Using clusters as a regional development strategy for marginal fields in the North Sea

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The UK North Sea is a mature basin with an extensive and well-developed network of production infrastructure consisting of platforms, pipelines and onshore processing plants and terminals. The basin has so far produced around 42 billion barrels of oil equivalent (boe), and it is estimated that up to 21 billion boe could be further produced[1]. Over the past four decades, this production capacity has been built up using 'daisy chains' of infrastructure that was originally installed to support large offshore projects, but which has since unlocked new opportunities. Each 'cluster' of fields typically started out with a single, large, field development in a fallow area, such as the Forties and Brent fields in the 1970's. To maximise economies of scale, exploration activities were then concentrated around these massive oil and gas fields and often led to new discoveries and prospects being found. Large fields were developed with above-surface infrastructure while smaller and more marginal discoveries were often then developed via subsea tie-back to existing host facilities, receiving terminals, or other subsea infrastructure which acted as a hub for development of the area. These small fields required a low cost development to be commercial, hence the option of tie-backs. This pattern has been repeated over several years, aided by high oil prices, resulting in the growth of infrastructure and production in the basin.

However, production efficiency of oil and gas fields across the UK Continental Shelf (UKCS) has declined from 81 per cent in 2004 to its current level averaging below 60 per cent[2] because the production facilities are experiencing more frequent and longer outages as they age and many are now operating beyond their design life. This has largely contributed to the 63 per cent fall in oil production over the same period[3], costing the Treasury £6 billion in lower tax receipts[4]. The maintenance procedures necessary to keep these ageing assets operating safely in order to extend useful life is cost intensive ensuring they have very high per barrel operating costs. This upward pressure on costs makes it more difficult for operators of smaller fields to negotiate satisfactory commercial tie-back arrangements with infrastructure owners. As such, infrastructure in mature areas in the North Sea is under increasing commercial pressure as maintenance costs increase and throughput diminishes[5]. The Wood Review notes that the pace of new developments is being constrained in part by the inability of third parties to negotiate appropriate technical and commercial terms to achieve access to existing infrastructure. As a result, developments are taking longer to implement and often end up being sub-optimal[6].

A New Development Model

A massive investment in existing production infrastructure is required to maintain safe and reliable operations and increase production, however, declining production income makes it difficult to support such levels of investment. Therefore, a shift in approach is necessary to facilitate an evolution in the design of low cost production systems that can be independent of ageing facilities. In our earlier article, we introduced two such production systems

[1] http://www.gov.uk/oil-and-gas-uk-field-data#uk-oil-and-gas-reserves
[2] PILOT presentation, 31 October 2013
[3] http://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes
[4] Comparison of UKCS Tax Yield – Budget 2011 and 2013
[5] UKCS Maximising Recovery Review
[6] ibid

developed by a British company, ABT Oil and Gas Limited (ABTOG), along with its partners – the Production Buoy and Self-Installing Floating Tower (SIFT). These are cost effective, mobile standalone production systems suited for use in marginal field developments which are capable of redeployment and can be independent of existing infrastructure. These systems have the added advantage of reduced reliance on expensive installation vessels, simplified project delivery, and can operate normally unattended.

The SIFT is an offshore oil production facility capable of multi-field processing which primarily targets oil and gas fields within 50 – 150 m water depth, ideally suited to the North Sea. It has a design life of 25 years, is redeployable, and can be remotely operated as a Normally Unattended Installation (NUI). It is comprised of structural columns that are fixed via the foundation to the seabed. The structural columns support multipurpose topsides which contain the necessary process, utilities and ancillary facilities required to process the well fluids. The crude oil is stored within the structural columns and additional oil storage cells can be located between the structural columns. The crude is then transported to a terminal via periodic shuttle tanker visits; hence the system can be independent of local infrastructure.

The Concern over Decommissioning

As larger fields are depleted and production facilities are abandoned and decommissioned, this will have an adverse effect on future production in the basin. The loss of strategic local infrastructure as the ‘daisy chain’ fragments will remove a primary means of oil production in the basin leading to more stranded small and marginal fields.

The Wood Review sets out a decommissioning strategy that aims to achieve the maximum economic extension of field life and to ensure key assets are not decommissioned prematurely to the detriment of production hubs and infrastructure. However, many of these assets are already past their design life and therefore decommissioning, whilst being possibly delayed, is inevitable. In the UKCS, there are several critical hubs at risk of decommissioning. The current course of action places at risk billions of reserves that could be left stranded and extending the useful life of existing assets is cost-intensive. With the ABTOG’s low cost production systems, there is an opportunity to avoid such risks and reframe how mature basins are exploited.

