CSPCWG2-INF 2

The Marking of Offshore Wind Farms

Submitted by:	Chairman (from IALA via IHB)
Executive Summary:	Provide guidance for a response to IALA.
	Does the Related Project reference have any impact on M-4?
Related Documents:	M-4 B445.8 & .9 (& B 374.6 for on-shore wind farms).
Related Projects:	IALA revision of Recommendation O-117, edition2 (Dec 2004)

Introduction / Background

The IHB has received a copy of IALA recommendation O-117 on "The Marking of Offshore Wind Farms" (Annex A). IALA wished to draw IHO attention to this matter and they are expecting comments.

Analysis/Discussion

Charting of offshore wind farms was addressed by CSPCWG over the past year and resulted in M-4 Specifications B445.8 and B445.9 (Annex B). These specifications have been adopted by IHO MS (IHO CL 14/2005 refers). Additionally, specification B374.6 was also adopted, which addressed "on-shore" wind farms/turbines.

The issue is whether IALA recommendation O-117 has any impact on M-4.

Conclusions - *Analysis not yet undertaken.*

Also, are there any considerations relevant for underwater turbines (current / turbine field - B445.10 and .11) and / or onshore wind farms.

Recommendations

Chairman to provide a response to IALA.

Justification and Impacts

1. Improve collaboration on technical matters with IALA.
2. Review if there is any impact on the recently revised specification of M-4.
3. Identify any other CHRIS WGs that may need to be consulted.
4. If appropriate, assign a priority and target completion date.

Action Required of CSPCWG

The CSPCWG is invited to provide guidance to the Chairman in the progress of this matter.

International Association of Marine Aids to Navigation and Lighthouse Authorities

AISM Association of Internationale de Signalisation Maritime **IALA**

IALA Recommendation O-117

On

The Marking of Offshore Wind Farms

Edition 2

December 2004

(Edition 1 issued May 2000)

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Document Revisions

Revisions to the IALA Document are to be noted in the table prior to the issue of a revised document.

Date	Page / Section Revised	Requirement for Revision
Oct 2004	Overall Document revised for format and readability. Definitions added Details on marking requirements clarified	Introduction of large offshore wind farms has led to a requirement for more detailed guidance on their marking. Trials indicate interference problems with radars.

IALA Recommendation on the marking of offshore wind farms

THE COUNCIL

NOTING the function of the Association with respect to the safety of marine navigation, the efficiency of maritime traffic and the protection of the marine environment;

NOTING ALSO the provisions contained within the IALA Maritime Buoyage System (MBS), and other IALA Recommendations and IALA Guidelines;

RECOGNISING the increase in the number of areas with multiple wind generators (classed as wind farms) being established and the consequent increased danger posed to navigation;

RECOGNISING ALSO that it is a matter for National Authorities to assess the navigational requirements and the risks involved and decide on how wind farms need to be marked;

RECOGNISING FURTHER that marking of wind farms is intended to preserve the safety of navigation, the marine environment and to protect the wind generators themselves;

HAVING CONSIDERED the proposals by the IALA Aids to Navigation Management Committee, and taking into account the IALA Recommendation O-114 on the marking of Offshore Structures (May 1998);

RECOMMENDS that:

1 - 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;

2 - National Members take into consideration the Annex to this Recommendation when marking offshore wind farms.

Annex

The marking of offshore wind farms

1 Introduction

There are an increasing number of structures, which may affect shipping. IALA is monitoring the developments of these structures and will continue to create and update documentation as required to ensure clear and unambiguous marking of waterways for safe navigation, protection of the environment and protection of the structures themselves. Authorities facing problems in this field are invited to bring them to the attention of IALA to obtain advice on current practice.

1.1 Background

The initial recommendation on the Marking of Wind farms was published in May 2000. At this point offshore wind generators were comparatively rare and "farms" were comparatively small. In the intervening years many national authorities have made decisions to increase the percentage of renewable energy generators. This has resulted in many offshore banks and navigable waters being designated for wind farm installation. The number of generators in such farms has also increased and some farms have proposals for hundreds of wind generators.

1.2 General

Consultation between the stakeholders such as Developers, National Administrations, Lighthouse Authorities, Aviation Authorities, AtoN providers, Competent Authorities and wind farm contractors and developers should take place at an early stage. In general, development of offshore energy structures or wind farms should not prejudice the safe use of Traffic Separation Schemes, Inshore Traffic Zones, recognised sea lanes and safe access to anchorages, harbours and places of refuge. On a case-by-case basis, National Authorities may consider establishing Exclusion or Safety Zones, which would prohibit or restrict vessels from entering wind farms. Such information should be shown on the navigation chart, as appropriate.

