

FIELD CASE STUDY: Offshore Hydraulic Artificial Lift Installation

1. Sintesi Esecutiva (Executive Summary)

- **Location:** Offshore Platform, French Sector
- **Project Objective:** Rapid and efficient restoration of well production via an Artificial Lift system utilizing a surface hydraulic pumping setup (HPU + Hydraulic Cylinder) paired with a downhole sucker rod completion, specifically designed to meet the strict space and deck load constraints of offshore structures
- **Operational Results:**
 - On-schedule startup and flow restoration achieved through a streamlined installation with minimal impact on platform logistics
 - Maximization of onboard working area driven by the surface unit's extremely compact footprint
 - Production optimization via independent and continuous control of upstroke and downstroke speeds managed by the HPU.

HSE & Environmental Compliance (Zero-Spill Policy):

- **Active Cylinder Containment System:** Spill-proof design engineered for marine environments. Any leakage from the hydraulic cylinder's top or bottom seals is captured directly at the source, routed through a dedicated flexible line, and directed into a closed collection tank located at the base, ensuring zero deck spills
- **Eco-Friendly Hydraulic Fluid:** Exclusive use of biodegradable hydraulic oil (EAL – Environmentally Acceptable Lubricant) in the HPU circuit, eliminating the risk of ecological impact on the marine ecosystem.
- **Personnel Safety:** Compact design free of bulky external linkages to minimize pinch points. The entire system is directly interfaced with the platform's Emergency Shutdown (ESD) system.



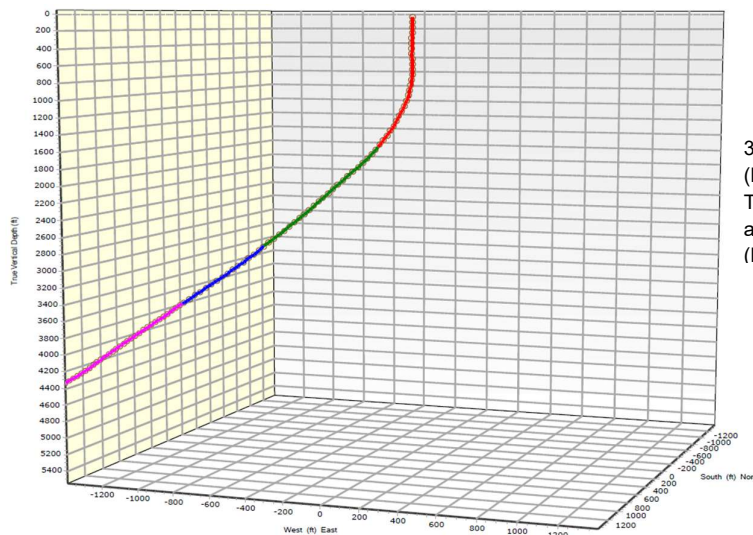
2. Well and Operational Data Sheet

This section details the actual well operating data and specifications of the installed artificial lift system. The parameters demonstrate the effectiveness of hydraulic technology in managing complex offshore wells, characterized by deviated profiles and high lifting capacity requirements with a minimal footprint

Parameter	Valore / Specifica Tecnica
Operator & Location	[Confidential] / Offshore Platform (French Sector)
Well Type	Directional producing well (Max Inclination: 36°)
Pump Depth (MD / TVD)	6.233 ft MD (~1.900 m) / ~5.500 ft TVD
Completion (Tubing & Anchor)	2-7/8" O.D. (I.D. 2,441") / Tubing Anchor at 7.559 ft
Downhole Pump	API Insert Rod Pump, Plunger 2.00"
Sucker Rods	High-strength tapered string (1" - 7/8" - 3/4" + 1" Sinker Bars)
Rod Centralization	Molded Sidewinder wear guides optimized for deviated profile
Surface Hydraulic Cylinder	Long-stroke configuration (Stroke Length: 354" / ~9 m)
Hydraulic Power Unit (HPU)	132 kW Electric Motor / Operating speed: ~3 SPM
Polished Rod Loads (PPRL / MPRL)	Peak Load: 27.335 lbs / Minimum Load: 6.638 lbs
Fluid Production	~389 bbl/day (~62 m³/day) / Water Cut: ~86%
Fluid Properties	37.0° API Oil / Specific Gravity: 1.0722
Surface Pressures	Tubing Pressure: 100 psi / Casing Pressure: 72,5 psi

