Appendix 5-8 Addendum: Updated Lighting and Marking Plan

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

A TETRA TECH COMPANY

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Energy for generations

ORIEL WIND FARM PROJECT

Environmental Impact Assessment Report - Addendum
Appendix 5-8 Addendum: Updated Lighting and Marking Plan

MDR1520C
EIAR – Appendix 5-8
Addendum
A1 C01
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Acronyms

Term	Meaning
AIC	Aeronautical Information Circular
AIS	Automatic Identification System
AMSL	Above Mean Sea Level
ASAM	Aeronautical Services Advisory Memorandum
AtoN	Aids to Navigation
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CIL	Commissioners of Irish Lights
DCCAE	Department of Communications, Climate Action and Environment (renamed DECC since 2019)
DoD	Department of Defence
EIAR	Environmental Impact Assessment Report
HAT	Highest Astronomical Tide
HWM	High Water Mark
IAA	Irish Aviation Authority
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IAIP	Integrated Aeronautical Information Package
ICAO	International Civil Aviation Organization
IRCG	Irish Coast Guard
LAT	Lowest Astronomical Tide
LMP	Lighting and Marking Plan
MCA	Maritime and Coastguard Agency (UK).
MSO	Marine Survey Office
NOTAMs	Notices to Airmen
NRA	Navigation Risk Assessment
OSS	Offshore Substation
OREDP	Offshore Renewable Energy Development Plan
OREI	Offshore Renewable Energy Installation
SAR	Search and Rescue
SPS	Significant Peripheral Structures
UKHO	United Kingdom Hydrographic Office
WGS	World Geodetic System
WTG	Wind Turbine Generator

Units

Unit	Description
cd	Candela
fpm	Flashes per Minute
kHz	Kilohertz
km	Kilometre
kt	Knot (unit of speed equal to nautical mile per hour, approximately 1.15 mph)

Unit	Description
m	Metre
MW	Megawatt
nm	Nautical Mile (1 NM = 1,852 m)

1 INTRODUCTION

A Lighting and Marking Plan (LMP) for the offshore elements of the proposed Oriel Wind Farm Project is included as part of the planning application documents submitted to An Coimisiún Pleanála (ACP (Formerly An Bord Pleanála) in May 2024 (see appendix 5-8 of EIAR volume 2A). This document provides an updated LMP for the Project and supersedes the one provided in appendix 5-8 of the EIAR. The updates have been made to address the following concerns and comments made by the Commissioner of Irish Lights in their statutory consultation submission on the Project (dated 30 July 2024):

- Propose contingency measures in cases of failure of aids to navigation during all phases of the project (addressed in section 4.1.1 and 5.1.3); and
- Address the following technical gaps:
    - Construction buoyage (addressed in section 4.1); and
    - Correct application of IALA standards and contingency planning (addressed in section 4 and section 5.1).

The LMP was also updated to address the following:

- To include a section regarding the Maintenance of Aids to Navigation (AtoNs) (addressed in section 5.1);
- To include Emergency Procedures (including action to be taken on loss of an AtoN, trigger point for guard vessels and notification requirements) (addressed in section 5.1 and section 5.2);
- To restructure the plan into construction/operational & maintenance phases rather than marine/aviation to bring it more in line with similar plans for other offshore wind farm projects; and
- To ensure that all suggested provisions/conditions by the CIL are addressed within the update.

The LMP will be updated following any future consultations on the Project.

1.1 Background

The Oriel Wind Farm Project (hereafter referred to as “the Project”) is a proposed offshore wind farm in the Irish Sea, off the coast of County Louth (approximately 22 km east of Dundalk town centre and 18 km east of Blackrock). Oriel Windfarm Ltd (hereafter referred to as “the Applicant”) is proposing to develop the Project, which will have a maximum export capacity of 375 MW. The offshore infrastructure will consist of 25 wind turbine generators (WTGs), inter-array cabling, an Offshore Substation (OSS) and an offshore cable to the landfall south of Dunany Point.

As described within the Navigation Risk Assessment (NRA) (EIAR volume 2B, appendix 13-1: Navigation Risk Assessment), lighting and marking is key a mitigation to manage the risks to shipping and navigation receptors.

1.2 Scope and objectives of the Lighting and Marking Plan

The overall purpose of this LMP is to set out the maritime lighting and marking scheme that will be implemented for the Project. The key objectives are:

- To ensure the Project is lit and marked in accordance with the requirements of the relevant guidance;
- To ensure the lighting and marking arrangements are appropriately managed;
- To set out the emergency procedures to be enacted should there be a failure of an AtoN;
- To mitigate the risks of navigation around the Project; and

- To ensure key details of the lighting and marking scheme are available to the relevant stakeholders.

The LMP applies to both the construction phase of the Project, including lighting and marking of temporary or part-built fixed structures and the operational and maintenance phase of the Project, including any sound signals or additional associated buoyage as required. Consultation in relation to the appropriate lighting and marking of the Project has been undertaken with the Irish Coastguard (IRCG), Marine Survey Office (MSO), Commissioners of Irish Lights (CIL), Irish Aviation Authority (IAA) and Department of Defence (DoD) and this has informed the development of this LMP (see section 3.2).

1.3 Structure of the document

This LMP is structured as follows:

- Section 2: Overview of the Project;
- Section 3: Guidance and Consultation;
- Section 4: Construction Phase;
- Section 5: Operational and Maintenance Phase;
- Section 6: Decommissioning; and
- Section 7: References.

2 OVERVIEW OF THE PROJECT

The Project will consist of 25 WTGs and one OSS installed on monopile foundations and a series of inter-array cables within an offshore wind farm area of 27.7 km^2. Electricity will be transferred from the OSS to shore through one offshore export cable located in the offshore cable corridor between the offshore wind farm area and the landfall south of Dunany Point. Key project parameters are presented in the sections below, with further details available in volume 2A, chapter 5: Project Description.

2.1 Wind Turbine Generators

The Project will include 25 WTGs with an upper blade tip height of 270 m above Lowest Astronomical Tide (LAT) (see Figure 2-1 and Table 2-1). The lowest point of the rotor sweep for the Project is 27 m above LAT, which is approximately 22 m above High Water Mark (HWM) in this location.

All naming / numbering of the WTGs (see Table 2-1) will be confirmed with the relevant authorities in advance of construction and will be in accordance with national guidance.

2.2 Offshore substation

The Project will include one OSS, with a main structure 40 m in height above LAT, 40 m in length and 30 m in width.

