

Safety regulations for operators and technicians

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Wind. It means the world to us.[™]

Wind turbine type

Read the full document before you start to do work.

Send questions or concerns about the document to Vestas Wind Systems A/S.

Wind turbine type	Mk version
V117-4.0/4.2 MW	Mk 3E
V136-4.0/4.2 MW	Mk 3E
V150-4.0/4.2 MW	Mk 3E

Change description

Description of changes
First edition.

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1 Abbreviations and technical terms

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Table 1.1: Abbreviations

Abbreviation	Explanation
CRofHVCB	Controlled reconnection of HV circuit breaker
EMF	Electromagnetic field
HS	High speed
HV	High voltage
I/O	Input/output
LCTU	Lightning current transfer unit
LOTO	Lockout-tagout
LS	Low speed
LV	Low voltage
PPE	Personal protective equipment
SBU	Sales business unit
SPRA	Standardised procedure risk assessment
UPS	Uninterruptible power supply

Table 1.2: Explanation of terms

Term	Explanation
None	

2 Referenced documentation

2.1 Safety documents

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Table 2.1: Safety documents

Document no.	Title
0001-0410	Personal protective equipment sheets
0004-4159	Standardised procedure risk assessment (SPRA)
0016-1661	General information about the environmental impact of Vestas wind turbines
0077-2293	Rotor locking system
0079-9374	Safe work in hub
0079-9377	Safety for the fire suppression system
0083-6002	Safety for the fire suppression system - China

Document no.	Title
0079-9608	Installation and removal of the manual blade pitch lock
0079-9804	Evacuation, escape, and rescue plan
0080-9075	Application of warning and safety signs
0081-1931	Operating mode selector system
	Appropriate LOTO document

2.2 Reference documents

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Table 2.2: Reference documents

Document no.	Title
0015-9531	Discharge of static electricity in blades
0017-5309*	Vestas standard control of hazardous energy
0025-1178	Operating instructions and control card for the rescue equipment RESQ RED™
0035-4815	Crane manual
0076-3047	Operating instructions, wind turbine service lift, type: SHERPA-SD2 (sliding door 2)
0079-9658	Placement of anchor points
0081-5541	Use of turning gear for installation and decommissioning

*) Document for internal use at Vestas only.

3 Purpose

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The purpose of this document is to describe how to operate the wind turbine to keep the work environment safe before you start the work.

4 General safety notes



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Work in the wind turbine must be done according to this manual and related documentation. All personnel must be instructed and must be familiar with related parts of this manual.

Also, read and understand the safety regulations given below before you go into the wind turbine.

- Be careful when you handle a wind turbine that is connected to the grid to prevent dangerous situations.
- Do not work on a wind turbine in operation without specific instructions and permissions.
- Make sure that the access doors of unattended wind turbines are locked so that unauthorised persons do not go into the wind turbine.
- Do not stay in the nacelle during power production.
- Clean up grease, oil and other spills in the yaw deck, nacelle and hub before you do service work.

- Be careful in situations where measurement and work is done in junction boxes that can be connected to power.
- Strong permanent magnets are used at various places in the wind turbine for attachments. Prevent close proximity to the magnets due to the magnetic fields. The magnetic fields can affect pacemakers.
- Use hearing aid protection against noise hazards while you are at and in the wind turbine.
- Instructions for different areas and operating conditions are given in 0016-1661 'General information about the environmental impact of Vestas wind turbines'.
- If there is a fire event, special precautions must be obeyed according to 0068-1056 'Safety for the fire suppression system' because of toxicity of the fire suppression agent.

EU classification (DSD): Very Toxic T+ Corrosive  T+  C)



Before you access the wind turbine, do a check of the related safety alerts.

5 Service wind speed values

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The different types of work and service work are given in [table Maximum permitted wind speed and other requirements to do work and service work \(V117-4.0/4.2 MW Mk 3E\), page 8](#), [table Maximum permitted wind speed and other requirements to do service work \(V136-4.0/4.2 MW Mk 3E\), page 9](#), and [table Maximum permitted wind speed and other requirements to do service work \(V150-4.0/4.2 MW Mk 3E\), page 11](#). For each type of service work, the maximum permitted wind speeds and the requirement to engage the hydraulic rotor lock and activate the HS brake are given in the table.

SBU engineering and safety representatives can have the specified service wind speed values. These values must not be higher than the values given in the table.



Always do an estimate to see if service, repair, or replacement tasks are safe to do in the current circumstances or wind speed.

The maximum permitted wind speeds for repair and replacement work are given in the related service work instructions.

If the wind speeds are not given in the service work instructions, see the SBU-specified service wind speed values.

If the SBU-specified values are not available, see the standard maximum permitted wind speeds given in the table.



Always do a check of the different wind speed limits given in the table. These limits change if the yaw system is active or not active.

Table 5.1: Maximum permitted wind speed and other requirements to do work and service work (V117-4.0/4.2 MW Mk 3E)

Type of work and service work	Maximum wind speed (m/s, 10 minute average)	LS rotor lock on (hydraulic rotor lock)	HS brake manually on	Active yaw upwind control	Yaw not active
Work in the hub	25	X		X	
Work in the hub	20	X			(X)*
Maintenance work with 1 or more blades not in the 90° position†	15	X		(X)‡	(X)**
When the LS rotor lock is engaged with 2 pins only§	19	X			(X)*
Work in the nacelle	25			X	
Work in the nacelle	20				(X)*
Inspection inside the gearbox	25	X		X	
Inspection inside the gearbox	20	X			(X)*
Work on the composite coupling	25	X	X	X	
Work on the composite coupling	20	X	X		(X)*
Work on the rotating parts of the generator	25	X	X	X	
Work on the rotating parts of the generator	20	X	X		(X)*
Work on the electrical parts of the generator	25	X	X	X	
Work on the electrical parts of the generator	20	X	X		(X)*
Inspection of the rotating parts of the brake	25	X		X	
Inspection of the rotating parts of the brake	20	X			(X)*
Work on the rotating parts of the brake	25	X		X	
Work on the rotating parts of the brake	20	X			(X)*
Work in the nacelle with the rotor parking tool installed	15	X		X	

Type of work and service work	Maximum wind speed (m/s, 10 minute average)	LS rotor lock on (hydraulic rotor lock)	HS brake manually on	Active yaw upwind control	Yaw not active
Maintenance and lubrication work	15		X	(X) [†]	(X) ^{*†}
Work on the yaw system [¶]	15				(X) [*]
Work on the nacelle roof	15	X			(X) [*]
Work in the tower	25			X	
Work in the tower	20				(X) [*]

^{*}) Always make sure that the lower wind speed limits are in accordance with 0024-9649 'Installation and removal of fishnet', if the yaw system is not active and the fishnets are not installed.

[†]) A manual pitch lock must be applied during the replacement work related to the pitch system.

[‡]) This type of work can be done if the yaw system is active or not active.

[§]) All 3 blades must be locked in the 90° position. The rotor must be locked in a symmetric configuration where the 2 lateral pins (3 o'clock and 9 o'clock) are to be fully engaged.

^{||}) The wind speed value is taken from previous Mk version.

[¶]) All 3 blades must be in idling position (78° position).

Table 5.2: Maximum permitted wind speed and other requirements to do service work (V136-4.0/4.2 MW Mk 3E)

Type of service work	Maximum wind speed (m/s, 10 minute average)	LS rotor lock on (hydraulic rotor lock)	HS brake manually on	Active yaw upwind control	Yaw not active
Work in the hub	22	X		X	
Work in the hub	21	X			(X) [*]
Maintenance work with 1 or more blades not in the 90° position [†]	13	X		(X) [‡]	(X) ^{*‡}
When the LS rotor lock is engaged with 2 pins only [§]	16	X			(X) [*]
Work in the nacelle	25			X	
Work in the nacelle	20				(X) [*]
Inspection inside the gearbox	22	X		X	
Inspection inside the gearbox	21	X			(X) [*]

Type of service work	Maximum wind speed (m/s, 10 minute average)	LS rotor lock on (hydraulic rotor lock)	HS brake manually on	Active yaw upwind control	Yaw not active
Work on the composite coupling	22	X	X	X	
Work on the composite coupling	21	X	X		(X)*
Work on the rotating parts of the generator	22	X	X	X	
Work on the rotating parts of the generator	21	X	X		(X)*
Work on the electrical parts of the generator	22	X	X	X	
Work on the electrical parts of the generator	21	X	X		(X)*
Inspection of the rotating parts of the brake	22	X		X	
Inspection of the rotating parts of the brake	21	X			(X)*
Work on the rotating parts of the brake	22	X		X	
Work on the rotating parts of the brake	21	X			(X)*
Work in the nacelle with the rotor parking tool installed	13	X		X	
Maintenance and lubrication work	13		X	(X)†	(X)*†
Work on the yaw system [¶]	15				(X)*
Work on the nacelle roof	15 [¶]	X			(X)*
Work in the tower	25 [¶]			X	
Work in the tower	20 [¶]				(X)*

*) Always make sure that the lower wind speed limits are in accordance with 0024-9649 'Installation and removal of fishnet' if the yaw system is not active and the fishnets are not installed.

