

2. SII-Functional safety test (yearly)

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Wind turbine type

Read the full document before you start to do work.

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Wind turbine type	Mk version
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Table of Contents

1	Safety	5
1.1	Emergency stop buttons.....	5
1.2	Rotor locking system	6
1.3	Lockout-tagout start.....	6
1.4	HV switchgear trip button	6
1.5	Disconnection from the main grid.....	6
1.6	Emergency or evacuation light.....	7
2	Educational requirements of service technician	7
3	Abbreviations and technical terms	7
4	Referenced documentation.....	8
4.1	Safety documents.....	8
4.2	Reference documents	8
5	Purpose	8
6	Note	9
7	Functional safety test.....	9
7.1	Tower	9
7.1.1	To do a test of the emergency stop button on the ++01 ground control panel.....	9
7.1.2	To do a test of the acoustic warning sounder and visual warning indicator lamp in the tower	10
7.2	Nacelle.....	11
7.2.1	To prepare the nacelle for test	11
7.2.2	To do a test of the emergency stop buttons in the tower top and nacelle	11
7.2.3	To do a test of the acoustic warning sounder and visual warning indicator lamp in the nacelle	13
7.3	Hub	13
7.3.1	To prepare the hub for test	14
7.3.1.1	Rotor lock.....	15
7.3.2	To do a test of the hub service LED in the hub	19
7.3.3	To do a test of the emergency stop buttons in the hub.....	19
7.3.4	To do a test of the acoustic warning sounder and visual warning indicator lamp in the hub	20
7.4	To finalise the functional safety test.....	21
7.4.1	To continue the work in the hub	21
7.4.2	To leave the hub	21

1 Safety

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All work relating to a Vestas wind turbine, including work methods and practices, employee training and protective measures, and use of tools and equipment, shall be in accordance with the requirements of the applicable governmental and private occupational safety and health codes and standards. Employers engaged in such work are also required to be familiar with and comply with the wind turbine-specific 'Safety regulations for operators and technicians' manual for the relevant wind turbine type. Vestas shall not be responsible for any liabilities arising from failure to comply with such requirements. Vestas reserves the right to inspect such work to ascertain such compliance.

The service technician must read and understand the PPE sheets for each of the chemicals used or work done in this instruction. The PPE sheets describe the correct personal protective equipment to wear for the specific work. If in doubt about the PPE requirements for the work, contact the site responsible or the line manager and confirm the correct procedure before starting the work.

Read the full document before you start to do work.

If you have any doubts about technical or safety issues while you do the work, stop your activities and contact your supervisor or local HSE. Make sure that you register the findings on the dedicated platform – ENABLON.

1.1 Emergency stop buttons

0027448390

Note the locations of the emergency stop buttons to use if there is an emergency situation.

++01 -610-02-S1	Ground control panel
++03 -610-02-S2	Nacelle control panel
+D -610-02-S3	Yaw lubrication
+D -610-02-S4	Manual brake switch
+D -610-02-S5	Nacelle ladder A – left
+D -610-02-S6	Nacelle ladder A – right
++73.F1 -610-02-S7	Converter cabinet
+D -610-02-S8	Nacelle ladder B – left
+D -610-02-S9	Nacelle ladder B – right
++05 -135-S1	Hub control panel
++70 -135-S2	Hub entrance

When you push an emergency stop button, the controller changes to the STOP mode. Thus, there is no power supply to the contactor solenoids, and the blades are fully feathered.

If the mode selector is in position 2, 3, or 4, it shows 'Man in Turbine' mode, and if an emergency stop push button is activated, the disc brake is applied. If the mode selector is in position 1, and an emergency stop push button is activated, the disc brake will not apply.



If an emergency stop button is activated, the gear lubrication and water pumps will first stop for 10 seconds after the brake is applied. The fans on the permanent magnet generator will not be stopped, if the emergency stop button is activated.

Service lift

An emergency stop button is installed in the service lift. This button is applicable to the service lift only. Conversely, the emergency stop buttons in the wind turbine are not applicable to the service lift.

Service crane

An emergency stop button is installed in the service crane. This button is applicable to the service crane only. Conversely, the emergency stop buttons in the wind turbine are not applicable to the service crane.

