

GAS

Subsea-to-shore innovation



The Laggan-Tormore project west of the Shetland Islands is the first subsea-to-shore development in UK waters. Nic Newman reports.

Developed by Total E&P UK (operator, 60%) in partnership with SSE E&P UK (20%) and DONG E&P UK (20%*), the innovative Laggan-Tormore project is located in blocks 206/1a and 206/5a, in water depths of 600 metres. Total field reserves are put at 1tn cf of gas and condensates – a substantial addition to the UK's known reserves.

The £3.5bn project comprises the development of two deep offshore gas fields – Laggan and Tomore – the first to be developed in the Atlantic Margin, a region that until now was known primarily for its oil output. First gas

was produced on 8 February 2016, via a semi-autonomous system lying on the seabed connected by a 143-km subsea export pipeline, known as the Laggan Tormore export pipeline (LTEP). The LTEP links the gas fields with a new £800mn gas plant located in Shetland, next to the Sullom Voe oil and gas terminal. The facility is able to process 500mn cf/d – enough gas to supply two million households or about 8% of the UK's energy needs. After processing, the gas is piped through a second 243-km newly constructed Shetland Islands Regional Gas Export (SIRGE) pipeline which connects with the Frigg-UK pipeline and then into the UK's gas pipeline network in Scotland.

A combination of the extreme weather experienced in the Atlantic Margin, including hurricane force winds in winter; water depths of some 600 metres, where temperatures are commonly -1°C ; typical current speeds as high as 0.64 m/s; and the large volumes of gas to be developed made it unrealistic to employ a traditional platform or a FLNG (floating LNG) vessel to collect, process and store gas ready to be offloaded onto LNG tankers. Instead, a subsea-to-shore development concept was chosen – a UK first.

Essentially, the Laggan and Tormore fields are each serviced by a semi-autonomous subsea production system consisting of a set of six-slot manifold templates lying beneath 600 metres of water on the seabed. Each manifold template measures approximately 30 metres wide, 40 metres long and 21 metres tall, weighing in at 900 tonnes. At present, five subsea wells are in operation out of a 12-well capacity.

These subsea installations represent two major engineering achievements for the UK. The first is the installation of a subsea production system with remote controlled wells, and the second is the longest tie-back between offshore wells and an onshore terminal.

Installation challenges

The depth of water at Laggan-Tormore precluded the use of divers so Heerema Marine Contractors's *Thialf* heavy-lift vessel was used to transport and install the production systems on the seabed. Subsea work was sub-contracted to Aberdeen-based Specialist Subsea Services (S³), who provided and operated remotely controlled underwater vehicles (ROVs) for the subsea installation work.

The project has a field life expectancy of 20 years. As with any production facility, wellhead pressures naturally decline over time and the pipeline export flow will fall below a critical value. At this juncture compression boosters will most likely be installed at each wellhead and one for each export pipeline in order to boost production and recovery from the reservoir by reducing backpressure on the wells by increasing the flow rate in the export pipelines, thus extending field production.

In the pipeline

Two sets of new pipelines were constructed for the project, the first being the LTEP network linking the fields with the newly constructed Shetland gas processing plant. A second pipeline system exports the processed gas from the gas plant to the UK mainland. The entire pipeline network required 200,000 tonnes of high-grade steel. Internally the pipes are protected by a three-layer polypropylene anti-corrosion coating, internal flow-efficiency coating and concrete-weight coating. The pipeline network is regularly inspected and can be cleaned by a remotely controlled pig.

The LTEP comprises three pipelines and a communication or control umbilical. On the seabed this network consists of two 18-inch diameter flow-lines that carry gas from the fields to the Shetland gas plant for processing and an 8-inch diameter pipeline carrying MEG (mono ethylene glycol) from the gas plant to the Laggan-Tormore field's production sites. MEG is used to prevent the condensate from freezing at the start of its journey, much like antifreeze is used in a car. When the gas arrives at the processing plant, the MEG is removed and pumped back to the wellheads, to start its journey again. Gravity causes the contents in the gas pipelines to separate into gas in the top half of the pipe, whilst the heavier gas liquids settle along the

Installation of import pipeline at Orka Voe, Shetland Islands

Source: Total



Gas processing plant,
Shetland Islands

Source: Total

bottom half. The critical element, the control umbilical, monitors and controls all the subsea infrastructure. Both the MEG pipeline and control-umbilical are buried under newly laid stone to protect them whilst the gas export pipelines are exposed to the elements.

Construction of the Shetland gas processing plant began in 2010 and was handed over to Total by lead contractor Petrofac Offshore Engineering & Operations in December 2015 for testing the complete range of command and control systems. As noted earlier, first gas arrived in February 2016 and in April the same year the

second gas compressor came online. It took a huge effort to get to this point – taking some 42mn person-hours over two years, employing 800 personnel on temporary contracts for the construction, and currently employing 70. By May 2015 Laggan-Tormore was producing at a peak 90,000 boe/d.

The gas processing plant separates the well fluid into gas, oil and water with the three fluids being discharged separately. The associated liquid hydrocarbons are exported to the Sullom Voe oil and gas terminal. The treated gas from the plant is exported to the Frigg UK pipeline in the North Sea via

the SIRGE pipeline system, which then links with another pipeline to deliver the processed gas to the St Fergus gas terminal, near Peterhead in the north-east of Scotland for final processing.

The plant can process up to 500mn cf/d of gas, which is more than Laggan-Tormore is likely to produce. This is in anticipation of future successful exploration in the West of Shetland region, an area estimated to contain as much as 17% of the UK's remaining yet-to-find gas reserves.

Development of the nearby Edradour and Glenlivet fields by Total and its partners, starting in 2017 and 2018, will necessitate installation of new mercury removal facilities at the Shetland gas plant, and will ensure production is kept at peak rates until at least 2020.

Looking ahead, Laggan-Tormore will have a key role to play, allowing future gas finds in West of Shetland waters to be easily transmitted to the UK mainland via the existing infrastructure. ●

*DONG's entire oil and gas business, including its interest in Laggan-Tormore, was sold to Ineos in late May 2017 for \$1.05bn, plus a contingent payment of \$150mn relating to the Fredericia stabilisation plant and a contingent payment of up to \$100mn subject to the development of the Rosebank field.

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