Partners in UK offshore wind

MONA OFFSHORE WIND PROJECT

Response to Ørsted IP's wake loss assessment report

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Glossary

Term	Meaning
Applicant	Mona Offshore Wind Limited.
Appropriate Assessment	A step-wise procedure undertaken in accordance with Article 6(3) of the Habitats Directive, to determine the implications of a plan or project on a European site in view of the site's conservation objectives, where the plan or project is not directly connected with or necessary to the management of a European site but likely to have a significant effect thereon, either individually or in-combination with other plans or projects.
Bodelwyddan National Grid Substation	This is the Point of Interconnection (POI) selected by the National Grid for the Mona Offshore Wind Project.
Competent Authority	Regulation 6(1) defines competent authorities as "any Minister, government department, public or statutory undertaker, public body of any description or person holding a public office".
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Project (NSIP).
Environmental Statement	The document presenting the results of the Environmental Impact Assessment (EIA) process for the Mona Offshore Wind Project.
Evidence Plan Process	The Evidence Plan process is a mechanism to agree upfront what information the Applicant needs to supply to the Planning Inspectorate as part of the Development Consent Order (DCO) applications for the Mona Offshore Wind Project.
Expert Working Group (EWG)	Expert working groups set up with relevant stakeholders as part of the Evidence Plan process.
Inter-array cables	Cables which connect the wind turbines to each other and to the offshore substation platforms. Inter-array cables will carry the electrical current produced by the wind turbines to the offshore substation platforms.
Interconnector cables	Cables that may be required to interconnect the Offshore Substation Platforms in order to provide redundancy in the case of cable failure elsewhere.
Intertidal access areas	The area from Mean High Water Springs (MHWS) to Mean Low Water Springs (MLWS) which will be used for access to the beach and construction related activities.
Intertidal area	The area between MHWS and MLWS.
Landfall	The area in which the offshore export cables make contact with land and the transitional area where the offshore cabling connects to the onshore cabling.
Local Authority	A body empowered by law to exercise various statutory functions for a particular area of the United Kingdom. This includes County Councils, District Councils and County Borough Councils.
Local Highway Authority	A body responsible for the public highways in a particular area of England and Wales, as defined in the Highways Act 1980.
Marine licence	The Marine and Coastal Access Act 2009 requires a marine licence to be obtained for licensable marine activities. Section 149A of the Planning Act 2008 allows an applicant for a DCO to apply for a 'deemed' marine licence as part of the DCO process. In addition, licensable activities within 12nm of the Welsh coast require a separate marine licence from Natural Resource Wales (NRW).

Term	Meaning
Maximum Design Scenario (MDS)	The scenario within the design envelope with the potential to result in the greatest impact on a particular topic receptor, and therefore the one that should be assessed for that topic receptor.
Mona 400kV Grid Connection Cable Corridor	The corridor from the Mona onshore substation to the National Grid substation at Bodelwyddan.
Mona Array Area	The area within which the wind turbines, foundations, inter-array cables, interconnector cables, offshore export cables and offshore substation platforms (OSPs) forming part of the Mona Offshore Wind Project will be located.
Mona Array Scoping Boundary	The Preferred Bidding Area that the Applicant was awarded by The Crown Estate as part of Offshore Wind Leasing Round 4.
Mona Offshore Cable Corridor	The corridor located between the Mona Array Area and the landfall up to MHWS, in which the offshore export cables will be located.
Mona Offshore Cable Corridor and Access Areas	The corridor located between the Mona Array Area and the landfall up to MHWS, in which the offshore export cables will be located and in which the intertidal access areas are located.
Mona Offshore Transmission Infrastructure Scoping Search Area	The area that was presented in the Mona Scoping Report as the area encompassing and located between the Mona Potential Array Area and the landfall up to MHWS, in which the offshore export cables will be located.
Mona Offshore Wind Project	The Mona Offshore Wind Project is comprised of both the generation assets, offshore and onshore transmission assets, and associated activities.
Mona Offshore Wind Project Boundary	The area containing all aspects of the Mona Offshore Wind Project, both offshore and onshore.
Mona Offshore Wind Project PEIR	The Mona Offshore Wind Project Preliminary Environmental Information Report (PEIR) that was submitted to The Planning Inspectorate (on behalf of the Secretary of State) and NRW for the Mona Offshore Wind Project.
Mona Offshore Wind Project Scoping Report	The Mona Scoping Report that was submitted to The Planning Inspectorate (on behalf of the Secretary of State) and NRW for the Mona Offshore Wind Project.
Mona Onshore Cable Corridor	The corridor between MHWS at the landfall and the Mona onshore substation, in which the onshore export cables will be located.
Mona Onshore Development Area	The area in which the landfall, onshore cable corridor, onshore substation, mitigation areas, temporary construction facilities (such as access roads and construction compounds), and the connection to National Grid substation will be located
Mona Onshore Transmission Infrastructure Scoping Search Area	The area that was presented in the Mona Scoping Report as the area located between MHWS at the landfall and the onshore National Grid substation, in which the onshore export cables, onshore substation and other associated onshore transmission infrastructure will be located.
Mona PEIR Offshore Cable Corridor	The corridor presented at PEIR that was consulted on during statutory consultation and has subsequently been refined for the application for Development Consent. It is located between the Mona Array Area and the landfall up to MHWS, in which the offshore export cables and the offshore booster substation will be located.
Mona PEIR Offshore Wind Project Boundary	The area presented at PEIR containing all aspects of the Mona Offshore Wind Project, both offshore and onshore. This area was the boundary consulted on during statutory consultation and subsequently refined for the application for Development Consent.

