



TWE GmbH  
TRADE WIND ENERGY

Founded 1999



Lanthan Gesellschaft  
für technische  
Entwicklungen mbH

Founded 2005

- Development and manufacture of ICAO obstacle lights and obstacle lights according to different national requirements
- Special developments
- Manufacturer of control systems and peripherals

# Working group AVV2018 of the BMVI



Initiated: 21.01.2016

Kick-off-meeting: 06.04.2016

57 participants

- Bundesverbandes Windenergie e.V. (BWE)
- VDMA Power Systems Task Force Kennzeichnung
- Authorities (federal and state governments)

aim:

Increase of the residents' acceptance while maintaining the same level of aviation safety

## Subjects:

Group 1 Unmarked height (rotor blade)

Group 2 Tower marking (night)

Group 3 night markings at sea

Group 4 nacelle marking day

**Group 5 Demand-controlled night obstacle lights (BNK)**

Group 6 IR obstacle light

**Group 7 obstacle lights with reduced radiation**

Group 8 Emergency power supply

Group 9 Block identification

# Working group AVV2018 of the BMVI

## Group 5 Demand-controlled night obstacle lights

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5A

5B • Primary radar

5C • Passive radar

5D • Transponders

7A

7B

7C

7D

# Working group AVV2018 of the BMVI

## Group 5 Demand-controlled night obstacle lights



5A

5B

- Primary radar

5C

Antennas **inside** the  
windpark  
realized by

5D

Antennas **outside** the  
windpark  
realized by

7A

7B

7C

7D

- Enertrag  
Systemtechnik und  
Airbus Defence &  
Space
- Vestas und OCAS

- Quantec, Nordex  
und Terma

# Working group AVV2018 of the BMVI

## Group 5 Demand-controlled night obstacle lights



5A

5B

5C

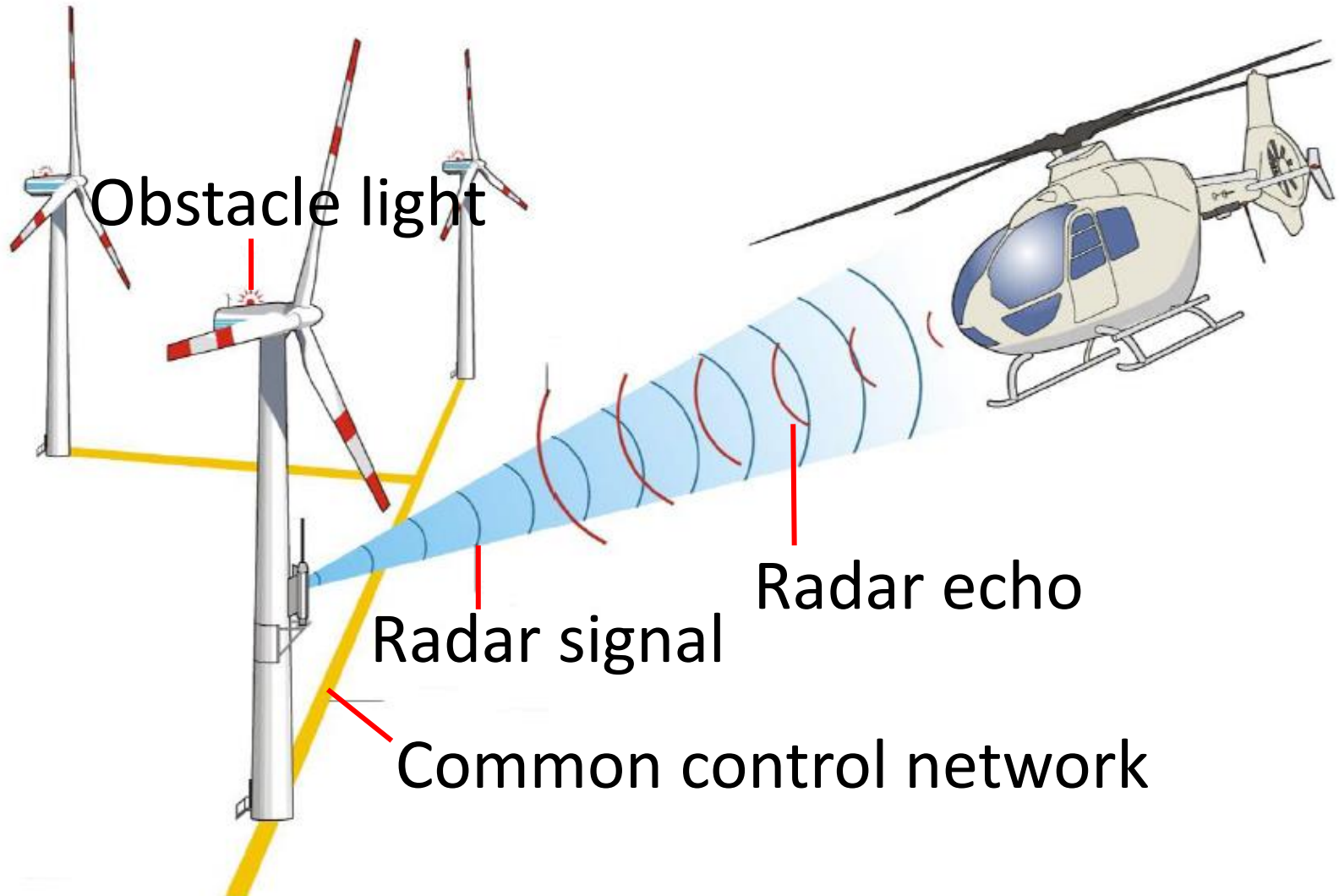
5D

7A

7B

7C

7D



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## Group 5 Demand-controlled night obstacle lights



5A

5B

5C

5D

7A

7B

7C

7D



Cassidian SPEXER 500 AC



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## Group 5 Demand-controlled night obstacle lights



5A

5B

5C

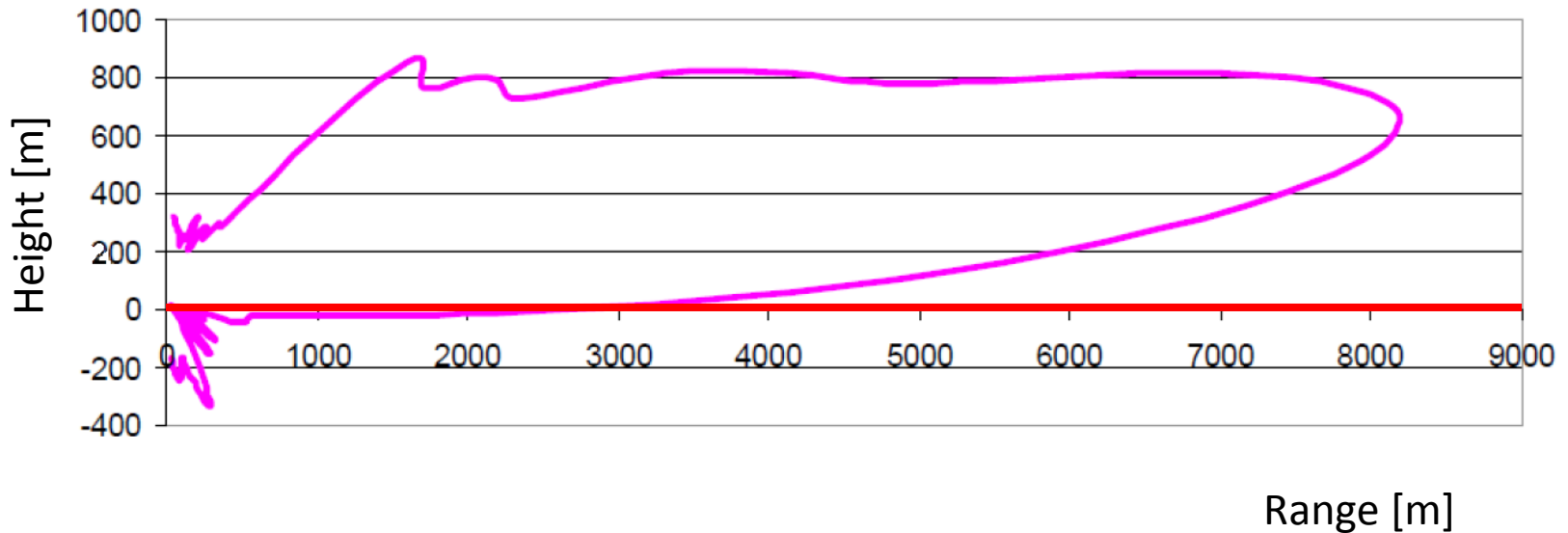
5D

7A

7B

7C

7D



Exemplary radiation characteristics

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## Group 5 Demand-controlled night obstacle lights



5A

5B

Example:

5C

Wind park

5D

monitoring

7A

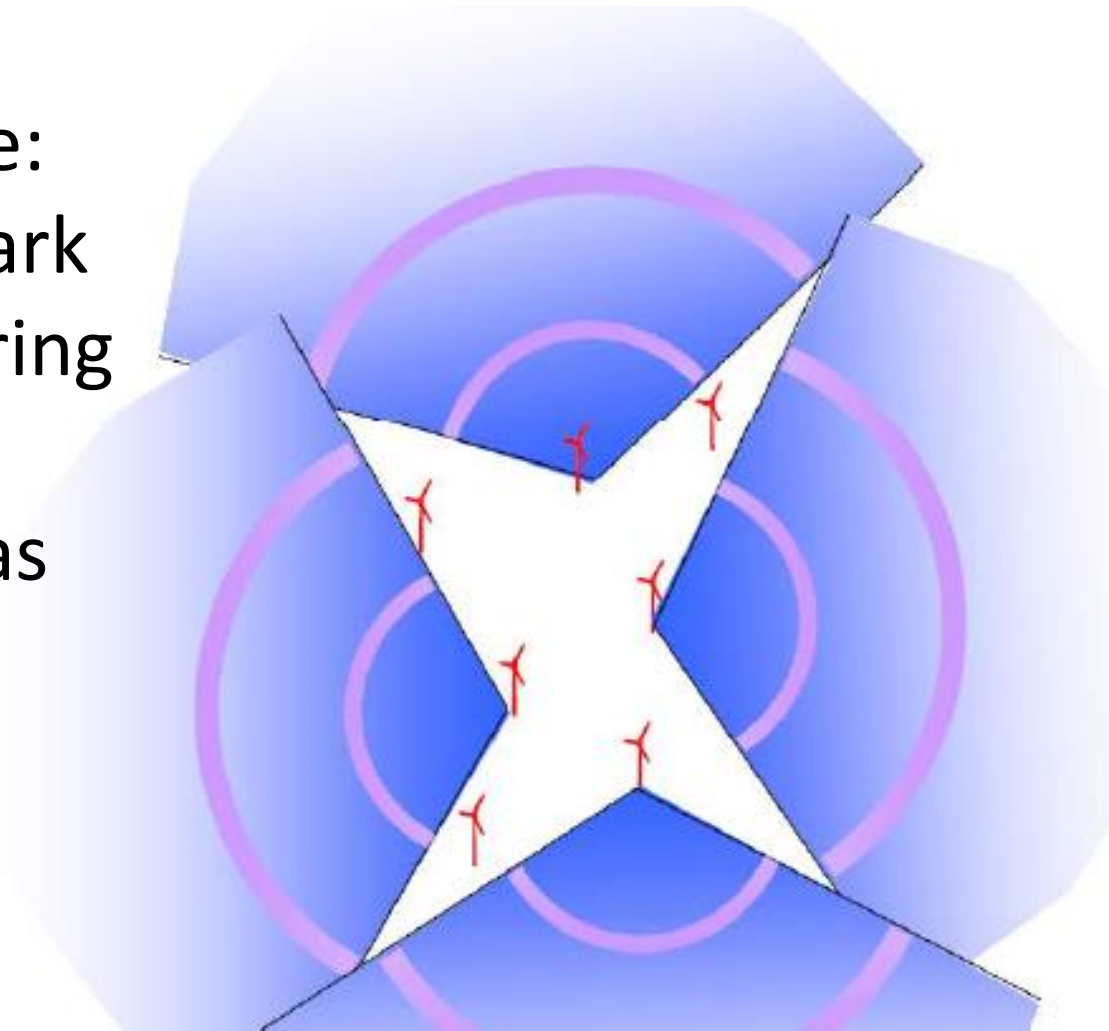
with 4

7B

antennas

7C

7D



5A The systems of

5B • Enertrag Systemtechnik und Airbus  
5C Defence & Space

5D • Quantec, Nordex und Terma  
7A are already approved.

