



# **Bowdun Offshore Wind Farm, Offshore EIA Report**

Volume 4, Appendix 31: Outline Lighting and  
Marking Plan

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## Contents

<b>1</b>	<b>Introduction.....</b>	<b>1</b>
1.1	Purpose of this Document .....	1
1.2	Other Relevant Consent Plans.....	3
1.3	Background .....	3
<b>2</b>	<b>Guidance .....</b>	<b>4</b>
2.1	Marine Requirements .....	4
2.2	Aviation Requirements.....	4
<b>3</b>	<b>Consultation .....</b>	<b>5</b>
<b>4</b>	<b>Construction Phase .....</b>	<b>6</b>
4.1	Marine .....	6
4.2	Aviation.....	7
<b>5</b>	<b>Operations and Maintenance Phase .....</b>	<b>8</b>
5.1	Marine .....	8
5.3	Aviation.....	10
<b>6</b>	<b>Recommendations .....</b>	<b>12</b>
<b>7</b>	<b>Cumulative Approach .....</b>	<b>13</b>
<b>8</b>	<b>Wind Turbine Layout Numbering .....</b>	<b>14</b>
	<b>References.....</b>	<b>15</b>

## List of Tables

Table 1.1:	Section 36 and Marine Licence Conditions Relevant to this Outline LMP.....	1
Table 1.2:	Other Relevant Consent Plans.....	3
Table 4.1:	Marine Lighting and Marking during Construction.....	6
Table 4.2:	Construction Buoy Locations and Details.....	7
Table 5.1:	Marine Lighting and Marking during O&M.....	9
Table 5.2:	Aviation Lighting and Marking during O&M .....	11

## List of Figures

Figure 1.1:	Proposed Development Site Boundary .....	2
Figure 4.1:	Construction Buoy Locations .....	7
Figure 5.1:	Marine Operational Lighting and Marking Locations.....	9

## Glossary

Defined term	Definition
<b>Additional Mitigation</b>	Also referred to as secondary mitigation which is defined by Institute of Environmental Management and Assessment (IEMA) as: Actions that will require further activity in order to achieve the anticipated outcome. These may be imposed as part of the planning consent, or through inclusion in the EIA Report (sic).
<b>Array Area</b>	The Array Area is the area in which the Offshore Generation Assets will be located.
<b>Bowdun Offshore Wind Farm Limited (BOWFL)</b>	A Special Purpose Vehicle (SPV) (legal entity) for the purpose of developing the Project. BOWFL are the Applicant for the Offshore Application.
<b>Civil Aviation Publication (CAP)</b>	Guidance material and policies for the aviation industry, ensuring the safe conduct of aircraft operations. CAPs include detailed information on various aspects of aviation, such as procedures, standards, best practices, and regulatory requirements. They address both technical and operational matters.
<b>Developer (the)</b>	Bowdun Offshore Wind Farm Limited (BOWFL) (also known as ‘the Applicant’ in pre-application and application documentation)
<b>Environmental Impact Assessment (EIA)</b>	Assessment of the potential likely significant effects of the Proposed Development on the physical, biological, and human environment during construction, Operations and Maintenance (O&M) and decommissioning.
<b>Export Cable Corridor</b>	The area seaward of Mean High Water Springs (MHWS) shaded in blue on Figure 1.1, which connects the Array Area with the Landfall Area within which the Offshore Export Cables will be installed.
<b>Inter-Array Cables (IAC)</b>	Cables which link the Wind Turbines to each other and with the Offshore Substation Platforms (OSPs).
<b>Interconnector Cables</b>	Cables which will connect individual OSPs to each other to provide redundancy against cable failure elsewhere.
<b>Marine Directorate (MD)</b>	The Marine Directorate of the Scottish Government, formerly known as Marine Scotland. The planning and licensing authority for Scotland’s seas and custodian of Scotland’s National Marine Plan (NMP). The Marine Directorate - Licensing and Operations Team (MD-LOT) are specifically responsible for managing Section 36 Consent and Marine Licence Applications seaward of MHWS.
<b>Offshore Environmental Impact Assessment (EIA) Report (hereafter, ‘Offshore EIA Report’)</b>	Document prepared to report the findings of the EIA for the Proposed Development and produced in accordance with the EIA Regulations. Submitted to support the Offshore Application for the Proposed Development.
<b>Offshore Export Cables</b>	Subsea cables used to transmit electricity generated offshore by the Wind Turbines from the OSPs to shore. The Transition Joint Bay (TJB) is the location where the Offshore Export Cables terminate, and the onshore cabling begins.
<b>Offshore Substation Platform(s) (OSPs)</b>	OSPs comprise the support structure, topside and electrical components used for collecting and/or converting electricity generated by the Wind Turbines for transmission by the Offshore Export Cables.

