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DRAFT Interim Guidance to mariners operating in the vicinity of UK Offshore Wind Farms

SUMMARY

This guidance note highlights issues that need to be taken into consideration when planning and undertaking voyages in the vicinity of United Kingdom offshore wind farms.

Key Points

- Wind farms present new challenges to safe navigation, but proper voyage planning and access to relevant safety information should ensure that life and vessel safety is not compromised.
- Information enables choices and reasoned decisions to be made.

Introduction:

- 1.1 The presence of wind farms and turbines in the marine environment is increasing. In January 2005 three farms are in situ with another 26 planned. These are mainly located in three strategic areas – East Irish Sea, the Greater Wash and the Thames Estuary – but with individual sites in other English, Welsh, Scottish and Northern Ireland areas.
- 1.2 The following information and considerations are offered so that Masters and Skippers may make a more informed risk assessment for their particular voyage. In pointing towards such information and considerations it aims to complement the guidance on voyage planning found in other publications, particularly in the implementation of SOLAS V Regulation 34, and it's associated Annex 24 contained within the MCA special publication on SOLAS V implementation.

This is readily accessible on the MCA website.

- 1.3 Mariners are reminded of their obligation to navigate safely at all times, and this guidance aims to assist in the discharge of that obligation. It is necessary to apply a caveat to this guidance, in that it is of a generic nature, based on the information available at the time of publication. Site specific detailed information may vary, and additional information may become available as experience is gained in the exploitation of this emerging renewable energy resource. It is anticipated that this MGN will be regularly reviewed and updated as required. Any urgent maritime safety information relating to offshore wind farms will be disseminated through existing maritime safety information channels of communication such as radio navigation warnings.

Marking of Wind Farms and turbines

- 2.1 Wind Farms and the wind turbines therein are readily identifiable both visually and by radar from a considerable distance in good meteorological conditions. The turbines typically comprise a foundation (tidally obscured), a transition piece painted yellow all

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round from the level of Highest Astronomical Tide (HAT) to 15 metres surmounted by a platform, then the turbine tower - typically 70 - 80 metres in height. At the top of the turbine tower is the nacelle, a box shaped structure housing the generator. The turbine blades are located opposite the nacelle. Everything above the yellow painted transition piece is painted in a matt grey colour.

- 2.2 The turbine height is currently up to about 150 metres tall, so the theoretical geographical range for an observer with a height of eye about 3 metres above sea level is in the order of 28 nautical miles. This, however, represents the blade tip height, the more substantial nacelle - at about 70 metres, has a theoretical geographical range for the same observer of about 20 nautical miles. Clearly, such ranges are indicative in prime conditions and will vary according with weather. Mariners should be guided accordingly.
- 2.3 Closer to the wind farms mariners will encounter standard aids to navigation as specified by the General Lighthouse Authorities (GLA). In turn, these will conform to guidance issued by the International Association of Lighthouse Authorities – “Offshore Wind Generators should be marked so as to be conspicuous by day and night, with consideration given to prevailing conditions of visibility and vessel traffic”. In practical terms, mariners can expect to encounter cardinal marks with the consequent obligation to pass in the appropriate quadrant.
- 2.4 At night, wind farms will be marked again as required by the GLAs. A “corner” or other significant point on the boundary of the wind farm is called a Significant Peripheral Structure (SPS). Every individual SPS should be fitted with lights visible from all directions in the horizontal plane. These lights should be synchronized to display an IALA “special mark” characteristic, flashing yellow, with a range of not less than five (5) nautical miles.
- 2.5 As a minimum, lights on individual SPSs should exhibit synchronised flashing characteristics, however in some cases there may be synchronisation of all SPSs. In the case of a large or extended wind farm, the distance between SPSs should not normally exceed three (3) nautical miles.
- 2.6 Selected intermediate structures on the boundary of a wind farm other than the SPSs, should be marked with flashing yellow lights which are visible to the mariner from all directions in the horizontal plane. The flash character of these lights should be distinctly different from those displayed on the SPSs, with a range of not less than two (2) nautical miles. The lateral distance between such lit structures or the nearest SPS should not exceed two (2) nautical miles. The chart will identify the characteristics of the lights displayed at a particular windfarm.
- 2.7 In addition to the use of lights for marking the SPSs and selected intermediate peripheral structures of a wind farm, IALA permits consideration for the use of:
 - Lighting all peripheral structures;
 - Lighting all structures within the wind farm (see below)
 - Racons;
 - Radar Reflectors and Radar Target Enhancers; and/or

