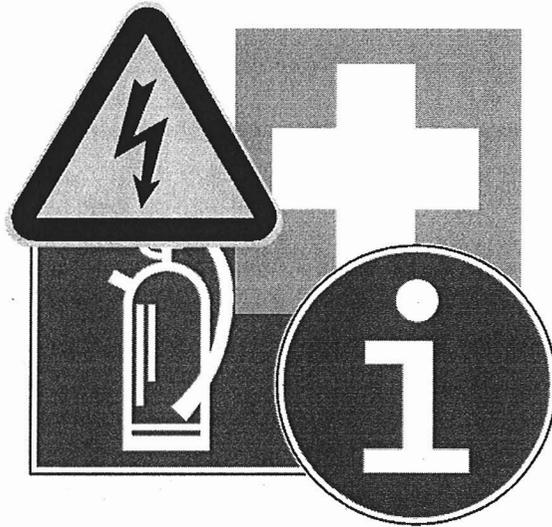


GE Energy

# Technical Documentation Wind Turbine Generator Systems 1.5 Series

(Unless otherwise specified, this manual is also applicable for 1.6-77  
and 1.6-82.5 Wind Turbine Generator Systems)



## Safety Manual

- Please read first -



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## 1 Basic Information on the Technical Documentation for GE Energy Wind Turbine Generator Systems

This "Safety Manual" is a constituent part of the technical documentation for GE Energy wind turbine generator systems. In the case of offshore plants, the supplementary safety information for offshore plants is also to be considered.

The safety manual must be read and understood by the operating and maintenance personnel and the owner, in order to guarantee safety in and on the wind turbine generator system and to prevent accidents and personal injuries.

In addition to the safety manual, the respective specific safety information in the technical documentation, in which e.g. installation or maintenance is described, must always be read.

The basic rules of conduct for safe working in and on the WTG are described in this safety manual.

Any unclear points in the technical documentation, which may jeopardize the correct performance of work in or on the WTGS, must first of all be clarified. Contact GE Energy for advice if necessary.

**In addition to the safety manual, the local safety and accident prevention regulations must be complied with to ensure the safety of personnel.**

### Explanation of Abbreviations

WTGS	Wind Turbine Generator System
PPE	Personal Protective Equipment
EHS	Environment / Health / Safety

## 2 General Safety Principles

The GE Wind Energy 1.5 Series Wind Turbine Generator System (WTG) has been built according to the state-of-the-art and the recognized safety rules.

Hazards for the user or third parties and impairment of the wind turbine generator system and other property may nevertheless arise during the use of this facility if it is

- operated by untrained or uninstructed staff
- not used properly
- improperly maintained or serviced

The owner / operator responsible for the WTG must ensure that

- The safety manual and the operating manual are available and are complied with
- The service conditions and technical data are complied with
- The protective devices are used
- The prescribed maintenance work is carried out
- The maintenance personnel are immediately informed or the plant immediately shut down if higher temperatures, noise, vibration, etc. compared to operation at normal rating should occur.

The operating manual contains the information required for operation of the WTG by qualified personnel.

The warranty of the manufacturer is only provided if the currently valid operating manual is observed and complied with.



**Take precautions against malfunctions and thereby prevent personal injury or death and material damage!**

### 2.1 Personnel Groups

Different personnel groups are specified for carrying out the various tasks in and on the WTG. Before work is started, it must be ensured that the personnel in question have the requisite qualifications to carry out the respective tasks. If necessary, suitable training or qualification measures are required, or the work is carried out by other personnel with a suitable qualification.

#### 2.1.1 Qualified Persons

Work on electrical equipment and machinery may only be carried out by qualified persons who are familiar with the currently applicable safety and installation regulations. The qualified persons must be authorized to carry out the requisite tasks by the person responsible for safety in the WTG under the health and safety regulations. A qualified person is a person who

- has appropriate training and experience
- is familiar with the currently applicable standards, regulations and accident prevention regulations and generally recognized code of practice
- has been instructed in the operating principle and service conditions of electrical and mechanical drive systems and
- can recognize and avoid dangers

Unqualified persons may not be deployed.

### 2.1.2 Technically Competent Persons

Technically competent persons are persons who have the requisite technical knowledge for the inspection of work equipment as a result of their professional training, their professional experience and their current professional activity.