In order to avoid confusion from a proliferation of Aids to Navigation in a high-density wind farm, full consideration should be given to the use of synchronised lighting, different light characters and varied light ranges.

Some IALA members have carried out trials on wind farms to identify if interference to radar, radio navigation and radio communications is experienced. Trials indicate that wind farm structures affects shipborne and shorebased radar systems. This interference returned radar responses strong enough to produce interfering side lobe, multiple and reflected echoes. Bearing discrimination was also reduced by the magnitude of the response. It has been determined that passage close to a wind farm boundary, or within the wind farm itself, could affect the vessel's ability to fully comply with the International Regulations for the Prevention of Collisions at Sea. Administrations / developers should keep this information in mind when designing wind farms, and they may wish to carry out individual trials to verify the impact of the wind farm on navigation.

There has been some evidence that scouring at the bases of wind generators in areas of strong tides or currents has resulted in significant deposits of material in other locations. Some authorities have insisted on fitting depth monitoring devices to wind generators to measure scour. This may need to be considered when approving wind farm proposals/locations.

2 Scope

This recommendation is for the guidance of stakeholders such as Developers, National Administrations, Lighthouse Authorities, Aviation Authorities and other competent Authorities, AtoN providers, and wind farm contractors and developers.

3 Definitions & Acronyms

Wind Generator - any individual surface structure, usually consisting of an embedded mast or tower with rotating blades and incorporating a generator.

Wind Farm - a group of individual wind generators, which are located in one block and are considered to be a unit.

Significant Peripheral Structure (SPS) - the "corner" wind generator on a rectangular wind farm or other significant point on the periphery of a wind farm.

Transformer Station - a special structure within or outside the wind farm to which the individual wind generators are connected via power cable. Power is transferred ashore from the transformer station by submarine cable.

4 Considerations During Construction

During the construction of an offshore wind farm, working areas should be established and marked in accordance with the IALA Maritime Buoyage System (MBS). National Authorities should also consider the use of guard ships in areas of high traffic density.

Notices to Mariners, Radio Navigational Warnings and Notices to Airmen must be promulgated in advance of and during any offshore wind farm construction.

Power cables between wind generators, between wind generators and the transformer station, and between the transformer station and the shore should be sufficiently trenched to avoid exposure from scouring / sand migration or trawling activities.

5 Marking of Individual Structures (Wind Turbines)

The tower of every wind generator should be painted yellow all round from the level of Highest Astronomical Tide (HAT) to 15 metres or the height of the Aid to Navigation, if fitted, whichever is greater.

Alternative marking may include horizontal yellow bands of not less than 2 metres in height and separation.

Consideration may be given to the use of additional retro reflective material.

