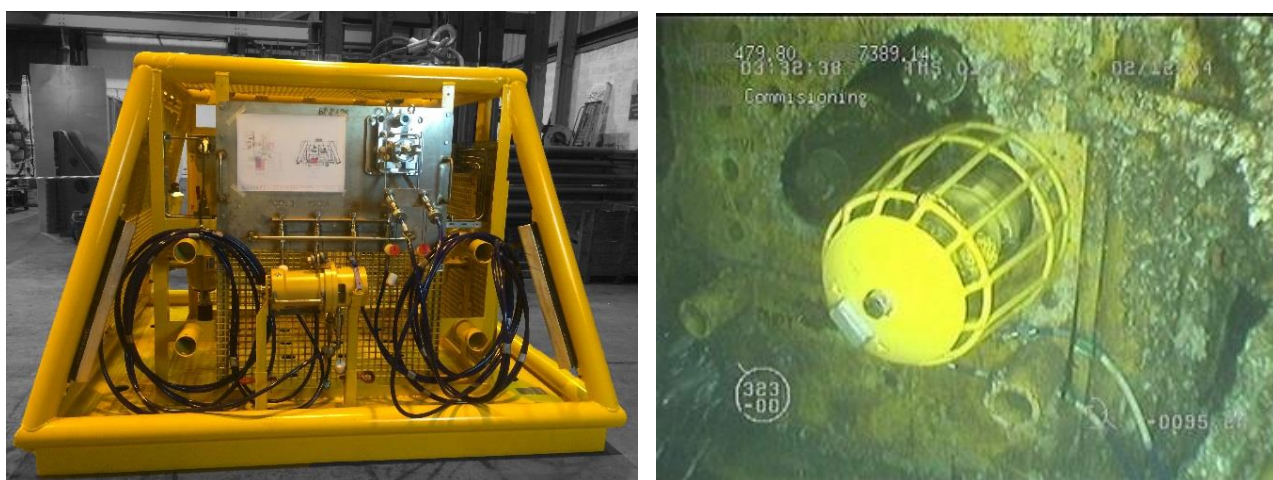


Figure 3: Left – Complete PCOL System engineered and manufactured by Neptune.
Right – PCOL System deployed subsea and successfully reinstating production of a tree.