

Completion Workover Riser System

Enabling efficient operations by reducing interface complexities and minimizes operational risk



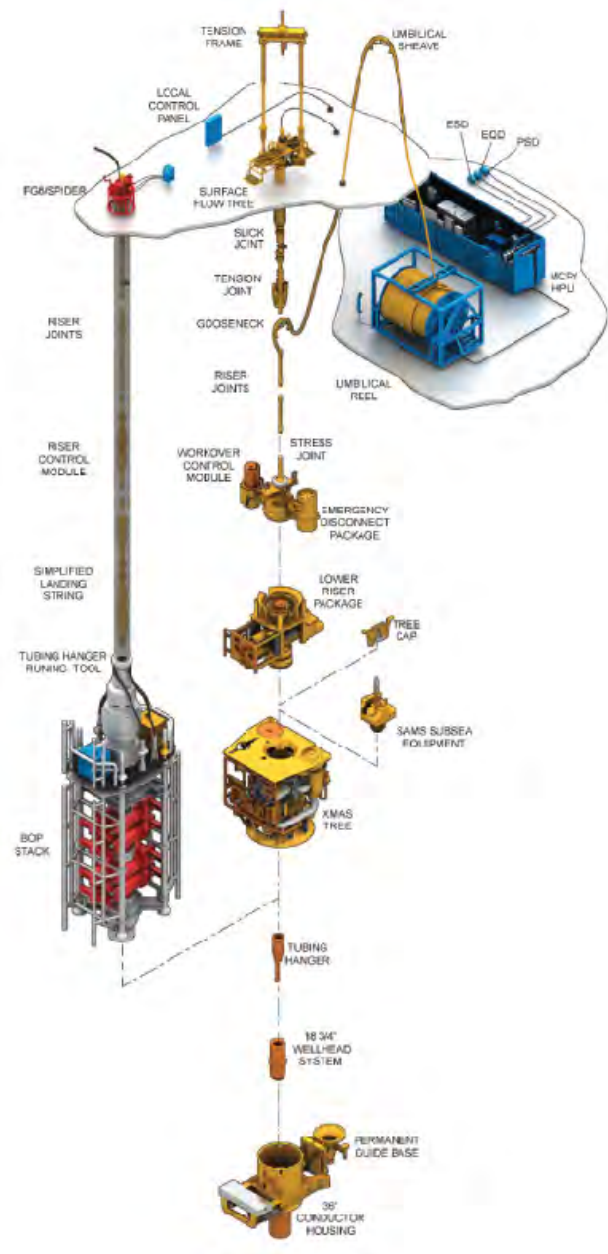
Well integrity with fatigue management were key drivers for our system design enabling efficient operations. Our full system integration of CWOR with the subsea equipment and vessel reduces interface management complexities and minimizes operational risk.

Technical description

The CWOR system is available in pressure ranges from 5,000 psi to 15,000 psi and bore sizes from 5 1/8" to 7 1/16". A 20,000 psi system with a 5 1/8" bore size is currently in development.

The system complies with ISO13628-7, has the capability for Safety Integrity Level 2 (SIL-2) control of both emergency shutdown (ESD) and emergency quick disconnect (EQD), whilst delivering accelerated response times, and is configurable to suit anchored, Dynamically Positioned and Jack-up vessels. Operators benefit from our CWOR system with:

- ▶ Minimal operational costs with less offshore personnel
- ▶ Minimal third party equipment on the vessel Minimal operational risk through system integration
- ▶ Minimal operational risk through Safety Integrity Level 2 (SIL-2) rated fast response control system Minimal risk and maximum operating envelope through use of optional Riser Monitoring and Management



System specification

Intervention Workover Control System:

- ▶ Multimode Hydraulic Power Unit/Master Control Panel rated for SIL-2 ESD and EQD
- ▶ Tree umbilical and reel system with umbilical disconnect system
- ▶ Landing String umbilical and reel system
- ▶ Lubricator Valve umbilical and reel system
- ▶ Surface Flow Tree jumper
- ▶ Umbilical Deck Jumpers and Emergency Shutdown Panels
- ▶ Electro Hydraulic Workover Control Module (WOCM)
- ▶ Riser Monitoring and Management - optional

Surface equipment:

