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Wind energy generation systems – Part 29: Marking and lighting of wind turbines

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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WIND ENERGY GENERATION SYSTEMS –

Part 29: Marking and lighting of wind turbines

FOREWORD

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IEC TS 61400-29 has been prepared by IEC technical committee 88: Wind energy generation systems. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
88/894/DTS	88/913/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61400 series, published under the general title *Wind energy generation systems*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

As the Wind Industry grows, airspace users (military, civil and emergency aircraft) need to continue to operate safely in an environment that includes wind turbines, and the two industries need to exist harmoniously.

To assist in creating a safe environment, some wind turbines are required to have aeronautical lights so they can be seen by airspace users. Unfortunately, some of these lights can have an adverse visual impact, which produces lighting pollution for nearby communities.

Annex 14 to the Convention on International Civil Aviation published by the International Civil Aviation Organization (ICAO) contains Standards and Recommended Practices (specifications) that prescribe the marking and lighting of wind turbines. However, many countries have interpreted these specifications differently and issued their own guidelines and conditions to suit their local requirements. Therefore, there is little homogeneity and wind turbine manufacturers are obliged to produce bespoke designs to suit specific markets.

There are currently approximately 20 different marking and lighting specifications for countries such as Belgium, Brazil, Canada, Finland, France, Germany and Japan. In many cases, those requirements are very similar. However, they often differ in terms of light intensity, positioning and markings, which could lead to confusion and reduction in air safety.

In some cases wind farms that are separated by only a few kilometers are marked and illuminated in accordance with different guidelines. This includes the transition from the onshore to the offshore wind environment, and vice versa.

This document reflects the need to allow the coexistence of wind turbines and aviation, ensuring that the ICAO Standards and Recommended Practices are followed but also balances with the environmental impact on nearby residents.

References to national regulations are important in this document, given the regional specific circumstances required in many cases. Users should be aware that national and/or "local" regulations can apply. The aim is to encourage safe airspace but with minimum light pollution.

NOTE Throughout the drafting process for this document, the National Guidelines, related to lighting and marking wind turbines, of many ICAO Member States have been used as a resource. However, the guidance documents are too numerous to list and, therefore, reference to any non-normative documents has been omitted.

WIND ENERGY GENERATION SYSTEMS –

Part 29: Marking and lighting of wind turbines

1 Scope

This part of IEC 61400, which is a Technical Specification, instils good practice for aviation lighting and marking of wind turbines in both onshore and offshore domains. Consideration is given to visible lighting and infrared (IR) lighting, which is necessary to maintain conspicuity to users of night vision goggles (NVGs).

ICAO Annex 14 Standards and Recommended Practices have been used as the basis to develop supplementary harmonised specifications to assist with implementation.

This document provides a set of technical requirements for marking and lighting of wind turbines with a tip height from/at 150 meters and below 315 meters Above Ground Level (AGL), or Above Mean Sea Level (AMSL) for offshore sites. This will improve situational awareness for airspace users, maintain safety of aircraft flying in the vicinity of wind turbines, and provide additional tools to assist with the reduction in environmental impacts consistent with aviation safety objectives. In the event that the wind turbine development exceeds 315 m tip height and the regulatory frameworks is updated to cater for these heights, this document will be reviewed and amended as necessary. In the absence of an update to the regulatory framework, the guidance in this document is to be followed as a minimum.

In some cases, lighting may be required for wind turbines at or below 150 meters tip height. However, this is not in the scope of this document and in these situations, the developer should contact the relevant National Aviation Authority or Planning Authority for further guidance.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61400-3-1:2019, *Wind energy generation systems - Part 3-1: Design requirements for fixed offshore wind turbines*

IEC 62443-4-2:2019, *Security for industrial automation and control systems - Part 4-2: Technical security requirements for IACS components*

International Civil Aviation Organization, Annex 14, *Aerodromes – Volume I – Aerodromes Design and Operations*. 8th Edition, July 2018

International Civil Aviation Organization, *Aerodrome Design Manual – Part 4 – Visual Aids* (Doc 9157 – Part 4). 5th Edition. 2021

European Union Aviation Safety Agency (EASA), *Certification Specifications and Guidance Material for Aerodromes Design CS-ADR-DSN*, Issue 5, June 2021

Federal Aviation Administration. Advisory Circular 150/5345-43J – *Specification for Obstruction Lighting Equipment*, 11 March 2019

Federal Aviation Administration. 70/7460-1M – *Obstruction Marking and Lighting*, 16 November 2020

IALA Recommendation R0139 (O-139) ,*The Marking of Man-Made Offshore Structures*, Edition 3.0, December 2021

NOTE Although too many to list explicitly, in drafting this document the national guidelines of many ICAO Member States, for lighting and marking wind turbines, have been given due consideration. In some cases, specific examples have been provided from national guidelines to enhance the international guidance in this document.