†) A manual pitch lock must be applied during the replacement work related to the pitch system.

‡) This type of work can be done if the yaw system is active or not active.

§) All 3 blades must be locked in the 90° position. The rotor must be locked in a symmetric configuration where the 2 lateral pins (3 o'clock and 9 o'clock) are to be fully engaged.

¶) The wind speed value is taken from previous Mk version.

¶) All 3 blades must be in idling position (78° position).

Table 5.3: Maximum permitted wind speed and other requirements to do service work (V150-4.0/4.2 MW Mk 3E)

Type of service work	Maximum wind speed (m/s, 10 minute average)	LS rotor lock on (hydraulic rotor lock)	HS brake manually on	Active yaw upwind control	Yaw not active
Work in the hub	20	X		X	
Work in the hub	18	X			(X)*
Maintenance work with 1 blade not in the 90° position†	10	X		(X)‡	(X)*‡
When the LS rotor lock is engaged with 2 pins only§	13	X			(X)*
Work in the nacelle	25			X	
Work in the nacelle	20				(X)*
Inspection inside the gearbox	20	X		X	
Inspection inside the gearbox	18	X			(X)*
Work on the composite coupling	20	X	X	X	
Work on the composite coupling	18	X	X		(X)*
Work on the rotating parts of the generator	20	X	X	X	
Work on the rotating parts of the generator	18	X	X		(X)*
Work on the electrical parts of the generator	20	X	X	X	
Work on the electrical parts of the generator	18	X	X		(X)*
Inspection of the rotating parts of the brake	20	X		X	
Inspection of the rotating parts of the brake	18	X			(X)*
Work on the rotating parts of the brake	20	X		X	
Work on the rotating parts of the brake	18	X			(X)*

Type of service work	Maximum wind speed (m/s, 10 minute average)	LS rotor lock on (hydraulic rotor lock)	HS brake manually on	Active yaw upwind control	Yaw not active
Work in the nacelle with the rotor parking tool installed	10	X		X	
Maintenance and lubrication work	10		X	(X) [†]	(X) ^{*†}
Work on the yaw system [¶]	15				(X) [*]
Work on the nacelle roof	15	X			(X) [*]
Work in the tower	25			X	
Work in the tower	20				(X) [*]

^{*}) Always make sure that the lower wind speed limits are in accordance with 0024-9649 'Installation and removal of fishnet', if the yaw system is not active and the fishnets are not installed.

[†]) A manual pitch lock must be applied during the replacement work related to the pitch system.

[‡]) This type of work can be done if the yaw system is active or not active.

[§]) All 3 blades must be locked in the 90° position. The rotor must be locked in a symmetric configuration where the 2 lateral pins (3 o'clock and 9 o'clock) are to be fully engaged.

^{||}) The wind speed value is taken from previous Mk version.

[¶]) All 3 blades must be in idling position (78° position).

5.1 To configure the rotor parking tool for various wind speeds

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- For V117 wind turbines, let the rotor parking tool stay in service configuration for wind speeds up to 22 m/s, if there is no personnel in the nacelle.
- For extreme wind conditions, put the rotor in the Y-position and pitch all blades to 90° to install the rotor parking tool in the long-term configuration.

For the item number of the rotor parking tool, see the table that follows:

Table 5.4: Item number for the rotor parking tool

Item no.	Quantity	Description
10205670	1	ERP: V112 ROTOR PARKING TOOL ASSY
10205672	1	ERP: V112 ROTOR PARKING MACHINED
10205664	2	ERP: V112 ROTOR PARKING PIN
10209568*	1	ERP: PARKING TOOL - STIFFENER ASSY
10209565	1	ERP: PARKING-TOOL STIFENER MACH. RH
10209567	1	ERP: PARKING-TOOL STIFENER MACH. LH

*) The assembly drawing will vary according to the bolted connection (new and longer stud bolts). The assessment is still valid for the new configuration.

6 Operation of the RtoP function

6.1 Lockout-tagout start

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Isolate the part of the wind turbine where you will do the work. Obey the LOTO procedure instruction referred to in 'Safety documents'. If no LOTO procedure instruction is included in 'Safety documents', obey the LOTO instruction supplied by the site-ECC.

6.2 To temporarily disable the CRofHVCB

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Risk of exposure to electric shock resulting in injuries! SPRA ID No. 3.01

- Do not start to do the work before the grid measured by the CTs is completely shut down.
- Obey the applicable LOTO procedures.
- Only qualified persons are allowed to do work with HV/LV cables or equipment.
- Use the necessary PPE that is given in PPE sheets 5 and 6.
- De-energise/isolate the work place before you start to do the work.
- Use an HV/LV voltage detector to measure zero voltage before you start to do the work.
- Use certified and correct equipment.

Temporarily disable the CRofHVCB function when the personnel go into the wind turbine.

- 1 On the front of the tower controller, set the mode selector **-615-08-S1** to position **2**, **3**, or **4**.

- 2 On the left-hand side of the tower controller cabinet, switch **-420-02-Q7** to **DISABLE**.



- 3 Apply LOTO on switch -420-02-Q7.



If it is necessary to switch the HV circuit breaker or to connect the switchgear, see 0021-4798 'HV switchgear operation'.

6.3 To enable the CRofHVCB

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- 1 On the front of the tower controller, set the mode selector -615-08-S1 to position 1.
 - The lamp -420-02-P3 will illuminate.

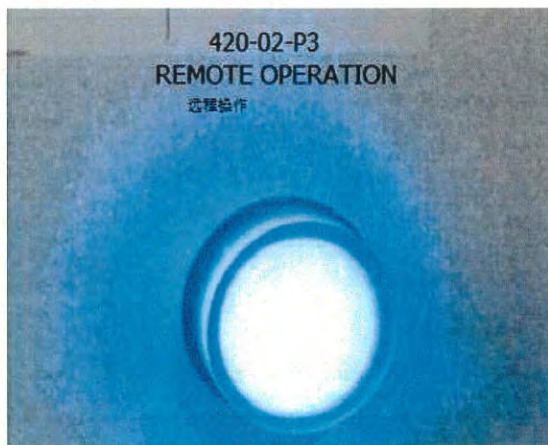


Figure 6.1: Lamp -420-02-P3

- 2 Remove the LOTO on the switch -420-02-Q7.

- 3 On the left-hand side of the tower controller cabinet, turn the switch -420-02-Q7 to position ENABLE. See [section 6.4.1 Manual restart procedure , page 16](#).

6.4 To manually energise the HV system

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First connection to grid or connection to grid after switchgear trip! SPRA ID No. 3.22

- Evacuate the nacelle and tower during first grid connection and after switchgear trip.
- Bring all personnel to a safe position before you operate the switchgear.
- Make sure that the gas insulation level on the pressure indicator is in the green area before you operate the HV switchgear.
- Only the switchgear operator may stay on the tower entrance platform or in the basement during grid connection.
- All personnel who remain on the tower entrance platform must use the necessary PPE sheet 8.
- Make sure that the conditions for operation of the switchgear are obeyed.
- Obey the manufacturer's operating instructions for the relevant switchgear.
- Make sure that all temporary earthing is removed and that the transformer room is locked.
- Operate the switchgear remotely from outside the tower, if possible.

If the HV grid is not available for more than 2 days (the UPS capacity can change the time period), the HV protection system goes into the SHUTDOWN mode, when the voltage relay -660-26-05-B2 measures a voltage below 21 VDC on the battery backup bank.

