Requirements for the use of Aircraft Detection Lighting Systems on wind turbines – version 02 - approved 12 July 2021

Requirements for the use of aircraft detection lighting systems on onshore wind turbines and wind farms in The Netherlands, as approved by the national project group on obstacle lighting in the meeting of the 12th of July 2022.

Obstacle lighting based on aircraft detection

1. The use of an aircraft detection lighting system is allowed for the operation of obstacle lighting on a wind turbine from 15 minutes after the end of the daylight period until the start of the daylight period, as meant in the Air Traffic Decree 2014.

2. If an aircraft detection lighting system is being used the wind turbines equipped with obstacle lights shall also be equipped with a flashing infrared light source on the nacelle.

3. It is not permitted to use an aircraft detection lighting system without the approval of the Civil Aviation Authority.

4. The aircraft detection lighting system shall not be used in the following obstacle restriction surfaces of aerodromes: approach surface, take-off climb surface, inner horizontal surface and conical surface as meant in chapter 4 of ICAO Annex 14, Volume I.

5. The aircraft detection lighting system shall not be used in the outer horizontal surface of an aerodrome, unless an aeronautical study indicates that the safety of air traffic is not endangered by the use of the aircraft detection lighting system.

6. The aircraft detection lighting system contains a detection zone situated at least 7 kilometre from the obstacle with a height between 300 and 2.000 feet.

7. The aircraft detection lighting system contains a warning zone situated at least 5,5 kilometre from the obstacle with a height between 300 and 2.000 feet.

8. In the detection- and warning zone aircraft between a height of 300 until 2.000 feet above ground level shall be detected by the aircraft detection lighting system.

9. The aircraft detection lighting system shall have the capacity to monitor at least 50 aircraft in the detection zone.

10. In case the aircraft detection lighting system loses the signal of an aircraft situated within the detection zone due to an unknown reason the obstacle lighting shall be switched on for at least 10 minutes.

11. If an aircraft is situated in the warning zone the obstacle light shall be switched on.

12. The obstacle light on a wind turbine can be switched off if:
a. there is no aircraft in the warning zone;
b. the system integrity is guaranteed.

13. Contrary to article 12, the obstacle light remains switched on for at least 1 minute after the aircraft has left the warning zone.

14. The power supply of the aircraft detection lighting system shall be monitored.

15. The aircraft detection lighting system shall conduct a self-diagnosis of the system integrity at least once every 24 hours.

16. When the aircraft detection lighting system detects a defect, failure or malfunction of a system or component the obstacle lights shall be switched on.

17. It is permitted to use a combination of methods for the detection of aircraft.

18. The Civil Aviation Authority grants a permission for the use of an aircraft detection lighting system when the operator of the wind turbine demonstrates the proper functioning of the following system functions:
a. control of all system components;
b. detection of aircraft;
c. self-diagnosis to continuously check the system integrity;
d. registration of the system status, including the signals from detectors, the activation commands, the status of communication systems, the status of the control unit and the status of the obstacle light, for a period of 30 days;
e. interface for the control of the lighting system.

19. The request for permission, as meant in article 18, contains at least the following information:
a. description of the location, coordinates, maximum tip height, charts and type of wind turbine;
b. description of the aircraft detection lighting system, including relevant system documentation;
c. location and coordinates of the aircraft detection lighting system, including charts, range, detection zone and warning zone;
d. if necessary, the aeronautical study, as meant in article 5;
e. validation, including a flight test, that proves that the aircraft detection lighting system detects aircraft in the detection zone and warning zone properly and that the obstacle light is switched on when an aircraft is present in the warning zone;
f. description of the fail-safe measures of the aircraft detection lighting system;
g. mentioning of the operator of the wind turbine and the person responsible for the use of the aircraft detection lighting system;
h. description of the management, inspection and maintenance of the aircraft detection lighting system;
i. declaration that the detection data will only be used for the purpose of the use of the aircraft detection lighting system.

