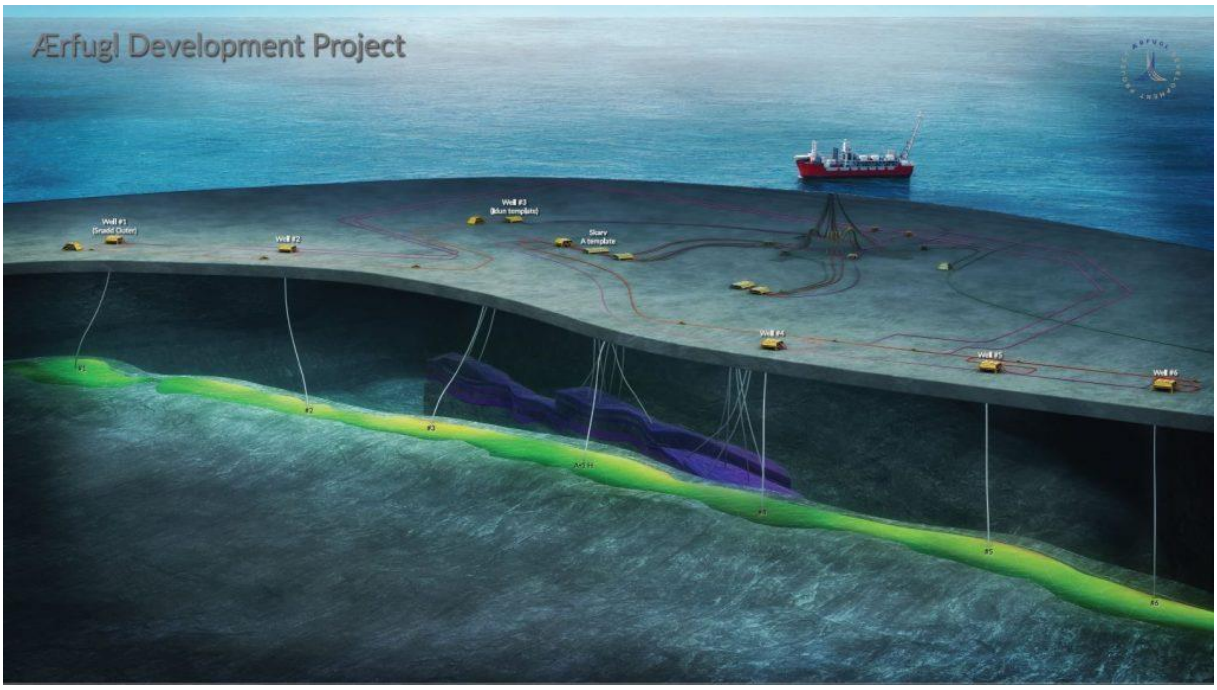
Ærfugl

A Case Study



Ærfugl Field Layout

Table of Contents

1 INTRODUCTION 3
2 HISTORY OF ÆRFUGL 3
3 EFFECT OF ALLIANCES ON ÆRFUGL 4
4 CASE STUDIES ÆRFUGL 6
5 LESSONS LEARNED 10
6 AFTERWORD 11
7 CONTRIBUTORS 11

1. Introduction

In 2016 Aker BP stopped believing in the traditional procurement model and embarked on a new path centred on collaboration and aligned interests with its key suppliers. “Restructuring the value chain through alliances and strategic partnerships” was listed as one of four transformation pillars in the company.

From 2017 Aker BP has been busy delivering on this strategy. The Subsea Alliance was launched through an initial series of subsea tie-back projects in the Alvheim area. Others followed swiftly, The Fixed Facility Alliance, two alliances for well construction, a Modifications Alliance, and Asset Integrity Alliance and finally The Alliance for Well Interventions and Well Stimulations.

In December 2017 Aker BP also delivered three plans for development and operation (PDO) for the Valhall Flank West (VFW), the Skogul and the Ærfugl projects. All these projects, as well as CAPEX projects sanctioned later, have been delivered with the alliance execution model. On November 12th first gas was achieved on the Ærfugl project – exactly as planned in the PDO. The execution model and team involved three alliances – the subsea, the semi and the modification alliances – working in the integrated team, also including Aker BP. The completion of Ærfugl, and with that the first wave of alliance projects, is a major milestone that calls for some reflections. This article will dive into the Ærfugl project and elaborate on the following conclusions:

1. The alliance model already delivers better than the traditional procurement model.
2. The alliance model already proves value beyond the first project – the Hod project (VFW copy) and the acceleration of Ærfugl phase 2. We argue that this could not have been done without the alliance way of working.
3. Through the alliances, a foundation of trust, collaboration methods and an extended One Team have been built – the set up that is needed to deliver the transformation of the oil and gas value chains – now more urgently needed in 2020 than anticipated in 2016.

