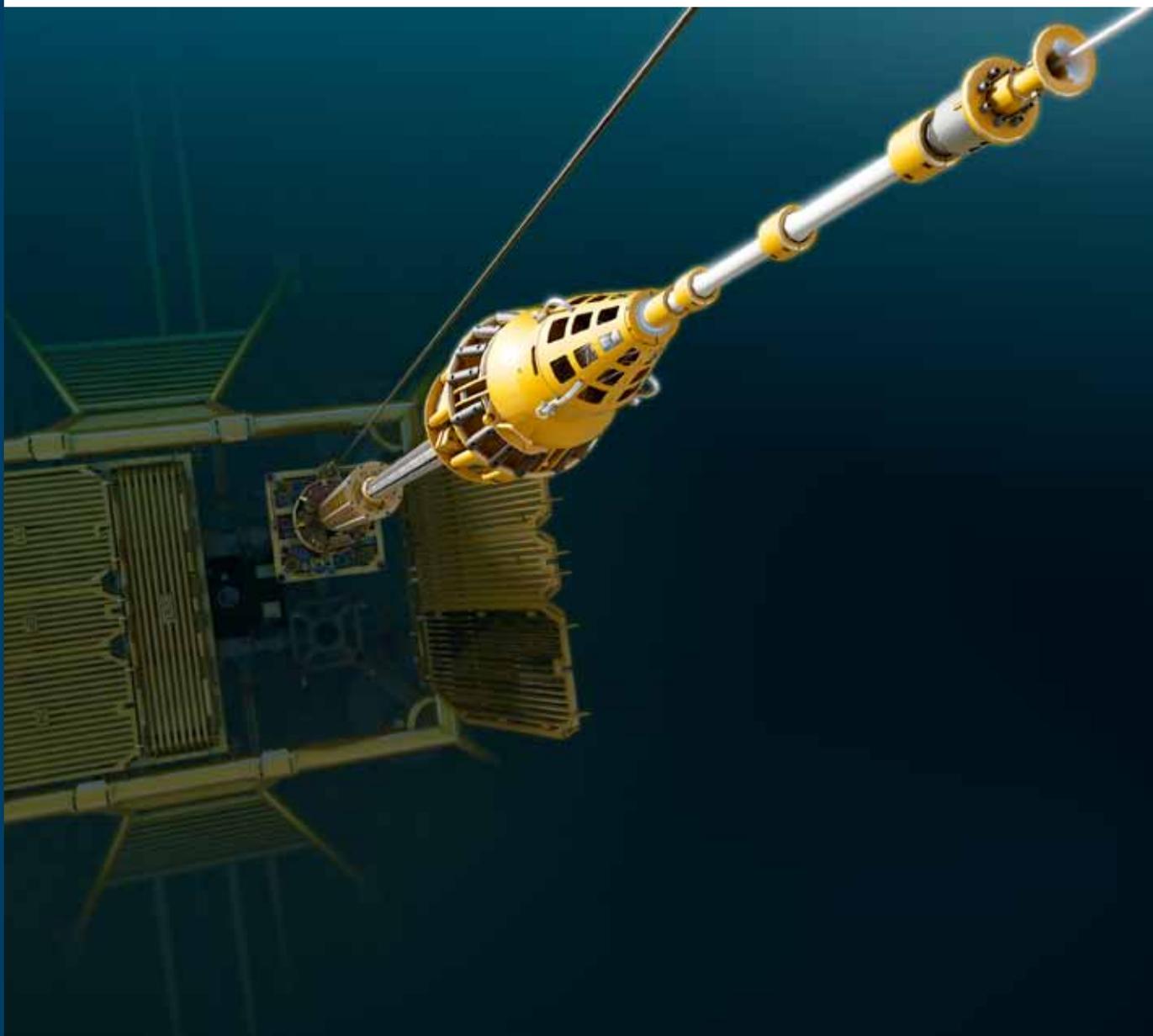


Riserless Light Well Intervention (RLWI)



Riserless Light Well Intervention, using FMC`s RLWI stack

FMC's RLWI technology enables safe and cost-effective intervention operations in existing subsea wells resulting in increased or accelerated production volumes from mature subsea fields with declining production, at a low per-barrel-cost for the incremental volumes of oil.

Well Intervention in Subsea Wells

RLWI – Riserless Light Well Intervention – is the term to describe the method for performing inspection and maintenance of subsea wells without a riserbased system (Riserless). This is performed by inserting downhole tools into the well under full pressure by the use of wireline. This method reduces the cost per operation by 40 to 60% compared to the cost for performing well intervention on subsea wells by using drilling rigs and traditional equipment.

