LIGHTING AND MARKING PLAN
KINCARDINE OFFSHORE WINDFARM PROJECT

Document Category
2

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Date	Rev. Status	Purpose of Issue*	Remarks	Initials
21-11-2017	00	Draft for Review	First Issue	AF
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*Purpose of Issue: for information, for review, for approval

Detailed Change Log

Date	Rev. Status	References	Description of changes	Initials

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ACRONYMS & ABBREVIATIONS

AIP	-	UK Aeronautical Information Publication
AIS	-	Automatic Identification System
ANO	-	Air Navigation Order
AtoN	-	Aid to Navigation
CAA	-	Civil Aviation Authority
cd	-	Candela
DGC	-	Defence Geographic Centre
HAT	-	Highest Astronomical Tide
IALA	-	International Association of Lighthouse Authorities
IPS	-	Intermediate Peripheral Structure
KIS-ORCA	-	Kingfisher Information Service – Offshore Renewable & Cable Awareness
KOWF	-	Kincardine Offshore Wind Farm
KOWL	-	Kincardine Offshore Wind Farm Limited
LMP	-	Lighting and Marking Plan
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MoD	-	Ministry of Defence
MS-LOT	-	Marine Scotland Licensing Operations Team
MW	-	Mega Watt
m	-	Metre
NLB	-	Northern Lighthouse Board
nm	-	Nautical Mile

NSP	-	Navigational Safety Plan
NOTAM	-	Notice to Airmen
OFCOM	-	Office of Communications
OREI	-	Offshore Renewable Energy Installation
RYA	-	Royal Yachting Association
RYAS	-	Royal Yachting Association Scotland
s	-	Second
SAR	-	Search and Rescue
SCADA	-	Supervisory control and data acquisition
SPS	-	Significant Peripheral Structure
UK-AIS	-	UK Aeronautical Information Service
UKHO	-	United Kingdom Hydrographic Centre

1. INTRODUCTION

The Kincardine Offshore Wind Farm (KOWF) was granted consent by the Scottish Ministers on the 7th March 2017 (S36 Consent), with a Marine License for the wind farm and its export cables issued on the same day. This document has been created to satisfy condition 18 of the S36 Consent (see Section 2 for the wording of the condition), which requires the submission of a Lighting and Marking Plan (LMP) no later than six months prior to the Commencement of the Development.

1.1. Project Description

When completed KOWF will consist of up to seven turbines installed approximately 15km south-east of Aberdeen, with two export cables running from the turbines to a landfall point near Altens. Generation capacity will not exceed 50 Mega-Watts (MW), with each turbine generating between 2 and 8.4MW. A detailed overview of the project is provided in Section 4. The initial turbine on site will be a smaller 2MW Vestas V80 machine for the initial 18 months (location 1) and then two separate installation phases for three 8.4 MW machines each (2019 and 2020). This will result in a varied development layout during the initial period of operation.

1.2. Scope of Document

This document has been authored to satisfy condition 18 of the S36 Consent and also conditions within the Marine Licence through the creation of an LMP (See Section 2 for detailed information). The LMP provides the proposed lighting and marking of the Development, which has been designed to ensure the safety of passing marine and aviation users. The following have been considered within the document:

- Marine lighting;
- Buoyage;
- Other marine Aids to Navigation (AtoN) during operation;
- Painting and signage during operation;
- Aviation lighting during operation;
- Aviation considerations during construction;
- Reporting of availability and failure to marine and aviation lighting and marking.

This version of the LMP represents an initial draft, created for the purposes of consultation with the relevant stakeholders, most notably the Northern Lighthouse Board (NLB) and Civil Aviation Authority (CAA). The nature of the construction process proposed for KOWF (installing the seven turbines over three seasons (2018, 2019 and 2020), see Section 4.2 for full details) means that updates to the proposed lighting and marking may be required as the project progresses.

1.3. Amending and Updating of this LMP

Where the need for an update or amendment is identified following approval from Marine Scotland Licensing Operations Team (MS-LOT) of the LMP, either through a consultation response, or due to practicalities arising as the project progresses, KOWL will communicate the suggested update/amendment to MS-LOT prior to editing the approved document. If the suggested change is accepted by MS-LOT, the LMP will be redrafted, and submitted for re-approval.

2. CONSENT CONDITIONS

This section provides the wording of the conditions relevant to lighting marking included within the S36 Consent and Marine License, and where they have been addressed within this LMP. It should be considered when viewing these conditions that a variation order is being filed with Marine Scotland by KOWL against the original consent application that these conditions are based on.

The relevant conditions within the S36 Consent are summarised in Table 2.1. Additional conditions pertinent to lighting and marking contained within the Marine License are then provided in Table 2.2.

Table 2.1 S36 Consent Condition relevant to Lighting and Marking

Condition Number	Condition Wording	Where Addressed in this LMP
Condition 18 of the S36 Consent	*The Company must, no later than 6 months prior to the Commencement of the Development or at such a time as agreed with the Scottish Ministers, submit a Lighting and Marking Plan ("LMP"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with the Maritime Coastguard Agency (MCA), NLB, Ministry of Defence (MoD), Civil Aviation Authority (CAA) and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers.*	This LMP will be issued to the Scottish Ministers no later than three months prior to the Commencement of the Development.
Condition 18 of the S36 Consent	*The LMP must provide that the Development be lit and marked in accordance with the current CAA and MoD aviation lighting policy and guidance that is in place as at the date of the Scottish Ministers approval of the LMP, or any such other documents that may supersede said guidance prior to the approval of the LMP. The LMP must also detail the navigational lighting requirements detailed in International Association of Lighthouse Authorities (IALA) Recommendation O-139 or any other documents that may supersede said guidance in place immediately prior to the approval of the LMP.*	This LMP has been created in line with CAA, MoD, MCA, and NLB guidance as detailed in Section 3.1, including conformation with IALA O-139. Additional consultation undertaken to date with the relevant authorities has also been considered, as detailed in Section 3.2.

Condition Number	Condition Wording	Where Addressed in this LMP
Condition 18 of the S36 Consent	*The Company must provide the LMP, for information, to Aberdeen City Council, Scottish Natural Heritage, the Defence Geographic Centre (DGC) and any other bodies as may be required at the discretion of the Scottish Ministers.*	KOWL will provide a copy of this LMP to the relevant bodies if requested to do so by the Scottish Ministers.

Table 2.2 Marine License Conditions relevant to Lighting and Marking

Condition Number	Condition Wording	Where Addressed in this LMP
Condition 3.1.13	*If the assistance of a Government Department (to include departments of Administrations other than the Scottish Government) is required to deal with any emergency arising from:* *a) the failure to mark and light the Works as required by this licence;* *b) the maintenance of the Works; or* *c) the drifting or wreck of the Works,* *to include the broadcast of navigational warnings, then the Licensee is liable for any expenses incurred in securing such assistance.*	KOWL will ensure the Development is marked and lit as set out in the final, approved LMP, and accept liability for any expenses arising as a result of the failure to do so.
Condition 3.2.2.3	*The Licensee must, no later than 7 days prior to Commencement of the Works, notify the UK Hydrographic Office ("UKHO") of the proposed Works to facilitate the promulgation of maritime safety information and updating of Admiralty charts BA741 and BA743 and publications through the national Notice to Mariners system.*	Details of the promulgation of information to marine stakeholders which will be undertaken are provided in Section 5.2, including notification to the UKHO.