Term	Meaning
Mona Potential Array Area	The area that was presented in the Mona Scoping Report and in the PEIR as the area within which the wind turbines, foundations, meteorological mast, inter-array cables, interconnector cables, offshore export cables and OSPs forming part of the Mona Offshore Wind Project were likely to be located. This area was the boundary consulted on during statutory consultation and subsequently refined for the application for Development Consent.
Mona Proposed Onshore Development Area	The area presented at PEIR in which the landfall, onshore cable corridor, onshore substation, mitigation areas, temporary construction facilities (such as access roads and construction compounds), and the connection to National Grid infrastructure will be located. This area was the boundary consulted on during statutory consultation and subsequently refined for the application for Development Consent.
Mona Scoping Report	The Mona Scoping Report that was submitted to The Planning Inspectorate (on behalf of the Secretary of State) and NRW for the Mona Offshore Wind Project.
National Policy Statement (NPS)	The current national policy statements published by the Department for Energy Security & Net Zero in 2024.
Non-statutory consultee	Organisations that an applicant may choose to consult in relation to a project who are not designated in law but are likely to have an interest in the project.
Offshore Substation Platform (OSP)	The offshore substation platforms located within the Mona Array Area will transform the electricity generated by the wind turbines to a higher voltage allowing the power to be efficiently transmitted to shore.
Offshore Wind Leasing Round 4	The Crown Estate auction process which allocated developers preferred bidder status on areas of the seabed within Welsh and English waters and ends when the Agreements for Lease (AfLs) are signed.
Pre-construction site investigation surveys	Pre-construction geophysical and/or geotechnical surveys undertaken offshore and, or onshore to inform, amongst other things, the final design of the Mona Offshore Wind Project.
Point of Interconnection	The point of connection at which a project is connected to the grid. For the Mona Offshore Wind Project, this is the Bodelwyddan National Grid Substation.
Relevant Local Planning Authority	The Relevant Local Planning Authority is the Local Authority in respect of an area within which a project is situated, as set out in Section 173 of the Planning Act 2008. Relevant Local Planning Authorities may have responsibility for discharging requirements and some functions pursuant to the DCO, once made.
the Secretary of State for Business, Energy and Industrial Strategy	The decision maker with regards to the application for development consent for the Mona Offshore Wind Project.
Statutory consultee	Organisations that are required to be consulted by an applicant pursuant to the Planning Act 2008 in relation to an application for development consent. Not all consultees will be statutory consultees (see non-statutory consultee definition).
Wind turbines	The wind turbine generators, including the tower, nacelle and rotor.
The Planning Inspectorate	The agency responsible for operating the planning process for NSIPs.