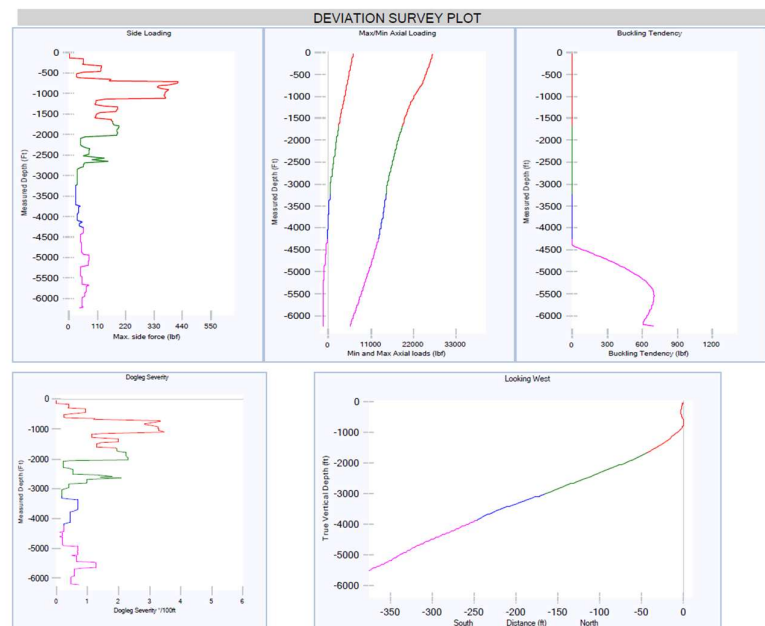
Engineering Details and Key Operational Benefits:

- Long-Stroke Optimization:** Deploying a hydraulic cylinder with an extended stroke length of approximately 9 meters (354") operating at a low frequency (around 3 SPM) maximized downhole pump fillage. This fluid dynamic drastically reduces stress cycles and mechanical fatigue on the rod string, significantly extending the system's overall run life
- Reliable Deviation (Dogleg) Management:** Despite the well profile featuring an inclination of up to 36°, combining the linear motion of the hydraulic cylinder with engineered rod centralization minimized side loading. This prevented abnormal tubing wear, eliminating the risk of premature failures.
- Active Dynamic Load Management:** Post-commissioning dynamometer card data confirms optimal dynamic load control. Thanks to the intrinsic dampening of the hydraulic system (with upstroke and downstroke speeds managed independently by the HPU), Peak Polished Rod Load (PPRL) spikes were smoothly cushioned, maintaining maximum material stress below 75% of the yield strength.



3D Directional Wellbore Trajectory Profile (Max Inclination: 36°).
The plot highlights changes in inclination and azimuth along measured depth (MD).

Integrated Engineering Analysis Dashboard: Detailed breakdown of side loading forces, Dogleg Severity (DLS), axial load distribution, and buckling risk assessment along the completion string.



3. Installed Equipment Details

3.1 Hydraulic Power Unit (HPU) – PowerLift PL645-C100

- **Footprint and Weight:** Extremely compact deck dimensions (3.9 x 1.8 x 2.2 m) and a skid weight of 5,100 kg, engineered to maximize available space on offshore structures
- **Eco-Friendly Fluid and Reservoir:** 800-liter reservoir filled with HLP SYNT E68 synthetic biodegradable hydraulic oil, designed to ensure maximum wear protection and zero environmental impact in marine environments
- **Power Supply:** Direct connection to the main platform power grid
- **Telemetry and Remote Control (RPC System):** Managed via an integrated Remote Pump Controller (RPC). The system transmits operational data via Starlink satellite connection, enabling full remote control, pumping parameter adjustments, and automated downloading of operating reports and dynamometer cards.