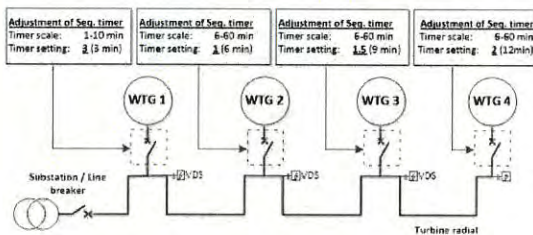


Figure 6.2: Example of sequential start-up/energising of wind turbines

To start the HV protection system again, in the SHUTDOWN mode, push the START button on the UPS for more than 3 seconds. See [section 6.4.1 Manual restart procedure , page 16](#). It is only possible to manually start the HV protection system again, if the VDS senses HV.

6.4.1 Manual restart procedure

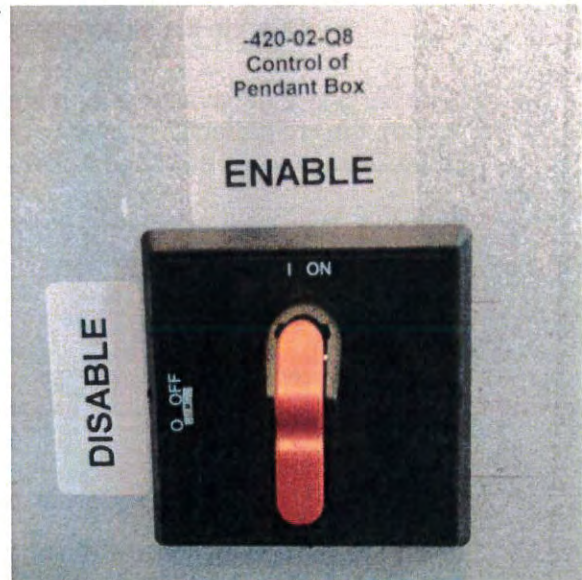
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- 1 Set the mode selector -615-08-S1 to position 2, 3, or 4.

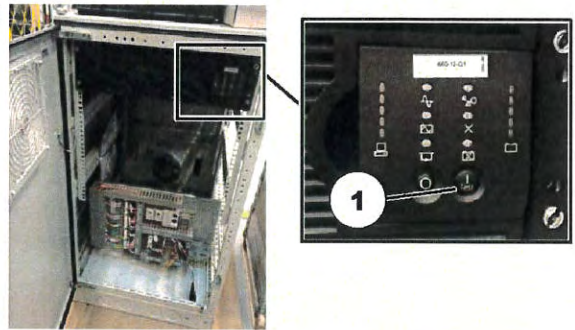
- 2 On the right-hand side of the tower controller cabinet, switch -420-02-Q7 to position DISABLE.



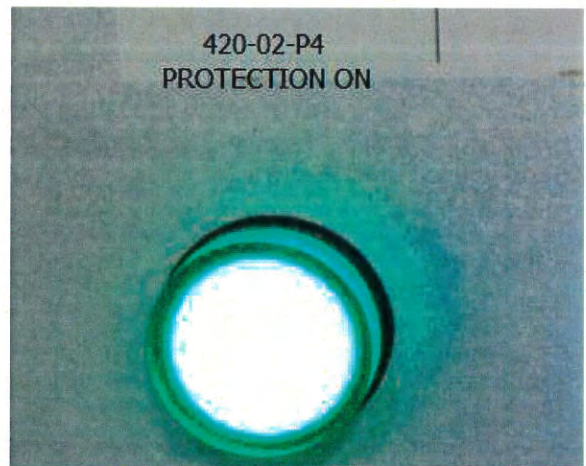
- 3 On the right-hand side of the tower controller cabinet, switch -420-02-Q8 to position ENABLE.



- 4 Push the manual restart button (1) inside the UPS for at least 3 seconds.



- 5 Wait until the lamp -420-02-P4 illuminates.



- 6 Make sure that there are no alarms on the HV switchgear.



- 7 Push the Enable button and the Close button on the pendant control box to close or connect the HV circuit breaker.



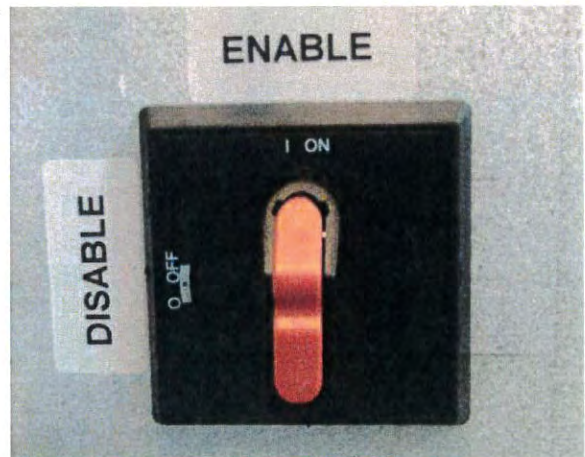
- 8 Start the wind turbine again.

- 9 On the right-hand side of the tower controller cabinet, switch -420-02-Q8 to position DISABLE.



- 10 Make sure that all the personnel who are not necessary to do the task are out of the wind turbine.

- 11 On the right-hand side of the tower controller cabinet, switch -420-02-Q7 to position ENABLE.



12 Set the mode selector -615-08-S1 to position 1.

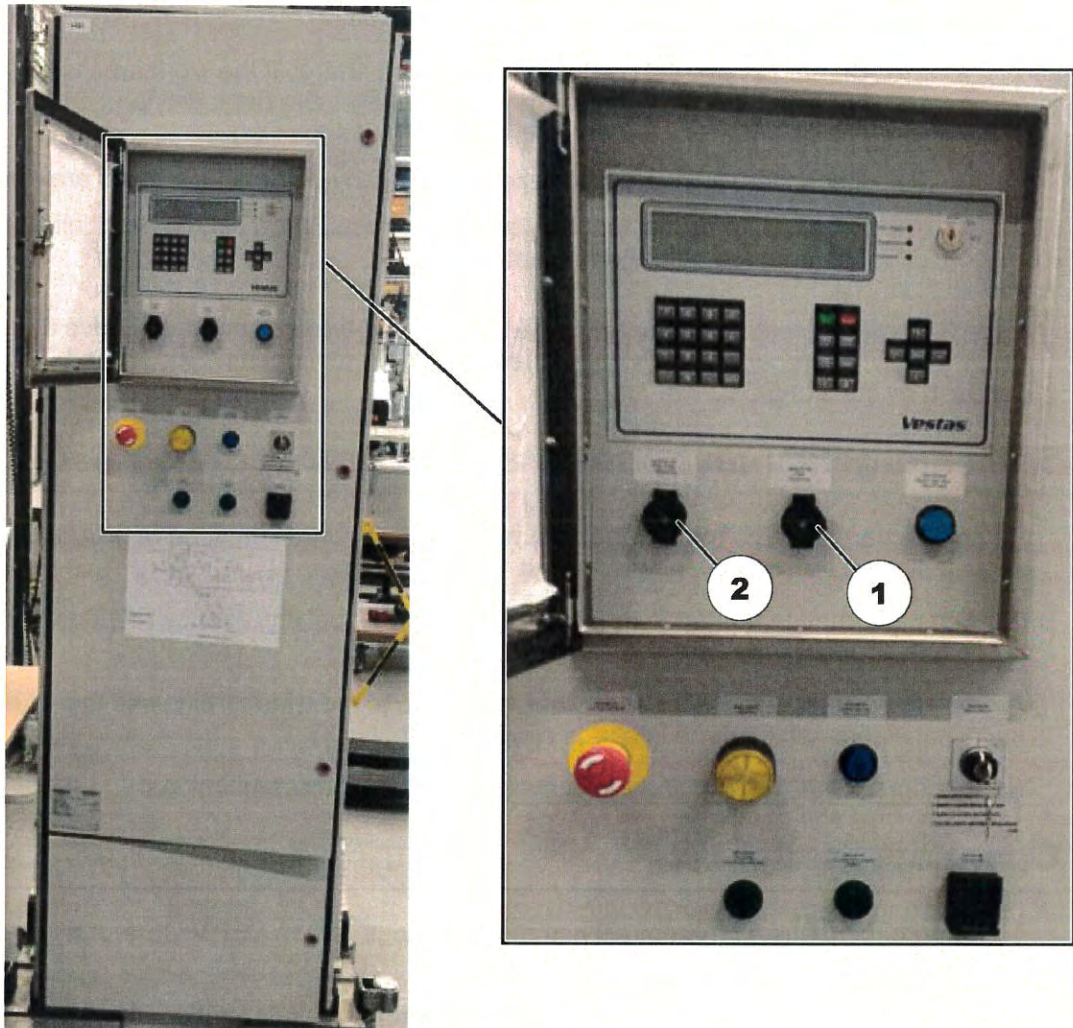


Figure 6.3: Example of the ground controller

- 1 'Test of active trip' button
- 2 'Test of undervoltage trip' button

6.5 Lockout-tagout end

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Risk of exposure to electric shock, arcing, flashover, fire, and explosion! SPRA ID No. 3.28

- Do not remove LOTO devices or restore energy if the work area is not clean of nonessential items which may accidentally have been dropped during the work. (Tools, screws, washers, cable cores, and such like).
- Inspect the work area to make sure that any of the above items are removed.
- Dropped items may cause severe arc blasts, short circuits, and injuries if they are not removed before energisation.