Condition Number	Condition Wording	Where Addressed in this LMP
Condition 3.2.2.3	*The Licensee must, no later than 14 days prior to Commencement of the Works and prior to any turbines being towed to the site, ensure that airmen are aware of the Works through local Notice to Airmen ("NOTAM") or by any other appropriate means.* *The Licensee must notify the DGC (mail to dvof@mod.uk) of the locations, heights and lighting status of the turbines, the estimated dates of construction and the maximum height of any construction equipment to be used, no later than 10 weeks prior to the Commencement of the Works, to allow for the appropriate notification to the relevant aviation communities. The DGC must be updated when the actual dates of construction are known.*	The information that will be provided to aviation stakeholders is detailed in Section 5.2.
Condition 3.2.2.3	*The Licensee must, prior to Commencement of the Works, complete an "Application for Statutory Sanction to Alter / Exhibit" form and submit this to the NLB for the necessary sanction to be granted.*	As stated in Section 5.1, KOWL will request Statutory Sanction as appropriate prior to the Commencement of the Works.
Condition 3.2.3.3	*The Licensee must notify the UKHO of the progress of the Works to facilitate the promulgation of maritime safety information and updating of Admiralty charts BA741 and BA743 and publications through the national Notice to Mariners system.*	Details of the promulgation of information to marine stakeholders which will be undertaken are provided in Section 5.1, including notification to the UKHO.
Condition 3.2.3.3	*The Licensee must, in the case of damage to, or destruction or decay of, the Works, notify the Licensing Authority, in writing, as soon as reasonably practicable following such damage, destruction or decay. The Licensee must carry out any remedial action as required by the Licensing*	KOWL will agree all planned lighting and marking with the NLB and MCA prior to the finalisation of this LMP. KOWL will comply with any additional requests for AtoNs from the NLB and MCA arising from any damage, destruction, or decay associated with KOWF.

Condition Number	Condition Wording	Where Addressed in this LMP
	Authority, and intimated to the Licensee in writing, which may include any requirement to display aids to navigation, following consultation with the MCA, the NLB or any such advisers as required by the Licensing Authority.	
Condition 3.2.3.3	*The Licensee must ensure that any vessels permitted to engage in the Works are marked in accordance with the International Rules for the Prevention of Collisions at Sea whilst under way and in accordance with the UK Standard Marking Schedule for Offshore Installations if the vessel is secured to the seabed.*	All vessels associated with the construction or operation of KOWF will comply with marking requirements as adopted by the Flag State, most notably the International Rules for the Prevention of Collisions at Sea (COLREGS 1972), as stated in Section 5.3.
Condition 3.2.3.3	*The Licensee must ensure that no radio beacon or radar beacon operating in the marine frequency bands is installed or used on the Works without the prior written approval of the Office of Communications ("OfCom").*	Applications for the use of transmission equipment as AtoNs will be issued to OfCom prior to their operation, as detailed in Section 5.8.
Condition 3.2.3.4	*The Licensee must ensure that the Works are marked and lit in accordance with the requirements of the MCA, NLB, the CAA and the Ministry of Defence ("MoD") at all times and such markings and/or lighting must be continued unless and until such time as the Licensing Authority, by notice, relevantly varies this licence under section 30(3)(c) of the 2010 Act.* *The Licensee must not display any marks and lights additional to those required by virtue of this licence and as agreed in the LMP without the written approval of the Licensing Authority following consultation with the NLB, the CAA, the MoD and the MCA.*	This LMP will be agreed and approved with the relevant authorities, and will be adhered to following its completion.

Condition Number	Condition Wording	Where Addressed in this LMP
Condition 3.2.3.4	*The Licensee must ensure that the Works are marked and lit in accordance with IALA Recommendation O-139.*	As stated in Section 3.1, this LMP has been informed by IALA O-139 (2013).
Condition 3.2.3.4	*The turbines must be lit with a single 2000 candela (cd), red aviation light, flashing Morse 'W' in unison with all other turbines and in accordance with the Civil Aviation Authority Air Navigation Order Part 28 Lights and Lighting (220).*	Section 6 details lighting and marking relevant to aviation users. The lighting plan proposed is compliant with the requirement of red aviation lights.
Condition 3.2.3.4	*Turbines 4 & 5, as specified in the Application, must be fitted with synchronised sound signals with a nominal range of two nautical miles, placed not less than 6 metres and not more than 30 metres above sea level. The character must be rhythmic blasts corresponding to morse letter 'U' every 30 seconds. The minimum duration of the short blast must be 0.75 seconds and the sound signal must be operated when the meteorological visibility is two nautical miles or less. The sound signal must comply with IALA recommendations and have an availability of not less than 97.0% (IALA Category 3), calculated over a rolling 3 year period.*	During consultation undertaken since the issue of the Marine License conditions (see Section 3.2), the NLB requested all seven turbines be fitted with sound signals due to the seasonal approach to construction. Therefore, as stated in Section 5.7, all turbines will be fitted with sound signals satisfying the specifications listed in the original condition, with certain signals then turned off upon final commissioning of the Project.
Condition 3.2.3.4	*Each turbine must display identification panels with black letters or numbers 1 metre high on a yellow background visible in all directions. These panels shall be easily visible in daylight as well as at night, either by the use of illumination or retro-reflecting material.*	The proposed Identification (ID) marking of each turbine is given in Section 5.5, and is compliant with the requirements set out in this condition.
Condition 3.2.4.3	*The Licensee must notify the UKHO of the Completion of the Works to facilitate the promulgation of maritime safety information and updating of Admiralty charts BA741 and BA743 and*	Details of the promulgation of information to marine stakeholders which will be undertaken are provided in Section 5.2.

Condition Number	Condition Wording	Where Addressed in this LMP
	publications through the national Notice to Mariners system. *The Licensee must, within 1 calendar month of the Completion of the Works, provide the "as-built" positions and maximum heights of all turbines along with any sub-sea infrastructure, to the UKHO for aviation and nautical charting purposes.* *The Licensee must ensure that local mariners, fishermen's organisations and HM Coastguard, in this case Aberdeen Coastguard Operations Centre, are made fully aware of the Completion of the Works.* *The Licensee must ensure that the Completion of the Works is promulgated in the Kingfisher Fortnightly Bulletin to inform the Sea Fish Industry.*	
Condition 3.2.4.3	*The Licensee must, where any damage, destruction or decay is caused to the Works, notify the Licensing Authority, in writing, of such damage, destruction or decay as soon as reasonably practicable following such damage, destruction or decay. The Licensee must carry out any remedial action which the Licensing Authority advises the Licensee, in writing, as requiring to be taken, which may include a requirement to display aids to navigation, following consultation by the Licensing Authority with the MCA, the NLB or any such advisers as required.*	Following completion of construction, KOWL will comply with any additional requests for AtoNs from the NLB and MCA arising from any damage, destruction, or decay associated with KOWF.
Condition 3.2.4.3	*The Licensee must ensure that no radio beacon or radar beacon operating in the Marine frequency bands is installed or used on the Works without the prior written approval of OfCom.*	Applications for the use of transmission equipment as AtoNs will be issued to OfCom prior to their operation, as detailed in Section 5.8.