7B The current focus of the working group  
7C concerns the long-term safeguarding of the  
7D frequency use.

5A

5B

- 5C • Passive radar

5D

### **Parasol**

7A

7B developed by

7C

- Fraunhofer Institut für Hochfrequenzphysik und Radartechnik

7D

- Dirkshof / EED GmbH & Co. KG

5A

# Passive Radar target localisation

5B

Radar without own emissions

5C

Use of DVB-T or DAB+

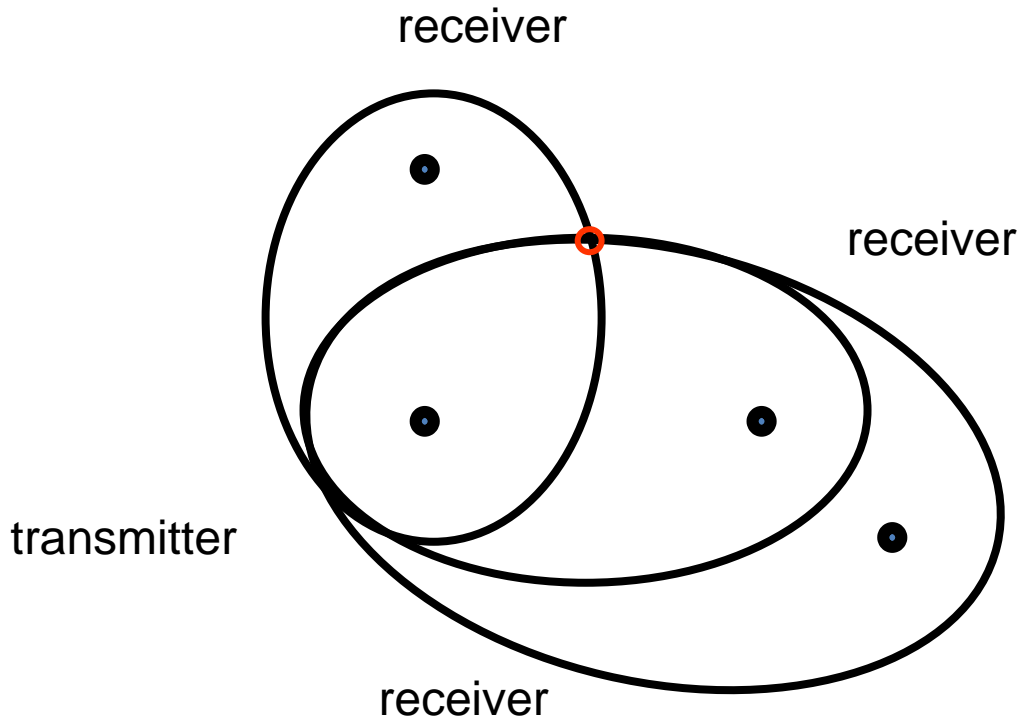
5D

7A

7B

7C

7D



Multi-Sensor-  
Procedure

Intersection of time-  
difference of arrival  
measurements

5A

## Target height measurement

5B

5C

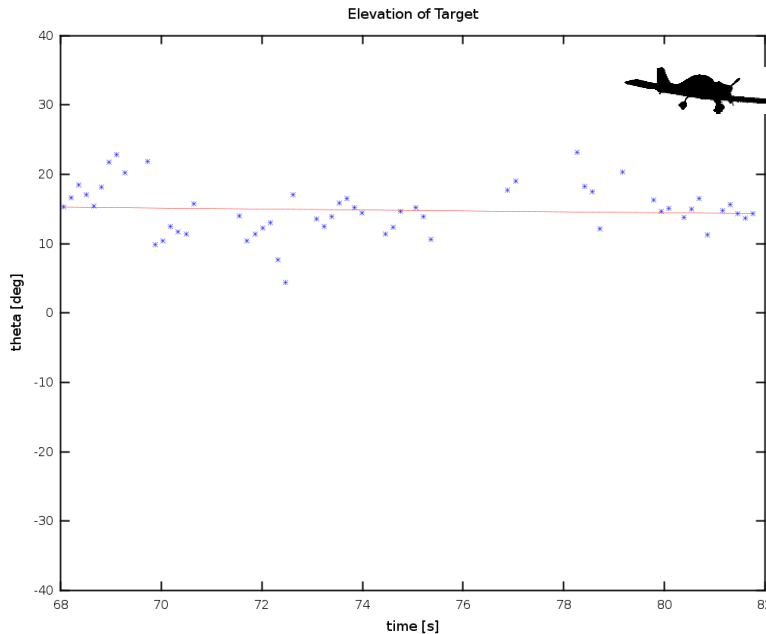
5D

7A

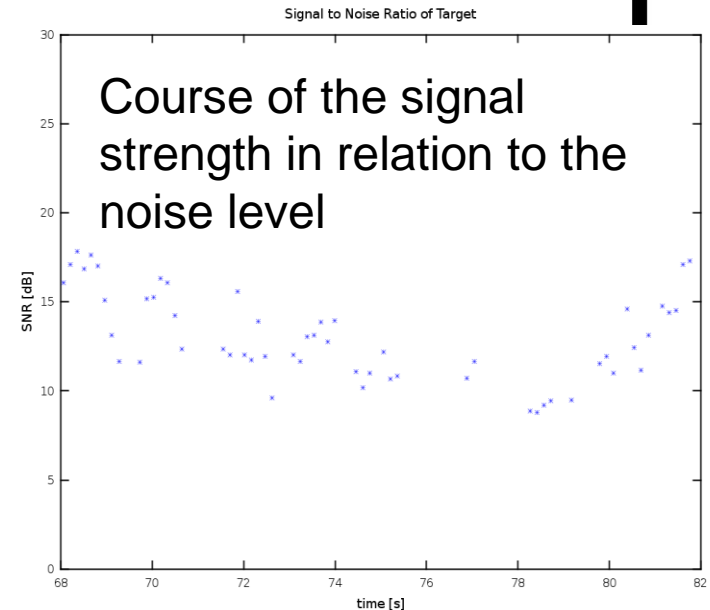
7B

7C

7D



ca. 17°



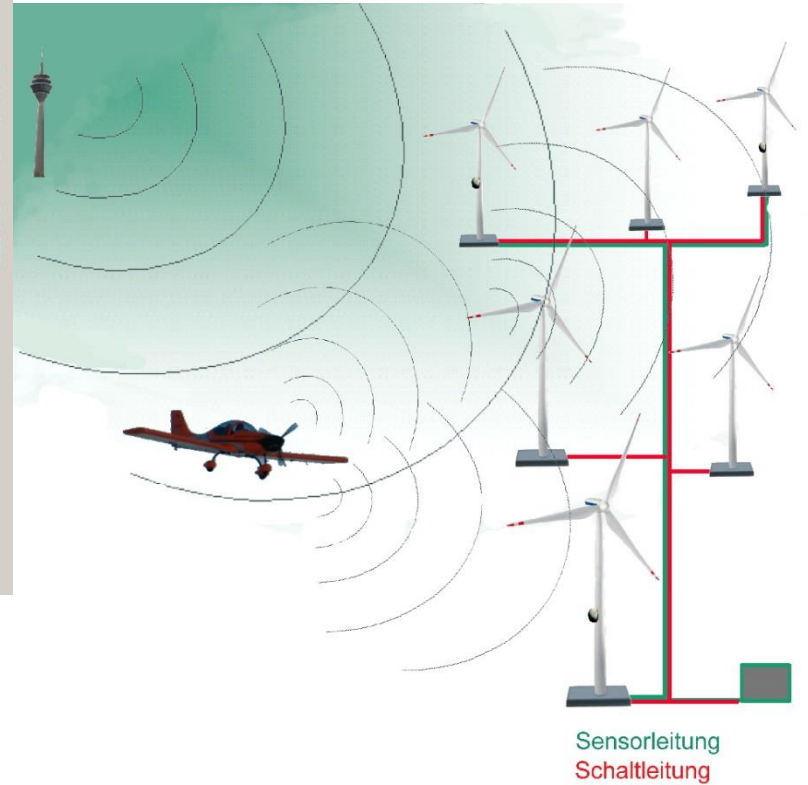
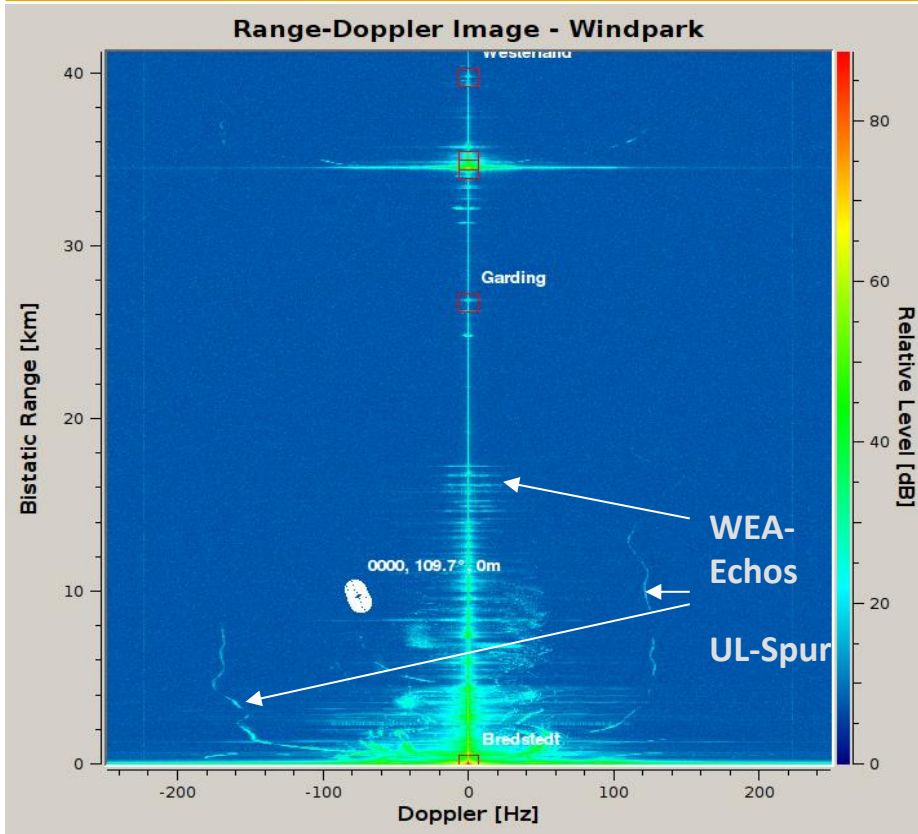
Example of the course of the elevation angle of an UL aircraft measured in the pre-flight.

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## Group 5 Demand-controlled night obstacle lights



5A  
5B  
5C  
5D  
7A  
7B  
7C  
7D



# Working group AVV2018 of the BMVI

## Group 5 Demand-controlled night obstacle lights



5A

### PARASOL sensor

5B

- post processing implemented on high performance server module

5C

- module provides a 40 GBit/s Infiniband

5D

- networking interface for high-speed communication

7A

- RAID-0 HDD array enables the continuous storage of data up to 300 MByte/s

7B

- discone antennas to cover a large bandwidth

7C

- **two vertically stacked antennas to allow height measurement**

7D

- radar absorbing material on backplane to avoid reflections from mast
- Plexi radome for weather protection





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## Group 5 Demand-controlled night obstacle lights



5A

## Mounting of the antennas

5B

5C

5D

7A

7B

7C

7D



## Conclusions

- PARASOL is a „green“ sensor system
- it exploits DAB+, DVB-T and possibly LTE
- nightly light pollution is reduced

### Advantages

- no frequency allocation required
- no additional electro-magnetic emissions
- 3 sensors per wind farm can be sufficient
- 360° coverage, no „Cone of Silence“
- DVB-T (DAB+) are fully available
- no weather constraints

### Challenges

- Object classification (bird swarms, small aircraft, ground vehicles)
- measurement of object height
- optimum sensor distribution

### 5A Transponders

5B Note:

5C Systems for on-demand control can not be used without the corresponding permission of the aviation authorities. **The system STHDS 3.0 has no corresponding appreciation.**

5D

7A

7B The system STHDS 3.0 has been subjected to a risk analysis. The result of this analysis a sufficient safety certified the system after aviation safety standards.

