MV Island Performer a first in Australia.

Island Performer coming alongside in Broome - pic, Michael Carroll

The Island Performer is an 'Ulstein SX121' design riserless light well intervention (RLWI), offshore construction and subsea support vessel. It was built by Ulstein Verft AS in Aalesund, Norway, and entered service in 2014 for Island Offshore AS. Its classification society is DNV GL. The vessel is now owned by "Edison Chouest Offshore" Louisiana and charted to TechnipFMC.

The vessel is capable of deep-water well intervention operations using a specialised RLWI stack, multi-skidding system and modular handling tower (MHT). It also features a Class 3 dynamic positioning (DP) system, 250t active heave compensated (AHC) crane, and two remotely operated vehicles (ROVs). The maximum person on board (POB) is 112.

Riserless Light Well Intervention (RLWI) enables the petroleum operators to increase the oil and gas recovery rate from subsea oil wells. The operation is performed through smaller dynamic positioned monohull vessels instead of larger mobile installations like traditional semisubmersible drilling rigs or drill ships.

The RLWI enable subsea well intervention without having to use a drilling riser package connected to the subsea stack (blowout preventer system= BOP).

The technology is based on wireline well maintenance, where the cable is routed via a subsea lubricator system [1] into the subsea well. [2]Traditional activities are wireline operations for well logging, perforation, and installing or pulling equipment like plugs and downhole safety valve inserts. The operational envelope can be extended by use of tractors in horizontal wells.

The recovery rate has traditionally been considerably lower on a subsea well than for a surface platform well due more complicated well intervention and maintenance issues. RLWI enables the operators to perform intervention to increase the recovery rate at reduced time and cost.

There is a positive safety aspect by employing RLWI services as no hydrocarbons are transported to the vessel, but flushed back into the well through the lubricator system during normal operations. However, RLWI is a complex operation requiring special expertise and control in all phases of the preparation and implementation.

As they say a picture says 1000 words so I refer the reader to YouTube Video animation of RLWI:

https://www.youtube.com/watch?v=CnXRIVGb2qQ

The vessel has had no previous suc-

One of the six Rolls Royce Bergen C25:33 L9A diesel gensets
Pic courtesy Mark Jones

cess obtaining this specific RLWI work elsewhere in the world. I believe due to the relative new nature of RLWI technology. IMPEX has employed TechnipFMC to unplug their "Ichthys Field" production wells. This contract has given the vessel it first opportunity to successfully prove its specialist capabilities in Australia also with Australian Offshore Solutions (AOS) marine crew in place for this major event.

Island Performer's hull and superstructure are of continuous welded steel construction with dual ROV hangars integrated as part of the superstructure. The hull features a central moon pool (8 x 8m) for conducting RLWI operations and a second moon pool (forward) dedicated to one of the ROVs. Both moon pools are provided with remotely-operable folding hatches at the A-deck level (above the main deck). The main deck features the 250t AHC offshore crane (starboard aft), and an open back deck aft of the crane.

The Vessel is arranged with accommodation and machinery sections forward. The Vessel is arranged as a single-decker. The Vessel is arranged for totally 130 persons accommodated in 40 single cabins and 45 double cabins. The POB of the vessel is limited to 112 persons based on the vessel lifeboat capacity.

The vessel is equipped with high redundancy dynamic positioning and propulsion system comprised of three azimuth thrusters in nozzles with fixed pitch propeller type. The propellers are driven by frequency controlled variable speed electric motor and controllable pitch propellers. One retractable and two tunnel thrusters are installed in the forward part of the vessel. Also provided are anti-heeling system for crane operations and a passive stabilizing system.

Rolls Royce propulsion thruster - courtest Mark Jones

The topsides of Island Performer consist of a Module Handling Tower (MHT) and other necessary equipment required performing the various operations of this specialty vessel.

The rescue equipment consists of two MOB boats with 10 and 9 person capacities each equipped with rescue scoop, two enclosed life boats with 112 person capacities each and six life rafts of 20 person capacity located on both sides of the vessel.