Condition Number	Condition Wording	Where Addressed in this LMP
Condition 3.2.4.3	*The Licensee must not exhibit, alter or discontinue navigational lighting of the Works without the Statutory Sanction of the Commissioners of Northern Lighthouses. An 'Application for Statutory Sanction to Exhibit/Discontinue' form must be completed by the Licensee as fully as possible and returned to the Northern Lighthouse Board via e-mail to navigation@nlb.org.uk for the necessary sanction to be granted prior to exhibiting, altering or discontinuing navigational lighting.*	KOWL will not exhibit, alter, or remove any AtoNs without first receiving Statutory Sanction from the NLB, as stated in Section 5.1.
Condition 3.2.4.5	*The Licensee must ensure that the Works are marked and lit in accordance with the agreed LMP and the requirements of the MCA, NLB, CAA and MoD at all times and such marking and/or lighting must be continued unless and until such time as the Licensing Authority, by notice, relevantly varies this licence under section 30 of the 2010 Act.* *The Licensee must ensure that the Works are marked and lit in accordance with IALA Recommendation O-139.*	As set out in Section 3.1, this LMP has been created in line with MCA, NLB, CAA and MoD requirements, and is in accordance with IALA O-139 Recommendations. KOWL commits to adhering to the final approved version of this LMP.

3. GUIDANCE AND CONSULTATION

3.1. Guidance and Legislation

This LMP has been created in order to be compliant with the relevant guidance on the lighting and marking of offshore wind farms, including for both marine and aviation users. The guidance considered is listed below:

- International Association of Lighthouse Authorities (IALA) O-139 – The Marking of Man-Made Offshore Structures (IALA 2013);
- Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 543 - Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response (MCA 2016);
- CAP 764 (Feb 2016) Civil Aviation Authority (CAA) Policy and Guidelines on Wind Turbines (CAA 2016a);
- CAP 393 (Aug 2016) Air Navigation: The Order (ANO) and the Regulations (CAA 2016b);
- CAP 437 (Dec 2016) Standards for Offshore Helicopter Landing Areas (CAA 2016c); and
- Ministry of Defence (MoD) Obstruction Lighting Guidance, November 2014 (MoD 2014).

3.2. Consultation

Consultation meetings with marine stakeholders listed below were held in 2015, with additional meetings held more recently with the MCA and NLB in 2017. The key points arising from these meetings which are considered relevant to this LMP are summarised in Table 3.1.

- Royal Yachting Association (RYA) (11th June 2015);
- NLB (16th June 2015);
- Royal Yachting Association Scotland (RYAS) (17th June 2015);
- Chamber of Shipping (25th June 2015);
- Cruising Association (25th June 2015);
- Scottish Fishermen's Federation (2nd July 2015);
- Aberdeen Harbour (2nd July 2015);
- Royal National Lifeboat Institution and the MCA (3rd July 2015);
- MCA (18th October 2017); and
- NLB (13th November 2017).

It should be noted that various aspects of the Development have been changed since the 2015 meetings (held pre-consent), including the plan to install the turbines over three seasons, rather than four separate seasons as described in Section 4.2. Any point raised at a 2015 meeting that has since been superseded has not been included in the table.

Table 3.1 Key Stakeholder Consultation relevant to Lighting and Marking

Stakeholder	Point Raised	Where Addressed in this LMP
RYAS	RYAS requested that consideration was given to pre-	The potential for light confusion has been considered

Stakeholder	Point Raised	Where Addressed in this LMP
Meeting held on the 17th June 2015.	existing lights during the creation of the KOWF LMP.	throughout the creation of this LMP.
MCA Meeting held on the 20th June 2017.	An ID marking plan should be included in the LMP.	The proposed ID marking of the site is summarised in Section 5.5.
MCA Meeting held on the 20th June 2017.	Aviation lighting should have 360 degree (°) visibility.	As set out in Section 6.3, aviation hazard lighting will be visible from 360°.
MCA Meeting held on the 18th October 2017.	All turbines should be fitted with a 2000cd red aviation light flashing Morse "W" with 360° visibility. The lights should be synchronised, and should be dimmable to avoid light confusion during Search and Rescue (SAR) operations.	As per Section 6.3, all turbines will be fitted with aviation lights satisfying the required specifications.
MCA Meeting held on the 18th October 2017.	The MCA did not require that the buoyancy chambers be ID marked, assuming 360° visibility of the ID markings on the turbines. It was noted that this would require agreement with the NLB.	The ID markings on the turbines will be visible from 360°, as stated in Section 5.5.
MCA Meeting held on the 18th October 2017.	The MCA require all turbine blades to be marked with red dots at 10, 20 and 30m, and for the blade tip to be painted red.	As per Section 6.4, each turbine blade will satisfy the MCA marking requirements.
NLB Meeting held on the 13th November 2017. *(Following changes to the planned developments schedule*	Each column of the semi-submersible steel structures should be fitted with a 5 nautical mile (nm) light with 360° visibility. These lights should be dimmable to 25%	As per Section 5.3 each column of the semi-submersible steel structures will be fitted with a light

Stakeholder	Point Raised	Where Addressed in this LMP
lighting and marking requirements were reconsidered with NLB).	output allowing the intensity to be reduced upon installation of intermediate structures.	satisfying the NLB requirements.
NLB Meeting held on the 13th November 2017.	A fog signal should be installed on each structure. Only certain fog signals will be active upon final commissioning, depending on whether Site 8 is utilised.	As per Section 5.7, each structure will be fitted with a fog signal, with those remaining active upon final commissioning to be agreed with NLB.
NLB Meeting held on the 13th November 2017.	Consideration should be given to installing warning signs on the structures to warn of subsurface hazards.	Signage plans are stated in Section 5.9.
NLB Meeting held on the 13th November 2017.	Each structure should be marked to indicate no-go areas for infield vessels.	Signage plans are stated in Section 5.9.
NLB Meeting held on the 13th November 2017.	Turbines at Sites 1, 3, 5, 7, and 8 should be fitted with 5nm lights.	The lighting scheme is detailed in Section 5.3.
NLB Meeting held on the 13th November 2017.	All lights and fog signals should be synchronised.	All Significant Peripheral Structure (SPS) lights will flash in synchronisation (Section 5.3). All aviation lights will flash in synchronisation (Section 6.3). All fog signals will sound in synchronisation (Section 5.7).
NLB Meeting held on the 13th November 2017.	A single RAL yellow paint should be used consistently for all turbines, however the NLB do not require a specific yellow.	As per Section 5.6, all turbines will be painted in RAL 1023 yellow.
NLB	Automatic Identification System (AIS) should transmit from turbines 1, 3, and 5, and	Turbines at sites 3, and 5 will transmit via AIS (as per Section 5.8). It is noted that AIS may be