2. History of Ærfugl

Ærfugl is an almost 60 kilometres long narrow gas and condensate field in The Norwegian Sea. It is located near the Skarv field, about 200 kilometres west of Sandnessjøen. The sea depth varies from 350 to 450 meters. It was discovered in 2000.

Ærfugl was deposited in the Cretaceous, in deep marine turbidites 100 million years ago and the reservoir quality is good, which means that production rates are high.

The reservoir is located 2800 meters below the ground. It is gas in the reservoir, while when it is produced up to atmospheric pressure, some oil also precipitates. The gas producers at Ærfugl are also the largest oil producers at Skarv because of this.

3. Effect of Alliances on Ærfugl

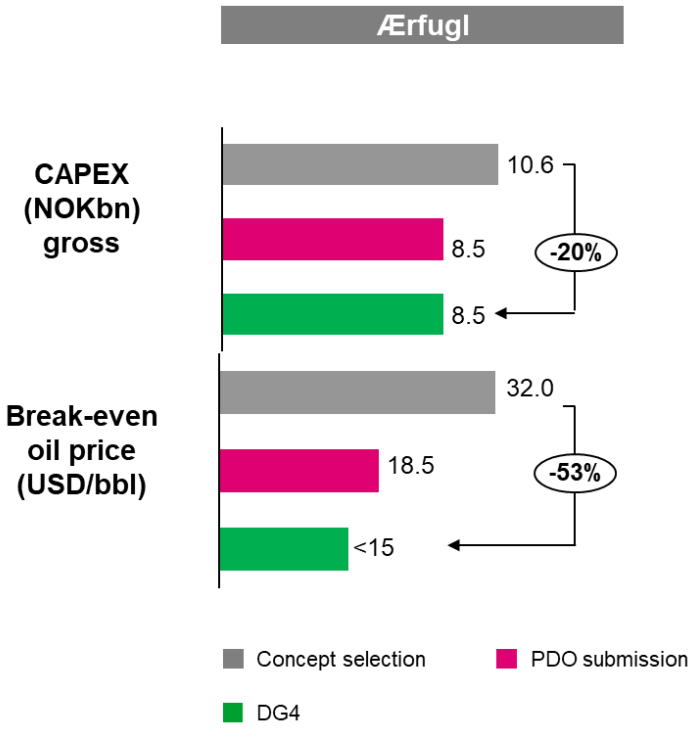
On the 12th of November 2020 Operator Aker BP and partners Equinor, Wintershall Dea and PGNiG reported that production had started from Ærfugl Phase 1 in the Norwegian Sea.

This was on the same date as promised in the PDO to the Ministry of Petroleum and Energy submitted three years earlier, and the project was delivered on budget.

The Subsea Alliance, Semi Alliance and Modification Alliance have all been vital in this project. The alliances have not only been delivering on cost and schedule, despite the "black swan" related to the challenges of Covid-19; They have as well achieved major improvements since the PDO was approved, including significantly accelerated development of phase 2 from 2023 to 2021, and improved economics.

With this Ærfugl has become one of the most profitable development projects on the Norwegian continental shelf. The initial estimated break-even oil price was USD 18.5 per barrel (converted from gas) at the time of the PDO submission. Due to increased reserves, earlier production, a stronger dollar and accelerated tax depreciation, the break-even price has improved to below USD 15 per barrel.

The overall development of Ærfugl from concept selection in 2017 up to DG4 shows a CAPEX reduction of 20 percent and over 50 percent improvement of the break-even price.



Improvement program showing tangible results

These are impressive figures bearing in mind that Ærfugl is a complex technology project that was enabled through two new technologies:

- More efficient drainage of the reservoir through new vertical valve trees.
- Worlds first long-distance, electrically heated flow lines to avoid hydrates in the gas pipelines. This technology significantly improves heat efficiency compared with regular technology and enables longer tie-backs.

The first well to come on stream on Ærfugl was actually one out of the three wells for Phase 2: well D4. Production from D-4 started up on the 19th of April 2020 only 166 days after sanctioning (FID, DG3) the Phase 2 project.

Reserves have as well increased since PDO due to continuous work to better understand the elongated reservoir.