Energise again or restore power to the part of the wind turbine where you have done the work. Obey the LOTO procedure instruction referred to in 'Safety documents' or the LOTO instruction supplied by the site-ECC.

7 Site emergency response plan and procedure

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Before the personnel go to the wind turbine site, all personnel must be familiar with the site emergency response plan and procedure.

For more information related to emergencies, see the local emergency response plan and procedure.

Always do a check of the wind speed before you go to the wind turbine site to make sure that the necessary work can be done in a safe environment.

See [section 5 Service wind speed values, page 7](#) for wind speed values.

8 Operating modes

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The wind turbine has 4 different service mode settings. When SERVICE mode is selected, the wind turbine can be stopped.

See 0081-1931 'Operating mode selector system' for more information about the mode selector.

9 Emergency stop buttons

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The wind turbine has 10 emergency stop buttons in the locations given in the table that follows:

Table 9.1: Location of the emergency stop buttons

Location	Location of the emergency stop buttons
Tower base	Tower base controller (1 button)
Nacelle rear	Nacelle control cabinet module (1 button)
Nacelle rear	Nacelle converter cabinet module (1 button)
Nacelle front	Near the hydraulic station (1 button)
	The ladder from the tower top to the nacelle (2 button)
	Over the main shaft and near the hub entry (1 button)
	Tower bottom (1 button)

Location	Location of the emergency stop buttons
Hub	Hub control cabinet module (1 button)
	Hub I/O box (1 button)

The emergency stop buttons are red buttons on a yellow background.

An emergency stop is activated when you push the red button.



It is not recommended to leave the wind turbine in the EMERGENCY STOP mode before you release the brake. The hydraulic rotor lock must be applied before you release the brake.

If the emergency brake is applied for more than 12 hours, the drive train must be rotated and lubricated at intervals of 12 hours.



Risk of severe crushing injuries! SPRA ID No. 5.04

- Keep all body parts, clothing, accessories, and PPE clear of the rotating parts.
- Remove the full-body harness before you do work on the rotating parts.



Risk of exposure to hazardous substances and mixtures, gear oil! SPRA ID No. 2.02

- See the wind turbine's 'Lubrication chart' or the label on the gearbox, or the service report to find the gear oil type.
- Read and comply with PPE sheet G and relevant SDS.

When an emergency stop button is activated:

- The blades pitch (emergency feathered position) and the brake engages when the generator speed is lower than 300 rpm. As a result, the drive train stops.
- The motors in the nacelle stop. Smaller motors that have power consumption of less than 100 W do not stop. For example, the motors that supply power to the cabinet cooling fans do not stop.
 - The power supply to the nacelle, the hub, and the communication controllers stays on.

The internal crane and the service lift have separate emergency stop buttons. The emergency stop buttons in the wind turbine do not stop the internal crane or the service lift, and the emergency stop buttons on the chain hoist and the service lift do not stop the wind turbine.

10 Safety and warning signs

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Safety and warning signs are found in relevant locations and on relevant equipment in the wind turbine. See 0080-9075 'Application of warning and safety signs' for information about safety and warning signs.

11 Evacuation, escape, and rescue plan

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Figure 11.1: Evacuation, escape, and rescue plan

- | | | | |
|---|---|---|--|
| 1 | Hub, front hatch (rescue point) | 2 | Tower ladder (evacuation route and rescue point) |
| 3 | Service crane hatch (escape and rescue point) | | |



The anchor point for the emergency descent equipment is installed above the service crane hatch.

The safety harness of the service technician must always be attached to the marked anchor points during evacuation from the wind turbine.

A copy of 0079-9804 'Evacuation, escape, and rescue plan' must be printed, laminated, and attached at the tower entrance so that it can be seen clearly when you go into the wind turbine.



Risk of fall to the ground! SPRA ID No. 1.02

- Use the necessary PPE that is given in PPE sheet 8. The PPE must be attached to approved anchor points, slides, or cables.
- Obey the rules for work at height. Refer to local requirements.
- Make sure that there are no persons in the areas where overhead work is done.
- Make sure that all platform hatches are closed when they are not in use.

**Risk of fall to the ground! SPRA ID No. 1.04**

- Do not do work in extreme weather conditions.
- Use the necessary PPE that is given in PPE sheet 8. The PPE must be attached to approved anchor points.
- Make sure that the applicable LOTO procedures are obeyed before you do work on the nacelle roof.
- Obey the rules for work at height. Refer to local requirements.
- Always close the skylight when you do work on the nacelle roof to make sure that you do not fall through the skylight.
- Set up a perimeter and signs to make sure that there are no persons in the areas where overhead work is done.

**Risk of falling out of the nacelle resulting in death! SPRA ID No. 18.01**

- Only open the crane hatch when service technicians inside the nacelle wear personal fall arrest equipment that is attached to an approved anchor point.

**Risk of suspended load failure! SPRA ID No. 18.04**

- Do not stay or work below a suspended load.
- Do not operate the lifting equipment without the correct training.
- Lifting equipment must have the correct ratings.
- Make sure that the crane is examined and tested in accordance with local requirements.
- Use only certified lifting equipment and fully examine the same before it is used.
- Obey the correct slinging arrangement or use correct lifting points.
- Examine the portable lifting equipment for visual damage before it is used.
- Portable hoists must be attached to an applicable lifting point.

Evacuation and escape routes in the wind turbine are as follows:

Hub



Risk of fall to the ground! SPRA ID No. 1.09

- Only open the nose cone when the service technicians, who are in the nacelle, wear personal fall arrest equipment. The personal fall arrest equipment must be attached to an approved anchor point.
- In an emergency situation, move out of the hub through the nacelle.

Nacelle

- In an emergency situation, move out of the nacelle through the tower.
- If the evacuation route through the tower is blocked it is possible to descent from the nacelle using a descent device. It is possible to descent from the nacelle through the service crane hatch in the nacelle bottom cover or alternatively through the nacelle front skylight.
- If there is a fire in the nacelle, evacuate the wind turbine from the tower through the tower ladder. It is not recommended to use the service lift.
- If there is a fire in the tower, prepare for escape from the nacelle immediately by use of the rescue and descent device.
- If a fire from the tower does not spread into the nacelle, it is possible to wait in the nacelle until the fire in the tower is extinguished. The descent device must be prepared and be ready for use.

Tower

- The tower must be used as the route to evacuate from fire or work-related accidents on-site.
- In an emergency situation, move out of the wind turbine through the tower door in the bottom of the tower.

See 0079-9804 'Evacuation, escape, and rescue plan' for information about rescue instructions and safety/rescue equipment.

12 Emergency light

0011397235

The wind turbine has battery-powered emergency lighting in the nacelle and tower, which turns on automatically in case of grid drop-out to provide light when you have to escape or evacuate from the wind turbine.



The emergency light can stay illuminated for a period of 30 minutes after the grid drop-out.

13 Fire and emergency

0021987498

The wind turbine has the fire protection and first-aid equipment that follow:

- A fire extinguisher is located in the nacelle and in the tower. A quickstep user guide is printed on the fire extinguisher.
- A fire blanket, which can be used to extinguish small fires.
- A first-aid kit is located in the nacelle and in the tower.

Make sure that you know the location of the fire extinguisher and the first-aid kit, and that you know how to use them.

14 Personal protective equipment

0011397233

Wear personal protective equipment. See 0001-0410 'Personal protective equipment sheets' for the correct selection and use of the PPE.

15 Anchor points

0021092521

The anchor points for the fall arrest equipment are marked and are painted yellow.

