SHEPHERD+WEDDERBURN

RESPONSE TO EXQ1 ON BEHALF OF

(1) BARROW OFFSHORE WIND LIMITED (REF: 20049595) (2) BURBO EXTENSION LTD (REF: 20049590) (3) WALNEY EXTENSION LIMITED (REF: 20048542) (4) MORECAMBE WIND LIMITED (REF: 20049596) (5) WALNEY (UK) OFFSHORE WINDFARMS LIMITED (REF: 20049592) (6) ØRSTED BURBO (UK) LIMITED (REF: 20049589) (THE "ØRSTED IPs")

IN CONNECTION WITH THE Application by Morgan Offshore Wind Limited for an Order Granting Development Consent for the Morgan Offshore Wind Farm

Introduction

1.1 We represent six owners[1] of operational offshore windfarms in the East Irish Sea, who we refer to together as the "**Ørsted IPs**" in respect of the application by Morgan Offshore Wind Farm Limited (the "**Applicant**") for an Order under the Planning Act 2008 (the "**Act**") granting Development Consent for the Morgan Offshore Wind Farm (the **"Project**").

1.2 This document provides some brief commentary on articles provided by the Ørsted IPs in response to question INF1.4 of the written questions of the examining authority [PD-004] ("**ExQ1**"), in accordance with Deadline 3 of the examination timetable.

1.3 The Ørsted IPs' responses to ExQ1 are set out in the table overleaf. The Ørsted IPs have responded to the following questions, which have been directed towards them:

1.3.1 MO1.5;

1.3.2 INF1.4; and

1.3.3 INF1.6.

1.4 Please note that parts of question INF1.4 are dealt with in separate documents, submitted alongside this submission. Those documents are a suite of articles and other evidence demonstrating that wake loss occurs at separation distances over 7.5km, and an explanatory memorandum.

1.5 We also note the examining authority's request at INF1.7 of ExQ1. To avoid repetition going forward, where the Ørsted IPs wish to raise the same matters, a single submission on behalf of all the Ørsted IPs will be provided to the case manager via email.

Shepherd & Wedderburn LLP

12.11.2024

[1] As set out relevant representations RR-005, RR-007, RR-023, RR-032, RR-043, RR-044.

Q. ref	Question	Response
MO 1.15	**Ørsted IPs Environmental Concerns** The Ørsted IPs refer to environmental concerns which relate to ornithology and the CEA, questioning the robustness of the assessments [PD1-024, REP1-060, REP1-061, REP1-062, REP1-063, REP1-064 and REP1-066]. The responses state that Natural England have raised similar concerns and that it will be best placed to further address the issues raised. Can the Ørsted IPs clarify whether they will be making further submissions regarding ornithology which may specifically related to the OWFs which it operates, or if they are content to defer the matter to Natural England.	The Ørsted IPs consider that Natural England is best placed address the issues they have raised. Therefore, the Ørsted IPs general approach will be to defer to Natural England. However, if particular information arises which the Ørsted IPs consider it would be helpful to provide their own response to, they may choose to do so.
INF 1.4	**Potential wake effects 2** Further to the responses submitted by the Ørsted IPs [PD1-024, REP1-060, REP1-061, REP1-062, REP1-063, REP1-064, REP1-066] and the not agreed matter in the SoCG [REP2- 027], the Ørsted IPs are asked to submit to the Examination any available evidence and data that you wish to rely on to support your contention of potential for loss of yield due to wake effects, including evidence base on their existing portfolio of OWFs, and answer the following:	The Ørsted IPs have separately submitted a number of articles and an explanatory memorandum which outline the academic basis for wake loss at wind farm separation distances of well beyond 7.5km. The Ørsted IPs also note that preliminary results of modelling they have commissioned indicates that the Project-alone impact on their developments of up to 3.5% Annual Energy Production ("**AEP**"), and cumulative effects (including effects from the proposed Mona and Morecambe developments) being up to 5.3%. The Ørsted IPs maintain that it is the Applicant's responsibility to undertake an assessment of wake effects, and that they are best placed to do this.
	i) Agreement that Table 9.8 of [APP-027] accurately reflects the approximate distances between the proposed Morgan array area and the operational wind farms that you represent.	These distances between the Project array area and the Ørsted IPs developments are displayed on the map provided at **Appendix 1** of this document. These are approximately the same as those listed in Table 9.8 of [APP-027].
	ii) Provide a plan/map which marks on the distances from each of Ørsted IP's OWFs to the Morgan order limits.	A map displaying these distances is provided at **Appendix 1** of this document**.**