2.3 Foundations

WTG and OSS foundations will comprise monopile foundations with associated scour protection.

2.4 Inter-array cables and offshore export cable

The project design includes for 41 km of inter-array cables installed within the offshore wind farm area, with a minimum burial depth of 0.5 m, and associated cable protection along a maximum of 50% of the route. There will be one offshore export cable of 16 km in length between the OSS and the landfall, with a minimum burial depth of 0.5 m, and associated cable protection along a maximum of 50 % of the route.

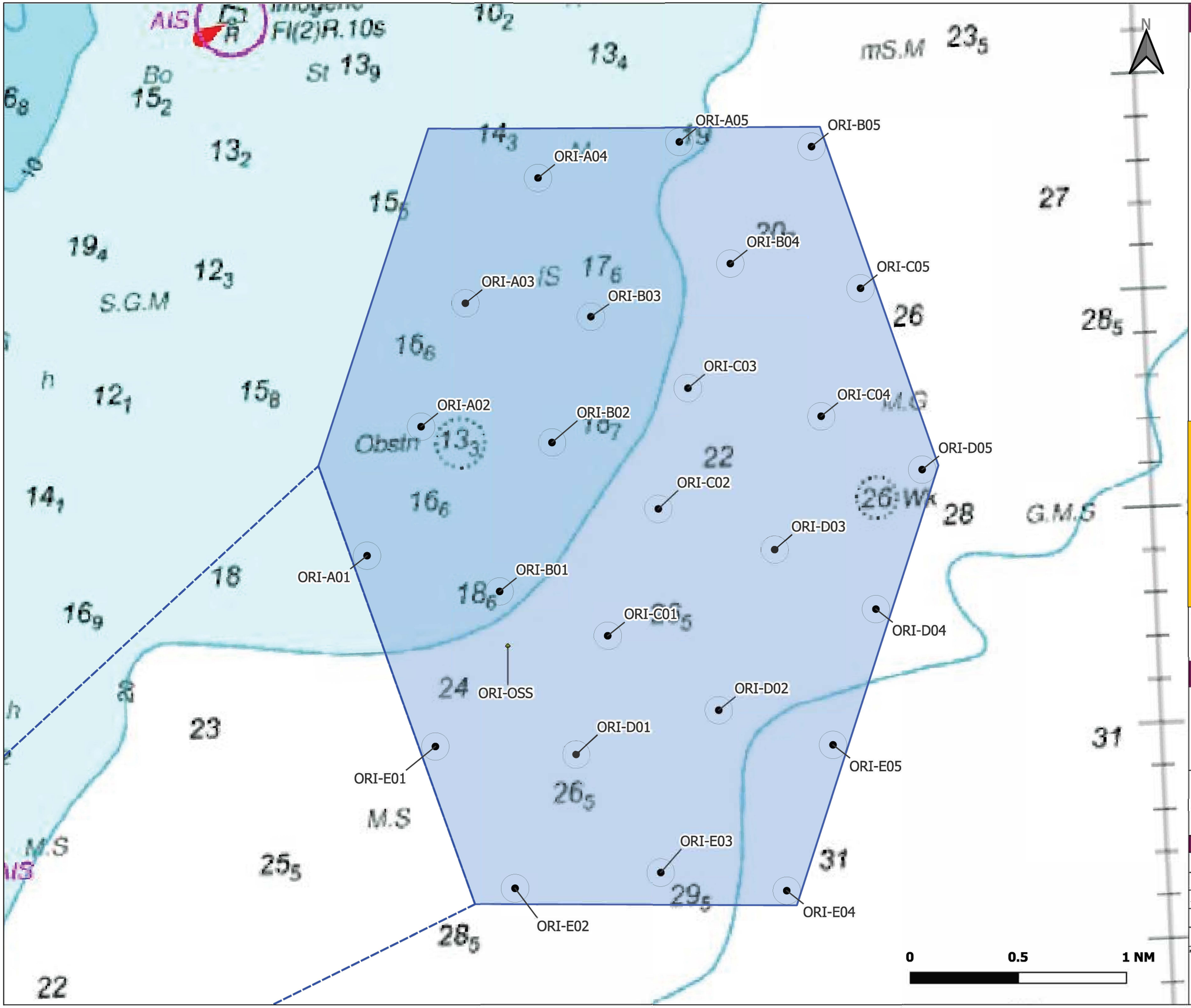
The project design allows for cable protection consisting of rock placement or concrete mattresses 10 m in width and 2 m in height above the seabed within the offshore wind farm area (inter-array cables) and along the offshore cable route.

2.5 Layout

The Project layout as well as the marking, lighting and fog-horn specifications will be designed and constructed in consultation with the IRCG, IAA, DoD and the CIL.

The Project layout will adhere to the following layout principles:

1. All surface offshore infrastructure will be confined within the offshore wind farm area;
2. A minimum spacing of 4 x maximum rotor diameter (i.e. 944 m) will be maintained between the centre points of all WTGs;
3. The layout will meet the requirements of IRCG to facilitate Search and Rescue (SAR) access; and
4. The offshore cable will be located within a defined offshore cable corridor from the southwestern side of the offshore wind farm area to the landfall south of Dunany Point.



Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Wind Turbine Generator
- Offshore Substation

Client: ORIEL WINDFARM, OFFSHORE RENEWABLE ENERGY

Project: **Oriel Windfarm EIAR**

Title

Figure 2-1: Infrastructure Naming

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Issue Details

Drawn:	DP	**Project:**	MDR1520
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Notes

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Table 2-1: Infrastructure naming and coordinates.

