

# Ormonde Offshore Wind Farm

Pile grouting for 31 four-legged jacket foundations in the Irish Sea, 10km off Barrow-In-Furness.

Subsea and offshore grouting  
for the global energy construction industries



# FoundOcean completes grouting operations for the Ormonde Offshore Wind Farm, the first large-scale commercial wind farm in European waters to use jacket foundations

## ABOUT THE ORMONDE OFFSHORE WIND FARM

The Ormonde Offshore Wind Farm is located 10km off Barrow-In-Furness, in the Irish Sea. On completion the wind farm will comprise 30 RePower 5MW wind turbines producing a capacity of 150MW, and 1 substation. This is sufficient to supply the equivalent of approximately 100,000 homes per year with clean power. The turbines will cover an area of 8.7km<sup>2</sup>.

### First for European waters

The wind farm utilises jacket-type foundations similar to those used at many offshore oil and gas platforms. Ormonde is the first largescale commercial wind farm in European waters to use jackets for the turbine foundations as well as the substation foundations.

The combined factors of water depth and turbine size typically determines the type of foundation. Jacket structures are ideal for most water depths.

### Efficiencies

By commissioning two vessels the project was able to work at a high level of efficiency. Scaldis Salvage and Marine Contractor NV's heavy lift vessel, Rambiz, installed the 31 four-legged jackets and the Swiber Else-Marie followed on with FoundOcean grouting equipment and offshore personnel onboard. The jackets were transported offshore four at a time on cargo barges, from Burntisland Fabrications, Methil.

This meant that whilst the jackets were being loaded out, cement resupply runs and grouting operations could take place without interrupting installation, and vice versa. Fewer turn-arounds meant that even very small weather windows could be taken advantage of.

*FoundOcean's unique Recirculating Jet Mixer (RJM) grouting spread*



## FOUNDATION DESCRIPTION

The 31 four-legged steel jackets are secured to the sea bed by their four main legs which were inserted into pre-driven piles. The connection between the leg and the pre-driven piles was made by injecting a cement grout into the annulus around each pile and stab-in-leg.

Each leg had a primary and secondary grout line through which grout could be pumped into the annulus. The top-side grout connectors were located on the jacket transition deck, with the lines running down the inside of the legs.

Grout overflow was observed at the top of each pre-driven pile. A minimum overage of 10% in excess of the theoretical annulus volume was pumped to the annulus after good quality grout returns were confirmed at the top of the pre-driven pile.

The grouting operations went very well and because of FoundOcean's vast offshore experience any problems they came up against were dealt with swiftly, effectively and professionally.

Annelie Doedens  
Project Engineer, Scaldis

*Jacket foundation OR-D3 in the foreground with Rambiz loading out a new delivery of jackets, taken from the Else-Marie*





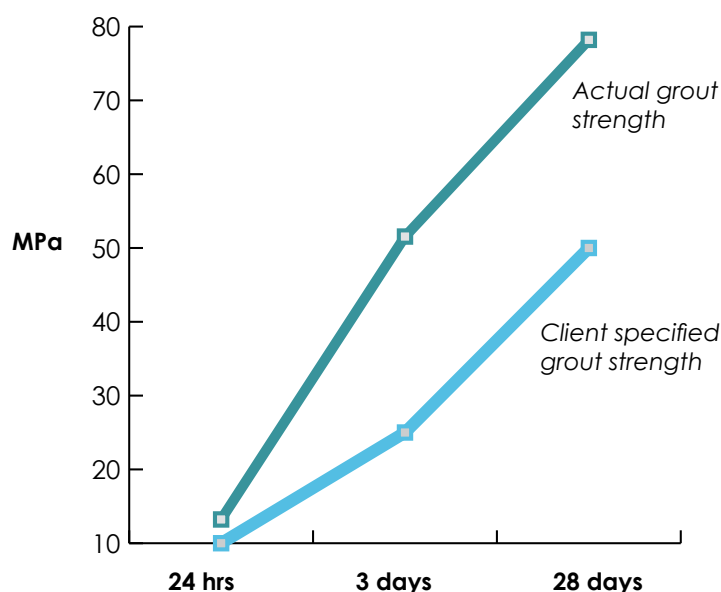
## THE MIXING SYSTEM

Cement was stored in bulk pressurised silos and delivered to a surge tank above the mixer. Water was delivered to the mixer from the vessel firemain pipework and measured through a water flow meter.