20. The flight test contains at least the flight patterns in height and direction around a wind turbine to prove the proper functioning of the aircraft detection lighting system.

21. The operator of a wind turbine which is equipped with an aircraft detection lighting system shall monitor the surroundings of the wind turbine for developments that can have influence on the functioning of the aircraft detection lighting system.

22. The operator of a wind turbine shall ensure that the aircraft detection lighting system keeps functioning properly despite changes in the surrounding of the wind turbine.

23. The aircraft detection lighting system contains a log with the detection data, activation and system status of the previous 30 days.

24. Periodical inspections of the aircraft detection lighting system shall be conducted according to the instructions of the manufacturer or supplier to ensure that the system is in reliable condition.

25. As part of the maintenance the operator shall inspect the aircraft detection lighting system at least every 6 months.

26. Reports of the inspections, as meant in article 24 and 25, shall be submitted to the Civil Aviation Authority on a yearly basis and shall be preserved for at least two years by the operator.

Transponder based aircraft detection lighting systems

27. In addition to the general requirements for aircraft detection lighting systems the following requirements are applicable when the system is using transponder signals for aircraft detection.

28. The aircraft detection lighting system is able to detect the following transponder signals and use them to switch-on the obstacle lights:
a. Mode S/ELS;
b. Mode A/C.

29. In addition other signals transmitted by aircraft can be used by the aircraft detection lighting system to switch on the obstacle lights, but not for the logical exclusion of activation that has to take place on the basis of the signals mentioned in article 28.

30. Other signals from the Mode-S system can be used for the logical exclusion and interpretation of the signals mentioned in article 28, if the signal fulfils the following criteria:
a. Surveillance Integrity Level (SIL) ≥ 1;
b. System Design Assurance (SDA) ≥ 1; and
c. Navigation Accuracy Category-Position (NACp) ≥ 7.

31. Active interrogation of transponders and intervention in the system of air traffic control on behalf of the functioning of the aircraft detection lighting system is not permitted.

Radar based aircraft detection lighting systems

32. In addition to the general requirements for aircraft detection lighting systems the following requirements are applicable when the system is using radar signals for aircraft detection.

33. The information for the request for permission, as meant in article 19, in addition contains:
a. the assessment of the disturbance of the radar of the aircraft detection lighting system from an independent expert;
b. the intention to provide a license for the use of a frequency for the aircraft detection lighting system by the Telecom Agency.

34. In the detection zone and warning zone objects shall be detected from a minimal radar cross section of 2m² and a radial speed up to at least 300 knots.

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General

According to the international ICAO safety requirements, obstacles of 150 meter or higher shall be lighted. This is essential to make these obstacles visible for aviation. The focus on climate change and developments in the domain of wind energy have resulted in an increase in the number of wind turbines. These modern wind turbines are also larger and higher in order to provide for an increase in energy production and therefore a reduced cost price. The current generation of wind turbines have a tip height of 250 meter.

Consequence of the increase in the tip height of wind turbines is that these wind turbines need to be equipped with obstacle lights for aviation purposes. These obstacle lights can be a nuisance for people living in the vicinity, especially during darkness. Studies have been undertaken in which way the light intensity can be reduced for the benefit of the people living in the surrounding area without compromising the visibility of obstacles and aviation safety. This resulted in the possibility to adapt the light intensity to the local visibility conditions. In good visibility conditions the light intensity in the dark can be reduced considerably. In certain cases it is also allowed to use steady lights which cause less nuisance instead of flashing lights. Additionally a study has been carried out whether the technology for aircraft detection can be used to switch the obstacle lights on and off according to the need for visibility for air traffic. In practical terms this means that the obstacle lights will only be switched on if there is an aircraft in the vicinity of the obstacle. The obstacle lights are particularly important for air traffic in visual flight conditions at an altitude below 2.000 feet. The available technology comprises aircraft detection systems based on the signals from radar or transponders. The general requirements are however drafted in a generic way, in order to make it applicable for other technology that could be used as an aircraft detection lighting system.