	iii)	Noting that the distance and orientation/wind direction of each of the Ørsted IP's OWFs varies, do the Ørsted IPs have concerns about all of the operational projects that you represent, or would effects be more pronounced for particular operational projects.	The degree of wake impact experienced at each of the Ørsted IPs' developments depends on a range of factors including location relative to wind resource (which can be illustrated by the wind rose), distance between sites, the wind regime on the site, as well as the size, number and density of the turbines. Preliminary modelling commissioned by the Ørsted IPs reflects these factors, and indicates there will be an impact at all of the developments (of up to 3.5% from the Project alone). Therefore, the Ørsted IPs are concerned about the impacts at all of their developments. However, due to the proximity and nature of the wind resource (as illustrated by the wind rose for the Walney Extension Windfarm provided at **Appendix 1**) the Ørsted IPs developments immediately to the North East of the Project will experience the most significant impacts, namely the Walney Extension and West of Duddon Sands Windfarms.
	iv)	Are you able to specify if there is a distance at which wake effects are substantially reduced, and the factors which affect loss of yield?	Wake impacts depend on more than the distance between the assets alone. Other important factors include nature of the wind resource (as illustrated by the wind rose and wind speed distribution), turbine characteristics and atmospheric conditions. A brief description of each factor is provided below. The Ørsted IPs are able to provide additional information regarding these factors, if that would be helpful: - **turbine characteristics** – the larger and denser the turbines in the wind farm causing the wake, the higher the wake impact on neighbouring wind farms; - **wind rose** – illustrates how often the wind blows from each direction and the wind speed. It predicts whether the wind direction which causes a wake from one asset on another is a common occurrence. **Appendix 1** includes a wind rose alongside a map of the East Irish Sea. This demonstrates that prevailing winds originate from the South-West direction; - **wind speed distribution** – how often different wind speeds occur. This is important because the turbine response and hence the strength of the wake depends on the incoming wind speed;

		- **atmospheric conditions** - such as air density, ambient turbulence and atmospheric stability. These are important factors to consider as they affect the duration of the wake. Turbulence describes frequent wind speed changes due to obstacles in the flow or due to air movements from thermal effects. Wakes are dissipated faster in high turbulence environments where there is more mixing between the slow-moving wake and fast moving un-waked wind. Atmospheric stability describes the thermal stratification whereby layers of air with different temperature and density characteristics sit on top of each other. For unstable atmospheres warm air sits at the surface and rises resulting in more turbulent mixing and hence reduced wake duration. Stable atmospheres describe the opposite; cooler air at the surface is prevented from rising by warmer air above, reducing turbulence and increasing wake duration. The offshore environment is both low turbulence due to the absence of obstacles, and frequently a stable atmosphere due to the cooling effects of the sea on the air above, hence causing wakes to propagate much further relative to, say, onshore wind farms. There is no specific distance where wakes stop having an impact – as mentioned above it depends on many factors and it is hence very typical in the industry for a wake assessment to be undertaken. The Ørsted IPs have also provided a range of academic evidence alongside this document, which demonstrate wakes can extend up to 90km downstream. Furthermore, based on information gathered across Ørsted A/S's (a parent company of the Ørsted IPs) extensive range of operational assets, wake impacts are clearly observable beyond 50 km. Observations of the power produced by existing wind turbines both before and after a neighbouring wind farm has been installed clearly demonstrate the impacts. These "natural experiments" occur with increasing frequency as the number of offshore wind farms that are installed globally increases. As the owner of the world's largest offshore wind portfolio, Ørsted A/S is very well placed to use its own operational data to observe the wake impacts of neighbouring wind farms.