1.2 Rotor locking system

0027590598

- Make sure that the blades are fully feathered.

The rotor locking system is not locked, when the wind turbine is ready for start-up. The rotor locking system must, however, be locked, when you go into the hub or do work on moving parts, such as the slip rings and the main shaft.



Engage the brake by use of the -200-16-13-S1 switch button for the manual activation of the brake. The manual activation of the brake is only possible when the mode selector is not in position 1.

If the mode selector is in position 4, the -615 08-S4 'Enable Controller Outputs' selector in the ++03 nacelle control panel must be activated to build up the brake pressure.

1.3 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.

1.4 HV switchgear trip button

0027590600

Note the HV switchgear trip button locations that follow:

- 420-02-S2 : HV switchgear trip button on the ground control panel
- 420-02-S3 : HV switchgear trip button on the nacelle control panel

When you push an HV switchgear trip button, the HV switchgear will be disconnected. Thus, the wind turbine is disconnected from the grid and the blades are fully feathered. Only the emergency lighting and components powered by the UPS will remain energised.

1.5 Disconnection from the main grid

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If it is necessary to disconnect the wind turbine from the main grid, speak to the electricity grid company first.



When you do the LOTO procedure on the ground controller and replace the tower SCP, the switchgear will trip and the switchgear must be connected again.

1.6 Emergency or evacuation light

0011412133

Before you start to do work in the wind turbine, make sure that the backup system for the lamps is functional.

Use the hand-held battery lamps when you do work in the wind turbine, until the backup system for the lamps is checked.

2 Educational requirements of service technician

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At least 2 of the service technicians who do work in a wind turbine must be able to prove that they have a valid GWO basic safety training certificate.

At least 1 service technician must hold the wind turbine-specific training course certificate for the wind turbine in question.

Some tasks require one or more advanced training modules or job-specific training, as described in the Vestas 'Technical Training Programme'. The person planning a specific task must make sure that the service technicians involved have the proper know-how for the completion of that task.

Part of this start-up procedure involves work on high-voltage installations. This work is only done by a person with special education in high voltage. Become familiar with local requirements.

3 Abbreviations and technical terms

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Table 3.1: Abbreviations

Abbreviation	Explanation
ECC	Energy control coordinator
GWO	The Global Wind Organisation
HPU	Hydraulic power unit
HV	High voltage
LED	Light-emitting diode
LOTO	Lockout-tagout
PPE	Personal protective equipment
SCP	Safety control processor
SDS	Safety data sheet
SII	Service inspection instruction
SPRA	Standardised procedure risk assessment
UPS	Uninterruptible power supply

Table 3.2: Explanation of terms

Term	Explanation
Trip	The automatic disconnection of the electrical circuit breaker.

4 Referenced documentation

4.1 Safety documents

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Table 4.1: Safety documents

Document no.	Title
0001-0410	Personal protective equipment sheets
0004-4159	Standardised procedure risk assessment (SPRA)
0092-3874	Rotor locking system
0092-3919	Safety regulations for operators and technicians
0094-2383	Mode selector system
0094-5716	LOTO transformer system
	Relevant SDS for the chemicals used in this document
	Appropriate LOTO document

4.2 Reference documents

0027461304

Table 4.2: Reference documents

Document no.	Title
920098	Torque wrench settings
960501	Bolt connections
0001-1995	User guide operating manual
0001-1996	Service guide, menu 11–19 operating manual
0001-1997	Service guide, picture 21 and onwards
0065-3482	Standard service tools
0093-1983	Safe work in hub
0094-4149	Inspection of the transformer, the transformer room, and the HV switchgear



Unless it is specified differently, see 920098 'Torque wrench settings' for information about bolt types and bolt lubrication, and see 960501 'Bolt connections' for information about torque values.

5 Purpose

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The purpose of this document is to give the instructions for how to do the yearly functional safety tests.

It is mandatory to do the yearly test (within 12 months) of all emergency stop buttons in the wind turbine.

The emergency stop buttons are then safe to use in emergency situations, and as part of other test and inspections.

Components to be tested in this test:

- All emergency stop buttons
- Mode selector in local LED - tower
- Mode selector in local LED - nacelle
- Acoustic sounder – tower
- Acoustic sounder – nacelle
- Acoustic sounder – hub
- Warning LED – tower
- Warning LED – nacelle
- Warning LED – hub
- Hub service mode LED



The HV trip push button on the ground control panel or nacelle control panel is tested during inspection of the transformer room and therefore not included in this inspection instruction.