Reducing cost of well intervention is the principal driving force behind the development of the RLWI technology

RLWI Operations

Typical intervention operations performed on subsea wells include:

- ▶ Run/pull tubing hanger crown plugs and seat protectors
- ▶ Running caliper/gauging tool
- ▶ Running production logging tools
- ▶ Plugging and zone isolation
- ▶ Re-perforation of new production intervals
- ▶ Removal of scale by milling
- ▶ Installation of insert downhole safety valves
- ▶ Well stimulation
- ▶ Installation/replacement of gauges
- ▶ Sand removal



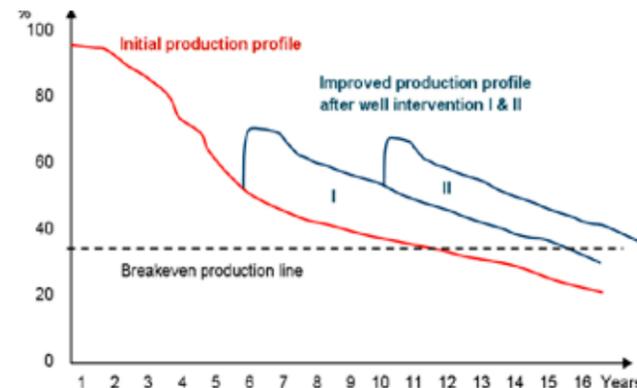
Experience

FMC has successfully performed more than 120 light well interventions since the start-up in 2000. Most of these well interventions are performed off the Norwegian continental shelf from the monohull vessels Island Frontier and Island Wellserver.

Improved production profile by RLWI

Well intervention by RLWI can immediately increase production from an oil or gas well. A successful light well intervention operation will result in accelerated production or increase the field recovery rate.

An improved production profile, and the resulting low cost per incremental barrel produced, will effectively increase the return on capital employed.



Intervention Vessels (Category A)

Traditional well intervention in subsea wells have been conducted using drilling rigs and workover riser systems. This is time consuming and require costly drilling rigs to perform the operations.

FMC has developed a Riserless Light Well Intervention (RLWI) stack, with a subsea lubricator to optimize this type of subsea well intervention. The RLWI stack can be run from an intervention vessel without the use of a workover riser or a conventional marine riser.



Island Constructor

RLWI System

FMC's RLWI Stack comprises the Well Control Package connected to the x-mas tree, the Lubricator Section, and the Pressure Control Head that is installed together with the wireline tools. All operations are controlled from the Work Over Control System on deck.

The RLWI Stack is easy adaptable to any existing subsea production system on the market. A one-piece XT-adaptor connects the RLWI stack to the X-mas tree.

FMC's RLWI technology includes a patented lubricator system for inserting downhole tool packages into the wellbore under full pressure without taking hydrocarbons back to the vessel or to the environment. The technology is enabling integrated operations, increasing safety and reducing cost.