This is the first new field linked back to Skarv, and it increases Skarv-asset's production from 85’ barrels per day to 140-150` barrels per day. The project not least contributes to reducing CO2 per barrel by up to 30 per cent.

Aker BP’s goal is to produce oil and gas as efficiently as possible to return greater value from the oil and gas resources to investors and society. The successful start-up of production from Ærfugl phase 1 demonstrates the ability to deliver on this strategy through excellent performance shown by the Aker BP project team and alliance partners despite extremely challenging times.

The Subsea Alliance between Aker BP, Subsea 7 and Aker Solutions has demonstrated substantial improvements and increased value creation over several years.

The performance by the rig alliance with Odfjell and Halliburton and the Modification alliance with Aker Solutions in collaboration with Kongsberg Maritime has been key to these achievements.

The production start-up of from Ærfugl shows how the alliances increase the value creation and deliver in line with the ambitious improvement agenda.

4. Case Studies – Ærfugl

The following examples are presented to illustrate the significant benefits of the alliance model and how they contributed to both deliver on time and cost as well as creating improved value for Ærfugl, Aker BP and its license partners;

Ærfugl Phase 1

- **Major re-scheduling of 2020 offshore campaigns required due to Covid-19.**

A big part of the critical offshore construction work for Ærfugl was initially planned to be performed during a three to four weeks revision shut-down window on Skarv in April/May 2020. However due to Covid-19 outbreak in March 2020 this was postponed by a year, to 2021. Further, there were several delays in deliveries from various fabrication sites around Europe due to factories being shut down. This led to a need for re-scheduling major parts of the marine schedule for the 2020 season, with the consequence of moving four vessel campaigns including finding a new smaller shut-down window on Skarv for Ærfugl specific activities. The re-scheduling also required changes to technical solutions in order to maintain first gas as promised.

In a traditional contract setup, these late major changes would have come with both significant cost and schedule impact on the project. However, with the flexibility and shared incentives of the alliance model, these changes were implemented without any impact to the overall project schedule, and overall cost impact of less than 10MNOK.

This demonstrates that the alliance model provides a high degree of flexibility at low cost, which is considered crucial during these challenging times, and when working towards brownfield projects such as subsea tiebacks to existing assets.

"*One of the strengths with the close collaboration by the alliance partners and overall project is the understanding of the different challenges and restrictions that exists for each party. Having this knowledge makes it easier to achieve a greater level of flexibility", says* Project Manager of the Subsea Alliance, Roar Saurdal.

- **Several significant value opportunities realised.**

In a traditional contract model, the scope is normally frozen relatively early in the project and the price is fixed as a lump sum. The likelihood of saving money from good ideas and opportunities that reveals later in the project is normally quite low. Even though promising opportunities are identified it is highly doubtful that the Contractor will return money from their fixed price scope to Company.

Through the Alliance model applied for Ærfugl there are several good examples of where high-value improvements have been realised late in the project through:

- "One Team" mindset achieved through common incentives and shared wins.
- Trough the alliances a large pool of both highly skilled resources as well as fabrication sites and construction vessels are available to increase the likelihood of enabling these savings.
- Doing things only once by involving all relevant personnel straight away creates a more efficient team across Aker BP and the alliance partners improve ways of working.
- By working together in multi-discipline and multi-alliance teams with common goals give better understanding of each other's constraints and possibilities hence increasing the chances of both identifying and realising high-value opportunities.

"In large projects high risks and opportunities are often hidden in the borderland between the different delivery lines and suppliers. By setting up alliances and integrated teams spanning across we increase our chances of revealing these risks and opportunities enabling ourselves to mitigate them properly", explains the technical integration lead for Ærfugl, Ole Magnus Holden.

A few highlights are presented briefly below demonstrating the effects of the alliance model with shared wins and flexibility to realise high-value opportunities, even late in the project. All these were identified, engineered and realised in 2020;

