



BERWICK BANK WIND FARM OFFSHORE ENVIRONMENTAL IMPACT ASSESSMENT

APPENDIX 27: OUTLINE LIGHTING AND MARKING PLAN

Document Status

Version	Purpose of Document	Authored by	Reviewed by	Approved by	Review Date
FINAL	Final	RPS	RPS	RPS	October

Approval for Issue

Ross Hodson	[Redacted]	10 November 2022
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1. INTRODUCTION

1.1. PURPOSE

1. The Lighting and Marking Plan (LMP) has been prepared by RPS and Berwick Bank Wind Farm Limited (BBWFL), a wholly owned subsidiary of SSE Renewables (SSER) Limited hereafter referred to as 'the Applicant', to support the Offshore Environmental Impact Assessment (EIA) Report for the Berwick Bank Wind Farm offshore infrastructure (hereafter referred to as 'the Proposed Development').
2. The lighting and marking of wind turbines and Offshore Substation Platforms (OSPs)/Offshore converter station platforms will be finalised in consultation with the Northern Lighthouse Board (NLB), Maritime and Coastguard Agency (MCA), Civil Aviation Authority (CAA) and the Ministry of Defence (MoD). The LMP is anticipated to be a licence requirement and therefore will be submitted to MS-LOT for approval.
3. This LMP aims to set out the aviation and navigational lighting and marking requirements for the Proposed Development.

2. PROJECT BACKGROUND AND CONSENT CONDITIONS

2.1. PROJECT BACKGROUND

4. The Proposed Development is an offshore wind farm located in the outer Firth of Forth and Firth of Tay, approximately 37.8 km east of the Scottish Borders coastline (St. Abb's Head) and 47.6 km to the East Lothian coastline (see Figure 2.1).
5. The Proposed Development covers an area of approximately 1,178.1 km² comprising 1,010.2 km² for the Proposed Development array area and 167.9 km² for the Proposed Development export cable corridor. It comprises up to 307 wind turbines, up to ten OSPs/Offshore converter station platforms and up to eight offshore export cables which extend from the Proposed Development array area to the Skateraw Landfall on the East Lothian coast, and a network of inter-array and interconnector cables.
6. All structures shall be lit once installed and shall use temporary lighting until the permanent lighting is in place.