Coordinate system	ITM - CRS: 2157		UTM-29N / CRS: 32629		WGS 84 / CRS: 4326	
WTG ID	Easting	Northing	Easting	Northing	Longitude	Latitude
ORI-A01	724655	797868	690292	5977973	-6.10248	53.91517
ORI-A02	725133	798965	690755	5979076	-6.09476	53.91567
ORI-A03	725531	800017	691138	5980134	-6.08827	53.93426
ORI-A04	726167	801082	691759	5981208	-6.07815	53.94367
ORI-A05	727383	801370	692970	5981513	-6.05952	53.94596
ORI-B01	725786	797546	691427	5977667	-6.08540	53.91200
ORI-B02	726257	798817	691881	5978944	-6.07771	53.92330
ORI-B03	726602	799887	692210	5980019	-6.07202	53.93283
ORI-B04	727805	800323	693407	5980472	-6.05353	53.93645
ORI-B05	728515	801314	694103	5981473	-6.04231	53.94517
ORI-C01	726712	797153	692359	5977287	-6.07148	53.90825
ORI-C02	727157	798233	692789	5978373	-6.06426	53.91784
ORI-C03	727425	799264	693042	5979408	-6.05976	53.92703
ORI-C04	728565	799006	694186	5979166	-6.04252	53.92443
ORI-C05	728918	800096	694523	5980261	-6.03669	53.93413
ORI-D01	726426	796140	692087	5976270	-6.07625	53.89922
OR-D02	727650	796503	693306	5976650	-6.05748	53.90218
ORI-D03	728152	797871	693789	5978025	-6.04928	53.91434
ORI-D04	729011	797349	694655	5977515	-6.03643	53.90944
ORI-D05	729424	798537	695051	5978709	-6.02965	53.92001
ORI-E01	725217	796227	690877	5976340	-6.09460	53.90029
ORI-E02	725885	795001	691562	5975123	-6.08494	53.88912
ORI-E03	727134	795120	692810	5975260	-6.06591	53.88989
ORI-E04	728213	794951	693891	5975106	-6.04957	53.88810
ORI-E05	728627	796193	694287	5976354	-6.04276	53.89915
ORI-OSS	725851	797078	691500	5977200	-6.08496	53.90778

3 GUIDANCE AND CONSULTATION

The lighting and marking scheme has been designed to comply with the relevant guidance presented in section 3.1. It is noted that in addition to consideration and compliance with the relevant guidance, the preparation of this LMP has also been informed by consultation undertaken with key stakeholders set out in section 3.2.

3.1 Guidance

The guidance documents contained in Table 3-1 have been used in the collation of this LMP.

Table 3-1: Guidance documents.

Policy/Guidance	Key provisions
Marine	
Maritime and Coastguard Agency's (MCA) Marine Guidance Note (MGN) 654 Guidance on "UK Navigational Practice, Safety and Emergency Response Issues" and its annexes (MCA, 2021; 2024).	This Marine Guidance Notice highlights issues to be considered when assessing the impact on navigational safety and emergency response arising from Offshore Renewable Energy Installations (OREI). Including traffic surveys, consultation, structure layout, collision avoidance, impacts on communications/ radar/ positioning systems and hydrography.
MGN 372 Amendment 1"Guidance to Mariners Operating in the Vicinity of UK OREIs" (MCA, 2022).	Covering Issues to be considered when planning and undertaking voyages near OREI off the coast.
International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) G1162 the Marking of Man-Made Offshore Structures (IALA, 2021).	Guidance to national authorities on the marking of offshore structures including wind farms.
Standard Operating Procedure 07-2025 *Guidance for Search and Rescue (SAR) and Emergency Response for Offshore Renewable Energy Installations (OREI)*	Provides guidance to ensure effective Search and Rescue (SAR) and emergency response operations in and around Offshore Renewable Energy Installations (OREI), focusing on layout, access, and safety measures to support maritime and aerial rescue efforts.
IALA R1001 – The IALA Maritime Buoyage System (IALA, 2017).	Guidance on the types of marine buoyage that can be deployed.
Aviation	
Aeronautical Services Advisory Memorandum (ASAM) No: 018 Issue 2 Guidance Material on Off-Shore Wind Farms (IAA, 2015).	The purpose of the document is to provide general guidance for lighting, marking and radar enhancement requirements and also on information required for promulgation to ensure the conspicuity of wind farm machines and associated structures, so as to protect air and marine navigation safety.
Civil Aviation Publication (CAP) 437 Standards for Offshore Helicopter Landing Areas (CAA., 2021).	This document provides the criteria applied by the Civil Aviation Authority (CAA) in assessing the standards of offshore helicopter landing areas for worldwide use by helicopters registered in the United Kingdom (UK).
IAA (Obstacles to Aircraft in Flight) Order, 2005 (IAA, 2005).	Relevant legislation on aviation safety.
MGN 654 Guidance on "UK Navigational Practice, Safety and Emergency Response Issues" and its annexes (MCA, 2021; 2024).	This Marine Guidance Notice highlights issues to be considered when assessing the impact on navigational safety and emergency response arising from Offshore Renewable Energy Installations (OREI). Including traffic surveys, consultation, structure layout, collision avoidance, impacts on communications/ radar/ positioning systems and hydrography. Contains key provisions for facilitating safe access for SAR aircraft.

3.2 Consultation

In addition to consideration and compliance with the relevant guidance, the preparation of this LMP has been informed by consultation with the MSO, IAA, CIL, IRCG and the DoD as key stakeholders of relevance to lighting and marking. Details of this consultation is contained within chapter 13: Shipping and Navigation and chapter 14: Aviation, Military and Communications in EIAR volume 2B (see also Addenda to these chapters in EIAR volume 2B Addendum).

The following conditions were proposed by the CIL during statutory consultation, and the Project confirms their commitment to full compliance with these requirements:

1. The Developer shall during the whole period from the commencement of construction of the authorised project to the completion of decommissioning, exhibit such lights, marks, sounds, signals and other marine aids to navigation (AtoN), and take such other steps for the prevention of danger to navigation as Irish Lights may from time to time direct.

2. The Developer must during the whole period from the commencement of construction of the authorised project to the completion of decommissioning keep Irish Lights informed of progress of the authorised project including:

    a. notice of commencement of construction of the authorised project within 24 hours of commencement having occurred.

    b. notice within 24 hours of any aids to navigation being established by the developer; and.

    c. notice within 5 days of completion of construction of the authorised project.

3. The Developer must submit a close out report to Irish Lights within three months of the date of completion of construction. The close out report must confirm the date of completion of construction and must include the following details:

    d. The final number of installed wind turbine generators (WTG)

    e. As-built plans

    f. Latitude and longitude coordinates of the centre point of the location for each WTG and offshore platform (OSP), substation, and meteorological mast; provided as Geographical Information System data referenced to WGS84 datum.

4. The Developer must provide reports to Irish Lights on the availability of marine aids to navigation (AtoN) in accordance with Irish Lights guidance and using the online portal reporting system provided.

    g. Irish Lights works closely with Local Lighthouse Authorities and Developers to ensure that AtoN standards in offshore developments meet International Association of Marine Aids to Navigation & Lighthouse Authorities (IALA) standards. To ensure these criteria are met each developer provides access to records and information concerning the aids to navigation under their management to Irish Lights. Irish Lights conduct inspections and audits on a regular basis to assist the developer in maintaining records and policies/procedures for the operation of AtoN. The Developer must agree to such inspections and audits by Irish Lights.