Article 1

Article 1 contains the possibility to use aircraft detection to switch on and off the obstacle lights when needed. The obstacle lights will only be lit when it is necessary to warn pilots flying visually (VFR) for a high obstacle. The detection of aircraft can be done using various methods such as radar or transponder signals. The requirements do not prescribe a certain method. The general requirements for aircraft detection and the specifications for the chosen method will have to be fulfilled. On top of that, the wind turbine operator shall demonstrate that the aircraft detection lighting system functions properly with the help of a flight test. If these condition are fulfilled the Civil Aviation Authority can approve the use of the aircraft detection lighting system at the specific wind farm.

The aircraft detection lighting system can be used during the period when aircraft can be detected and that is outside the daylight period. The colour of the obstacle lights is then generally red. During the beginning and end of above mentioned time period there is also a possibility that the lights are flashing white in the twilight period for a short while. Obstacle lighting is experienced as most annoying by local residents in an environment of darkness and the aircraft detection lighting system can be used in this time period. For radar detection it is important that aircraft have such characteristics that the radar signals are sufficiently reflected and a minimum radar cross section is therefore prescribed. With a transponder based aircraft detection lighting system it is necessary that aircraft use a transponder. That is why there is an obligation to use a SSR Mode S/ELS transponder for flights under visual flight rules (VFR) outside the daylight period. The term daylight period is defined in the Air Traffic Decree 2014 as part of the day between 15 minutes before sunrise and 15 minutes after sunset, as it applies in the Netherlands at the position 52^{o}00’ N and 05^{o}00’ O at sea level. The time of sunrise and sunset for aviation is recorded in the Aeronautical Aviation Publication

(AIP) of the air traffic service provider LVNL. It has been decided to maintain an extra safety margin of 15 minutes in the requirement after the end of the daylight period in case an aircraft flying VFR has unintentionally not landed on time due to unforeseen circumstances. The white flashing obstacle lights for the daylight period cannot be switched off on the basis of aircraft detection. The reason for this is the fact that there is much more and different kind of air traffic during the daylight period flying at lower altitudes. Not all of these aircraft can be detected by the aircraft detection lighting system, either because they do not have a transponder or the radar cross section is too small for reliable reflections.

Article 2

The aircraft detection lighting system is used to warn pilots performing VFR flights during darkness for high obstacles by switching on the obstacle lights if an aircraft approaches. Several organisations, such as the military, police and HEMS operators, make use of night vision equipment during their VFR flights in darkness. With this equipment the available ambient light is amplified many times so that objects and the environment can be recognised in the darkness. An infrared light source is highly visible to users of night vision equipment. Article 2 stipulates that when an aircraft detection lighting system is used a flashing infrared light source shall be present on the nacelle of the wind turbine. The light source shall be visible from all sides. The infrared lighting must be flashing, because the movement of the flashing light can be more easily observed by pilots using night vision equipment between the other ground-based lights present. It is possible to integrate the visible obstacle lighting and the infrared lighting in a single lighting installation. Even when a fixed red light source can be used in the darkness, the infrared light must also flash. This is possible if it concerns a separate light source or if the infrared light source can be operated separately. Only if the infrared light source is integrated with the visible light in existing light installations and cannot be operated separately it is permitted that a fixed infrared light is used. The infrared lighting must be available when the aircraft detection lighting system is activated outside the daylight period, but may also be switched on during the daylight period. Since infrared light is not visible to the human eye, it will not cause any nuisance to local residents in the vicinity of the wind farm.

Article 3

The use of an aircraft detection lighting system to switch the obstacle lights on and off can have an impact on aviation safety. Therefore it is imperative to have an approval from the Civil Aviation Authority to use an aircraft detection lighting system. The Civil Aviation Authority can make the safety assessment whether the system can be used safely at the requested location and consult with the military and other involved organisations.