		In a presentation delivered at the Wind Europe Technology Workshop 2023, Ørsted's Nicolai Nygaard shared some of this evidence. The presentation (which has been provided in the Ørsted IPs portfolio of academic evidence) is referenced in the Frazer-Nash Consulting Study referred to by the Applicant. The presentation uses operational data from 37 offshore wind farm pairs located in Northern Europe to demonstrate the neighbouring wake effect through the reduction of power generated by front row turbines. The paper demonstrates that when a wind farm is in the wake of a neighbour at a distance of 30 km you can expect a power reduction of just under 10%, whereas at 50km the reduction is still about 5% of the available power.
	v) The likelihood of loss due to both direct and indirect effects.	Preliminary modelling suggests the Project will have a direct impact on the Ørsted IPs' developments by reducing AEP by up to 3.5% on a Project-alone basis and by up to 5.3% on a cumulative basis (including the proposed Mona and Morecambe Offshore Windfarms). Additionally, the Ørsted IPs consider there will be losses as a result of indirect effects which should be taken into account, including: - Increased wind turbulence resulting from the Project could accelerate the deterioration of the turbines & foundations at the Ørsted IPs developments faster than expected thus reducing the developments' operational duration; - the Ørsted IPs' developments are expected to continue operation for a minimum period of 24-years. The Ørsted IPs do not consider that operating assets beyond this period will require additional consents. Therefore, the Ørsted IPs may decide to continue to operate the developments beyond this initial 24-year period. This will primarily be subject to maintaining foundation integrity and a profitable business case, both of which will be impacted by the Project. These impacts are of a level which is likely to impact long term decisions on the future of the assets.

	vi)	Comments on any other matters which form the basis for the Crown Estate's stipulation of a 7.5km separation distance between OWF arrays.	Based on publicly available documentation regarding the Crown Estate's round 4 bidding process, it is not clear what factors resulted in the 7.5km separation distance stipulation. We note that the 7.5km separation distance was set out in the Crown Estate's Round 4 Leasing Information Memorandum dated September 2019, which has no reference to wake effect. The Frazer-Nash study referred to by the Applicant is dated 5 October 2023. Therefore, the 7.5km distance was not based on outcomes of this study. The Ørsted IPs cannot speculate as to the factor or factors which resulted in the stipulation of the 7.5km separation distance. The 7.5km separation distance is solely linked to the agreement for lease process and has no bearing on the subsequent and separate DCO consenting process. We note that Agreement for Lease Areas are not fixed at the outset but rather are tested through the consenting process.
	vii)	Whether lack of prescription in EIA regulations or precedent for wake assessment are obstacles to making estimation or quantification of likely effects.	First, the Ørsted IPs reiterate their position that they consider the need for an assessment of the wake effects of the Project is grounded in the NPS-EN3. Primarily, this requirement is created by the following provisions: • paragraph 2.8.197 requires that, where a potential offshore wind farm is proposed "*close to existing operational infrastructure or has the potential to affect activities for which a licence has been issued by government"* the applicant should assess the potential effects on that development; and • paragraphs 2.8.344-2.8.345, which relate to SoS decision making, direct that where a project potentially affects other offshore infrastructure or activity, applicants should work with the relevant sector to minimise negative impacts, and that the SoS should be satisfied that "*the site selection and site design of a proposed offshore wind farm and offshore transmission has been made with a view to avoiding or minimising disruption or economic loss… to other offshore industries"* Therefore, an assessment is required whether the EIA regulations make particular provision for one. However, the Ørsted IPs consider that such an assessment does fall within the scope of the EIA Regulations. Regulation 5(2) of the EIA Regulations sets out the factors for which significant effects should be assessed. These factors