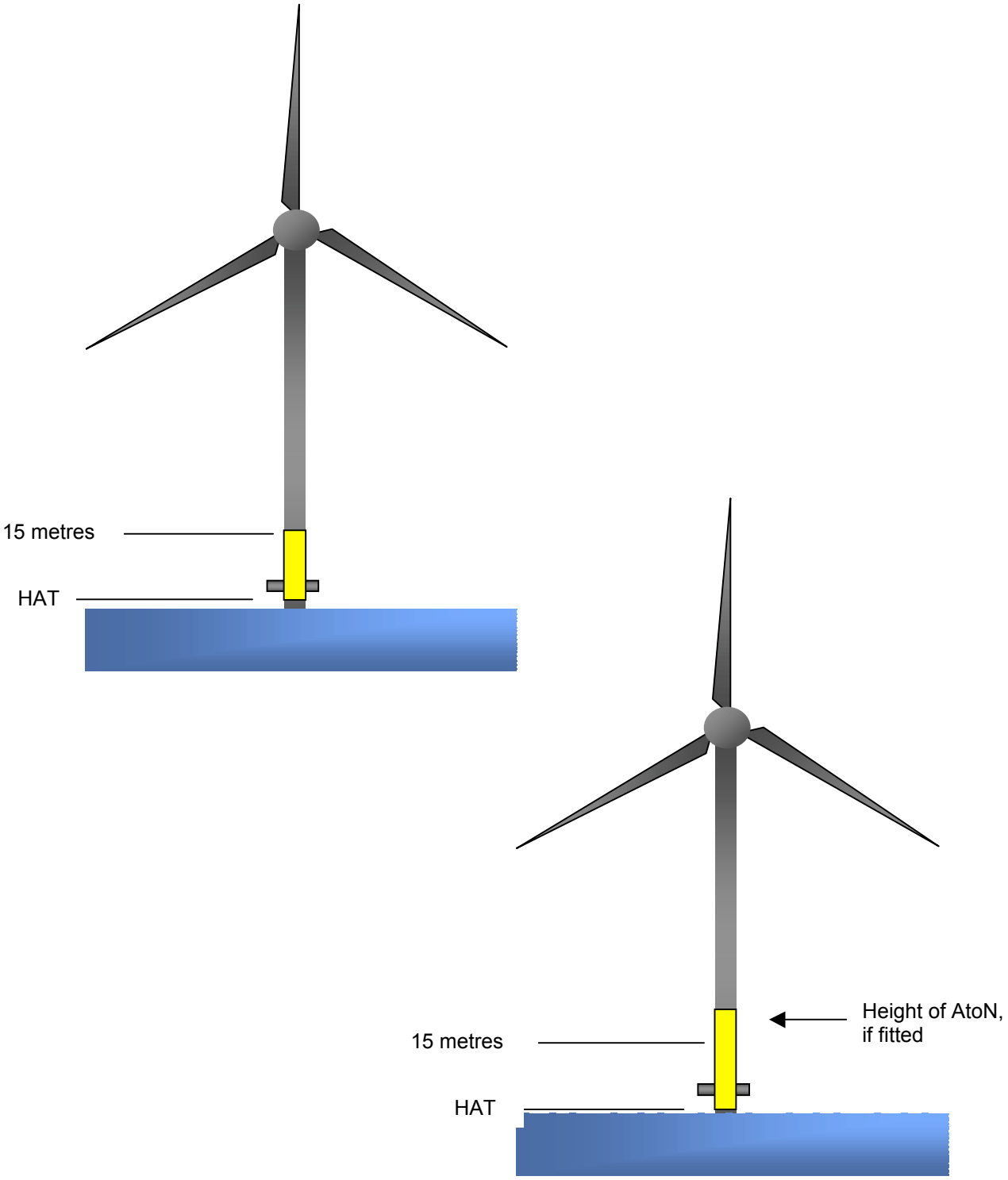
Due to the increased danger posed by an isolated structure, it should be lighted as per the IALA Recommendation on the marking of Offshore Structures(0-114) i.e. a white light flashing Morse code "U".

5.1 Aids to Navigation for marking Individual Structures

The Aids to Navigation on the structure of a wind generator should be mounted below the lowest point of the arc of the rotor blades. They should be exhibited at a height above the level of the Highest Astronomical Tide (HAT) of not less than 6 metres or more than 15 metres.

Aids to Navigation on wind turbines should comply with IALA Recommendations and have an availability of not less than 99.0% (IALA Category 2).

Sample marking of individual wind turbines



6 Marking Groups of Structures (Wind Farms)

A Significant Peripheral Structure (SPS) is the "corner" or other significant point on the periphery of the wind farm. 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.

As a minimum, lights on individual SPSs should exhibit synchronised flashing characteristics, however Administrations should consider the 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.

Selected intermediate structures on the periphery 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.

6.1 Aids to Navigation for marking Wind Farms

In addition to the use of lights for marking the SPSs and selected intermediate peripheral structures of a wind farm, further consideration should be given to the use of:

- Lighting all peripheral structures;
- Lighting all structures within the wind farm;
- Racons;
- Radar Reflectors and Radar Target Enhancers; and/or
- AIS as an Aid to Navigation (as per IALA Recommendation A-126).

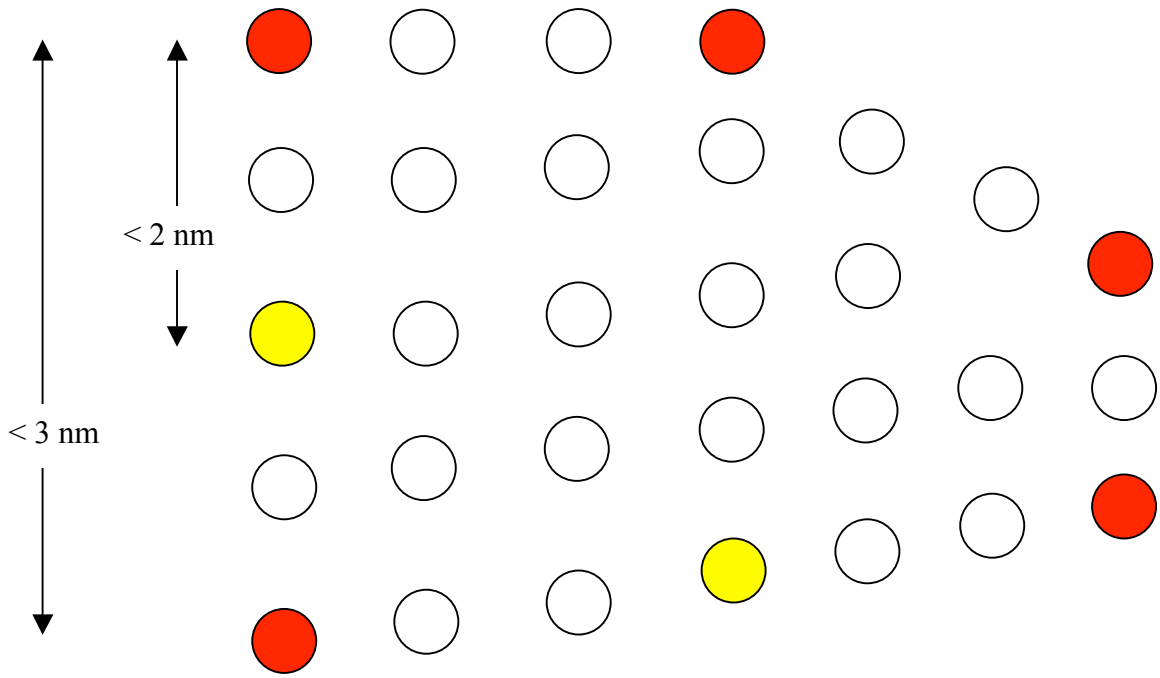
It is important that these AtoNs be used with care to mark the grouping of wind generators.