7C

7D

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## Group 5 Demand-controlled night obstacle lights



5A

Pilot project

5B

Installation of the first permanent installation in Germany for the switching of the wind turbine obstacle lights by the evaluation of transponder signals.

5C

Location:

Enercon Windpark

5D

Federal Police

Flying Squadron

7A

in Fuhlendorf

7B

Commissioning:

02.03.2010

7C

7D



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## Group 5 Demand-controlled night obstacle lights



### 5A Functional description

The STHDS 3.0 system detects the transponder signals of the aircraft. This perception determines the activation of the lighting. The signals from SSR aircraft transponders are received and classified as relevant or not relevant by the evaluation software. The lighting is deactivated when it is certain that an aircraft is not in the danger zone of a wind park. In all other cases, the lighting is activated.

### 7A The aircraft transmit transponder signals

- in response to ground station requests
- in response to TCAS request and
- every 0.8 to 1.2 seconds automatical.



### 7D

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## Group 5 Demand-controlled night obstacle lights



5A The system STHDS 3.0 evaluates the Signals from:

- Mode S - DF0 (TCAS), DF4, DF5, DF11 and DF17 (ADS-B)

5B

- Mode A / C
- Flarm signals

5C The "No-Plane ID" is also used to activate the fire: if no transponder signal is detected for a certain period of time, the lighting is activated.

5D To enhance functional safety, the STHDS 3.0 system includes a test signal generator, which ensures a permanent monitoring of the system. The STHDS 3.0

7A system has an integrated pressure measurement to compensate the barometric inaccuracy in the height measurement, and a signal-level measurement for the distance determination.

7B

7C

7D

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## Group 5 Demand-controlled night obstacle lights



5A  
5B  
5C  
5D  
7A  
7B  
7C  
7D

Status Viewer [V1.2]

Message Reception

```
15:57:38:961;AC;
15:57:39:680;DF21;
15:57:39:680;DF4;
15:57:39:680;AC;
15:57:39:743;AC;
15:57:40:040;AC;
15:57:40:883;AC;
15:57:40:993;DF5;
15:57:40:993;DF11;
15:57:41:743;AC;
```

Target Positions / Altitudes

TargetState

No	Hits	Age	Formats	Addr	Lat	Long	Alt	ID	AircrID
1	285	6 s	DF21,AC	0x4238DA	--	--	--	2227	--
2	234	7 s	AC	--	--	--	35000 ft	--	--
3	234	7 s	AC	--	--	--	--	5124	--
4	14	16 s	AC	--	--	--	26500 ft	--	--
5	14	16 s	AC	--	--	--	--	5120	--
6	14	15 s	AC	--	--	--	58500 ft	--	--
7	14	15 s	AC	--	--	--	--	4124	--
8	12	14 s	AC	--	--	--	--	2207	--
9	19	4 s	AC	--	--	--	77000 ft	--	--
10	19	4 s	AC	--	--	--	--	2226	--
11	11	6 s	AC,DF21	0xE32437	--	--	--	2225	--
12	24	16 s	AC	--	--	--	34500 ft	--	--
13	13	16 s	AC	--	--	--	--	1124	--
14	26	12 s	AC,DF20	0x47090A	--	--	3350 ft	1134	--
15	42	3 s	AC	--	--	--	110100 ft	--	--
16	41	3 s	AC	--	--	--	--	3432	--
17	26	1 s	DF11,DF21,DF20,DF17pos,AC	0x4008AD	53.811310	9.815657	3300 ft	3432	--
18	7	16 s	AC	--	--	--	--	2027	--
19	2	18 s	DF20,DF4	0x4249B6	--	--	35000 ft	--	--
20	5	6 s	AC	--	--	--	--	0227	--
21	7	15 s	AC	--	--	--	--	4530	--
22	3	7 s	AC	--	--	--	38500 ft	--	--
23	3	7 s	AC	--	--	--	--	5024	--
36	10	1 s	AC	--	--	--	--	4510	--
41	2	3 s	DF4,DF21	0x3C78C3	--	--	4475 ft	1134	--

Range: 50 km    maxAlt: 40000 ft    Min Hits: 2    reported Targets: 45    filtered Targets: 25    display duration: 16 ms

LANTHAN

receive DataRate: 1778 Bytes/s    receiving data    Light OFF    Exit

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Monitoring display

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## Group 5 Demand-controlled night obstacle lights



5A

5B

5C

5D



Antennas

7A

7B

7C

7D

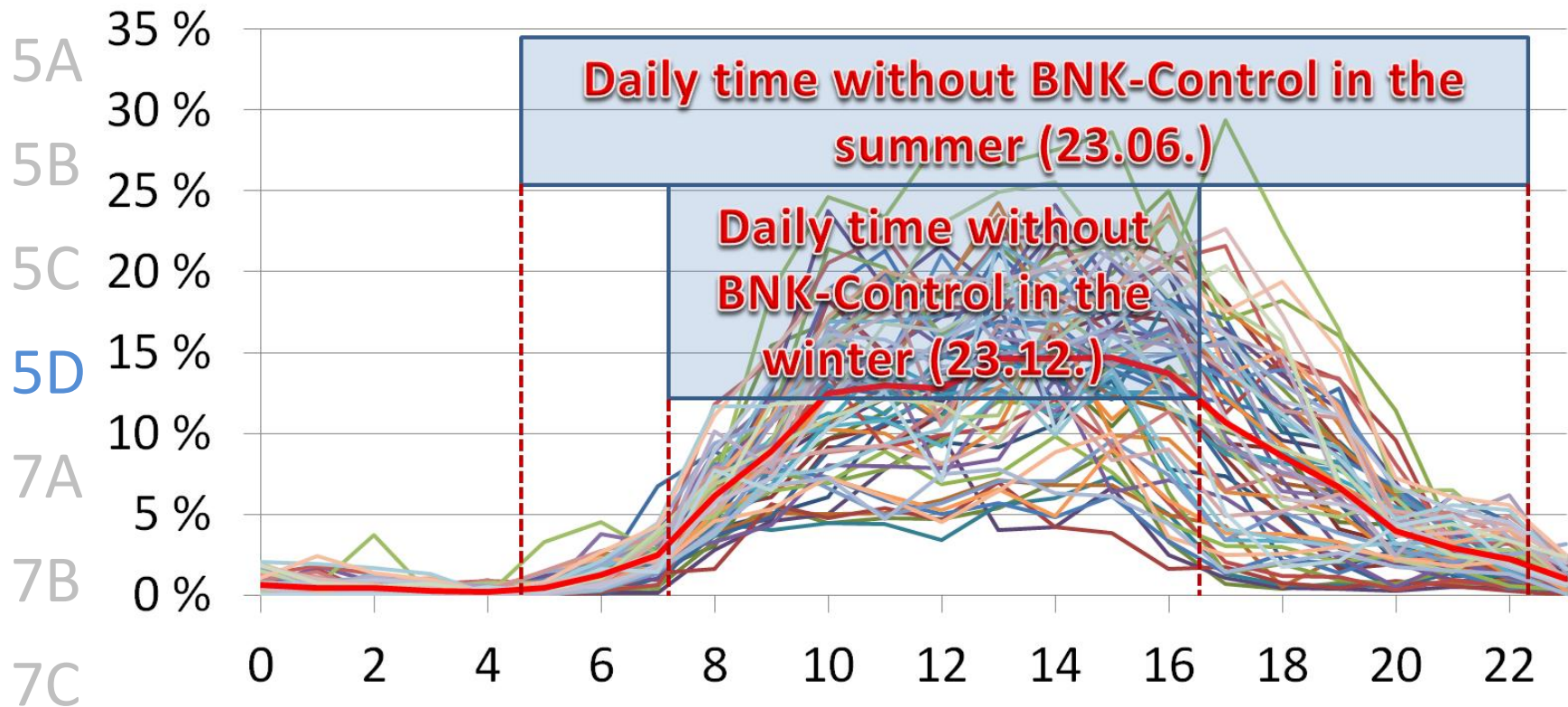
Switch cabinet





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## Group 5 Demand-controlled night obstacle lights



7D The figure shows the activation of the firing as a Monthly averages recorded over 5 years. The 24 hours of the day are plotted on the X axis. The Y-axis shows how much of the time the lighting is switched on. Averaged over the year, the operating time is **0.35%**.

5A

## Criteria for

5B

5C

5D

7A

- obstacle lights with reduced radiation:

7B

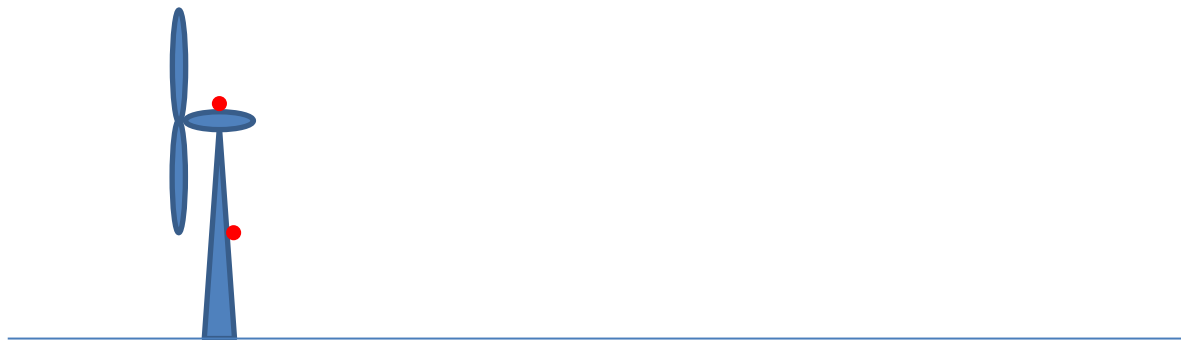
- illuminated airspace

7C

- scope of the light

7D

Example Windturbine:



5A

5B

5C

5D

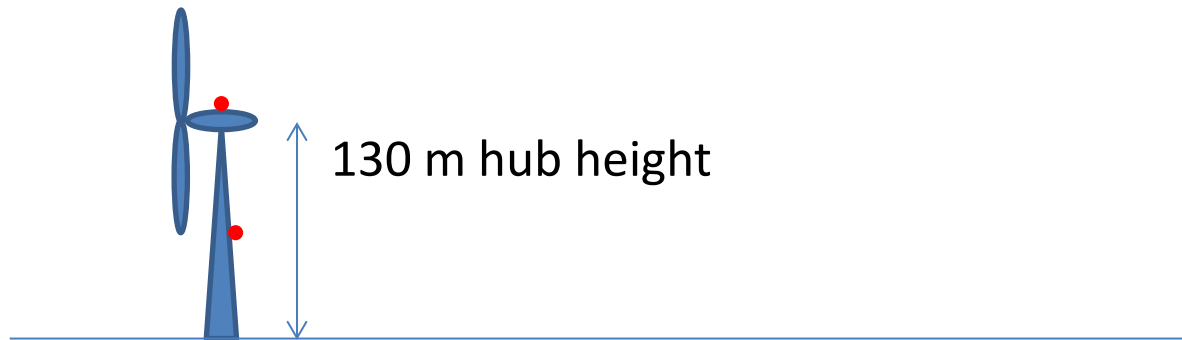
7A

7B

7C

7D

Example Windturbine:



5A

5B

5C

5D

7A

7B

7C

7D

5A

5B

5C

### Example Windturbine:

5D

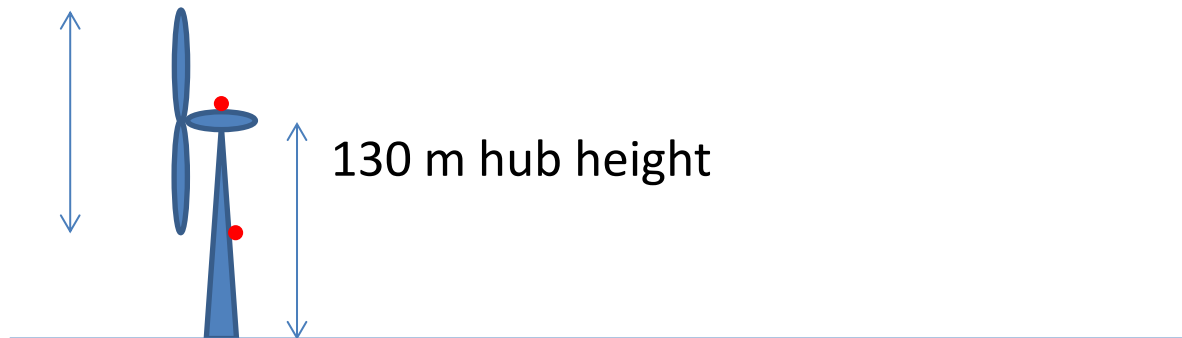
7A

7B

130 m Rotor diameter

7C

7D



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## Group 7 obstacle lights with reduced radiation



Safety minimum height : 600 m

5A

5B

5C

5D

7A

7B

7C

7D



# Working group AVV2018 of the BMVI

## Group 7 obstacle lights with reduced radiation



5A

---

Safety minimum height : 600 m

5B

5C

5D

7A

7B

7C

7D



---

Wind turbines <100 m are not lighted in Germany

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# Working group AVV2018 of the BMVI

## Group 7 obstacle lights with reduced radiation



5A

5B

5C

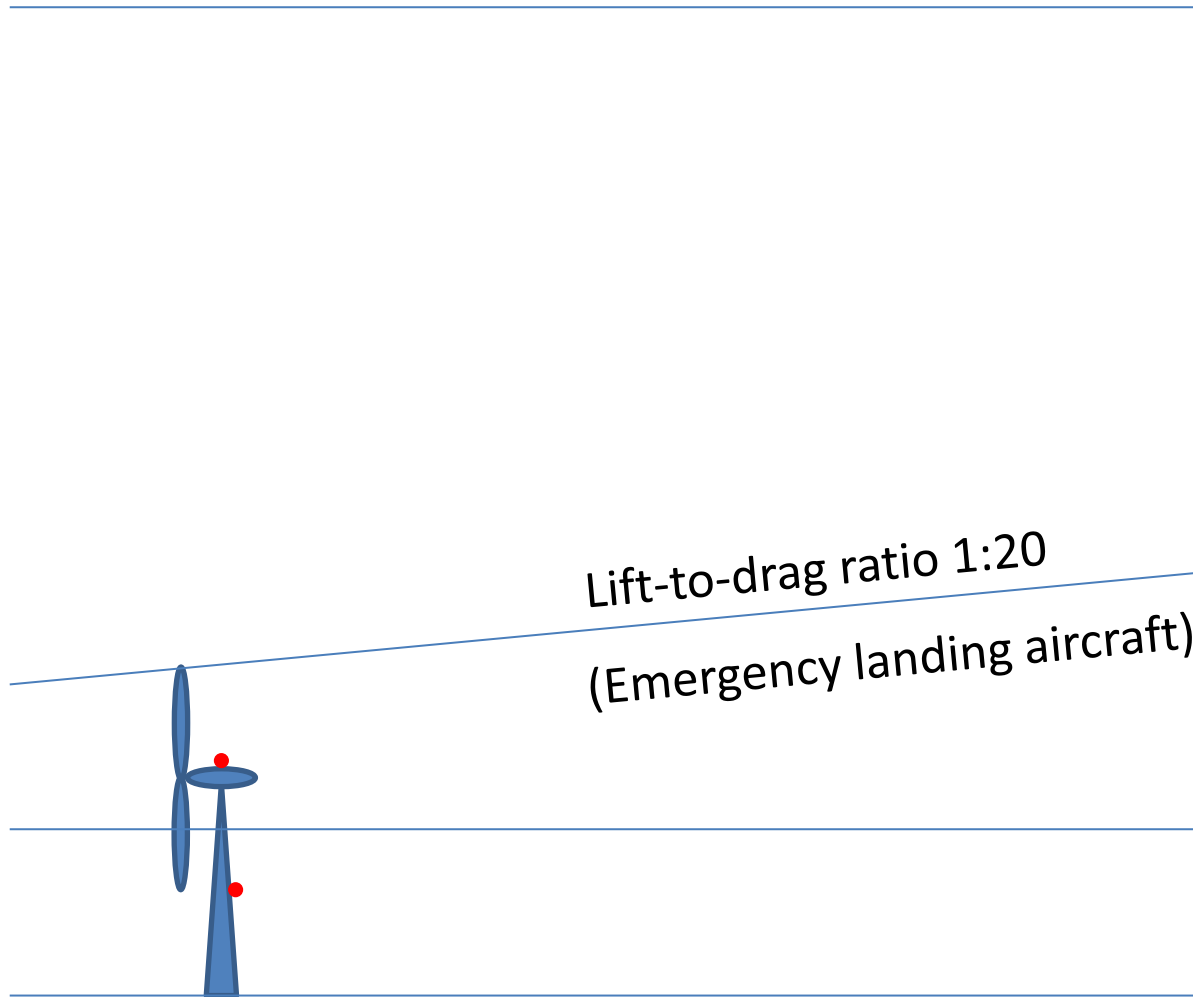
5D

7A

7B

7C

7D



Lift-to-drag ratio 1:20  
(Emergency landing aircraft)



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## Group 7 obstacle lights with reduced radiation



5A

5B

5C

5D

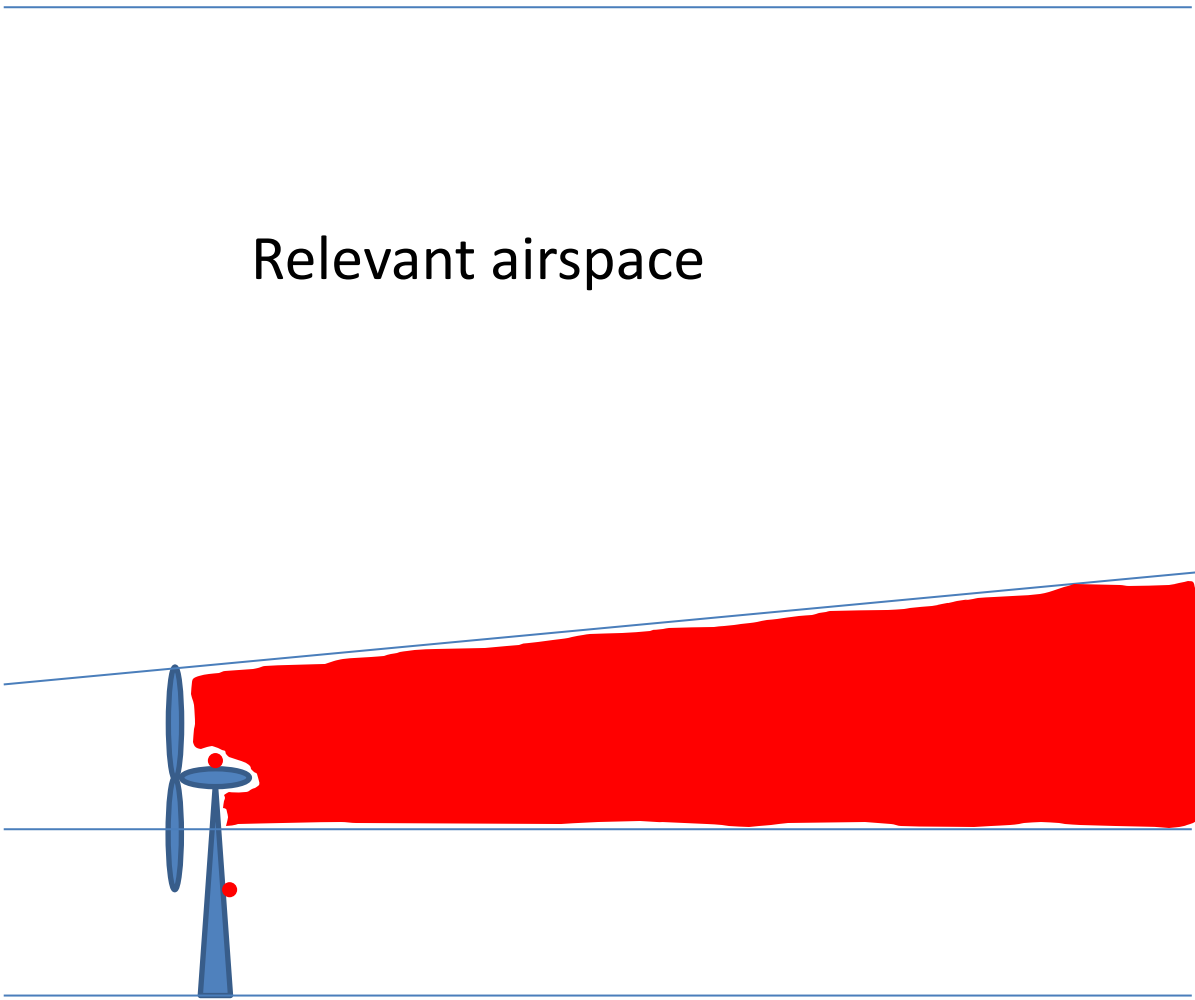
7A

7B

7C

7D

Relevant airspace

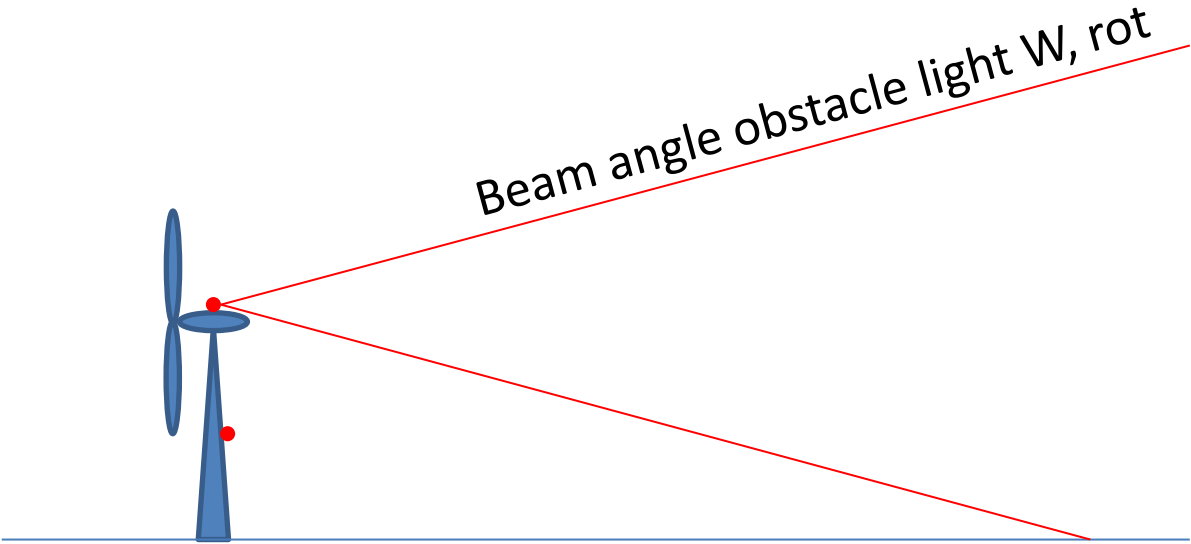


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## Group 7 obstacle lights with reduced radiation