		include 'climate'. Effects on climate are further elaborated on in under Schedule 4 (Information for inclusion in Environmental Statements), which relevantly provides that "*the impact of the project on climate (for example the nature and magnitude of greenhouse gas emissions)"* should be assessed. The Applicant has carried out an assessment of the Project's impacts in respect of climate change in its Environmental Statement (F2.12 Environmental Statement - Volume 2, Chapter 12 Climate change) [APP-016]. This assessment includes a net assessment of the GHG emissions arising from the Project, and concludes the Project will have a significant benefit in EIA terms, as a result of avoided emissions. While the Ørsted IPs do not dispute that the Project will result in avoided emissions, they consider that the assessment contains inaccuracies, in that it does not account for the loss of renewable generation at their developments, arising from the Project. More generally, the Ørsted IPs do not consider lack of singular guidance on carrying out wake assessments prevents a robust assessment from being undertaken. Projects of the scale contemplated by the NSIP consenting process are likely to result in a large variety of potential effects, some of which may not yet be subject to single industry guidance. These effects cannot simply be ignored. The purpose of the highlighted NPS-EN3 policies is to ensure that the effects of a project on pre-existing/authorised infrastructure are understood and addressed. Applicants for developments of this significance should take a dynamic approach and be prepared to respond to the potential for such effects. As directed by the NPS-EN3, applicants should be working with the relevant sector with an aim of resolving issues. Further, we note there is a significant body of research on wake effects between offshore windfarms (as evidenced by the research submitted by the Ørsted IPs alongside this submission). Specialist consultants who work with the offshore wind industry have developed software and models to assist the industry in understanding energy yield and wake effects. As with other modelling, assumptions require to be made in carrying out such assessments. In that regard, there is the potential to utilise both publicly available and private information to facilitate the modelling of effect.

		As we have previously submitted, the Applicant is best placed to provide information regarding site layout and information about existing schemes is in the public domain. There are also ways confidential information can be provided which assists in improving the accuracy and robustness of the assessment. This is standard practice in the offshore wind industry and there is no reason why this information should be withheld. Therefore, wake loss is an effect which, practically speaking, can be accurately and robustly assessed. We note also that the NPS-EN3 directs that applicants engage with interested parties in the potentially affected offshore sectors early with an aim to resolve as many issues as possible before an application is submitted.[2] Regrettably, the Applicant has not taken this approach in respect of engagement with the Ørsted IPs. Additionally, we note that there is precedent for this issue being considered in the Awel y Mor DCO application. As the panel will be aware, the examining authority and Secretary of State ("**SoS**") in that case considered that the NPS-EN3 policies required such an assessment to be undertaken. As a result, a DCO requirement was imposed which required a wake loss assessment to be undertaken before the construction of any turbines. Evidently, the decision makers in that case were not deterred by a lack of prescriptive guidance on this matter. In fact, the examining authority indicated these assessments were likely to become increasingly common: "…*it is likely such circumstances* [wake loss disputes] *may become more common with the increase in offshore wind development, it is important to fully understand the economic effects on existing offshore wind farms".*[3]
	viii) What level of information might reasonably be considered as an 'assessment' having been carried out in accordance with NPS EN-3 paragraphs 2.8.197 and 2.8.198].	These provisions of NPS EN-3 are framed in relatively broad terms. However, should enable the SoS to carry out decision making in the manner envisaged by paragraphs 2.8.342-2.8.348. In particular, any assessment should ensure paragraph 2.8.345 can be satisfied: *"the Secretary of State should be satisfied that the site selection and site design of a proposed offshore wind farm and offshore transmission has been made with*

[2] At 2.8.200.

[3] Paragraph 5.14.85 of the examining authority's recommendation report.

