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VDSI Verband für Sicherheit, Gesundheit und Umweltschutz bei der Arbeit

VDSI-Rule

Use of drones in wind turbines

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02/2019

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Professional group Renewable Energy

- 11 / 2020 -

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VDSI-Guideline:

VDSI-Guidelines are elaborations of VDSI working groups, VDSI professional groups and other committees within the VDSI. They focus on topics requested by whomever out of engineering practice where no other institutions in the sector occupational health and safety and environmental protection have published information. As a result of this VDSI-Guidelines document a new circumstance or show up the state of technology in a defined specific field.

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1. Introduction

Target

VDSI rule 02/2019 describes a rule for safe and activity-related use from the perspective of a drone pilot, an entrepreneur, a manufacturer and an operator on a wind turbine on- / offshore (WTB). It thus forms a standard template for all areas of application on a WTB.

The VDSI rule was developed by members of the VDSI department "Renewable Energies". The department is made up of experts from operators, installers, manufacturers, suppliers and service providers for renewable energy generation systems, especially WTB. All work with a focus on occupational safety, health protection and environmental protection. The VDSI rule reflects the professional opinion of these members and can be understood as a guideline for a safety-related industry standard.

Target groups are all those involved in using drones on WTB on- / offshore. These include owners, operators, manufacturers, installers, service providers and craftsmen.

Scope

The validity of this VDSI rule refers to the national German environment for construction, installation, commissioning, operation, maintenance and repair, large component replacement, special uses such as B. Fire damage investigation and dismantling of WTB.

All applicable laws and regulations are not affected by this VDSI rule and must be fully taken into account.

Definitions

MTOW =	Maximum Take-Off Weight
Pilot =	Drone pilot, long-distance pilot
found people =	people involved in the operation
UAS =	Unmanned Aircraft System
UAV =	Unmanned Aircraft Vehicle
LuftVO =	Air traffic regulations
GRC =	Risk class for possible damage to the ground
ARC =	Risk class for possible damage to the air
SORA =	Operational Risk Assessment
SORA-GER =	Operational Risk Assessment Germany
ConOps =	Concept of Operations
LBA =	Federal Aviation Office
LUC =	Light UAS operator certificate
LUC-Holder	Holder of an light UAS operator certificate
EASA =	European Aviation Safety Agency

Emergency protection =	Under emergency protection in the field of nuclear power Safety Protective measures understood in the event of serious accidents, which either aim to mitigate a meltdown that is already in progress by means of technical emergency measures within the power plant concerned (blocks), or are then intended to protect the population outside the power plant.
EU =	European Union
WTB =	Wind turbine

2. Basics of using drones

The goal is to create a uniform regulation for threats across the EU. To this end, a commission from EASA (European Aviation Safety Agency) has prepared a bill that will standardize (harmonize) the rules and regulations for drone operation in the EU. For drones (internationally known as Unmanned Aircraft System - UAS) and model aircraft, there are the EU regulations listed below.

COMMISSION DELEGATED REGULATION (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and third country operators of unmanned aircraft systems.
This Ordinance contains the requirements for the design and manufacture of unmanned aerial vehicle systems (hereinafter "UAS"), which are intended for operation in accordance with the regulations and conditions specified in Implementing Regulation (EU) 2019/947, as well as the requirements for the design and manufacture of additional devices for remote identification. It also contains specifications for the type of UAS, the design, manufacture and maintenance of which is subject to approval.

COMMISSION IMPLEMENTING REGULATION (EU) 2019/947 of 24 May 2019 on the regulations and procedures for the operation of unmanned aerial vehicles.
This regulation contains detailed provisions for the operation of unmanned aircraft systems and for personnel, including remote pilots and organizations involved in this operation.

IMPLEMENTING REGULATION (EU) 2020/639 OF THE COMMISSION of 12 May 2020 amending Implementing Regulation (EU) 2019/947 with regard to standard scenarios for operation in or outside of direct view.

From the VDSI's point of view, this rule contains the information required for safe use of drones on wind turbines. In addition, other requirements, such as by the operator, manufacturer or owner.