Defined term	Definition
<b>Operation and Maintenance (O&amp;M)</b>	The phase of the Proposed Development following completion of construction. This phase of development includes routine inspections, repairs and replacement of infrastructure and equipment (including interconnector and IACs), scour protection replenishment or replacement, major component replacement, painting and/or other coating works, removal of marine growth, replacement of access ladders and geophysical surveys.
<b>Plan Option Area (POA)</b>	A location identified in the SMP as a preferred area for commercial scale offshore wind development.
<b>Project (the)</b>	An overarching term for the Bowdun Offshore Wind Farm (Bowdun OWF) comprising the offshore and onshore infrastructure required to generate and transmit electricity from the Array Area to the onshore Grid Connection Point (GCP). The Project includes the Offshore Generation Assets, the Offshore Transmission Assets and the Onshore Infrastructure.
<b>Proposed Development</b>	Term used to define the Offshore Infrastructure associated with the Project seaward of MHWS for which consent is being sought. Further details of the parameters are included in Volume 1, Chapter 3: Project Description.
<b>Risk</b>	The likelihood of an adverse event occurring.
<b>Scour Protection</b>	Protective materials installed to avoid sediment being eroded away from the base of the foundations and/or buried subsea cable due to the flow of water.
<b>Sectoral Marine Plan (SMP)</b>	A plan developed by the Scottish Government which provide the strategically planned spatial footprint for offshore wind development in Scotland.
<b>Thistle Wind Partners (TWP)</b>	The Joint Venture (JV) of DEME Concessions, Qair Marine, and Aspiravi International.
<b>Wind Turbines</b>	Structures comprising of a tubular tower, rotor blades, and a nacelle which houses the Wind Turbine generator.

## Acronyms

Acronym	Definition
<b>ACOMS</b>	Airspace Coordination Obstacle Management Service
<b>AtoN</b>	Aids to Navigation
<b>BEIS</b>	Business, Energy and Industrial Strategy
<b>BOWFL</b>	Bowdun Offshore Wind Farm Limited
<b>CAA</b>	Civil Aviation Authority
<b>CAP</b>	Civil Aviation Publication
<b>EIA</b>	Environmental Impact Assessment
<b>ERM</b>	Environmental Resources Management
<b>GCP</b>	Grid Connection Point
<b>HAT</b>	Highest Astronomical Tide
<b>HWS</b>	Hazard Warning Signals
<b>IAC</b>	Inter-Array Cables

Acronym	Definition
<b>IALA</b>	International Organisation for Marine Aids to Navigation (formerly International Association of Marine Aids to Navigation and Lighthouse Authority)
<b>IPS</b>	Intermediate Peripheral Structures
<b>JV</b>	Joint Venture
<b>LAtON</b>	Local Aids to Navigation
<b>LMP</b>	Lighting and Marking Plan
<b>MCA</b>	Maritime and Coastguard Agency
<b>MD-LOT</b>	Marine Directorate - Licencing Operations Team
<b>MGN</b>	Marine Guidance Note
<b>MHWS</b>	Marine High Water Springs
<b>MoD</b>	Ministry of Defence
<b>NLB</b>	Northern Lighthouse Board
<b>NMP</b>	National Marine Plan
<b>NOTAM</b>	Notice to Airmen
<b>O&amp;M</b>	Operation and Maintenance
<b>OREIs</b>	Offshore Renewable Energy Installations
<b>OSP</b>	Offshore Substation Platform
<b>POA</b>	Plan Option Area
<b>SAR</b>	Search and Rescue
<b>SC</b>	Subsea Collector
<b>SMP</b>	Sectoral Marine Plan
<b>SPS</b>	Significant Peripheral Structures
<b>SPV</b>	Special Purpose Vehicle
<b>TJB</b>	Transition Joint Bay
<b>TWP</b>	Thistle Wind Partners

