

## 4D Marine Seismic Acquisition

4D programs are increasingly employed to improve oil recovery but are challenging to execute safely and efficiently. To detect fluid movements, repetition is critical. However, matching source and receiver positions to prior surveys is challenging due to variability introduced by ocean currents. If the positions are far enough apart, the area has to be re-shot. Known as infill, this process can account for 15% or more of the survey cost and increases survey duration. ION collaborated with Statoil, a leading proponent of 4D, to develop a more cost-effective solution. Employing a unique combination of ION marine acquisition technologies and acquisition optimization services, Statoil was able to achieve over 20% infill reduction while exceeding repeatability requirements for the survey.

# 4D Marine Seismic Acquisition

**Challenge:** Minimize infill and acquisition costs for a 4D program over an obstructed producing field without compromising data quality.

**Approach:** ION Marine Acquisition Technologies and Acquisition Optimization Services.

**Result:** Over 20% infill reduction while exceeding repeatability requirements.

## STATOIL SEEKS TO REDUCE INFILL IN 4D ACQUISITION PROGRAMS

4D monitoring programs are currently being used in more than 140 fields around the world, but they are challenging to execute safely and efficiently. To detect fluid movements, repeatability of seismic source and receiver positions is critical but often difficult, due to variability introduced by ocean currents. If the positions are far enough apart from prior surveys and repeatability specifications are not met, the area has to be re-shot. The process of re-shooting is known as infill and can add 15% or more to the survey cost. Infill not only impacts cost, but also survey duration, adding to HSE risk profiles and delaying the time data becomes available to make critical leasing or drilling decisions.

## ION MARINE ACQUISITION TECHNOLOGIES AND SERVICES OPTIMIZE 4D SURVEYS IN REAL TIME

As an active consumer of time-lapse seismic for reservoir monitoring, Statoil worked with ION to make their 4D surveys more efficient while maintaining the required repeatability. Traditional 4D surveys attempt to replicate all the survey lines, which often results in excessive infill and decreased efficiency. ION's approach



Photo Courtesy of Statoil.

targeted the survey lines that provided the most unique coverage. Advanced prediction software forecasted when ocean currents provided the best chance of acquiring these prioritized lines. As each line was acquired, source and streamer steering technologies made final adjustments to ensure the in-water equipment positions aligned with the specified survey plan.

Two of ION's marine acquisition technologies – Orca and DigiFIN – are instrumental in more efficiently achieving the survey plan by reducing infill through automated streamer steering. Orca command & control software acts as the 'brain' for complex streamer operations, providing a central, automated point of control and QC for navigation, positioning, source, and recording systems. DigiFIN provides lateral streamer control to improve positioning and maintain the desired cable separation. Combined, Orca automatically steers streamers to desired positions by controlling DigiFIN devices along the cables, minimizing infill and maximizing repeatability during the survey.

At Statoil's request, ION's Concept Systems group provided a team of on-board Acquisition

“We're really pleased with the results achieved in our field in the North Sea and plan to use this approach for all future 4D surveys where possible.”

– Peter Sabel  
Acquisition Manager, Statoil

Optimization Specialists to manage the survey and provide real-time recommendations on how to modify operations and control ION technology to provide the best chance of achieving the survey plan in the safest, most cost-effective manner.

### **ION TECHNOLOGIES IMPROVED EFFICIENCY AND REPEATABILITY**

Statoil benefited from reduced infill, lower acquisition costs, improved cycle time, and high levels of survey-to-survey repeatability, critical to revealing only changes associated with fluid movement.

→ Infill and cost reduction. By prioritizing lines that provided the most unique coverage and predicting when the ocean currents were optimal to acquire them, the sail line count was reduced by over 20%, and no new infill lines were acquired, significantly reducing the cost of acquisition.

→ 4D repeatability. This novel methodology not only reduced infill, but also exceeded repeatability specifications, improving repeatability by 6%.

→ Survey completion. By reducing infill, cycle time was accelerated, increasing the likelihood of survey completion during the short acquisition window in the North Sea.

→ Risk mitigation. Streamer steering not only improves data quality and productivity, but most important, it mitigates Health, Safety, and Environmental (HSE) concerns. Seismic acquisition over producing fields introduces unique challenges. Close-pass undershoots around rigs and other in-field obstructions were completed safely and in conditions that otherwise wouldn't have been possible without streamer steering. Orca automatically generated shooting plans that accounted for multiple vessels passing through a high-traffic shipping lane. By maintaining even streamer separation, the risk of cable entanglement was reduced as well.

### **ION'S 4D MARINE SEISMIC ACQUISITION TOOLKIT**

#### **TECHNOLOGY PROVISION:**

- Orca® command and control
- DigiFIN® lateral streamer control
- DigiSHOT® digital source control
- DigiBIRD® depth control
- DigiRANGE™ II acoustic ranging

#### **ACQUISITION OPTIMIZATION SERVICES:**

- Survey planning - design and feasibility studies
- Feather prediction
- Intelligent line selection
- 4D survey optimization



## ABOUT ION

ION Geophysical Corporation is a leading provider of geophysical technology, services, and solutions for the global oil & gas industry. ION's offerings are designed to allow E&P operators to obtain higher resolution images of the subsurface to reduce the risk of exploration and reservoir development, and to enable seismic contractors to acquire geophysical data safely and efficiently.

**To learn more about how ION helps oil & gas companies and seismic contractors solve their toughest imaging and operational challenges, visit us at [iongeo.com](http://iongeo.com).**

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