International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R BT.805

(03/1992)

Assessment of impairment caused to analogue television reception by a wind turbine

BT Series

Broadcasting service (television)

International Telecommunication Union

Foreword

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Series	Title
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RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
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Note: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

Electronic Publication
Geneva, 2011

RECOMMENDATION ITU-R BT.805*, **

Assessment of impairment caused to analogue television reception by a wind turbine

(1992)

The ITU Radiocommunication Assembly,

considering

a) that severe degradation of television reception can be caused by reflections from moving objects such as the blades of a wind turbine;

b) that these effects are particularly serious because the impairment caused can be quasi-permanent, being reduced only during periods when the wind turbine is not rotating;

c) that it is important to have available a simple method for calculating the potential impairments which could be caused by the installation of any proposed wind turbine;

d) that ghost cancellation techniques are being investigated and that these may offer some amelioration of the impairment caused by wind turbines,

recommends

1 that the method given in Annex 1 be used to assess the potential interference from a proposed wind turbine installation consisting of a single machine to analogue television reception;

2 that further work be carried out to refine the simplified model given in Annex 1;

3 that further work be carried out to investigate the impairment caused by a multiple-machine wind turbine installation;

4 that the temporal nature of the impairment caused by a wind turbine be investigated.

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* Radiocommunication Study Group 6 made editorial amendments to this Recommendation in 2002 in accordance with Resolution ITU-R 44.

** Radiocommunication Study Group 6 made editorial amendments to this Recommendation in October 2010 in accordance with Resolution ITU-R 1.

Annex 1

Simplified model of impairment caused to analogue television reception by a wind turbine

Figure 1 shows the plan view of the general wind turbine problem.

At any receiving location, R the wanted field strength is *FSR*. At the wind turbine site, WT, the field strength is *FSWT*. A "reflection factor", *RF*, may be defined which includes the free-space path loss for the first km of the path from the wind turbine site to R. Thus, *FSWT* + *RF* gives the maximum amplitude, at a distance of 1 km from the wind turbine, of the signal scattered from the wind turbine. The maximum value of this reflection factor due to the wind turbine blades is $20 \log (A/\lambda) - 60$ dB.

The relative amplitude, *RA*, in the forward scatter region is given by:

$$RA = 20 \log \frac{\sin (\pi \cdot W/\lambda \cdot \sin \alpha)}{\pi \cdot W/\lambda \cdot \sin \alpha}$$

where:

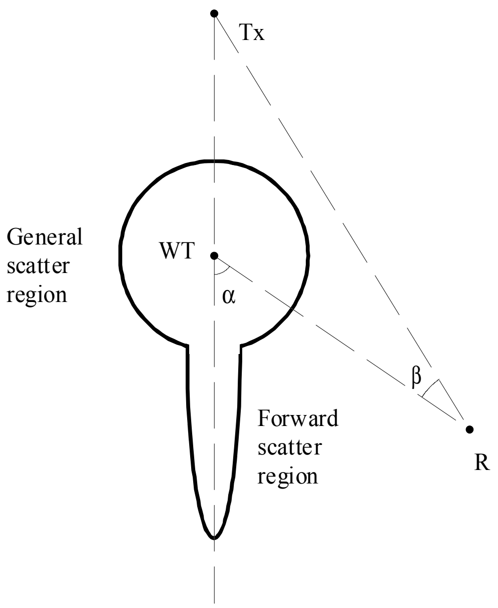
A: blade area (m^2)

W: width of the blade (m)

λ: wavelength (m).

The relative amplitude in the general scatter area is taken to be –10 dB.

FIGURE 1



Tx: television transmitter
WT: wind turbine
R: receiving location

In the case of a free-space path, of length d (km), between the wind turbine and the receiving location, the unwanted field strength may be calculated as:

$$FSWT + RF + \max(-10, RA) - 20 \log d$$

where:

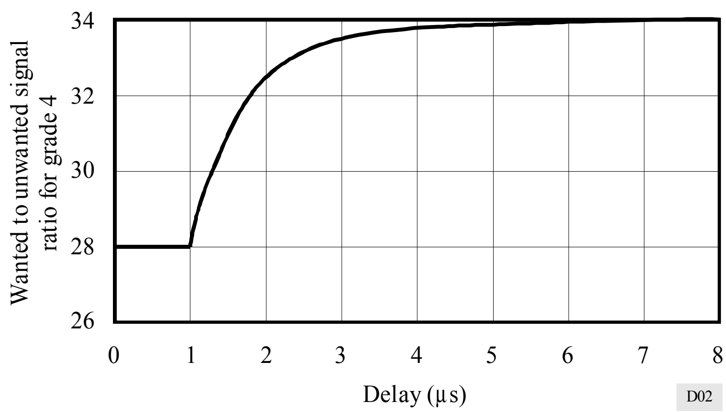
$\max(-10, RA)$: larger of –10 dB and the relative amplitude of the forward lobe.

If this path is obstructed, the field strength may be calculated by other means, with the first three terms giving the field strength at 1 km on an unobstructed path.

The receiving antenna directivity discrimination as a function of β is given in Recommendation ITU-R BT.419 and this should be applied to determine the ratio of the wanted to unwanted signal for any specific receiving location.

The required wanted to unwanted signal ratio as a function of the time difference between the wanted and unwanted signals is given in Fig. 2.

FIGURE 2



An example of the use of this method is given in Appendix 1.

Appendix 1 to Annex 1

Example of use of simplified assessment method

In Fig. 1 of Annex 1, the point marked R is a receiver location, near the site of a proposed wind turbine WT.

As a first step, calculate or, preferably, measure the field strength values, *FSR*, at the various receiver locations.

Experience suggests that in the case where the terrain is fairly flat and reception locations are not screened from the wanted transmitter, it is unlikely that a wind turbine installation will cause significant impairment to reception at distances of more than about 0.5 km from the wind turbine site.

Experience also suggests that it is unlikely to be necessary to extend the investigation area to more than about 5 km from the proposed wind turbine site (or sites, if there are multiple turbines). However, if there are special circumstances, for example buildings which are screened from the wanted transmitter but which are line-of-site to the wind turbine, then the area may need to be extended.

Calculate or, preferably, measure the field strength, *FSWT*, at the wind turbine site, near the height of the centre of rotation of the blades.

Calculate the maximum amplitude of the reflection factor:

$$RF = 20 \log (A/\lambda) - 60 \text{ dB}$$

For each of the receiving points, R:

– calculate the unwanted field strength using details of the path between the wind turbine and the receiver using *FSWT* + *RF* as the field strength at 1 km for an unobstructed path;

– calculate the larger of (–10, relative amplitude of forward lobe) where the relative amplitude, *RA*, of the forward lobe is given by:

$$RA = 20 \log \frac{\sin (\pi \cdot W/\lambda \cdot \sin \alpha)}{\pi \cdot W/\lambda \cdot \sin \alpha}$$

(For convenience, the –10 dB half width of the forward lobe is given approximately by: $\sin^{-1} (0.75 \cdot \lambda/W)$);

– calculate the wanted to unwanted signal ratio, taking account of the receiving antenna directivity discrimination;

– using the curve given in Fig. 2, determine if the impairment at the receiving point will be worse than grade 4.

The results of the study may then be presented in the form of a map showing the areas/locations where worse than grade 4 impairment may be expected.

It should be noted that the process is more complicated if there are multiple wind turbines on a given site as there are then several possible sources of impairment at each receiving location. It is desirable to carry out further investigations in order to derive a suitable calculation process for this case.