The main features of Island Performer are:

- ◆ 250 tons AHC Crane
  - ❍ Increased range at 14 meters and lifting height approx. 36 meters make NOV. Ready for installation of one additional 100tons AHC crane
- ◆ Increased power plant
  - ❍ Total installed power of 16.2MW, configured with
  - ❍ 6 x main Roll Royce (RR) Bergen C25:33 L9A diesel gensets and MSB in 4 parts
- ◆ Increased thruster capacity
  - ❍ 3 x 3 MW main Roll Royce (RR) thrusters and 3 x 2 MW Roll Royce fwd. thrusters
- ◆ Large Offshore switchboard
  - ❍ On main deck capacity 2 x 2.5 MW
- ◆ The vessel is designed for two main operation modes:
  - ❍ DYNPOS-AUTR or DP Class 3 Mode – Two split configuration (MBB1 and MBB2 + MBB3 and MBB4)
  - ❍ DYNPOS-AUTRO, or DP Class 2 Mode – Three split configuration (MBB1 + MBB2 and MBB3 + MBB4)
- ◆ Additional redundancy in DP2 / AUTR
  - ❍ Propulsion and Power Systems arranged to tolerate occurrence of a "single failure", i.e. Vessel to keep position and remain redundant as defined by class (DYNPOS-AUTR) after such "single failure"

Other systems on Island Performer contain the following:

- ✹ Cargo/service Handling-Cranes, Winches, Loading/Discharge systems
- ✹ Ship Equipment- Navigation equipment, Underwater searching equipment, Nautical equipment, Anchoring & Mooring equipment, etc.
- ✹ Systems for main machinery

components- Fuel oil, Lube oil, cooling water, Compressed air systems, fresh water generation 40m^3/day etc.

✹ External Gas detection monitoring system with ESDs.

✹ The vessel is fitted with a Ballast Water Treatment System to remove harmful aquatic organisms. The system comprises a several filters, two Ultra Violet (UV) chamber, flow and pressure control systems and valves. The system is designed for one ballast pump operating at full capacity of 230m3/h. Ballast water treatment equipment may operate at the uptake or discharge of ballast water or during transit. There are 51 ballast tanks on the vessel providing a total ballast water capacity of 6,582m3.

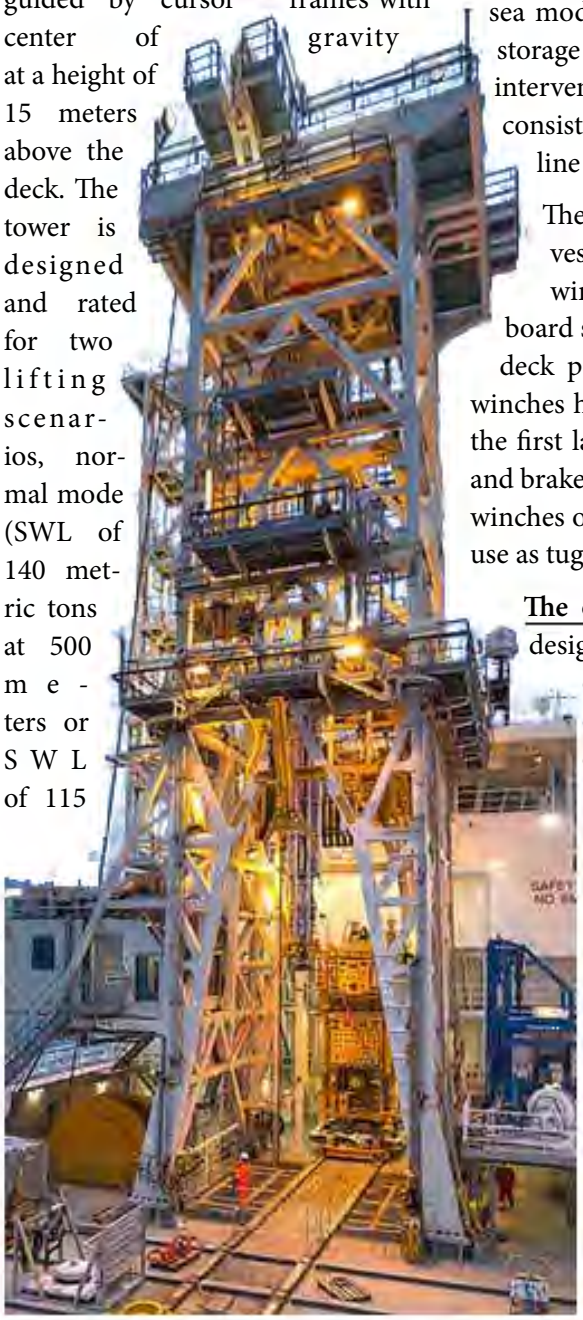
✹ Anti-heel and anti-roll systems integrated into ballast system.