Stakeholder	Point Raised	Where Addressed in this LMP
Meeting held on the 13th November 2017.	an OFCOM license should be obtained as such. The NLB stated that having all turbines transmit via AIS was not favourable as it may lead to confusion to passing mariners.	installed on all turbines for the purpose of tracking in the event of a turbine breaking free of its moorings, however only those at Sites 3, and 5 will transmit publically. Prior to final commissioning, the turbine at Site 1 will also transmit vis AIS.
NLB Meeting held on the 13th November 2017.	The NLB do not require the export cables to be marked with cable marker boards.	Export cable marker boards will not be utilised (see Section 5.10).
NLB Meeting held on the 13th November 2017.	Based on the length of the construction periods and the size of the site, the NLB do not require buoyage.	No buoyage is proposed during the construction phase other than that used to mark subsea hazards (see Section 5.4). No buoyage is proposed during the operational phase.
NLB Meeting held on the 13th November 2017.	The NLB raised the importance of Notice to Mariners, and timely issuing of navigational radio warnings. It should also be ensured that the UKHO are informed well in advance of the installations.	As per Section 5.2, NtM will be issued, including notifications to the UKHO.

4. PROJECT OVERVIEW

4.1. Introduction

This section provides an overview of the aspects of the KOWF that are relevant to this LMP. The KOWF site was given consent for eight potential turbines as positions shown in Figure 4.2 (noting that Site 4 is no longer under consideration as indicated in the figure, leaving seven positions, as shown in Figure 4.2). Two export cables will run from the turbines to the shore, at a landfall point south of Nigg Bay. The first being installed in 2018 and the second in 2019 – both with will buried to at least 1.5m below seabed or if not achievable will be protected by rock armour.