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- Automatic Identification System (AIS) as an Aid to Navigation (as per IALA Recommendation A-126).
- 2.8 Sound signals may be made at some wind windfarms. The typical range of such a sound signal should not be less than two (2) nautical miles. Again, the chart will provide details.
- 2.9 Mariners navigating within a wind farm can expect to see individual turbines marked with an individual identifier numeral which should be able to be clearly seen from a distance of not less than 150 metres. At night, this individual turbine identifier will be lit discretely, (probably with down lighters), enabling it to be seen at a distance of not less than 150 metres.
- 2.10 Overall, wind turbines should be readily visible in good conditions but mariners are cautioned that they may not be so readily identifiable at night or in reduced visibility from the wind farm interior.
- 2.11 All offshore wind farms will be charted on charts published by the UK Hydrographic Office. Mariners should note the newly approved chart symbol used by the UK Hydrographic Office, and International Hydrographic Organisation. (It looks like a turbine tower - with a rotor attached, in a magenta colour). For definitive guidance mariners should consult NP 5011 Symbols and Abbreviations used in Admiralty Charts, available from Hydrographic Office agents. Additionally, submarine cables associated with the wind farm will be charted. Clearly, mariners should recognise the potential hazard associated with anchoring in proximity to these charted cables. This is no different to any other charted submarine cable that exists at present. The Hydrographic Office may additionally add notes on the chart relating to wind farms to be found on that chart. Mariners should be guided by such information.

Effects of Wind Farms and Wind Turbines with routeing options

- 3.1 In planning their voyage route mariners make an assessment of the hazards, and consequent risk, associated with their prospective passage. The presence of wind farms and turbines in the marine environment should not alter this fundamental principle. Such a presence does add to the considerations that need to be taken into account. This section provides information about the effects of wind farms and their turbines and offers considerations for routeing that may be necessary.
- 3.2 Turbines within a wind farm have an inter turbine spacing of about 700 metres or greater. This is because as they harvest the wind energy, turbines create a down wind wake effect. They seek to efficiently exploit the wind resource so inter turbine spacing is related to rotor size and the wash created. In general terms, the larger the rotor the greater the inter turbine distance. It is clear that small craft may be able to safely navigate within the wind farm boundaries, whereas larger craft will need to remain clear.
- 3.3 Wind turbines within wind farms that are presently operating or are planned are located in relatively shoal water, often on sand banks. Where this is the case, the inter-relationship between a vessel's draught and the depth of water available provides a natural control between vessels and turbines. Conversely, it may also constrain vessels to a particular passage that obliges them to close a wind farm boundary by being denied the option of standing off from the wind farm. The inter-relationship of draught to depth of

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water available is a normal consideration for mariners and their customary awareness should be maintained.

- 3.4 In a similar manner, the turbines may affect the depth of water in their locale. In dynamic seabed areas with appropriate tidal streams, scouring of the sea bed may occur. This may result in depth information being unreliable. Once a wind farm has become established for, say, five years, there will be a better appreciation of any tidal scour or changes in sedimentation. As part of their consent, wind farm developers are required to make an assessment of any potential changes in sedimentation that may occur as a consequence of their plans. Whilst developments will be permitted where this is considered tolerable, modelling of scouring and sedimentation is just that, and empirical evidence may prove otherwise. It is however anticipated that such an impact will be localised, but mariners may wish to stand off at an appropriate distance in relation to their draught.
- 3.5 Similarly, the presence of turbines in the marine environment will obstruct tidal stream flow, creating eddies in close proximity to the turbines. Mariners should alert to the presence of such eddies which are expected to be only significant in very close proximity to the individual turbines. To remain well clear is a prudent precaution.
- 3.6 Notwithstanding these potential navigational challenges, small craft may be encountered within a wind farm or emerging from it. Service craft will be involved in turbine maintenance and safety duties, and fishing vessels, for example potting craft, may be conducting their business. Other mariners need to be alert to the potential presence of such vessels, particularly as they may be visually obscured by the turbines. This is particularly relevant at night. Foul weather may reduce the likelihood of encountering such vessels but will not discount it fully. The potential for visual masking of vessels by the turbines and auxiliary platforms does not only apply to small vessels. Even large vessels on opposing sides of a wind farm may be periodically obscured. A good lookout should be maintained at all times by all available means, as required by the International Regulations for the Prevention of Collision At Sea (COLREGS). This is particularly important as the presence of the turbines may be a distraction initially, but then once accepted may become an accustomed presence that masks risk.
- 3.7 The visual masking by the turbines does not only apply to vessels but also to shore marks in coastal areas. Mariners navigating in such areas will need to be particularly alert to this potential challenge. In particular, the characteristics of lights at night may need careful verification if turbines temporarily mask their characters. Mariners may wish to verify their position by alternative means if navigating solely using lights at night when in proximity to an offshore wind farm.
- 3.8 Within the larger wind farms an offshore electrical sub station may be encountered. These will be similar looking to mini offshore production platforms. Buried submarine cables inter link turbines to this sub station from whence it is exported to the shore. These submarine cables may not necessarily be charted, it will depend upon the scale of the chart, - the export cable only being shown on the chart. Mariners of small craft operating within a wind farm should avoid anchoring except in when extremis. There is potential for a foul anchor.