✹ Dynamic Positioning System The vessel is equipped with a Maritime Technologies Bridge Mate 3 DP system based on specifications to DNV Class DYNPOS-AUTRO, equivalent to IMO DP Class 3. The system is designed to ensure there is no potential for single point failure. The DP system interfaces with all necessary reference systems and sensors and controls vessel position and heading via the propellers and thrusters.

✹ The vessel is equipped with steering gear of RR swing up type of capacity 2000 kW and two RR tunnel thrusters each of capacity 2380. Emergency steering gear is also provided and is powered by the emergency generator.

Modular Handling Tower (MHT) by NOV

The MHT, which is installed over the central moon pool for safe handling of RLWI equipment and subsea modules. The MHT system is designed to work in conjunction with the main hoisting winch, moon pool doors and horizontal skidding system. The SWL for the MHT is 300 metric tons; however, the maximum load that can be handled is 200 metric tons due to the static capacity of the winch. During well intervention mode, 60 metric tons SWL will be guided by cursor frames with center of gravity at a height of 15 meters above the deck. The tower is designed and rated for two lifting scenarios, normal mode (SWL of 140 metric tons at 500 meters or SWL of 115 metric tons at 2,500 meters) and AHC mode (SWL at 2,000 meters or SWL at 2,500 meters).



The MHT Hoisting System

The MHT is equipped with an open loop hydraulic ring-line system connecting all hydraulic consumers via the piping system to the vessel's HPU. The HPU designed for the system has a capacity to supply 210 bar operating pressure to the ring-line system.

The MHT hoisting system is used for lifting RLWI equipment and subsea modules from their respective storage areas to the point of well intervention service. It primarily consists of hoisting system, deadline anchor and compensators.

The hoisting system on the vessel is equipped with two winches, one on A-deck starboard side and the other on main deck portside forward. Both the winches have a pull of 14 tonnes on the first layer at a rate of 30 m/min and brake at 30 tonnes. The mooring winches on aft deck are arranged for use as tugger winches.

The operator control cabin is designed to operate the main equipment from a safe location and has three fully equipped control stations located on BB side tower balcony. The cabins are A-60 fire rated with windshield wiper/washdown system, two access/escape doors and HVAC inlet/outlet diffusors. The MHT control system has an integrated operation of machinery and instrumentation. The complete system is separated into three levels consisting of the operator's chair for remote control and monitoring functions to communicate, machinery control PLC's and I/O equipment for interfacing, control and automation tasks, physical machinery and field instrumentation.

Control functions for hydraulically operated equipment are provided remotely from the operator control

cabin and locally, including emergency controls.

Pullback arms are designed to work in cooperation with the guideline winches, MHT and the moon pool doors. The vessel is equipped with four pullback arms with a SWL of 700kg at a working envelope of 700 horizontal by 600 vertical sectors.

Module hang-off system is hydraulically operated by cylinders and is locally operated from the tower maneuver station, mainly used to safely store and transport the upper lubricator package (ULP) and lower lubricator package (LLP).

Module guide arm main function is to assist the module hang-off system while transporting the ULP/lubricator modules to/from the center of the tower safely. The module guide arm is hydraulically driven and is controlled locally from the maneuver station.

Cursor guide rails assist the upper cursor frame and lower cursor frame to safely handle the modules during travel. A pinned wedge splits the cursor guide rails into the tower part and a moon pool part.