6 Note

0027461302

This document gives the description of the service inspections that must be done during the yearly inspection. Unscheduled replacement procedures are not included in the yearly inspection. If it is necessary to make an unscheduled replacement, then make a note of it in the service report.

The functional safety test must be carried out in 2 parts as follows:

- 1st part: Rotation of the rotor is necessary during the test of the emergency stop push buttons in the tower and the test of the emergency stop push buttons in the nacelle.
- 2nd part: The rotor must be locked during work in the hub. When the functional safety test in the hub is completed, it is easy to continue with other scheduled service tasks in the rotor, hub, and powertrain.

7 Functional safety test

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7.1 Tower

7.1.1 To do a test of the emergency stop button on the ++01 ground control panel

0027461301

- 1 Turn the ++03 -615-08-S1 mode selector switch in the tower to position 2.

-
- 2 Push * > **PAUSE** on the service panel to set the wind turbine to IDLE mode.
-

- 3 Push the ++01 -610-02-S1 emergency stop button on the ++01 ground control panel.
-

- 4 Do a check of the service panel report **EmergStopButtonActivated: 1** on the service panel menu **1: OVERVIEW SERVICE**.
-

- 5 Do a check of the ++01 -615-08-P1 blue LED that flashes to make sure that the mechanical brake is applied.

► If the ++01 -615-08-P1 blue LED does not start to flash on/off, see the service picture **11.84: BRAKE APPLY/RELEASE CONTROL** and do a check to see if the brake is applied. If so, the ++01 -615-08-P1 blue LED has an error.

- 6 Release the ++01 -610-02-S1 emergency stop button.



The display only shows the number on **EmergStopButtonActivated: 1** until the ++01 -610-02-S1 emergency stop button is released again. After the ++01 -610-02-S1 emergency stop button has been activated and released again, the display shows **EmergStopButtonActivated: 0**.

7.1.2 To do a test of the acoustic warning sounder and visual warning indicator lamp in the tower

0027461300

-
- 1 Use the service picture **11.103B: Acoustic Alarms** to start acoustic warning sounder -615-02-P1 and visual warning indicator lamp in the tower.

a In menu **11.103B: Acoustic Alarms**, select **[1:Test]** to do the acoustic or visual test.

- 2 Do a check of acoustic warning sounder -615-02-P1 to make sure that it makes sound.
-

- 3 Do a check of the visual warning indicator lamp in the tower to make sure that it flashes.

- 4 Use the service picture **11.103B: Acoustic Alarms** to stop acoustic warning sounder -615-02-P1 and visual warning indicator lamp in the tower.

- a In menu **11.103B: Acoustic Alarms**, select **[2:Auto]** to end the acoustic or visual test.

7.2 Nacelle

7.2.1 To prepare the nacelle for test

0027461299

- 1 Turn mode selector switch ++03 -615-08-S1 in the tower to position 4.

- 2 Continue the test in the tower top and the nacelle.

7.2.2 To do a test of the emergency stop buttons in the tower top and nacelle

0027461298

The table that follows shows the location of the emergency stop buttons in the tower top and nacelle.

Table 7.1: Emergency stop buttons in the tower top and nacelle

Emergency stop button RDS number	Location of the emergency stop button in the wind turbine	Emergency stop activated display on the controller panel
++03 -610-02-S2	Nacelle control panel	EmergStopButtonActivated:2
+D -610-02-S3	Yaw lubrication	EmergStopButtonActivated:3
+D -610-02-S4	Manual brake switch	EmergStopButtonActivated:4
+D -610-02-S5	Nacelle ladder A – left	EmergStopButtonActivated:5*
+D -610-02-S6	Nacelle ladder A – right	EmergStopButtonActivated:5*
++73.F1 -610-02-S7	Converter cabinet	EmergStopButtonActivated:7
+D -610-02-S8	Nacelle ladder B – left	EmergStopButtonActivated:8†
+D -610-02-S9	Nacelle ladder B – right	EmergStopButtonActivated:8†

*) The display reports a common alarm for activation of S5 and S6, reported as **EmergStopButtonActivated:5**.

