Evacuation, escape and rescue instruction for onshore wind turbine

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Class: RESTRICTED
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Table of Contents

1 Wind turbine type

0011652680

Wind turbine type	Mk version
V105-3.45 MW	Mk 3
V112-3.45 MW	Mk 3
V117-3.45/4.0 MW	Mk 3
V126-3.45 MW	Mk 3
V136-3.45/4.0 MW	Mk 3
V150-4.0 MW	Mk 3

2 Change description

0011652679

Description of changes
First edition.

3 Abbreviations and technical terms

0011461401

Table 3.1: Abbreviations

Abbreviation	Explanation
RCS	Remote control system
SBU	Sales business unit
ER	Evacuation route
EP	Escape point
RP	Rescue point
PPE	Personal protective equipment
SPRA	Standardised procedure risk assessment

Table 3.2: Explanation of terms

Term	Explanation
Evacuation 	Evacuation means the process of leaving the wind turbine generator in an emergency situation when you are able to use any of the predefined access route/system.
Escape 	Escape means the process of leaving the wind turbine generator in an emergency situation when you are unable to use the predefined access route/system. It is a last resort method of getting out of the wind turbine generator.
Rescue 	Rescue is an operation to retrieve injured persons out of the wind turbine generator.

4 Referenced documentation

4.1 Safety documents

0011461400

Table 4.1: Safety documents

Document no.	Title
0001-0410	Personal protective equipment sheets
	Relevant SDSs for the chemicals used in this document
0004-4159	Standardised procedure risk assessment (SPRA)
0036-5891	Safety regulations for operators and technicians
0052-0258	HSE RA on access

4.2 Reference documents

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Table 4.2: Reference documents

Document no.	Title
0061-2443	Placement of anchor points Mk 3
0044-5081	Operating instructions for the Power Climber turbine service lift, type SHERPA-SD4
0044-7237	User's, installation and maintenance manual for Avanti service lift, model DOLPHIN
0057-0583	Evacuation, escape, and rescue plan

5 Purpose

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The purpose of this document is to give how the design supports the capability of evacuation, escape, and rescue of an injured person from the wind turbine.

This instruction applies in case of evacuations from an onshore wind turbine.

6 General information

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See ‘Safety regulations for operators and technicians’ for general instructions for how to do a safe stop of the wind turbine and how to prepare the wind turbine before evacuation and rescue.

0057-0583 ‘Evacuation, escape, and rescue plan’ has all the relevant information and will be made available on site. All personnel will be trained according to the evacuation instruction and in the proper techniques for evacuation, rescue, and escape during an emergency.

7 Implementation of evacuation, escape and rescue

7.1 Evacuation route, escape points, and rescue points

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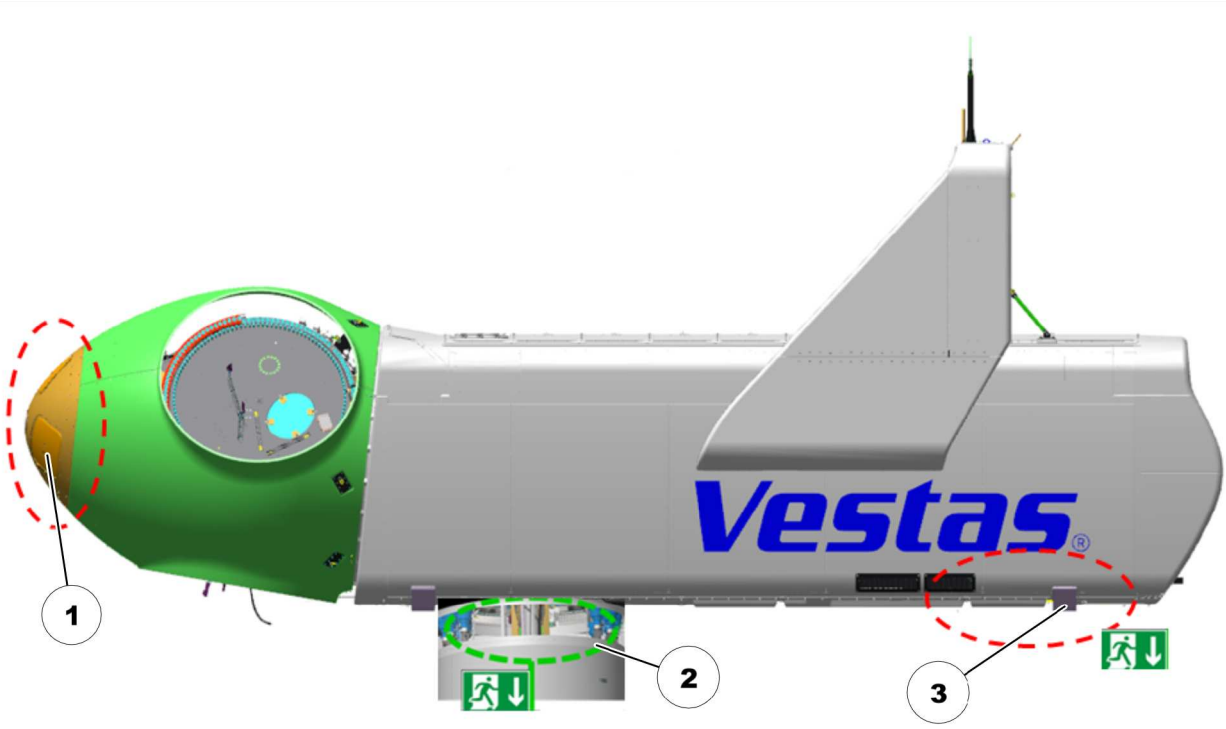

Figure 7.1: Evacuation routes (ER), escape points (EP), and rescue points (RP) in the nacelle and hub

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

7.2 Overview of zones in the nacelle and the tower

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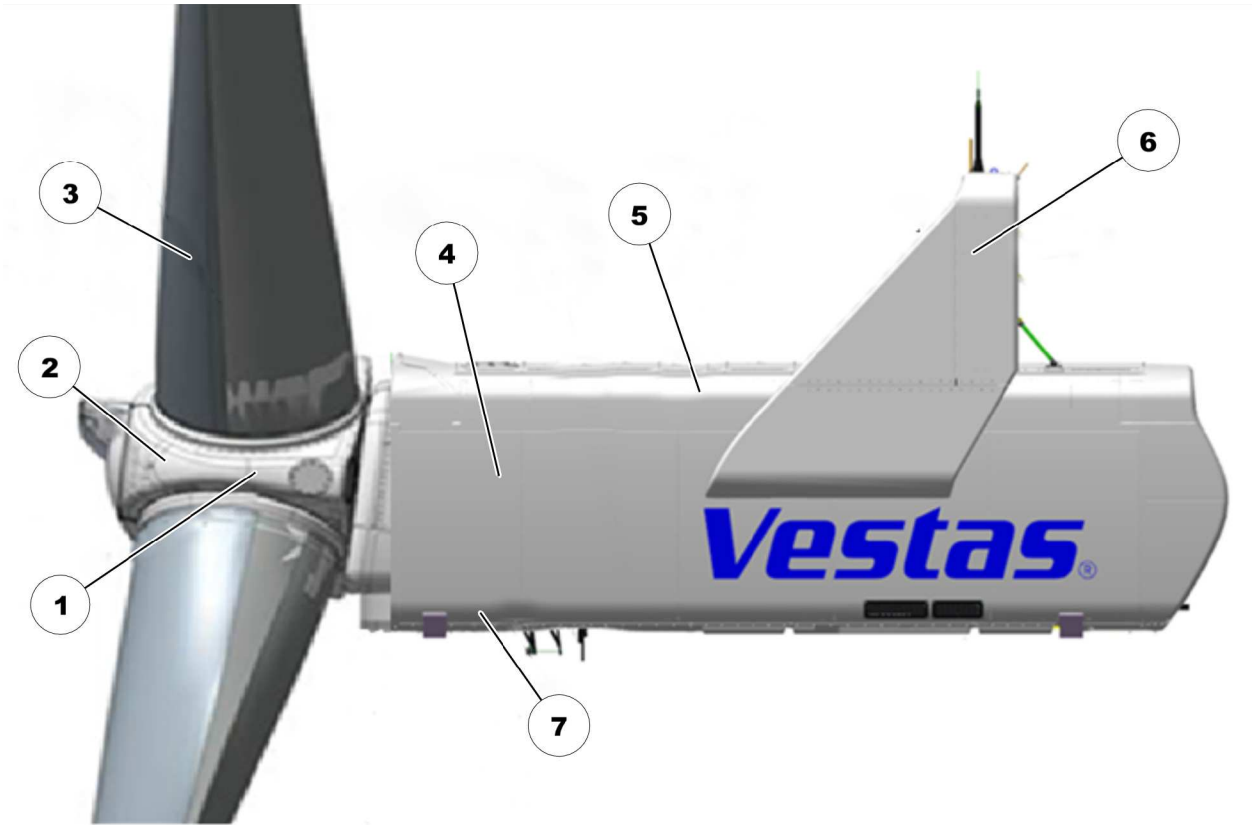