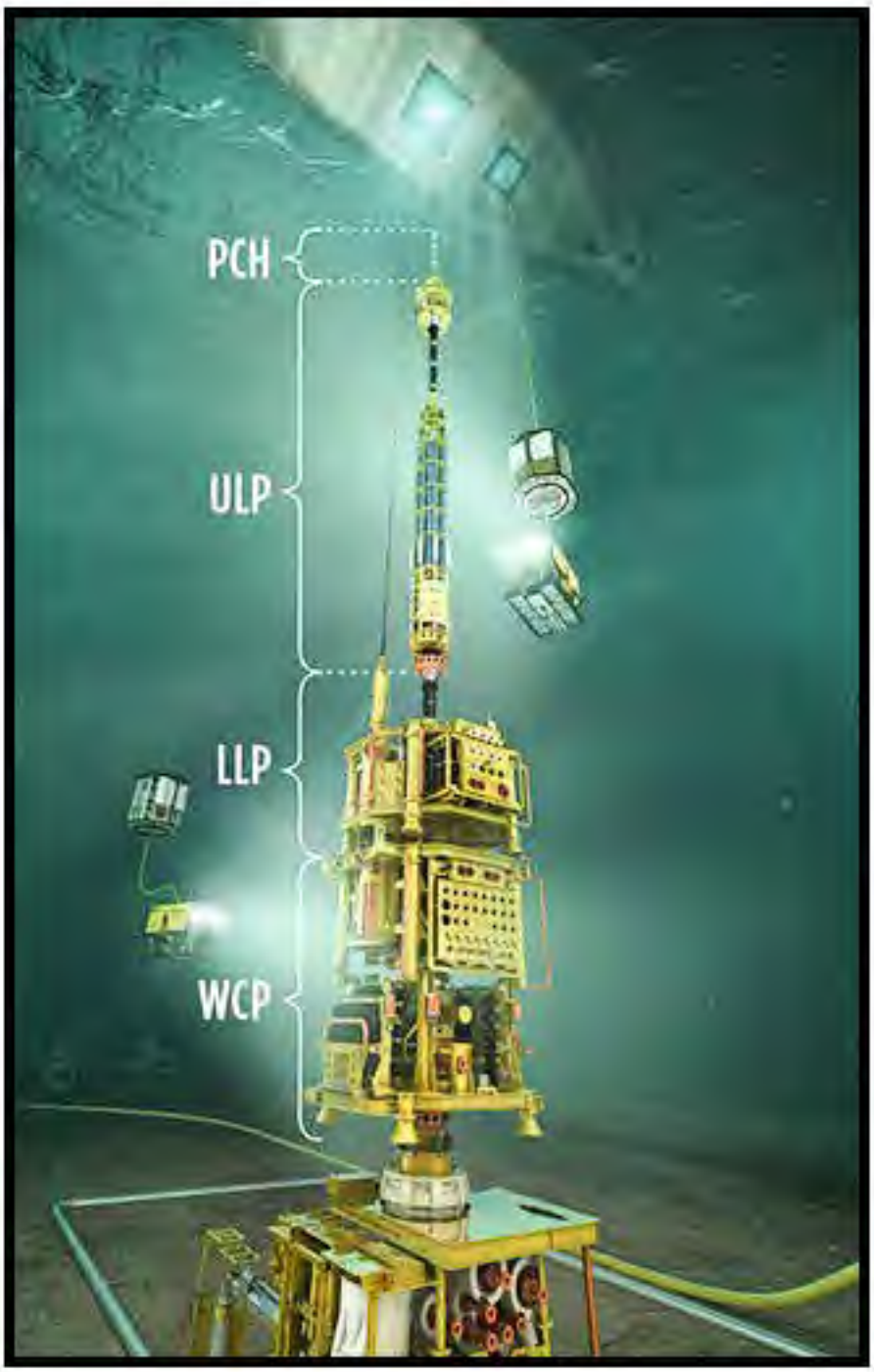
Compensated wireline cylinder guides and compensates the wireline used in the vessel during well intervention work. The compensated wireline cylinder is rated at SWL of 10 metric tons wire pull, capable to compensate 6 metric tons in AHC mode and can be controlled from the Operator Control Cabin. The system is designed to work in cooperation with the wireline rig-up arrangement.

Cursor system consists of an upper and lower cursor frames to provide safe handling of tools/equipment and to guide the hook inside the tower. The purpose of upper cursor frame (UCF) is to safely guide the hook over the length of its travel inside the tower to ensure that the load interface point is fixed horizontally. Unlike the UCF, the lower cursor frame (LCF) has moving parts and is moved by the cursor line winch connected by two wires to ensure an even pull. The LCF is fitted with a subsea camera and floodlight to have full control in the splash zone during deployment/retrieval of subsea modules. The LCF is controlled remotely from the Operator Control Cabin.

The vessel is equipped with two turn-over sheaves to lead the main hoisting wire entering from the starboard side over the crown to the center of the tower/moon pool.

The main umbilical sheave is rated at SWL of 10 metric tons static umbilical pull and consists of one multi-roller sheave with an API groove design to handle the delicate umbilical used for the sub-sea lubricator with one main umbilical.