- The anchor points must be examined for damage before use.
- The anchor points for the fall arrest equipment must not be used as lifting points.
- Only 1 person can be attached to an anchor point at a time.

For placement of the anchor points, see 0079-9658 'Placement of anchor points'.

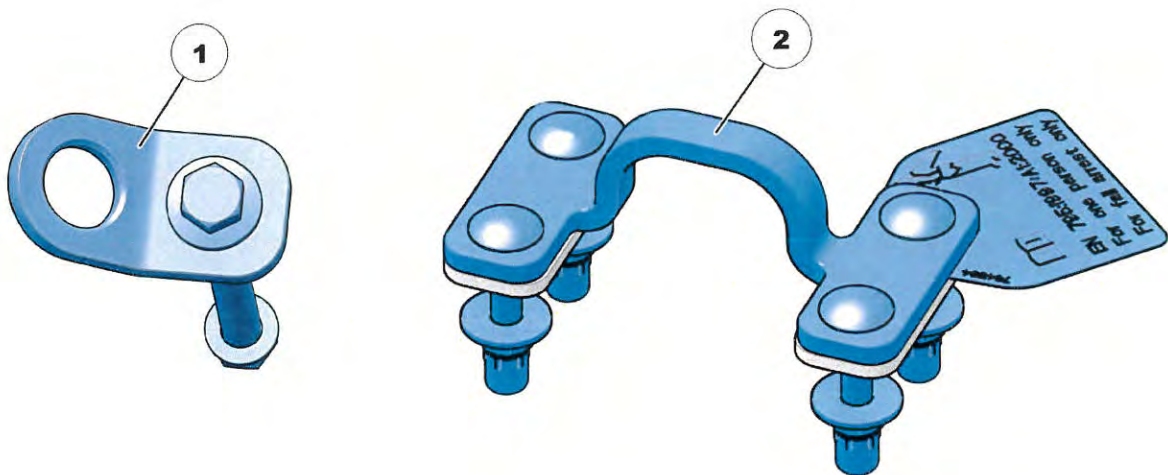


Figure 15.1: Anchor points

1 Single anchor point, 1 bolt

2 Single anchor point, 4 bolts

15.1 Overview of the tags on the standard anchor points

0021782533



Selected anchor points must be sealed with a tag after the installation of the wind turbine generator.



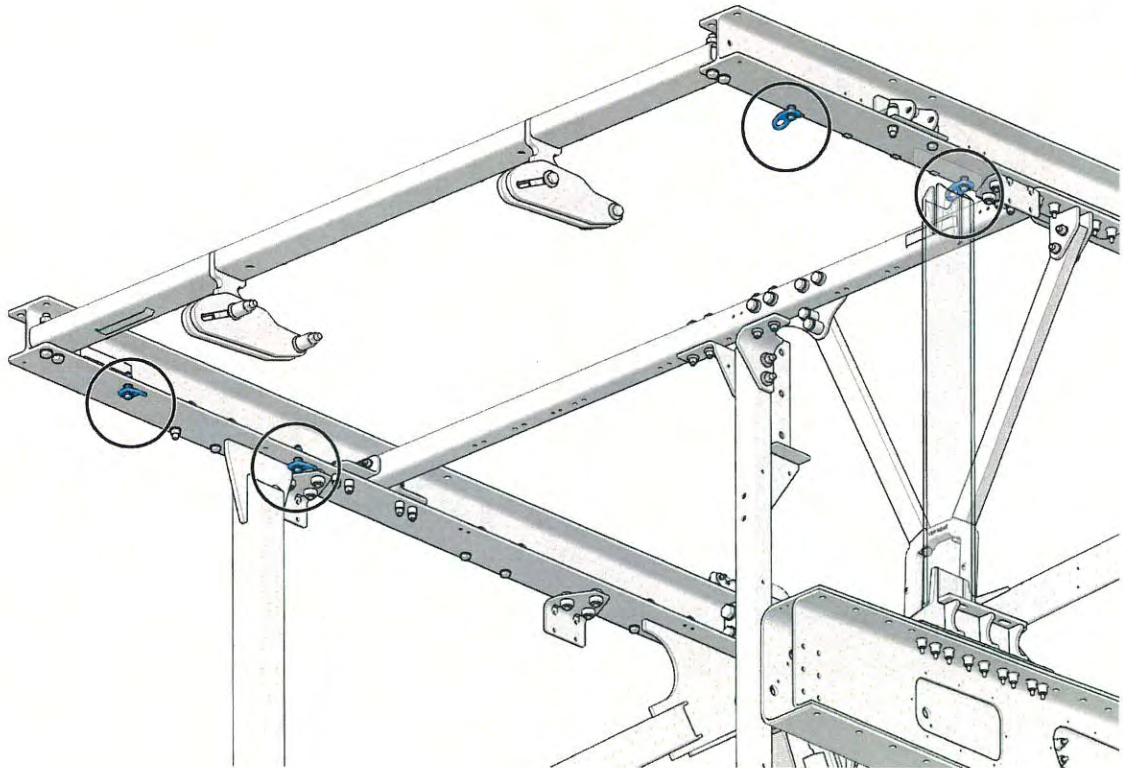
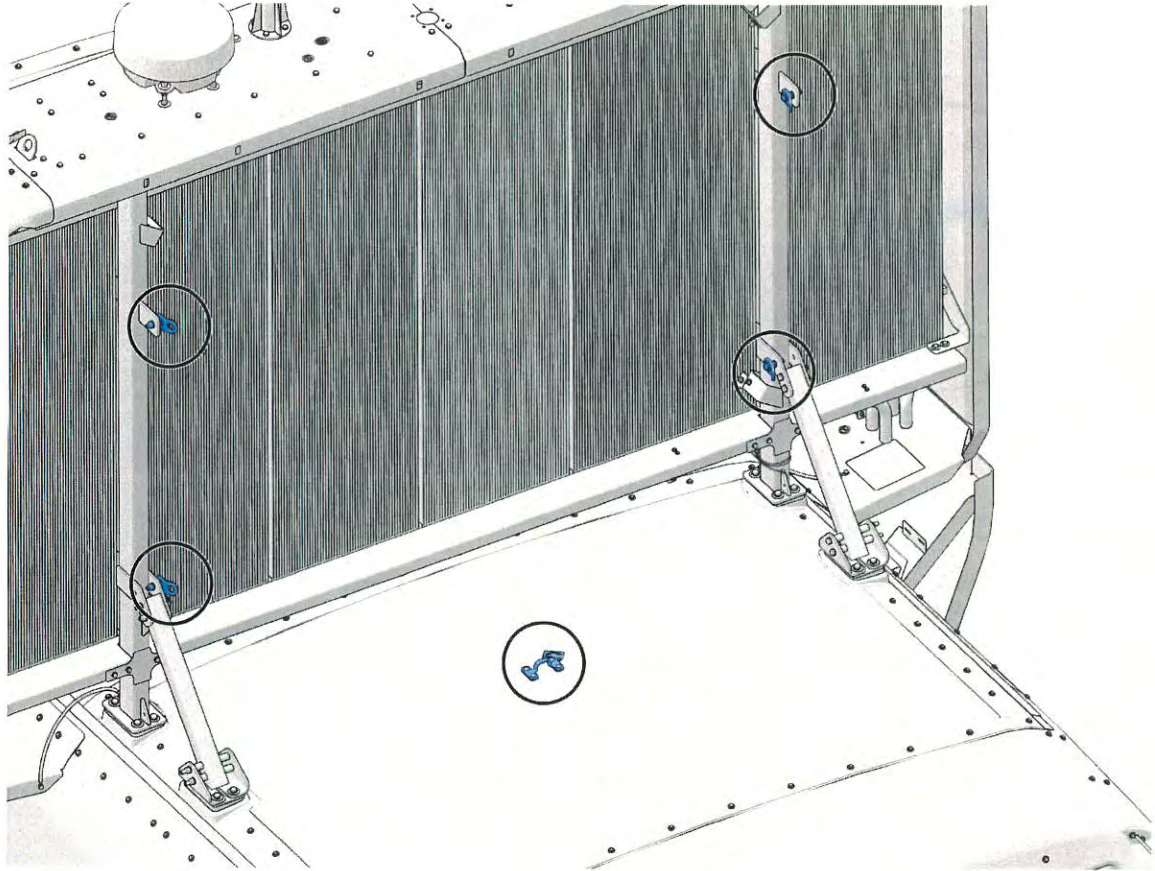
The tags must be put on the roof, the CoolerTop[®], and inside the transformer room at the last visit before you start commissioning.