Figure 7.2: Zones in the nacelle

1	H: Hub	2	S: Spinner
3	B: Blade	4	N: Nacelle
5	R: Nacelle roof	6	C: Cooler top
7	Y: Yaw deck		

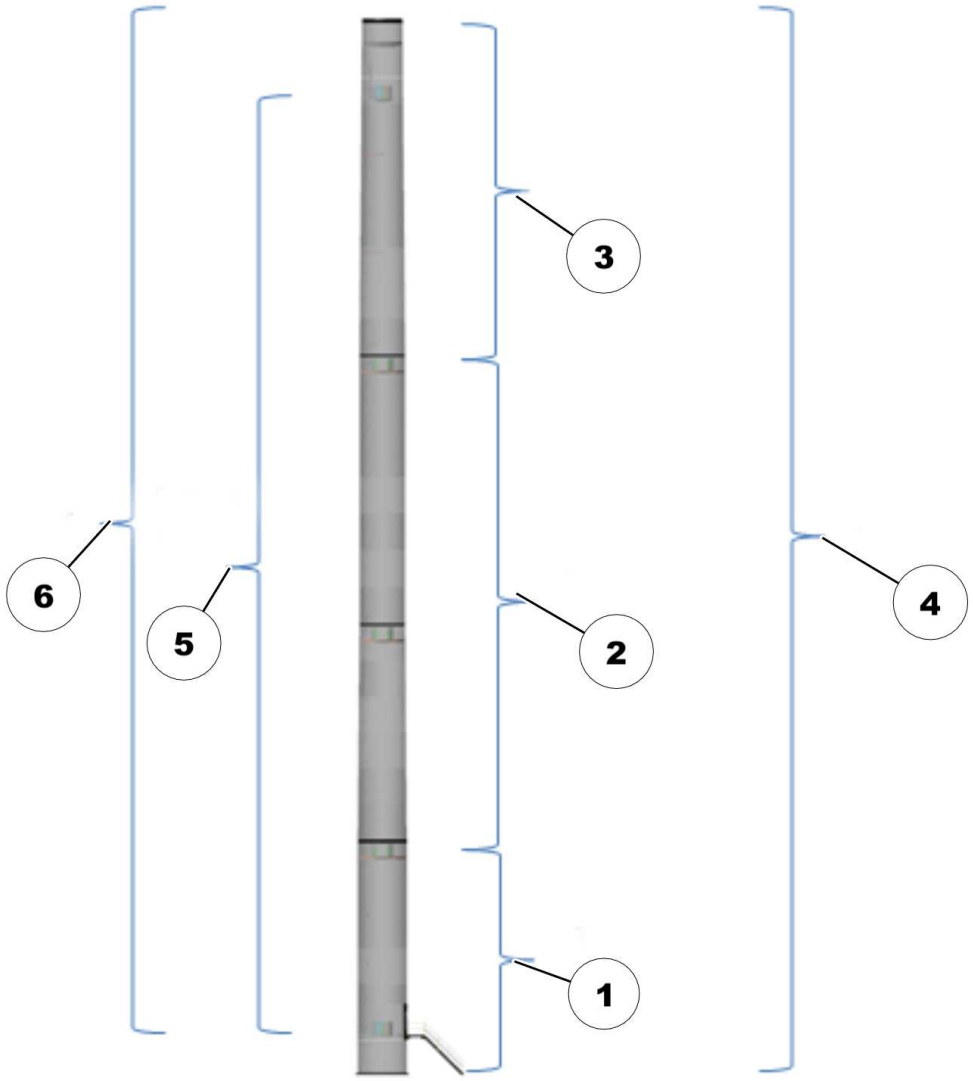

Figure 7.3: Zones in the tower

1	T1: Tower bottom	2	T2: Tower middle
3	T3: Tower top	4	Tower
5	Service lift	6	Tower ladder

7.2.1 Evacuation route in the blade (B: Blade)

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Evacuation from the blade platform is through the manhole in the blade bearing and then the normal evacuation route must be used.

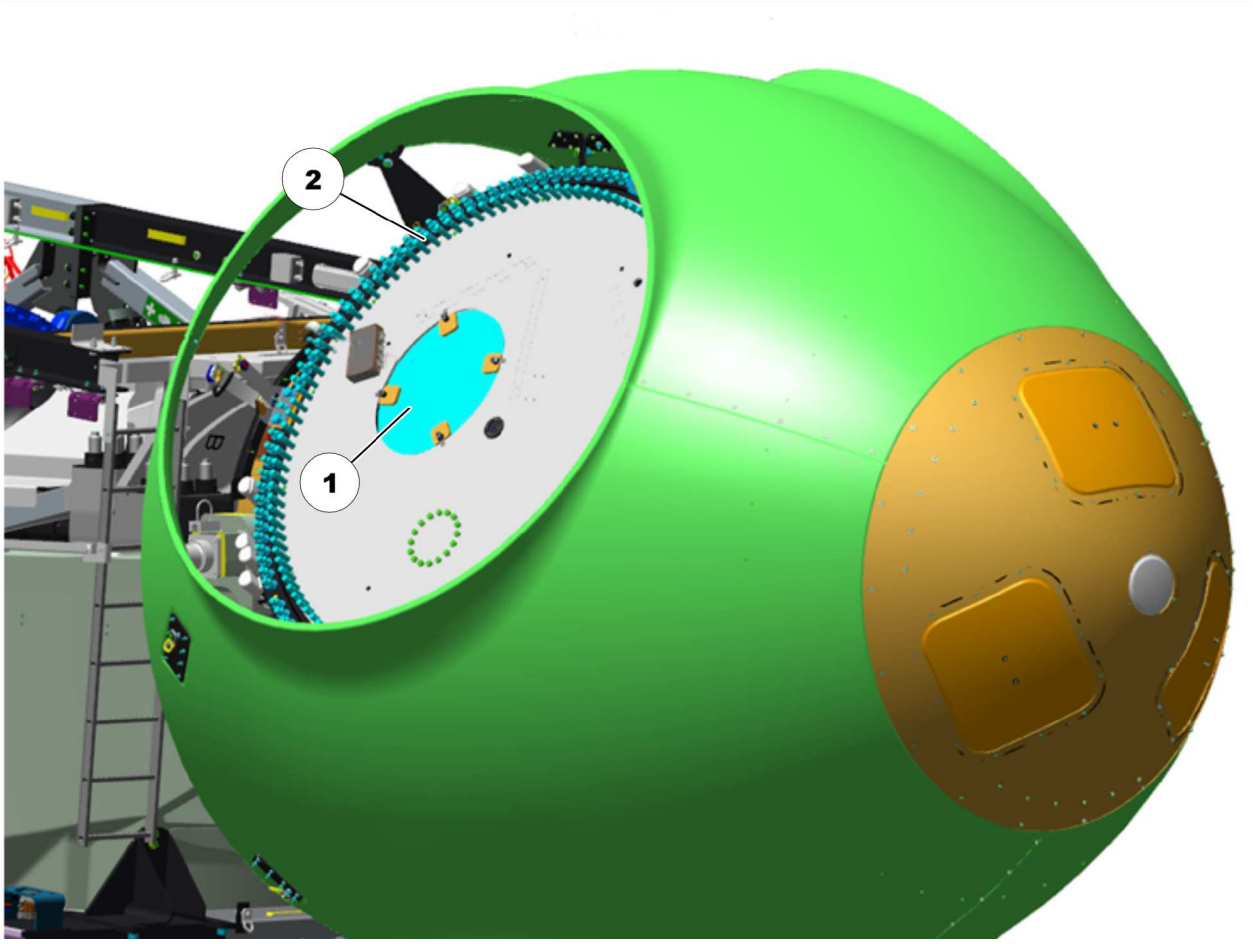

Figure 7.4: Evacuation route from blade to hub

1	Manhole	2	Blade bearing

7.2.2 Evacuation route in the hub (H: Hub)

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Evacuation from the hub to the nacelle is through the opening in the casted hub and then over the casted hub to the nacelle platform.

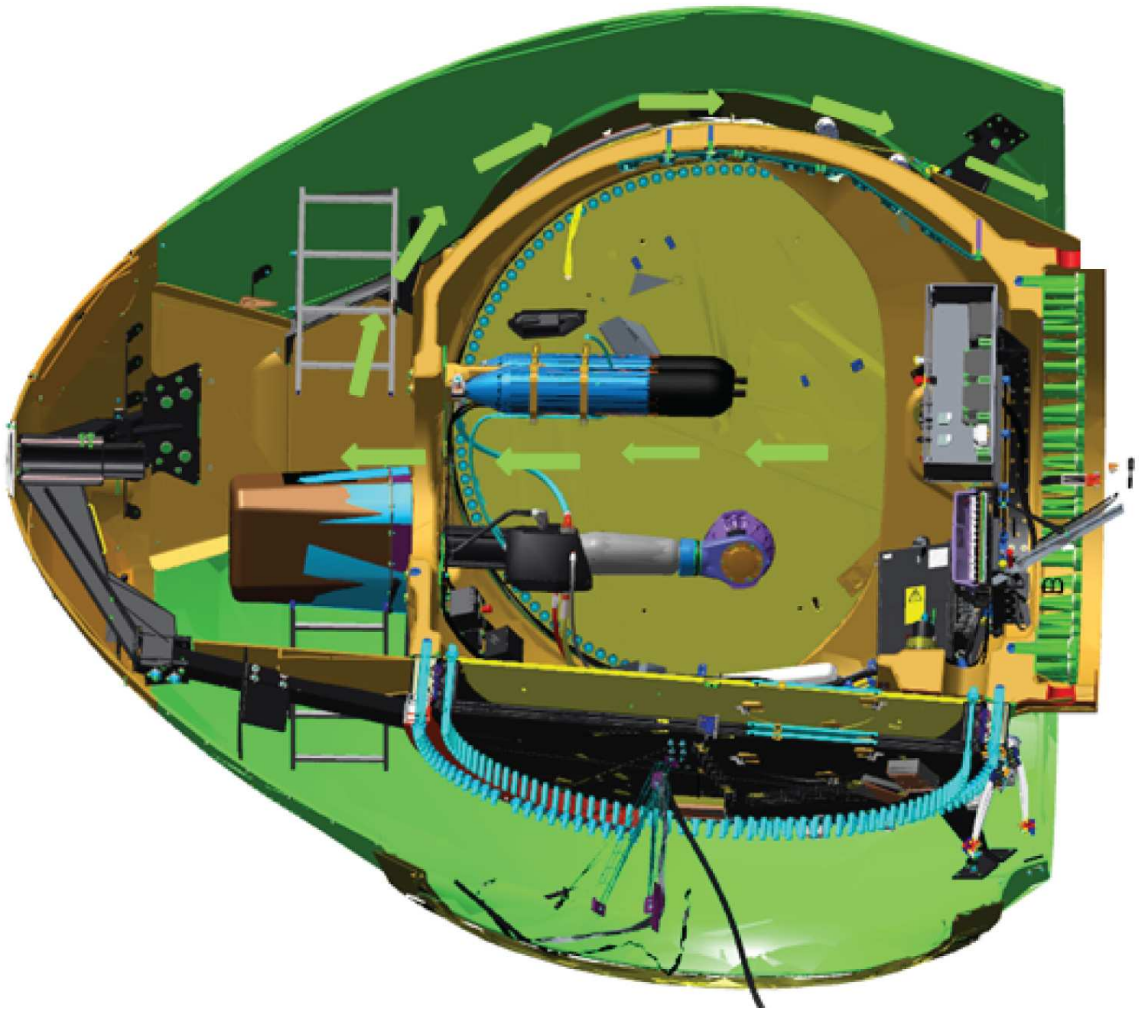

Figure 7.5: Evacuation route in the hub

7.2.3 Evacuation routes in the nacelle (N: Nacelle)

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Evacuation from the nacelle platform to the yaw platform is through the nacelle ladder to the yaw deck.