- 5A
- 5B
- 5C
- 5D
- 7A
- 7B
- 7C
- 7D

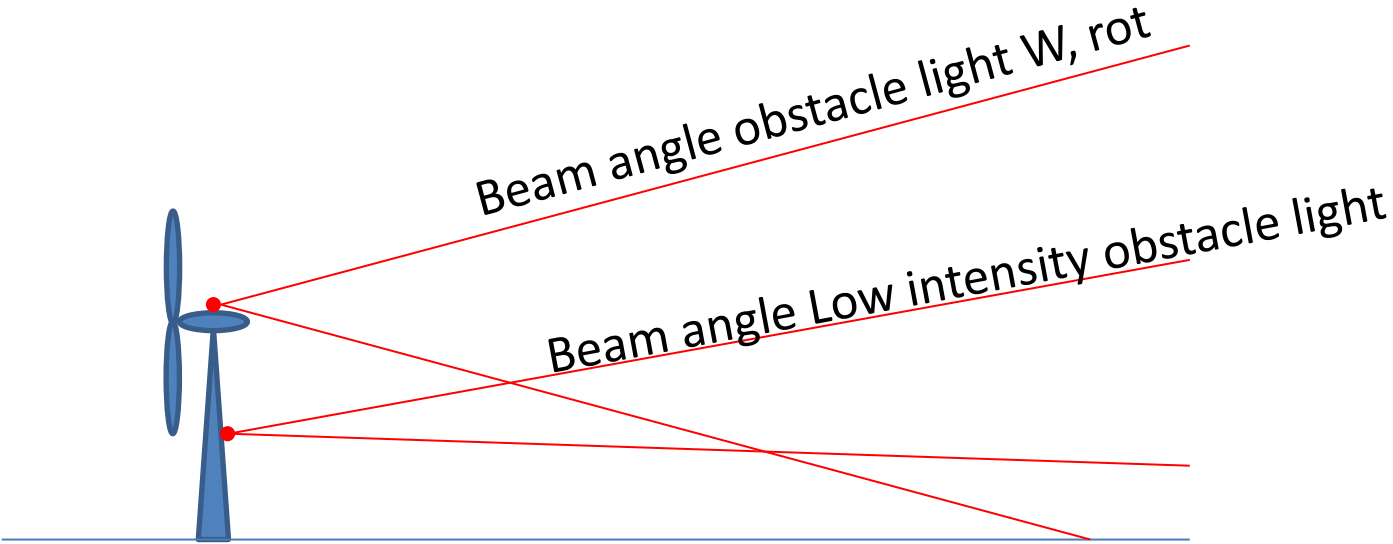


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## Group 7 obstacle lights with reduced radiation



- 5A
- 5B
- 5C
- 5D
- 7A
- 7B
- 7C
- 7D



# Working group AVV2018 of the BMVI

## Group 7 obstacle lights with reduced radiation



5A

5B

5C

5D

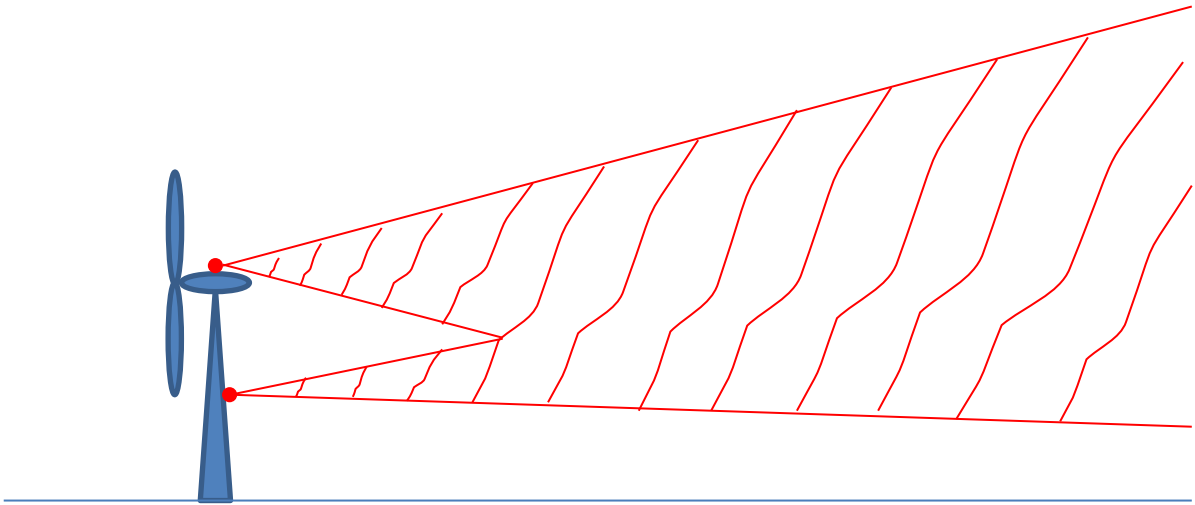
7A

7B

7C

7D

illuminated airspace



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## Group 7 obstacle lights with reduced radiation



5A

5B

5C

5D

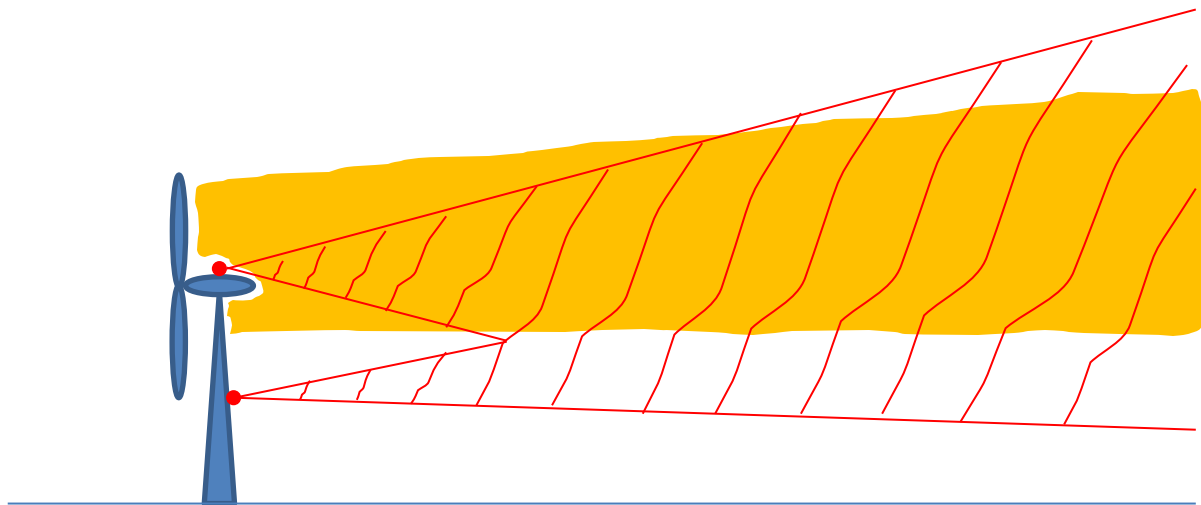
7A

7B

7C

7D

illuminated airspace  
versus  
Relevant airspace



### 5A Scope of the light

5B

The Obstacle light W, red is designed for a practical

5C

meteorological visibility of 800 meters and a threshold

5D

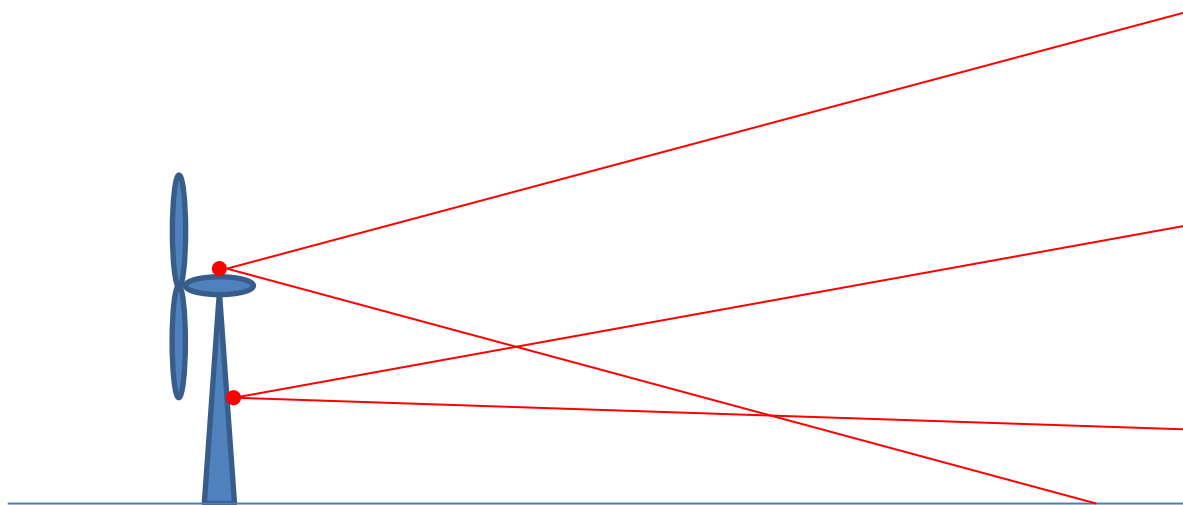
lighting intensity of  $1 * 10^{-6}$  lx. This is the most critical case in which visual flight is allowed (helicopter).

7A

7B

7C

7D

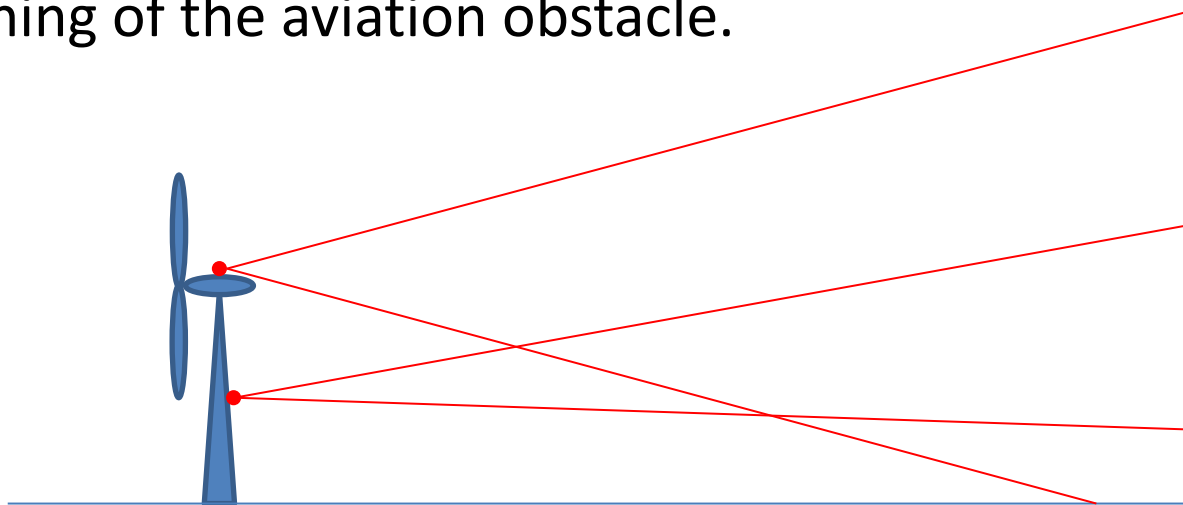


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## Group 7 obstacle lights with reduced radiation



- 5A Taking into account the maximum flight speed of 250 knots
- 5B plus 50 knots of the backwind component, a flight distance of more than
- 5C
  - 20 seconds with a meteorological visibility of 5.000 m and
  - 30 seconds with a meteorological visibility of 10.000 m
- 5D between the safe perception of the obstacle light and the
- 7A reaching of the aviation obstacle.