### 2.1.3 Experienced Persons

An experienced person is someone who, on the basis of his technical training and experience, has gained adequate knowledge in the particular field of the equipment/device to be tested and who is acquainted with the pertinent national industrial safety legislation, the regulations for the prevention of accidents, directives and generally accepted engineering standards (DIN standards, VDE regulations, technical rules of other member states of the European Union or other contracting states of the agreement concerning the European Economic Area) to the extent that he is able to assess the safe working order of the equipment/device concerned.

### 2.1.4 Experts

Experts are persons who are familiar with the relevant industrial safety regulations, directives and generally recognized code of practice and can verify and authoritatively assess the presence of threats and dangers.

## 2.2 Proper Use

The GE Energy 1.5 Series Wind Turbine Generator Systems are intended solely for the generation of electrical power by means of wind energy. The nominal electrical output is 1500 kW at a nominal rotor speed of:

- 18.3 min<sup>-1</sup> in the GE 1.5sle
- 16.8 min<sup>-1</sup> in the GE 1.5xle

Any other use or use extending beyond this is deemed to be improper. The operator / owner of the WTG bears the sole responsibility for any damage resulting therefrom.

The same also applies to any unauthorized modifications made to the WTG. As a general principle, modifications to the WTG may be carried out only after consultation with GE Energy, in order to guarantee the safety and the correct functioning of the WTG.

Proper use also includes compliance with the information on

- Safety
- Operation
- Service and maintenance

provided in the technical documentation of the WTG.

## 2.3 General Information

The wind turbine generator system may only be used in a technically perfect condition in line with the technical documentation. In addition, it must be used as intended, as well as with safety in mind and with an awareness of the dangers. Any malfunctions, particularly those which could impair safety, must be reported and remedied immediately.

Anybody who has been authorized to carry out erection, commissioning, operation or maintenance work must have read and understood the complete operating manual, in particular the safety manual.

It is too late to read the manual while carrying out the work. This applies especially to personnel who are only occasionally deployed on the wind turbine generator system.

The operating manual must be readily available at the site of operation of the wind turbine generator system at all times. It is kept in the main cabinet of the WTG.

The relevant regulations for the prevention of accidents (see "Information for the Operator" in "Basic information regarding the operating instructions manual") and any other generally recognized safety and industrial health regulations must also be complied with.

We cannot be held liable for any damage or accidents as a result of non-compliance with the operating instructions, the relevant regulations for the prevention of accidents and any other generally recognized safety and industrial health regulations.

Responsibilities for the different activities within the framework of operation, service and maintenance of the WTG must be clearly defined and complied with. This is the only way to prevent mistakes, particularly in dangerous situations.

The instructions for

- Shutting down the WTG
- Maintenance work
- Handling the rotor lock
- Entering the rotor hub

must be followed during the inspection, maintenance and repair of the wind turbine generator system and the safety devices.

### 3 Marks, Signs and Symbols

#### 3.1 Danger Classifications and Symbols

The following danger classifications and symbols are used in the technical documentation of the GE Energy 1.5 Series wind turbine generator systems:



**Danger!**

**Exact description of the danger!**

Indicates an imminent threatening danger resulting in death or serious injury.



**Warning!**

**Exact description of the danger!**

Indicates a potentially hazardous situation that may result in death or serious injury if the dangerous situation is not avoided.



**Caution!**

**Exact description of the danger!**

Indicates a potentially hazardous situation that may result in slight or minor injury if the dangerous situation is not avoided.



**Attention!**

**Exact description of the danger!**

Indicates a potentially hazardous situation that may result in damage to the WTG or surrounding area if the dangerous situation is not avoided.



**Notes include user tips and useful information.**

The notes should be read in the interests of proper use as well as with regard to proper operation and maintenance of the WTG.

All notices and symbols directly attached to the WTG, such as safety signs, operating notices, rotation arrows, component identification markings, etc., must be observed without fail. They may not be removed and must be maintained in a fully legible condition.

#### 3.2 Marks and Signs attached by GE Energy

The personnel in the WTG must be able to check certain data at all times, in order to ensure safe operation of the WTG. The following information must therefore be clearly visible and permanently attached:

1. Marks for identification of the device
2. Characteristic values by means of which the permissible limits for safe use are specified, e.g. permissible load, rotational speed, pressure

In addition, information about the prescribed use and about possible dangers which could arise when handling a device must be provided.