†) The display reports a common alarm for activation of S8 and S9, reported as **EmergStopButtonActivated:8**.

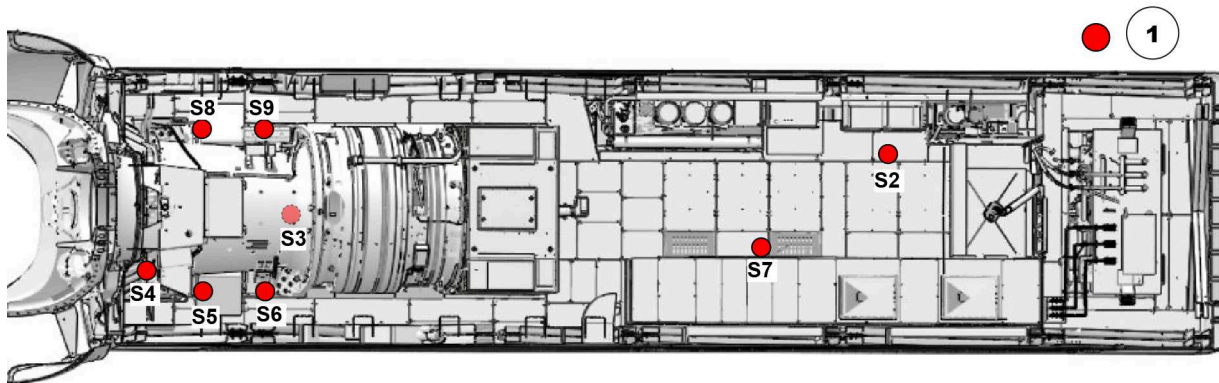


Figure 7.1: Emergency stop buttons in the tower top and nacelle

- 1 Emergency stop button

Do the steps that follow to make sure that the emergency stop buttons report correctly:

- 1 Push one emergency stop button at a time, from [table Emergency stop buttons in the tower top and nacelle, page 11](#).

- 2 Do a check of the number and location of the emergency stop button which is tested to match the displayed information in menu 1: **OVERVIEW SERVICE**.

- 3 Release the emergency stop button.

The display shows **EmergStopButtonActivated: 0**.

- 4 Do steps 1–3 again until all the emergency stop buttons in [table Emergency stop buttons in the tower top and nacelle, page 11](#) are tested.



The display only shows the number on the emergency stop activated until the emergency stop button is released again. After the emergency stop button has been activated and released again, the display shows **EmergStopButtonActivated: 0**.

- 5 Do a check of the ++01 -615-08-P2 blue LED on the nacelle control panel that flashes, to make sure that the mechanical brake is applied.

► If the ++01 -615-08-P2 blue LED does not start to flash on/off, see the service picture **11.84: BRAKE APPLY/RELEASE CONTROL** and do a check that the brake is applied. If so, the ++01 -615-08-P2 blue LED has an error.

7.2.3 To do a test of the acoustic warning sounder and visual warning indicator lamp in the nacelle

0027461297

- 1 Use the service picture **11.103B: Acoustic Alarms** to start acoustic warning sounder 610-PJ2 and visual warning indicator lamp -735-04-PF1 in the nacelle.

a In menu **11.103B: Acoustic Alarms**, select **[1:Test]** to do the acoustic or visual test.

- 2 Do a check of acoustic warning sounder 610-PJ2 on the converter cabinet to make sure that acoustic warning sounder 610-PJ2 makes a sound.

- 3 Do a check of visual warning indicator lamp -735-04-PF1 in the nacelle control panel to make sure that visual warning indicator lamp -735-04-PF1 flashes.

- 4 Use the service picture **11.103B: Acoustic Alarms** to stop acoustic warning sounder 610-PJ2 and visual warning indicator lamp -735-04-PF1 in the nacelle.

a In menu **11.103B: Acoustic Alarms**, select **[2:Auto]** to end the acoustic or visual test.

7.3 Hub

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Risk related to rotating parts! 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.
- Do not enter and exit the hub without headlights or portable lights with enough batteries.
- Obey the rules for work at height.