With the help of this VDSI rule, a uniform standard for the safe use of drones in wind turbines on- / offshore plants is to be created. The licensing authority (competent aviation authority) issues a general operating license to fly with UAS to wind turbines if the requirements are met.

With the help of this VDSI rule, a uniform standard for the safe use of drones on wind turbines on / offshore is to be created. The approving authority (LBA) issues the LUC owner with an operator certificate to fly with UAS on wind turbines if the requirements are met. Operators of light "unmanned aviation systems" (UAS) have the right with an "operator certificate for light UAS" (LUC), within the scope of their approval, to operate their own UA in one place in your organization Approve operating scenario without having to submit an operating declaration and / or an application for an operating license.

For the use of drones on wind turbines at special locations (e.g. in the vicinity of industrial plants or no-fly zones), individual ascent permits may be required.

Prerequisite for this general operating permit is participation in a certified training system with theoretical and practical components in the field of drone flight, SORA / SORA-GER and occupational health and safety management wind energy.

Most of these recommended standards can also be transferred to industrial sectors, e.g. Energy supply (conventional / nuclear generation, photovoltaic systems), petroleum and chemical industries….

3. General conditions for a drone deployment

3.1 Requirements for the drone

The technical requirements existing at the time of deployment must correspond to the state of the art. Specifications of EASA and SORA / SORA-GER as well as their implementing regulations are to be implemented. The future CE marking and the energy requirements such as operating time (flight time) must also be taken into account.

3.1.1 Classification in drone category

UAS operations are classified in the open, special, or certified category under the following conditions.

a) UAS operations in the open category do not require prior approval or a declaration of operation by the operator (operational description of the drone) of the UAS before they can be carried out.

b) UAS operations in a specific category require an operating permit issued by the competent aviation authority.

c) The operation of UAS in the certified category requires the certification of UAS and the operator and, if applicable, the licensing of the controller.

3.2 Standard for drone pilots

When using drones on wind turbines, in addition to the requirements listed below, the physical and mental requirements of the drone pilot, such as participation in a recognized training module focusing on wind energy, must be met in theory and practice.

3.2.1 Necessary tests by a drone pilot (pilot) before use

Before starting a UAS operation, the controller must have updated information about the planned UAS operations in relation to geographical areas. He must observe the operating environment, check for the presence of obstacles and check for the presence of people who are not found. It must be ensured that the UAS is able to safely complete the intended flight. If the UAS is equipped with an additional payload, it must be checked that its mass does not

exceed the MTOW (maximum take-off weight, maximum take-off weight) specified by the manufacturer or the MTOW limit of its class.

3.2.2 Aptitude test according to DGUV principle "driving, control and monitoring activities" (G25)

The driver must reliably fulfill all physical and mental abilities, skills and properties (e.g. hearing and vision, physical resilience and the sense of touch). The mental abilities and qualities include z. B. comprehension, mental resilience, concentration and coordination skills as well as technical understanding and ability to react.
Evidence of physical suitability must be provided through the valid suitability test for “driving, driving, monitoring activities”.

3.2.3 Further requirements of the drone pilot

The controller must not be under the influence of psychoactive substances or alcohol during the flight. He must also be in good health to carry out the flight without danger (daily form).

The flight must be stopped if the continuation of the flight can endanger other aircraft, people, animals, the environment or property.

The taxpayer must comply with operational restrictions in defined geographic zones or the published local conditions.

He must have the ability to take control of the UAV, except in the event of loss of connection or operation of a UAV with free flight.

He must operate the UAS according to the user manuals provided by the manufacturer, including any applicable restrictions.

The operator must perform a thorough visual inspection of the airspace around the UA to observe other aircraft and maintain a safe distance.

During the flight, controllers and UAS operators may not fly the UAV near or to areas in which so-called emergency protection is carried out, unless they have the permission of the responsible emergency services.

Controllers can be assisted by a UA observer in their line of sight, who will assist the controller in safely performing the flight by unattended visual observation of the UA.
Clear and effective communication must be established between the controller and the UA observer.

3.2.4 Flying out of sight

When using UAV on wind turbines, the drone may be out of the pilot's view. To ensure safe flying here, z. B. training with virtual reality glasses.