## Table of Units

Units	Definition
<b>km</b>	Kilometre
<b>km<sup>2</sup></b>	Square kilometre

# 1 Introduction

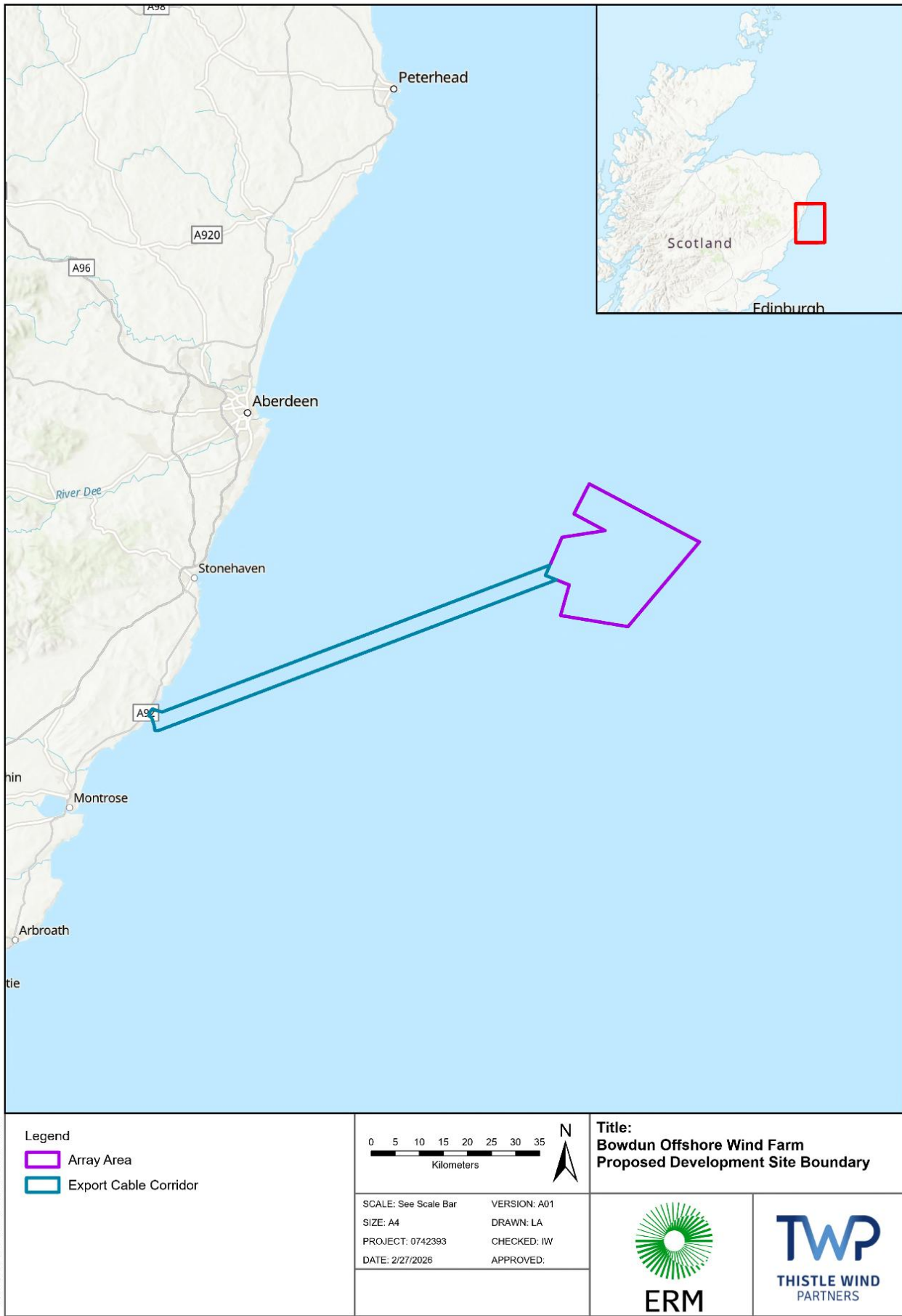
## 1.1 Purpose of this Document

- 1.1.1 This Outline Lighting and Marking Plan (LMP) has been prepared by ERM on behalf of Bowdun Offshore Wind Farm Limited (BOWFL) (the Developer) for the Bowdun Offshore Wind Farm (OWF) Project (hereafter referred to as the Proposed Development). The Proposed Development covers the Option Lease Area that is located in the E3 Plan Option Area (POA) detailed in the Scottish Sectoral Marine Plan (SMP) (Scottish Government, 2020), and the Export Cable Corridor. The Array Area is located 38 km from the Aberdeenshire coast at its closest point, covering an area of 187 km<sup>2</sup> (Figure 1.1). The Proposed Development will comprise of Wind Turbines (fixed foundations), Inter-Array Cables (IACs), Offshore Substation Platforms (OSPs), Interconnector Cables, Offshore Export Cables and any necessary scour/cable protection. The Export Cable Corridor will include a maximum of three High Voltage Alternating Current (HVAC) Offshore Export Cables, each with a length of up to 70 km and will make Landfall at Benholm, Aberdeenshire.
- 1.1.2 The purpose of the Outline LMP is to outline the aviation and navigational lighting and marking of the Proposed Development throughout the construction, and operation and maintenance (O&M) phases to ensure safe navigation of vessels and aircraft in accordance with regulatory requirements and guidance and fulfil the Section 36 and Marine Licence conditions relevant to the Outline LMP. Section 36 and Marine Licence conditions will be detailed in Table 1.1 pre-construction and on finalisation of the LMP, including where the specific requirements are addressed in this document.

**Table 1.1: Section 36 and Marine Licence Conditions Relevant to this Outline LMP**

Condition Reference	Condition	Relevant Section