- To activate the hub safety system, the blades must be pitched to $\geq 95^\circ$.
- The service technician must not go into the nose cone before the blades are pitched to $\geq 95^\circ$.
- When the hub safety system is activated, the indicator lamp for the **HUB IN SAFE MODE** flashes on/off.
- The indicator lamp for the **HUB IN SAFE MODE** must flash on/off before you go into the hub.

7.3.1 To prepare the hub for test

0027461317

- 1 Turn enable output switch ++03-615-08-S4 to position 1.
- 2 Press blue push button ++03-610-S2 to reset the safety system.
- 3 Push * > **PAUSE** on the service panel to set the wind turbine to IDLE mode.
- 4 Lock the rotor according to [section 7.3.1.1.2 Procedure to lock the rotor, page 15](#).
- 5 In the service panel, select service menu **11.99: Hub service mode** and press the **1** key to activate **1: ENTER SERVICE MODE**.

The hub service mode pitches the blade to end position, locks the blade, and decreases the hydraulic pressure in the pitch accumulators to ≤ 5 bar.
- 6 Wait for approximately 2 minutes until the hydraulic pressure in the pitch accumulators is ≤ 5 bar in picture **11.99: Hub service mode**.
- 7 Go into the nose cone.

7.3.1.1 Rotor lock

7.3.1.1.1 Location of the service technician

0027169907



Operate the rotor lock system from the left-hand side of the nacelle.

The location of the service technician in the nacelle is given in the figure that follows.

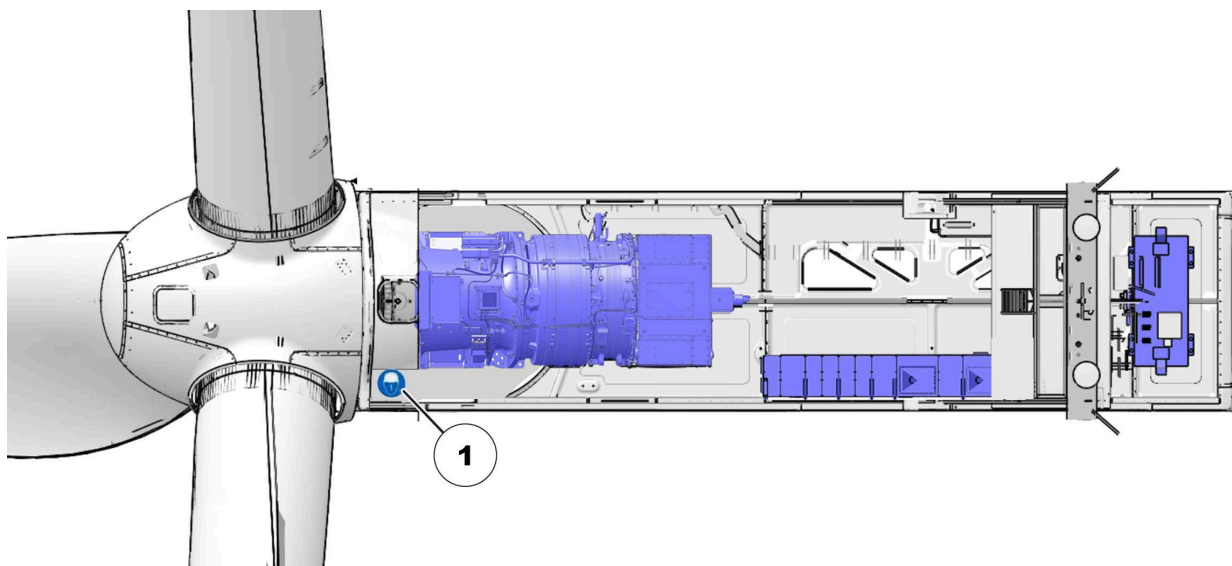


Figure 7.2: Top view of the nacelle

- 1 Area of operation for the service technician

7.3.1.1.2 Procedure to lock the rotor

0025648317



Risk related to rotating parts! SPRA ID No. 5.01

- Stop the wind turbine to prevent unintended start and remote operation.
- Obey the applicable LOTO procedures.
- Lock the rotor mechanically according to applicable LOTO procedures to prevent all rotation of the parts before you start to do the work.



Risk of damage to the rotor lock!

- Do not try to lock the rotor when the rotor turns.
- Always engage the mechanical brake before you lock the rotor.