3.2 Surface Hydraulic Cylinder (Wellhead Cylinder)

- **Mounting and Weight:** Low weight of 500 kg, flanged directly onto the wellhead without requiring civil works or auxiliary deck support structures
- **Mechanical Performance:** Ultra-long 354" (9 m) stroke length with a maximum load capacity of up to 31,600 lbs (14,333 kg)
- **Active Zero-Spill System:** Active containment circuit. Any normal operational leakage from the top seal is intercepted directly at the source, routed through a flexible line, and directed into a safety tank at the base, ensuring zero deck spills



3.3 Downhole Equipment

- **Sucker Rod String:** Completion string with a total weight of 7.5 metric tons, consisting of a high-strength tapered string (1", 7/8", and 3/4" sections, plus 1" sinker bars).
- **Downhole Pump:** API insert rod pump with a 2.00" plunger set at approximately 1,900 m MD
- **Anti-Wear Centralization:** Molded Sidewinder guides distributed along the string to eliminate side loading and prevent tubing wear in deviated wellbore sections (inclination up to 36°).

4. Operational Sequence and Installation Timeline (Field Execution)

Operational Phase	Details and Resources Used	Duration
1. Logistics and Lifting	Positioning of a crane barge alongside the platform for heavy equipment lifting operations	Half day
2. Surface Mobilization	Deck positioning of the HPU skid (5,100 kg) and installation of the hydraulic cylinder (500 kg) on the wellhead	4 - 5 Hours
3. Rod String RIH (Running in Hole)	Running the sucker rod string (7.5 MT) to 1,900 m using a compact service rig (doubles capacity) and hydraulic rod tongs	3 Days (12-hr shifts)
4. Hookup and Telemetry	Connection to the platform power grid, routing of hydraulic lines, and alignment of the Starlink dish with the RPC system setup	2 - 3 Hours
5. Commissioning and Start-up	Zero-spill system testing, pumping startup at ~3 SPM, and remote verification of dynamometer reports	2 Hours



5. Key Customer Benefits (Business Value & ROI)

- **Drastic Reduction in Deck Footprint:** The compact HPU skid (3.9 x 1.8 m) and lightweight design (5,100 kg) reduce occupied surface area and deck loading by over 70% compared to conventional systems. This makes the technology ideal for unmanned platforms or structures with severe load constraints
- **Reduced Logistics and Mobilization Costs (Rigless Setup):** Cylinder mounting (500 kg) and HPU hookup are completed in just 4–5 hours. Utilizing only a barge crane for surface equipment and a compact service rig for the rod string eliminates the need to mobilize costly full-scale workover rigs
- **HSE Excellence & Environmental Compliance (Zero-Spill & EAL):** Combining the active containment circuit at the cylinder head with HLP SYNT E68 synthetic biodegradable oil completely eliminates the risk of deck spills, ensuring full compliance with the most stringent European and offshore environmental regulations
- **Asset Integrity & MTBF Maximization:** The combination of an extended stroke length (354") and low pumping speed (~3 SPM) drastically reduces fatigue cycles on the 7.5 MT rod string. Coupled with centralization using Sidewinder guides, the system prevents abnormal wear and tubing failure risks, even in wells deviated up to 36°
- **OPEX Optimization & POB (Personnel on Board) Reduction:** Integrating Starlink satellite telemetry with the RPC system enables continuous remote dynamometer card diagnostics, automated reporting, and pumping parameter adjustments, minimizing the need for technician mobilization via helicopter or crew boat