5. The Developer must during the whole period from the commencement of construction of the authorised project to the completion of decommissioning notify Irish Lights of any failure of the aids to navigation and the timescales and plans for remedying such failures, as soon as possible and no later than 24 hours following the developer becoming aware of any such failure.

    h. During the construction and decommissioning phase, it is recommended that working areas be established and marked as appropriate. As construction areas become larger the spacing between marine aids to navigation and ranges of lights, need to be assessed so that it is readily apparent to the mariner that the AtoN are marking a zone.

6. In case of damage to, or destruction or decay of, the authorised project seaward of MHWS or any part thereof, excluding the exposure of cables, the Developer must as soon as reasonably practicable and no later than 24 hours following their becoming aware of any such damage, destruction, or decay, notify Irish Lights. In the event of this occurrence the developer must lay down such buoys, exhibit such lights and take such other steps for preventing danger to navigation as directed by Irish Lights.

7. In case of exposure of cables on or above the seabed, the developer must, within three days following identification of a potential cable exposure, notify mariners, DOT and Irish Lights of the location and extent of exposure.

8. The Developer must submit an application for statutory consent on each occasion to Irish Lights prior to the establishment, alteration, or disestablishment of any required aid to navigation associated with the Project. Such a consent must be sought in good time and cannot be granted in retrospect.

9. The Developer must, no later than 6 months prior to the Commencement of the Development, agree a Lighting and Marking Plan (LMP) with Irish Lights.

    i. The LMP must make provision for amending the marking and lighting of the OSPs, as required by Irish Lights, in the event that any OSPs are constructed prior to the construction of WTGs within the Site, to ensure the marking and lighting of any OSP suits the layout of any surrounding WTGs that form part of any wind farm development located within the Site.

10. All marine aids to navigation must be published on nautical charts, in relevant publications and by promulgation of Maritime Safety Information.

3.3 Promulgation of information

Details of the Project will be promulgated to relevant marine and aviation stakeholders in advance of, and during, construction, and also during the operational and maintenance phase where appropriate. Stakeholders will also be informed when construction is complete. The relevant marine and aviation stakeholders to be informed include but are not limited to:

- CIL;
- IRCG;
- MSO;
- United Kingdom Hydrographic Office (UKHO);
- Local fishing organisations;
- Local marine organisations;
- Irish Sailing;
- Kingfisher Bulletin;
- Belfast MCA marine office; and
- DoD.

4 CONSTRUCTION PHASE

This section describes the marine (section 4.1) and aviation (section 4.2) lighting and marking to be implemented during the construction phase.

4.1 Marine

The marine lighting and marking to be implemented during the construction phase is summarised in Table 4-1. This consists of a guidance column, listing the relevant guidance/stakeholder for each lighting and marking aspect where appropriate, noting that the guidance provides the full technical specifications required by the relevant stakeholders.

Table 4-1: Construction Phase Lighting and Marking.

Lighting and Marking Aspect	Relevant Structures	Specifications	Relevant Guidance or stakeholder Requirements
Temporary construction lighting	All WTGs and OSS	• All structures marked with a temporary light during construction and until operational lighting is commissioned; • Yellow 5 second (s) flash (FL. Y. 5s); • At least 2 nm range; • 360° visibility (multiple lights per structure may be required to achieve this); and • Category 2 availability requirement – 99.0%.	• Industry Standard. • IALA G1162 (IALA, 2021).
Construction buoyage – numbers and types	Marking periphery of Array Area	• Buoy types as directed by CIL; • Focal plane of at least 3 m and nominal range of 5 nm range; • Minimum of 3 m in diameter at the waterline; • Pillar shaped with a yellow 'X' shaped top mark; • Some buoys may be required to transmit via Automatic Identification System (AIS); • Removed once CIL have confirmed content with operational lighting and marking; • Positions as directed by CIL but anticipated to be within 500 m of the Array Area; and • Radar reflector.	• Industry Standard. • IALA R1001 – The IALA Maritime Buoyage System. Edition One. (IALA, 2017).

The offshore wind farm area will be marked as a construction area during the construction phase via the use of temporary construction buoyage. This will be a combination of cardinal marks and special marks as shown in Figure 4-1 and Table 4-2. Construction buoyage is anticipated to be established eight weeks prior to the Project commencing construction to allow time for passing traffic to familiarise with the buoyed construction area, noting this is in accordance with best practice to allow passing vessels time to familiarise with the Project. The buoyage shall remain in place until the operational marking requirements have been installed, then inspected and passed by CIL. Precise buoyage locations will be as directed by CIL, noting it is anticipated that they will be located within 500 m of the offshore wind farm area (see Figure 4-1).

Table 4-2: Indicative construction buoyage naming and coordinates.

Coordinate system	ITM - CRS: 2157		UTM-29N / CRS: 32629		WGS 84 / CRS: 4326	
WTG ID	Easting	Northing	Easting	Northing	Longitude	Latitude
CB 1	725907	801507	691493	5981630	-6.08802	53.94769
CB 2	728589	801482	694175	5981643	-6.04100	53.94620
CB 3	729566	798570	690072	5978193	-6.02800	53.92000

Coordinate system	ITM - CRS: 2157		UTM-29N / CRS: 32629		WGS 84 / CRS: 4326	
WTG ID	Easting	Northing	Easting	Northing	Longitude	Latitude
CB 4	728298	794824	693978	5974981	-6.04800	53.88700
CB 5	725538	794872	691221	5974989	-6.09000	53.88800
CB 6	724437	798091	690072	5978193	-6.10569	53.91722

The Project will submit the following reports and notices on construction marine lighting and marking:

- The Project will submit an application for statutory sanction to the CIL prior to the implementation, alteration, or removal of any aid to navigation;
- CIL will be notified within 24 hours of the commencement of construction;
- Any establishment of marine aids to navigation (AtoNs) will be reported within 24 hours of their installation;
- All marine AtoNs will be published on nautical charts, in relevant publications by promulgation of Maritime Safety Information;
- Upon completion of construction, the Project will provide notification to CIL within five days, confirming that the construction phase has concluded; and
- Within three months following the completion of construction, the Project will submit a comprehensive close-out report to CIL, confirming the date of construction completion. Further information provided will include the final number of WTGs, as-built plans and latitude/longitude coordinates of each structure.