Article 4

The use of an aircraft detection lighting system is not permitted in a number of obstacle limitation surfaces around an aerodrome as mentioned in ICAO Annex 14, Volume I, Chapter 4. It concerns the approach surface, take-off climb surface, inner horizontal surface and conical surface. These surfaces are either in the extended area of the runway or are circle shaped obstacle limitation surfaces located close to the aerodrome. Within these surfaces aircraft are by nature flying at low altitudes, due to their take-off or landing at the airport. The obstacle lights are more important for navigation purposes in these areas. Not being able to use an aircraft detection lighting system within the area of these obstacle limitation surfaces will not have many consequences in practise. First of all it is in any case not possible to build high wind turbines in these areas. Furthermore it would not be very useful to have an aircraft detection lighting system in these areas, due to the high number of aircraft present that will constantly switch on and off the obstacle lights.

Article 5

The outer horizontal surface around an aerodrome is a circle shaped obstacle limitation surface at a height of 150 meter and a distance of 15 km from the runway (5,2 km at small aerodromes). In the outer horizontal surface it is not forbidden to build obstacles penetrating the obstacle limitation surface, however a safety assessment is required. Depending on the flight procedures, the kind of traffic at the aerodrome and the location and height of the obstacle a penetration of the surface might be permitted if after an aeronautical study it is determined that the obstacle would not adversely affect the safety or significantly affect the operations of aircraft. In these cases it is absolutely necessary that the obstacle is equipped with obstacle lighting. Article 5 states that the use of an aircraft detection lighting system is not allowed for obstacle lighting on obstacles located within the outer horizontal surface unless an aeronautical study determines that the use of this system would not endanger the safety of aircraft. When multiple wind turbines with obstacle lighting are assessed the outcome could be that the use of an aircraft detection lighting system is possible for some wind turbines in the wind park but not for all of the wind turbines in the wind park.

Aeronautical studies are conducted by aviation consultants according to a certain method. They will take into account the purpose of the regulation and the reasons to deviate from a requirement in the specific case. Attention is given to the aerodromes, flight procedures, air space, kind and number of aircraft which use the aerodrome. This results in a qualitative risk assessment about the use of a method of aircraft detection for obstacle light control on a specific location in the outer horizontal surface and the application of mitigating measures to reduce safety risks. This leads to a conclusion in the aeronautical study whether the use of an aircraft detection lighting system at that location is acceptable. The aeronautical study is part of the information that has to be submitted to the Civil Aviation Authority according to article 19 for the request for approval for the use of the aircraft detection lighting system.

Article 6

Each aircraft detection lighting system shall contain at least two zones. A fixed zone in which the system detects the aircraft present in that zone and a fixed warning zone that causes the obstacle lights to switch on when an aircraft enters this zone. These zones are necessary to be able to assess whether the aircraft detection lighting system actually detects relevant objects and switches the obstacle lights on when needed. The detection zone is by definition bigger than the warning zone. Article 6 contains the minimum range of the detection zone from the obstacle. This zone has a radius of 7 km. This range is derived from the minimum radius of the warning zone from the obstacle which is set at 5,5 km. The detection zone gives an indication of the range of the aircraft detection lighting system and the area it can cover. There is no maximum range for the detection zone as long as the proper functioning of the system and compliance with the applicable requirements can be demonstrated. This can for instance be of importance when multiple wind farms are being equipped by one aircraft detection lighting system.

Article 7

The distance between the warning zone and the obstacle is very important. This distance ensures that pilots can observe the burning obstacle lights in time and are able to conduct an evasive manoeuvre when necessary. In The Netherlands the choice has been made to use a criterion for the range of the zone and not to relate the distance to the speed of aircraft. The choice for a range of 5,5 km is based on the similar requirement from the US Federal Aviation Administration (FAA). After an international comparison this range has been chosen, because it undoubtedly guarantees aviation

safety. It gives pilots a longer reaction time for an evasive manoeuvre after observing the obstacle lights.