		a view to avoiding or minimising disruption or economic loss… to other offshore industries" and ensure the SoS can understand if the circumstances require 2.8.347 to be applied: "*Where a proposed development is likely to affect the future viability or safety of an existing or approved/licensed offshore infrastructure or activity, the Secretary of State should give these adverse effects substantial weight in its decision-making."* It is noted that wake loss assessments are extremely commonplace in the wind industry. Developers will likely carry out thousands of wake loss assessments while developing a project as they are essential to estimate the expected production of a project which feeds into the economic assessment. There are multiple softwares available in the industry, both commercial and open source, which have been validated with operational data. In addition specialist consultants provide wake modelling services, typically to feed into an independent view of the project economics to support financing decisions. A brief overview of the steps typically involved in a wake loss assessment is provided below: - Assessment of the wind climate at the project under consideration. Typically this will be based on a high quality wind measurement campaign on or near the project in question. It will inform the expected long-term distribution of the wind speed, the wind direction and other atmospheric parameters such as the air density, the turbulence intensity and potentially other parameters. Such measurement campaigns exist in the Irish Sea – there are currently 7 publicly available wind datasets available on the Crown Estate Marine Data Exchange which could be used for this study. Additionally, the Project recently announced that it had successfully deployed high-tech wind measurement devices in its lease area. - An assessment of the horizontal extrapolation of the wind speed between the project and the project which is being waked. Typically, this is achieved using weather models, and many commercial and free models exist and are widely used in the industry. This aims to correct for the fact that the wind speed will naturally vary across distances whether waked or not.

		- An assessment of the vertical extrapolation of the wind speed – if the project under consideration and the project being waked use different hub heights then the change in wind speed from one turbine rotor to another must be estimated. Typically, this can be calculated from measurements as is the case in the Irish Sea where wind measurements at multiple heights exist. - Assumptions on the turbine technology and layouts. For the Irish Sea the operational projects represented by the Ørsted IPs are known – the layouts, hub heights and turbine technologies are a matter of public record. For the Project, some assumptions must be made as the turbine type and layout are not currently known, however there are limited suppliers for offshore turbines and hence the models are well known to developers and consultants. - The wake model is a mathematical model of how the wind speed will change when it interacts with a turbine. There are many complexities to this which are captured within the software which is running the model - For a study such as this it is important to establish a baseline – what will the wake situation be if the Project is not built – and then compare it to the scenario where the new development is added. For the Irish sea the baseline can be achieved by calculating the wake on the existing assets, both internal to each asset and for each asset on each other. Then different scenarios can be run by adding a new development and calculating how the wake in the existing project changes – scenarios can be run for Morgan alone and also for cumulative impacts if Morgan is added with other projects such as Mona and Morecambe. In order for the SoS to have the information required by the NPS-EN3 to make a decision on the Project, the Ørsted IPs consider a wake loss assessment which follows the process outlined above (and details the findings of such process) must be provided.

INF 1.6	**Potential wake effects 4** In the event that no wake assessment was undertaken during the Examination, would both the Applicant and the Ørsted IPs comment whether a requirement along the same lines of Requirement 25 of The Awel y Mor Offshore Wind Farm Order 2023 (requiring such an assessment post-consent) would be justified and would meet the relevant legal and policy tests	The NPS EN-3 requires that, where a potential offshore wind farm is proposed close to existing operational offshore infrastructure or has the potential to affect activities for which a licence has been issued by government, the Applicant should undertake an assessment of the potential effects of the proposed development on such existing or permitted infrastructure or activities. Independent literature as well as modelling commissioned by the Ørsted IPs indicate that the Project will have an impact on energy yield at their developments. This is a matter which can and must be properly assessed by the Applicant. We do not consider the effects of the Project can be properly understood and therefore factored into the design process, until such an assessment is undertaken. This effect should properly be assessed before the examining authority makes its recommendation on the Project, such that examining authority and the SoS are in a position to understand the implications and effects of the Project before making their decisions. The Ørsted IPs consider that, if wake effects remain unassessed at the close of the examination, the examining authority will not be in a position to understand the degree of the potential effect and how it has been mitigated nor the extent to which a requirement could provide mitigation for any residual impacts. As such, the SoS would not be in a position to make a decision in accordance with the NPS EN-3. Any requirement should be based on an understanding of the effect that it is seeking to mitigate or offset. In addition, any residual effects post-mitigation should be understood. Any requirement cannot make up for a lack of assessment nor a failure to properly account for relevant information in the decision-making process.

Appendix 1 – map provided in response to ExQ1 INF 1.4