4.1.1 Failure of Marine Lighting

The Applicant will ensure that appropriate redundancy and / or back up capability is utilised to ensure the appropriate IALA availability categories as set out in Table 5-2 and Table 5-3 are met. In the unlikely event of any failure of marine AtoNs, the Applicant will notify CIL within 24 hours of becoming aware of the issue, via structured monitoring regimes (see section 5.1.1). This notification will include a proposed plan and timeline for remedying the failure.

The Applicant will ensure that appropriate redundancy and / or back up capability is utilised to ensure the appropriate IALA availability categories as set out in Table 4-1 are met. In the unlikely event of a significant loss of an AtoN such that a significant risk to navigation is considered likely to occur, consultation, in advance of implementation, shall be undertaken with the CIL, IRCG and the MSO to determine the need for any additional mitigation. This may include a guard vessel to maintain navigational safety until the AtoN is repaired or replaced, promulgation of navigational warnings or deployment of temporary AtoNs.

CB 1
CB 2
CB 3
CB 4
CB 5
CB 6
ORI-A01
ORI-A02
ORI-A03
ORI-A04
ORI-A05
ORI-B01
ORI-B02
ORI-B03
ORI-B04
ORI-B05
ORI-C01
ORI-C02
ORI-C03
ORI-C04
ORI-C05
ORI-D01
ORI-D02
ORI-D03
ORI-D04
ORI-D05
ORI-E01
ORI-E02
ORI-E03
ORI-E04
ORI-E05
ORI-OSS
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Legend

- Offshore Wind Farm Area
- Offshore Cable Corridor
- Wind Turbine Generator
- Offshore Substation
- Buoyage

Client
ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project
Oriel Windfarm EIAR

Title
Figure 4-1: Construction Buoyage

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Issue Details

Drawn:	DP	**Project:**	MDR1520
Checked:	ES	**File Ref:**	MDR1520QG0000F01
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4.2 Aviation

Chapter 14: Aviation, Military and Communications of the (EIAR volume 2B) identified creation of physical obstacles affecting air traffic as a potential impact. However, with the implementation of the measures included in the Project this impact was scoped out from further assessment. One of the measures included in the Project is the preparation and implementation of a LMP setting out specific requirements in terms of aviation lighting to be installed on the turbines. Other measures included in the Project (chapter 14: Aviation, Military and Communications) relevant to the LMP are summarised in Table 4-3.

Table 4-3 Measures included in the Project relevant to the LMP.

Measures included in the Project	Justification
Civilian and Military Aviation Interests	
All SPS, to the highest point of the structure, will be fitted with high intensity warning lighting. Specific requirements are listed in IAA ASAM No: 018 (IAA., 2015).	To meet IAA requirements as listed in IAA ASAM No:18 (IAA., 2015) and to ensure appropriate lighting is in place to facilitate aeronautical safety.
Preparation and implementation of a LMP setting out specific requirements in terms of aviation lighting to be installed on the turbines. The LMP will be prepared in consultation with the IAA, DoD and IRCG.	To ensure appropriate lighting is in place to facilitate aeronautical safety.
The IAA 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 IAA Integrated Aeronautical Information Package (IAIP).	To comply with Offshore Renewable Energy Development Plan (OREDP) (Department of Communications, Climate Action and Environment (DECC), 2022) which requires the IAA to be notified of the construction and location of wind turbines.
During the operational phase, the Project operator will issue, as necessary, requests to the IAA to submit Aeronautical Information Circulars (AIC) in the event of any failure of aviation lighting. Any light which fails will be repaired or replaced as soon as is reasonably practicable. An alerting system for light failure will be put in place, such as remote monitoring or other suitable method agreeable to the IAA.	To comply with IAA ASAM No.18 (IAA., 2015) which contains the policy on actions in the event of the failure of aviation warning lights on offshore wind turbines listed in the IAA IAIP.
All structures > 90 m Above Mean Sea Level (AMSL) in height will be charted on aeronautical charts and reported to the IAA at least three months prior to construction, for input into the IAA's database of tall structures in Ireland.	An object which is higher than 90 m in height is considered to have significance for the *en route* operations of aircraft in Irish airspace.

No specific aviation lighting or marking will be implemented during the construction phase. As outlined in section 3.3, the Applicant will undertake promulgation of information to the relevant aviation authorities and stakeholders prior to and during construction. In particular, as required under S.I.215 (IAA, 2005) (see section 3.1), the IAA will be notified of any en-route obstacles (including mobile cranes) above 45 m in height, giving at least 30 days' notice.

The following details will be provided:

- Geographic latitude;
- Geographic longitude;
- Elevation; and
- Height.

In line with ASAM No 18 (IAA, 2015), at least three months in advance of the erection of the structures the following information will be supplied to the IAA for promulgation in a manner considered appropriate by the Authority in order to allow inclusion on aviation charts and the IAA IAIP. The information will include:

- Positional data representing the estimated position of each machine or structure to be erected. The geodetic datum to which all obstructions will be referred is the World Geodetic System of 1984 (WGS-84). Co-ordinates will be provided in degrees, minutes, seconds and decimals of a second, as appropriate;
- The maximum elevation of each structure in feet and metres;
- Proposed lighting details for each structure;
- Proposed marking details for each structure;
- Whether it is proposed that a Radar Enhancer / Transponder / Reflector or AIS be fitted;
- Minimum and maximum spacing between structures;
- Planned earliest date of erection; and
- Any other information considered relevant for air navigation.

The IAA indicated during consultation (see section 3.2) that Notices to Airmen (NOTAMs) may be issued based on the information provided.

There is an IAA requirement for all structures (temporary or otherwise) of 90 m or more to be charted on aeronautical charts. WTG locations will be reported to the IAA at least three months prior to construction, for input into the IAA's database of tall structures in Ireland. As per IAA requirements, the lighting status of the WTGs and the estimated start/end dates for construction will be provided together with the estimate of when the WTGs are scheduled to be removed.

5 OPERATIONAL AND MAINTENANCE PHASE

This section presents the marine (section 5.1) and aviation (section 5.2) lighting and marking to be implemented during the operational and maintenance phase.

5.1 Marine

The marine operational lighting and marking to be implemented for the WTGs and OSS are summarised in Table 5-2 and Table 5-3 respectively. These include a guidance column listing the relevant guidance for each lighting and marking aspect where appropriate, noting that this guidance will provide the full technical specifications required. The proposed marine lighting and marking is then illustrated in Figure 5-1.