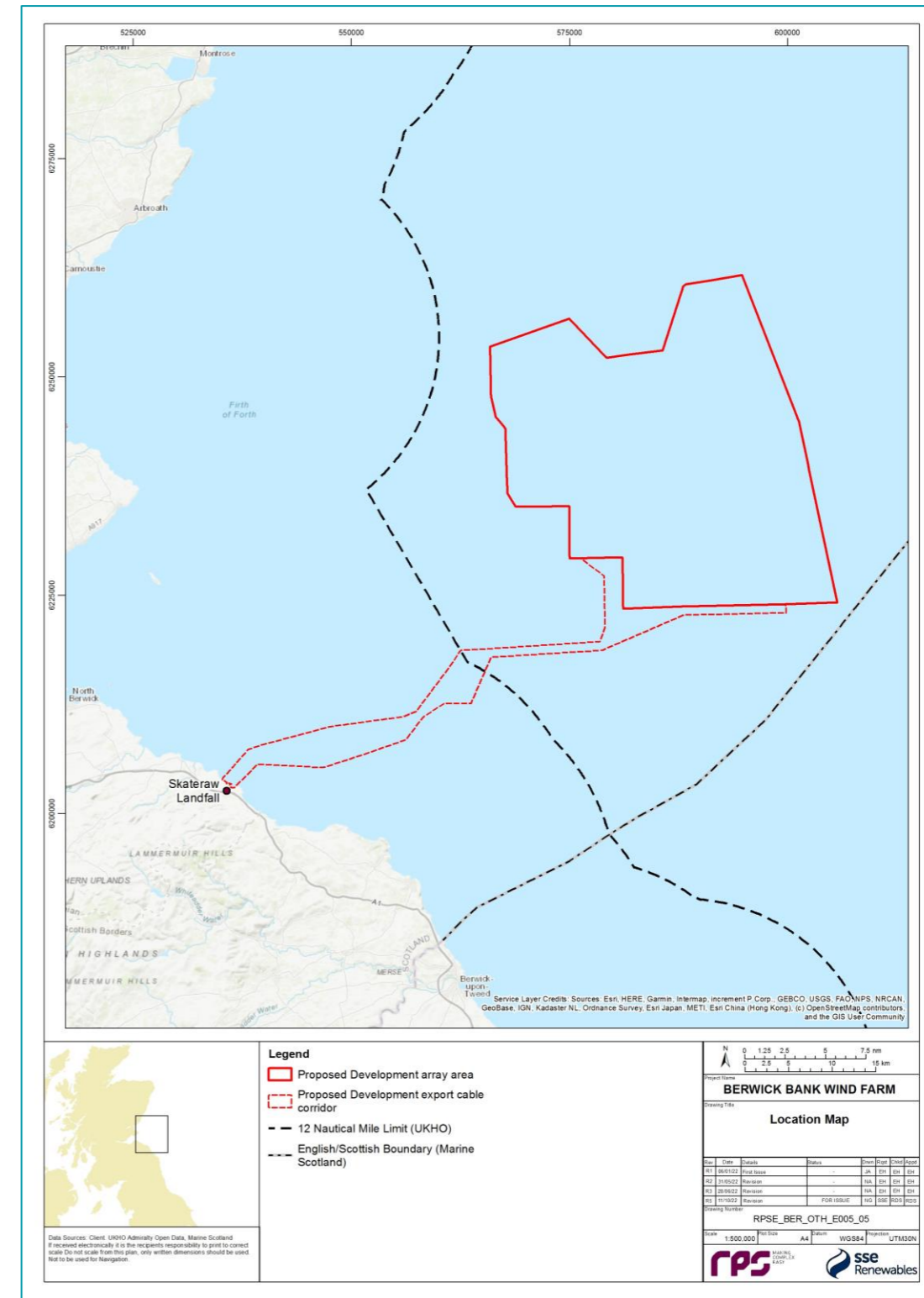


Figure 2.1: Location of the Proposed Development Offshore Infrastructure

2.2. CONSENT CONDITIONS

7. Table 2.1 lists the consents obtained for the Proposed Development relating to lighting and marking. The information in this table will be populated once consents are received.

Table 2.1: Proposed Development Consents

Reference	Consent Condition

8. The Applicant is submitting this lighting and marking plan as part of the Offshore EIA Report submission for consent and to seek approval for the commitments within this LMP prior to the commencement of construction activities. This LMP is a live document and will be further developed in accordance with the requirements of the relevant consent conditions and in consultation with relevant stakeholders.

3. SUMMARY OF DESIGNED IN MEASURES, MITIGATION AND MONITORING INCLUDED IN THE OFFSHORE EIA REPORT

9. This section describes the designed in measures, mitigation and monitoring commitments adopted as part of the Offshore EIA Report in relation to lighting and marking. These are included by receptor and Offshore EIA Report chapter below.

3.2. SHIPPING AND NAVIGATION

10. Volume 2, chapter 13 of the Offshore EIA Report has identified all potential impacts and designed in measures relevant to lighting and marking. These are listed in Table 3.1.

Table 3.1: Designed in Measures Relevant to Shipping and Navigation

Designed in Measures	Justification
Application for Safety Zones up to 500 m around structures where vessels are undertaking construction work during construction and periods of major maintenance and 50 m around partially completed or completed but not yet fully commissioned surface piercing structures during construction.	Protects third-party vessels from project vessels involved in construction and major maintenance activities which may be Restricted in their Ability to Manoeuvre (RAM).
Deployment of a buoyed construction area in agreement with the NLB.	Protects third-party vessels from project vessels involved in construction and major maintenance activities which may be Restricted in their Ability to Manoeuvre (RAM).