Decommissioning will also have a significant impact on exploration and future discoveries. Exploration activity is declining rapidly as the size of discoveries continue to reduce and this coupled with ageing infrastructure in the basin does not create a conducive environment for the sanction of multi-million pound investments that could be deployed anywhere in the world.

The maturity and decline of the North Sea means that decommissioning activities will be ongoing at different hub locations for the remainder of the North Sea’s productive life. Hannon Westwood estimate that by the 2020’s the areal coverage of active hubs may shrink to less than 50 per cent of the area containing prospects or discoveries and some 3 billion boe would remain “unassigned” to hubs and would require either standalone development or extended connectivity to existing hubs[7]. As such, what is required is a focus on proven standalone production systems which can be independent of existing infrastructure and also capable of providing a commercial development for small and marginal fields, thereby maximising recovery and extending the life of the basin. Therefore, given the emergence of ABTOG's production systems, the current concern over decommissioning is somewhat misplaced.

The Development Potential

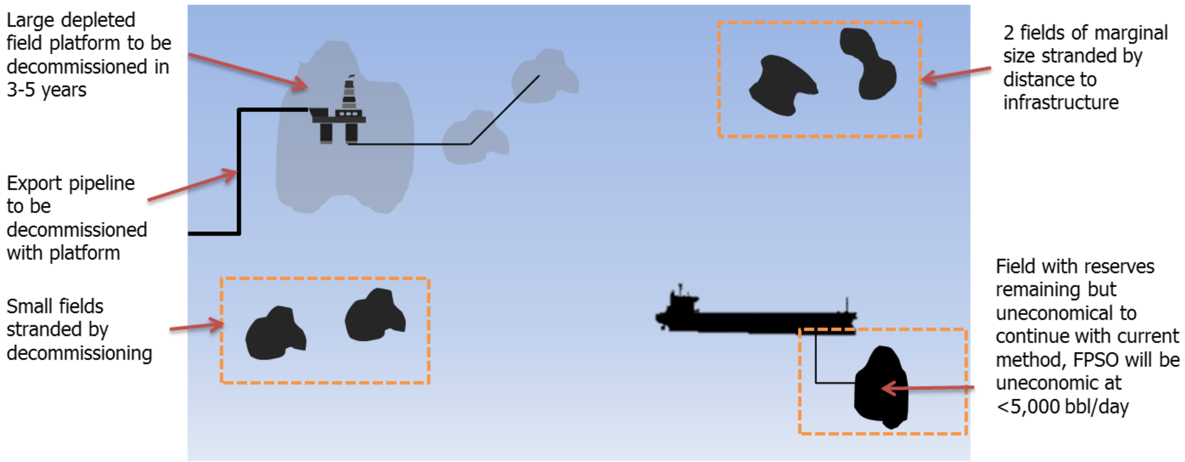

Figure 1 - Map of a cluster of marginal fields in the North Sea

In this report, we have set out to demonstrate an alternative model for the development of a cluster of marginal fields in the North Sea using a SIFT. To illustrate this model, we have modified data from the central North Sea (CNS) where we identified a cluster of five marginal discoveries and end of life fields in a 25 km radius, all located in 100 – 110 m water depths and within the operating envelope of the SIFT. A map of the area is shown in Figure 1 above. Two discoveries within this group are stranded by distance (~ 19 km) and insufficient processing capacity at the nearest platform which is due for decommissioning in around 5 years. Another two are closer to the fixed platform but have been held back by inability to finalise a commercial agreement for a tie-back. The final one is an end of life field due to be stranded when the nearby FPSO is removed. The total mid-case reserve size for all five fields is 25.6 million boe. The end of life field at 3 million boe can be developed because the cost of the SIFT has been amortised over the production life of the first two fields to be developed, therefore the major capital expenditure associated with this field is the well re-entry cost. This unique advantage of the SIFT enables the economic development of minute reserves and therefore maximises economic recovery of the basin. A map of the sequence of development of the fields using a SIFT as a hub or enabler is shown in Figure 2 below.