The WTGs will be painted, marked and fitted with navigation lights in accordance with IALA standards and more specifically as required by the CIL. When in operation, all the WTGs will be marked with clearly visible and unique identification characters, which will be visible from all sides of the WTGs and comply with applicable international and local rules guidance and requirements. Each structure will be:

- Painted yellow all-round from the level of Highest Astronomical Tide (HAT) to 15 m, or the height of any Aid to Navigation if fitted, whichever is greater; and
- Marked with a unique alphanumeric identifier (“ID Boards”).

WTGs to be marked as Significant Peripheral Structures (SPS) located on the “corner” or other significant point on the periphery of a wind farm have been identified, shown in Figure 5-1 and Table 5-1. Each individual SPS will be fitted with lights visible from all directions in the horizontal plane. The lights will be synchronised and display an IALA “special mark” characteristic (i.e. flashing yellow, with a range of not less than 5 nm). The lateral distance between such lit structures or the nearest SPS does not exceed 3 nm.

Table 5-1: SPS coordinates.

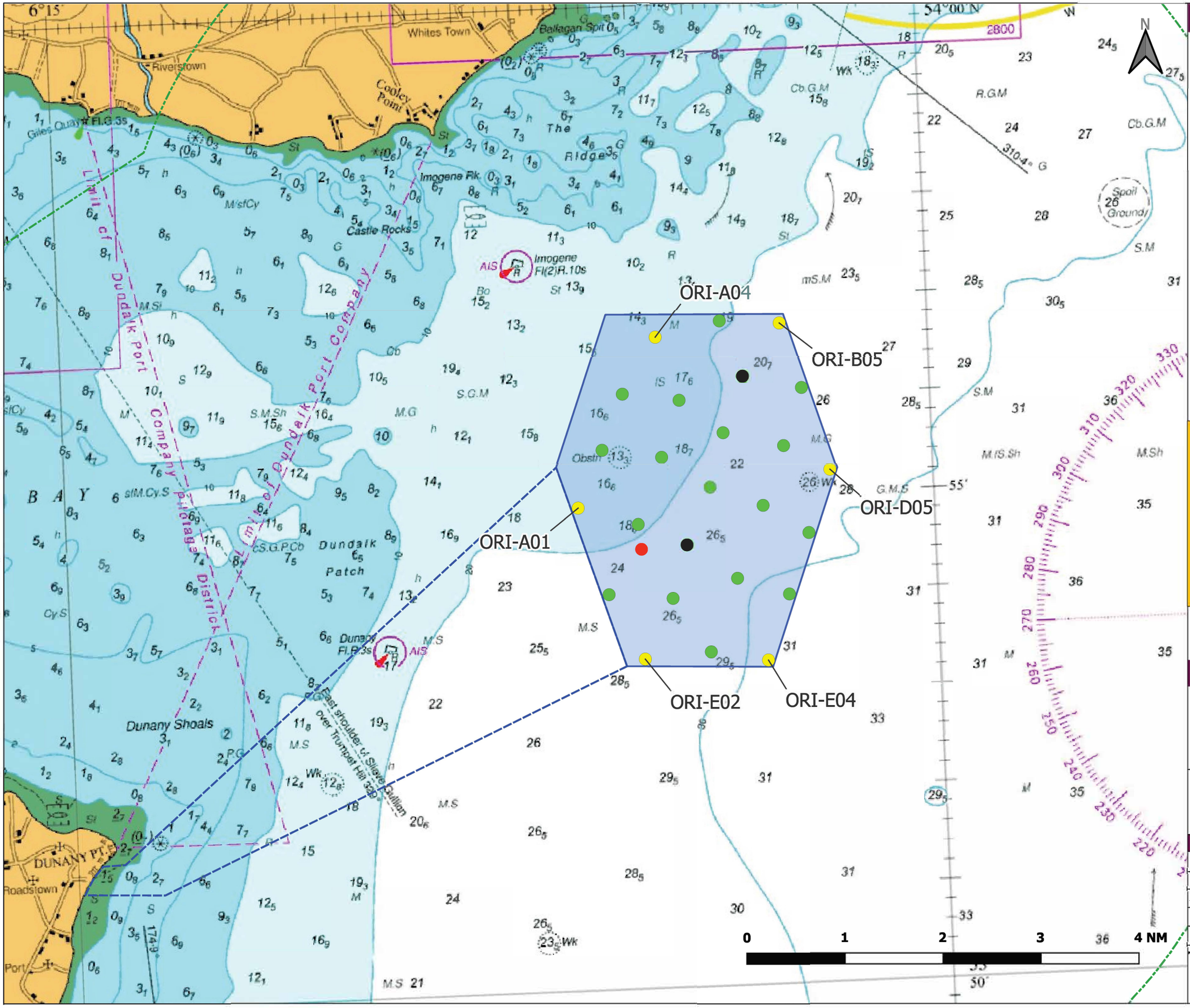
Coordinate system	ITM - CRS: 2157		UTM-29N / CRS: 32629		WGS 84 / CRS: 4326	
WTG ID	Easting	Northing	Easting	Northing	Longitude	Latitude
ORI-A04	725907	801507	691493	5981630	-6.08802	53.94769
ORI-B05	728589	801482	694175	5981643	-6.04100	53.94620
ORI-D05	729566	798570	690072	5978193	-6.02800	53.92000
ORI-E04	728298	794824	693978	5974981	-6.04800	53.88700
ORI-E02	725538	794872	691221	5974989	-6.09000	53.88800
ORI-A01	724437	798091	690072	5978193	-6.10569	53.91722

Table 5-2: Operational Phase WTGs' Marine Lighting and Marking Summary.