Safety marks could be texts, signs, signals, pictographs and colors. All texts are to be in two languages, i.e. English and the respective national language. Pictographs must be easy to understand and self-explanatory.

The signs are made of durable materials with stable colors.

**The instructions on the safety signs and marks must be followed.**

The presence and legibility of the safety signs must be checked as part of the regular maintenance work. Any missing or illegible safety signs must be replaced immediately.

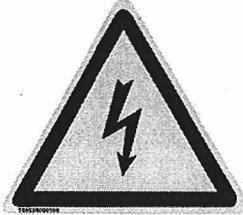
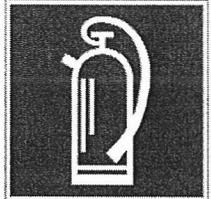
The signs in the wind turbine generator systems may differ as a result of country-specific differences in the environmental and safety regulations.

All possible signs attached by GE Energy are listed in the following:

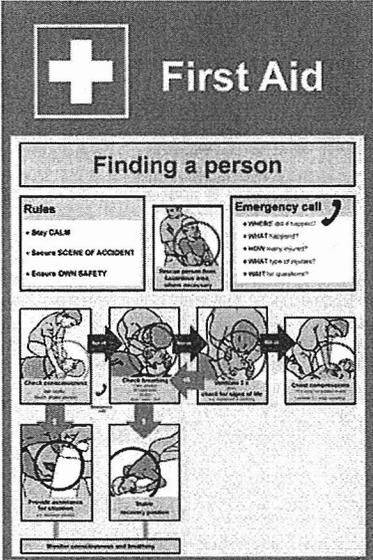
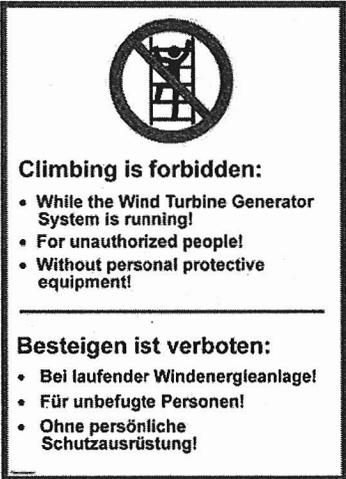
**3.2.1 Tower**

<p><b>Keep escape and rescue routes clear!</b></p> <p>This sign is attached in the entrance area of the turbine.</p> <p>Not for USA/Canada!</p>	 <p><b>Escape and rescue routes must be kept clear at all times!</b></p> <hr/> <p><b>Die Flucht- und Rettungswege müssen frei von Hindernissen sein!</b></p> <p><small>104W2066P002</small></p>
<p><b>It is strictly forbidden to leave the WTGS with rotor lock applied!</b></p> <p>This sign is attached in the tower at the bottom of the ladder.</p>	 <p><b>It is strictly forbidden to leave the Wind Turbine Generator System with the rotor lock applied!</b></p> <hr/> <p><b>Das Verlassen der Windenergieanlage bei eingelegter Rotorarretierung ist streng verboten!</b></p>