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Communications and Navigation systems

- 4.1 In the Summer 2004 the MCA, together with Qinetiq, conducted trials at the North Hoyle wind farm, (off North Wales), to determine the impact of turbines upon marine communications and navigations systems. The results are offered in précis form to inform mariners as to potential impacts for their particular voyage. The full report is available on the MCA web site.¹
- 4.2 The results of the trials indicate that there is minimal impact on Very High Frequency (VHF) radio, Global Positioning Systems (GPS) receivers, cellular telephones (clearly if within cellphone range), and Automatic Identification Systems (AIS). As with any similar obstruction, UHF (and microwave) systems suffered from masking if turbines were within the line of sight transmissions.
- 4.3 It was found that the turbines present clear and readily identifiable radar returns from distance giving mariners unambiguous and early warning of the presence of the turbines. Unfortunately, as the range is closed towards the turbines the trials ascertained that the turbines provide erroneous returns to radar transceivers. Multiple side echoes may be generated that have the potential to mask real targets. The onset range from the turbines of these returns is about 1.5 nautical miles, with a progressive deterioration in the radar picture as the turbines are closed to about 500 metres. Target size and bearing discrimination of the turbine echo increases with the proximity to the turbine with a consequent degradation of the target. These effects were encountered on both 3cm and 10 cm radars.
- 4.4 Adjustment of the radar controls can filter out some of these unwanted radar returns but comes at the cost of potentially losing small radar cross sectional targets such as buoys or small craft – particularly yachts or GRP constructed craft. Mariners are cautioned accordingly.
- 4.5 If mariners experience such erroneous returns on their radars they should consider their responsibilities in accordance with the COLREGS, particularly Rule 6 (Safe Speed), and act appropriately. If operating in restricted visibility, and being subject to Rule 19, compliance with Rule 6 becomes especially relevant. In these latter circumstances it is appropriate to take into account Rule 5, which introduces the need to take into account information derived from other sources. Hearing (sound signals), VHF information - for example from a VTS, and AIS all become complementary information sources in such circumstances. It is not the purpose of this MGN to be prescriptive but it is to point the mariner towards information sources that assist in the risk assessment for his particular voyage, and also the dynamic circumstances that may affect that risk assessment. Mariners should be guided accordingly.

Rotor effects

- 5.1 A requirement for offshore wind turbines located around the UK is that the lowest point of the rotor sweep should not be lower than 22 metres above Mean High Water Springs. This clearance should provide comfort to the majority of small craft and particularly sailing vessels that customarily are to be found around UK. Vessels with a greater air

¹ www.mcga.gov.uk/c4mca/northhoyle_ver_2.pdf

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draught are cautioned accordingly, and those vessels with a significantly variable air draught should take appropriate care if they consider that they may be at risk. It is considered imprudent that such vessels would in any event be so close to a turbine, other than through force majeure.

- 5.2 Clearly, the purpose of wind turbines is to harvest the energy of the wind. As a consequence turbines de-power the wind and a 10% reduction in wind velocity has been predicted from research undertaken by Powergen. This wind shadow effect was predicted to be similar throughout the air column up to heights of 15 metres. The impact of this wind shadow varies with the down wind distance from the turbine – indeed the inter turbine spacing reflects the consequences of rotor wash or wake. The width of the rotor wake is about 150 metres which is broadly similar to the rotor diameter. As the rotor wake interacts with the sea at sea level further shadow effects are predicted. The wind, having changed its flow through the turbines rotor, can be expected recover downwind of the turbine. Consequently, wind sheer may be anticipated as the wind back fills.
- 5.3 In simple terms, the impact of a turbine rotor harvesting the wind can be pictured as a cone, centred on the rotor hub with a diameter approximating to the rotor diameter then extending down wind, attenuating to a point distanced from the turbine depending upon the wind velocity. This down wind effect will be also dependent upon the azimuth of the rotor. The impacts experienced also will be proportional to a vessel's windage or a sailing mast head height.
- 5.4 In practical terms mariners need to be vigilant to these potential effects, particularly yachtsmen. By day, in appropriate weather, the customary visual clues should be noted. Additionally, changes in leeway or the balance of tidal stream to wind power can be reasonably anticipated. Safety may be assured by vigilance and alertness so that the resulting dynamic risk assessments preserve the safety of the vessel. At night, when the visual clues so characteristically used by yachtsmen are not so readily available it may be appropriate to carefully consider or re-evaluate risks.