The **RLWI stack** (below) is deployed and recovered through the MHT po-



sitioned over the vessel's main construction moon pool. The equipment is deployed and recovered in three parts; Lower Stack and Upper Stack and PCH. These are defined as:

- Lower Stack: LCM, WCP, LLP
- Upper Stack: Safety Joint, ULP
- PCH

The stack is deployed and installed on the subsea Xmas Tree (XT) or wellhead. The UTH is deployed through the moon pool using a dedicated Active Heave Compensated (AHC) winch and is subsequently connected to the lower stack subsea.

The PCH and wireline tools are then deployed and attached to the ULP. When onboard the vessel, the lower stack (LS) is stored in a hanger forward of the MHT. Access to the stack while in the maintenance / storage position is to be via a mixture of permanent platforms (port, starboard, and forward sides) and temporary platforms (aft side). When required, the lower stack will be maneuvered from its covered maintenance / storage position forward of the tower via a dedicated skidding system.

Guidewires can be used for deploying the stack. The guidewires feature a quick disconnect system/breakaway feature (shear pin) if the load exceeds a set maximum tension.

When on board the vessel, the upper stack is stored in the tower and secured by a sea fastening grip system, or laid out on the deck.

The two stack components will be deployed using the MHT main winch. This main winch has AHC for the final lowering operations.

The skidding system is also used to transport the PCH's from their storage locations aft of the tower to the moon pool.

Well control package (WCP) acts as a double barrier between the well and the environment safety head during well intervention operations. WCP interface serves the purpose of providing hydraulic pressure as well as communication to XT functions. WCP contains the upper valve block, shear/seal ram and a lower valve block usually installed on top of the x-mass tree. The shear/seal is used to cut the wireline or toolstring, inside the wellbore when an uncontrolled well situation occurs. The x-over valves equipped on WCP flushes the hydrocarbons back into the well in case of uncontrolled well situation.

The WCP equipped on Island Performer comprises of the following major components:

- Workover control module (WOCM)
- Subsea batteries
- Network routers
- Flow meters
- Safety head, shear/seal ram
- Production isolation valves (PIV)
- Hydraulic reservoir of 500-litre capacity and accumulators
- Subsea Hydraulic Power Units (SHPUs)

The safety joint protects the WCP and equipment below from overload due to accidental loss of vessel position. The connector hub in the lower end of the safety joint has a main bore and ports for hydraulic functions in the PCH and ULP, flushing of main bore, and MEG injection/dispersion.

The ULP mainly comprises of the wireline cutting ball valve, circulation outlet and the connector hub towards the PCH is mounted on top of the LT. This acts as pressure barrier for the wireline tool string and a carrier for the grease system.

The main components of the ULP include four grease reservoirs with a capacity of 800 liters each and two electric driven grease pumps operating at a pressure of 690 bar for feeding the PCH. The safety joint located at the lower end of the ULP acts as a last barrier for protecting the WCP and the permanent installation from being exposed to excessive bending loads. A cutting ball valve located at the upper end acts a working valve to enable displacement and leak testing of the lubricator without installation of any PCH. The ULP can also be used as an additional mechanism for cutting wireline.

The LT is mounted on top of the LLP and carries the grease reservoirs and the high pressure grease injection pumps. The well intervention tools placed in the lubricator may be conveyed to the well bore by pressurizing the lubricator well bore pressure.

The LLP is used to protect the permanent equipment from excessive loads by providing a safety joint in the RLWI system. The system is designed in such a way that it bends the stack when exposed to excessive forces preventing it from permanent damage.

A connector in the lower part of the LLP can be attached to the WCP. The LLP is designed to house RLWI controlling equipment such as subsea control modules, subsea hydraulic pressure units and hydraulic accumulators. Function of LLP is distribution of power and communication to ULP, XT-controller, WCP and XT.

The LS is a system comprising of ULP, LT and LLP. Intervention wire from the wellbore pressure below and the open water above can be sealed off by connecting the pressure control head (PCH) with the top of the lubricator subsea.

The stuffing box or grease injection head is to provide a dynamic pressure seal between the well bore and external pressure. The

pressure control head includes the necessary components to provide a static seal with minimum grease consumption and cable locking capability. A tool catcher is incorporated at the bottom of the PCH in order to hold the tool string without wire.