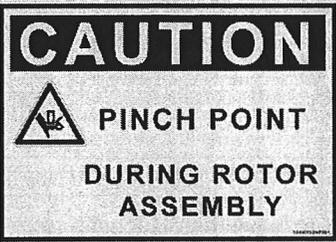
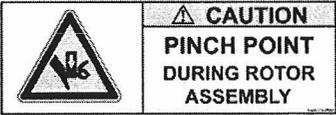
<p><b>Falling hazard warning on trap doors and floor openings!</b> This sign is attached to each platform.</p>	
<p><b>Falling objects hazard warning!</b> This sign is attached to each hatch.</p>	
<p><b>Admissible maximum loading of the platform!</b> This sign is attached to each platform.</p>	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;"><b>Admissible max. loading of the platform 200 kg/m<sup>2</sup></b></p> <hr/> <p style="text-align: center;"><b>Zulässige Höchstbelastung der Plattform 200 kg/m<sup>2</sup></b></p> </div>
<p><b>Always close hatch after climbing through!</b> This sign is attached to each platform.</p>	<div style="border: 1px solid black; padding: 5px;"> <div style="display: flex; justify-content: space-around;">   </div> <p style="text-align: center;"><b>Attention!</b></p> <p style="text-align: center;"><b>Hatch always to be closed after climbing through!</b></p> <p style="text-align: center;"><b>Achtung!</b></p> <p style="text-align: center;"><b>Luke immer nach dem Durchstieg schließen!</b></p> </div>
<p><b>Climbing the WTG - Things to do!</b> This sign is attached in the tower near the ladder.</p>	<div style="border: 1px solid black; padding: 5px;"> <div style="display: flex; justify-content: space-around;">     </div> <p><b>Before climbing the Wind Turbine Generator System:</b></p> <ul style="list-style-type: none"> <li>• make sure that you are familiar with the safety information in the technical documentation,</li> <li>• put on personal protective equipment!</li> </ul> <p>Carry a mobile phone!</p> <hr/> <p><b>Vor dem Bestiegen der Windenergieanlage:</b></p> <ul style="list-style-type: none"> <li>• mit den Sicherheitshinweisen der technischen Dokumentation vertraut machen,</li> <li>• persönliche Schutzausrüstung anlegen!</li> </ul> <p>Mobiltelefon mitführen!</p> </div>

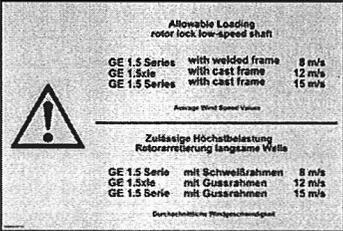
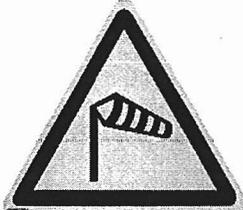
<p><b>Danger: Electricity!</b> This sign is attached to the outside of the door..</p>	
<p><b>Dangerous batteries!</b> This sign is attached to the emergency power supply unit and to the main cabinet.</p>	
<p><b>Attention, confined space!</b> This sign is attached to the underside of the access hatch leading to the transformer section.</p>	 <p><b>Attention! Confined space</b> <b>No unauthorized entry!</b> <b>Achtung! Enger Raum</b> <b>Zutritt für Unbefugte verboten!</b></p>
<p><b>No access for persons with pacemakers!</b> This sign is attached to the outside of the door.</p>	
<p><b>Fire extinguisher!</b> This sign is attached in the tower near the fire extinguisher.  Not for USA/Canada!</p>	



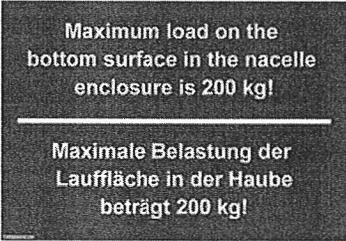
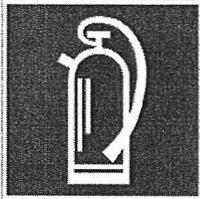
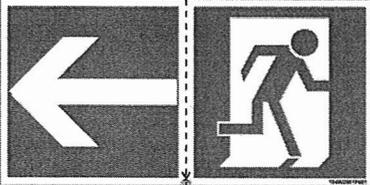
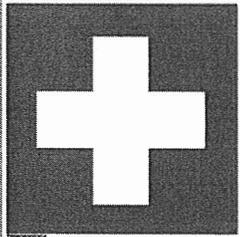
<p><b>First Aid!</b></p> <p>This sign is attached at the bottom of the tower.</p> <p>Not for USA/Canada!</p>	
<p><b>Climbing the WTG - Things not to do!</b></p> <p>This sign is attached in the tower at the bottom of the ladder.</p>	
<p><b>Tie off point</b></p> <p>Only for USA/Canada!</p>	

3.2.2 Nacelle

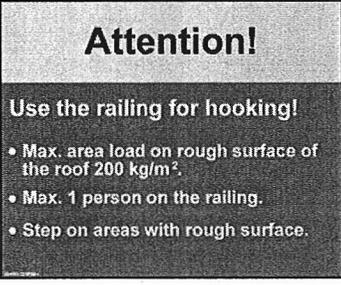
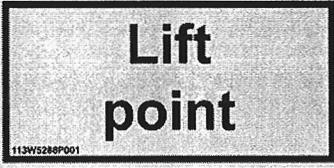
Description	Sign
<p><b>Pinch Point (ANSI)</b>                      This sign is attached in the nacelle during the assembly.                      Only for USA/Canada!</p>	
<p><b>Pinch Point (ISO)</b>                      This sign is attached in the nacelle during the assembly.                      Only for USA/Canada!</p>	
<p><b>Instructions for working in the nacelle!</b>                      This sign is attached in the nacelle.</p>	
<p><b>Instruction for the rotor lock on the high-speed shaft!</b>                      This sign is attached to the cover beside the rotor lock on the high-speed shaft.</p>	