Acronyms

Acronym	Description
AfL	Agreement for Lease
BEIS	Department for Business, Energy and Industrial Strategy
BNG	Biodiversity net gain
DCO	Development Consent Order
EIA	Environmental Impact Assessment
EnBW	Energie Baden-Württemberg AG
EWG	Expert Working Group
HVAC	High Voltage Alternating Current
IEF	Important Ecological Feature
IEMA	Institute for Environmental Management and Assessment
ISAA	Information to support the Appropriate Assessment
MDS	Maximum Design Scenario
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
NBB	Net Benefits for Biodiversity
NRW	Natural Resources Wales
NSIP	Nationally Significant Infrastructure Project
NTS	Non-Technical Summary
OSP	Offshore Substation Platform
PDE	Project Design Envelope
PEI	Preliminary Environmental Information
PEIR	Preliminary Environmental Information Report
POI	Point of Interconnection
SAC	Special Area of Conservation
SoCC	Statement of Community Consultation
SPA	Special Protection Area
TCE	The Crown Estate
WTW	Wildlife Trust Wales
TWT	The Wildlife Trusts

Units

Unit	Description
GW	Gigawatt

Unit	Description
km	Kilometres
km^2	Kilometres squared
kV	Kilovolt
MW	Megawatt
nm	Nautical miles

1.1 Response to Ørsted IP's wake impact assessment report

1.1.1 Introduction

1.1.1.1 This document sets out the Applicant's response to the Ørsted IPs Wake impact assessment report (REP5-120), referred to below as 'the Report'.

1.1.1.2 This response does not repeat the Report in full, in order to limit the document size (given it extends to 122 pages of text and appendices), but makes some general observations on the Report, as well as specific observations on the model set-up, validation and assumptions, and on its conclusions, to assist in an understanding of the context and limitations of the Report.

1.1.2 General observations on the Report

1.1.2.1 The Applicant has the following general observations on the Report:

- Section 1.1 of the Report Says states it is an '*independent assessment'*. The Applicant does not consider this to be an accurate representation as it is a study commissioned by the Ørsted IPs to underpin their position on wake effects. This is highlighted by the stated starting hypothesis of the Report, that '. . . *additional losses will be incurred from the proposed future neighbouring wind farms, including Morgan, Mona and Morecambe (abbreviated as MoMoMo) and Awel y Môr'*.
- The Report states in section 5 (and other places) that the assessment is '*industry standard'*. As the Applicant has highlighted in its previous representations, there is no industry standard approach to assessing wake effects. Whilst the model used to inform the Report is one known to be used within the offshore wind industry there are also a number of other models that are used. Each of the models uses a different approach to modelling, such as 'engineering models' (of a range of complexity and typically empirically tuned using power data from operational wind farms) and higher-fidelity 'numerical models' (such as those based on the principles of computational fluid dynamics (CFD)). There are also multiple variants on those approaches from different model providers- the model reported as used in the assessment can be considered an engineering model of which there are many alternatives in use across the offshore industry.
- While most models would be considered to provide credible predictions by their developers, a wide range of wake loss estimates may be expected from these different models for any given wind farm scenario. This is particularly the case for scenarios involving the estimation of wake impacts over large distances, given the very limited opportunity to calibrate and validate the models. This is due to the small number of suitable operational wind farms for such studies from which operational data can be readily obtained, not least those relevant to the specific meteorological conditions which may be experienced in the Irish Sea. The Report refers to Wood Thilsted's typical best practice approach being used, but all consultants or competent model users would argue their modelling approach accords with their own best practice, despite the range of different predictions which may be expected for the same scenario assessed. The Report acknowledges this difficulty in section 5, where it states that ' . . *No specific sensitivity*

assessment of the available range of wake models has been undertaken . . .'. The Applicant's view is that the results of any alternative modelling approach may substantially differ from those presented in the Report, so the output values in the Report must be viewed in that context of significant uncertainty.