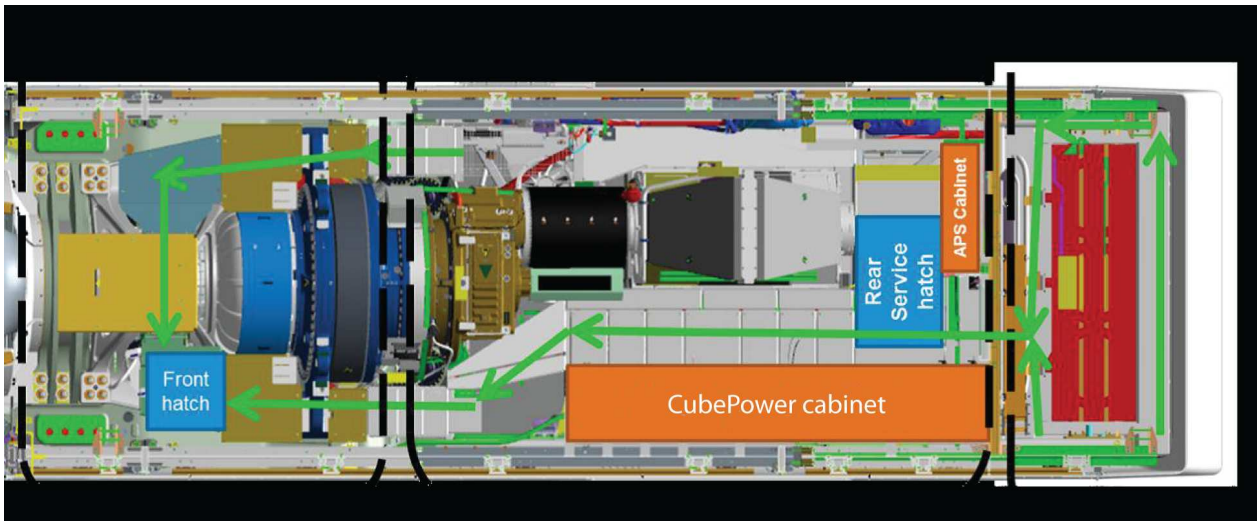

Figure 7.6: Evacuation route in the nacelle

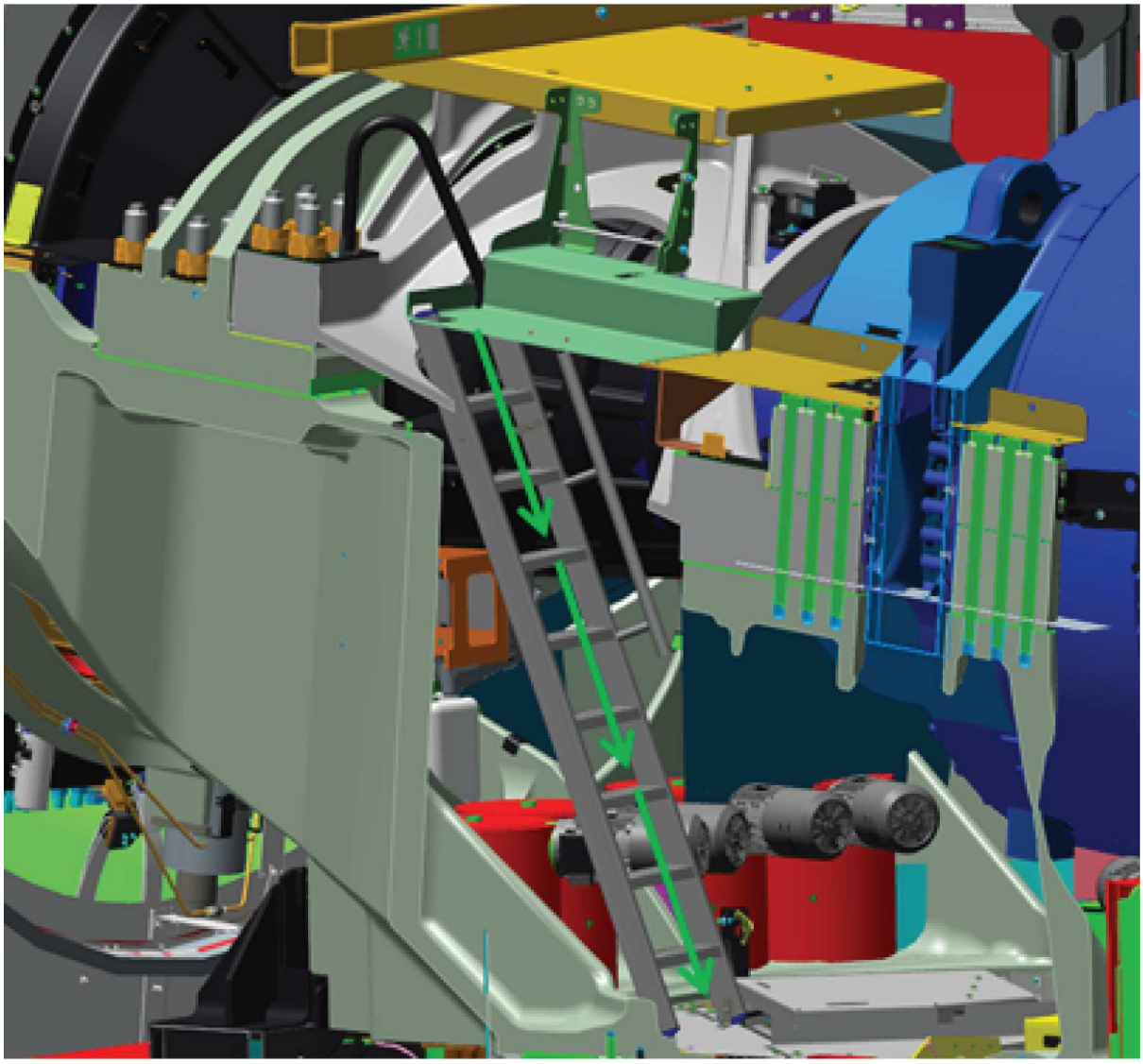

Figure 7.7: Ladder to yaw deck

7.2.4 Evacuation from the nacelle roof (R: Nacelle roof)

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Evacuation from the nacelle roof is through one of the 3 skylights in the nacelle roof.