Water entered the mixer through a high pressure jet and the cement through a valve at a fixed rate. Any increase or decrease in the mix density, as monitored by the densitometer, was corrected by altering the water flow rate.

The grout was then transferred to a ten barrel capacity holding tank from where it was drawn off by the pump and delivered to the jacket via a flexible hose. The grout was mixed and pumped at a rate of between 0.3 – 0.5 m<sup>3</sup>/min.

**Client Specified Vs. Actual Grout Strengths in 24hr, 3 day and 28 day cube tests**

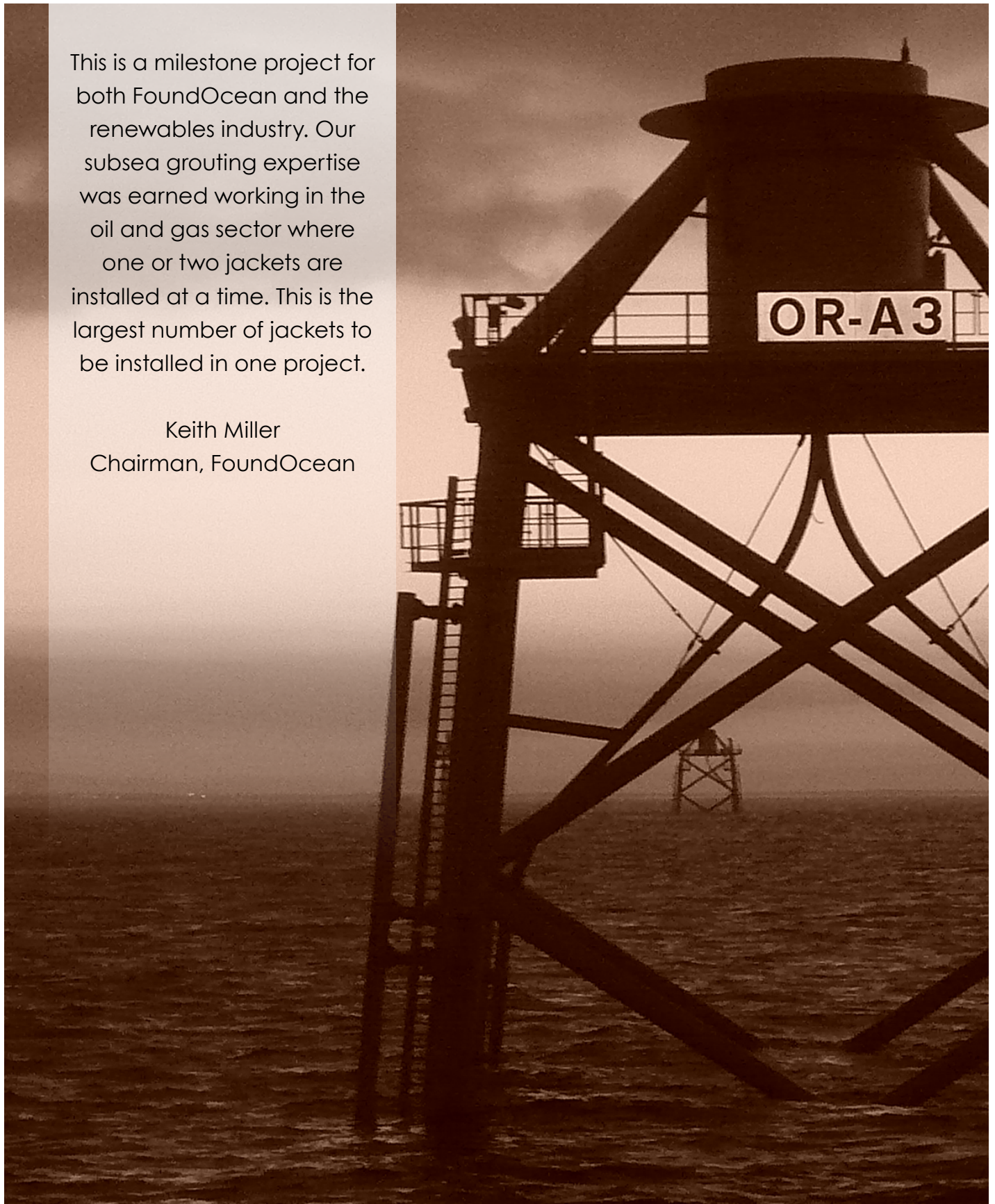


## Key Project Facts

Operator	Vattenfall UK	Installation vessel(s)	Swiber Else-Marie
Contractor	Scaldis		Rambiz
Region	Irish Sea	Crew size	4 (rotating)
Mobilisation port(s)	Vlissingen, Holland	Water depth	17m to 21m
	Heysham, UK	Cement type	CEM1 type 52.5N
Grouting equipment	RJM16 Spread:	Total cement used	1,894.82 tonnes
	2 pumps	Grout strength	13.22 MPa @ 24 hours
	20ft Stores container		78.2 MPa @ 28 days
	Lab container	Curing temperature	8°C ± 0.5°C
	Hose winch	Distance offshore	10km
	1 x 35 tonne vertical silo		
	Backup 12V Spread:	Number of jackets	31
	10ft Stores container	Number of annuli	124
	12V Grout Mixer	Cement re-supply	7
	1 x 40 tonne vertical silo	Highest wave	4.7m

This is a milestone project for both FoundOcean and the renewables industry. Our subsea grouting expertise was earned working in the oil and gas sector where one or two jackets are installed at a time. This is the largest number of jackets to be installed in one project.

Keith Miller  
Chairman, FoundOcean







*(above) A FoundOcean lab technician takes grout samples and manufactures cubes for testing*



*(above) Cubes being demoulded ready for testing*

*(below) A FoundOcean technician recording cube crushing results*



## QUALITY CONTROL

During mixing of the CEM1 type 52.5N cement, the grout slurry density was monitored by densitometers mounted on the mixer units to provide a record of the slurry density. The slurry density was also monitored at intervals using a pressurised slurry density balance.

Three samples were taken during the grouting of each annulus: one after approximately 1.5m<sup>3</sup> had been pumped, one approximately halfway through grouting, and one towards the end of the grouting process.