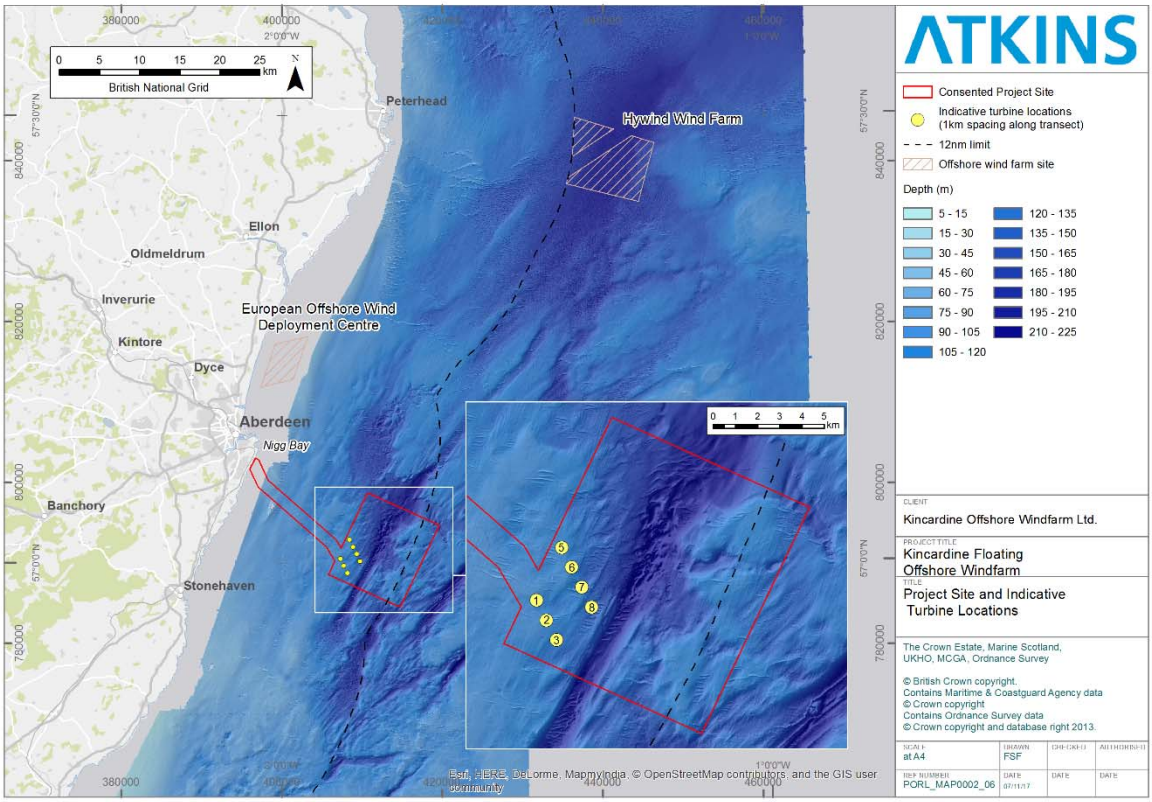

Figure 4.1 KOWF General Overview

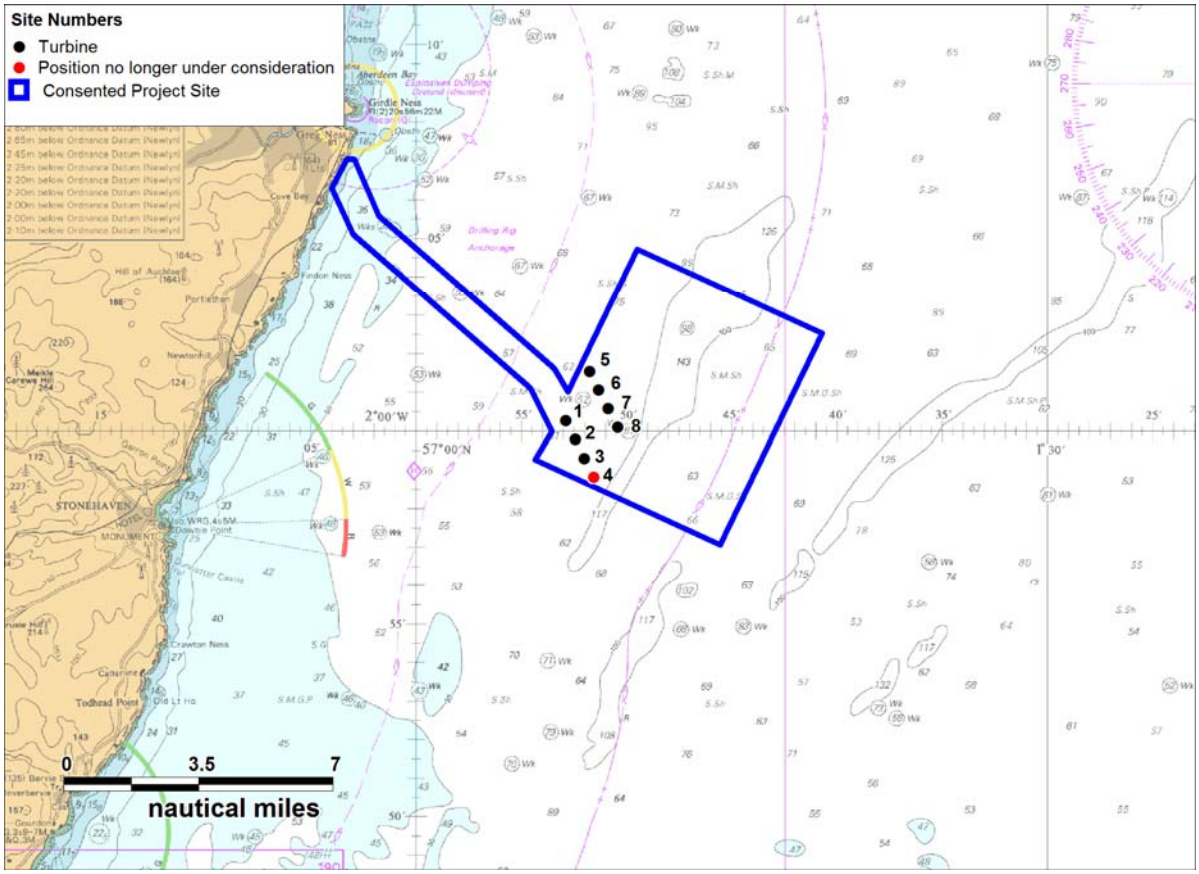

Figure 4.2 KOWF Turbine Locations

4.2. Construction Overview

Construction is anticipated to occur over three "Seasons", defined as Season 1 (Spring/Summer 2018), Season 2 (Spring/Summer 2019), and Season 3 (Spring/Summer 2020). Summaries of each Season are provided below, with an illustration of the anticipated final turbine layout shown in Figure 4.3.

The first turbine, a 2 MW demonstrator turbine prototype fitted on a semi-submersible steel substructure will be installed during Season 1 at **Site 1.** The turbine will be refurbished in Lisnave, Portugal, before being towed for outfitting, likely within a Moray Firth port. Once complete, the turbine will be towed to site during the summer of 2018. The first export cable and associated mooring system for the 2MW system will be installed prior to this, in May/June of 2018.

In Season 2, three turbines will be installed on semi-submersible steel substructures at **Sites 5, 6, and 7.** These are full size versions of the prototype installed in Season 1.

Finally, in Season 3, three turbines will be installed on SEMI-SPAR concrete substructures at **Sites 1, 2, and 3**. Prior to this, the demonstrator turbine at Site 1 will returned to port for a full marine warranty inspection and if approved moved back to site and onto Site 8. However if an extended marine

warranty is not obtained for the 2MW substructure, Site 8 will not be used for the development. This will be reflected in an updated LMP at this time.

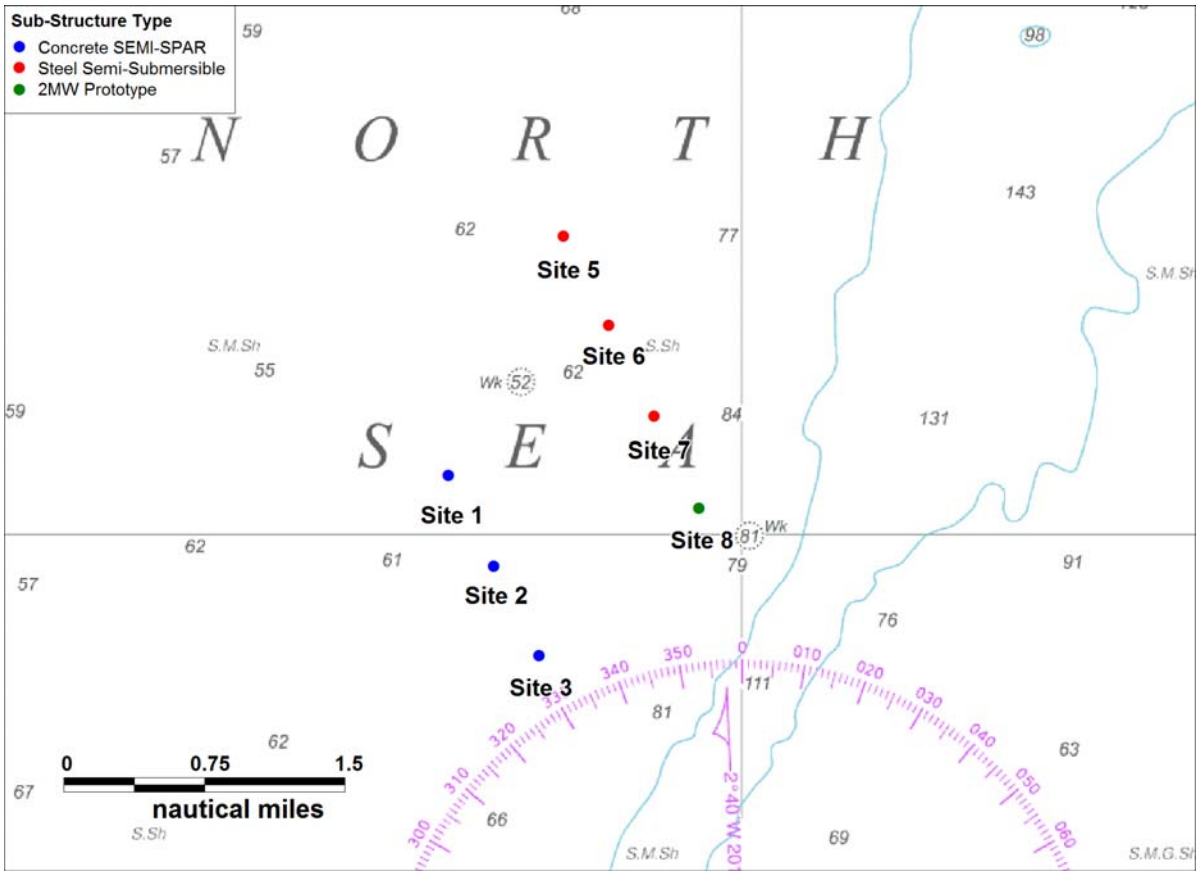

Figure 4.3 Final KOWF Summary Plot (Note season one will see 2MW prototype at Site 1)

It is noted the turbines could be moved between various sites following commissioning however all turbines will have the same lighting and marking installed (maximum requirements) so that they can be external Significant Peripheral Structures (SPS) or internal Intermediate Peripheral Structures (IPS) turbines. The MCA and NLB will be notified in writing of any significant changes (i.e. changes in substructure type locations) prior to the move.

4.3. Sub-Structure Types

For reference, sample figures illustrating the sub-structure types to be used are presented in Figure 4.4 and Figure 4.5. The steel semi-submersible sub-structures consist of three floating columns, orientated in a triangle (turbines one through four), with the turbine attached to one of the columns (and is therefore not central within the sub-structure). The concrete SEMI-SPAR structures (turbines five through seven) consist of a subsurface base, with the turbine positioned centrally on the structure.