Description	Sign
<p><b>Allowable Loading rotor lock - low-speed shaft!</b></p> <p>This sign is attached to the rotor lock of the low-speed shaft.</p>	
<p><b>It is forbidden to leave the WTGS with rotor lock applied!</b></p> <p>This sign is attached in the nacelle above the passage to the tower.</p>	
<p><b>Standing on the starter terminal box prohibited – NOT A STEP!</b></p> <p>This sign is attached to all surfaces which may not be used as a step.</p>	
<p><b>Warning: strong wind currents!</b></p> <p>This sign is attached to the hatch leading to the roof of the nacelle (exit to the hub).</p>	
<p><b>Falling Hazard Warning!</b></p> <p>This sign is attached to the hatch leading to the roof of the nacelle (exit to the hub).</p>	
<p><b>Caution! Hot surface.</b></p> <p>This sign is attached to the generator.</p>	

Description	Sign
<p><b>ONLY FOR PLANTS WITH COLD WEATHER EQUIPMENT!</b></p> <p><b>Caution! Hot surface.</b></p> <p>This sign is attached to the anemometer on the roof of the nacelle.</p>	
<p><b>Instructions for entering the rotor hub!</b></p> <p>This sign is attached to the hatch leading to the roof of the nacelle (exit to the hub).</p>	
<p><b>Instructions for yaw stop!</b></p> <p>This sign is attached beside the yaw stop switch on the uppermost tower platform.</p>	
<p><b>ONLY FOR PLANTS WITH AN "EMERGENCY DESCENT HATCH":</b></p> <p><b>Falling hazard at hatches!</b></p> <p>This sign is attached to the optional emergency descent hatch.</p>	

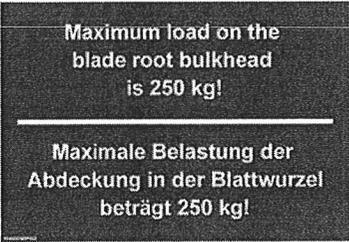
Description	Sign
<p><b>Maximum load on the bottom surface in the nacelle enclosure!</b></p> <p>This sign is attached in the nacelle enclosure near the generator.</p>	
<p><b>Warning! Must be tied off at all times!</b></p> <p>This sign is attached to the hatch leading to the roof of the nacelle (exit to the hub).</p> <p>Only for USA/Canada!</p>	
<p><b>Attention! Danger from rotating parts!</b></p> <p>This sign is attached to the yaw and the low-speed and the high-speed shaft.</p>	
<p><b>Fire extinguisher!</b></p> <p>This sign is attached in the nacelle near the fire extinguisher.</p> <p>Not for USA/Canada!</p>	
<p><b>ONLY FOR PLANTS WITH AN "EMERGENCY DESCENT HATCH":</b></p> <p><b>Emergency exit!</b></p> <p>This sign is attached above the emergency descent hatch!</p>	
<p><b>First Aid!</b></p> <p>This sign is attached near the First Aid box.</p> <p>Not for USA/Canada!</p>	

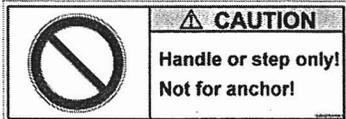
Description	Sign
<p><b>First Aid!</b></p> <p>This sign is attached near the First Aid box.</p> <p>Not for USA/Canada!</p>	
<p><b>First Aid!</b></p> <p>This sign is attached near the First Aid box.</p> <p>Not for USA/Canada!</p>	
<p><b>Use the railing for hooking!</b></p> <p>This sign is attached beside the roof hatch in the nacelle enclosure.</p> <p>Not for USA/Canada!</p>	