- Skylight access

Figure 7.8: Skylight access

- Rear end, skylight access

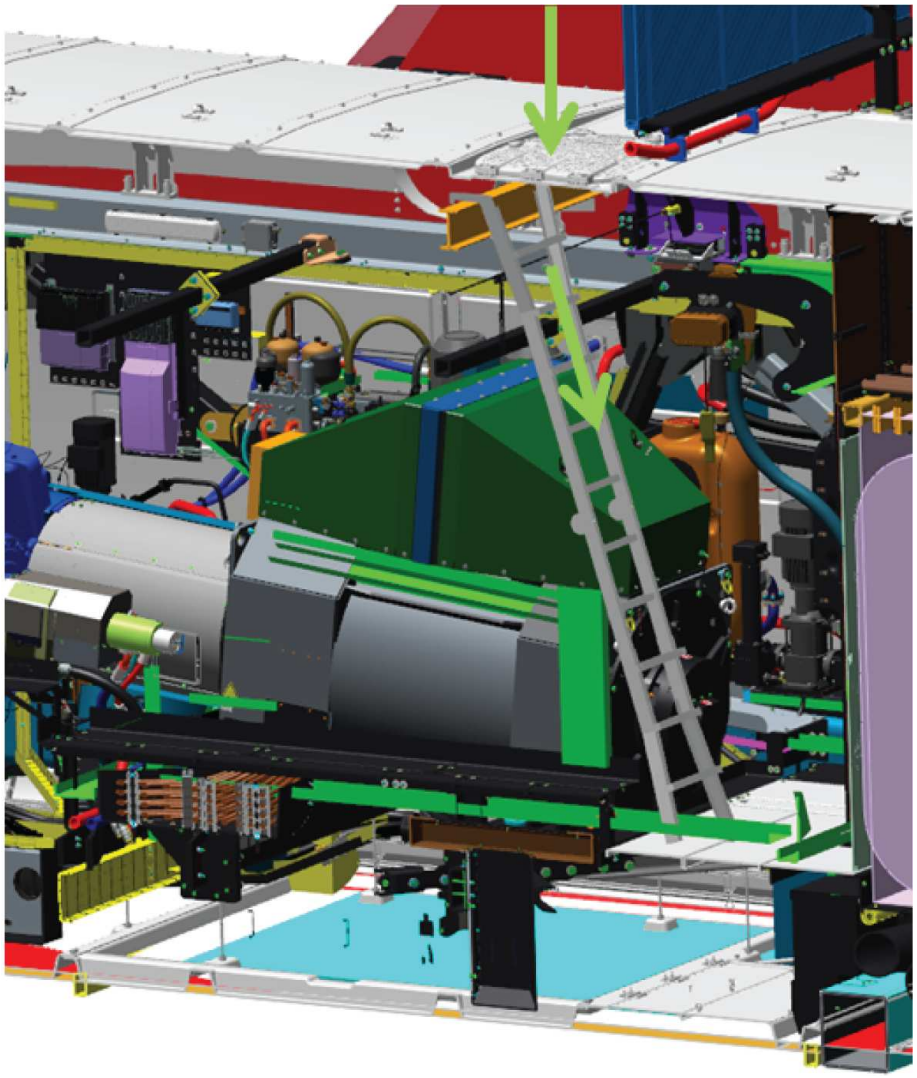

Figure 7.9: Rear end, skylight access

- Front end, skylight access

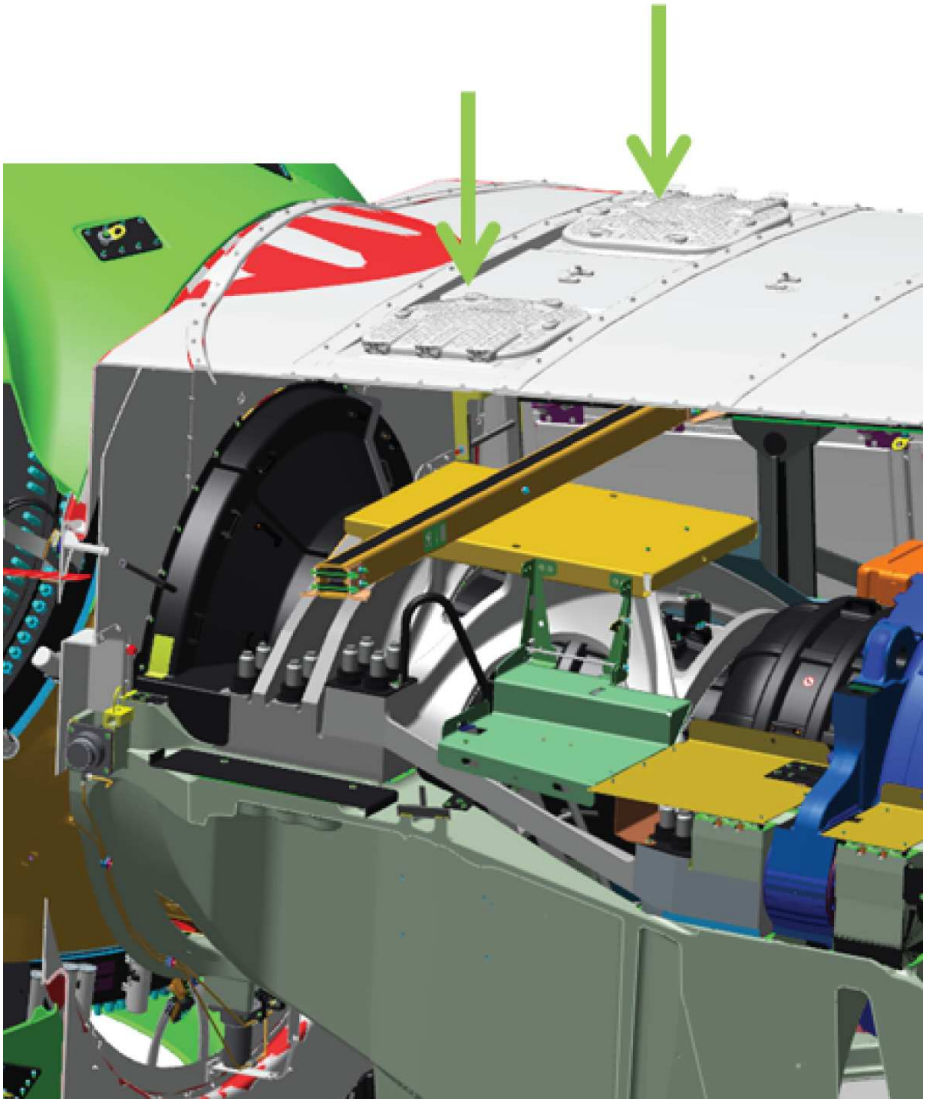

Figure 7.10: Front end, skylight access

7.2.5 Evacuation in the yaw deck (Y: Yaw deck)

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Evacuation from the yaw deck is through the yaw hatch and then the tower ladder must be used.

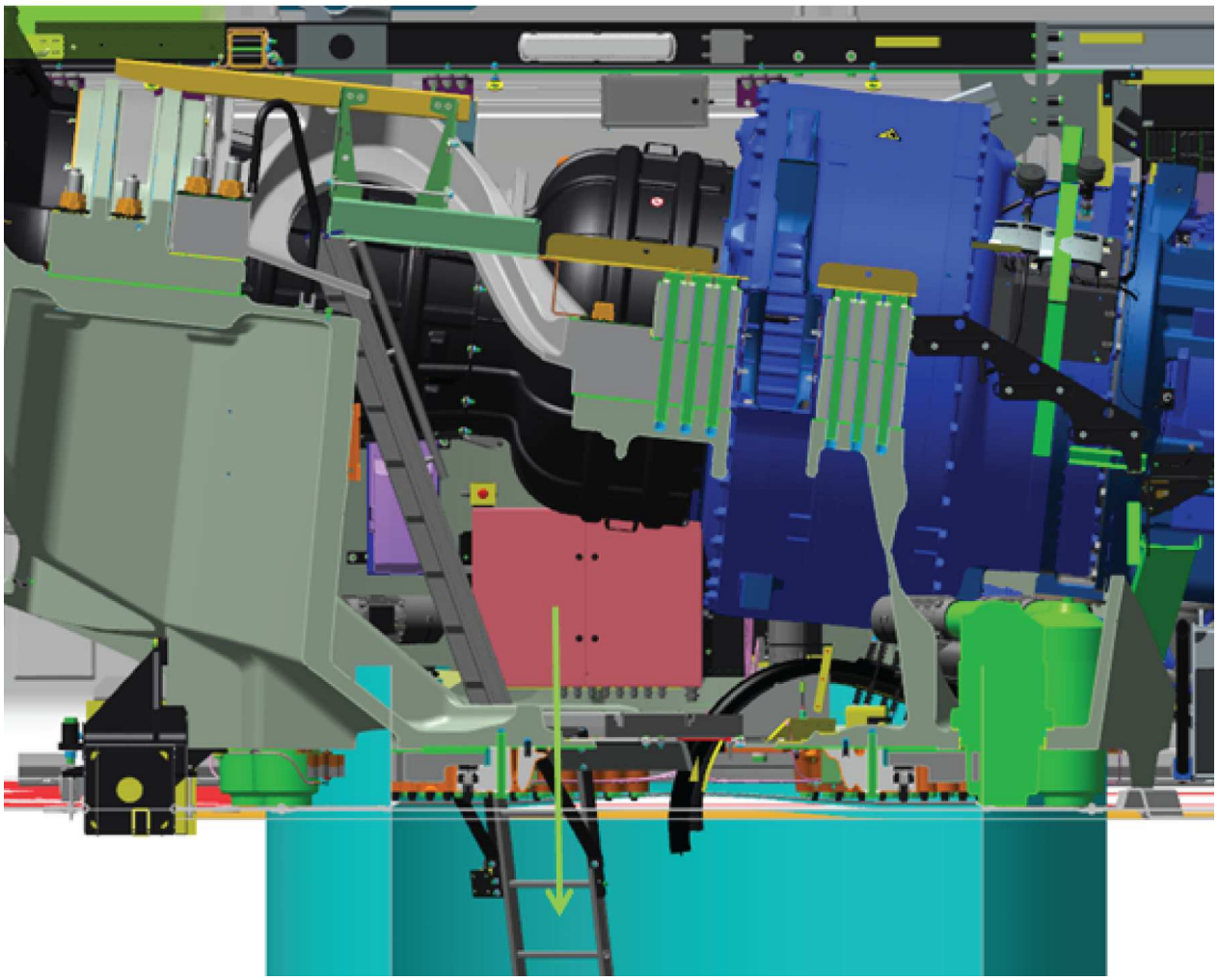

Figure 7.11: Evacuation route from the yaw deck

7.2.6 Evacuation in the tower from (T3 – T1)

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See section 7.5 *Tower, evacuation, and rescue from (T3 to T1)* , page 27.

7.3 Escape route

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It is intended that the service crane hatch in the rear end of the nacelle can be used for escape. For escape through the hatch, the use of a descent device is necessary.

It is also possible to escape through the hatches in the spinner cover.

There is one descent device in the nacelle. A descent device can lower one or two people at the same time. It is recommended to have 1 descent device for every 2 persons working in the nacelle. If more than two people are present, more descent devices should be available, (that is, additional descent devices should be brought to the wind turbine).

7.3.1 Escape route in the hub and the nacelle

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Figure 7.12: Escape route in the hub and the nacelle

1	Hub, front hatch, EP	2	Service crane hatch, EP

Escape route from the nacelle is through the service hatch. Use the anchor points for the descent device.