[to be updated pre-construction]	[to be updated pre-construction]	[to be updated pre-construction]

- 1.1.3 This Outline LMP is a ‘live’ document and as such it will be further developed pre-construction in consultation with regulatory bodies and stakeholders such as the Marine Directorate - Licensing Operations Team (MD-LOT), Northern Lighthouse Board (NLB), Maritime and Coastguard Agency (MCA), Civil Aviation Authority (CAA) and Ministry of Defence (MoD), once the project design has been finalised.
- 1.1.4 The Outline LMP is anticipated to be required through the Section 36 Consent and Marine Licences as a condition and therefore will be submitted to MD-LOT for approval.



**Figure 1.1: Proposed Development Site Boundary**

## 1.2 Other Relevant Consent Plans

- 1.2.1 This document is one of several consent plans which requires approval from MD-LOT regarding the compliance with relevant Section 36 and Marine Licence conditions.
- 1.2.2 Where additional information which is linked to this LMP is provided in a separate document, these have been summarised in Table 1.2 below.

**Table 1.2: Other Relevant Consent Plans**

Relevant Plan	Link to LMP	Relevant Section
[to be updated pre-construction]	[to be updated pre-construction]	[to be updated pre-construction]

## 1.3 Background

- 1.3.1 The main components of the Proposed Development, as shown in Volume 1, Chapter 3: Project Description of the Offshore Environmental Impact Assessment (EIA) Report (hereafter, ‘Offshore EIA Report’) will include:

### **Offshore Generation Assets**

- Up to 67 Wind Turbines (each comprised of three rotor blades, a nacelle housing the generating unit, hub and tower section) and associated supporting structures which will be fixed foundations
- A network of up to 167 km of IACs which will be static cables;
- Up to 36 km of Interconnector Cables; and
- Scour Protection, cable protection and utility crossings.