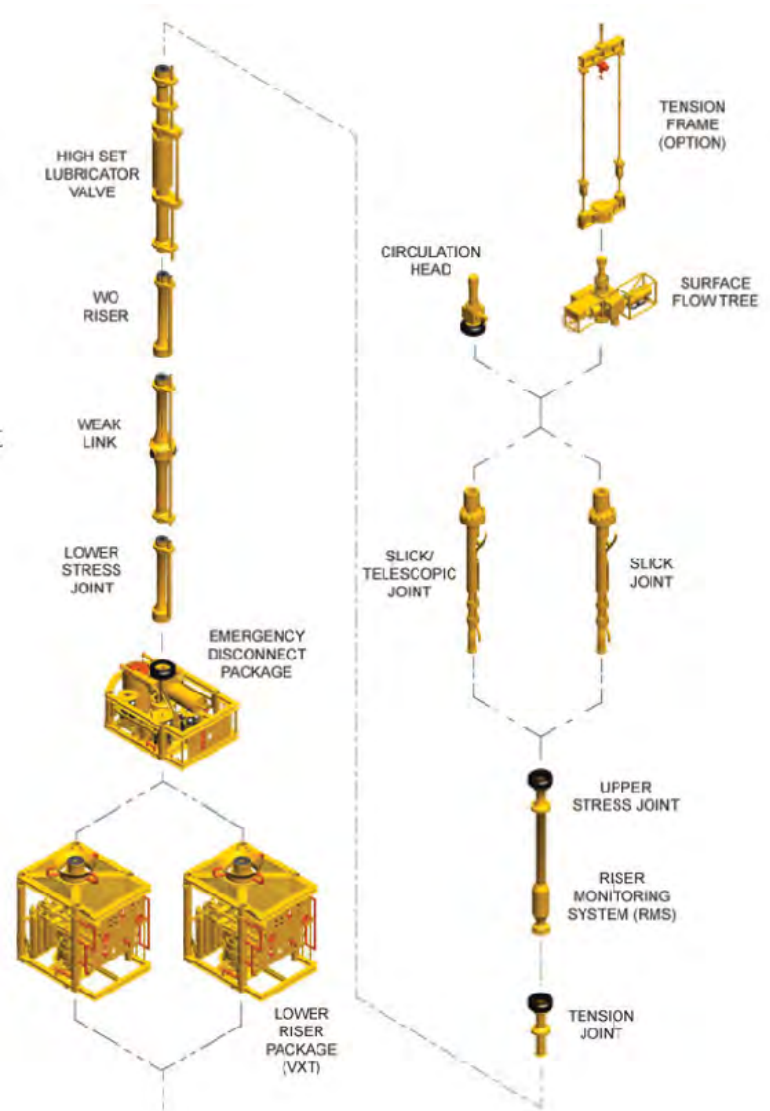
- ▶ Surface Flow Tree (SFT) - Available in 7 1/16" 10,000 psi and 5 1/8" 15,000 psi
- ▶ Wire Line / Coil Tubing adapter
- ▶ Swivel
- ▶ Riser Slick Joint - also called Cased Wear Joint
- ▶ Upper Tension and Stress Joints
- ▶ Tension Frame

Riser system (available in):

