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MORGAN OFFSHORE WIND PROJECT: GENERATION ASSETS

Environmental Statement

Volume 4, Annex 12.2: Climate change risk assessment

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Acronyms

Acronym	Description
BEIS	Department for Business, Energy and Industrial Strategy
CCRA	Climate Change Risk Assessment
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
RCP	Representative Concentration Pathway
RCP8.5	Highest emission scenario for Representative Concentration Pathway
UKCP18	2018 UK Climate Change Projections

Units

Unit	Description
%	Percentage
km^2	Square kilometres
ºC	Degrees Celsius
m/s	Meters per second
M	Meter
MW	Megawatt
Km	Kilometre

1 Climate change risk assessment

1.1 Overview

1.1.1.1 This Climate change risk assessment (CCRA) technical report assesses the potential significant effects of the Morgan Offshore Wind Project: Generation Assets (hereafter referred to as the Morgan Generation Assets) in line with the UK's guidance on climate change risk assessments. This report informs the assessment of climate change impacts reported in Volume 2, Chapter 12: Climate change of the Environmental Statement.

1.2 Project description

1.2.1.1 For the purpose of the CCRA, the Morgan Generation Assets includes all project infrastructure within the project boundary; wind turbine generators (wind turbines), offshore substation platforms, inter-array and inter-connector cables. The project will have a potential operating capacity of up to 1,500 MW.

1.2.1.2 The Morgan Array Area covers 280 km^2 and is located in the east Irish Sea, 37.13 km (20.1 nm) from the northwest coast of England, 22.22 km (12 nm) from the Isle of Man and 58.5 km (31.6 nm) from the North Wales coastline (Anglesey), (when measured from Mean High Water Springs).

1.3 Methodology

1.3.1.1 The scope of this CCRA is defined in accordance with the Climate Change Committee (2021) recommendations. This report considers the climate-related physical risks (as detailed in Table 1.2) to identify the current and anticipated risks facing the Morgan Generation Assets throughout its 35 year project lifetime. This technical report evaluates the processes utilised for managing the risks through four key stages:

1. An assessment of the baseline climate to understand present-day vulnerability and assess current climate-related risks, opportunities and levels of adaptation
2. An assessment of future offshore climate projections, to understand future vulnerability and adaptation for England
3. Identify vulnerability of project components to climate change and undertake an assessment of their likelihood and severity
4. Review potential adaption and mitigation options.

1.4 Policy context

1.4.1 The Paris Agreement

1.4.1.1 The Paris Agreement came into force on 04 November 2016 and has been adopted by 196 parties, including the United Kingdom. The overarching aim of the agreement is to set long term goals to guide nations in substantially reducing global greenhouse gas emissions to limit the global temperature increase to 2ºC, while pursuing efforts to limit the increase to 1.5ºC (UNFCCC, 2015).

1.4.2 Climate Change Act 2008

1.4.2.1 The Climate Change Act 2008 sets a target for the year 2050 for the reduction of targeted greenhouse gas (GHG) emissions, whilst providing for a system of carbon budgeting. The Committee on Climate Change was also established under the Act, alongside the requirement for the UK Government to publish a CCRA every five years to assess the risks for the UK from the current and predicted impacts of climate change.

1.5 Baseline climate

1.5.1 Overview

1.5.1.1 To understand the impact of the Morgan Generation Assets on climate change, the baseline environment must be considered. The Morgan Generation Assets is located in the east Irish Sea and necessitates the consideration of the offshore climate.

1.5.1.2 Baseline offshore climate conditions have been sourced from observational data collated within the UK Offshore Energy Strategic Environmental Assessment (BEIS, 2022) and Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Reporting of the physical science (IPCC, 2021). The time period for the wind data is between 1984 to 2014 with atmospheric temperature and precipitation data from 1999. This aligns with baseline data periods used for the Marine UK Climate Projections 2018 (UKCP18), which use a 1981 to 2000 baseline.

1.5.2 Offshore baseline climate

1.5.2.1 Mean temperatures range from lows of 7°C in January to 14°C in July, with surface air temperatures exceeding sea surface temperatures during the spring and summer months and falling below sea surface temperatures during the autumn and winter months (BEIS, 2022).