Consideration may be given to the provision of sound signals where appropriate, taking into account the prevailing visibility, topography and vessel traffic conditions. The typical range of such a sound signal should not be less than two (2) nautical miles.

Sample marking of wind farm

SPS - 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

Intermediate structures on the periphery of a wind farm other than the SPSs - marked with flashing yellow lights which are visible to the mariner from all directions in the horizontal plane with a flash character distinctly different from those displayed on the SPSs and with a range of not less than two (2) nautical miles



7 Additional Considerations

Depending on the marking, lighting and lateral separation of the peripheral structures, the additional marking of the individual structures within a wind farm may be considered as follows:

- Lighting of each structure
- Individual structures unlighted with retro-reflective areas.
- Individual structures illuminated with down-lights on ladders and access platforms.
- Use of flashing yellow lights with a range of not less than two (2) nautical miles.
- Identifying numbers on each individual structure, either lit or unlit.

An Electrical transformer station or a meteorological or wind measuring mast, if considered to be a composite part of the wind farm, should be included as part of the overall wind farm marking. If not considered to be within the wind farm block it should be marked as an offshore structure. (i.e. a white light flashing Morse code "U").

As far as practicable, Aeronautical obstruction warning lights fitted to the tops of wind generators should not be visible below the horizontal plane of these lights. Aviation Authorities should be consulted regarding the specification of such lights.

B-445.8 **Wind turbines** are generally tall, multi-bladed structures, usually with two or three blades, often visible over long distances. Their purpose is to generate electricity for large communities, or to feed a national grid. They are often in groups (known as wind farms) and may be sited on-shore (see B-374.6). Individual wind turbines must be shown by the symbol:

IL 5.1

If a navigational light is attached to the wind turbine, a flare should be added to the base, and the light description placed alongside. Where vessels may navigate close to the structure, it is appropriate to show the minimum clearance height under the blade, using symbol ID 20.

B-445.9 **Wind farms** may be shown by groups of wind turbines in their actual positions (if scale and available information permits), or by a maritime limit with the centred symbol:

The symbol IN 1.1 (black maritime limit implying permanent physical obstructions) should normally be used for the limit of a wind farm:

IL 5.2

However, this should be replaced by IN 2.1 or 2.2 as appropriate, where restrictions on navigation apply, eg:

IL 5.2

Note: Individual wind turbines which have navigational lights attached should normally be charted, even within a wind farm, if scale permits.

B-445.10 **Underwater turbines,** for generating electricity from tidal currents, must be represented:

IL 24

Where the depth of water over the turbine is known, it may be inserted within the danger circle. The rules for blue tint, swept and safe clearance depths must be applied as for wrecks and other obstructions (see B-415 and 422), eg:

Where part of the structure is above water, and marked (e.g. with a beacon or light), the appropriate symbols must be used. On small scale charts, where it may not be practicable to show the danger circle, the legend '*Underwater Turbine*' should be used, eg:

B-445.11 **Current Farm (or Turbine Field).** Where groups of underwater turbines exist they should preferably be charted individually. Where scale or available information does not permit this, then the symbol IN 1.1 (black maritime limit implying permanent physical obstructions) should normally be used for the limit of a current farm:

However, this should be replaced by IN 2.1 or 2.2 as appropriate, where restrictions on navigation apply. A legend should be inserted within the boundary, eg: