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CONSULTING SERVICES

Inch Cape Wind Farm

Appendix 17A Aviation Lighting Requirements

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Executive Summary

ICOL is seeking consent for the Inch Cape Wind Farm and Offshore Transmission Works (the Development). The Development will comprise of an offshore array of Wind Turbine Generators (WTGs), connected to one another by subsea inter-array cables, which will in turn connect the WTGs to one or two Offshore Substation Platform(s) ("OSPs"), where power generated by the WTGs is transformed and subsequently carried to an onshore landfall location via Offshore Export Cables.

The worst-case design scenario used for assessment of aviation lighting requirements assumes that up to 72 WTGs will be populated across the Development Area at the maximum blade tip height being considered of (291 metres (m))(955 feet (ft)) above Lowest Astronomical Tide (LAT).

This report considers the aviation stakeholders, their operational and legal requirements, associated regulatory policy and guidance in order to identify potential lighting scheme solutions for the operational phase of the Inch Cape Wind Farm. The detailed scheme will be agreed in consultation with the Civil Aviation Authority (CAA) and the Maritime and Coastguard Agency (MCA) prior to construction.

A scheme covering the construction phase will be agreed separately once the construction plan is finalised; this is discussed briefly later in the report. The principles discussed for construction also apply to decommissioning, and will be considered at the appropriate time. The lighting requirement of the Development was considered against the following stakeholders:

- The Ministry of Defence (MOD) Defence Infrastructure Organisation (DIO) have requested within a response to the section 36 application for the wind farm[Reference 1] *"that all turbines be fitted with aviation lighting in accordance with Article 219 of the Air Navigation Order"*[1].
- The CAA is responsible for the national aviation regulations and guidance and publishes specific Civil Aviation Publications (CAPs) with key points on offshore aviation, including support to renewables. CAP764 Policy and Guidelines on Wind Turbines [Reference 3] provides additional guidance for the lighting of offshore obstacles, including WTGs. The Scoping Opinion [Reference 4] informed that the CAA either sent a nil return or stated that they have no comments to the Development.
- Search and Rescue (SAR) Operations, SAR flying units are important stakeholders as the requirement to demonstrate an effective and safe capability to mount airborne rescue from within an offshore wind farm has been recognised. Associated trials have been conducted and much of the guidance published is incorporated in this report. The CAA and MCA will want to ensure that SAR interests are accommodated.

[1] Civil Aviation Publication (CAP) 393 The Air Navigation Order 2016 and Regulations [Reference 2] provides regulations for the lighting of offshore WTGs in United Kingdom territorial waters within Chapter 2 Article 223 not Article 219.

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1 Aviation Lighting Requirements

1.1 General

Inch Cape Offshore Limited (ICOL) is seeking consent for the Inch Cape Wind Farm and Offshore Transmission Works (the Development). The Development will comprise of an offshore array of WTGs, connected to one another by subsea inter-array cables, which will in turn connect the Wind Turbien Generators (WTGs) to one or two Offshore Substation Platform(s) ("OSPs"), where power generated by the WTGs is transformed and subsequently carried to an onshore landfall location via Offshore Export Cables. The worst-case design scenario used for assessment of aviation lighting requirements assumes that up to 72 WTGs will be populated across the Development Area at the maximum blade tip height being considered of (291 metres (m))(955 feet (ft)) above Lowest Astronomical Tide (LAT).

1.2 Documents

Guidance for aviation marking and lighting requirements can be found in the following publications:

- Civil Aviation Authority (CAA) Civil Aviation Publication (CAP) 764 Policy and Guidelines on Wind Turbines [Reference 3];
- Maritime and Coastguard Agency (MCA) Marine Guidance Note (MGN) 543 safety of Navigation: Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response [Reference 5];
- MCA MGN 372 OREI: Guidance to Mariners Operating in the Vicinity of UK OREIs [Reference 6]; and
- CAA CAP 437 Standards for Offshore Helicopter Landing Areas [Reference 7].

1.3 Aviation Lighting Requirements

The regulatory requirements for the lighting of offshore WTGs are contained in CAP 393 The Air Navigation Order 2016 and Regulations [Reference 2] which requires that offshore WTGs of 60 m or more above the level of the sea at the Highest Astronomical Tide (HAT) and which is situated in waters within or adjacent to the UK up to the seaward limits of the territorial sea are fitted with Aviation Warning Lights. The CAA states that the person in charge of a WTG must ensure that it is fitted with at least one medium intensity (2000 candela) steady red light positioned as close as possible to the top of the obstruction (nacelle).

In general, offshore WTGs of 60 m and higher are required to be fitted with aviation obstruction lighting as follows:

- At least one medium intensity (2000 candela) steady red light positioned as close as possible to the top of the fixed structure;

- Where four of more WTGs are located together in the same group[2], with the permission of the CAA only those on the periphery of the group need be fitted with obstruction lighting. Such lighting, where achievable, shall be spaced at longitudinal intervals not exceeding 900 m; and
- The downward spread of light is restricted as far as possible to minimize any potential confusion with maritime lighting whilst maintaining flight safety.

When aviation lighting is displayed:

- The angle of the plane of beam of peak intensity emitted by the light must be elevated to between three and four degrees above the horizontal plane;
- Not more than 45% or less than 20% of the minimum peak intensity specified for a light of this type is to be visible at the horizontal plane; and
- Not more than 10% of the minimum peak intensity specified for a light of this type is to be visible at a depression of 1.5 degrees or more below the horizontal plane.

If visibility in all directions from every WTG in a group is more than 5 kilometres (km) the light intensity for any light required by Article 223 is to be fitted to any WTG in the group and displayed may be reduced to not less than 10% of the minimum peak intensity specified for a light of this type.

There is no current routine requirement for offshore obstacles to be fitted with intermediate vertically spaced aviation lighting; however, the CAA considers that if WTGs are above 150 m above sea level, additional lighting may be required. The CAA will consider such applications on a case by case basis.

When considering offshore lighting requirements for WTGs, the MCA should also be consulted. Recently there have been disparities between the maritime and aviation requirements for offshore lighting. To resolve concerns from the maritime community, work has been undertaken to develop an aviation warning lighting standard where, from the nature of the lighting, it will be apparent to mariners that the aviation lighting is clearly distinguishable from maritime lighting. Where it is evident that the default aviation obstruction lighting, above, may generate issues for the maritime community, through MCA consultation, a developer can make a case, that is likely to receive CAA approval, for the use of a flashing red Morse Code Letter 'W' to resolve potential issues for the maritime community. Where flashing lights are used, they are to be synchronised to flash simultaneously. Where the Flashing Morse W standard is approved by the CAA and utilised, the recommendation is for a 5 second long sequence, visually synchronised across aviation and maritime lighting sequences. 543 provides further guidance on the lighting of wind farms specific to the marine community which is considered within Chapter 15: Shipping and Navigation.

1.4 Helicopter Winching and Airborne Search and Rescue Operations

There may also be a lighting requirement associated with winching and Search and Rescue (SAR) operations:

[2] A WTG is in the same group as another WTG if the same person is in charge of both and
(1) It is within 2 km of that other WTG; or
[2] It is within 2 km of a WTG which is in the same group as that other WTG.

- Winching: The lighting needed to facilitate safe helicopter hoist operations to WTG platforms conducted by day in visual meteorological conditions consists of a helicopter hoist status light located on the nacelle which is capable of being operated remotely and from the WTG platform or from within the nacelle. The light consists of Low Intensity green lighting capable of displaying in both steady and flashing mode used to indicate to the pilot when the WTG is in a safe configuration to conduct hoist operations. A steady green light is displayed to indicate to the pilot that the turbine blades and nacelle are secure and it is safe to operate. A flashing green light is displayed to indicate that the turbine is in a state of preparation to accept hoist operations or, when displayed during hoist operations, that parameters are moving out of limits. When the light is extinguished this indicates to the operator that it is not safe to conduct helicopter hoist operations.

- SAR: The MCA through HM Coastguard provides emergency response within the Develoment area. The Wind Farm will be designed, operated and decommissioned as per MGN 543, including Annex 5 which details *'Standards and procedures for generator shutdown and other operational requirements in the event of a SAR, counter pollution or salvage incident in or around an Offshore Renewable Energy Installation (OREI)'*. An Emergency Response Co-operation Plan (ERCoP) based on the MCA template and site Safety Management Systems, in consultation with the MCA will be created. Procedures will be the followed in the event of an emergency during all phases of the Development.

1.5 Military Low Flying

The MOD may have concerns with regard to military low flying which is conducted within the UK Low Flying System (UKLFS). Whilst the mapped range of the UKLFS extends to 2 Nautical Miles (NM) beyond the UK coast line, military low flying activities may be conducted beyond this over the sea. As such, subject to verifying the precise location and height of structures above sea level, the MOD may request that structures featured in the scheme (such as platforms) are fitted with aviation warning lighting when there is no mandatory requirement for installation. This would serve to maintain safety in relation to defence aviation activities undertaken in the area.

1.6 Conclusions

Guidance and regulatory documents provided by the CAA and MCA detail the requirements for the lighting of offshore WTGs. The lighting characteristics as laid down in CAP 393, the Air Navigation Order 2016 and Regulations [Reference 2] and further clarified in CAA CAPs and MCA MGN's will be taken into account during the consenting and design phases of the wind farm.

2 References

Reference	Name	Origin
1	Letter in Response to Section 36 Application DIO Reference 10039940 13 December 2017	MOD (DIO)
2	CAP 393: The Air Navigation Order 2016 and Regulations Fifth Edition Amendment March 2018	CAA
3	CAP 764: Policy and Guidelines on Wind Turbines Version 6 February 2016	CAA
4	Marine Scotland Licensing Operations Team (MSLOT) Scoping Opinion for the Inch Cape Offshore Wind Farm – Revised Design Parameters 28 July 2017	MSLOT
5	MGN 543 OREI – Guidance on UK navigational Practice, Safety and Emergency Response January 2016	MCA
6	MGN 372 Guidance to Mariners Operating in Vicinity to UK OREIs August 2008	MCA
7	CAP 437: Standards for Offshore Helicopter Landing Areas Version 8 9 December 2016	CAA