Article 8

Article 8 defines the relevant height limits which the aircraft detection lighting system should be able to cover and these are set between 300 and 2.000 feet above ground level. The height of 300 feet is well below the minimum flight level in darkness. The height of the upper limit of 2000 feet is set because the aircraft detection lighting system is meant for air traffic flying under Visual Flight Rules (VFR) at a relatively low altitude. Commercial aviation crossing at a higher altitude should be filtered out of the detection zone to prevent that the lights constantly switch on. The aircraft detection lighting system is not meant for commercial air traffic operating at higher altitudes, since there is no collision risk with the obstacles.

Article 9

The aircraft detection lighting system should be able to detect multiple aircraft at the same time when they are present in the detection zone. Therefore article 9 requires that the system shall be able to detect and monitor at least 50 aircraft in the detection zone at the same time. This ensures that the system is in any circumstance capable to effectively monitor the movements of detected aircraft and the aircraft do not disappear out of sight due to lack of capabilities of the system. The number of 50 is a minimum requirement but in general aircraft detection lighting systems are able to detect and monitor many more aircraft. There is however no need for a higher number of aircraft that can be detected at the same time, because the number of aircraft in the airspace of the detection zone will anyway be limited due to the collision risk between the aircraft.

Article 10

When an aircraft detection lighting system does not monitor a once detected aircraft in the detection zone anymore due to an unknown cause this might lead to dangerous situations. In these cases it is not assured anymore that the obstacle lights are switched on the moment the aircraft enters the warning zone. Therefore article 10 stipulates that in these circumstances the obstacle lights shall be switched on for at least 10 minutes to ensure that the pilot is warned that high obstacles are in the vicinity. The 10 minutes period is based on German requirements for the same theme.

Article 11

When an aircraft enters the warning zone the system must switch on the obstacle lights. This is the essence of an aircraft detection lighting system and therefore article 11 is an obvious and important requirement. Switching on the obstacle lights shall be done automatic and immediately.

Article 12

Article 12 states the circumstances when it is permitted to switch the obstacle lights off. This can be done when there is no aircraft in the warning zone. This is logical, because the obstacles are equipped with an aircraft detection lighting system for this situation in the first place. Next to that the system integrity must be guaranteed. This situation involves the self-control and fail-safe measures of the aircraft detection lighting system. The aircraft detection lighting system contains advanced technology in combination with complex software and continuously monitors the functioning of the system. It assesses the power supply and generates a test signal for internal

system function control. When the aircraft detection lighting system establishes the improper functioning of the system or a component thereof the obstacle lights are switched on automatically.

Article 13

Once the aircraft has left the warning zone the obstacle lights should remain switched on for a certain period of time to indicate the position of the obstacle for navigation purposes. This period is related to the moment when the aircraft leaves the detection zone. Due to the average speed of aircraft this time period is set to 1 minute and after that the lights can be switched off automatically. When the aircraft makes a turn and enters the warning zone again the obstacle lights shall be switched on again unless the lights are still switched on because the 1 minute time frame has not yet elapsed.

Article 14

The aircraft detection lighting system needs an electric power supply to function properly. With the help of continuous electrical monitoring the system integrity is guaranteed. The software of the system generates a regular test signal and the moment such a test signal cannot be generated the fail-safe system is activated and the obstacle lights have to be switched on. It is not necessary to have an emergency power supply for these situations.

Article 15

It is possible that there are periods of time when there are no aircraft present in the detection zone. This can be the case when the aircraft detection lighting system is located in an area with low air traffic activity or when the weather situation results in a limited number of VFR flights. In these cases the obstacle lights will not be switched on for some time. To guarantee the proper functioning of the system it shall generate an automatic test signal at least every 24 hours for self-control purposes. This ensures that any defect or failure in the system is detected within a reasonable time frame. When the system has been activated within the period of 24 hours due to the presence of an aircraft the internal self-control is not necessary because the system is functioning properly. The internal self-control includes only the functioning of the aircraft detection lighting system itself and the connection to the obstacle lights. The test signal does not have to be an externally generated signal, but can be an internally generated signal representing a target in the detection zone.