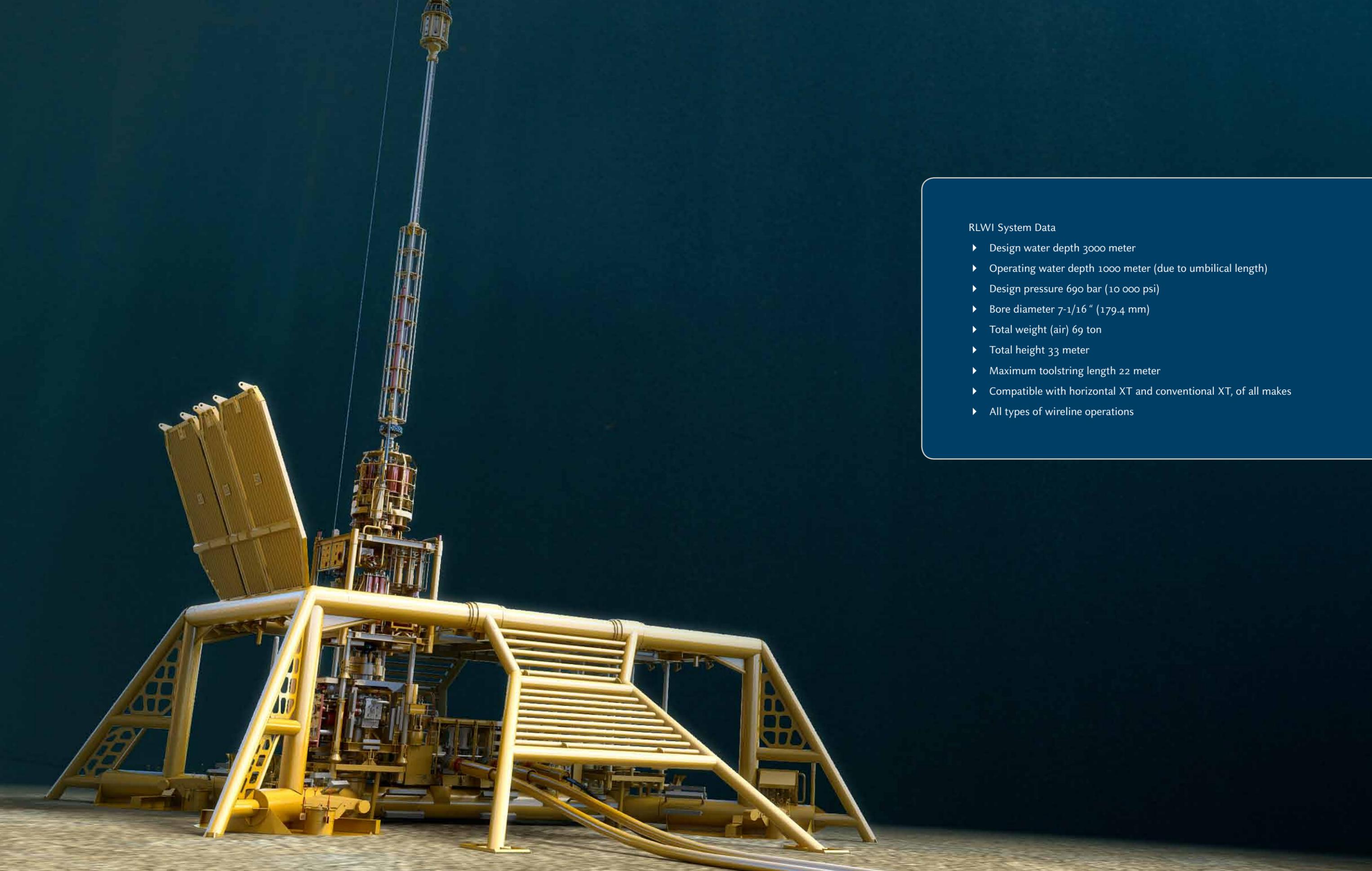
RLWI stack onboard Island Constructor

Well Access Services

Providing safe access to live Subsea Wells systems require skilled offshore personnel and high quality equipment. Testing of equipment and training of personnel onshore is vital to success for offshore operation.

FMC has developed an extensive program for training of Clients representatives alongside training of own service technicians and supervisors. The excellent skills and good chemistry developed during such training has resulted in a unique track record of successful offshore operations.





RLWI System Data

- ▶ Design water depth 3000 meter
- ▶ Operating water depth 1000 meter (due to umbilical length)
- ▶ Design pressure 690 bar (10 000 psi)
- ▶ Bore diameter 7-1/16 " (179.4 mm)
- ▶ Total weight (air) 69 ton
- ▶ Total height 33 meter
- ▶ Maximum toolstring length 22 meter
- ▶ Compatible with horizontal XT and conventional XT, of all makes
- ▶ All types of wireline operations

Technical Description

Pressure Control Head (PCH)

The PCH contains the connector for attachment to the top of the Lubricator Section (LS), and the sealing section with the flowtubes, sealing off the intervention wire from the wellbore pressure below and the open water above.

Upper Lubricator Package (ULP)

The ULP is mounted on top of the LT, and contains the wire line cutting ball valve, the circulation outlet, and the connector hub towards PCH.

Lubricator Tubular (LT)

The LT is mounted on top of the LLP and carries the grease reservoirs and the high-pressure grease injection pumps.

When well intervention tools are placed in the lubricator and the lubricator pressurized to wellbore pressure, tools may be conveyed into the wellbore under live well pressure.

Lower Lubricator Package (LLP)

The LLP provides the safety joint in the RLWI Stack, and is designed to bend if the stack is exposed to excessive forces, protecting permanent equipment from excessive loads. The lower part contains the connector to be attached to the WPC. The LLP also houses the Subsea Control Modules (SCM) and the subsea hydraulic pressure unit (HPU) and hydraulic accumulators, controlling the RLWI Stack.

