RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Outline Scour Protection Plan

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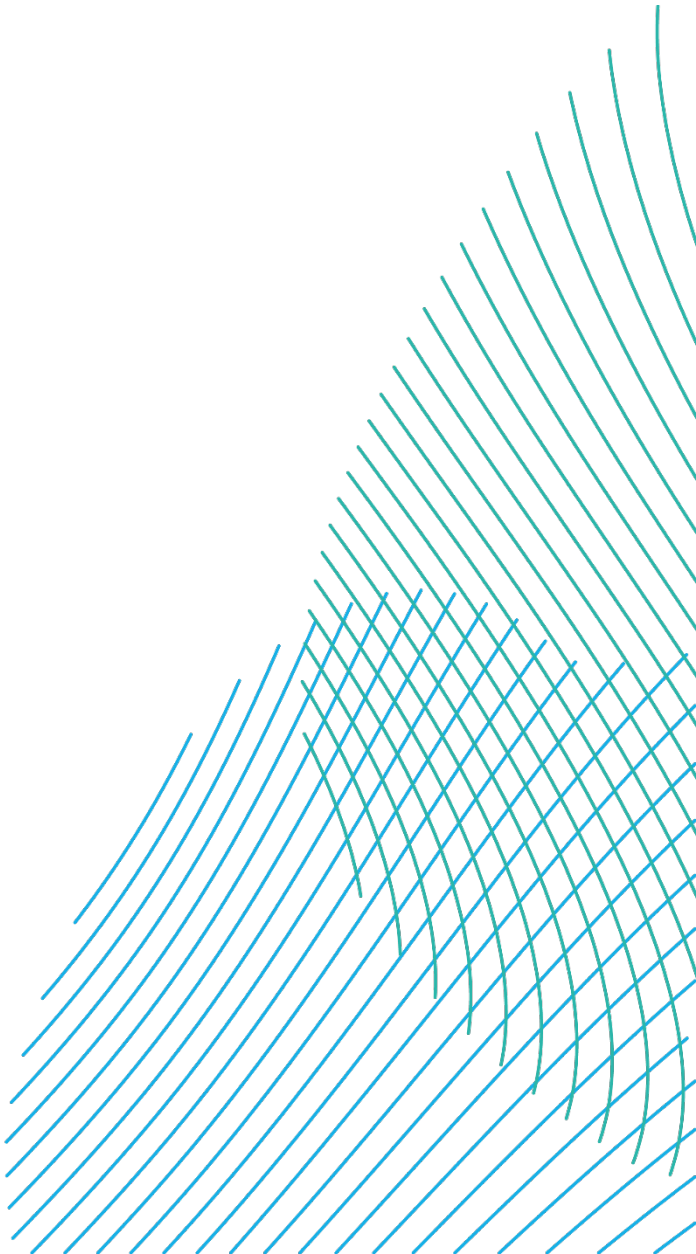

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Contents

Tables

Glossary

Term	Definition
Array Areas	The DBS East and DBS West offshore Array Areas, where the wind turbines, offshore platforms and array cables would be located. The Array Areas do not include the Offshore Export Cable Corridor or the Inter-Platform Cable Corridor within which no wind turbines are proposed. Each area is referred to separately as an Array Area.
Collector Platforms (CPs)	Receive the AC power generated by the wind turbines through the array cables, collect it and transform the voltage for onward transmission to the Offshore Converter Platforms (OCPs).
Dogger Bank South (DBS) Offshore Wind Farms	The collective name for the two Projects, DBS East and DBS West.
Electrical Switching Platform (ESP)	The Electrical Switching Platform (ESP), if required would be located either within one of the Array Areas (alongside an Offshore Converter Platform (OCP)) or the Export Cable Platform Search Area.
Environmental Statement (ES)	A document reporting the findings of the EIA and produced in accordance with the EIA Directive as transposed into UK law by the EIA Regulations.
Onshore Converter Stations	A compound containing electrical equipment required to transform HVDC and stabilise electricity generated by the Projects so that it can be connected to the electricity transmission network as HVAC. There will be one Onshore Converter Station for each Project.
Offshore Development Area	The Offshore Development Area for ES encompasses both the DBS East and West Array Areas, the Inter-Platform Cable Corridor, the Offshore Export Cable Corridor, plus the associated Construction Buffer Zones.