Article 16

The moment the aircraft detection lighting system establishes a defect or failure in the system the obstacle lights are switched on. This is the essence of the fail-safe design of the aircraft detection lighting system. With this function it is ensured that the lights on the obstacle are always visible for pilots in the vicinity of the obstacle. Only when it is demonstrated that the aircraft detection lighting system is again functioning properly the activation of the obstacle lights can be terminated and the lights can be switched off again.

Article 17

An aircraft detection lighting system is in most cases based on a single method for the detection of approaching aircraft, such as radar or transponder signals. It is however permitted to use a combination of methods for the detection of aircraft. So when a radar is installed it is possible to use transponder signals as well for the detection of aircraft.

Article 18

Article 18 contains the criteria for granting a permission by the Civil Aviation Authority for the use of an aircraft detection lighting system. The operator of the aircraft detection lighting system has to demonstrate the proper functioning of a number of system functions. First of all this concerns the control of the components of the system. Then it has of course to be demonstrated that the system is adequately detecting aircraft in the detection and warning zones. The system shall be able to continuously monitor its functioning and integrity. The functioning of the components of the system and the system status shall be registered for a period of 30 days. Finally the operator shall demonstrate the proper functioning of the interface for the control of the obstacle lighting system.

Article 19

To assess a request for permission to use an aircraft detection lighting system the Civil Aviation Authority needs information about the system and the obstacles that will be protected by the system. Article 19 contains a list of data and information that has to be submitted to the Civil Aviation Authority with the request for permission.

First off all it is necessary to indicate which wind turbines equipped with obstacle lighting shall be covered by the aircraft detection lighting system. It is necessary to describe the location, coordinates and maximum height of the wind turbines.

Next to that the relevant system documentation of the aircraft detection lighting system has to be submitted, including the location and range of the detection and warning zone.

In case of use of the aircraft detection lighting system for wind turbines located in an outer horizontal surface of an aerodrome the aeronautical study, as meant in article 5, should also be included.

The request also includes a report of a flight test. The flight test contains the ultimate evidence that the aircraft detection lighting system is functioning properly. The moment the flight test can be conducted the system is already actually installed at the site and it is possible to demonstrate that the entire system is working as it should. The system is able to detect all relevant aircraft, gives the signal upon entering the warning zone that the obstacle lights shall be switched on and the obstacle lights are actually lit. On the basis of the report of the flight test the Civil Aviation Authority can be assured that the installed aircraft detection lighting system at a specific location covering certain wind turbines is functioning adequately. There are a number of specific requirements for conducting the flight test and these are laid down in article 20. Several operational flight patterns have to be flown to assess that the aircraft detection lighting system is detecting the aircraft at all times.

The fail-safe measures shall ensure that the obstacle lights are lit when necessary and provide pilots sufficient time to avoid the wind turbines.

It is important that it is clear who is the operator of wind turbines and who is responsible for the proper functioning of the aircraft detection lighting system. In most cases this will be obvious because the operator is submitting the request for permission to use the system to the Civil Aviation Authority. It is however possible that a radar based aircraft detection lighting system is covering more than one wind farm and in those cases it should be clear who is responsible for the distinct parts of the total system. There shall only be one entity responsible for the use of the aircraft detection lighting system and there cannot be any doubts about who is the accountable contact person for the Civil Aviation Authority.

When the aircraft detection lighting system is installed and functioning it is necessary that the system keeps functioning adequately in the future. Therefore it is essential that monitoring and maintenance of the system is properly managed.

The detection data from the aircraft detection lighting system can only be used for the purpose of the system, which is the control of the obstacle lights. It is for instance possible that a radar based aircraft detection lighting system registers flight patterns of military aircraft conducting an exercise in the surrounding airspace of the wind turbines. These flight patterns can be classified data and the operator of the aircraft detection lighting system may not disclose or publish this information.