- The Report states that the WindFarmer: Analyst Eddy Viscosity with large wind farm correction model has been used to estimate the wake effects in the modelled scenarios. It is known that the model outputs are entirely sensitive to the settings used for this modelling. These settings are neither provided nor referenced in the Report, so it is not possible to scrutinise or reproduce the modelling that has been performed.
- There is a more general lack of information on some of the assumptions and inputs that mean another party (Mona, or any other) is not able to repeat the assessment in order to check, verify, or refute the findings. The Applicant would draw specific attention to the statement made in section 2.2.1 that ' . . *the characteristics and performance data of the turbines are presented in Appendix B. It should be noted that the characteristics and performance data of the neighbouring operational wind farms [the Ørsted IPs projects] are redacted for confidentiality reasons'*. This information, in particular the Ørsted IPs turbine power curves for each of its operational projects, are fundamental to any attempt to model or understand potential impacts on those projects.
- The Report attempts to present ' . . .*the comparative loss in energy for Ørsted assets due to wakes caused by the addition of new wind farms, and not estimating the absolute values for energy production and wakes'*. This therefore means there is no inclusion of impacts or losses from other sources on the Ørsted IPs, including downtime from their operations and maintenance activities and grid curtailments. This presents a significant limitation in understanding the results of the Report in a real-world setting, where numerous factors other than wind climate will affect the energy output of a project.
- The Applicant would query why Awel y Mor has not been included in the Baseline scenario, or as a first additional scenario, as it is an already consented project, in comparison to Mona, Morgan Generation Assets and Morecambe Generation Assets. The Applicant would also note that there is an inconsistent approach taken to inclusion of other projects in the Report. In section 1.1 it is noted that '. . . *the Mooir Vannin wind farm is excluded from the assessment since it hasn't obtained consent at the time of writing.'* On that basis Mona, Morgan and Morecambe would be excluded from the assessment. The Applicant would note that Mooir Vannin is being developed by Ørsted, and that the *'. . .likely . . . additional impact . . .* ' it would have on the results of the assessment are not quantified or presented.

1.1.3 Model set-up, validation and assumptions in the Report

1.1.3.1 The Applicant has the following observations regarding the model set-up and assumptions used:

- In section 1.2 of the Report there is reference to the Eddy Viscosity model used in the assessment being validated by its developers, DNV, in 2019. This validation exercise only assessed cases of wind farms in isolation and so is not relevant for cases of wind farms interacting with one another over large distances, as for the scenarios modelled in the Report. The Applicant is also aware that the settings recommended for use of the model by DNV are known to have changed in 2022, with significant consequence on the predictions made by this model, making this 2019 validation study irrelevant. The Applicant does not recognise that the Eddy Viscosity approach used in the study can be considered to be 'validated' as stated in the Report, particularly for the case of modelling wake impacts over large distances.
- In section 2.2.2 of the Report it is noted that project details for the future wind farms (Mona, Morgan and Morecambe) have been taken from project submissions on the respective Planning Inspectorate portal pages. The project boundary used in the Report for Morgan Offshore Wind Project: Generation Assets is not the Morgan Generation Assets DCO application order limits, but the boundary Morgan Offshore Wind Limited consulted on in its section 42 consultation (using their Preliminary Environmental Information Report (PEIR)). That PEIR array area is approximately 13% larger, and is 0.6 km closer to the 'Walney cluster' of Ørsted IP projects, than the array area presented in the Morgan Generation Assets DCO application. This will result in the assessment overestimating the outcomes for both the Morgan alone and the cumulative scenarios. The Applicant is unable to say what the level of effect of that error would be, other than to highlight it is likely to have increased the level of effects presented.
- The Report has made assumptions on the turbine parameters for Mona (as well as the other planned projects modelled) that do not align with the Maximum Design Scenario (MDS) for Mona (or Morgan Generation Assets or Morecambe Offshore Windfarm: Generation Assets). The Report states that a nominal 22.6 MW turbine with a 276 m rotor diameter and a 170 m (above Mean Sea Level (MSL)) hub height has been used for Mona. The Applicant notes that the Mona MDS is a turbine with a 320 m rotor diameter, with a maximum tip height of 364 m (above lowest astronomical tide (LAT)), which would result in a hub height of 204 m above LAT (or c. 200 m above MSL). The Applicant would note that in section 6 (6) the Report concludes that based on the sensitivity tests undertaken in the Report ' . . *additional wakes losses are reduced when using the larger turbine.*' The Applicant would therefore highlight that in not using Mona's MDS turbine the assessment is likely to have overestimated the effects on the Ørsted IPs projects.
- Section 3.1 of the Report sets out assumptions on the wind climate used for the assessment. The Applicant notes that Wood Thilsted did not have access to information that would allow them to validate the long-term corrected time series of wind data that was provided by the Ørsted IPs. Whilst they did undertake some cross comparison of the data set with the Shell Flats met-mast, the Applicant would note that there is a degree of uncertainty in the validity of the inputted wind climate information. This has the potential to affect not just the overall value of effects predicted by the model, but the distribution of effects, where assumptions on the distribution