Term	Definition
Scour Protection	Protective materials to avoid sediment erosion from the base of the wind turbine foundations and offshore substation platform foundations due to water flow.
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South Offshore Wind Farms).
Wind turbine	Power generating device that is driven by the kinetic energy of the wind.

Acronyms

Term	Definition
CP	Collector Platform
DBS	Dogger Bank South
ESP	Electrical Switching Platform
FEED	Front-End Engineering Design
GBS	Gravity Based Structure
OCP	Offshore Converter Platform

1 Introduction

1.1 Purpose of This Document

1. This Outline Scour Protection and Cable Protection Plan lays out the key principles of how the Dogger Bank South Offshore Wind Farms intend to manage the protection of foundations from the effects of scour and hazards (e.g. snagging anchors in the case of cables), both immediately post-construction and throughout the operational life of the Projects. This statement also provides a summary of the effects of scour protection as presented in the Environmental Statement.

1.1.1 Background

2. RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited has submitted an application to the Planning Inspectorate on behalf of the Secretary of State, for a Development Consent Order for the Dogger Bank South Offshore Wind Farms (hereafter referred to as The Projects). The Projects comprise two separate sites, DBS West and DBS East situated at a minimum of 100km and 122km from the northeast coast of England, respectively. When operational, DBS West and DBS East combined would have the potential to generate renewable power for up to 3 million UK homes.

3. The Projects include provision for the construction, operation, maintenance and decommissioning of the Dogger Bank South Offshore Wind Farms with up to 200 wind turbine generators and 8 offshore platforms.

1.2 Scour Protection

4. Scour protection material may be required around the base of some or all foundations to provide protection from currents and wave action, thus ensuring structural integrity is not compromised. Structural health monitoring systems may be used to monitor the extent of scouring around each foundation. The findings of this monitoring, together with bathymetry survey results, will help determine the criticality of any scouring and will inform whether remedial action is required.

5. The maximum design scenario for scour protection has been estimated to inform the Environmental Impact Assessment. This information is presented in **Table 1-1** to **Table 1-3** which present the maximum scour protection parameters for turbines (**Table 1-1**) and platforms (**Table 1-2**). Maximum scour parameters for the project as a whole are presented in **Table 1-3**.

6. The scour protection types to be employed may include, but are not limited to, rock filter layers (typically laid before foundation installation) with a rock armour layer consisting of rock / stone filled geotextile bags and/or anti scour mattress solutions (typically laid after foundation installation).

7. The first principle of the Projects' adoption of scour protection during construction and operation is that scour protection will be minimised to the greatest practicable extent.

8. Developing scour protection designs for the Projects will involve the following steps:

- Pre-construction surveys to inform concept design
- Front-End Engineering Design (FEED) design studies; and
- Detailed design of scour protection.

1.2.1 Turbine Foundations

9. The foundation types that may be used for the turbines are monopiles and pin-pile jackets. Scour protection may be required around the base of the foundations to protect against localised erosion of the seabed. **Table 1-1** shows worst case turbine foundation scour protection parameters for the Projects.

Table 1-1 Maximum Turbine Foundation Scour Protection Parameters.

	Small Turbines	**Large Turbines**
Monopile		
Maximum number of turbines	200	113
Indicative pile diameter (m)	11	15
Maximum footprint on the seabed per foundation (excl. scour protection) (m^2)	95	177
Maximum outer scour protection diameter at seabed (incl. foundation structure) (m)	63	83
Maximum area of scour protection per foundation (incl. structure footprint area) (m^2)	3,117	5,411
Maximum scour protection volume per foundation (m^3) (rock)	5,278	9,450