There are a total of 27 anchor points, which are located as follows:

- 9 on the roof
- 14 on the CoolerTop[®]
- 4 in the transformer room

The items that are to be used for this procedure are as follows:

- Marking plate (item no. 29121927)
- Metal tie (item no. 29122371)



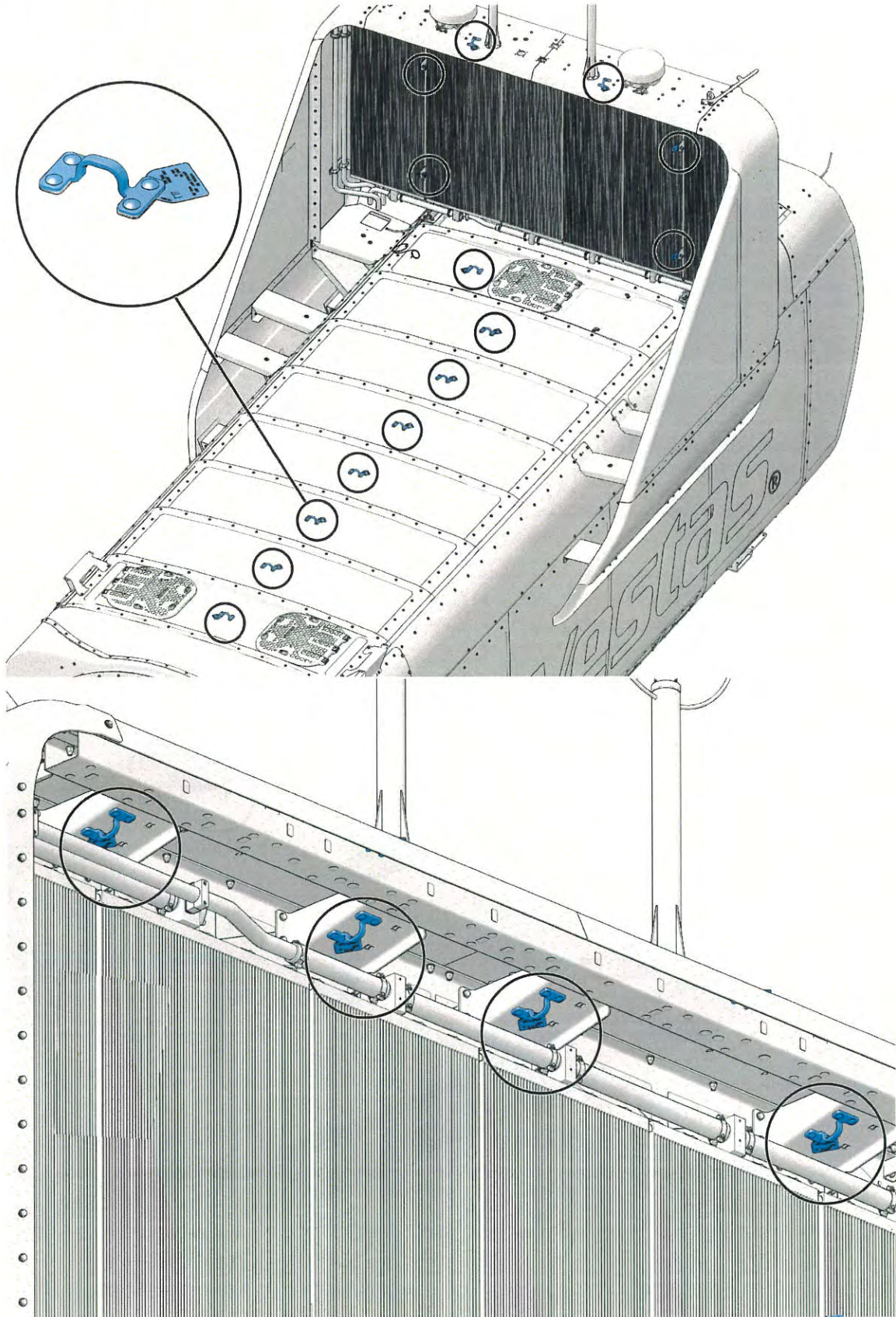
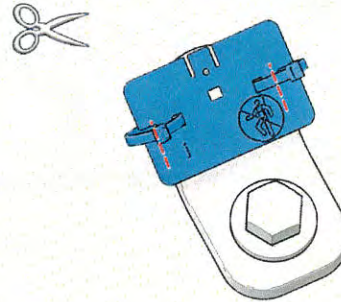


Figure 15.2: Overview of anchor points, which need to be sealed with a tag

15.2 To remove the tags on the standard anchor points

0021782531

- 1 Cut the metal ties by use of side cutters and remove the tags.



- 2 Put the cut pieces of the ties away so that they do not fall from the nacelle.

- 3 Keep the tags safely as they can be used again, for instance, by the attachment of the tags to the anchor points by a single tie in a very loose loop.

15.3 To attach the tags on the standard anchor points

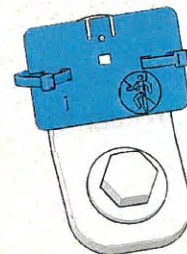
0021782532

Two types of anchor points that must be attached with a tag are as follows:

- Single anchor point, 1 bolt
- Single anchor point, 4 bolts

- 1 Attach the tag to the single anchor point, 1 bolt as follows:

- a Put the tag on the top of the anchor plate and attach the ties on each side.

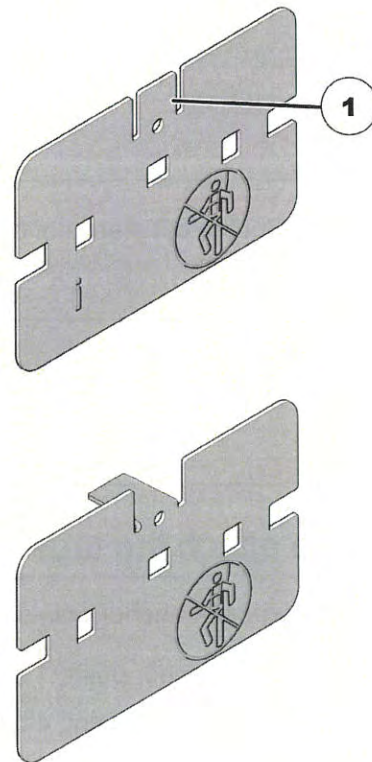


- b Pull the ties tightly and cut the extra length by the use of the side cutters.

- c Put the cut pieces of the ties away so that the cut pieces do not fall from the nacelle.

2 Attach the tag to the single anchor point, 4 bolts as follows:

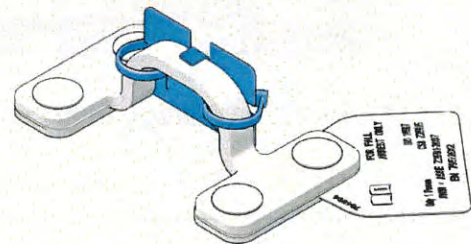
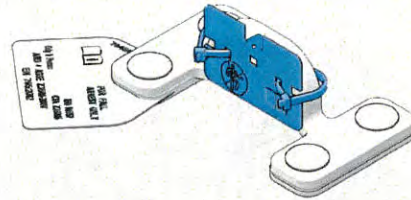
- a Bend the middle flap (1) with the small hole.



The flap holds the tag free of the roof.

- b Put the bent flap on top of the anchor point so that the tag is on the opening of the anchor point.
- c Tighten the 2 ties so that the tag is secured in position.

- d Put the tag on the top of the anchor plate and attach the ties on each side.



- e Pull the ties tightly and cut the extra length by the use of the side cutters.
- f Put the cut pieces of the ties away so that the cut pieces do not fall from the nacelle.

16 Access routes and passages

0021978335

The ladder or the service lift is used as an access route from the ground controller to the nacelle. The fall arrest equipment must be used when you use the ladder or the service lift.



Risk of fall to the ground! SPRA ID No. 1.02

- Use the necessary PPE that is given in PPE sheet 8. The PPE must be attached to approved anchor points, slides, or cables.
- Obey the rules for work at height. Refer to local requirements.
- Make sure that there are no persons in the areas where overhead work is done.
- Make sure that all platform hatches are closed when they are not in use.

