Marginal field development in the UKCS using innovative low cost solutions

Study commissioned by

ABT Oil and Gas Ltd.

Submitted by:

Chidozie Ewuzie, Analyst, RMRI

James Fox, Analyst, RMRI

Date:

24th July 2014

Forty years ago the United Kingdom Continental Shelf (UKCS) boasted a small number of very large oilfields discovered by major operators. Now, as a mature offshore basin, the average discovery size has shrunk to a fraction of what it once was with small and medium independent companies dominating the region. Oil and Gas UK estimate that 42 billion barrels of oil equivalent (boe) have already been produced from the UKCS and a further 12 to 21 billion boe could yet be recovered[1]. Many studies show that these resources are likely to be increasingly smaller accumulations which are technically challenging and economically marginal[2]. In recent years, the UKCS has also consistently recorded one of the highest levels of unit capital and operating expenditure of any oil producing region in the world[3]. These conditions combine to ensure that many small fields are not developed due to marginal economics.

Despite the meteoric rise in development costs in the last few years to the point where the unit costs of development and operation are now approaching £30 per boe[4], two new production systems have been introduced to the market that enables such fields with marginal economics to be developed. They cost a fraction of traditional production systems and can be Normally Unattended Installations (NUIs). The huge reduction in capital costs at the front end of the project and the savings in operating expenditure along the production period combine to drastically alter the project economics. For example, a development project involving three small fields with combined gross reserves of 30 million boe using one of the systems was modelled and the results showed it delivered a post-tax profit of over half a billion pounds.

A review of the UK offshore oil and gas recovery and its regulation was commissioned in 2013 by the Secretary of State for Energy and Climate Change, the Rt Hon Ed Davy MP. The *UKCS Maximising Recovery Review* was led by Sir Ian Wood who issued his final report earlier this year in which he called for a new strategy for Maximising Economic Recovery ('MER') in order to reverse some of the trends evident in recent years, notably:

- **Declining production:** Production has fallen by around 38% over the last 3 years producing around 500 million boe less over the period[5].
- **Rising costs:** The UKCS is now one of the most expensive offshore regions in the world with development costs per barrel having risen five fold over the last decade[6].
- **Ageing assets:** Some operating assets are over 30 years old, beyond their design life[7]. As production continues to decline, maintaining these assets will become unsustainable.
- **Low exploration drilling:** Only 15 exploration wells[8] were completed last year and just 79 million boe of recoverable reserves were discovered in the UK[9]. The last three years have witnessed the lowest rate of exploration activity in the history of the UKCS[10].

These issues are longstanding and unlikely to be completely resolved in the near future. A pragmatic approach is therefore required to stem the decline in production. The Wood Review highlighted the

[1] UKCS Maximising Recovery Review: Final report
[2] J. Harpin (2011). Measuring the impact of aging infrastructure in the UK North Sea
[3] See reference 1
[4] Oil and Gas UK Economic Report 2013
[5] ibid
[6] ibid
[7] ibid
[8] https://www.gov.uk/oil-and-gas-wells#drilling-activity
[9] Wood Mackenzie – Review of 2012 & 2013 – UK upstream sector
[10] Oil and Gas UK Activity Survey 2014

need for better use of existing infrastructure but also recognised the need for applying low cost, standalone solutions to small field development that do not rely solely on channelling production through ageing assets.

The number of marginal fields in a geographic region slowly increases over time and the field size distribution typically follows a lognormal distribution. As larger discoveries are developed initially, much like in the North Sea, this leaves a scattering of smaller accumulations spread over a vast area. As this area continues to mature and decommissioning activities increase due to cost and age, access to these smaller accumulations become more difficult, and they become further removed from existing infrastructure.

The opportunity

The scope of marginal fields and their potential in providing a much needed boost to production and revenues for mature basins such as the UKCS has been the subject of a great deal of discussion in recent months over. There are an increasing number of marginal fields in the North Sea with the average size of new discoveries now less than 25 million boe and declining. Given that a majority of the discoveries in the future are expected to be relatively small, bringing them into production is critical to maximising economic recovery for the UK. Therefore, we believe that having a marginal field development blueprint is essential in order to achieve the goals of MER UK as described in the Wood Review.

Marginal fields can be broadly classed as fields with any of the following five characteristics:

1. Low stock tank oil initially in place (STOIIP) and therefore low recoverable reserves.
2. Long distance from existing production facilities thereby making the field economically unviable to develop and put on stream.
3. Fields not yet considered for development because of marginal economics under the current market and fiscal conditions.
4. Fields with technically challenging crude oil characteristics (such as crude with very high viscosity and low API gravity) which cannot be produced through conventional methods or would require significantly increased capital investment to develop.
5. Low volume producing fields which have become uneconomic due to production income falling below operating expenditure.

Excluding medium to large fields with challenging technical characteristics which require significant capital investment to overcome, such as the Mariner field located in the northern North Sea, and end of life fields, the majority of marginal fields are small discoveries. These discoveries are generally determined towards the end of a project lifecycle. Leads and prospects may have huge estimated resources at the initial stage but they are gradually pared down by seismic assessment and other techniques such as exploration and appraisal drilling. When discoveries are determined to have small reserves and classed as marginal, operators are then faced with tough decisions such as a part or full asset sale or holding the asset in their portfolio with no imminent decision on development. These small fields cannot support the cost of traditional exploration and extraction methods typically employed in the North Sea over the last 40 years.