	Small Turbines	Large Turbines
Maximum scour protection total footprint area (incl. structure footprint area) (m^2)	623,400	611,443
Maximum scour protection total volume (m^3)	1,055,600	1,067,850
Pin Pile Jacket		
Maximum number of turbines	200	113
Maximum. number of legs per foundation	4	4
Number of legs across wind farm	800	452
Indicative separation of adjacent legs at sea-bed level (m)	20	34
Maximum pin pile diameter (m)	3	4
Maximum outer scour protection diameter at seabed per leg (including foundation structure) (m)	23	28
Maximum scour protection area per foundation (incl. structure footprint area per pile) (m^2)	1,662	2,463
Maximum scour protection volume per foundation (m^3) (rock)	2,229	3,542
Maximum scour protection total footprint area (incl. structure footprint area) (m^2)	332,400	278,319
Maximum scour protection total volume (m^3)	445,800	400,246

1.2.2 Platform Foundations

10. The foundation types that may be used for the platforms within the Array Areas are monopiles and pin-pile jackets. For the potential Electrical Switching Platform (ESP) within the Offshore Export Cable Corridor, monopiles, pin-pile jackets or gravity based foundations may be used. Scour protection may be required around the base of the foundations to protect against localised erosion of the seabed. **Table 1-2** illustrates worst case platform foundation scour protection parameters for the Projects.

Table 1-2 Worst Case Platform Foundation Scour Protection Parameters

Parameters	Value
Monopile	
Maximum number	8 (Six CPs / OCPs + Two Other Platforms)
Maximum pile diameter (m)	15
Maximum outer scour protection diameter at seabed (including foundation structure) (m)	83
Maximum footprint on the seabed per foundation (excl. scour protection) (m^2)	177
Maximum scour protection area per offshore platform foundation (including structure footprint area monopile) (m^2)	5,411
Maximum scour protection volume per offshore platform monopile foundation (m^3) (rock)	9,450
Maximum total offshore platform foundation scour protection area (including structure footprint area monopile) (m^2)	43,285
Maximum offshore platform foundation scour protection volume for project (rock) (m^3)	75,600
Pin-pile jacket	
Maximum number	8 (Six CPs / OCPs + Two Other Platforms)
Number of legs per platform	8
Pin pile diameter (m)	3.8
Maximum outer scour protection diameter at seabed (including foundation structure) (m)	27
Maximum scour protection area per offshore platform foundation (including structure footprint area pin pile) (m^2)	4,580

Parameters	Value
Maximum scour protection volume per foundation leg (m^3) (rock)	808
Maximum scour protection area for all foundations (including structure footprint area pin pile) (m^2)	36,644
Maximum scour protection volume for project (rock) (m^3)	51,712
Gravity-based structure	
Maximum number	1 ESP
Maximum base diameter (OD) (m)	65
Indicative seabed preparation diameter (m)	70
Indicative scour protection width (m)	260
Maximum gravity based height above seabed (m)	10
Maximum outer scour protection diameter at seabed (including foundation structure) (m)	268
Maximum scour protection area per offshore platform foundation (including structure footprint area) (m^2)	56,410
Maximum scour protection volume per offshore platform foundation (m^3) (rock)	102,842

Table 1-3 Maximum Lifetime Footprints (Wind Turbines and Offshore Platforms). All figures presented include structure footprints.

Infrastructure	Worst case scenario description	Footprint – DBS East	Footprint – DBS West	Footprint – (combined)
Maximum wind turbine scour protection footprint (m^2)	200 turbines x 3,117m^2 total scour protection per turbine	311,725	311,725	623,449
Maximum offshore platform scour protection footprint (m^2)	Offshore platforms with scour protection (assumes three monopile foundations)	16,233	16,233	48,699
Total worst case scour protection for ESP (m^2)	One ESP with a GBS foundation	56,410	56,410	56,410
Combined Infrastructure footprints (m^2)	200 turbines, 8 offshore platforms.	384,368	384,368	768,736

1.3 Conclusions

11. Scouring of seabed around structures causes a serious risk to compromising foundation stability. Scour protection is essential in reducing risk. The Projects will undertake extensive site investigation in order to minimise the use of scour protection through design decisions. Though the maximum worst case scenario total scour protection footprint is 768,736m^2, it's unlikely the Projects will reach that limit.

RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Windmill Hill Business Park
Whitehill Way
Swindon
Wiltshire, SN5 6PB