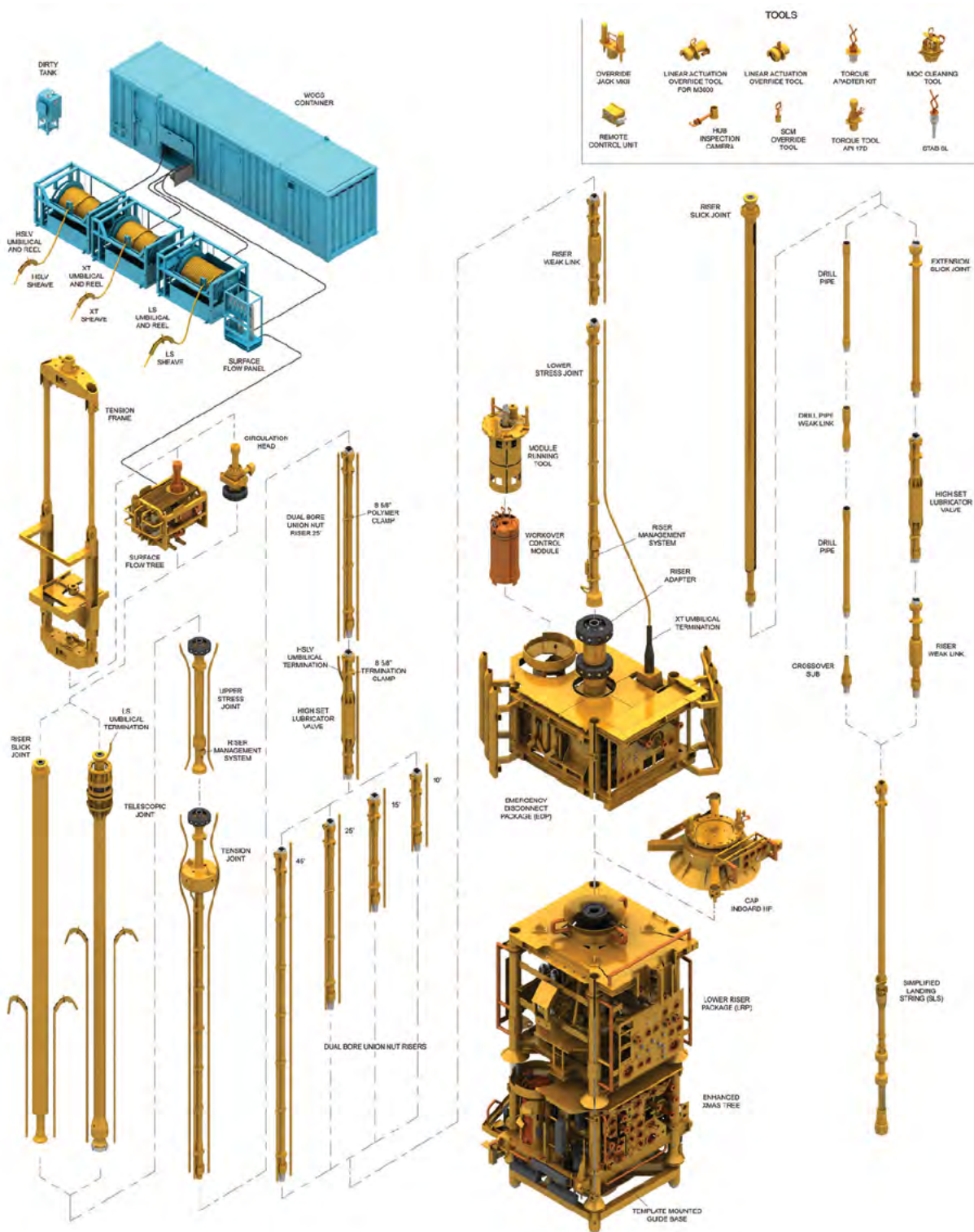
- ▶ 5 1/8" 10,000 psi drill pipe style
- ▶ 5 1/8" to 7 1/16" casing riser style
- ▶ 5 1/8" to 7 1/16" union nut style
- ▶ Dual bore and mono bore
- ▶ Safety joint protection system

CWOR valve package equipment:

- ▶ All products available in 5 1/8" 10,000/15,000 psi and 7 1/16" 10,000 psi
- ▶ Single or Dual Lubricator Valves
- ▶ EDP system with High Angle Release Connector and Retainer Valve
- ▶ WCP configurable with safety heads, Grip Seal Rams and Shear Seal Rams rated
- ▶ Annulus access via dual bore riser or via independent flexible hoses



Completion Workover Riser System overview



Lubricator Valve (LV)

Functions:

- ▶ The LV is a ball valve controlled by a separate control umbilical which can be configured as single or dual assemblies.
- ▶ It is a working valve which allows long wireline or perforating assemblies to be rigged up and run into the well.
- ▶ The LV allows the Landing String to be used in lieu of very long wireline lubricator assemblies above the surface flowhead. It therefore saves time and improves job safety.
- ▶ Designed to withstand dropped object impact from above (i.e. tools).
- ▶ Chemical injection porting is also provided both between and below the valves if required.



Emergency Disconnect Package (EDP)

Functions:

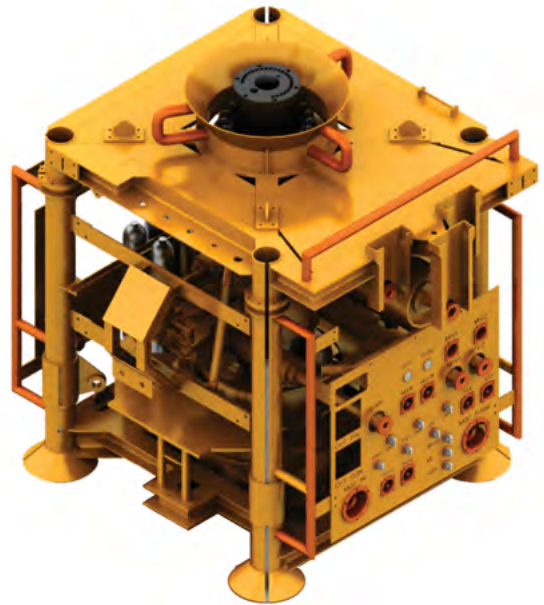
- ▶ The EDP contains a Retainer Valve (RV) which closes (cuts and seals wireline and/or coil tubing) just prior to unlatching the EDP connector, preventing hydrocarbon leakage to the environment.
- ▶ Provides a high angle release Emergency Quick Disconnect (EQD) connector which can unlatch under applied bending moments from a vessel drift or drive off scenario.