1.5.2.2 Precipitation generally falls 18 days per month during the winter, and 10 to 15 days per month during the summer. Rainfall intensity and duration varies greatly from day to day (BEIS, 2022).

1.5.2.3 High wind speeds can be expected at the Morgan Generation Assets due to the lack of obstructions (both man-made and natural) in open water. Wind conditions are generally westerly and south-westerly throughout the year. During the winter, winds occasionally exceed 14 m/s (with 20% probability) in the Irish Sea to the east of the Isle of Man. During the summer the chance of these higher wind speeds drops to 2% chance (BEIS, 2022).

1.5.2.4 Mean sea level is a crucial element of climate change related risks for offshore wind farms – global MSL rose by 0.2 m between 1901 and 2018, and continues to rise (IPCC, 2021).

1.6 Offshore climate projections

1.6.1.1 Probabilistic local climate projections consistent with those referenced above and used to illustrate future possible onshore climate trends are not available for offshore regions. As such, the results of marine climate projections detailed within the UKCP18 Marine Report (Palmer *et al.,* 2018) and interrogated within the UK Climate Risk

Independent Assessment (CCRA3), Chapter 4: Infrastructure (Jaroszweski *et al.,* 2021) have been used to examine future trends for wind speed, wave height and sea levels. The projections are based on Representative Concentration Pathway (RCP) 8.5 (RCP8.5), with data largely available for the end of the 21st century. Whilst this is outside of the initial lifetime of the Morgan Generation Assets, these projections display climate trends that will begin to be felt throughout this century.

1.6.1.2 The RCP scenarios (four scenarios presented in the IPCC fifth Assessment report which are included within the UKCP18 database) describe different climatic futures, all of which are considered possible depending on the volume of GHG emitted. These provide the basis for future assessments of climate change and possible response strategies, thereby giving a low-high range in potential global GHG reduction initiatives and resulting rate of climatic effects over a given time period.

1.6.1.3 It is virtually certain that sea surface temperatures will continue to increase in the 21st century, with global mean sea surface temperatures predicted to increase by approximately 2.9°C by 2100 under RCP8.5. It is anticipated that the north Atlantic, and as such Irish Sea, will warm at a slower rate in comparison to other oceans (IPCC, 2021).

1.6.1.4 The average wave height is predicted to decrease around much of the UK at a factor of about 10% to 20% over the 21st century, with average wave heights in the Irish Sea decreasing by approximately 0.1 m. However, maximum wave heights in the Irish Sea are anticipated to increase, with projections showing a change in elevation of the height of maximum waves of up to 2 m to the end of the century.

1.6.1.5 Given the close relationship between wave heights and wind speeds, average changes in wind speed are predicted to follow similar patterns to those predicted for average wave height, with a reduction in average wind speeds projected for the west and southwest of Ireland. Changes in maximum wind speeds associated with storm surges vary regionally, with changes in the order of +/- 1.5 m/s. However, there is little consensus between models regarding the extent and pattern of such winds in relation to climate change (Palmer *et al.,* 2018). As such, conservatively an increase in maximum wind speed should be anticipated.

1.6.1.6 Global MSL will continue to rise throughout the 21st century, a change that is projected within all future climate change scenarios. Under RCP8.5, the UK can expect to see sea level rise of approximately 1 m by 2100. This change is regionally variable, with a lesser impact anticipated in the north of the UK. The northwest coastline can expect to see a MSL rise of approximately 0.6 m by 2100 (Palmer *et al.,* 2018).

1.7 Climate risk and resilience scoping

1.7.1.1 A combined risk score of five or more when considering the factors in Table 1.1 has been defined as an impact that would be a significant adverse or beneficial effect on the Morgan Generation Assets. An initial screening exercise identified the relevant climate change risks on the Morgan Generation Assets based on information sourced from the UK Climate Independent Assessment (CCRA3) which are presented in Table 1.2. A high-level assessment of such risks has been undertaken, considering the hazard, potential severity of effect on the development and its users, probability of that effect, and level of influence the development design can have on the risk. The severity of effect score considers the potential consequences of the hazard and the sensitivity of the receptor(s) affected. Each element of the risk assessment has been scored on a scale of one to three, representing low, medium or high; the scores are then summed to give a combined risk score.

