CLOV: high performance at every level

Xavier Bougro, Project Installation Engineering Manager

At more than $1.5 billion, the CLOV project for Total E&P Angola is the largest single project executed to date by Subsea 7. It included the design, fabrication and installation of pipelines, riser towers, flexible risers and umbilicals over a four-field development with 34 subsea wells in water depths ranging from 1,100 to 1,400 metres.

So, while there were a number of worthy submissions in the Performance Award category, the collaborative efforts of the CLOV project teams and the offshore crew of the *Seven Borealis* can only be described as outstanding.

The award recognised their safe and on-schedule installation of heavy Pipe-in-Pipe (PIP) production lines (see What is PIP? opposite) on the large EPIC project.

The challenges facing the team were equally sizeable. This was the maiden project for the *Seven Borealis*, our flagship pipelay/heavy lift vessel, which joined the fleet in 2012 and, at $550 million, represents Subsea 7's largest vessel investment to date.

The pipeline specification was also challenging. To meet the flow assurance demands of the deepwater development, the Subsea 7 project engineering team had designed a high-performance 38.9km PIP production line to be installed by the vessel's J-lay system.

"The combination of the PIP construction and the water depths made this the heaviest J-lay pipeline installation to date for Subsea 7," explains Xavier Bougro, the Project Installation Engineering Manager.

"To meet these extreme load specifications, we not only upgraded the vessel's J-lay tower during her build programme in Rotterdam, but also developed an innovative method for the laydown of the heavy pipelines which involved deploying some of the vessel's higher-capacity S-lay equipment."

Seven Borealis, spool installation

"Getting a new vessel of the scale and complexity of the *Seven Borealis* into service was a substantial challenge. Fitting into the demanding and lengthy schedule of the CLOV project with minimal downtime was a tremendous achievement. And to successfully develop the adapted J-lay system called for the highest standards of collaborative performance from teams in Paris, Aberdeen, Singapore and Angola.

"This really was a case of hitting the ground running with our largest and most complex vessel," confirms Vessel Support Team (VST) Manager Ben Moffat. "We relied on close cooperation between our vessel-build, Offshore Resources (OR), engineering design, project installation and VST teams.

"For example, we had offshore managers who completely understood the J-lay operations from previous projects working on the build alongside the equipment installation team in Rotterdam.

"They appreciated that there are generally about fifteen people working

Abandonment FLET in the Seven Borealis J-lay tower

at any one time in the J-lay tower area, whose safety has to be assessed not only in their work environment but also during their transit routes to and from the tower. There are many simultaneous operations taking place on the vessel, so a lot of detailed and integrated risk assessments had to be carried out.

"We also had a notable contribution from our vessel superintendent who grasped exactly what had to be done from day one. On vessels the size of the *Seven Borealis*, you generally need a period of bedding-in until everybody on board understands exactly what they will be doing during operations.

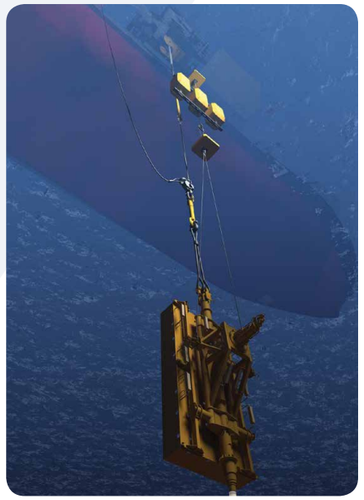
"In this case, however, there was a huge amount of focus by lots of people to ensure that everyone fully understood their capabilities and responsibilities right from the start of operations."

The methodology selected for the project was developed by project engineers who are highly experienced in J-laying, working in very close collaboration with the vessel superintendent and offshore managers who were developing the asset.

The main technical challenge was how to lay the heavy pipeline down onto the seabed (technically referred to as abandonment). The J-lay system was capable of laying and holding onto the pipeline, but the maximum capacity of its abandonment and recovery (A&R) winch was only 325t, which would be insufficient for the calculated pipeline tension of between 500 and 600t.

The solution was to connect an additional string of welded double joints to the pipeline extremity until the pipeline was lowered to 200m water depth, at which point it was cross-hauled to the vessel's higher capacity S-lay A&R winch system. This system was then used to lower the pipeline and its end structures onto the seabed while the additional string of pipe was cut out and recovered to deck.

"This process may sound simple, but it involved extensive engineering to deploy large riggings and a custom-made hang-off over-boarding sheave to minimise the stress on the pipeline during installation," says Ben. "To design and deploy this new system within a tight project schedule was a tremendous achievement, and the many teams involved have demonstrated the great versatility of the *Seven Borealis* on even the most challenging projects."



PiP heavy laydown arrangement

What is PIP?

Pipe-in-Pipe is a double-wall pipeline comprising an inner pipe inserted into a protective carrier pipe. The annular space between the two pipes contains high-performance insulation material and a partial vacuum to reduce heat loss from the hydrocarbon fluid flowing through the inner pipe. Without this protective insulation (which can also be augmented by electrical heating), fluids in deepwater pipelines are at risk of solidifying, restricting the flow and potentially causing blockages.