Well Control Package (WCP)

Functions:

- ▶ Together with the EDP, the WCP serves as a subsea tree running and retrieval tool and remotely controlled fail safe main safety barrier towards the well during vertical intervention.
- ▶ It can be configured with a combination of Safety Heads, Grip Seal Rams (GSR) and Shear Seal Rams (SSR).
- ▶ It can be left in a secure status at any time when the CWOR is disconnected from the subsea tree system.
- ▶ It provides cutting and sealing capability for small drill pipe, coiled tubing, wireline & slickline.
- ▶ Pressure test capability from above.
- ▶ The LRP also facilitates circulation of the CWOR string and cut coil tubing if fitted with a combination of grip seal and shear rams.
- ▶ Can be configurable for multiple subsea tree upper hub interfaces (both monobore and dual bore).



Workover Control Module (WOCM)

Functions:

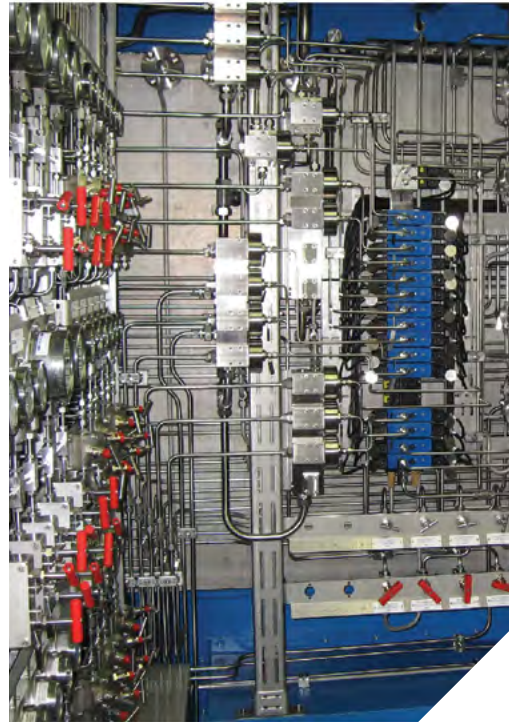
- ▶ Operation of valves and connectors on the EDP, LRP and workover valve on the subsea tree.
- ▶ Operation of connectors on the choke module.
- ▶ Monitoring of the PT/TT in the main and annulus bore on the LRP.
- ▶ Close the defined barrier envelopes required for ESD and EQD.
- ▶ SIL-2 rated system which includes redundant electronic modules and a manifold block for solenoid valves.



IWOCS HPU/MCP

Functions:

- ▶ No single failure in the IWOCS will cause an unintended system shut-down, unacceptable risk for personnel safety, environment or loss of financial assets.
- ▶ HPU/HDU/MCP can be one or several containers, typical 12-35ft. They are DNV 2.7-1 certified and A60 fire rated containers, with a control room section and a hydraulic section.
- ▶ Shutdown, PSD/ESD/EQD panels are included in system.
- ▶ Remote control panel for installation in driller cabin will show the same information as HMI in MCP control room.
- ▶ Redundant communication, A and B side with WOCM on EDP and SCM on Tree, is typically signal on power.
- ▶ SIL-2 rated safety system.



Umbilicals and reels

Functions:

- ▶ In riser Landing String (Electro Hydraulic comms) and Lubricator Valve (Hydraulic comms) umbilicals are optimized for size to minimize risk of damage.
- ▶ Open water umbilicals (Electro Hydraulic and Optic comms) are multifunction standardized designs that maximize flexibility towards TechnipFMC and other suppliers' subsea tree production control systems.
- ▶ Umbilical reels can be delivered electrical or pneumatic driven with a local and remote control panel.
- ▶ They can all be run manually or have a constant tension.



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