Description	Sign
<p><b>Attention! Use the railing for hooking!</b></p> <p>This sign is attached beside the roof hatch in the nacelle enclosure.</p> <p>Only for USA/Canada</p>	
<p><b>Hook onto Spinner!</b></p> <p>This sign is attached to the hatch leading to the nose cone.</p> <p>Not for USA/Canada!</p>	
<p><b>Hook onto Spinner!</b></p> <p>This sign is attached to the hatch leading to the nose cone.</p> <p>Only for USA/Canada</p>	
<p><b>Lift point (ANSI)</b></p> <p>This sign is attached to the lifting lugs of the main frame.</p> <p>Only for USA/Canada</p>	
<p><b>Lift point (ISO)</b></p> <p>This sign is attached to the lifting lugs of the main frame.</p> <p>Only for USA/Canada</p>	
<p><b>Lift point for top cover only (ANSI)</b></p> <p>This sign is attached to the tie-off points of the top cover.</p> <p>Only for USA/Canada</p>	

Description	Sign
<p><b>Lift point for top cover only (ISO)</b>                      This sign is attached to the tie-off points of the top cover.                      Only for USA/Canada</p>	 

3.2.3 Hub

Description	Sign
<p><b>Dangerous batteries!</b>                      This sign is attached to the battery cabinet in the hub.</p>	
<p><b>Attention! Danger from rotating parts!</b>                      This sign is attached to the pitch drive mechanisms.</p>	
<p><b>Danger: Electricity!</b>                      This sign is attached to the axis cabinets in the rotor hub.</p>	
<p><b>Falling Hazard Warning!</b>                      This sign is attached to the hatches of the hub.</p>	
<p><b>Maximum load on the blade root bulkhead</b>                      This sign is attached above and below each rotor blade connection, so that the signs are exposed to view on entering the rotor blade.</p>	

Description	Sign
<p><b>Attention! Confined space</b>                      This sign is attached to the access hatch leading the hub.</p>	
<p><b>Caution! May energize without warning (ANSI)</b>                      This sign is attached to the pitch drive mechanisms.                      Only for USA/Canada</p>	
<p><b>Caution! May energize without warning (ISO)</b>                      This sign is attached to the pitch drive mechanisms.                      Only for USA/Canada</p>	
<p><b>Secure hatch (ANSI)</b>                      This sign is attached to the access hatch to the hub                      Only for USA/Canada</p>	
<p><b>Secure hatch (ISO)</b>                      This sign is attached to the access hatch to the hub                      Only for USA/Canada</p>	
<p><b>Caution! Handle or Step only (ANSI)</b>                      This sign is attached to the handles in the entrance to the hub.                      Only for USA/Canada</p>	
<p><b>Caution! Handle or Step only (ISO)</b>                      This sign is attached to the handles in the entrance to the hub.                      Only for USA/Canada</p>	

## 4 Information for the Operator / Owner of the Wind Turbine Generator System

The operator of the WTG is responsible for ensuring that no unauthorized persons remain inside or on the WTG. The WTG must be kept locked to prevent this.

The wind turbine generator system may only be started up if it has been completely assembled and is in working order.

The wind turbine generator system may only be operated if all safety equipment and safety-relevant devices, e.g. detachable protective equipment, are in place and operational.

If any malfunctions occur or if ice builds up on the rotor blades, the wind turbine generator system must be shut down immediately and secured. Malfunctions are to be remedied without delay by trained technical personnel.

In the case of malfunctions which are not automatically reset by the control system of the WTG, GE Energy must be contacted before a restart is carried out, in order to confirm that the WTG may be placed in the automatic operating mode (i.e. whether the WTG may be restarted).

Follow the switch-on and shut-down procedures and take note of the visual and monitoring displays in accordance with the operating manual!

In addition to this, the operator/owner of the WTG must comply with the following additional safety instructions (if maintenance is not carried out by GE Energy employees):

- If the WTG is not directly connected to the public telephone system, the maintenance personnel must have a cellphone with them when ascending the tower.
- The personnel must be informed about who to contact in an emergency. (Telephone numbers of a rescue center, police, fire department..)
- For safety reasons, the personnel must be instructed that the WTG may only be entered by a minimum of two persons.
- Special authorization from GE Energy is required to carry out inspection and maintenance work inside a WTG while it is in operation.
- The personnel must be instructed to keep the WTG escape routes clear at all times when carrying out work as a part of maintenance or operation.
- In the case of work involving a fire hazard, the personnel must have a fire extinguisher ready at hand, in order to be able to immediately extinguish any fire that may start.
- Personnel are not permitted to remain at a higher level in the WTG while work involving a fire hazard is being carried out.
- Personnel instructed to carry out work in or on the WTG must be provided with instructions and the appropriate personal protective equipment (PPE).