Designed in Measures	Justification
Suitable implementation and monitoring of cable protection (via burial, or external protection where adequate burial depth as identified via risk assessment is not feasible) with any damage, destruction or decay of cables notified to the MCA, NLB, Kingfisher and UKHO no later than 24 hours after discovered.	Minimises the risks of underwater allision with cable protection, anchor or fishing gear interaction with subsea cables and interference with magnetic position fixing equipment.
Compliance with MGN 654 and its annexes (in particular SAR annex 5 (MCA, 2021) and completion of a SAR checklist) where applicable.	Ensures the final inter-array cable layout is suitable for SAR operations and that reductions in under keel clearance are acceptable.
Use of guard vessel(s) as required by risk assessment.	Maximises awareness of temporary hazards.
Layout finalised through the DSLP via consultation with the MCA and NLB.	Ensures the final inter-array cable layout is suitable for both surface and air based (for SAR purposes) navigation.
Lighting and marking of the Proposed Development array area in agreement with the NLB and in line with IALA G1162 (IALA, 2021 (b)).	Maximises awareness of the Proposed Development in both day and night conditions including in restricted visibility and assists with SAR operations.
Marine coordination and communication to manage project vessel movements.	Ensures project vessels are suitably managed to minimise the likelihood of involvement in incidents and maximise the ability to assist in the event of a third-party incident.
Creation and implementation of a Marine Pollution Contingency Plan	Minimises the environmental effects in the event of an incident involving pollution.
Appropriate marking of structures (both within the Proposed Development array area and export cable corridor) on UKHO Admiralty Charts.	Maximises awareness of the Proposed Development allowing vessels to passage plan in advance.
Minimum blade clearance of 22 m above MHWS (in line with RYA policy (RYA, 2019)).	Minimises the risk of blade allision particularly for sailing vessels with a mast, noting that the minimum blade clearance will be 37 m above Lowest Astronomical Tide (LAT).
Compliance of all project vessels with international marine regulations as adopted by the Flag State, notably the COLREGs (IMO, 1972/77) and SOLAS (IMO, 1974).	Minimises the risk introduced due to the presence of project vessels.
Promulgation of information for vessel routes, timings and locations, Safety Zones and advisory safe passing distances as required via Kingfisher Bulletins.	Maximises awareness of the Proposed Development allowing vessels to passage plan in advance.

3.3. AVIATION, MILITARY AND COMMUNICATIONS

11. Volume 2, chapter 14 of the Offshore EIA Report identified creation of physical obstacles affecting air traffic as a potential impact. A designed in measure identified within this chapter is the preparation and implementation of an LMP which should set out specific lighting requirements in relation to aviation - to be installed on the wind turbines. Volume 2, chapter 14 of the Offshore EIA Report has identified all potential impacts and designed in measures relevant to lighting and marking. These are listed in Table 3.2.

Table 3.2: Designed in Measures Relevant to Civil and Military Aviation and Radar

Designed in Measures	Justification
Adherence to CAA CAP 393 (2016a) requires approval and implementation of an LMP which will set out specific requirements in terms of aviation lighting to be installed on the wind turbines. The LMP will be prepared in consultation with the CAA, MoD and MCA and will take into account requirements for aviation lighting as specified in Article 223 of the UK ANO, 2016 and changes to ICAO (Annex 14 Volume 2, Chapter 6, paragraph 6.2.4 of the ICAO) promulgated in November 2016.	To comply with CAA CAP 393 (2016a) which sets out the mandatory requirements for the lighting of offshore wind turbines, and to ensure appropriate lighting is in place to facilitate aeronautical safety.
All structures of more than 91.4 m in height will be charted on aeronautical charts and reported to the Defence Geographic Centre (DGC) which maintains the UK's database of tall structures (Digital Vertical Obstruction File) at least ten weeks prior to construction. Furthermore, any temporary obstacles associated with wind farms which are of more than 91.4 m in height (e.g. construction infrastructure such as cranes and/or meteorological masts) are to be alerted to aircrews by means of the Notice to Airmen (NOTAM) system.	An object which is more than 91.4 m in height is considered to have significance for the en route operations of aircraft in UK airspace.
CAA will be informed of the locations, heights and lighting status of the wind turbines, including estimated and actual dates of construction and the maximum heights of any construction equipment to be used, prior to the start of construction, to allow inclusion on aviation charts and in the UK Integrated Aeronautical Information Package (IAIP).	To comply with CAA CAP 764 (2016b) which requires the CAA to be notified of the construction and location of wind turbines.