Lubricator Section (LS)

The LS consists of the Upper Lubricator Package (ULP), the Lubricator Tubular (LT) and the Lower Lubricator Package (LLP). The Pressure Control Head (PCH) is connected to the top of the Lubricator subsea., sealing off the intervention wire from the wellbore pressure below and the open water above.

Well Control Package (WCP)

The WCP is installed on top of the x-mas tree. It contains the upper valve block, the shear/seal ram, and the lower valve block. The WCP serves the purpose of the conventional Lower Riser Package (LRP) and provides the main safety barrier during the well intervention operation. In case of an uncontrolled well situation, the shear/seal ram will cut the wireline, coiled tubing or WL toolstring inside the wellbore. By use of the x-over valves, the WCP enables flushing of hydrocarbons back into the well. During an intervention operation, the WCP interface provides hydraulic pressure and supply, as well as communication to XT functions.

Work Over Control System (WOCS)

The topside control system is all electric, while the subsea part has hydraulic power generation. The control system is fully redundant both for the power and the communication systems. The surface controllers are equipped with back-up battery for autonomous control. All the communication between topside and subsea is by 10 Mbit/s Ethernet. The system is SIL rated for critical safety functions.



Riserless Light Well Intervention system

Operation

After installation of the WCP and Lubricator Section the Pressure Control Head (PCH) with the sealing section and toolstring are lowered from the vessel and the toolstring is guided by the ROV into the open top of the Lubricator Section.

Then the sealing is pressuretested using glycol (which is heavier than both well fluid and water) before the valves in the WCP are opened to permit passage of the toolstring into the well, whilst the glycol migrates into the well.

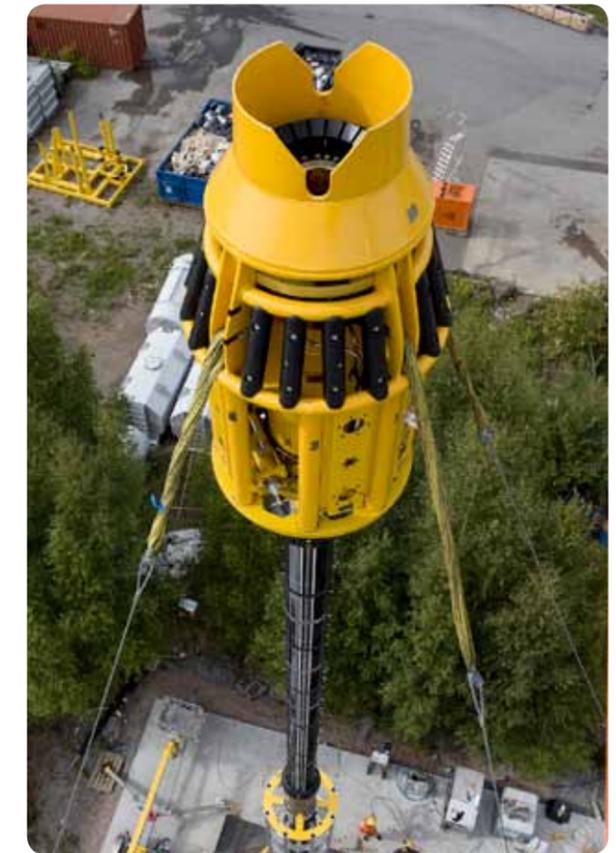
Finally the toolstring is lowered into the well by paying out wireline from the vessel. Sealing between well pressure and ambient water pressure in the PCH is provided by injecting bio degradable grease into the sealing section as the wireline passes through.



Pressure Control Head (PCH)

Second generation RLWI system

- ▶ Inspection and maintenance of subsea wells by inserting downhole tools into the well under full well pressure by the use of wireline or slickline
- ▶ Subsea flushing of hydrocarbons from lubricator to well
- ▶ Subsea closed hydraulic systems
- ▶ Subsea grease injection pump and reservoir
- ▶ All-electric control system with subsea hydraulic power generation
- ▶ Conformance to relevant API/SIL and ISO Standards



Lubricator Section Stack Up

Contingency

TYPE OF ACTIVITY	RLWI PROCEDURE
PRODUCTION SHUTDOWN	CLOSE ALL VALVES OUTSIDE MAIN BORE
EMERGENCY SHUTDOWN	SEQUENTIAL SHUTDOWN OF ALL VALVES AND WIRELINE CUTTING
EMERGENCY QUICK DISHCONNECT	SEQUENTIAL SHUTDOWN OF ALL VALVES, WIRELINE CUTTING AND DIS-CONNECTION OF UMBILICAL



**We put you first.
And keep you ahead.**