Always use the yellow anchor points.

The work areas in the wind turbine include the tower platforms, the remaining platforms along the ladder, and the nacelle floor.

The floors of the platforms and the nacelle have anti-slip surfaces.

Connection points for electrical tools are located on each tower platform and in the nacelle.

Additional foot supports are provided at various locations in the wind turbine for maintenance and service work.

It is not recommended to go into the composite coupling area to get access to the other side of the nacelle. Follow the marked route that follows:.

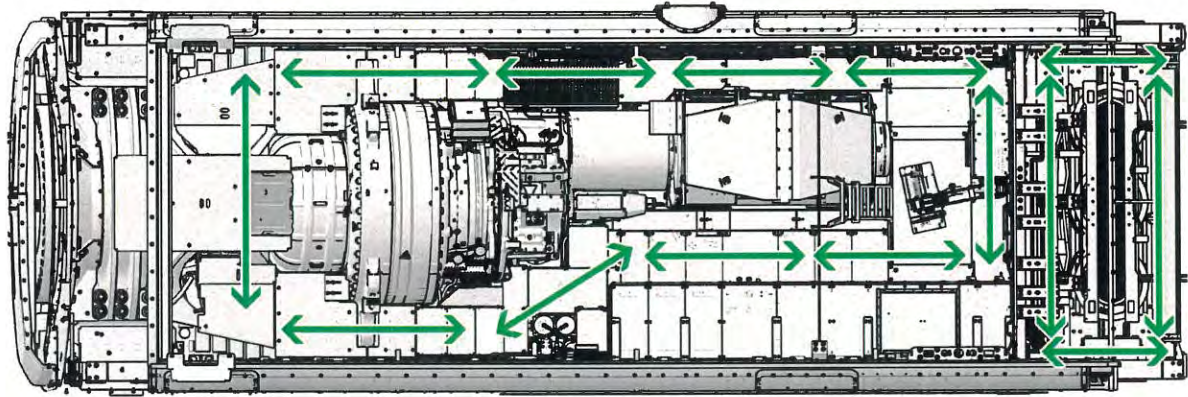


Figure 16.1: Walkway in the nacelle

17 Service lift

0021092540



Risk of crushing of body parts! SPRA ID No. RW 21.78

- Only qualified service personnel are allowed to operate the service lift.
 - To reduce the risk of personal injury, keep hair, loose clothing, fingers, and all body parts inside of the service lift cage and away from moving parts.
 - Never try to open the service lift gate while it is in motion.
 - Ensure that all are clear of and around the service lift before you operate it.
-
- Only trained personnel can operate the service lift.
 - Do a check of the service lift before use in accordance with the service manual of the supplier.
 - Do a check of the lifting capacity of the service lift before you use the service lift. Personnel and material weight must not be more than the maximum rated lifting capacity.
 - Always wear a full-body harness when you use the service lift.
 - For the operating instructions of the service lift, see 0076-3047 'Operating instructions, wind turbine service lift, type: SHERPA-SD2 (sliding door 2)'.

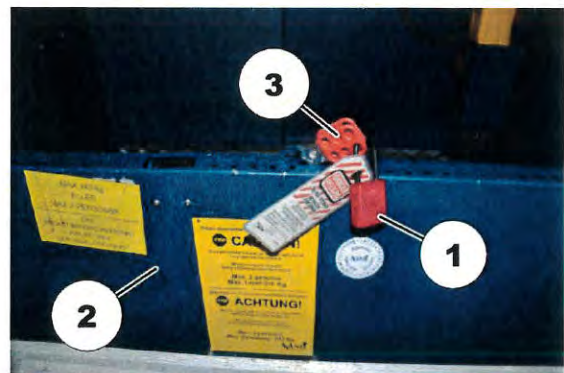
- Do not operate the service lift unless the 'Annual inspection test report' (1) in the service lift gives the information that the service lift was examined in accordance with the applicable manufacturing and local legislation requirements. The inspection must be done once in a year.



- If the service lift is not examined, or if the 'Annual inspection test report' is more than 1 year old, use a lockout device (1) to lockout the power supply for the service lift in the tower basement. The service lift must not be used until a valid 'Annual inspection test report' is available.



- Before you do work on the platforms in the tower, the service lift (2) must be locked out. Lift the door to the service lift and attach a lockout hasp (3) and a padlock (1) to the lower front of the service lift (2) to lockout the service lift.



- The service lift must stay locked out until all personnel have stopped to do the work on the platforms. If some personnel do work on the platforms at the same time, each person must attach a padlock to the lockout hasp.



For more information about the lockout procedure, see 0017-5309 'Vestas standard control of hazardous energy'.

18 Yaw system

0021092539



Risk of severe crushing injuries! SPRA ID No. 5.06

- Obey the applicable LOTO procedures.
- Lock the rotor mechanically.
- Apply the yaw lock.



Always see [section 5 Service wind speed values, page 7](#), for information about when to disable the automatic yaw mode.

Automatic yawing must be activated or deactivated in accordance with the wind speed values specified in [section 5 Service wind speed values, page 7](#).

For service purposes, it is not possible to lock the yaw system mechanically.

To prevent the movement of the yaw system, disconnect the power plugs on the yaw gears to de-energise the yaw system.

The brake on the electrical motors and the friction in the yaw bearing hold the position of the nacelle.

When you disassemble the parts in the yaw system, the power plugs on the yaw gears must be disconnected.

Make sure that the yaw system (the spring pack fasteners) is free from oil, grease, and such like before you do the service activities.

19 To work in the nacelle

0011397258



Risk of severe crushing injuries! SPRA ID No. 5.01

- Obey the applicable LOTO procedures.
- Stop the wind turbine to prevent unintended starts and remote operation.
- Apply the brake before you remove the covers.
- Lock the rotor mechanically before you remove the covers.

Before you go into the hub or do work near rotating parts in the nacelle, make sure that the rotor is locked and that the blades are pitched to 90°.

When the wind turbine is in operation, the EMFs generated are stronger than the action levels required for a safe stay. These EMFs are in the area in front of the transformer room wall and behind the generator. Do not stay in the EMF areas.



As a general rule, do not stay in the nacelle while the wind turbine is in operation unless specific instructions are given. If you stay in the nacelle during operation, all covers on the rotating parts must be installed.

19.1 To work with the brake hydraulics

0011397257



Risk of exposure to hot oil! SPRA ID No. 4.03

- Use the necessary PPE that is given in PPE sheet 'G' and PPE sheet 3.
- Do not get in direct contact with hydraulic oil.
- Switch off the pump.
- Release the stored pressure in hoses, pipes, or storage tank.

Do the procedure that follows before you work with the brake hydraulics.

- Switch off the motor supply.
- Make sure that the rotor lock is engaged before you remove any part of the brake system.
- Use the needle valves to drain all the accumulators.
- Use a pressure gauge to examine if the brake system is pressurised.

20 Rotor

0021092538

See 0077-2293 'Rotor locking system' for how to lock the rotor.

21 Turning of the rotor

0021092537

There are different methods to turn the rotor, which depends on what type of operation is being done:

- By use of an external turning gear toolkit, which is used during installation, removal, and decommissioning of the blades.
- By use of the wind turbine controller during service tasks.
- By use of the idle functionality.
- By use of the manual blade pitch to turn the rotor into position.
- By use of the turner gear for unbalanced rotor, which is used during blade installation or replacement of the blade/blade bearing.



It is not allowed to use the generator in MOTOR mode to turn the rotor into position as there is a risk of damage to the converter. There is no temperature surveillance on the generator when the wind turbine is not in operation, so there is a risk of damage to the generator.



For more information about how to use the rotor turning gear, see 0081-5541 'Use of turning gear for installation and decommissioning'.

22 To do work in the hub

0021092536

The rotor lock must be applied before you go into the hub and do work in the hub.

You can go into the hub from the nacelle through the hub hatch above the main bearing.

Do not touch the LCTU and the blade lightning band while you go into the hub.



Risk of severe crushing injuries! SPRA ID No. 5.09

- Do not enter the hub and do not do any procedures on the hub or nose cone unless you have done the applicable LOTO and made sure that the pitch system is in a safe condition.
- Obey the rules for work at height.

Do not have tools, spare parts, or other items in your hand when you go into or come out of the hub. Get tools, spare parts, or other items from the other service technician in the nacelle after you go into the hub. Give the tools, spare parts, or other items to the other service technician in the nacelle before you leave the hub.