Figure 4.4 Steel Semi-Submersible

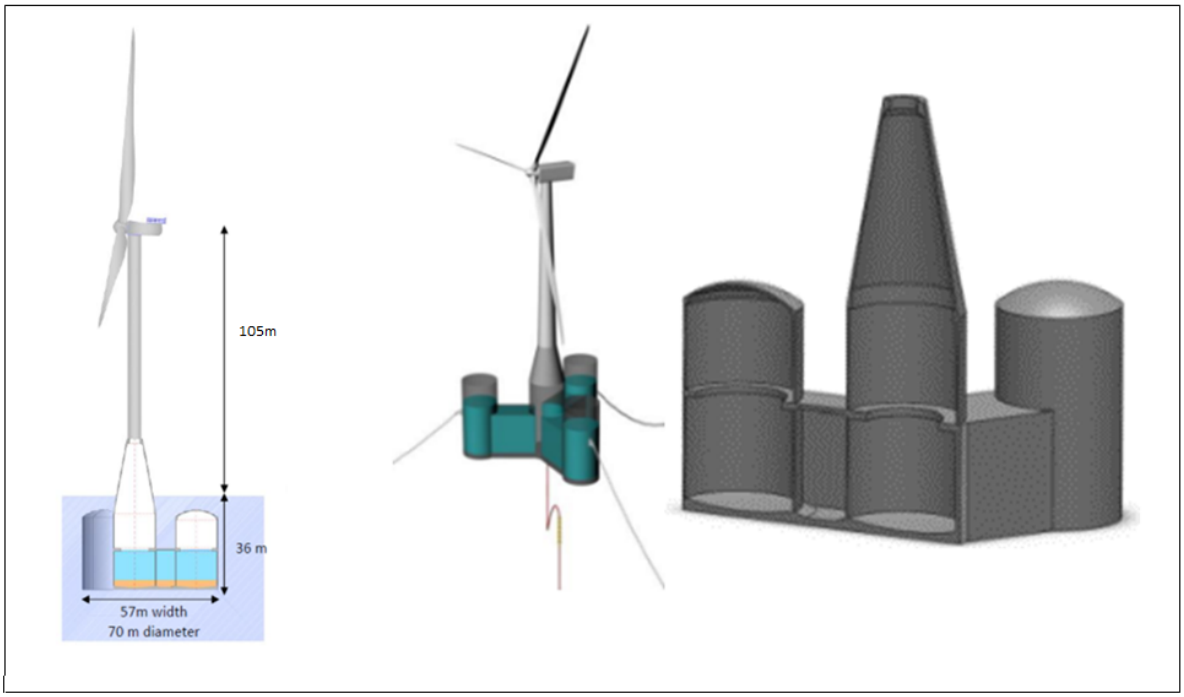

Figure 4.5 Concrete SEMI-SPAR

4.4. Construction Timeline

The anticipated construction timeline is summarised in Table 4.1. It should be noted that the periods presented are subject to change (for example in the event of adverse weather).

Table 4.1 Construction Timeline

Stage of Construction	Period
Installation of first export cable & moorings for turbine 1	May/June 2018
Installation of 2MW Demonstrator Turbine	Season 1 (Spring/Summer 2018)
Installation of second export cable and interarray cables	May/June 2019
Installation of moorings and Turbines on Semi-Submersible Steel Substructures (turbines 2-4)	Season 2 (Spring/Summer 2019)
Installation of mooring and Turbines on concrete SEMI-SPAR substructures (turbines 5-7)	Season 3 (Summer 2020)

5. MARINE NAVIGATION LIGHTING AND MARKING

5.1. Introduction

This section sets out the marine lighting and marking to be implemented during each operational season of the KOWF. The proposed lighting and marking has been designed to comply with the relevant MCA, and NLB guidance (see Section 3.1) for marking offshore wind farms, and also any additional relevant consent conditions (Section 2).

It should be noted that as turbines will be installed on a seasonal basis, operational lighting and marking must be agreed for each season with the NLB in advance of deployment. KOWL will also seek Statutory Sanction from NLB prior to exhibiting or altering any AtoNs as appropriate.

5.2. Promulgation of Information

Conditions 3.2.2.3, 3.2.3.3, and 3.2.4.3 of the Marine License require that KOWL notify relevant marine stakeholders (most notably the United Kingdom Hydrographic Office (UKHO)) of the progress of the project prior to commencement of construction, during construction, and once construction is complete, including via Notice to Mariners and KIS-ORCA. The details provided will include information in relation to the lighting and marking to be implemented.

At least seven days prior to the Commencement of the Works, stakeholders (including the UKHO, local mariners, fishermen's organisations and Aberdeen Coastguard Operations Centre) will be informed of the proposed works.

Due to the staggered nature of the construction of KOWF (see Section 4.2), information will be promulgated in advance of any of the following:

- Installation of any AtoN;
- Installation of any subsea infrastructure for each Season individually;
- Installation of the turbines for each Season individually;
- Commissioning of each Season's turbines individually; and
- The completion of construction works.

Full details of the promulgation of information to be undertaken will be provided in the Navigational Safety Plan.

5.3. Turbine Lighting

The NLB require that all turbines would be fitted with a five nautical mile (nm) light with the capability of being dimmed to 25% output, which will allow full flexibility in the positioning of turbines within the site locations. All turbines will therefore be fitted as follows:

- Yellow light with special mark characteristic (flash once every five seconds);
- Light to have range of five nautical miles;
- 360° visibility[1];
- Classed as IALA Category 1 (availability of at least 99.8%); and

[1] NLB indicated one light would be required on each column for the steel submersibles; the concrete SEMI-SPAR will require three lights on the turbine tower.

- Mounted at least 6m above Highest Astronomical Tide (HAT), and below the lowest point of the blade arc (and not more than 30m above HAT)

The 5nm lights will remain on full intensity unless designated as an IPS by NLB. Those turbines designated as IPS will have their 5nm lights dimmed to 25% intensity[2].

All marine aid to navigation lights will flash in synchronisation and be controlled (on/off) by a Supervisory control and data acquisition (SCADA) system.

It is also noted that all vessels associated with the construction of the KOWF will comply with marking requirements as adopted by the Flag State, most notably the International Regulations for the Prevention of Collisions at Sea (COLREGS 1972 as amended).

5.4. Buoyage

Based on the short durations of the construction periods during each Season, and based on the size of the site, it has been agreed with the NLB (13th November 2017, see Section 3.2) that no buoyage will be required to mark construction activities, or to mark the turbines once operational. However, temporary buoyage may be required to mark any subsea infrastructure that poses a temporary hazard to passing traffic prior to turbine installation (noting a guard vessel may also be used for this purpose in addition to, or instead of temporary buoyage). This will be agreed with the NLB in advance of implementation.

5.5. ID Markings

Each turbine will be assigned a unique ID which will be displayed on identification panels fitted to the turbines, with the alphanumeric characters visible from 150 metres (m) away (typically at least 1m in height), and shown in black over a yellow background. Multiple illuminated panels will be used per turbine to ensure the ID is clearly visible in all directions, and during both the daylight and night hours.

The IDs will be of the form KIN-XX, where XX is a unique number between 01 and 07, assigned as shown in Figure 5.1, which shows the final ID scheme. It is noted that due to Site 4 being removed from consideration in the scheme, and as the demonstrator turbine installed during Season 1 will potentially be moved to Site 8, ID markings do not exactly correspond to the Site positions. Therefore, ID markings will be fixed per Site (rather than turbine), and ID boards will be transferable between turbines should they change location so that positions will always align with charts and emergency documentations.