Key functions of the PCH include used the following:

- Provides a dynamic seal around the wireline with grease injection during wireline operations;
- Provides static seal around the wireline with the activation of safe mode;
- Hydrate prevention, MEG and grease injection;
- Acts as a primary flushing outlet;
- Prevents drop down of wireline tool by incorporating a tool catcher; and
- The PCH will be deployed or retrieved together with the WL tool string for each wireline run.

The PCH on Island Performer is equipped with the following components:

- Flow tubes
- Upper Stuffing Box (USB) located on top of the flow tubes
- Dual Stuffing Box (DSB) with grease injection system located below the flow tubes
- Tool catcher
- Two MEG injection points to allow low rate MEG injection, if required

The operations of RLWI are controlled from the work over control system (WOCS) located on deck. The WOCS has two sections, electric topside control system and hydraulic power generated subsea system. The topside control system is equipped with a Master Control Station (MCS) with a control room comprising an operator station, and master shutdown and status panels. The control system is also equipped with a Subsea Power unit (SPU), Subsea Control and Interface Unit (SCIU) and XT Control cabinet (XTCC). The surface controls are equipped with UPS and UPS batteries for power supply in the event of power outage. Other components equipped on the system are Chemical Injection Unit (CIU), workover Umbilical reel including reel control cabinet and test and flush HPU.

The RLWI control system features the following:

- Closed loop hydraulic system on the stack.
- Separate closed loop hydraulic system for XT-Controller.
- Single umbilical cable containing the following elements:
  - Redundant tubes for fiber optics, minimum six fibers each
  - Redundant twisted quads or four twisted pairs for communication with the Subsea Tree Subsea Control Module (XT SCM). The communication to the XT SCM will not be influenced by noise.
  - One ¾" internal diameter (ID) 10K hose for chemical injection, collapse resistant to design water depth.

The control system and the Human-Machine Interface (HMI) is segregated onboard the vessel. Shut down sequences are stored locally in each Workover Control Module (WOCM).

A Command Authorizer (CA) is a computer program used onboard the vessel to prevent unintended operation of main bore valves and connectors by the operator, and for the protection against unwanted operations on the stack by unauthorized users. The CA will further be used to check the validity of any command from the HMI against the selected mode.

Communication between the vessel and the RLWI stack is accomplished via a hard line/fiber optics Ethernet system. Redundancy is maintained for the power supply throughout the system from the switchboards on the vessel to the final elements (solenoids in the SCM). One control umbilical will have redundant communication and power.

Total Uninterruptable Power Supply (UPS) capacity topside is sufficient to keep the system operational for one hour, including the continuous operation of both subsea grease pumps at full speed against 10,000 psi well pressure, and two full cycles of pressurization (pre-charge pressure to the maximum working pressure) of all subsea accumulators between pre-charge pressure and maximum working pressure.

Hydrocarbon Venting Package

The well intervention program may require that the RLWI Stack—principally the lubricator—is depressurized using a surface hydrocarbon venting package. Such a package is brought on board and rigged-up when required.

The hydrocarbon venting package is a temporary system that comprises well test equipment downstream of the downline reel. Appendix X presents the P&ID for the package.

Well fluids flow from the lubricator into the ¾" downline, and subsequently to the surface safety valve (SSV) and choke manifold. The choke manifold features dual chokes and is used to control the downstream pressure and hence the flow rate. Down-

stream of the choke manifold, the fluids are routed into the surge tank.

A controlled pressure drop is achieved across the choke manifold, with the upstream and downstream data headers providing local instrumentation for pressure and temperature. A further pressure drop is achieved in the surge tank, which operates at atmospheric pressure and has an open vent. An orifice plate on the surge tank inlet limits the flow rate into the tank such that it does not exceed the tank's venting rate. The dual-compartment surge tank also temporarily stores liquid. Transfer pumps pump the tank contents to tote tanks for disposal onshore.

The hydrocarbon venting package includes an ESD system that is independent of the RLWI Stack and vessel ESD systems.

Conclusion

It is hope that the successful demonstration of this new RLWI technology during this contract with IMPEX will demonstrate the speed, safety and cost savings to other oil/gas production companies to keep the vessel working in Australasia and Australian marine crews employed long term.

Lloyd May

Refer: YouTube Video animation of RLWI: https://www.youtube.com/watch?v=CnXRIVGb2qQ

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