Fixed steel structures are not viable solutions for marginal fields due to their enormous cost outlay and need for many years of production which goes beyond the much shorter production period for marginal fields. FPSO's are usually not considered for marginal fields as the lower production rate mean revenue generated is unable to sustain the daily lease rate and operational cost. While tiebacks to existing infrastructure may be an option for some marginal fields, commercial and

technical complexities can prove to be challenging and have often held back such development options. For fields isolated from existing production systems, tiebacks are not an option. Due to cost constraints, the average tieback distance for small fields is approximately 10 km[11]. A low cost solution is needed if the goal of marginal field development is to be achieved and therefore, capital and operational expenditure has to be reduced.

The solution

The Wood Review states that new technology will be key to enabling the exploitation of new and complex discoveries which are generally smaller and often remote. Given that new technology will likely take years of testing and intense scrutiny before gaining industry acceptance, existing and proven technology solutions are needed to deliver immediate results.

Recognising marginal fields as a huge untapped resource, British company, ABT Oil and Gas (ABTOG) scoured the market for proven technology which could be adapted to transform the economics of small or stranded reserves. Having identified appropriate solutions ABTOG, along with its partners, have developed two production systems, the Production Buoy and the Self-Installing Floating Tower (SIFT), which fit the strategic objectives of their marginal field initiative. They are relatively low cost systems which combine existing and proven technologies reconfigured to deliver innovative solutions for marginal field development. They are generically buoyant solutions for use in offshore oilfields with an operating envelope of water depth up to 600m and liquid production rates of up to 20,000 barrels of oil per day.

Both systems can be remotely operated Normally Unattended Installations (NUIs) incurring relatively low operating costs thereby providing significant cost savings compared to more conventional production systems such as FPSOs. The SIFT is simple to fabricate and transport, as evidenced by the CX-15 Buoyant Tower which uses similar existing and proven shallow water technologies. The CX-15 is currently installed in the Corvina field offshore Peru and took 13 months to design, build, transport and install. The Production Buoy and SIFT are ideally suited for developing fields in mature basins such as the North Sea which have an increasing number of small fields and can also be redeployed to new fields, significantly reducing the capital expenditure required to bring a new field on stream. Working with strategic partners these production systems have been designed for use in the North Sea and are also well suited for regions of seismic activity.

The benefits

To demonstrate the benefits of ABTOG solutions, a discounted cashflow model was developed to illustrate the development of three identical marginal oilfields with 10 million boe reserve size each and a production life of 6 years using a single SIFT. Since the SIFT units are able to be redeployed, the model starts with a single field producing for 6 years and at the end of production, an 18 month break to retrofit the SIFT is taken and a second field is subsequently developed using the same SIFT. This process is repeated for the third field and eventually, close to 30 million boe is produced over a 21 year period.

With oil prices fixed at $90 per barrel, the project generates revenue of £1.7 billion based on an estimate capital and operating expenditure of over £660 million. The project generates a pre-tax profit of just over £1 billion. With £485 million deducted as corporation tax on production for the Treasury, even after deductions for the small field tax allowance, this gives a post-tax profit of £555 million. This equates to £18.50 of post-tax profit per boe and £16.20 of tax income per boe.

[11] See reference 2

The total recoverable for discovered undeveloped marginal fields in the UKCS is estimated as 1.2 billion boe. If we assume that all the marginal fields are developed and the total reserves produced, then the potential post-tax profit based on a $90 per barrel oil price is £22.2 billion for operators and the potential tax income to the Treasury is £19.4 billion. Given that the recent production decline is estimated to have cost the Treasury over £6 billion in lower tax receipts[12], this will contribute to make up for the shortfall and also give the national economy a much needed boost. UK energy security will be significantly strengthened and there will be benefits for the Treasury as the spending on oil imports which runs into several billion pounds annually is reduced. As such, the balance of payments deficit will be reduced. According to the Office for National Statistics (ONS), the balance of trade in crude oil was in deficit by around £9.8 billion in 2013. If these fields are put on stream, added revenue will ensure this deficit is eroded and benefit the Treasury in the form of tax revenue.

Also, it is estimated that developing these marginal fields will lead to a potential investment of over £26 billion in capital and operating expenditure and this could in turn lead to the creation of over 2,500 new jobs in the UK and support many thousand more along the supply chain and the contribution to the local economy could be substantial. These results show that the size of the opportunity and the potential returns to operators and contribution to the Treasury are very significant.

In addition to the benefits for the producers and the Treasury, marginal field development offers a major new area of commercial opportunity for the UK's oil and gas supply chain industry which could benefit by building expertise in marginal field technologies, with the potential to transfer these to other mature offshore basins.

The Production Buoy and SIFT could be further developed to enhance efficiency and performance, and is able to be adapted to the characteristics of other offshore regions. Indeed, although the UKCS is one of the most mature hydrocarbon basins, the need to develop marginal fields does not apply to the North Sea alone. Our analysis shows that marginal fields of sufficient size and water depth are located across the globe in nearly every offshore jurisdiction, opening up a massive global market for these systems. These low cost solutions can also be applied to brownfields being redeveloped, clusters of marginal fields or isolated small fields, unlocking billions of barrels of oil and gas reserves with significant potential.

The Conclusion

There has not been a significant (multi-hundred million boe) discovery for five years in the UKCS[13] and it is uncertain if any will emerge in the future. Mature petroleum regions such as the UKCS will therefore become increasingly reliant on the development of smaller, marginal hydrocarbon reserves which will struggle to be exploited using relatively high cost conventional production systems. As such, a huge market with unforeseen potential exists which can be unlocked by applying proven, innovative production systems to achieve significant cost savings and early production delivery. ABTOG is at the forefront of these developments with access to technologies, systems and a business model ideally suited to marginal field opportunities.

[12] See reference 10
[13] Wood Mackenzie industry database