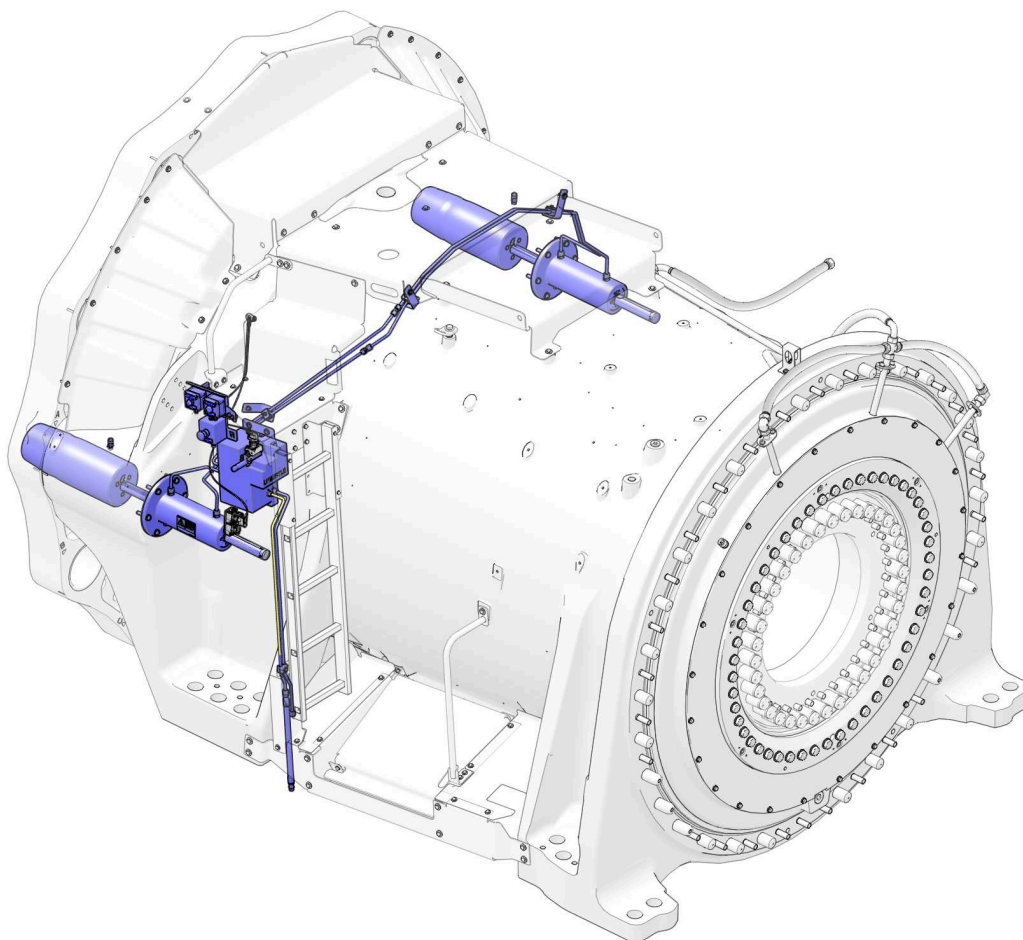
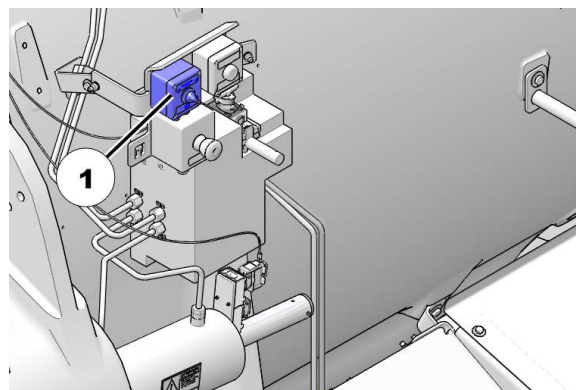


Figure 7.3: Rotor locking system

- 1 Operate the manual brake switch (1) to engage the mechanical brake.