1.7.1.2 Given the variability in the nature of the potential effects of climate change on the Morgan Generation Assets, receptors have been identified on a risk-specific basis, whereby all receptors relate to the continued safe and effective operation of the Morgan Generation Assets. In line with IEMA (2020) guidance, the vulnerability and susceptibility have been considered in determining the severity of risk.

1.7.1.3 The assessment of effects has considered the design measures (as detailed in Table 12.13 of Volume 2, Chapter 12: Climate change of the Environmental Statement) included within the Morgan Generation Assets in determining the combined risk score. As detailed in paragraph 1.7.1.1 a score of 5 or more after considering all design measures is assessed as a significant effect which is presented in the 'significant effect' column. Should an effect be significant after primary mitigation further mitigation is presented where relevant to reduce the residual effect to negligible and not significant in Environmental Impact Assessment (EIA) terms.

Table 1.1: Severity, probability and influence factor definitions.

Factor	Score definitions
Severity: the magnitude and likely consequences of the impact should it occur.	**1 =** unlikely or low impact: for example, low-cost and easily repaired property damage; small changes in occupiers' behaviour.
	2 = moderate impacts with greater disruption and/or costs.
	3 = severe impact, e.g. risk to individual life or public health, widespread property damage or disruption to business.
Probability: reflects both the range of possibility of climatic parameter changes illustrated in CP18 projections and the probability that the possible changes would cause the impact being considered.	**1 =** unlikely or low probability of impact; impact would occur only at the extremes of possible change illustrated in projections.
	2 = moderate probability of impact, plausible in the central range of possible change illustrated in projections.
	3 = high probability of impact, likely even with the smaller changes illustrated as possible in the projections.
Influence: the degree to which design of the proposed development can affect the severity or probability of impacts.	**1 =** no or minimal potential to influence, outside control of developer, e.g. reliance on national measures or individuals' attitudes/actions; or hypothetical measures would be impracticable.
	2 = moderate potential to influence, e.g. a mixture of design and user behaviour or local and national factors; measures may have higher costs or practicability challenges.
	3 = strong potential to influence through measures that are within the control of the developer and straightforward to implement.

1.7.1.4 Table 1.2 shows the climate change risks to the Morgan Generation Assets that have been identified prior to any mitigation and the risk scores assigned, following the approach set out in Table 1.1. Risks associated particularly to the onshore and offshore elements of the Morgan Generation Assets have been identified as necessary and design measures detailed which accordingly reduce the risk to an acceptable level and mitigate a potential significant effect.

Table 1.2: Risk scores for Morgan Generation Assets.

Risk	Potential Consequences	Design Approach	Severity	Probability	Influence	Total Score	Significant
Increases in average and extreme temperatures, both in winter and summer.	• Heating/overheating of turbine mechanisms may result in failure of electrical equipment and gear boxes • Heating/overheating may inhibit power infrastructure performance and export • Expansion of turbine materials leading to degradation • Operating conditions could be impacted, leading to a shutdown of turbines resulting in decreased electricity generation • Increased loading from ice build-up.	Safety margin within the wind turbine design to be fitted with automatic shutdowns/lockdowns with regards to spinning too fast. OSP may be located outside or within a building. Should it be located within a building, appropriate cooling plant will be designed to account for a range of temperature conditions. These are not likely to be required should the OSP be located externally given the tempersture ratings of equipment and adequate airflow would reduce the risk. Inter-array and interconnector cables would be designed with suitable allowance. Explore the use of wind turbine blade heating systems and hydrophobic coatings on wind turbine blades to avoid damaging ice build-up.	1	1	2	4	Negligible (Not Significant)
Increase in sea surface temperatures and ocean acidification	• Increased temperatures and ocean acidification may lead to accelerated corrosion of submerged structures, including inter-array and interconnector cables.	Application of anti-corrosion protective coatings.	1	1	2	4	Negligible (Not Significant)
Changes to rainfall patterns, leading to increased annual precipitation.	• Increased wear and tear resulting in erosion and degradation of blade surfaces, increasing drag and thereby decreasing energy production.	Regular inspections be carried out to assess wind turbine condition.	1	1	2	4	Negligible (Not Significant)
Increased frequency and intensity of extreme weather i.e. storms	• Increased wear and tear of mechanical systems from high wind speeds • Damage to structures and equipment from fatigue and erosion as a result of the impact force of rain and hail. Results in degradation of blade surfaces, increasing drag and thereby decreasing energy production.	Wind turbines to be fitted with automatic shutdowns/lockdowns with regards to spinning too fast from storms. Employing a flexible operation and maintenance strategy will aid in mitigating this risk. Allowing for flexible scheduling will mean the frequency of maintanence can be scaled by need, accounting for factors such as an increased number of storm events, if necessary. This will enable the minimisation of disruptions through quick and effective identification of issues.	1	1	2	4	Negligible (Not Significant)

