

Spotlight

LIFE OF FIELD

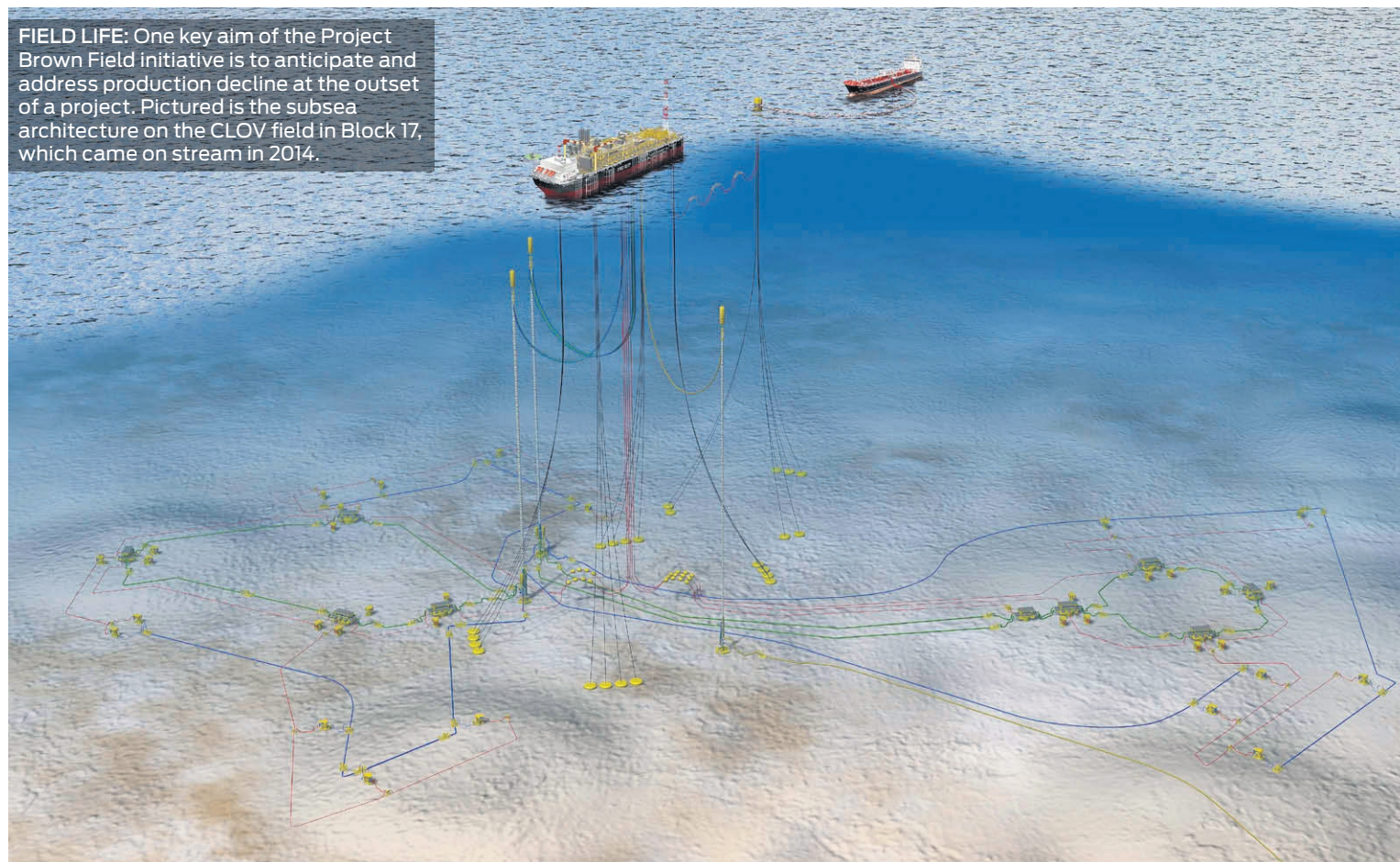
Ultra-deep enters a new phase



POWER ON: The FPSO *Girassol*, pictured with Technip's deepwater support vessel *Deep Pioneer*, being connected by power umbilical to the FPSO *Dalia* (not pictured). The two FPSOs together provide power for the multiphase pumps at the Rosa subsea tieback.

As ageing ultra-deepwater developments assume brownfield status, operators are looking to technology to help keep them viable in a low oil price environment. Russell McCulley talks to Total about its strategy in Angola's Block 17, which includes deepwater application of subsea multiphase pumping.

FIELD LIFE: One key aim of the Project Brown Field initiative is to anticipate and address production decline at the outset of a project. Pictured is the subsea architecture on the CLOV field in Block 17, which came on stream in 2014.



At 1300 metres, Total's Girassol project off Angola was considered the first ultra-deepwater field when it came on stream in 2001. Today, deepwater fields are being developed at more than twice that water depth, while Girassol and other projects of its generation are reaching late maturity and inevitable production declines.

Operators have adopted a number of strategies to enhance recovery and extend field life at ultra-deep installations. In 2014, Total E&P Angola created the Project Brown Field division specifically to address life-of-field issues at its Block 17 developments, which include four floating production, storage and offloading (FPSO) units on the Girassol, Pazflor, CLOV and Dalia fields. The initiative would also try to anticipate and address production decline for new projects from the development stage.

At the beginning of this century, when Angola's deepwater fields began coming on stream, "the brownfield business was restricted to ageing onshore and conventional shallow-water

fields, mainly located in the North Sea, Middle East and Gulf of Guinea", says Philippe Charlez, senior technical advisor at Total E&P.