3.3 Standard for working with drones - Drone deployment regulations -

When using drones on wind turbines, in addition to the requirements listed below, general requirements such as existing operational and drone liability, local and plant knowledge, an existing work order and the correct selection of the drone used must be met.

3.3.1 Aim and purpose

With the general information, all those involved in the process receive an overview of the

wind turbine site within the scope of the services to ensure the necessary coordination, communication, cooperation and monitoring on the basis of legal and local (customers, operators) and internal requirements.

The aim is to continue to enable trouble-free use of drones and to ensure the safety of those involved, bystanders and equipment (work equipment). Country-specific requirements or project-specific requirements may make further measures necessary.

The drone assignment regulations and their applicable documents are created and kept up to date by the executing company. Additional information required is provided by the client.

3.3.2 Scope

The drone regulations and the applicable documents apply to the named on- and offshore wind farms and their wind turbines.

The drone deployment regulations to be drawn up and the applicable documents also apply to subcontractors and visitors to the service company and the client (customer / operator).

3.3.3 General information

Organization and communication

As part of the service deployment, current documentation of the companies involved in the service, safety signs and a daily service procedure meeting must exist.

3.3.4 Emergency management

An emergency management is to be created by the service operations manager of the contractor in cooperation with the respective client.

3.3.4.1 Emergency plan

Before any work at the service location begins, an emergency plan must be drawn up and adherence to it must be ensured.

3.3.4.2 Instruction, qualification and suitability

The service personnel must be demonstrably qualified and instructed for the activities to be performed.

3.3.5 General regulations and requirements

3.3.5.1 Working hours

Working hours must comply with the statutory provisions (Working Hours Act). A continuous

driving time of more than 60 minutes should be avoided. Battery change times can be taken into account.

3.3.5.2 Subcontracting of orders to subcompanies and partnerorganisation of the LUC owner

When assigning work to other entrepreneurs, the LUC owner has to comply with his duty of coordination and support and coordination according to § 8 ArbSchG as well as § 6 paragraph 1 accident prevention regulation "Principles of Prevention" (DGUV regulation 1) before service work. The LUC owner is obliged to provide information and documentation when commissioning subcompanies and partnerorganisations.

3.3.5.3 Visitors, non-site personnel

A ban on access and residence must be set up by the contracted company in consultation with the operator.

3.3.5.4 Obligation to use personal protective equipment (PPE)

The personal protective equipment PPE (e.g. safety shoes S3 ankle-high, helmet, safety vest ...) must be specified by the contractor as part of the risk assessment taking into account the operator's specifications.

3.3.5.5 Hazards during use and the environment

Any existing analyzes regarding hazards at the place of use and the environment are available from the client and can be requested / viewed if necessary. Measures resulting from the analysis must be implemented and inventory plans must be made available, e.g. B.

- Transmitting devices (e.g. mobile radio, directional radio, WLAN ...)
- Restrictions in the area of forest areas

3.3.5.6 Limiting influences from the area around the place of use

The restrictions, regulations and measures restricting service activities, e.g. B. for flies outside the field of vision, fire hazards, environmentally hazardous substances must be documented.

3.3.5.7 Road safety obligation towards third parties

The following measures for the public sector must be defined and ensured:

- Protective measures against falling objects and possibly falling drones.

3.3.6 Traffic routes on site

3.3.6.1 Traffic routes for vehicles and people

Access routes for fire, rescue, police and other auxiliary vehicles must be ensured. Speed specifications of the operator for the wind farm must be observed. The traffic routes for people must be safe to use in any weather.

3.3.7 Electrical systems, equipment and drone training

Electrical systems and equipment are to be checked regularly by all participating companies in accordance with the accident prevention regulation “Electrical systems and equipment” DGUV

regulation 3 and the industrial safety regulation.

Drone batteries must be kept in a fireproof case or container!

A safe use of drones must be ensured by trained, trained and certified personnel. This must be confirmed by an approved and approved drone training academy.

3.3.8 Operating instructions, occupational health care, suitability

The participating companies must ensure that current operating instructions are available for all activities.

The required occupational medical precaution and aptitude tests (G25) must be currently valid.