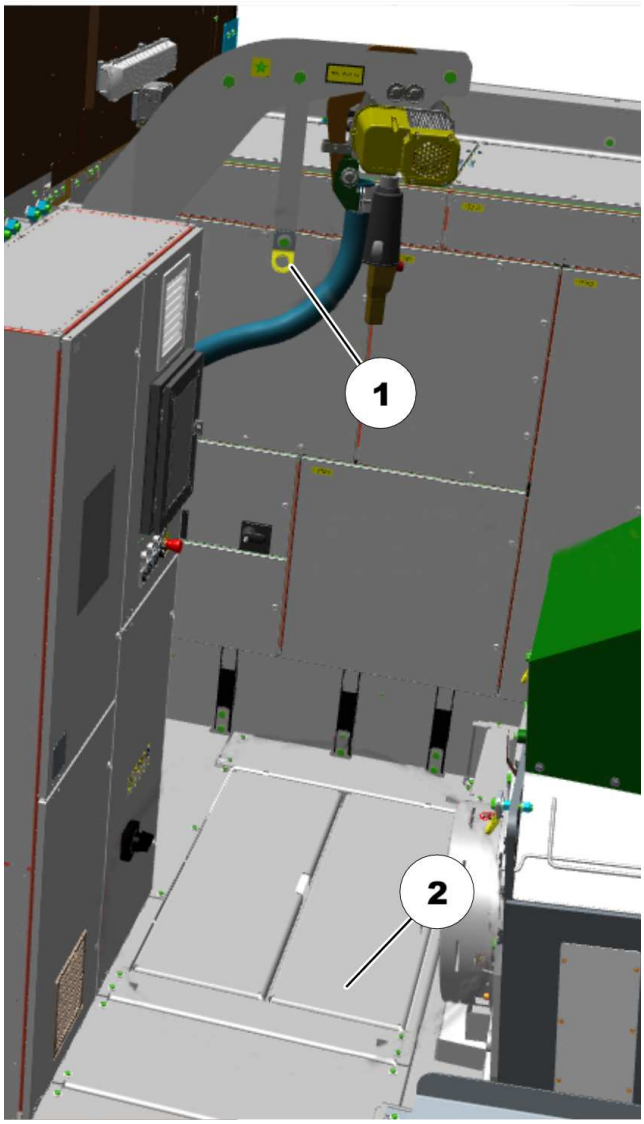

Figure 7.13: Attach the descent device to an anchor point to escape through the service crane hatch

1	Anchor points	2	Service crane hatch

Escape route from the hub through the front hatches in the spinner cover. Use the anchor points.

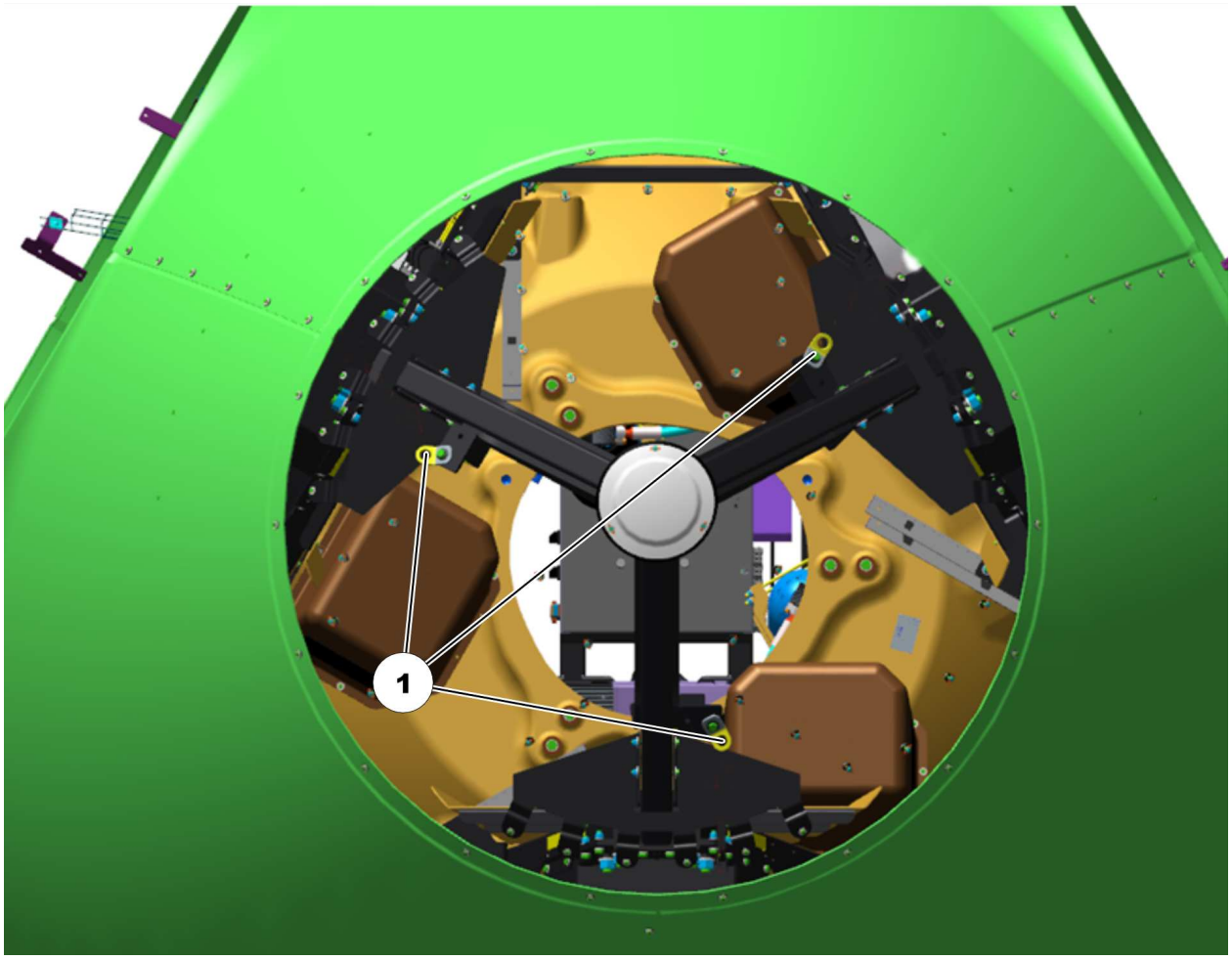

Figure 7.14: Anchor points near hatches in the spinner cover

1 Anchor points

Escape through the front hatches in the spinner must be considered the last possibility. Escape through the rear service hatch instead is recommended.

7.4 Rescue route

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It is intended that normal access, evacuation routes, and escape routes can be used for rescue depending on where the injured person is located in the wind turbine, the type of injury, and the safety equipment which is used (e.g. stretcher or descent device).

Risk of being trapped in confined space! SPRA ID No. RW 24.76

- Always make sure that a service technician is on standby if there is an emergency outside the entrance of the confined area.
- Obey the rules, procedures, and local requirements for confined spaces.
- Make sure that an emergency rescue plan is in place before the start of work.

Risk of fall to the ground! SPRA ID No. 1.01

- Do not do work at a height of more than 2 m from the ground unless you wear PPE. The necessary PPE is given in PPE sheet 8. The PPE must be attached to approved anchor points.
- Use a ladder or a man basket, as necessary.
- Make sure that there are no persons in the areas where overhead work is done.

See section 7.2.1 *Evacuation route in the blade (B: Blade)*, page 11, section 7.2.2 *Evacuation route in the hub (H: Hub)* , page 12, section 7.2.3 *Evacuation routes in the nacelle (N: Nacelle)*, page 13, section 7.2.4 *Evacuation from the nacelle roof (R: Nacelle roof)*, page 15, section 7.2.5 *Evacuation in the yaw deck (Y: Yaw deck)*, page 17, section 7.2.6 *Evacuation in the tower from (T3 – T1)*, page 18 for the evacuation routes.

See section 7.3 *Escape route*, page 18 for the escape routes.

Rescue differs from evacuation and escape in that the aim is not to get out of the wind turbine as fast as possible but to retrieve an injured person safely from the turbine. It will often take longer time to leave the turbine and sometimes it can be necessary to use a stretcher.

If the injured person is conscious and the injured allows this it is preferable to use normal evacuation routes.

7.4.1 Rescue route from the blade (B: Blade)

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Rescue route inside the blade towards the hub. Depending on the injury, the person can be rescued through the spinner hatch by use of the descent device or by guidance of the person through the normal evacuation route.

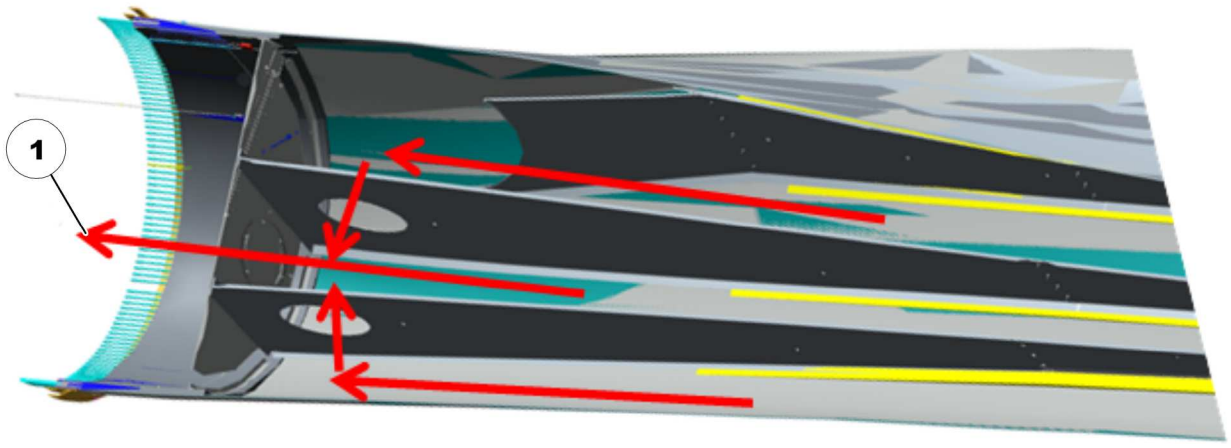

Figure 7.15: Rescue route inside the blade (the blade is locked in horizontal position)