Risk	Potential Consequences	Design Approach	Severity	Probability	Influence	Total Score	Significant
Increase in mean sea level and wave height	• Additional loading on turbine structure, resulting in structural stress and additional corrosion.	The wind turbines and OSPs are designed in accordance with the relevant design codes which have sufficient safety factors to account for the most extreme weather events and using site data extrapolated over the expected life-cycle of the Morgan Generation Assets. Regular maintenance of assets will be carried out to identify and remediate any damage.	1	2	1	4	Negligible (Not Significant)
Increased wave height	• Degradation of turbine structures and foundations due to additional loading.	Regular inspection routine. Integrated scour protection.	1	1	2	4	Negligible (Not Significant)

1.7.1.5 When considering the proposed mitigation within the above Table 1.2, the potential risk posed to the Morgan Generation Assets would be negligible and not significant in EIA terms.

1.8 References

Climate Change Committee. (2021). Independent Assessment of Climate Risk. Advice to Government for the UK's third Climate Change Risk Assessment (CCRA3). Available: https://www.theccc.org.uk/wp-content/uploads/2021/07/Independent-Assessment-of-UK-Climate-Risk-Advice-to-Govt-for-CCRA3-CCC.pdf. Accessed December 2023.

Department for Business, Energy & Industrial Strategy (BEIS). (2022). UK Offshore Energy Strategic Environmental Assessment: Appendix 1F: Climate & Meteorology. Available * https://assets.publishing.service.gov.uk/media/623332cd8fa8f504a584cfd1/Appendix_1f_-_Climate___Meteorology.pdf Accessed: December 2023

GOV.UK. (2022). Flood map for planning. Available: https://flood-map-for-planning.service.gov.uk/ Accessed October 2022.

HM Government. (2022). UK Climate Change Risk Assessment 2022. Presented to Parliament pursuant to Section 56 of the Climate Change Act 2008. Available:https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1047003/climate-change-risk-assessment-2022.pdf Accessed December 2023

IPCC. (2021). Climate Change 2021: The Physical Science Basis. Available:https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FullReport.pdf Accessed December 2023

Jaroszweski, D., Wood, R., and Chapman, L. (2021) Infrastructure. In: The Third UK Climate Change Risk Assessment Technical Report. [Betts, R.A., Haward, A.B., Pearson, K.V. (eds)] Prepared for the Climate Change Committee, London

Met Office. (2020). UK Climate Averages. Available:https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcmwbpsb4 Accessed December 2023

Palmer et al. (2018) UKCP18 Marine Report. Available:https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Marine-report.pdf. Accessed December 2023

UKCP UI (2022). PDF/CDF for probabilistic projections (25km) over UK, 1961-2100. Available: https://ukclimateprojections-ui.metoffice.gov.uk/ui/home

Accessed September 2022.

UNFCCC (2015) The Paris Agreement. Available: https://unfccc.int/sites/default/files/resource/parisagreement_publication.pdf Accessed December 2023