- 7B
- 7C
- 7D

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## Group 7 obstacle lights with reduced radiation



5A

5B The scope of the light depends on

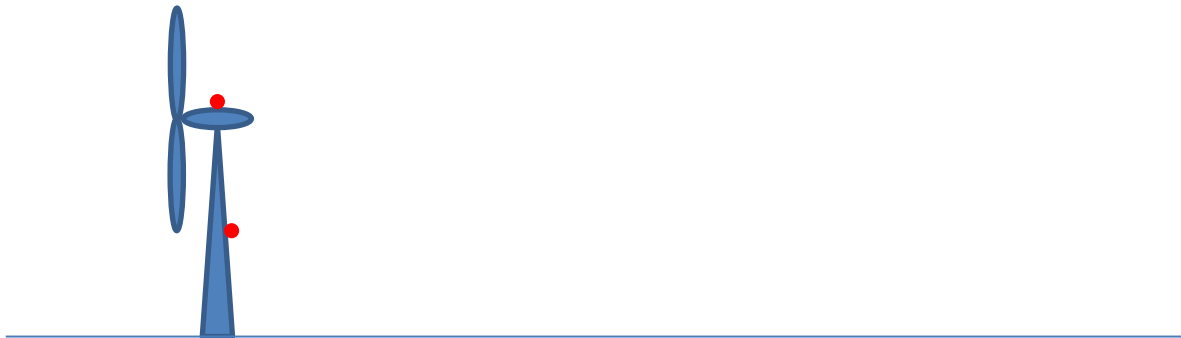
- 5C • meteorological range
- Treshold light intensity
- 5D • Intensity of the light

7A

7B

7C

7D





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## Group 7 obstacle lights with reduced radiation



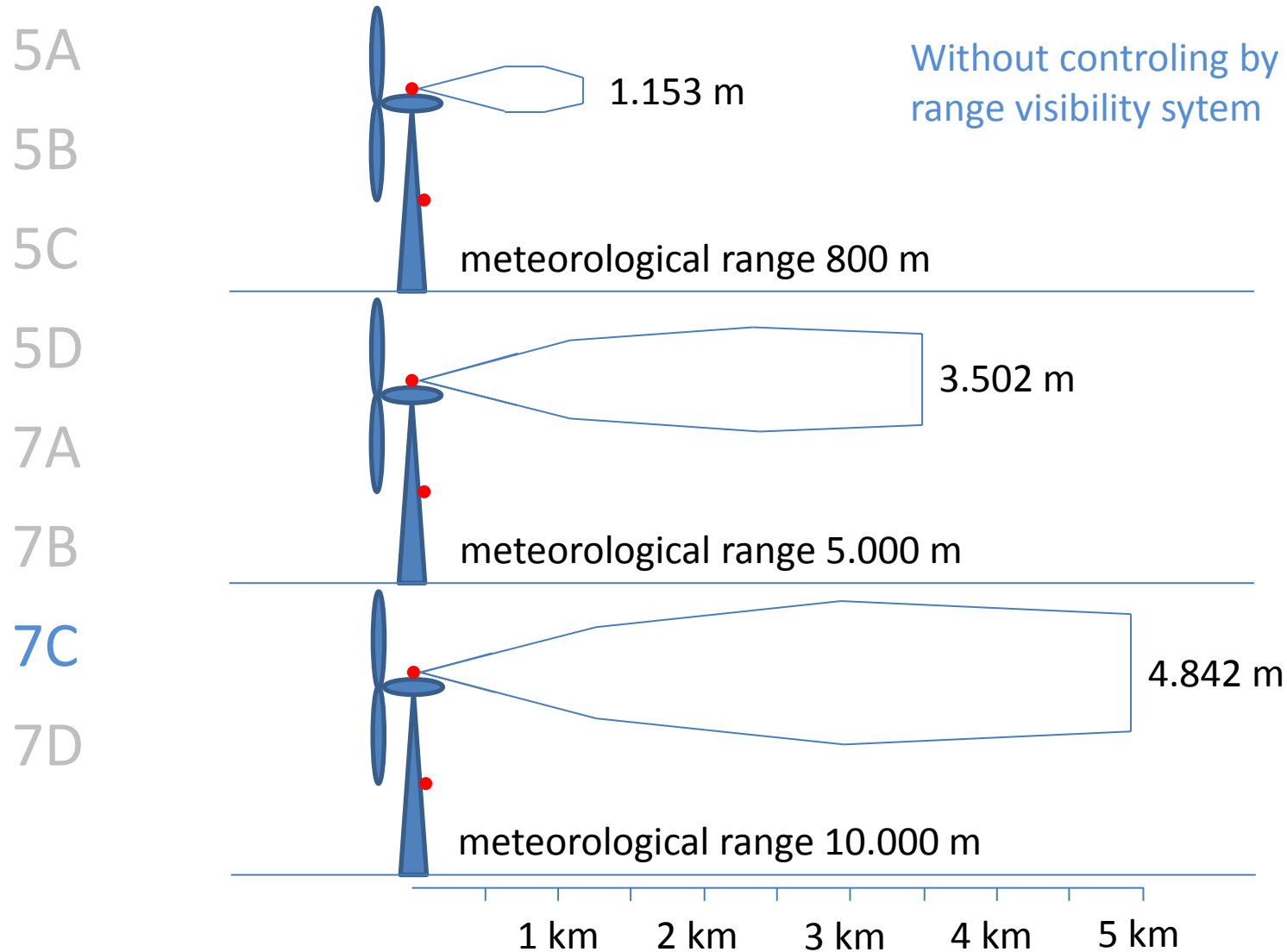
	Meteorological visibility	Intensity	scope of the light
5A			
5B	800 m without RVS	100 cd	1153 m
	5.000 m without RVS	100 cd	3502 m
5C	10.000 m without RVS	100 cd	4842 m
5D	800 m with RVS	100 cd	1153 m
7A	5.000 m with RVS	30 cd	2550 m
	10.000 m with RVS	10 cd	2256 m
7B			
7C			
7D			



Obstacle light W, rot with a Treshold light intensity of 1E-6 Lux

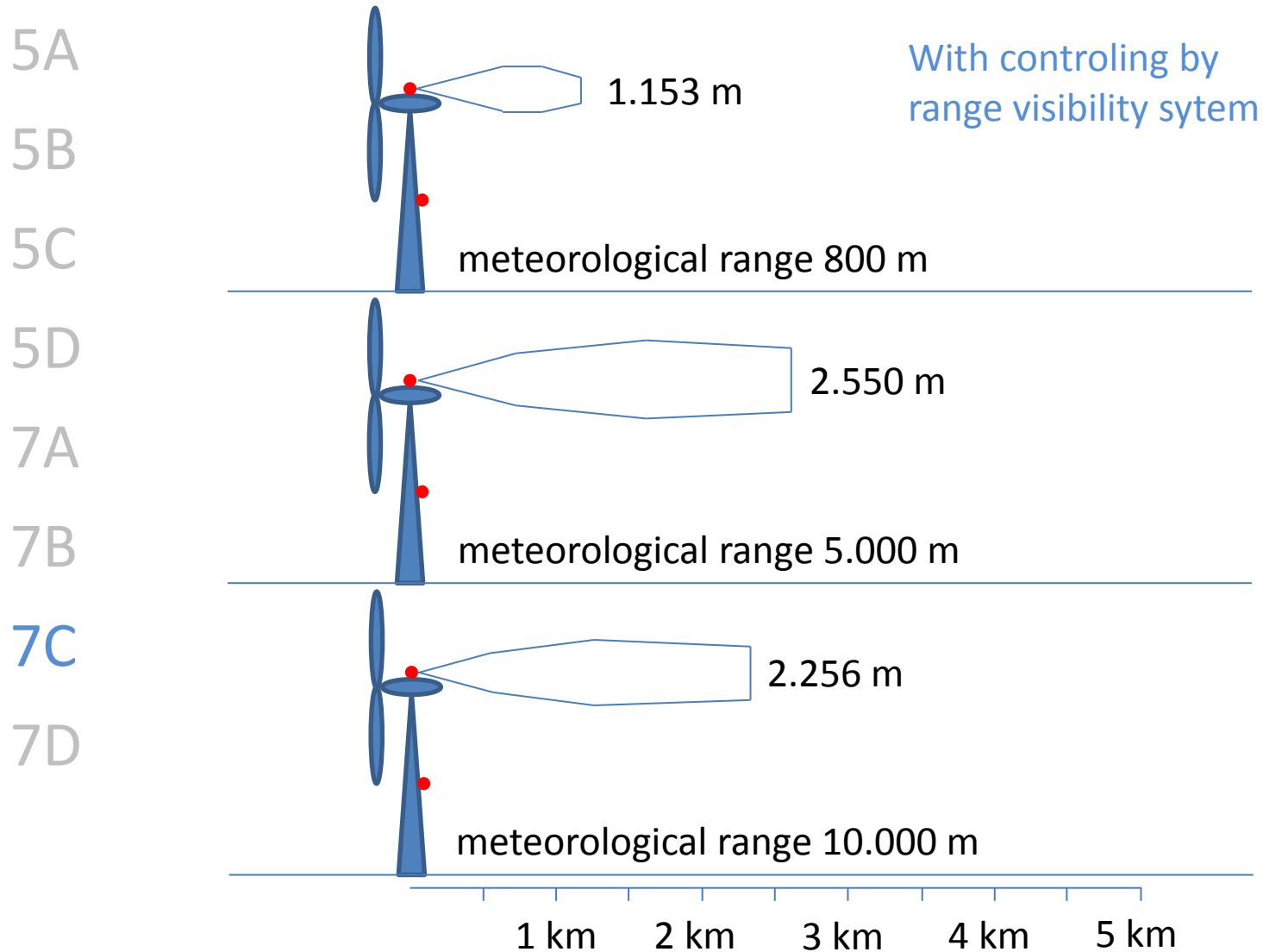
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## Group 7 obstacle lights with reduced radiation