See 0079-9374 'Safe work in hub' for more information.

23 To do work on the blade

0021092534

To do work on the blade, you need to apply the rotor lock and the manual blade pitch lock. See 0079-9608 'Installation and removal of the manual blade pitch lock' for more information on how to apply the pitch lock and see 0077-2293 'Rotor lock system' for how to lock the rotor.



Risk of exposure to electric shock! SPRA ID No. 3.15

- Use the necessary PPE that is given in PPE sheet 7.
- Make sure that the discharge cable is connected before you do work on the LCTU.
- Make sure that the LCTU is fully operational before you remove the discharge cable.
- If repairs of the LCTU cannot be completed, or if the LCTU is removed for other reasons, install a jumper cable inside the blade before you remove the discharge cable.



Risk of severe crushing injuries! SPRA ID No. 5.07

- Obey the applicable LOTO procedures.
- Lock the rotor mechanically.
- Apply the pitch lock.

If the LCTU is damaged or not found, discharge the static electricity in the blade before you do work on the blade. See 0015-9531 'Discharge of static electricity in blades'.

24 To work on the nacelle roof

0022006740

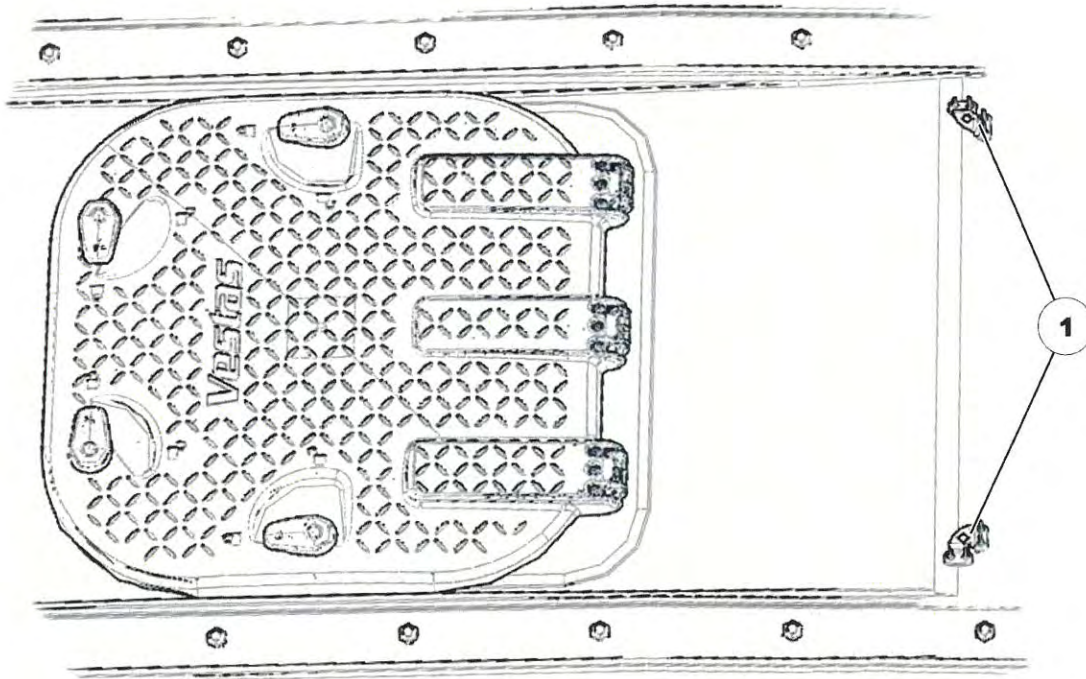


Figure 24.1: Skylight hatch

1 Brackets



Risk of fall to the ground! SPRA ID No. 1.04

- Do not do work in extreme weather conditions.
- Use the necessary PPE that is given in PPE sheet 8. The PPE must be attached to approved anchor points.
- Make sure that the applicable LOTO procedures are obeyed before you do work on the nacelle roof.
- Obey the rules for work at height. Refer to local requirements.
- Always close the skylight when you do work on the nacelle roof to make sure that you do not fall through the skylight.
- Set up a perimeter and signs to make sure that there are no persons in the areas where overhead work is done.



Risk of falling objects! SPRA ID No. RW 22.79

- If there is still ice on nacelle or blades, DO NOT ENTER THE NACELLE ROOF.
- Always make sure that the rotor lock is applied before you do work on the nacelle roof.

- Always be connected to at least 1 anchor point when you do work on the nacelle roof.
- Use 2 lanyards with energy absorbers.
- Secure the skylight hatch when it is in the open position.
- Close the skylight when you leave the nacelle roof.

25 Electrical equipment

0011397261



Risk of exposure to electric shock resulting in injuries! SPRA ID No. 3.01

- Do not start to do the work before the grid measured by the CTs is completely shut down.
- Obey the applicable LOTO procedures.
- Only qualified persons are allowed to do work with HV/LV cables or equipment.
- Use the necessary PPE that is given in PPE sheets 5 and 6.
- De-energise/isolate the work place before you start to do the work.
- Use an HV/LV voltage detector to measure zero voltage before you start to do the work.
- Use certified and correct equipment.

Before you do the work on the electrical parts, follow the LOTO procedure to make sure that the power supply is switched off.

Always make sure that the electrical parts are de-energised after the disconnection. Use approved measuring equipment.

25.1 HV compartment

0011397250

The service technicians who switch and earth the HV installation must be educated in this subject in accordance with the laws and regulations of the country in question. Also, Vestas requirements for work with electrical parts must, as a minimum, be met.

25.2 Generator

0011397249

Before you do an inspection of the generator cables and do work on the generator, disconnect the circuit breakers. Use approved measuring equipment to examine for absence of voltage and follow the LOTO procedure.

Only authorised personnel can get access to the key(s).

25.3 Full-scale converter system

0011397268

Before you do work on the full-scale converter system, disconnect the circuit breakers. Use approved measuring equipment to examine for absence of voltage and follow the LOTO procedure. Only authorised personnel can get access to the key(s).

Work on the grid interface requires shutdown of the transformer.

25.4 Tower control cabinet

0011397267

Disconnect the tower control cabinet before you do work on the electrical part of the tower control cabinet. Use approved measuring equipment to examine for absence of voltage and follow the LOTO procedure. Only authorised personnel can get access to the key(s).

25.5 Nacelle control cabinet and auxiliary transformer

0011397266

Before you do work on the electrical part of the nacelle control cabinet and the auxiliary transformer, disconnect the controller. Use approved measuring equipment examine for absence of voltage and follow the LOTO procedure.

Only authorised personnel can get access to the key(s).

25.6 Hub control cabinet

0011397265

The hub control cabinet has 2 power supplies, 1 regular supply and 1 with UPS backup. Both supplies must be disconnected before you do work in the hub control cabinet.

The hub control cabinet has 2 power supplies:

- 1 regular supply
- 1 with UPS backup

Disconnect the 2 power supplies before you do work in the hub control cabinet.

26 Service crane

0021092535



Risk of falling out of the nacelle resulting in death! SPRA ID No. 18.01

- Only open the crane hatch when service technicians inside the nacelle wear personal fall arrest equipment that is attached to an approved anchor point.



Risk of suspended load failure! SPRA ID No. 18.04

- Do not stay or work below a suspended load.
- Do not operate the lifting equipment without the correct training.
- Lifting equipment must have the correct ratings.
- Make sure that the crane is examined and tested in accordance with local requirements.
- Use only certified lifting equipment and fully examine the same before it is used.
- Obey the correct slinging arrangement or use correct lifting points.
- Examine the portable lifting equipment for visual damage before it is used.
- Portable hoists must be attached to an applicable lifting point.



The service crane has an emergency stop button. This emergency stop button only applies to the service crane. Other emergency stop buttons in the wind turbine do not apply to the service crane.

- Before you operate the internal crane and open the nacelle floor hatch and the bottom hatch, attach your safety harness to an approved anchor point with at least 1 lanyard with energy absorber.
- Always do an inspection of the chain hoist before use. If defects are found, for example, a broken locking bolt, make sure that the defective part is replaced.
- When the service crane is in operation, do not hold the chain and do not put your hands on the swing arm.
- Be careful while you operate the chain hoist in high wind speed conditions.

See 0035-4815 'Crane manual' for operating instructions.