"Some 15 years later, deepwater fields have become mature, and international oil companies are now focusing on how to revitalise these assets in a low price environment."

Maturing deepwater fields exhibit many of the same characteristics as their shallow-water counterparts, Charlez says — decreasing reservoir pressures and higher water cuts, obsolescence or integrity issues with wells and surface facilities, and "mismatch between processing facilities' needs and means requiring heavy and costly debottlenecking projects".

The methods used to mitigate natural declines are similar as well. Operators may drill infill wells, debottleneck processing or tie back satellite or marginal fields, he notes.

"But deep offshore fields have also some particularities related to the specific exploitation mode — in particular, the fact that most of them have been developed using subsea wellheads, quite

long flowlines and umbilicals, and FPSOs. Consequently, revitalising such assets also requires innovative thinking."

Power sharing

Total brought the Rosa field on stream in 2007. The field, in about 1350 metres of water, ties back to the FPSO Girassol via two 18-kilometre subsea production loops. Rosa's production helped maintain the vessel's production rate of 250,000 barrels per day for a while, but a drop in reservoir pressure and increased water cut put a considerable dent in output over the years.

The operator faced a stark choice — close the wells at Rosa, install additional topsides facilities to support an enhanced recovery project, or use recent technological advances to come up with a more economically sound plan. Total and its Block 17 partners opted for subsea multiphase pumps to provide the boost needed to keep the mixture of gas, water and oil flowing to the FPSO Girassol.

Oilfield multiphase pumps have a long history above the waterline. Total and the French Institute of Petroleum teamed up

in the 1970s to develop multiphase pumps for topsides application. They were joined by Statoil in 1984 in the Poseidon project, a five-year research programme with the aim of developing multiphase pumping technology for subsea development of deepwater fields. The project produced a prototype of a helicoaxial multiphase pump, considered a milestone.

Multiphase pumps have been deployed subsea in a limited number of installations. Rosa pushed the boundaries, however, for water depth and 130 bar differential pressure.

"We were one of the first at using multiphase pumping, at the Dunbar field in the North Sea," Charlez says. Dunbar, part of the Greater Alwyn development, includes two multiphase pumps based on work done through the Poseidon project. "It's a surface system," he says of the multiphase pumps, which are mounted on a small platform. "The idea on Dunbar was to have a small platform without processing, and to use the Alwyn platform for processing."

"I think our surface experience on Dunbar was a precipitator for the development of this

SPACE SAVER: With deck space in short supply, Total opted not to install additional power generation on the FPSO Girassol.



multiphase pump on Block 17," he continues. "The idea is the same — we have a multiphase fluid which is under-pressured because of depletion and maturity."

Rosa's subsea boosting system consists of two pumping stations, each containing a pair of subsea multiphase pumps built by Framo, now part of OneSubsea. The first set of pumps began service in September 2015, followed by the second pair in April 2016.

"We have four multiphase pumps in operation for the time being, and everything is working as planned," Charlez says.

"Their implementation within an existing subsea installation not originally designed for has deeply modified the flow assurance and the way of operating both the Rosa and Girassol fields. Design optimisations were proposed, verified and tested through dedicated simulations, then translated into operating procedures and maintenance programs."

Getting the power needed to run the systems to the seabed presented another challenge. The FPSO Girassol alone could

upstream technology ANGOLA BLOCK 17

- Sonangol, licence concessionaire
- Total (operator) 40%
- Statoil 23.33%
- Esso Exploration 20%
- BP 16.67%

not furnish sufficient power to activate and operate the pumps, so Total devised a plan to connect electrical power systems from Girassol and the nearby FPSO Dalia, which came online in 2015. The project required a 13-kilometre interconnecting power cable from the FPSO Dalia to the FPSO Girassol and an integrated power management system that allows the sharing of 100MW of power in full automatic mode, a set-up that Charlez describes as "a world's first".

The project also required debottlenecking of the existing power systems, he says.

"We could have added power on FPSO Girassol, but the big problem with adding power is that power needs space. So the idea here was to recover power from Dalia and connect the two FPSOs."

Technology boost

As ultra-deepwater fields enter later life, operators are facing significant technological and economic challenges.

"Wringing the last barrel from a deepwater field costs a lot of money," Charlez says. "And the low cost of oil today goes against extensive redevelopment of deepwater fields."

In general, he says, the cost of a shallow-water redevelopment runs about 25% of a field's initial development costs, for a typical return rate of 10% to 15% more oil. "So the cost per barrel is high," he notes. The margins can be tighter for deepwater redevelopments.

"Redeveloping Rosa with a specific FPSO would not have been economic. Good technology ideas, such as subsea multiphase pumping, and using the existing facilities with existing power, were the only solutions that could make such a development economic."

"Bad economics can be a strong booster of technology," he adds, citing the dramatic increase in oil and gas industry patents in the wake of the first major oil shock of the late 1970s.



"Bad economics can be a strong booster of technology."
Philippe Charlez,
Total

"When you have a difficult economic situation, people think more."

However, successful redevelopment of ultra-deepwater brownfields will require more than technology. "As for any other mature fields, such projects are executed on facilities in production and require managing complex SIMOPS (simultaneous operations) activities to minimise the production losses."

The challenge is compounded on FPSOs and other floating production facilities, where redevelopment work often must share space with accommodations, drilling activities and maintenance work.

Charlez expects more subsea multiphase pump systems will be deployed in the coming years as deepwater fields in West Africa, Brazil and the Gulf of Mexico reach maturity.

"This was one of the first projects of this type because Girassol was one of the first greenfield developments in deepwater," he says. "There will be many more." □