Lighting and Marking Aspect	Relevant Structures	Specifications	Relevant Guidance or stakeholder Requirements
SPS	All SPS	• Marine lights marking selected periphery WTGs as required; • Yellow 5s flash; • At least 5 nm range; • 360° visibility; • Synchronised; • Located not less than 6 m and not more than 30 m above HAT, and below the lowest point of any arc of rotor blades; • The lateral distance between such lit structures or the nearest SPS does not exceed 3 nm; • At least IALA Category 2 (> 99.0%); and • At least 96 hours back up / Uninterrupted Power Supply capability.	IALA G1162 (IALA, 2021).
Sound signals	All SPS	• Located not less than 6 m and not more than 30 m above HAT; • Minimum range of two 2 nm; • Character Mo (U) 30s with a minimum duration for the short blast of 0.75 seconds; and • Operated when the meteorological visibility is 2 nm or less.	IALA G1162 (IALA, 2021).
AIS	All SPS	• At least IALA Category 3 (>97.0% availability).	IALA G1162 (IALA, 2021).
ID marker boards	All WTGs	• Marked with a unique alphanumeric identifier; • ID system will be agreed with CIL and IRCG; • ID panels with black letters on yellow background; • Letters 1 m high; • Visibility in all directions; and • Use of either illumination or retroreflective material, noting any illumination will be hooded / baffled to avoid confusion with AtoN.	IALA G1162 (IALA, 2021). MGN654 (MCA, 2021; 2024).
WTG paint	All WTGs	• Painted yellow all-round from the level of HAT to 15 m, or the height of any AtoN if fitted, whichever is greater.	IALA G1162 (IALA, 2021).

Table 5-3: Operational Phase Substations Marine Lighting and Marking Summary.

Lighting and Marking Aspect	Relevant Structures	Specifications	Relevant Guidance or stakeholder Requirements
ID marker boards	OSS	• Marked with a unique alphanumeric identifier; • ID system will be agreed with CIL and IRCG; • ID panels with black letters on yellow background; • Letters 1 m high; • Visibility in all directions; and • Use of either illumination or retroreflective material, noting any illumination will be hooded / baffled to avoid confusion with AtoN.	IALA G1162 (IALA, 2021). MGN654 (MCA, 2021; 2024).
OSS paint	OSS	• Foundations painted yellow (RAL 1023) all round from HAT to a height of at least above 15 m HAT; and • Remainder painted light grey (RAL 7035), excludes topside structures such as work cabins, cranes etc.	IALA G1162 (IALA, 2021).



Legend

- Offshore Cable Corridor
- Offshore Wind Farm Area
- Significant Peripheral Structure
- Wind Turbine
- Offshore Substation

Client: ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project: **Oriel Windfarm EIAR**

Title

Figure 5-1: Operational Marking

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Issue Details

Drawn:	DP	**Project:**	MDR1520
Checked:	RT	**File Ref:**	MDR1520QG0000F01
Approved:	AR		
Scale:	1:110,000 @ A3	**Projection:**	EPSG: 32639
Date:	08/09/2025		

5.1.1 Maintenance of AtoNs

Throughout the lifetime of the project, the Applicant is responsible for the ongoing monitoring, testing, and maintenance of all AtoNs. These activities will ensure continued compliance with the standards set out by IALA, specifically IALA Guideline G1162 (IALA, 2021), “The Marking of Offshore Man-Made Structures,” and applied by CIL.

The Applicant will implement a structured monitoring regime that includes both automated and manual status checks to verify the functionality of each AtoN. Routine testing procedures will be carried out to confirm operational integrity, anticipated to be annually, and preventive maintenance schedules will be established to minimise the risk of failure. In the event of any fault or anomaly, immediate detection and response protocols will be in place to restore service as quickly as reasonably possible.

All monitoring and testing activities will be thoroughly documented and retained for audit purposes. These records will be made available to CIL upon request.

In addition, all vessels (in all phases of the Project) will be made aware of the requirement to report any failures immediately so that measures can be put in place to rectify the failure.

5.1.2 Availability requirements

The Applicant is responsible for reporting on the operational status and availability of all marine AtoNs throughout the project lifecycle. These reports will be submitted via the CIL online portal and in accordance with their guidance. All AtoN will comply with the standards set by the IALA. To support this, the Applicant will provide CIL with access to relevant records and systems and will cooperate fully with inspections and audits conducted to verify compliance and maintenance practices.

Furthermore, the Applicant will provide CIL with access to relevant monitoring systems and records and cooperate fully with any inspections, audits, or performance reviews conducted by CIL. All marine AtoNs associated with the project will be published on official nautical charts, included in relevant maritime publications, and disseminated through Maritime Safety Information channels to ensure that mariners are fully informed of their presence and operational status.

5.1.3 Failure of Marine Lighting

In the unlikely event of any failure of marine AtoNs, the Applicant will notify CIL within 24 hours of becoming aware of the issue. This notification will include a proposed plan and timeline for remedying the failure. All project construction and operational vessels will be required to report any observed failures of marine AtoNs immediately, in accordance with good seamanship and Rule 5 of the COLREGs, which mandates maintaining a proper look-out by all available means.

The Applicant will ensure that appropriate redundancy and / or back up capability is utilised to ensure the appropriate IALA availability categories as set out in Table 5-2 and Table 5-3 are met. In the unlikely event of a significant loss of an AtoN such that a significant risk to navigation is considered likely to occur, consultation, in advance of implementation, shall be undertaken with the CIL, IRCG and the MSO to determine the need for any additional mitigation. This may include a guard vessel to maintain navigational safety until the AtoN is repaired or replaced, promulgation of navigational warnings or deployment of temporary AtoNs.

5.1.4 Damage or Decay of Offshore Infrastructure

Should any part of the authorised offshore infrastructure – excluding cable exposure – become damaged, destroyed, or subject to decay, the Applicant will notify CIL as soon as reasonably practicable and no later than 24 hours after becoming aware of the issue. In such cases, the Applicant will follow the directions of CIL, which may include laying buoys, exhibiting lights, or taking other necessary steps to prevent danger to navigation.

5.1.5 Cable Exposure Notification

If any subsea cables become exposed on or above the seabed, the Applicant will notify CIL, the MSO, and mariners within three days of identifying the exposure. The notification will include accurate details regarding the location and extent of the exposed cables to ensure appropriate safety measures can be taken and a plan provided to remedy the situation.

5.2 Aviation

Throughout the lifetime of the Project, aids to air navigation will be provided in accordance with the requirements of the IAA. The aviation operational lighting and marking to be implemented for the WTGs and OSS are summarised in Table 5-4 and Table 5-5 respectively. These include a guidance column listing the relevant guidance for each lighting and marking aspect where appropriate, noting that this guidance will provide the full technical specifications required.

The key IAA guidance is ASAM No 18 (IAA, 2015), which provides aviation lighting requirements for offshore wind farms that are not located:

- Within 8 nm of publicly licensed aerodromes;
- Within 32 nm of Air Navigation Services Radar and other radio navigation facilities; or
- Within 4 nm of any permanent offshore helipads.