### **Offshore Transmission Assets**

- Up to three OSPs with fixed foundations and supporting infrastructure including scour protection (as required);
- Up to three Offshore Export Cables totalling approximately 210 km in length; and
- Cable protection and utility crossings where required.

- 1.3.2 A full description of the Proposed Development is provided in Volume 1, Chapter 3: Project Description of the Offshore EIA Report. However, the detailed and final design of the Proposed Development will be determined pre-construction.

## **2 Guidance**

### **2.1 Marine Requirements**

2.1.1 The marine navigation lighting and marking described in this Outline LMP will be consulted on with the relevant stakeholders and will be in line with the following guidance documents:

- International Organisation for Marine Aids to Navigation (formerly International Association of Marine Aids to Navigation and Lighthouse Authority) (IALA) Recommendation R0139 on the Marking of Man-Made Offshore Structures (IALA, 2021a) and Guidance G1162 on the Marking of Man-Made Offshore Structures (IALA, 2021b);
- IALA Recommendation R1001 on The IALA Maritime Buoyage System (IALA, 2023);
- Marine Guidance Note (MGN) 654 Safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response and Annexes (MCA, 2021); and
- Department of Business, Energy and Industrial Strategy (BEIS) Standard Marking Schedule for Offshore Installations (BEIS, 2011).

### **2.2 Aviation Requirements**

2.2.1 The aviation lighting and marking described in this Outline LMP will be consulted on with the relevant stakeholders and will be in line with the following guidance documents:

- CAA Civil Aviation Publication (CAP) 393 Regulations made under powers in the Civil Aviation Act 1982 and the Air Navigation Order 2016 (CAA, 2021);
- CAA CAP 437 – Standards for Offshore Helicopter Landing Areas (CAA, 2023);
- CAA CAP 764 – Policy and Guidelines on Wind Turbines (CAA, 2025);
- MGN 654 Safety of Navigation: OREIs – Guidance on UK Navigational Practice, Safety and Emergency Response and Annexes (MCA, 2021); and
- MoD Obstruction Lighting Guidance (MoD, 2020).

### **3 Consultation**

- 3.1.1 This Outline LMP will be informed by consultation with NLB, MCA and CAA. Details of the consultation that will be undertaken will be described in this section pre-construction and finalisation of the Plan.

## 4 Construction Phase

### 4.1 Marine

4.1.1 During the construction phase of the Proposed Development, it is necessary to implement temporary construction lighting and marking in accordance with industry standards. During the construction phase 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.

#### Construction Marine Requirements

4.1.2 Various guidance documents (Section 2) detail the lighting and marking requirements for each stage of the Proposed Development. Requirements relevant to the construction phase include:

- IALA (2021b) recommends that Wind Turbines, meteorological masts and offshore transformer/substation are painted yellow from the level of Highest Astronomical Tide (HAT) up to at least 15 m; and
- IALA (2021b) also 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.

4.1.3 The construction lighting and marking requirements will be finalised pre-construction on finalisation of the LMP, however the minimum requirements during the construction phase are detailed in Table 4.1.

Table 4.1: Marine Lighting and Marking during Construction

Lighting and Marking Requirement	Relevant Offshore Structure	Details	Relevant Guidance
Temporary construction lighting	[to be updated pre-construction]	[to be updated pre-construction]	BEIS, 2011
Construction buoys	Buoys	[to be updated pre-construction]	IALA R1001
Construction buoyage removal	Buoys	[to be updated pre-construction]	IALA R1001
Transition lighting and marking	[to be updated pre-construction]	[to be updated pre-construction]	[to be updated pre-construction]
Hazard Warning Signals (HWS)	[to be updated pre-construction]	[to be updated pre-construction]	IALA G1162

4.1.4 Details on the construction buoy number and locations are shown in Figure 4.1 and Table 4.2.

*Hold for Figure to be added pre-construction showing construction buoy locations and final array layout]*

**Figure 4.1: Construction Buoy Locations**

**Table 4.2: Construction Buoy Locations and Details**

Buoy	ID	Location		Details
		Latitude (Degrees Decimal Minutes (DDMM.mm))	Longitude (DDDMM.mm)	
[to be updated pre-construction]				

## 4.2 Aviation

4.2.1 There are no aviation lighting and marking requirements anticipated during the construction phase in line with the guidance in Section 2.2.