Article 20

The flight test is the last step in the process to submit a request for permission to use an aircraft detection lighting system. The flight test demonstrates that the system detects the relevant aircraft and switches the obstacle lights on when an aircraft enters the warning zone. The flight test shall be conducted according to a test matrix containing several operational flight patterns in height and direction through the detection and warning zone. In case of the use of radar signals the detection of an aircraft flying low from behind the wind turbines towards the radar installation shall be monitored to assess whether the system detects the aircraft behind the obstacles. Next to that a pattern shall be flown descending into the detection and warning zone through the activation limit of 2.000 feet. The establishment of a suitable test matrix should however take into account the local situation and risks connected to the specific aircraft detection lighting system. A flight test to assess the detection of aircraft has to be conducted both in case of a radar based as well as in case of a transponder based aircraft detection lighting system. It might be possible that developments in the use of drones can play a role in conducting flight tests in the future.

Article 21

The permission granted by the Civil Aviation Authority and the formal commissioning of the aircraft detection lighting system is just a fixed moment in time. It is however of great importance that the system continues to function properly in the future. Developments in the surrounding of the aircraft detection lighting system, such as the erection of new obstacles, can have negative consequences for the functioning of the system. This is especially important for a radar based aircraft detection lighting system. The radar itself is not protected by an obstacle restriction zone in the spatial planning law. Therefore there is a requirement for the operator of the aircraft detection lighting system to monitor the surroundings of the wind turbines and the aircraft detection lighting system for developments with a possible negative impact on the functioning of the system.

Article 22

Once the operator becomes aware of developments with a possible negative impact on the functioning of the aircraft detection lighting system he has to take measures to prevent or mitigate the consequences of the development. The operator is an interested person in the procedure for a building permit to raise the new obstacle and he can claim that his interest of a proper functioning aircraft detection lighting system is at stake. It could be advisable to inform local government about this interest beforehand. If there are any doubts about the functioning of the aircraft detection lighting system due to new developments that have taken place the operator has to demonstrate that the system is still compliant with the requirements and the permission granted. It might for instance become necessary to add an extra transponder signal receiver to keep the system

functioning properly. In an extreme situation there is the possibility that the use of the aircraft detection lighting system has to stop because aviation safety cannot be guaranteed anymore.

Article 23

The aircraft detection lighting system contains complex software controlling all system functions. Part of this software is the memory function of what the system has done in the past and how the system has functioned. It is important that the systems logs all data and stores this in the system so it can be studied afterwards. Therefore article 23 states that the aircraft detection lighting system shall have a log containing the detection data, activation and system status of the previous 30 days.

Article 24

Wind turbines are complex installations and systems and need regular maintenance. The same is applicable for aircraft detection lighting systems. At the time of the delivery of the product the manufacturer or supplier adds guidance to what kind of maintenance is necessary to keep the aircraft detection lighting system functioning properly. Therefore the operator shall inspect the aircraft detection lighting system according to these instructions in order to ensure the system remains in a reliable condition at all times. The way the management, inspection and maintenance of the aircraft detection lighting system will be conducted is documented as required in article 19, sub h.

Article 25

Article 25 states that the operator shall as part of the maintenance procedure inspect the aircraft detection lighting system at least every 6 months.

Article 26

When inspections of the aircraft detection lighting system have been conducted a report of the results of the inspection shall be prepared. These reports shall be submitted to the Civil Aviation Authority at least once every year and shall be preserved by the operator for two years.

Article 27

The articles 28 to 31 contain some additional requirements which are applicable for the use of aircraft detection lighting systems based on transponder signals. These requirements have to be fulfilled next to the general requirements. In these articles the transponder signals are determined that allow the aircraft detection lighting system to function.

Article 28

Article 28 contains an important requirement concerning the transponder based aircraft detection lighting system. The system shall be able to function properly on the basis of the SSR transponder with Mode S/ELS (Elementary Surveillance) signals from aircraft. This is the standard transponder equipment being used in aircraft and which are mandatory to be installed in aircraft flying under Visual Flight Rules (VFR) outside the daylight period. In addition to that the system shall also be able to detect signals from a Mode A/C transponder.