4. GUIDANCE

- International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) published Recommendation O-139 for the marking of man-made offshore structures, which has subsequently changed into a guidance in 2021 (Document number G1162, IALA, 2021b).
- IALA (2021b) provides guidance and information to stakeholders such as National Authorities, Lighthouse Authorities, Aviation Authorities and other competent Authorities, Aids to Navigation providers, and the Contractors, Developers and Operators involved with the offshore structures. The marking of offshore structures as defined in IALA (2021b) will be considered as a minimum requirement to ensure the safety of navigation in the vicinity of the structures.
- The Marine Guidance Note (MGN) 654 published by the UK MCA provides recommendations and criteria to be taken into account by Offshore Renewable Energy Installations (OREIs) developers seeking formal consent for marine works regarding navigation safety or emergency response preparedness. MGN 654 guidance is to be applied in this LMP as it is the main guidance to be followed (MCA, 2021a).

- The following sections set out the lighting and marking specifications for the Proposed Development during construction, operation and maintenance and decommissioning phases. The recommendations and proposals made in this LMP will be finalised in consultation with NLB, MCA, CAA and MoD.

5. MARINE NAVIGATION SAFETY

- This section provides the minimum lighting and marking requirements for marine navigation safety of OREIs as defined in IALA Recommendation O-139 (IALA, 2021a). It also outlines any proposed site-specific enhancers relevant to lighting, marking, sound signal and radar.
- Marine aids to navigation will be provided throughout the lifetime of the Proposed Development in accordance with the requirements of the NLB.

5.2. LIGHTING REQUIREMENTS TO PROTECT MARINE NAVIGATION SAFETY

- Lighting requirements are provided in this section, in accordance with IALA Recommendation O-139 (IALA, 2021a). These are summarised in Table 5.1.
- When considering offshore wind farms, IALA (2021b) includes the following structures: meteorological mast, wind turbine and offshore transformer/substation.
- IALA (2021b) classifies wind turbines as follows:
 - Significant Peripheral Structure (SPS), which includes the structures on the corners and other structures on the periphery of the wind farm as decided by the competent authority, normally not exceeding a three nm distance;
 - Intermediate Peripheral Structure (IPS), which are located in the periphery of the wind farm, normally not exceeding two nm separation; and
 - All other wind turbines not classified as either SPS or IPS.
- Table 5.1 provides the requirements for the lighting of offshore structures for marine navigation in accordance with IALA (2021b).

Table 5.1: IALA Requirements for Marine Navigation

Offshore Structures	Colour Lighting	Minimum Height (m)	Maximum Height (m)	Visibility Range (nm)	Availability
SPS	Flashing yellow, synchronized	6 m above Highest Astronomical Tide (HAT)	30 m above HAT	5	99%
IPS	Flashing yellow, synchronized	6 m above HAT	30 m above HAT	2	99%
All other wind turbines	None	None	None	None	None
Meteorological Masts and Other Individual Structures	Flashing white	6 m above HAT	30 m above HAT	10	99%

5.2.2. PROPOSED MEASURES

22. The proposed lighting requirements (Table 5.1) have been defined during IALA (2021b) and are subject to agreement with the NLB, IAA and the MCA.
23. MCA (2008) stipulates that “SPS will be marked with lights visible from all directions in the horizontal plane. These lights should be synchronized to display simultaneously an IALA “special mark” characteristic, flashing yellow, with a range of not less than five (5) nautical miles. Aids to navigation on individual structures are placed below the arc of the rotor blades, typically at the top of the yellow section”. Also that “(IPS) on the boundary of a wind farm between SPSs will be marked with flashing yellow lights which are visible from all directions horizontally. The characteristics of these lights areas differ from those displayed on the SPSs, and have a range of not less than two (2) nautical miles. The distance between such IPS or the nearest SPS should not exceed two (2) nautical miles”.
24. The use of working lights, such as down lighting on ladders and access platforms, must not reduce the visibility of marking lights. Furthermore, it is recommended they are switched off when personnel are not working on, or at, the structure (IALA, 2021b).