[2] Following consultation with NLB

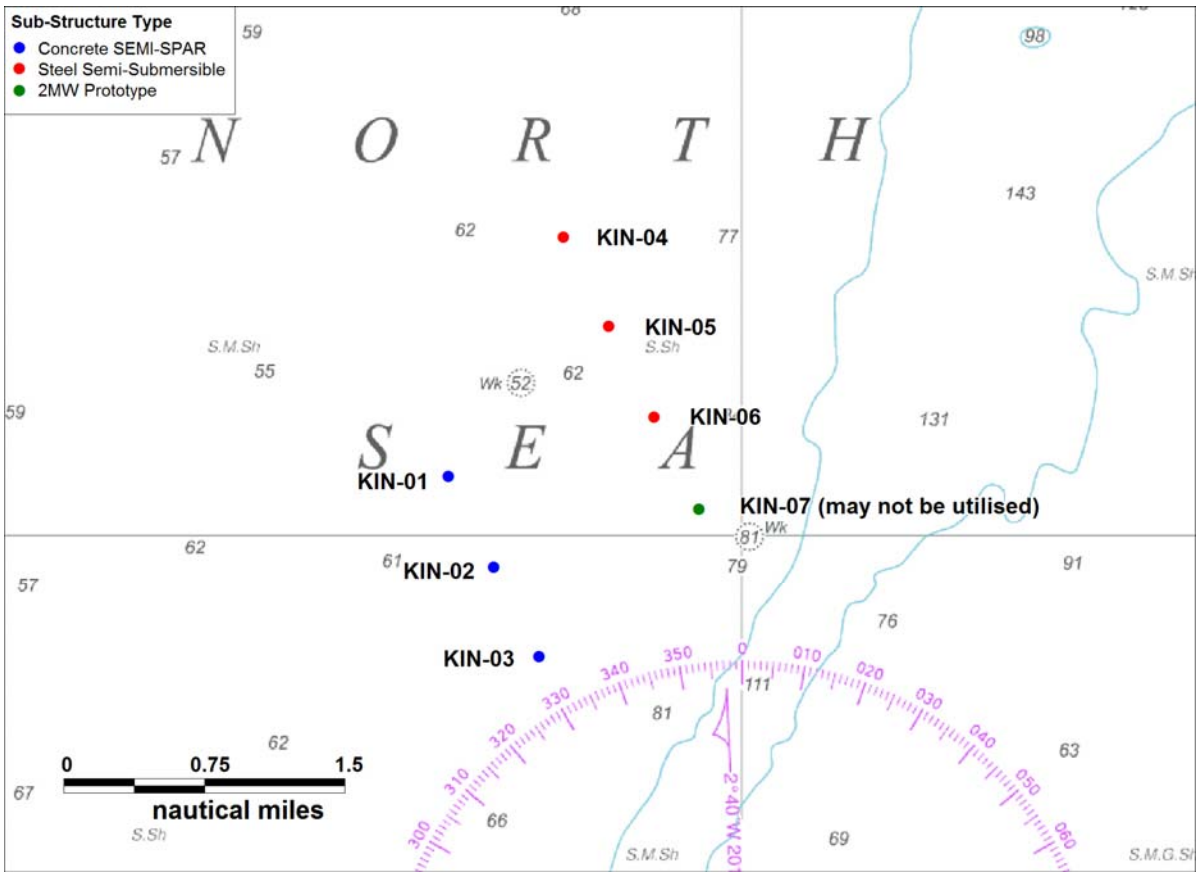

Figure 5.1 Final Turbine ID Markings

5.6. Paint

The turbine structure will be painted yellow (RAL 1023) in lead free pigmentation from a height of at least HAT to 15m above HAT. The portion of structure painted yellow may extend above 15m above HAT depending on engineering requirements; however this will be agreed with the NLB prior to finalisation. Sections of structure that will remain below Lowest Astronomical Tide at all times are not required to be painted. The remainder of the structure above the yellow paint will be painted light grey (RAL 7035) in lead free pigmentation.

5.7. Sound Signals

All turbines will be fitted with fog signals, however a number of these will be switched off upon final commissioning[3]. The turbine fog signals to be switched off will depend on whether Site 8 is utilised, however as a minimum, the signals on the southernmost and northernmost turbines (Sites 3 and 5 respectively) will remain on. The final layout of turbines requiring sound signals will be agreed with the NLB.

All fog signals will satisfy the following specifications:

- Range of at least two nautical miles;

[3] At NLBs request.

- Sound a Morse “U” every 30 seconds, with a minimum duration of the short blasts of 0.75 seconds;
- Classed as IALA Category 3 (availability of at least 97%); and
- Will be activated automatically when visibility falls below two nautical miles, as detected by the visibility metres.

5.8. Automatic Identification System (AIS)

It is proposed that the turbines at Sites 3, and 5 (Turbines KIN-03, and KIN-04, the southernmost and northernmost turbines respectively) broadcast via AIS, transmitting continually no later than from the point of commissioning of the corresponding Season’s turbines.

It is also proposed that the demonstrator turbine at Site 1 transmits via AIS, until KIN-03 begins AIS transmission in Season 3.

The AIS AtoN will be classed as IALA Category 3, and will therefore have a minimum availability of 97%.

It should be noted that AIS may be installed on all seven turbines for the purpose of tracking in the event of a turbine breaking loose from its moorings, however only those turbines listed above will broadcast publically to avoid confusion to passing mariners.

KOWL will apply for the relevant licenses from Office of Communications (OFCOM) in advance of the use of any AIS.

5.9. Signage

Warning signs will be fitted to all sub-structures indicating the presence of subsea infrastructure (including mooring lines). The signage installed on the concrete SEMI-SPAR substructures will also indicate the presence of the subsurface base, and warn approaching vessels to avoid the area surrounding the surface structure.

The relevant stakeholders will be made aware of the presence of cables, mooring lines, and other subsea infrastructure via various means including Notice to Mariners. This will include details of the intended installation dates.

Temporary buoyage (see Section 5.4) may also be used to mark any subsea infrastructure that poses a temporary hazard to passing traffic prior to turbine installation (noting a guard vessel may also be used for this purpose in addition to, or instead of temporary buoyage). This will be agreed with the NLB in advance of implementation.

5.10. Export Cable Marking

Following consultation with the NLB, export cable marker boards are not considered necessary. The location of the export cables (and also the mooring systems and interarray cables) will be submitted to the UKHO for inclusion on the appropriate charts.

5.11. Emergency Response – Marine AtoNs Reporting

In line with requirements associated with the management of marine AtoNs within Scottish waters, KOWL will maintain a record of the availability of all AtoNs associated with KOWF. Summaries of these

records will be provided to NLB in the event of any AtoN failure or loss of availability, as soon as it is practicable to do so.

KOWL, or a nominated contractor will be responsible for submitting the availability reports to the NLB. Specific details of other reporting requirements including notifications to local mariners are provided in the NSP.

