



## The North Hoyle Farm comprises 30 Vestas V 80 2 MW turbines.

Type of structure:	Wind turbines, 2 MW. Vestas type. V80
Location:	Irish sea. Liverpool bay.
Maximum water depth:	21 m (*)
Pile diameter at seabed:	4.0 m
Soil conditions:	10 m sediments, sand and clay underlaid by Mudstone and sandstone.
Installed:	2003
Installation method:	Driving through upper sediment layers followed by drilling and driving through rock layer
Number of foundations:	30
Maximum pile penetration below seabed:	33 m
Connection tower/pile:	Flange connection on grouted transition piece.
Special feature:	Grouted transition piece between pile and tower above sea water level.
Scour protection:	Stones placed on stony sea bottom protecting power cables.
LICengineering tasks:	Tender design, detailed design, specifications. Engineering follow-up. Special supervision.

(\*) Water depth at highest tide. The tidal variations in the area are up to 10 m.



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## MONOPILE FOUNDATIONS



### Introduction

The North Hoyle Windfarm is the first completed large scale UK offshore windfarm, comprising 30 x 2 MW wind turbines. The windfarm is located 8-11 km off the coast of Rhyl in North Wales in an area with very high tidal variations. LICengineering A/S undertook design of the 30 monopile foundations and associated structures such as tower flange connection, grouted transition piece, boatlanding, J-tubes and access platform. The foundations were installed in 2003.

### Project Details

The windfarm is operated by National Wind Power Offshore. Vestas-Celtic was the main partner in the supply and construction contract and Seacore installed the 30 monopile foundations, using an 8 legged jack-up drill rig. The turbines and towers were supplied by Vestas. LICengineering A/S carried out the detailed design for the foundations and provided engineering support throughout the project. Smulders B.V. supplied the main steel and provided the fabrication layout for some of the steel details.

### Design Analysis

The design analyses were carried out to determine the required wall thickness and penetration depth for the monopile. Dynamic analyses were carried out including the vibrational behaviour of the pile and tower subjected to combined wave and wind loads. The pile was designed to resist ultimate storm loads and fatigue loads in the operational lifetime. The integrated boatlanding and J-tube arrangement was analysed for extreme waves on the location.