# Working group AVV2018 of the BMVI

## Group 7 obstacle lights with reduced radiation



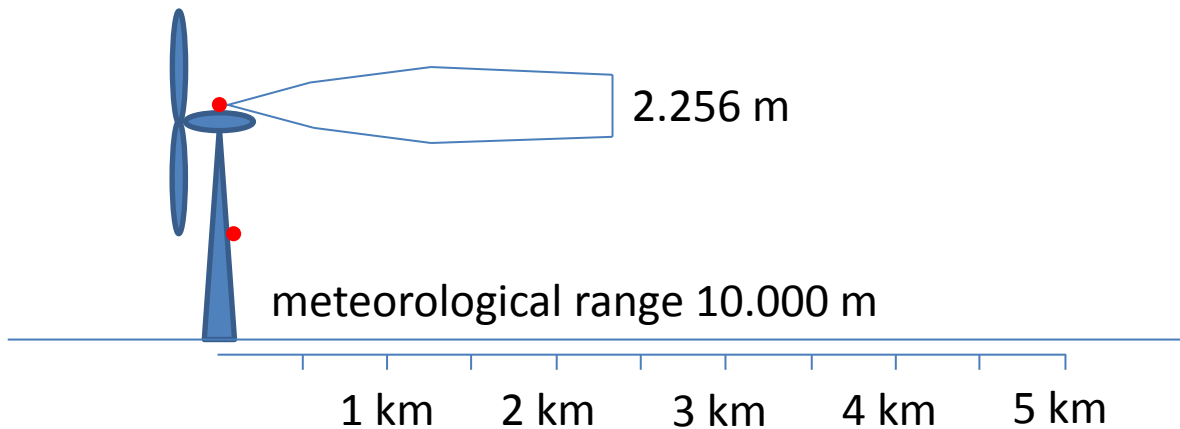
# Working group AVV2018 of the BMVI

## Group 7 obstacle lights with reduced radiation



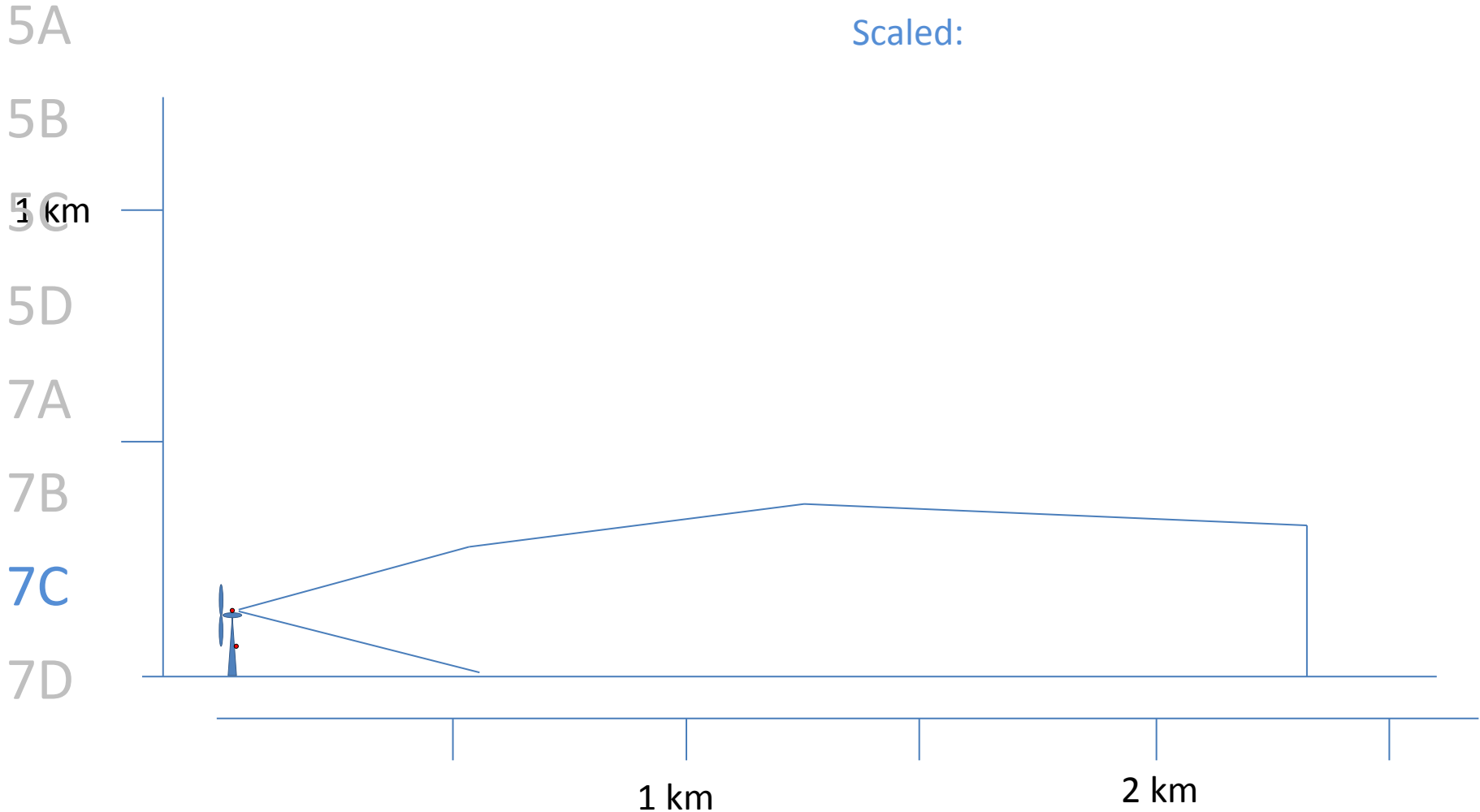
5A  
5B  
5C  
5D  
7A  
7B  
7C  
7D

With controlling by  
range visibility system



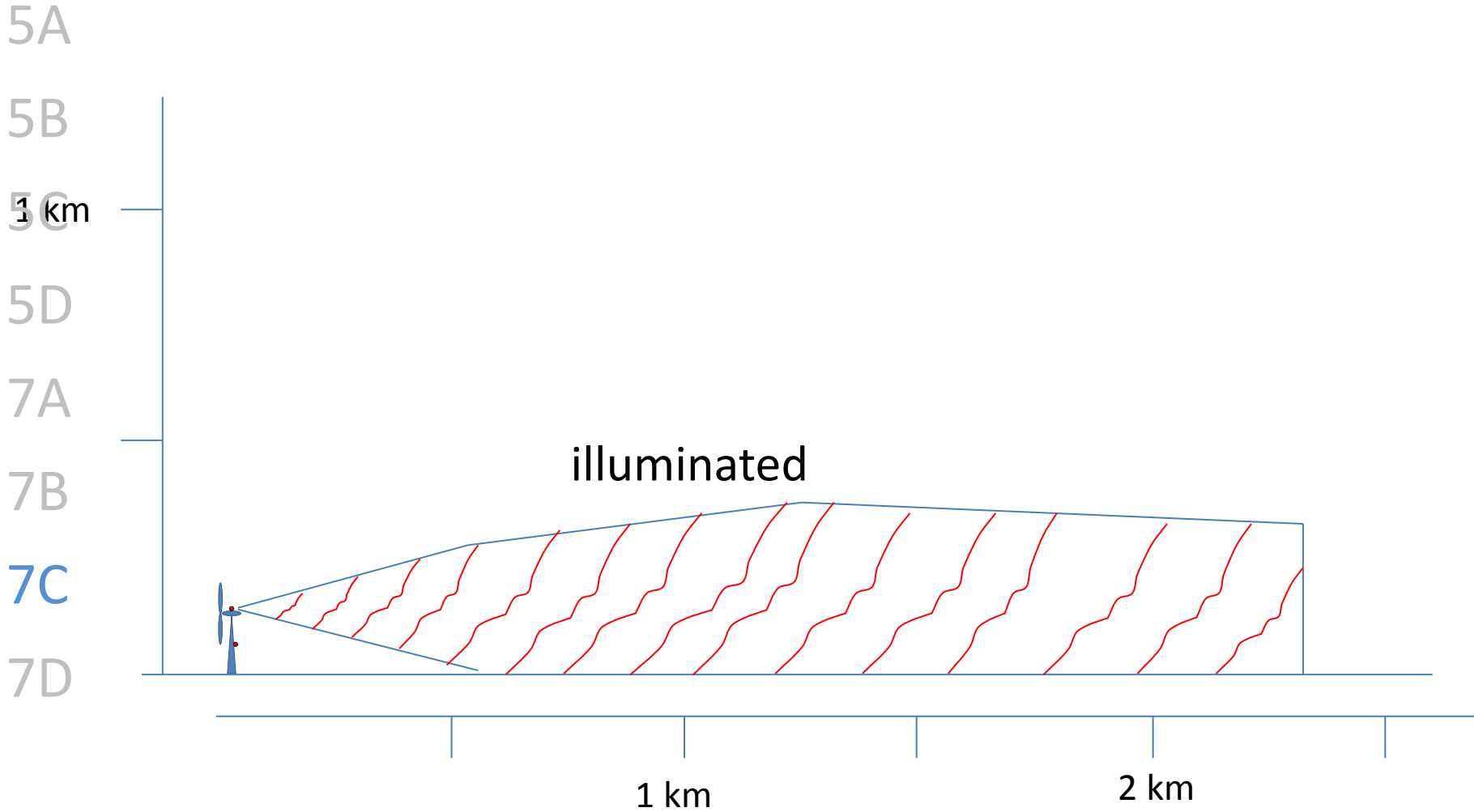
# Working group AVV2018 of the BMVI

## Group 7 obstacle lights with reduced radiation



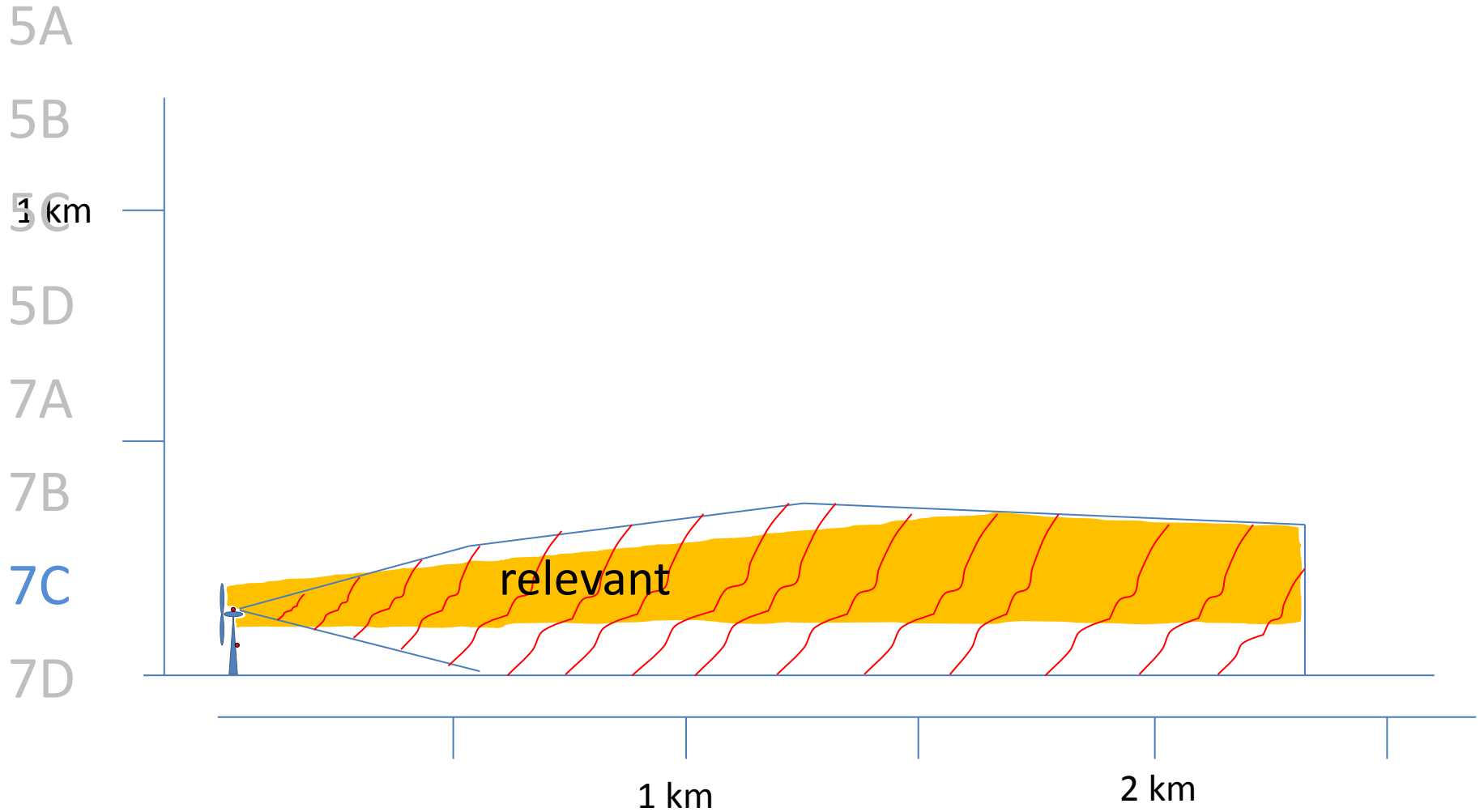
# Working group AVV2018 of the BMVI

## Group 7 obstacle lights with reduced radiation



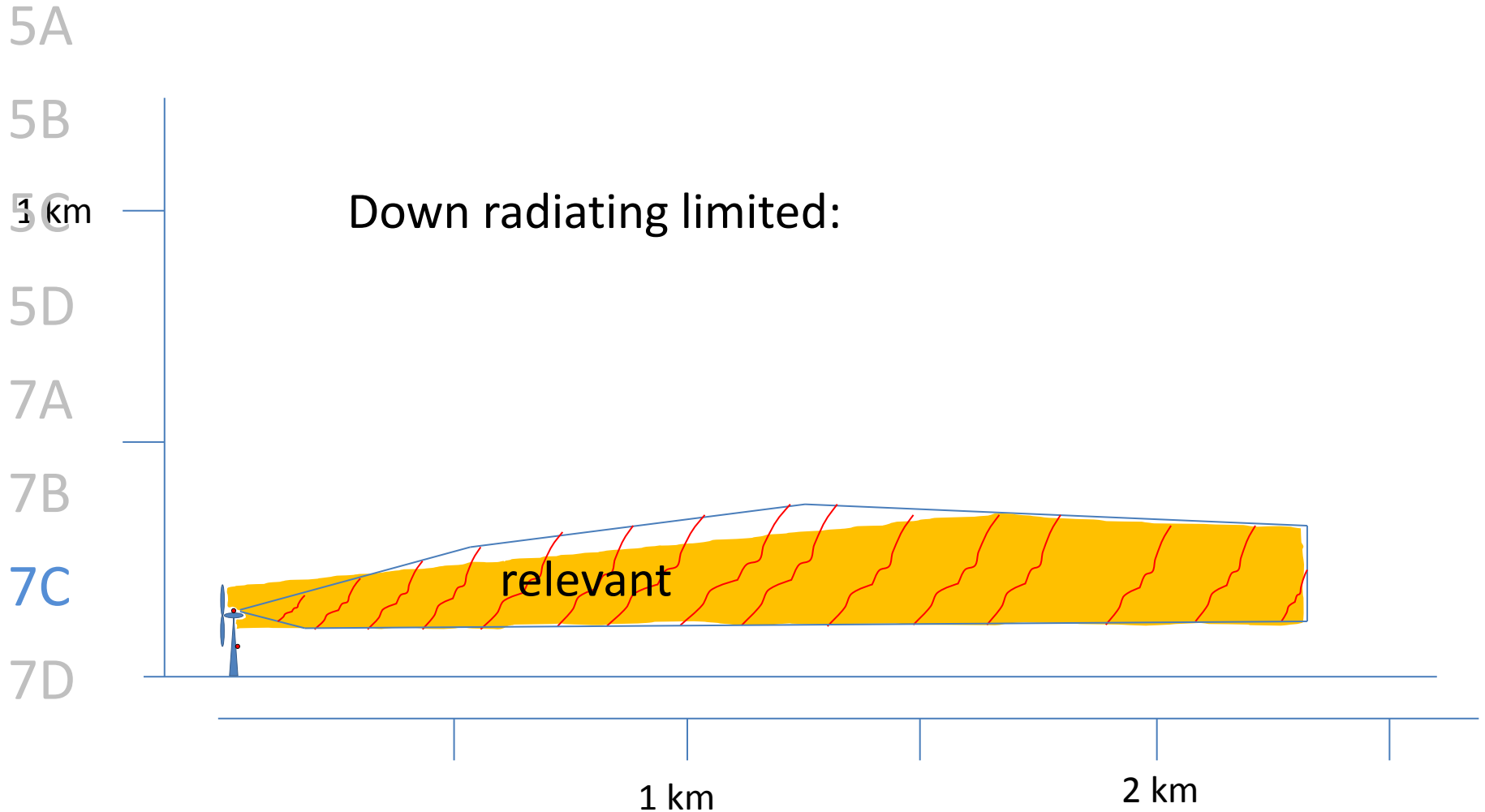
# Working group AVV2018 of the BMVI

## Group 7 obstacle lights with reduced radiation



# Working group AVV2018 of the BMVI

## Group 7 obstacle lights with reduced radiation





# Working group AVV2018 of the BMVI

## Group 7 obstacle lights with reduced radiation

---



5A

5B

5C

5D

7A

7B

7C

**7D** • Realization: ARC-SIRIL

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## Group 7 obstacle lights with reduced radiation