5.3. MARKING REQUIREMENTS TO PROTECT MARINE NAVIGATION SAFETY

25. IALA (2021b) recommends that wind turbines, OSP/Offshore convertor station platform, meteorological masts and offshore transformer/substation are painted yellow from the level of HAT up to at least 15 m.
26. It is also recommended that each of said structures display identification panels with black letters or numbers 1 m high on a yellow background visible in all directions. These should be visible in daylight and at night, either by using illumination or retro-reflecting material (IALA, 2021b).

5.3.2. RECOMMENDATION

27. All wind turbines foundations to be painted yellow (RAL 1023 or similar) up to the interface level between the foundation and tower.
28. All OSPs/Offshore convertor station platforms to be painted yellow (RAL 1023 or similar) from the level of HAT up to at least 15 m above HAT.
29. All wind turbines and OSPs/Offshore convertor station platforms shall have identification plates consisting of a unique alphanumeric identifier of black letters, 1 m in height. Three identification plates shall be positioned around the working platform so that at least one identification plate is visible from every direction. Each identification plate will be illuminated by a low-intensity light, so it is clearly readable at night.

5.4. SOUND SIGNAL REQUIREMENTS TO PROTECT MARINE NAVIGATION SAFETY

30. IALA (2021b) provides guidance on the marking of offshore structures by using Hazard Warning Signals (HWS), with the following recommended requirements:
 - located not less than 6 m and not more than 30 m above HAT;
 - have a minimum range of 2 nm;
 - have the character Mo (U) 30 s with a minimum duration for the short blast of 0.75 s; and
 - are operated when the meteorological visibility is 2 nm or less. For this, a visibility detector will typically be used.

5.4.2. RECOMMENDATION

31. The Proposed Development shall have sound signals installed on the wind turbines along the perimeter of the Proposed Development array area. The exact number, locations and minimum spacing of sound signals to be used at the Proposed Development will be determined once the wind turbine layout has been finalised prior to construction.

6. AIR NAVIGATION SAFETY

32. This section details the minimum specification for lighting and marking requirements for air navigation safety, in accordance with the requirements of the IAA. Any requirements relating to lighting, marking and radar enhancers are also included below. These requirements will be finalised when a final wind turbine layout is established.

6.2. LIGHTING REQUIREMENTS TO PROTECT AIR NAVIGATION SAFETY

6.2.1. HELIHOIST LIGHTING GUIDANCE

33. The UK requirements as described in CAA (2021) and listed below will be adopted for the Proposed Development:
 - Low intensity green lights to be fitted to the wind turbine nacelle to indicate the status of the wind turbine for hoisting operations to helicopter pilots. The status shall be indicated as follows:
 - Steady green light indicates that the wind turbine blades and nacelle are secure and it is safe to operate.
 - Flashing green signal indicates that the wind turbine is in a state of preparation to accept hoist operations, or if displayed during hoist operations, that parameters are moving out of limits.
 - Extinguished light indicates that it is not safe to conduct helicopter hoist operations.

6.2.2. AVIATION WARNING LIGHTS

34. In the UK, the International Civil Aviation Organization (ICAO) requirements for lighting wind turbines are implemented through CAA publication CAP 764: Policy and Guidelines on Wind Turbines (CAA, 2016b), and CAP 393: Air Navigation Order 2016 (CAA, 2016a).
35. Red, medium intensity aviation warning lights (2000 candela (cd)), with the 2000 cd light conforming to ICAO specification. Aviation lighting will be subject to reduction in lighting intensity, to a minimum of 200 cd, when the visibility in all directions from every wind turbine is more than 5 km.
36. Aviation lighting to be located on top (or as close as possible) of the nacelle for 360 degree visibility and on all peripheral wind turbines. Aviation warning lights would flash simultaneously synchronised morse ‘W’ and be able to be switched on and off by means of twilight switches.
37. Article 223 of Air Navigation Order (CAA, 2016) also requires that ‘the angle of the plane of the beam of peak intensity emitted by the light must be elevated to between 3-4° degrees above the horizontal plane’, but that 20-45% of the peak intensity is to be visible at the horizontal plane and not more than 10% of the peak intensity is visible at 1.5 degrees or more below the horizontal plane. This focusses the 2,000cd lighting in the horizontal plane between 3-4° above horizontal and allows for a reduced intensity of the light at and below the horizontal plane.