1 To hub

7.4.2 Rescue route from the hub platform (H: Hub)

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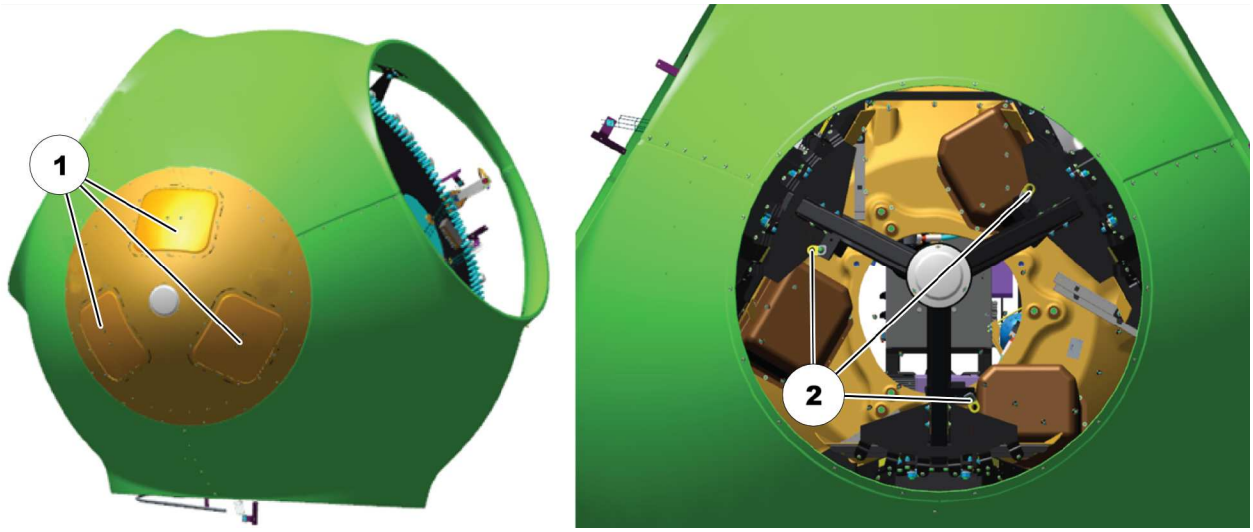

Figure 7.16: Rescue route through spinner hatches and anchor points shown for descent device

1	Spinner hatch	2	Anchor points

Rescue from the hub to the nacelle is done as follows:

- From the hub platform: through the manhole in the hub.
- Bu use of a descent device through one of the hatches in the spinner cover (nose cone). The descent device must be attached to one of the anchor points.

A stretcher should not be used during rescue from blade or hub. If relevant, the injured person should be secured in a stretcher at the nacelle rear platform.

It is not recommended to retrieve an injured person from the hub area to the nacelle through the gap between the hub and the spinner cover. This route is only suitable for a person who can move without help or with minimal assistance.

7.4.3 Rescue route in the nacelle (N: Nacelle)

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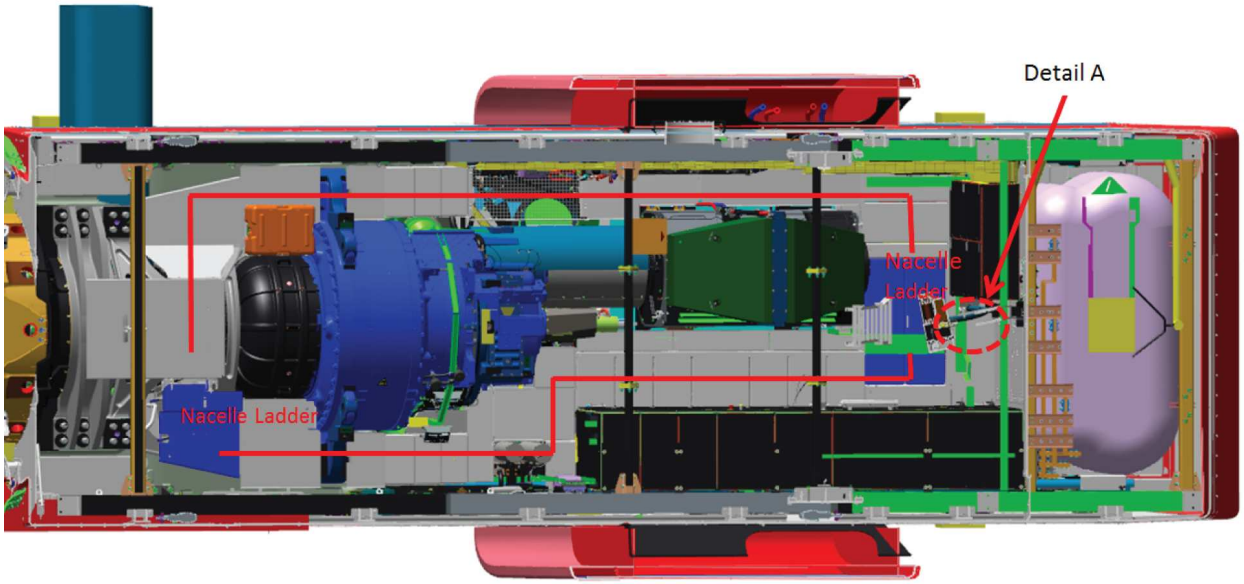

Figure 7.17: Rescue route in the nacelle

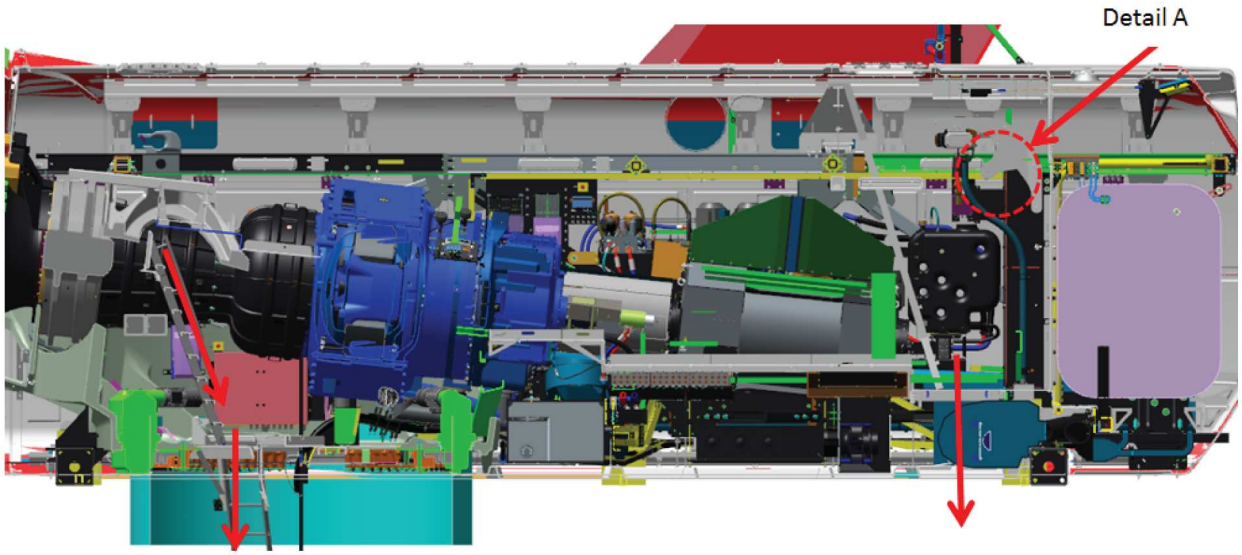

Figure 7.18: Rescue route in the nacelle

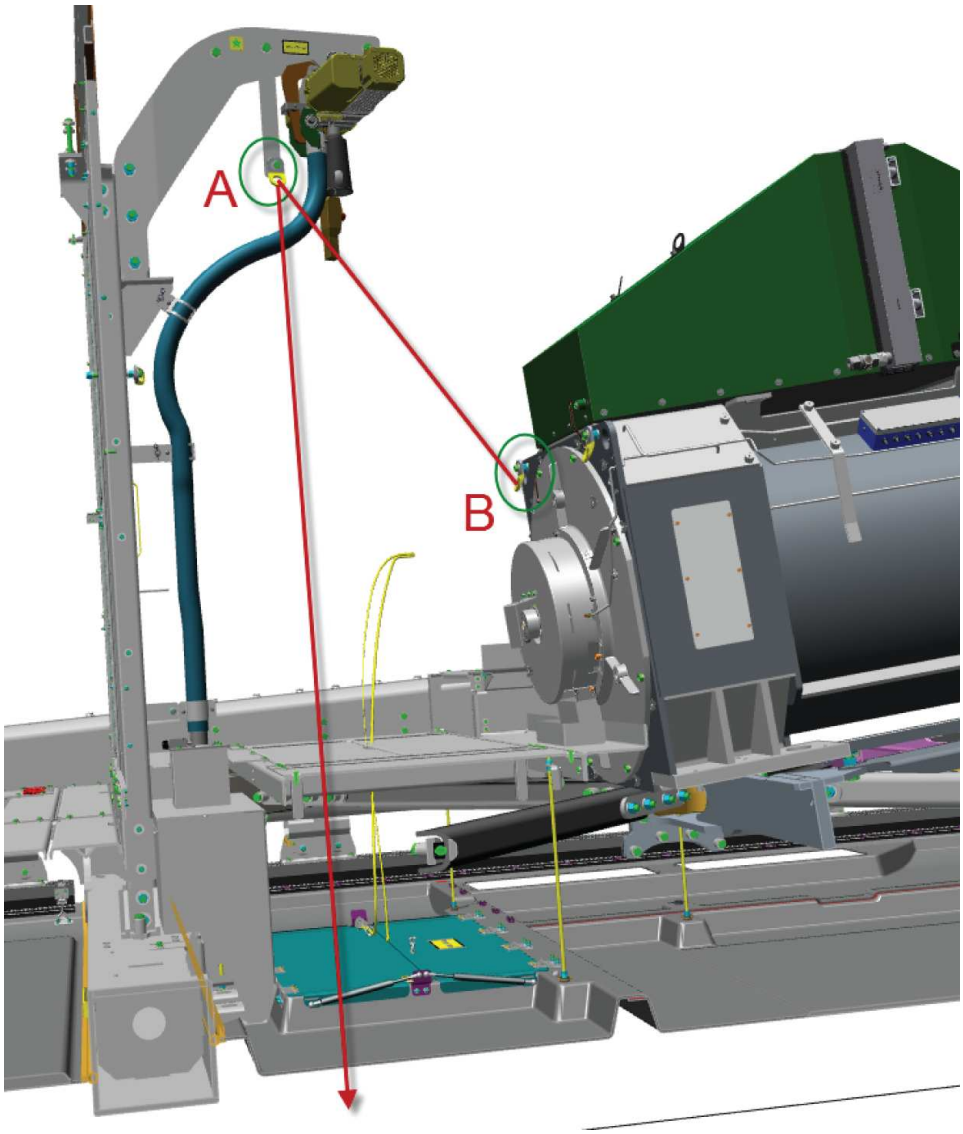

Figure 7.19: Rescue route in the nacelle (detail view)

1	Point A	2	Point B

Detail view: It is recommended to attach the decent device to an anchor point at the rear for the generator (point B) and route the rope through a pulley which is placed at the decent point on the jib crane (point A). This setup provides better access to the decent device during the lowering of the injured person through the hatches and to the ground.