Safety Zones or Exclusion Zones

- 6.1 At present there are no safety zones or exclusion zones around UK offshore wind farms or the turbines therein.
- 6.2 Temporary safety zones will be established around wind farm construction operations when required. This is no different to customary practice during offshore construction works. Such safety zones will be promulgated by Notices to Mariners and radio navigation warning broadcast messages issued in the usual way. These safety zones will be monitored by support craft. Mariners will be invited to remain well clear of such zones in the tradition of the sea.
- 6.3 Exclusions zones are not expected to be established without reasonable cause. Compelling risk assessed arguments would be required for their establishment. At present, it is most unlikely that exclusions zones around whole wind farms are justifiable, although it may be appropriate around individual turbines to a limited distance. Additionally, it may be necessary to limit access to specific activities such as trawling where risk mitigation may require restriction of such activity. Where this is the case any such exclusions will be promulgated separately. It is not for this generic guidance to

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provide detail, but in due course a tabular annex to this MGN could incorporate any such detail as wind farms become established. It is anticipated that the Hydrographic Office will publish site specific information on their charts and in their publications.

- 6.4 Mariners should be aware that there is no right of access to wind turbines. They are private property and appropriate warning signs are displayed. In any event access to individual turbines is challenging, being limited by sea state, and is best undertaken in controlled circumstances by trained personnel.

In extremis

- 7.1 Notwithstanding such access constraints, mariners may when in extremis seek refuge on turbine towers. Access is via long vertical ladders which may well be encrusted with marine growth in the inter-tidal zone. There are risks in boarding turbines in any circumstances, - it is difficult, but turbine towers may provide refuge if the circumstances require. Shelter may be found on the platform around the turbine permitting some flexibility to evade the prevailing elements pending rescue. Internal access to the turbine tower will not be available.
- 7.2 If taking refuge on a turbine tower mariners are cautioned that the rotors will continue to turn until others become aware of their plight. In such distressed circumstances mariners should alert HM Coastguard by the best means available, remembering that the turbine tower may obscure line of sight communications, so they may need to adjust their position on the turbine platform appropriately or temporarily.
- 7.3 Once alerted, HM Coastguard have direct communications links to the wind farm operations control room which can remotely control individual turbines permitting their shut down. Wind farm operators are obliged to have an active safety management system that requires them to park rotor blades in a suitable configuration to permit helicopter approach for access for the winchman. Irrespective of this capability, there may be occasions when the prevailing circumstances preclude the safe evacuation of distressed personnel from turbines by rescue helicopter. In such conditions, mariners may have to await evacuation by sea – when sea conditions permit.
- 7.4 Mariners responding to a distress call or alert from others within a wind farm or on a turbine should make a careful assessment of the risks associated with entering a wind farm, taking guidance from the considerations outlined above in this MGN. Large or unmanoeuvrable vessels may be unable to be requisitioned but all vessels should invariably respond as law requires.

Choices

- 8.1 It is not for this guidance to be prescriptive. Mariners must make their choice and their decisions should be reasoned on the information available, hence this guidance. In simple terms there are three options for mariners:
- a) Avoid
 - b) Skirt around
 - c) Go through

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- 8.2 The choices will be influenced by a variety of circumstances – their vessel’s characteristics (size, draught, manoeuvrability etc), weather, their domain tolerances, probability of encounters, indeed the usual influences that affect their voyage planning.
- 8.3 Similarly, prescriptive definition of what is a safe distance from which to pass from a wind farm cannot be offered, as the same influences (above) prevail. The only definitive safe distance that can be specified is that declared in any exclusion zone that may be authorised around turbines.
- 8.4 It is appropriate to repeat one aspect of this guidance in relation to avoidance. Mariners should avoid anchoring in the vicinity of charted cables – particularly the high voltage power export cable.

Way ahead

- 9.1 This guidance may be updated in due course, as we gain more experience of co-existing with these structures in the marine environment. Problems of an urgent nature relating to wind farms should be reported immediately to HM Coastguard. Mariners may wish to report effects or other problems they encounter to the Navigation Safety Branch of the MCA.

Conclusion:

Although wind farms present new challenges to safe navigation, proper voyage planning and access to relevant safety information should ensure that life and vessel safety is not compromised.