- Enabled pull-in of dynamic umbilicals on Skarv during production, saving 12 days of a shutdown on Skarv; saving **150 MNOK.**
- Change of end structure on flowline to eliminate additional in-line structure enabling cost saving of **100 MNOK.**
- Reduction in rock volumes for Phase 2; Saving of **50 MNOK.**
- Drilling speed records: 1000 meters in 6 hrs and 26 minutes, The English mile, 1609 meters in 11 hrs and 58 minutes, The Nautical mile, 1852 meters in 13 hrs and 38 minutes, 181m/hr average on-bottom ROP.
- The alliance teams have a performance first mindset, they improve continuously, eliminate waste and have a high focus on efficient operations. As a result, two out of four wells are in the top 10 list for the most efficient wells on the Norwegian shelf, according to Rushmore.
- Production start at D-4 was 43 hours after disconnecting blowout preventer. Commissioning of subsea Christmas tree was made offline while the rig completed its operations on the Ærfugl Phase 2 D-4H well. This resulted in the start of production already the day after the rig sailed from the location. Undoubtedly a record in Aker BP, and this helped to create value for Asset when they got production at an earlier time than normal.
- Very rough winter conditions made the operations extremely challenging. Cooperation with the alliance partners has been paramount for the successful execution of Phase 1 and learning towards Phase 2. Combined optimised vessel campaign October/November 2020 with construction scope and commissioning/start-support for Phase 1 and Template Installation for Phase 2. Commissioning support scope of eight days in total was performed without any standby although there were 40 days between

first and last support task. Template installation for Phase 2 (2 off) was performed in October and November without any waiting on weather. Without the combination of the different scopes standby for weather would have been around 10-14 days. Overall estimated saving; **40 MNOK**

"The success criteria have been the approach with common goals, increased flexibility, and development of competence. Although we have had challenges to overcome the common denominator has been that these are best solved as a team where everyone wants to find the good solutions" summarises Saurdal.

- **The Alliance model enables the operator to reduce on their project organisation**

Through the alliance model, a larger part of the work is performed within the alliances and directly between the partners in the alliance. Hence, Aker BP has been able to reduce on their project team. In a traditional project of the size of Ærfugl a typical operator's team would consist of 100-150 full time employee's (FTE). For Ærfugl, the number is around 50 FTE's including Aker BP personnel working within the alliances. This has demonstrated that the alliance model enables a leaner project organisation for the operator.

"The alliance model provides flexibility and value creation through effective processes reducing waste and transaction cost in projects", emphasizes Tom Storvik, the Ærfugl project manager.

Ærfugl Phase 2

- **Schedule acceleration of Ærfugl Phase 2**

At PDO submission, the first gas from Ærfugl Phase 2 was initially planned for 2023. Early in the project development phase, a two-year accelerated start-up was achieved using blueprint copies of the Ærfugl Phase 1 design. The same project team and alliance partners maximized the synergies and learnings from the first phase.

The aggressive schedule acceleration was tested as technical challenges arose during the installation of the EHTF-pipeline for Phase 1, and several design improvements had to be implemented for Phase 2. In addition, the delivery of the new pipelay installation vessel "Seven Vega" was significantly delayed due to Covid-19 jeopardizing the whole 2021 offshore schedule for Ærfugl Phase 2.

Through a significant degree of flexibility combined with efficient and high-quality decision-making, production start-up was reached one month ahead of the accelerated schedule based on trust and transparency across the alliance partners. Despite the challenges, a flawless EHTF-pipeline was delivered on time within a relatively short time frame based on the efficient implementation of key learnings from Phase 1.

"Yet again, the alliance model has proven to enforce AKER BPs capability of delivering complex projects on time and cost in a volatile and challenging environment. The flexibility - and the capacity to manage significant risks - provided by the alliance way of working has been essential for the successful acceleration, and start-up of Ærfugl Phase 2," summarizes Ole Magnus Holden, Technical integration Lead of Ærfugl.

■ Quality improvements

Through Ærfugl Phase 2 the project has significantly improved the quality of the deliverables. The foundation for achieving this in the Subsea Alliance has been a structured approach to implement lessons learned from previous projects, including Ærfugl Phase 1, and a high focus on delivering quality from an early phase into the engineering design. Process improvements and the additional adherence to quality in all deliverables through the project phases has created a strong foundation for excellent project execution performance. As a concrete example from the Subsea Alliance, there were only three recorded quality incidents throughout Ærfugl Phase II, resulting in direct costs of quality of less than 0,5 MNOK.

"Quality performance in the project has been driven by the strong cooperation across delivery lines and a "One Team" mindset. The project team established common goals and created an atmosphere of trust, openness, and transparency", Saurdal explains.

The close cooperation between the alliance partners has improved the way projects are developed. Several alliance effects have materialized, including significant design improvement and re-design of components to enhance the safety performance of the installation activities.

"Cooperation, both within the Subsea Alliance and the integrated project, improved the quality of our processes and our deliverables", concludes Roar Saurdal, the project manager of the Subsea Alliance.