To rescue an injured person from the nacelle.

- If a stretcher is necessary to rescue an injured person, the person must be moved to the rear end of the nacelle. If the person is unable to walk, it is recommended to use the rescue/ descent device and the moveable beam to move the person. At the rear end of the nacelle the injured person is secured in a stretcher on the nacelle floor.
- Use the descent device to lower the injured person through the service hatch. Anchor points are used for attachment of the descent device. If relevant, the person can be lowered in a stretcher. Consider to use tagline (guiding rope) to control the descent.

- Use the nacelle ladder. NB: The descent device is not appropriate on the nacelle ladder. If the injured person is unable to climb the ladder, it is recommended to use the descent device through the service hatch.

7.4.4 Rescue from the yaw deck (Y: Yaw deck)

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- Normal access and evacuation routes can be used to rescue an injured person from the yaw deck.
- If the injured person is conscious and can be moved without use of descent unit or stretcher, it is recommended to use the normal evacuation route.
- If the injured person is not conscious, or cannot move, it is recommended that a descent device is used to lift the person up into the nacelle and move the person to the nacelle rear platform, from where the person is lowered down through the rear service hatch, either by the use of the stretcher and/or the descent device.
- To lift the person from the yaw deck to the nacelle, the moveable beam must be placed above the front hatch, a sling must be attached to the beam, and the descent unit must be attached in the sling.

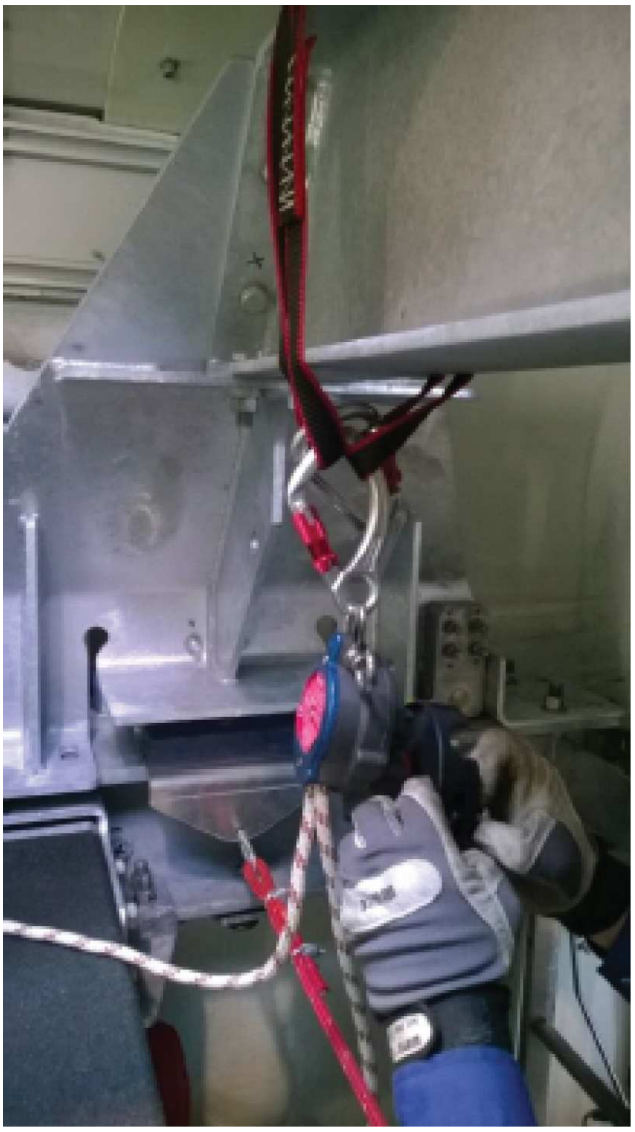

Figure 7.20: Descent unit device attach the to the moveable beam

7.5 Tower, evacuation, and rescue from (T3 to T1)

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- Evacuation and rescue in the tower are dealt with in one and the same chapter, as the route is the same in all tower zones. Escape is not considered, because there are no alternative routes in the tower.
- The tower ladder and the service lift are intended to be used for evacuation and rescue.
- If the injured person, during rescue, cannot be moved to the service lift, a descent device can be used instead. A stretcher may be used. The route is down the tower ladder.
- Depending on where the person is located in the tower, evacuation or rescue can also take place upwards in the tower.
- In case of fire in the tower, the evacuation can also take place upwards in the tower to the nacelle, and then by the escape route in the nacelle. During a fire, it is important to ventilate the nacelle.

7.5.1 Rescue with the tower ladder

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- It is recommended to attach 2 slings around the ladder and secure the descent unit in the straps. This secures a centred lowering when the descent unit is used.

Figure 7.21: Attach the descent unit to the ladder with 2 slings

- Slowly lower down the injured person.
- Guide the injured person through the platforms.

Figure 7.22: Guide the person during lowering when the descent unit is used

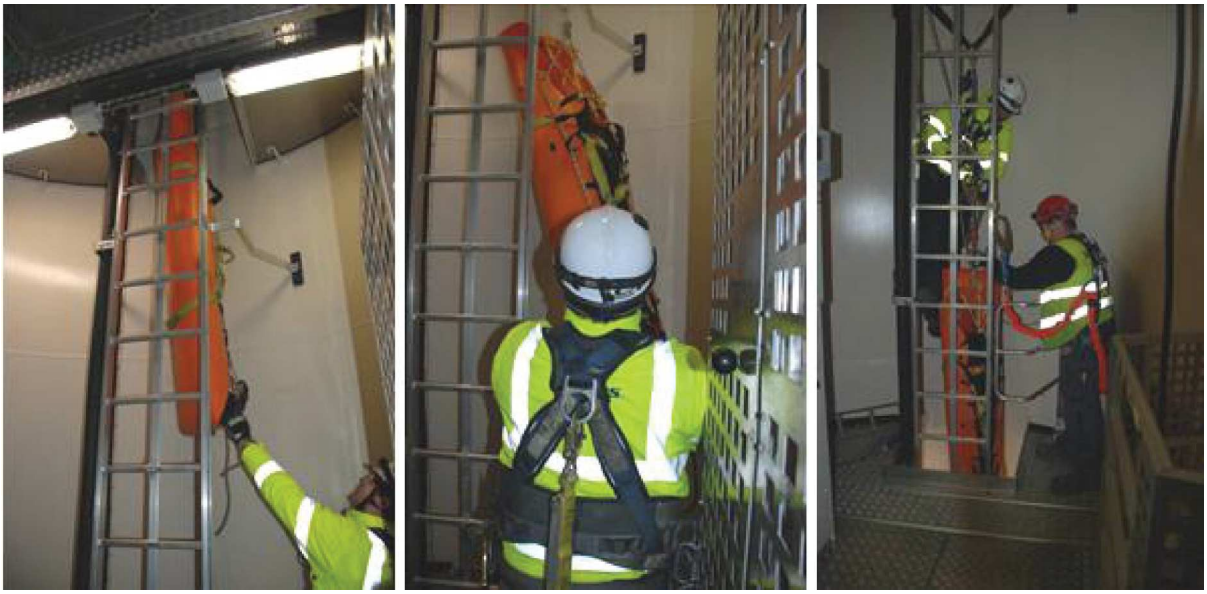

Figure 7.23: Guide the person during lowering when the descent unit is used

During descent of a person in the tower, it is possible to rest on the platforms between the tower sections.

7.5.2 Evacuation from the service lift

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It is highly unlikely that evacuation from the service lift will be necessary. However, if the lift wire breaks, or the hoist unit fully fails, evacuation from the service lift may be necessary.

- The lift user manual and instruction booklet are located in the pouch inside the service lift and must be followed at all times.
- Make sure that the fall arrest equipment is connected to the anchor point inside the service lift and makes it possible for you to exit the service lift.
- Step across from the service lift to the ladder and connect your other fall arrest lanyard to the ladder stile, (not the rung). Disconnect the other lanyard from inside the lift and connect it to the ladder stile. See the sequence in the below figure.