4.2.2 Relevant information will be shared with aviation stakeholders as required under CAA guidance throughout the construction phase of the Proposed Development. This includes any temporary obstacles of more than 91.4 m in height e.g. construction cranes which will be communicated to the aviation community through the Notice to Airmen (NOTAM) system.

## 5 Operations and Maintenance Phase

### 5.1 Marine

5.1.1 This section of the LMP details the marine O&M lighting and marking to be implemented on any offshore structures.

5.1.2 When considering offshore wind farms, IALA (2021b) includes the following structures: meteorological mast, Wind Turbine and offshore transformer/substation, and classifies offshore wind farm structures 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 3 nm distance;
- Intermediate Peripheral Structure (IPS), which includes selected locations on the periphery of the wind farm, normally not exceeding 2 nm separation; and
- All other Wind Turbines not classified as either SPS or IPS.

#### Operation and Maintenance Marine Requirements

5.1.3 Various guidance documents (Section 2) detail the lighting and marking requirements for each stage of the Proposed Development. Marine requirements relevant to the O&M phase include:

- IALA (2021b) requires SPS to have flashing yellow synchronized lighting between a minimum height of 6 m above HAT and a maximum height of 30 m above HAT at a visible range of 5 nm. IALA (2021b) also states the same requirements for IPS but at a lower visible range of 2 nm; and
- MCA (2021) requires that each of said structures display identification panels with black letters or numbers. ID numbers must be clearly readable by an observer stationed three metres above sea level at a distance of at least 150 m from the turbine. Each ID number plate shall be illuminated by a low intensity light visible from a vessel thus enabling the structure to be detected at a suitable distance to avoid a collision. Lighting for this purpose must be hooded or baffled so as to avoid unnecessary light pollution or confusion with navigation marks (MGN 654 Annex 5).

5.1.4 The operational lighting and marking requirements will be finalised pre-construction and on finalisation of the LMP in consultation with relevant stakeholders and detailed in Table 5.1.

**Table 5.1: Marine Lighting and Marking during O&M**

Lighting and Marking Requirement	Relevant Offshore Structure	Details	Relevant Guidance
Lighting	[to be updated pre-construction]		
Marking	[to be updated pre-construction]		
HWS	[to be updated pre-construction]		IALA G1162
SPS	[to be updated pre-construction]		IALA G1162
Intermediate Peripheral Structures (IPS)	[to be updated pre-construction]		IALA G1162

5.1.5 Details of the marine operational lighting and marking locations are shown in Figure 5.1.

*[Hold for figure to be added pre-construction showing marine operational lighting and marking locations in line with final array layout]*

**Figure 5.1: Marine Operational Lighting and Marking Locations**

#### Failure of Marine Lighting

- 5.1.6 Navigational failures (with the exception of temporary lighting) must be reported to the NLB as per the requirement of the management of Aids to Navigation (AtoN) within UK waters. This will be done through Local Aids to Navigation (LAtoNs) in the event of any failure or loss of availability during both the construction and O&M phases.
- 5.1.7 The LAtoN system is administrated by NLB and supports wind farm operators to maintain a record of AtoN availability and subsequently provide these to NLB.
- 5.1.8 Should there be a significant loss of AtoN which results in a likely significant risk to navigation, consultation with NLB and MCA will be carried out to confirm if there is a need for additional mitigation.

## 5.3 Aviation

5.3.1 This section of the LMP details the aviation O&M lighting and marking to be implemented on any offshore structures.