■ Reduced owners cost and transaction cost

The continuous development of the teams and the alliance way of working during the Ærfugl phase 2 project has further proven the potential efficiency of the execution model. The owner's cost and associated transaction cost of the project execution have been reduced by approximately 20 per cent compared to the estimated cost at project sanctioning. The project management cost for phase 2 of the project is 5.9 per cent using the Performance Forum definition, which ranks in the low end of reference projects. Considering the complexity of the project and the degree of technological development and implementation, this shows the value of the high degree of integration between involved parties.

The main contribution to the reduced cost is the high degree of alignment across contracts, efficient communication within the project, efficient interface processes between alliances and reduced need for administrative support.

"The long-term perspective of working in alliances builds trust and transparency. This enables improved flow efficiency in the project management, which reduces associated cost," says Tom Storvik, the Ærfugl project manager.

5. Lessons Learned

The Ærfugl-project is completed safely, efficiently, on time and within budget at a time with two "black swans"; Covid-19 and a major fall in the oil price. This way of working has shown itself very resilient in a time of disruption.

Through the alliance collaboration, we have been innovative and adopted new technology. We have built the first digital twin of both topside, wells and subsea, and set up a large degree of automation and installed the world's first EHTF-pipeline.

Through a demanding period with several challenges along the way, Aker BP, together with our alliance partners, suppliers and licensing partners, has managed to deliver the project on time and cost. The key has been a tightly integrated supply chain through our alliances.

In the alliances, Aker BP works with the best suppliers in a long-term perspective. We believe that by working together in an integrated team, we succeed. In the alliances, all parties are equal, we share risk and have incentives that reward all parties when we deliver. We reap the best experience and knowledge from each other and put the best person to the job - regardless of the company. We have owned challenges and solutions together. We have had mutual respect and trust. That is exactly what alliances are all about. It is not them and us. We are one team.

One of the most important success criteria in the project has been to make partners and alliances good. If they succeed, we will succeed. Saurdal explains the advantages of the alliance model from a supplier's point of view;

"The alliance model incentivises all parties to pursue opportunities for the overall project. Earlier engagement in field developments ensures that existing capabilities are taken into account in decisions. Any plans for technology development can be brought to the market earlier and more efficiently through close cooperation."

We have worked systematically to create an integrated project. Seeing the alliances manage to bring out improvements, get closer to the project through the alliance model and help us achieve our goals is a success and value we believe extends beyond Ærfugl.

Holden shares some thoughts on what Ærfugl see as important focus areas for further developing the alliance model.

"We now takes experiences and learnings with us into future projects and field developments. The potential of the alliance model is very high. It creates great opportunities with win-win for the company and our value chain. However, we need to stay fully committed to the improve-agenda. One of the key focus areas will be to further develop incentive models to

continue strengthening the "One Team"-mindset and enhance cultural behaviors to enable Aker BP and its alliance partners to deliver world class project execution".

Storvik emphasizes the importance of not underestimating the complexity of working in an alliance setting, and the new challenges arising from new ways of working.

"Working with alliances requires a change in the way of thinking and behaviour to take full advantage of the opportunities an alliance model give".

6. Afterword

Aker BP manages natural resources to create value. That is why we will maximize value by utilizing available resources in the best possible manner, keeping costs low and emissions at a minimum. To reach these goals, we always strive to outperform ourselves: Always do our very best. Always seek improvement. The Ærfugl project is an excellent example of what we do and how we do it.

Aker BP is using alliances to reach our goals. Aker BP does not achieve its targets by having an "us and them" approach. We must succeed, and together is the better way. We will create a win-win culture. Where we will win, suppliers will win, and society will win. This is an integral part of our strategy, with "low-cost and low-carbon".

Cooperation is essential in Aker BP. Through Ærfugl, we have delivered top-class teamwork. We tackle major challenges by combining a willingness to invest with technological and digital innovation, and the expertise of creative problem solvers. Data and solutions are shared across the business ecosystem we are a part of.

This is how we optimize our value chain, new working methods arise, and value creation improves. Our long-term close integration of alliance partners has received international appreciation.

7. Contributors

There are several contributors to the Ærfugl Case Study. Ole Magnus Holden, Technical Integration Lead, Ærfugl, is the lead author. Main contributors are Project Manager for the Ærfugl Project Tom Storvik, and Senior Advisor Commercial Stephen McCracken. The Ærfugl Project Team and individuals in the alliances have provided information. Senior Communications Professional Brynjar Skjærli has coordinated and edited the work.