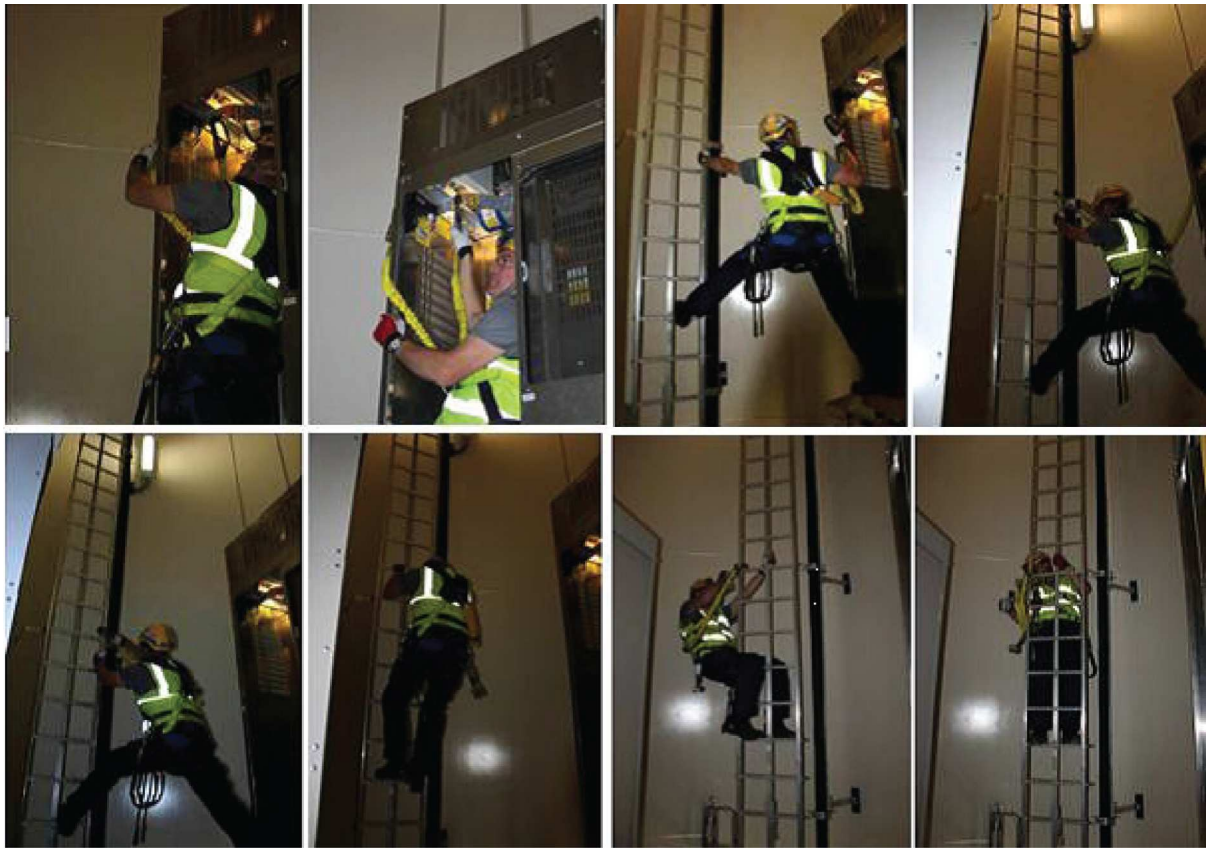

Figure 7.24: Sequence for evacuation from the service lift

- Connect the fall arrest slider to the fixed system. Remove the lanyard from the ladder stile and continue down to the entrance.

7.5.3 Evacuation from the service lift (large diameter tower)

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Additional equipment is necessary for this procedure to enable safe evacuation from the lift to a lower platform or ladder, whichever is the nearest. In large diameter towers, an additional descent device must be carried in the service lift due to the large distance from the lift to the ladder in the bottom tower sections.

- Before you open the door in the service lift, attach the descent unit to the anchor point inside the service lift.
- The person can remove the lanyard from the anchor point.
- If there are 2 technicians, the other person must make sure that he or she is connected to the other anchor point in the service lift.
- The person attached to the descent unit can open the door and start descending.
- When possible, grab the ladder or continue the descent down the nearest platform.
- Once in a safe location, disconnect yourself from the line so that the next technicians can descend by the use of the same procedure.

8 Safety equipment

8.1 Safety equipment placement

0011461417

Table 8.1: Safety equipment placement

Safety equipment	In the nacelle (position number)	In the tower (position number)
Descent device	1	NA
First aid kit	2	2
Fire blanket	3	3
Fire extinguisher	4	4

8.1.1 Nacelle

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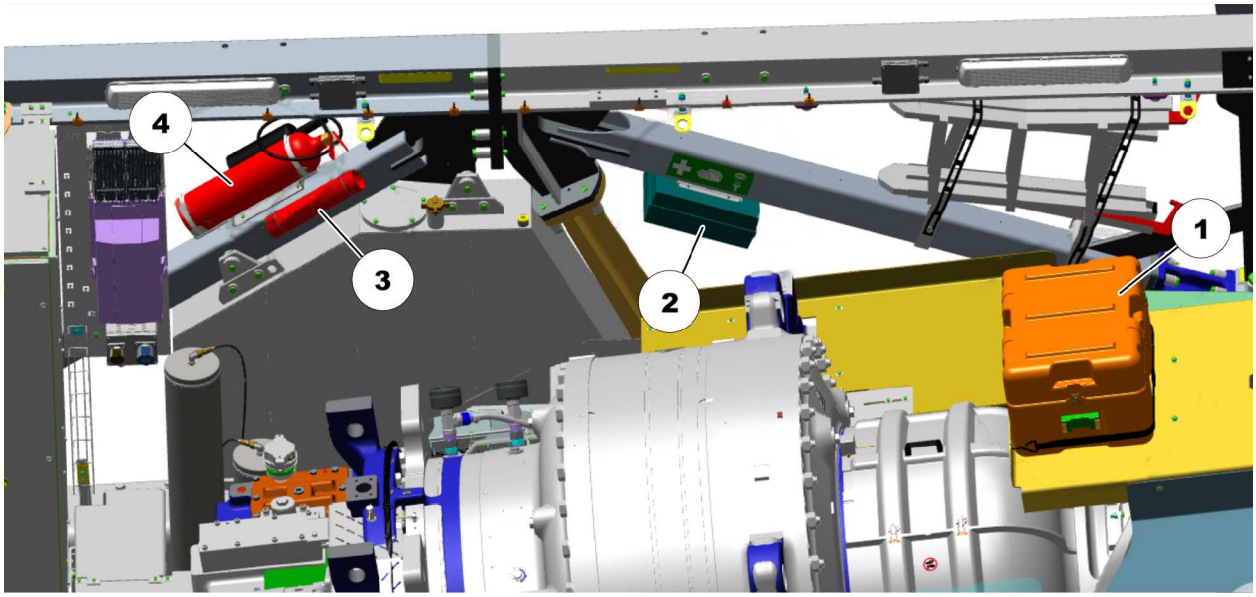

Figure 8.1: Safety equipment

1	Descent device	2	First aid kit
3	Fire blanket	4	Fire extinguisher

8.1.2 Tower

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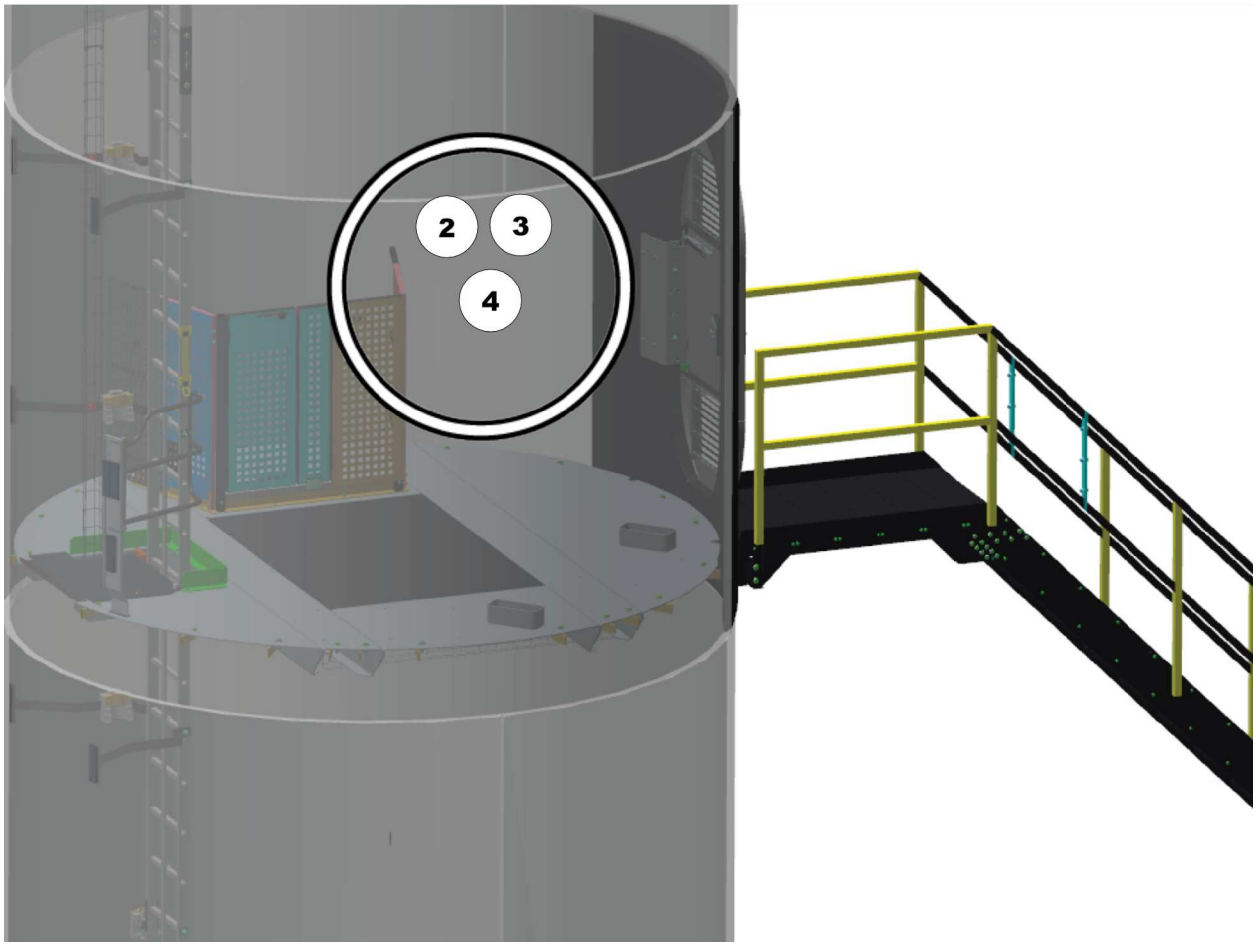

Figure 8.2: Location of the safety equipment in the tower

2	First aid kit	3	Fire blanket
4	Fire extinguisher		