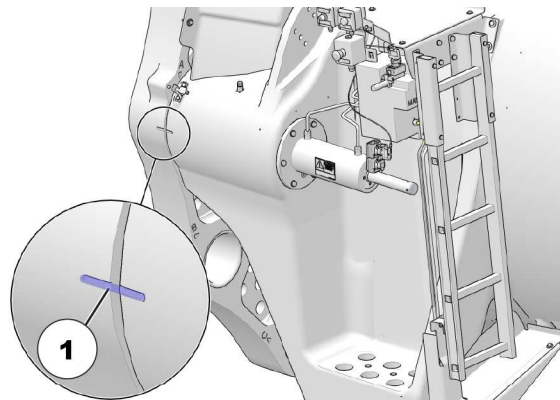


- 2 Release the mechanical brake to adjust the rotor to align the rotor lock marks.

- 3 Engage the mechanical brake when the rotor lock marks (1) are aligned.



When the mark on the rotor lock disc is aligned with the reference mark, the rotor lock pins can be engaged.



- 4 Use the valve handle to open the manual valve in the rotor lock manifold.

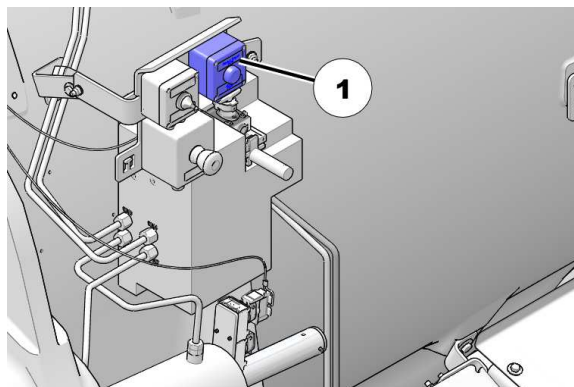
- 5 Make sure to do the steps that follow before you activate the HPU in the nacelle:

- a Turn the mode selector switch to position 4.
- b Activate the -615 08-S4 'Enable Controller Outputs' selector in the ++03 nacelle control panel.
- c Push the reset button.

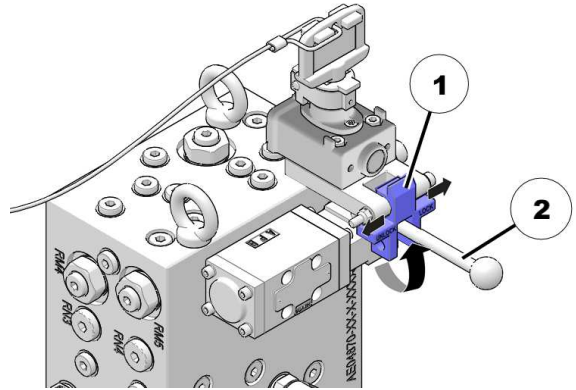
- 6 Push the manual pressure switch (1) constantly to activate the HPU.



The manual pressure switch is a momentary switch. Pressurised flow to the HPU is necessary to activate the rotor lock.



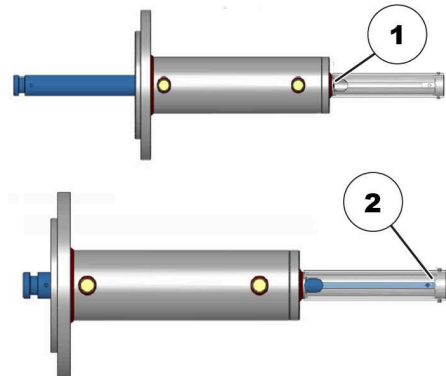
- 7** Lift the locking plate (1) and move the handle (2) to the lock position (engage).



- 8** Do a visual inspection to see if the 2 rotor lock pins are fully engaged.



The transparent cover on the hydraulic cylinders shows the position of the piston rod. The cylinder cover includes additional marks for fully engaged (1) and disengaged (2) positions.

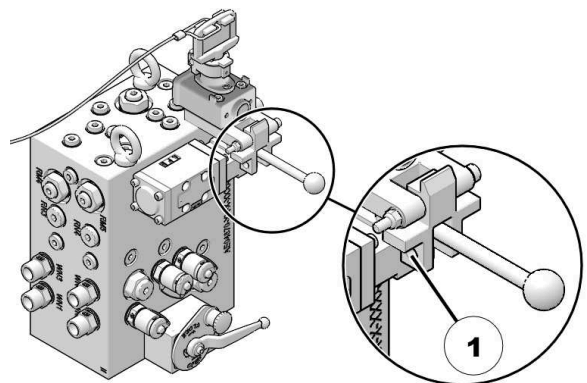


- 9** After the rotor lock pins are fully engaged, use the valve handle to close the manual valve.