38. Search and rescue (SAR) lighting of wind turbines will be combi infra-red (IR)/200 cd steady red aviation hazard lights, individually switchable. These low intensity lights will not be switched during normal operations and only during SAR operations.

6.3. MARKING REQUIREMENTS TO PROTECT AIR NAVIGATION SAFETY

6.3.1. BLADE HOVER REFERENCE MARKING

39. Wind turbine blades need to be marked to provide a Search and Rescue (SAR) pilot with a hover reference point when hovering over a nacelle. There is a requirement for three marking on the blade, on both faces of the blade at 10 m, 20 m and 30 m internal (starting from the hub end of the blade and placed near the trailing edge of the blades).
40. These marks (preferably dots) should be painted in a contrasting shade to the blades overall colour, red (RA 3020) being considered the most suitable option. The diameter of these marks should be at least 600 mm (MCA, 2021b).

6.3.2. BLADE TIPS

41. Wind turbine blade tips should also be marked in a contrasting shade to the wind turbines overall colour, red (RAL 3020) being considered the most suitable option. Approximately 2% of the blade length should be coloured (MCA, 2021b).
42. Where blade tips cannot be painted, an alternative solution will be discussed with the MCA and approval by the MCA sought after before placing them on the blades. Furthermore, all markings must be maintained in operational condition throughout the life of the wind farm (MCA, 2021b).

6.3.3. NACELLE ROOF

43. Wind turbine identification numbers should also be placed on the nacelle roof. These identification numbers should be as large as possible but not less than 1.5 m in height and proportionate width. They should also be recognisable from an aircraft flying 500 ft (152 m) above the highest part of the structure (MCA, 2021b).

6.3.4. HELIHOIST DECK

44. The colour of the helideck should be dark green for the safety zone and a contrasting dark grey for the associated access route. The perimeter of the safety zone should be clearly marked with a white painted line 0.3 m wide. The surface of the winching area (a minimum 4 m² 'clear area') should be painted yellow. The railings around the entire winching area, including the helihoist deck, safety zone and associated access route, should be painted in a conspicuous colour, preferably red (CAA, 2021).

6.4. RADAR ENHANCERS TO PROTECT AIR NAVIGATION SAFETY

45. Radar reflectors, retro-reflecting material, racons and/or Automatic Identification System (AIS) transponders should be considered where the level of traffic and degree of risk requires (IALA, 2021b). This will be discussed and agreed with the CAA once the final wind turbine layout is established.

7. CONSTRUCTION PHASE

7.1. MARINE LIGHTING AND MARKING DURING CONSTRUCTION

46. During the construction phase of the Proposed Development, all structures regardless of construction status will be marked with temporary flashing yellow 2.5 seconds lights (visible through 360°) with a 2 nm range. It is likely that two lights per structure will be used to ensure 360° visibility.
47. Temporary construction buoyage will be in place during the construction phase at the Proposed Development. This will be a combination of cardinal marks and special marks. Specifications of each buoy are to be agreed with NLB.
48. Likewise, the lighting and marking requirements for the transition to the operation phase will be agreed with NLB as the construction programme is developed.

7.2. AVIATION LIGHTING AND MARKING DURING CONSTRUCTION

49. No specific aviation lighting or marking will be implemented during the construction phase. The Applicant will undertake promulgation of information to the relevant aviation authorities and stakeholders prior to, and during construction.
50. The lighting and marking requirements for the transition to the operation phase will be agreed with CAA as the construction programme is developed.

8. WIND FARM LAYOUT NUMBERING

51. Unless otherwise agreed by the MCA, the numbering of the wind turbines at the Proposed Development shall follow the MCA (2021a) guidance. This numbering should be sequential, aligned with 'SAR lanes' and begin with the OREI name designator code, then the row/column numbering starting with 'A' and then the wind turbine number.
52. The identification marking must be discussed with the MCA who will advise on any specific requirements for the Proposed Development. This will be confirmed once layouts have been finalised.

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