For each sample the slurry density was measured and recorded and three 75mm grout cubes were manufactured in accordance with BS EN 12390-2 Part 2. Each cube was marked to identify the platform, leg/sleeve number, time and date of casting and the specific gravity. The samples were cured underwater at 8°C ± 0.5°C until testing.

## THE ENGINEER'S PERSPECTIVE

It's exciting to be part of this milestone project for FoundOcean and the offshore wind sector. Ormonde is the largest multiple jacket grouting project to date in European waters and for FoundOcean, and it clearly demonstrates the scalable nature of our operations.

Poor weather halted installation and therefore grouting operations a few times but this crucial phase was complete within the timeframe and before the winter weather really started to affect the project. Working off a dedicated grouting vessel from the installation vessel meant that we could be grouting the jackets that had been placed whilst more were being loaded. We grouted 123 of the 124 annuli in accordance with FoundOcean's offshore grouting procedures. One annulus was completed using standard contingency procedures.



FoundOcean  
RJM16  
grouting  
spread  
onboard  
the Else-Marie



FoundOcean offshore crew looking out over  
the jacket whilst the grout hose is being moved  
to the next top-side grout connector

#### CLIENT'S PERSPECTIVE

Annelie Doedens, Project Engineer at Scaldis praised FoundOcean's work, "The grouting operations went very well and because of FoundOcean's vast offshore experience any problems they came up against were dealt with swiftly, effectively and professionally."

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**ABOUT FOUNDOCEAN**

FoundOcean is the subsea and offshore grouting specialist for the global oil, gas and renewables construction industries.

In addition to their 45 years securing structures to the seabed by foundation grouting, FoundOcean also provides structural inspection, repair and maintenance services for subsea and offshore structures, as well as pipeline and cable support and protection services.

And that's why, to offshore installation contractors, FoundOcean is the subcontractor of choice to reduce their project risks.