5A

5B

5C

5D

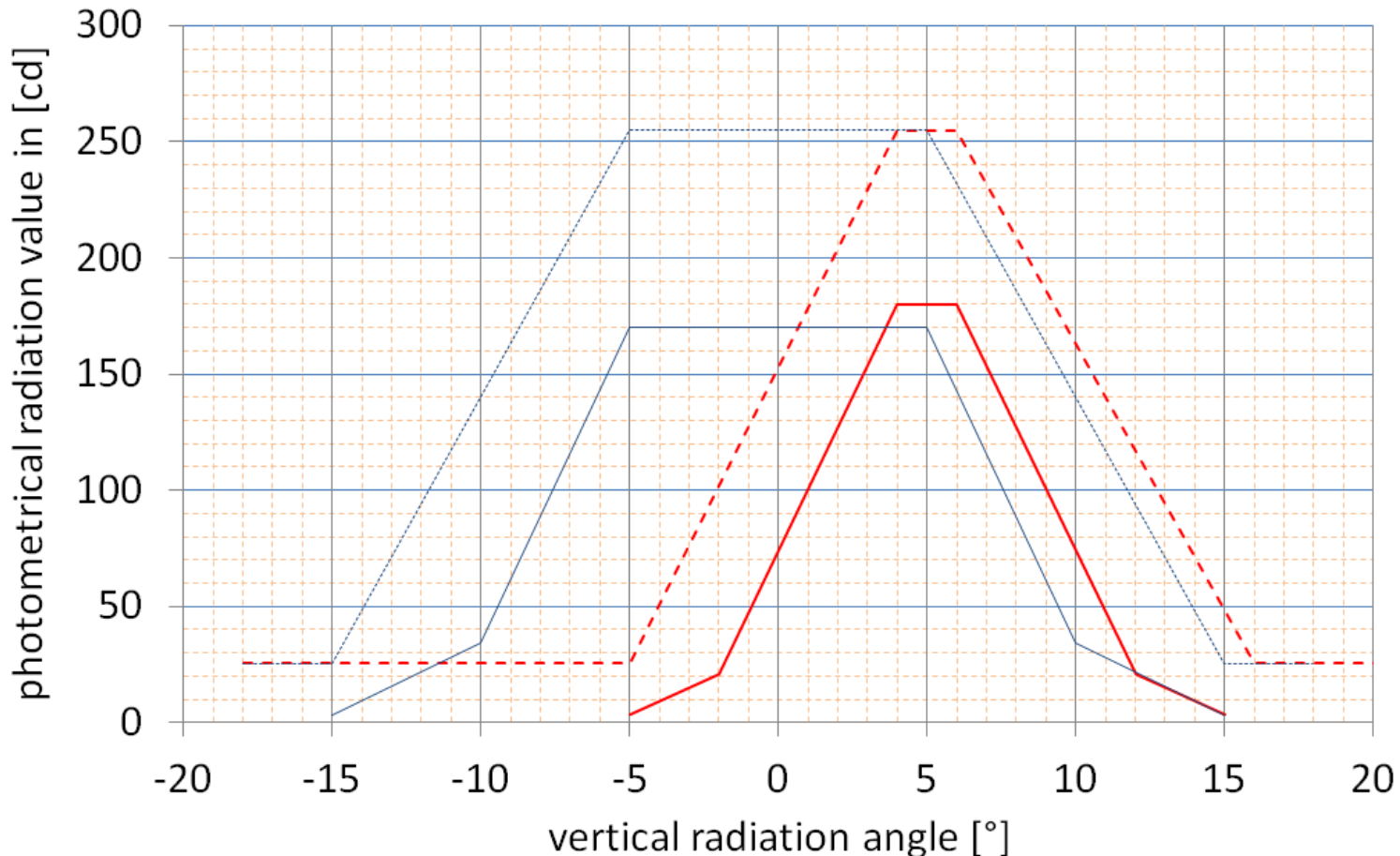
7A

7B

7C

7D

- (solid red) Obstacle light W, rot with reduced spread minimum
- - - (dashed red) Obstacle light W, rot with reduced spread maximum
- (solid blue) Obstacle light W, rot ES minimum
- - - (dashed blue) Obstacle light W, rot ES maximum



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## Group 7 obstacle lights with reduced radiation

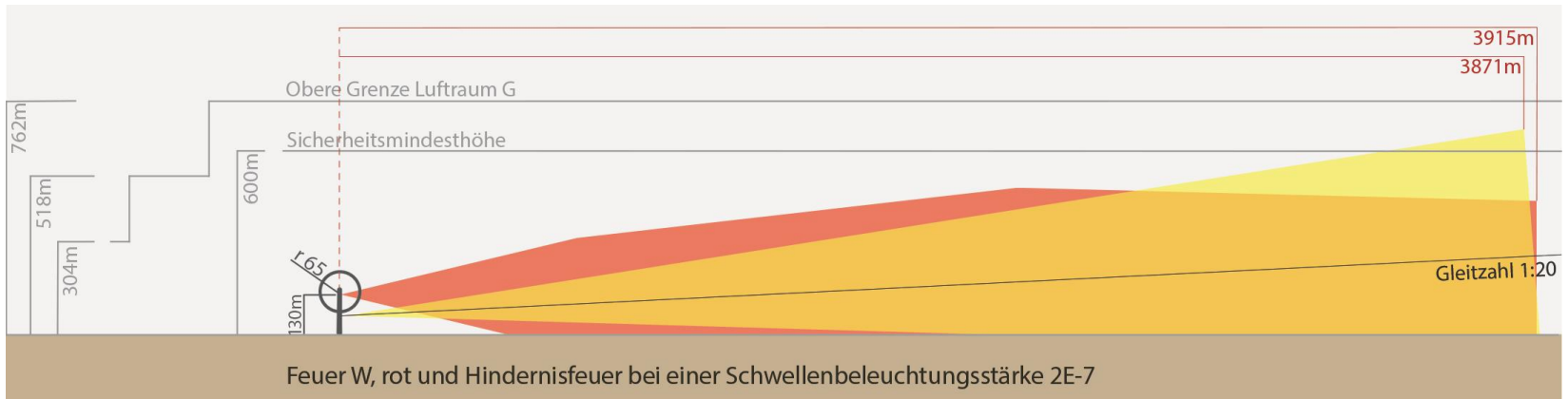


5A

5B

5C

5D

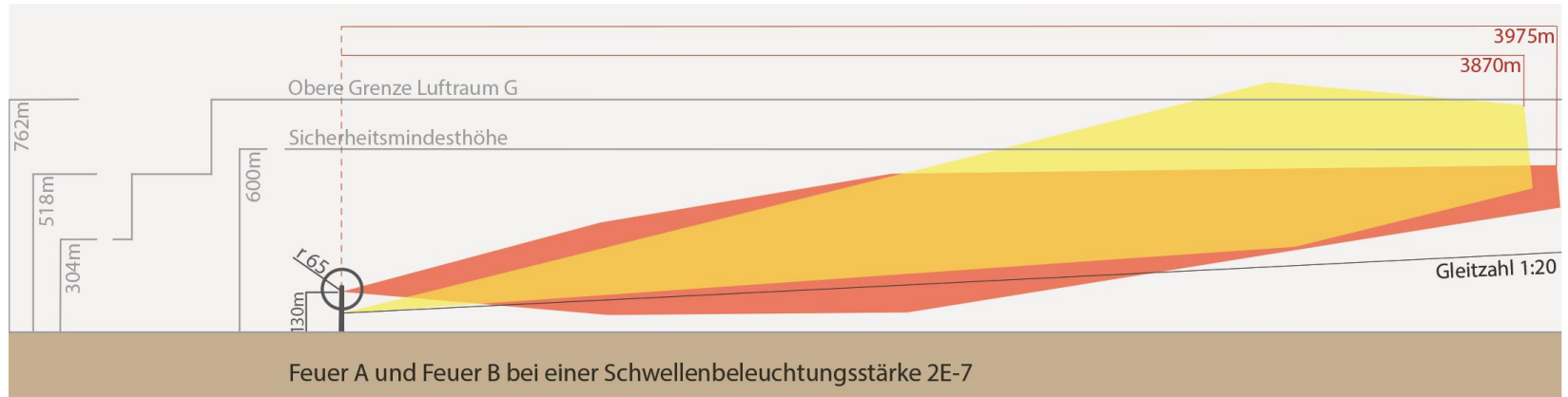


7A

7B

7C

7D



5A

## ARC-SIRIL

5B

5C Aviation Regulation Conformal - Surface Intensity  
5D Reduced Intelligent Lighting

7A

- Theoretical evidence provided by Lanthan: Concept in 03/15

7B

- Statement on the concept by airsight GmbH in 11/15

7C

- Evaluation of the concept by airsight (3 field tests)

7D

Duration: 4 months, ready in 3/17

# Vielen Dank für Ihre Aufmerksamkeit!

obstacle light concept: ARC-SIRIL

W,rot ES

0°

W, rot with reduced spread



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