Liuhua 4-1 Subsea Tieback Project
Thermoplastic Production Control Umbilical
ESP Power Umbilicals

JDR’s Hartlepool facility recently delivered umbilicals and ESP power cables for the Liuhua LH4-1 subsea tieback project. The project is located in the South China Sea approximately 215km from Hong Kong and 240km from Shenzhen. The China National Offshore Oil Corporation (CNOOC) operates the subsea field in depths ranging from 260 to 300m. Host production facilities comprise the FPS Nanhai Tiao Zhan and the FPSO Nanhai Sheng Li.

The development of the LH4-1 oil field includes one production manifold for eight production wells, jumpers and an 18” Subsea Pipeline. JDR supplied 3 x 14km ESP power umbilicals, 1 x 14km main production control umbilical and a bridging manifold control umbilical.

LH11-1 FPS and LH11-1 FPSO were modified to meet LH4-1 production requirements. The development also allows for future expansion of the field with an additional manifold serving up to four additional wells.

The ESP power umbilicals were produced on JDR’s state-of-the-art vertical lay-up machine (VLM). The VLM was commissioned for demanding projects such as LH 4-1.
Main Thermoplastic Umbilical – 1 x 14km
The LH 4-1 subsea tieback enabled utilisation of existing facilities with modifications to the FPS. The thermoplastic umbilical was optimized for hydraulic control system response and delivery of required injection chemicals. The cross section was designed with a drag diameter to apparent weight ratio necessary to meet dynamic mode requirements.

A thermoplastic umbilical solution was selected at FEED to minimize project cost and maximize system reliability.

ESP Power Umbilical – 3 x 14km
Each ESP power umbilical contained three x 3 phase power circuits to service the eight wells and provide a complete spare circuit. The use of multi-triad power umbilicals reduced the number of risers thereby simplifying system complexity and minimizing project cost.

The umbilical bundles were laid up on JDR’s state-of-the-art vertical lay-up machine (VLM). The VLM has a capacity of 60 tonnes per bobbin, which reduced the number of core splices thus reducing risk to the project.
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Dynamic Analysis
Umbilical Hardware

Dynamic Analysis
A major part of the supply contract included dynamic riser design. JDR’s in-house riser team performed the riser design and undertook extensive analysis using Orcaflex software. The JDR riser team was faced with challenges including the need to model FPS rig movements during workovers of existing LH 11-1 wells directly under it. The main umbilical and ESP power umbilical risers were optimized to provide fatigue resistance for the design life.

Riser engineering included:
• Tension/angle plots for bend stiffener design
• Calculation of FPS hang-Off loads
• TDP location & arc-length
• Distribution of buoyancy modules
• Specifying tension across entire length of riser
• Specifying min/max sag/bend clearance

Umbilical Hardware
Hardware design is undertaken internally by JDR’s termination hardware design team. Subsea equipment was designed with stand alone CP for the design life. All hardware and ancillary equipment was designed using the latest 3D CAD software. Fabrication drawings were produced from 3D models.

Hardware delivered included:
• Flexible pull-in heads
• Hang-off bodies and split clamps
• Dynamic bend stiffeners
• Buoyancy modules
• Riser base clamps
• Subsea termination units
Hartlepool UK Factory

JDR produces umbilicals and cables from three principle manufacturing locations: 1) Hartlepool UK, 2) Littleport UK and 3) Sattahip Thailand. Hartlepool was chosen for the LH 4-1 project because of its twin thermoplastic umbilical and power cable production lines. Both products were made concurrently to reduce delivery lead time.

The Hartlepool factory assets are:
- Experienced labour force
- Horizontal lay-up machine (6 carrier)
- Vertical lay-up machine (3 / 6 / 12 carrier)
- SZ hydraulic umbilical line
- 2 x 2,200 tonne carousels
- 2 x 4,000 tonne carousels
- 2 x 100 bobbin armourers
- 220 mm OD extrusion Line

LH 4-1 – Complex Loadout

A heavy lift vessel fitted with a temporary 2,000 tonne carousel was used to ship the umbilicals to China. Once in country, the umbilicals will be transferred to an installation vessel. The loadout process was complex because the single carousel had to contain all four umbilicals complete with topside hardware, dynamic bend stiffeners and subsea terminations. JDR engineering teams provided detailed packing design while JDR’s loadout team executed a safe and effective loadout. All lengths were packed on the carousel.