In the event of a significant AtoN failure which may lead to a significant risk to navigational safety, additional temporary risk mitigation measures will be considered, including the use of a guard vessel until such time as the AtoN has been repaired or replaced.

6. AVIATION LIGHTING AND MARKING

6.1. Introduction

This section sets out the aviation lighting and marking to be implemented during the construction and operational phases of the KOWF. The proposed lighting and marking has been designed to comply with the relevant CAA and Defence Infrastructure Organisation guidance (see Section 3.1) for marking offshore wind farms and also any additional consent conditions relevant to aviation.

6.2. Promulgation of Information

Prior to the Commencement of the Development, and following the approval of the Development Specification and Layout Plan, KOWL will provide the UKHO with positions and heights of each of the turbines to be installed over the three construction phases, for aviation charting purposes. It is noted that the turbines will be installed in three separate Seasons; it is proposed that the relevant information of all turbines is provided to the UKHO prior to the installation of the first turbine.

Within one month of commissioning of each of the three Seasons, KOWL will provide the installed positions (accurate to three decimal places of minutes of arc) of the corresponding of turbines to the UKHO. There will therefore be three separate submissions of final positions to the UKHO.

There is also an international civil aviation requirement detailed in CAP437 (CAA 2016) for all structures over 91.4m to be reported to the Defence Geographic Centre (DGC) no later than ten weeks prior to construction. As discussed above, it is proposed that the relevant details of all turbines are provided to the DGC at least ten weeks prior to the first Season. Details will be submitted electronically to dvof@mod.uk, and will include:

- Type of structure;
- Name of location;
- Accurate position of structure;
- Maximum height AMSL;
- Lighting status; and
- Anticipated date of completion of construction, and removal (if applicable).

The maximum height of any construction equipment used is also required to be provided to the DGC.

To ensure aviation stakeholders are aware of the construction of the turbines while aviation charts are being updated, promulgation of the information listed above will also be undertaken in the form of a Notice to Airmen (NOTAM). KOWL will arrange this with the CAA Airspace Regulation (AROps@caa.co.uk / 0207 453 6599) no later than 14 days prior to construction. A NOTAM will be arranged for each of the three Seasons.

6.3. Lighting

Each turbine will be fitted with a medium intensity 2000 candela (cd) red light visible from 360°, and mounted as close as is reasonably practicable to the top of the nacelle, as per Air Navigation Order (ANO) Article 223 (CAA 2016b). In order to avoid confusion with the marine lights, and in line with standard marine practise and NLB recommendation, the red aviation hazard lights will flash Morse W with a five second sequence. All red aviation lighting will be synchronised across the turbines.

Where visibility is adjudged to be at least 5km in all directions (as indicated by the visibility meters fitted to the turbines as discussed in Section 5.7), the red aviation lights may be dimmed to no less than 10% of the original intensity. It is noted that the lights will also be able to be dimmed manually via the SCADA system if requested by the MCA for the purposes of Search and Rescue (SAR) operations.

Each red aviation hazard light will be active no later than upon commissioning of that Season's turbines.

6.4. Blade Marking

For the purposes of SAR operations, Annex 5 of MGN543 (MCA, 2016) requires the marking of all turbine blades with hover reference marks. In line with this guidance, the trailing edge of each blade will have three red marks at points 10, 20, and 30m from the hub end. These marks will have a minimum diameter of 600 millimetres. In addition, the tip of each blade will be painted red, up to a distance of approximately 2% of the total blade length. An indicative blade marking plan is presented in Figure 6.1.

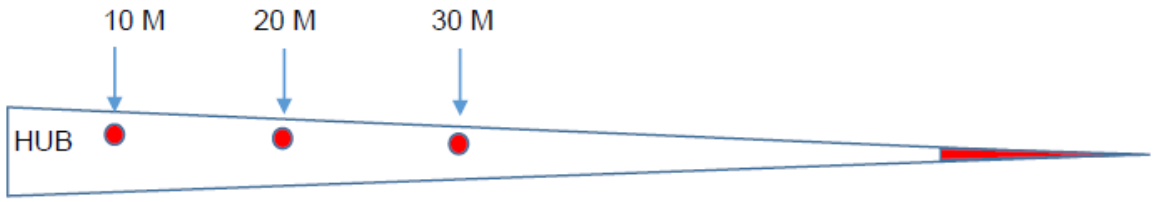

Figure 6.1 Indicative Blade Marking

6.5. Nacelle Marking

The ID number of each turbine will be clearly displayed on the roof of the nacelle, ensuring SAR helicopters can visually identify any given structure. The ID numbers will be as large as is reasonably practicable, but not less than 1.5m in height, and will be displayed on each turbine such as to be recognisable from an aircraft flying at a height of 150m above the highest point of the structure.

6.6. Emergency Response – Aviation Lighting and Marking Reporting

Article 223 (7) of the ANO (CAA 2016) states that "In the event of the failure of any light which is required by this article to be displayed by night the person in charge of a wind turbine generator must repair or replace the light as soon as reasonably practicable."

Details of procedures to be followed in the event of the failure of aviation lights fitted on wind turbines are detailed in CAP 764 (CAA 2016a). Where meteorological or sea conditions prevent safe access for the purposes of replacing or repairing a failed aviation light, such that the light will be inactive for a period of 36 hours or more, KOWL will arrange a NOTAM be issued. KOWL, or a nominated contractor will contact the NOTAM section of the UK Aeronautical Information Service (UK-AIS) (+44 (0) 20 8750 3773/3774, operated 24 hours) as soon as is reasonably practicable. The following details will be provided, with the UK-AIS also providing a copy of the information to the CAA:

- Name of the wind farm (as will already be recorded in the UK Aeronautical Information Publication (AIP));
- Identifiers of affected lights (as listed in the AIP) or region of wind farm if fault is extensive;

- Expected date of reinstatement; and
- Contact telephone number.

If considered necessary, KOWL may also make contact directly with local aviation stakeholders that may be affected (e.g., local air traffic service units, local airports or helicopter operators), providing the same information as was provided to the UK-AIS.

If aviation light is expected to be inactive for a period of greater than 14 days, KOWL or a nominated contractor will notify the CAA directly via windfarms@caa.co.uk to consult on and agree an appropriate strategy to be implemented until such a time as the light is repaired or replaced.

7. REFERENCES

CAA (2016a), CAP 764 – Policy and Guidelines on Wind Turbines. Feb 2016.

CAA (2016b), The Air Navigation Order (ANO) 2016, Statutory Instrument No. 765. Civil Aviation Publication 393. Aug 2016.

CAA (2016c), Civil Aviation Publication (CAP) 437 – Standards for offshore helicopter landing areas. Dec 2016.

IALA (2013), International Association of Lighthouse Authorities (IALA) 0-139 – The Marking of Man-Made Offshore Structures. Dec 2013.

International Maritime Organisation (COLREGS 1972). International Regulations for Preventing Collisions and Sea, as amended. 1972.

MCA (2016), Marine Guidance Note (MGN) 543 – Offshore Renewable Energy Installations – Guidance on UK Navigational Practice, Safety and Emergency Response. Jan 2016.

MoD (2014) Ministry of Defence Obstruction Lighting Guidance. November 2014.