of wind direction will influence the modelled effects on individual Ørsted IPs projects, as they lie in a range of directions from Mona.

- Model set-up parameters are presented in the Report, but some key parameters are not stated. For instance, in section 5 of the Report it is noted that a large wind farm correction model has been applied in the Windfarmer: Analyst software, the predictions from which are known to be entirely dependent on a number of key settings which are not provided. In addition, the Blockage Effect Estimator Tool (BEET) has been used to calculate blockage effects. The Applicant is aware that there are different settings for this tool, but it is not disclosed which has been used.

1.1.4 Conclusions and outcomes in the Report

1.1.4.1 The Applicant has the following observations to make regarding the conclusions and outcomes of the Report:

- Section 1.2 notes that '. . . *The full recovery behind a single turbine usually requires distances such as 10-12 turbine rotor diameters. However, wake effects from entire wind farms have been shown to persist for much greater distances > 30km and potentially up to 100km downstream, potentially affecting wind farms located further away*.' The Applicant would reiterate that it does not dispute that the fact that wake effects models and some studies using measured data show that there may be a measurable impact on a wind farm > 30 km away. However, the Applicant would also reiterate that those theoretical effects are only one of a number of influences on an existing project's energy yield, and those effects are likely to be insignificant in comparison to some of those other influences, such as annual variability in wind direction and strength and wake effects within and between adjoining wind farms.
- Section 6 of the Report states that along with impacts on the operational project's' generation *'. . . increased turbulence levels due to the added wake may increase the fatigue / structural loading and also may cause additional downtime for the turbines, where electricity production is halted*.' The Report references IEC 61400-1 Wind turbines – Part 1: Design requirements, Edition 4, 2019, which sets out that beyond a distance of 10 rotor diameters (which for Mona's MDS would be 3.2 km) fatigue effects arenot considered relevant. The Applicant is not aware of any published studies that demonstrate any relevant increase in fatigue effects on turbines at distances greater than 3.2 km..

  The Report relates outcomes of the assessment to a recent study by DNV and RWE which assesses the prediction of wake losses at two operational projects – Amrumbank West and Triton Knoll – from neighbouring wind farms at various separation distances, using various engineering and numerical wake models. However, there are issues of relevance and accuracy in this comparison. To add context to the prediction of wake losses on the Ørsted IPs projects, the Report draws out values of -3.0% and -3.6% from the DNV/RWE study, predictions made by the Windfarmer: Analyst models used in the Ørsted IPs projects assessment. This is an incorrect comparison as the DNV/RWE study intentionally uses synthetic wind conditions, an assumption that they purposefully state '. . . *will exaggerate the magnitude of the cluster effect. Resulting losses are not the true losses [at the two projects]*'. The DNV/RWE study therefore provides

no assurance that the impacts on the Ørsted IPs projects in the assessment is in any way appropriate. Furthermore, the Report does not disclose that these predicted values are part of a wide range of predicted losses from the various models in the DNV/RWE study. For instance, the value of -3.0% for Triton Knoll is in a range of -1.8% to -3.7% from the models applied, with a sophisticated numerical model from RWE providing the lower estimate in this range, suggesting that wake effects could feasibly be overpredicted by 40% in a relative sense by the Windfarmer: Analyst approach used for the Ørsted IPs projects assessment. The range of estimates from the models reinforces the significant level of uncertainty in the outcomes from the assessment, supporting the Applicant's position that an accurate, robust assessment of the wake impacts on the Ørsted IPs projects cannot be undertaken.