The Project satisfies these criteria and therefore IAA guidance is ASAM No 18 (IAA, 2015) applies. No marking requirements to protect air navigation safety are contained in the IAA ASAM No: 18, Issue 2; however, the MCA provides UK requirements in MGN 654 Annex 5 as summarised in the following sections.

5.2.1 Failure of Aviation Lighting

ASAM No 18 (IAA, 2015) states that "*any light which fails will be repaired or replaced as soon as is reasonably practicable. An alerting system for light failure will be put in place, such as remote monitoring or other suitable method agreeable to the IAA*". The IAA (En Route Obstacles to Air Navigation) Order, 1999 (S.I. No. 423/1999) states 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."

It is accepted that there may be occasions when meteorological or sea conditions prohibit the safe transport of personnel for repair tasks. Furthermore, there may be fault conditions that are wider ranging and would take longer to diagnose or repair. In such cases, the IAA requires that appropriate aeronautical information be promulgated to ensure continued air navigation safety.

Where an aviation light required under IAA regulations becomes unserviceable and the outage is expected to exceed a reasonable duration, the Applicant must submit a NOTAM request to the IAA. This is done using the IAA NOTAM Proposal Form. The Applicant is considered the appropriate party to initiate this request in relation to offshore wind farm lighting.

Upon completion of the remedial works, the IAA shall be notified as soon as possible to enable a cancellation to be issued. If an outage is expected to last longer than 14 days, then the IAA shall also be notified directly to discuss any issues that may arise and longer-term strategies.

Table 5-4: Operational Phase WTGs Aviation Lighting and Marking Summary.

Lighting and Marking Aspect	Relevant Structures	Specifications	Relevant Guidance or stakeholder Requirements
Aviation warning lighting	All SPS	• The lighting must be mounted on the highest point practicable of the fixed structure. • Be in accordance with the International Civil Aviation Organisation (ICAO) Annex 14 standards, on a H24 basis, for High Intensity Type A lighting: – Colour white with a flash rate of 40~60 fpm); – An effective intensity, with background luminance above 500 cd/m², of 200,000 cd ± 25%; – An effective intensity, with background luminance 50~500 cd/m², of 20,000 cd ± 25%; – An effective intensity, with background luminance below 50 cd/m², of at least 2,000 cd; – Light fittings will be fully cut off so that practically no light will be emitted below the horizontal, or as otherwise agreed with the IAA; – All lights across the wind farm should flash in synchronisation and reductions in light intensity should occur simultaneously, if practicable; and – Be visible through 360° in azimuth. • Incandescent or compatible with Night Vision Imaging System (NVIS).	ASAM No 18 (IAA, 2015).
SAR lights	All structures	SAR lighting is an MCA requirement for UK projects under MGN 654. Specifications shown as per MGN 654: • 200 cd red light, steady when in use off otherwise; • 360° visibility; and • Compatible with NVIS.	MGN 654 (MCA, 2021).
Green heli-hoist light	All structures	Low-intensity green lights are required to be fitted to the WTG nacelle to indicate the status of the WTG for hoisting operations to helicopter pilots • Steady green will indicate when the WTG has been made safe for hoist operations; • Flashing green (120 flashes per minute (fpm)) will indicate that the WTG is preparing for hoist operations; and • Extinguished lights will indicate that it is not currently safe to perform hoisting operations.	Civil Aviation Authority (CAA) in Civil Aviation Publication (CAP) 437 (CAA 2023).
Blade markings	All WTGs	Specification under MGN 654: • Three marks are required in red (recommended RAL 3020) on each WTG blade at distances of 10 m, 20 m and 30 m from the blade root (see Figure 2-1); • Displayed near trailing edge of blades;	MGN 654 (MCA, 2021).

Lighting and Marking Aspect	Relevant Structures	Specifications	Relevant Guidance or stakeholder Requirements
		• The marks should have a minimum diameter of at least 600 mm however may need to be larger dependent on overall size, shape of turbine and blades; and • Positioned on both faces of the blades.	
ID markings	All WTGs	• ID numbers should be recognisable and in a logical manner so that the OREI can be easily distinguished from an aircraft flying 500 ft (152 m) above the highest part of the structure; • ID numbers will be marked on the WTG nacelle roofs; • ID system will be agreed with CIL and IRCG; and • Not less than 1.5 m in height, with proportional width.	MGN 654 (MCA, 2021).
Hoist area lighting and marking	All WTGs	• Railings shall be marked in red for easy identification of the boundaries; • The hoist zone shall be marked in yellow; and • The safe zone marked in green.	CAA in CAP 437 (CAA, 2023).
Radar Enhancers	All SPS	• Radar reflectors fitted to SPS WTGs.	ASAM No 18 (IAA, 2015).

Table 5-5: Operational Phase Substation Aviation Lighting and Marking Summary.

Lighting and Marking Aspect	Relevant Structures	Specifications	Relevant Guidance or stakeholder Requirements
SAR lights	OSS	SAR lighting is an MCA requirement for UK projects under MGN 654 (MCA, 2021). Specifications shown as per MGN 654: • 200 cd red light, steady when in use off otherwise; • 360° visibility; and • Compatible with NVIS.	MGN 654 (MCA, 2021).
Green Heli-host Light	OSS	Low-intensity green lights are required to be fitted to the OSS for hoisting operations to helicopter pilots: • Steady green will indicate when the OSS has been made safe for hoist operations; • Flashing green (120 flashes per minute (fpm)) will indicate that the OSS is preparing for hoist operations; and • Extinguished lights will indicate that it is not currently safe to perform hoisting operations.	CAA in CAP 437 (CAA, 2023).
ID markings	OSS	• ID numbers will be marked on the OSS roofs; • ID system will be agreed with CIL and IRCG; and • Not less than 1.5 m in height, with proportional width.	MGN 654 (MCA, 2021).
Hoist area lighting and marking	OSS	• Railings shall be marked in red for easy identification of the boundaries; • The hoist zone shall be marked in yellow; and • The safe zone marked in green	CAA in CAP 437 (CAA, 2023).

6 DECOMMISSIONING

The lighting and marking requirements throughout the decommissioning phase have not yet been finalised (i.e. what navigational lights shall be employed). However, the required lighting and marking of the Project during, and following decommissioning, shall be agreed in consultation with CIL, IRCG and IAA at least six months prior to the decommissioning works including any requirements for maintaining and monitoring.

7 REFERENCES

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