[7] Hannon Westwood hub analysis presentation, December 2011

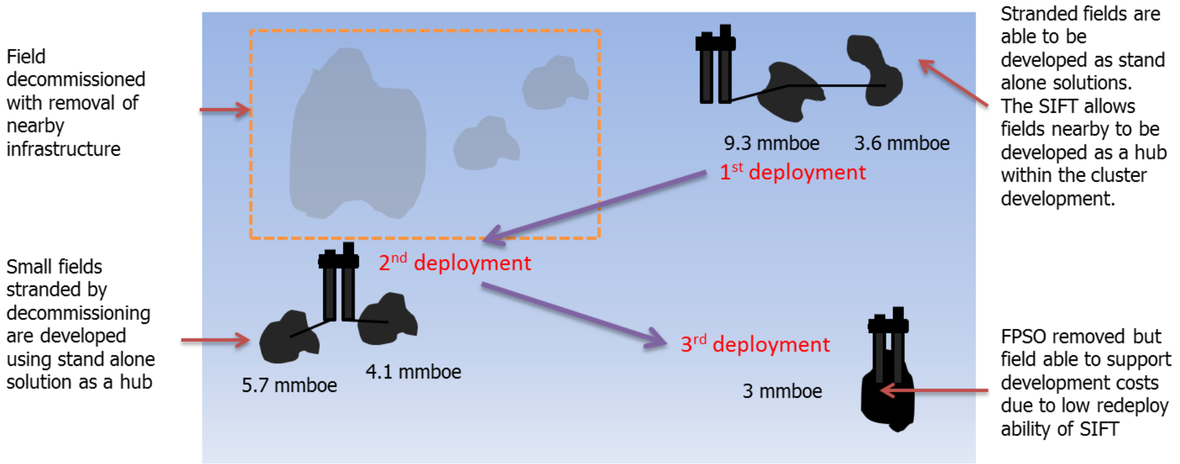

Figure 2 - Map showing the sequence of development of the cluster area using the SIFT as a hub

To see what can be achieved by this development scenario, a cashflow model was developed to evaluate the development of marginal fields in this cluster area. The development is split into three phases. In the first phase, the SIFT is deployed to the first stranded field and after two years of production, the second stranded field is tied-in. At cessation of production (COP) after six years, the SIFT is retrofitted for a year and redeployed to the mid-point of the two discoveries close to the fixed platform to be decommissioned. These will be developed simultaneously and produce for six years before COP, and then the SIFT is retrofitted again and moved to develop the end of life field using existing wells. Eventually, 25.6 million boe of reserves is produced from all five fields over 20 years from project inception to abandonment.

With oil prices fixed at $90 per barrel and ignoring the impact of inflation, the entire project has a pre-tax NPV10 of £365 million and generates gross revenue of close to £1.5 billion with a combined capital and operating expenditure of approximately £650 million. The project as a whole therefore generates a pre-tax profit of close to £800 million. Taking deductions such as the small field tax allowance, we estimate the tax revenue to be almost £390 million and therefore the post-tax profit is over £400 million. This equates to almost £16 of post-tax profit per boe and £15 of tax revenue per boe.

We have identified over 120 marginal fields in the North Sea which could be developed using a SIFT and we estimate that it would take between 20 – 30 clusters such as the one described above to develop these fields. If we assume that all the fields are developed, the potential worth to the UK economy is estimated to be in excess of £37 billion; over £19 billion of post-tax profit and £18 billion of tax revenue. While we estimated the contribution to the UK to be in excess of £40 billion in our earlier study, the cluster model is simply one way of unlocking marginal reserves and therefore this is consistent with our earlier results.

Summary and Conclusion

The conventional view of marginal field development assumes that as critical infrastructure is lost, tie-backs will become increasingly difficult to implement and less cost effective. Higher costs will lead to medium sized fields becoming marginal and small fields becoming sub-commercial. Also, with fewer production hubs available, the basin will continue to decline as the means of production is lost. As such, developing marginal fields in the North Sea has been described as a race against time[8]. This view is mistaken and now outdated as the standalone systems introduced by ABTOG have the dual benefit of utilising pipelines and existing infrastructure if available or acting as a standalone production system if necessary.

The joint industry – government task force – PILOT – estimates that between 0.5 – 2 billion boe[9] of reserves are at risk from the early decommissioning of existing infrastructure while industry experts Hannon Westwood estimate the overall potential loss in reserves due to loss of infrastructure is around 7 billion boe[10]. These reserves that were thought to be at risk from decommissioning and soon to be stranded can now be commercially recovered through the use of ABTOG's production systems. Improved data sharing, collaboration, greater third party access and fairer commercial and technical agreements for access to infrastructure are all valuable ideals, but it is debateable how these will be achieved in a highly competitive environment, even with a newly constituted and empowered regulator. Therefore, independent, standalone production systems such as the Production Buoy and SIFT are the right solutions.

ABTOG's solutions present a viable means of developing marginal fields in the North Sea with or without the use of existing production and process facilities. These systems can also be applied to marginal or end of life fields in other regions where access to existing old infrastructure is not viable or simply not available. The UK could benefit via technology and knowledge transfer as these production systems are engineered and built in the UK and can exported to other regions to the benefit of the wider UK economy. In subsequent studies, we will further explore this opportunity.

[8] J. Harpin (2011). Measuring the impact of aging infrastructure in the UK North Sea
[9] PILOT presentation, 2 May 2013
[10] See reference 7