Article 29

Apart from the transponders with Mode S/ELS and Mode A/C there are also transponders with more advanced functions transmitting information about the aircraft. Article 29 states that it is allowed that the aircraft detection lighting system makes additional use of these signals, but that the system has to function properly at least with the signals as mentioned in article 28.

Article 30

Article 30 contains quality requirements about other transponder signals from the Mode S-system. These transponder signals from the Mode S-system can be used by the aircraft detection lighting system as long as they comply with these specific quality requirements.

Article 31

It is not allowed that the aircraft detection lighting system is actively interrogating transponders or intervenes in the system of air traffic control. The Air Navigation Service Providers have no role or responsibility in the use of aircraft detection lighting systems and the use of the aircraft detection lighting system shall not interfere with the air traffic control system.

Article 32

Article 33 and 34 contain additional requirements which are applicable to the use of an aircraft detection lighting system based on radar signals. These articles state which additional information shall be submitted to the Civil Aviation Authority for the request for permission and provide a quality requirement for the detection of aircraft with radar signals.

Article 33

Article 33 contains the additional information necessary for a request to use a radar based aircraft detection lighting system. First of all a report with the assessment of the disturbance of the radar signals by an independent expert has to be submitted. This assessment of obstacles causing disturbance to the radar signals is important because the presence of obstacles can result in a blind spot in radar sight and can lead to the not properly functioning of the aircraft detection lighting system. These obstacles can be anything with some height, such as buildings, trees, dikes and the wind turbines itself. The manufacturer of the radar based aircraft detection lighting system can and will perform an disturbance assessment to determine a suitable location to install the radar. It is important that the operator has some certainty that the radar based aircraft detection lighting system will function as expected before procuring the product. When the final location has been determined an disturbance assessment shall be conducted by an independent expert. This assessment will give an important indication of the reliability of the functioning of the system. This assessment report results in detection calculations shown in maps giving information about blind spots and in which sectors the radar signal detection might not be sufficient. This information is also input for establishing the test matrix for the flight test to determine whether the radar coverage in these sectors is sufficient to ensure aviation safety. On the basis of the radar disturbance assessment the operator can determine in an early stage whether the choice of location for the radar installation will lead to any problems. The report of the disturbance assessment from the independent expert is submitted as additional information to the Civil Aviation Authority with the request for permission.

Article 33 also states that there should be an intention from the Telecom Agency to provide a license for a frequency for the radar of the aircraft detection lighting system. Because the radar is transmitting signals with a certain frequency it is necessary that there is capacity available in the frequency spectrum. The Telecom Agency also performs an interference assessment. The check

whether the signals from the proposed radar installation will not cause interference on other transmitting installations which are already present and have a licence. This is a very specialised assessment and the Telecom Agency is able to perform such an assessment, because of the knowledge of other installations in the vicinity that can be influenced by the radar signals. It is advised that an operator wishing to use a radar based aircraft detection lighting system starts the procedure with the Telecom Agency. If there is no capacity available for the frequency of the radar signals it has no use to start a procedure for requesting permission with the Civil Aviation Authority. The article explicitly mentions the intention to provide a licence by the Telecom Agency. This is to prevent the situation that the Telecom Agency cannot issue a frequency license because the location of the radar is not fixed yet and the Civil Aviation Authority cannot issue the permission for the use of the radar because there is not a license from the Telecom Agency yet.

Article 34

Linked to the requirement that the radar based aircraft detection lighting system shall be able to detect aircraft is the operational requirement that the system should detect at least a certain type of objects as a relevant object. Therefore article 34 states that objects with a minimal radar cross section of 2m² and a radial speed up to 300 knots shall be detected by the system. The dimension of the radar cross section has been derived from requirements for air traffic control radar and the requirement for the radial speed is based on leading German requirements. These requirements are design objectives and not requirements which are part of the flight test as mentioned in article 20. The requirement of article 34 is not based on the possibility to detect the F-35 (Joint Strike Fighter) which is hard to detect by radar due to stealth capabilities. The F-35 flies at exercises in peace-time configuration which gives it a larger radar cross section while it is also using a transponder.