### Operation & Maintenance Aviation Requirements

5.3.2 Various guidance documents (Section 2) detail the lighting and marking requirements for each stage of the Proposed Development. Aviation requirements relevant to the O&M phase include:

- 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 markings 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) (MCA, 2021) (MGN 654 Annex 5).
- 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, 2021) (MGN 654 Annex 5). Where blade tips cannot be painted, an alternative solution should be discussed and approved with the MCA.
- Wind Turbine identification numbers should also be placed on the nacelle and OSP topside roofs. 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, 2021).
- Should helidecks be installed, 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 m<sup>2</sup> '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, 2023).
- Should heli-hoisting be undertaken as part of normal operations the CAA (2023) requires 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; and.
  - extinguished light indicates that it is not safe to conduct helicopter hoist operations.

5.3.3 The operational lighting and marking requirements will be finalised pre-construction in consultation with relevant stakeholders and detailed in Table 5.2.

**Table 5.2: Aviation Lighting and Marking during O&M**

Lighting and Marking Requirement	Relevant Offshore Structure	Details	Relevant Guidance
Lighting	[to be updated pre-construction]		
Marking	[to be updated pre-construction]		

### Failure of Aviation Lighting

- 5.3.4 Article 222 of the Air Navigation Order 2016 describes that *“in the event of the failure of any lighting which is required by this article to be displayed by night the person in charge must repair or replace the light as soon as reasonably practicable.”*
- 5.3.5 There are some circumstances where an immediate repair or replacement of the light is not possible for example, in unsafe meteorological or sea conditions to transfer personnel and/or where the fault may require a longer time period to diagnose or repair. In these circumstances, a NOTAM should be issued as per the requirements of international standards and recommendations practices. As per the CAA’s Airspace Regulation department the operator of an offshore wind farm is considered the appropriate person to request a NOTAM in relation to the lighting of their wind farm (CAA, 2025).
- 5.3.6 In the event that there is a failure to aviation lighting which cannot be repaired within 36 hours, the Developer will request to issue a NOTAM by informing the CAA through the Airspace Coordination Obstacle Management Service (ACOMS) via the CAA customer portal<sup>1</sup>.
- 5.3.7 Once the fault has been repaired/replaced, the UK Aeronautical Information Services will be notified as soon as possible. If the failure of aviation lighting is anticipated to last more than 14 days, the Developer will consult the CAA to discuss potential issues and the approach going forward (CAA, 2025).

<sup>1</sup> <https://www.caa.co.uk/commercial-industry/airspace/event-and-obstacle-notification/obstacle-notification>

## **6 Recommendations**

- 6.1.1 All Wind Turbines foundations to be painted yellow (RAL 1023 or similar) up to the interface level between the foundation and tower.
- 6.1.2 All OSP foundations to be painted yellow (RAL 1023 or similar) from the level of HAT up to at least 15 m above HAT.
- 6.1.3 All Wind Turbines and OSPs shall have identification plates consisting of a unique alphanumeric identifier of black letters and numbers. Characters shall be at least 1 m in height such that they are clearly readable by an observer stationed 3 m above sea level at a distance of at least 150 m from the turbine
- 6.1.4 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. Lighting will be hooded or baffled so as to avoid unnecessary light pollution or confusion with navigation marks.
- 6.1.5 The Array Area shall have HWS installed on the Wind Turbines along the perimeter of the Array Area, likely on the SPS. The exact number, locations and minimum spacing of sound signals to be used at the Array Area will be determined once the Wind Turbine layout has been finalised prior to construction.

## **7 Cumulative Approach**

- 7.1.1 Where there may be cumulative temporal overlap between the Proposed Development and any other relevant offshore developments, consultation will be held with relevant stakeholders to determine any updates to the Outline LMP that may be required with consideration of the construction and O&M schedules.

## **8 Wind Turbine Layout Numbering**

- 8.1.1 Unless otherwise agreed by the MCA, the numbering of the Wind Turbines shall follow the MCA (2021) 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.
- 8.1.2 The identification marking must be discussed with the MCA who will advise on any specific requirements for the Array Area. This will be confirmed post-consent once layouts have been finalised.

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