3.3.9 Dangers from the weather

Measures against dangers due to weather influences must be determined before service work. These include e.g. B. icing and ice dropping, storm, heavy rain, extreme heat and cold, heavy fog and snowfall as well as thunderstorms and lightning. The entrepreneur is responsible for the safety of the people working in his company - including temporary workers. When placing the order, the client is responsible for checking that this duty of care is adequately met. The following parties are responsible for deciding whether work is to be carried out in adverse visual conditions, and each person concerned can make the decision to stop work in a controlled manner:

The entrepreneur ensures that the necessary communication is guaranteed at all times for the employees.

4. Specific requirements for a drone deployment

In this section the additional required aviation criteria as well as the specific requirements of the operator / manufacturer are presented.

4.1 Standard for the specific use of drones

The security management serves the risk analysis of the different areas of application of drones and is directly related to the approval procedure of the LUC holder.

Risk detection, risk assessment, risk minimization and risk control are the essential and

overarching points of safety management. For this purpose, a risk assessment for specific operations, the so-called SORA, is carried out.

4.1.1 SORA / SORA-GER (Risk management)

SORA / SORA-GER is a risk assessment, adapted to national law, for the basic assessment of the damage classes of UAV and expressly refers only to the prevention of accidents.
Other protected goods, such as crime prevention, privacy, nature and noise protection, are not considered.

4.1.1.1 Precheck

Checking the requirements of the Air Traffic Ordinance (LuftVO) whether there is a need for a

SORA / SORA-GER.

In many cases, a SORA / SORA-GER is required for special or individual permits, unless the simplified procedure without SORA / SORA-GER applies.

4.1.1.2 Preparation for risk assessment (Preliminary ConOps / Concept of Operations)

For this purpose, deployment considerations are made with the help of maps of the place of deployment, the air spaces and the ground conditions.

4.1.1.3 Determination of uncorrected risk category "ground" (GRC)

Identification of risks from the drone for people and infrastructure on the ground. The uncorrected GRC risk category of an unmanned aerial vehicle relates to the risk that an out of control unmanned aerial vehicle can pose to people on the ground.

4.1.1.4 Correction of risk category "ground" (GRC)

In order to determine a corrected risk value “soil”, technical and organizational measures to prevent damage must be taken. Damage inhibition is divided into the robustness levels "low", "medium" and "high" and divided into the categories "lowering the damage effect" and "reducing the probability of occurrence".

4.1.1.5 Determination of uncorrected risk category "air" (ARC)

dentify risks from the drone for people and other aircraft in the air. The criteria for determining the risk value for the risk category "air" are e.g. B. Flight altitude, the visual flight and instrument rules, as well as airfields within a radius of 1.5 km.

4.1.1.6 Correction to risk category "air" (ARC)

In order to determine a corrected risk value “air”, technical and organizational measures to prevent damage must be taken. Damage inhibition is divided into the robustness levels "low", "medium" and "high" and divided into the categories "lowering the damage effect" and "reducing the probability of occurrence".

4.1.1.7 Determination of higher corrected value

The higher corrected value of GRC and ARC is decisive for the classification in the corresponding risk category and the associated requirements! If the value corresponds to the risk category very high (> = 7), no permission can be granted.

According to the rescue concept, which the operator of the wind farm and the entrepreneur coordinate with each other, rescue equipment is used that has specific requirements for the environmental conditions and therefore cannot be used in the worst case. In poor visibility conditions, the ability to quickly transfer employees from structures to the ship may also be limited.

4.1.1.8 Risk categories

Risk ratings	
Risk category low	1+2
Risk category medium	3+4
Risk category high	5+6
Risk category very high	>=7

Risk category low:

In this category, with the help of a self-declaration on e.g. B. the fulfillment of maintenance requirements, the knowledge of the training of the personnel, etc. and a simplified ConOps (short description of the drone operation) an application for a flight permit can be implemented.

Risk category medium:

There are extended requirements in this category.
With the help of evidence of drone maintenance, aids used, procedural instructions, flight documentation, qualification of the controller, etc. as well as a simplified ConOps (brief description of the drone operation), an application for a flight permit can be implemented.