The manual valve must be in the open position when the rotor lock is used and must be in the closed position at all other times.

- 10** Do the LOTO procedure at position (1) after the rotor lock pins are engaged.



7.3.2 To do a test of the hub service LED in the hub

0027461315

1 Turn on the hub light switch.

2 Turn the -135-S3 hub service switch on the hub entrance to the SERVICE position.



The -135-P1 visual indicator lamp is constantly ON, when the hydraulic pressure in the pitch accumulators is ≤ 5 bar.

3 Do a check to see if the -135-P1 visual indicator lamp is constantly ON.



If the accumulators are not fully drained, a warning light flashes.

7.3.3 To do a test of the emergency stop buttons in the hub

0027461314

The table that follows shows the location of the emergency stop buttons in the hub

Table 7.2: Emergency stop buttons in the hub

Emergency stop button RDS number	Location of the emergency stop button in the wind turbine	Emergency stop activated display on the controller panel
++05 -135-S1	Hub control panel	HubEmergStopButtonAtivated: 51
++70 -135-S2	Hub entrance	HubEmergStopButtonAtivated: 52

Do the steps that follow to make sure that the emergency stop buttons report correctly:

1 Push one emergency stop button at a time, from [table Emergency stop buttons in the hub, page 19](#).

2 Do a check of the number and location of the emergency stop button which is tested to match the displayed information in menu **1: OVERVIEW SERVICE**.

3 Release the emergency stop button.

The display shows **EmergStopButtonActivated: 0**.

-
- 4 Do steps 1–3 again until all the emergency stop buttons in [table Emergency stop buttons in the hub, page 19](#) are tested.



- The display only shows the number on the emergency stop activated until the emergency stop button is released again. After the emergency stop button has been activated and released again, the display shows **EmergStopButtonActivated: 0**.
-

7.3.4 To do a test of the acoustic warning sounder and visual warning indicator lamp in the hub

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-
- 1 Use the service picture **11.103B: Acoustic Alarms** to start acoustic warning sounder -735-PJ1 and visual warning indicator lamp -735-PF1 in the hub.
- a** In menu **11.103B: Acoustic Alarms**, select **[1:Test]** to do the acoustic or visual test.
-
- 2 Do a check of acoustic warning sounder 735-PJ1 on the hub control panel to make sure that acoustic warning sounder 735-PJ1 makes a sound.
-
- 3 Do a check of visual warning indicator lamp -735-PF1 on the hub control panel to make sure that visual warning indicator lamp -735-PF1 flashes.
-
- 4 Use the service picture **11.103B: Acoustic Alarms** to stop acoustic warning sounder 735-PJ1 and visual warning indicator lamp -735-PF1 in the hub.
- a** In menu **11.103B: Acoustic Alarms**, select **[2:Auto]** to end the acoustic or visual test.
-

7.4 To finalise the functional safety test

0027461312

- 1 Press the blue push button ++03-610-S2 on the nacelle control panel to reset the safety system.
- 2 Push * > **PAUSE** on the service panel to set the wind turbine to IDLE mode.

7.4.1 To continue the work in the hub

0027461311

- 1 Continue to do work in the hub with the **Hub service mode** condition applied or leave the hub, based on the next inspection task. See [section 7.4.1 To continue the work in the hub, page 21](#), for more information.

7.4.2 To leave the hub

0027461310



Risk related to rotating parts! SPRA ID No. 5.07

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

- 1 Make sure that the blade pitch lock is activated.
- 2 Make sure that there are no tools in the hub.
- 3 Turn hub service switch -135-S3 on the hub entrance to the OFF position.
- 4 Switch off the hub light switch.
- 5 Leave the hub and press the blue push button ++03-610-S2 on the nacelle control panel to reset the safety system and leave the SERVICE mode.

6 Release the rotor lock, if the rotor lock is not necessary for the work in the nacelle.

7 Continue the work in the nacelle or leave the nacelle.