Risk category high:

There are increased requirements in this category.
With the help of evidence such as a maintenance contract, special approvals, aids used / Redundancies, information gathering, flight documentation, increased qualification of the controllers, etc. as well as a detailed ConOps (detailed description of the drone operation) can be applied for a flight permit.

Risk category very high:

Permission cannot be granted!

4.1.2 ConOps

The ConOps is an operational description of the area of operation (populated area, crowd and vulnerability), the airspace, the drone, the general type of operation, the knowledge and the preparation of the controller.

The scope depends on the respective risk category determined.

4.1.2.1 Simplified ConOps - brief description of the company

To be created for low and medium risk categories.
The brief description contains information about the company and its organization, the controllers and their qualifications, company description / standard operation procedures and brief information about the unmanned aerial vehicle.

4.1.2.2 Detailed ConOps - description of the operation and technical information of the drone

To be created for risk category high.

The detailed ConOps is divided into the sub-areas "Description of the company, operations and controllers" and "Technical information".

Description of the company, the operations and the controllers

1. Definitions, glossary and list of abbreviations
2. Information on the company and the organizational structure

   Representation of how safe operation of the drone is implemented. (Organizational structure, management structure, responsibilities)
3. Missions

   (Information on normal operation and special operations)
4. Training

   (Presentation of personnel qualifications)
5. Appendices

Technical information

1. Definitions, glossary and list of abbreviations
2. Technical description

   (Details on the drone, the data link and the ground station (control))
3. Appendices

4.1.2.3 Further requirements by third parties or other authorities

Possibly. further rights must be taken into account. They can e.g. B. be:

- Special location requirements
- Data protection requirements
- Antitrust requirements
- Patent law requirements
- Copyright requirements

The drone company is responsible for collecting the information required for this purpose and, if necessary, implementing the resulting measures / requirements / specifications.

4.2 Specific requirements of the manufacturer / operator

In order to ensure the safe and activity-related use of drones on a wind turbine, the requirements and specifications of the legislator and the manufacturer / operator must also be observed. These include e.g. B. the creation of a drone assignment order, a risk assessment, behavior when climbing and working on a wind turbine, rescue chain, etc.

For aviation law approval, a wind turbine operator approval (private law approvals, permits or permits) must be available, which is part of the applicable documents.

Persons who are to enter the wind turbine and perform operating actions must have been trained by the operator / manufacturer and have read and understood the respective safety manual and the operating instructions for the wind turbine.

Requirements and specifications are also in the trade association regulations, rules and information (e.g. DGUV regulation 3, DGUV rule 112-198, DGUV information 203-007) and standards (e.g. DIN VDE 0105-100, DIN EN 361, DIN EN 353-1, DIN EN 354) described.

5. Rescue chain

The VDSI information 01/2016 "Optimization of the rescue chain - onshore" describes in its focus the optimization of the rescue chain, the location and directions for wind turbines and for other, predominantly regenerative energy generation plants that are installed in remote locations.

6. Training concept

VDSI Rule 01/2013 serves as **a safety-related rule for determining basic qualifications for personnel who are to work in wind turbines onshore and offshore**, and describes in its modules the necessary minimum training standards. Additional information is described in the additional modules 13a "Drone pilots - category special - on wind turbines on- / offshore" and 13b " LUC organization operating scenario - category "special" - on wind turbines on / offshore ".

7. Task and responsibility matrix

With the help of this matrix, the roles and responsibilities of the parties involved, operators (in individual cases also manufacturers), drone pilots, drone companies and the aviation authority are to be shown.

Task	Operator WTB	Drones		LUC-Holder
		Pilot	Companies	
Announcement, selection, commissioning, coordination	**V**	**M**	**M**	**-**
Delivery of specifications and information on the wind farm / WTB	**V**	**M**	**M**	**-**
Creation of drone deployment regulations and applicable documents	**M**	**M**	**V**	**-**
Fulfillment of the required Qualification (e.g. according to VDSI rule module 13a and 13b)	**-**	**M**	**V**	**-**
Granting of in-house aviation law approval	**M**	**M**	**M**	**V**
System responsibility and work coordination within the WTB and on the WTB site	**V**	**M**	**M**	**-**
Compliance with the requirements during the drone flight	**M**	**V**	**M**	**-**

V - Responsible

M - Cooperation