- If the WTG is part of a wind farm and connected to a wind power plant, this safety manual must be supplemented in cooperation with the local power supply company, so that it also:
  - describes the safety aspects relevant to the wind farm
  - describes the exchange of information and names the persons who are to be contacted
  - describes access to basic first aid facilities

## 5 Signs to be attached by the Operator/Owner

The operator/owner of the WTG is obliged to attach additional warning signs to the WTG. These are intended to cover safety aspects which are not related to the scope of supply of the manufacturer of the WTG.

The warning signs must state that

- It is dangerous and prohibited for unauthorized persons to enter or climb the WTG
- It is prohibited to remain in the vicinity of the WTG while work is being carried out outside the nacelle
- Deposits of ice which have formed on the rotor blades (depending on the location of the WTG) could drop off

The operator/owner is responsible for seeing that any components or plant components which he has supplied are properly equipped with signs.

## 6 Safety Equipment

The safety equipment serves to reduce risks and dangers. You will find further information on equipment and items which are subject to inspection in the annex of this safety manual.

### 6.1 Personal Protective Equipment

Everybody must wear Personal Protective Equipment (PPE) when working on or in the WTG to protect themselves from injury.



#### Danger of accident!

Never enter or climb the WTG without the personal protective equipment. Otherwise there is danger of injury and falling.

The PPE is especially required for climbing the tower. It comprises:

- Safety harness
- Travelling safety hook
- Lanyard (safety rope) with fall absorber
- Hard hat
- Safety shoes
- Gloves
- Safety glasses
- Hearing protection (if required)
- Respirator (if required)
- Thermal clothing (if required)

The PPE must be of an approved type and must bear marks of conformity stating that it is suitable for the work and protection involved and that it is also suitable for the climatic conditions at the site of the WTG.



#### Note!

The extent and the equipment of the personal protective equipment may vary in some countries. Please comply with the local regulations!

As a rule, two safety harnesses, travelling safety hooks and hard hats are supplied by GE Energy. The remaining constituents of the PPE are not part of the scope of supply of the wind turbine generator system. The safety harnesses and travelling safety hooks must be properly stored in the WTG and must be accessible.

If several persons ascend the tower simultaneously, personal protective equipment must be available for the respective number of persons.

**Note!**

Check the completeness, the condition and the function of your personal protective equipment in good time before entering the WTG. If a piece of the equipment is missing, it must be replaced before starting work.

The safety harness and the entire safety equipment must be checked before use. Damaged equipment must never be used.

The PPE must be inspected and tested by a technically competent person after any fall, or at the intervals recommended by the manufacturer at least.



**Follow the manufacturer's directions for use for all component parts of the personal protective equipment!**

## 6.2 Safety Harness

**Attention!****Safety harness and the complete safety equipment**

Never expose to acids/caustic chemicals. If this is unavoidable, rinse with water immediately afterwards.

Protect from sharp edges and sharp-edged objects.

Wash in warm water up to 40 °C and washing powder for delicate fabrics. Afterwards dry in the shade.

Store in a well-aired place out of direct sunlight.

The safety harness is used to protect personnel during the ascent to the nacelle of the WTG, during the descent from the nacelle of the WTG and, in combination with a lanyard (safety rope) and a fall arrest block, when carrying out work in areas where there is a danger of falling.

As a rule, the WTG is provided with two safety harnesses.

The safety harnesses and the entire safety equipment must be cleaned, cared for, maintained and stored in accordance with the manufacturer's instructions.

Follow the manufacturer's instructions when putting on the safety harness.

6.2.1 Putting on a Standard Safety Harness – Example 1

The safety harness is put on as follows:

1. Hold the safety harness by the arrest eyelet (1). The leg loops (2) hang down.
2. Put on the shoulder straps (3) like rucksack straps. The arrest eyelet (1) rests on your back with the plastic plate.
3. Pass the loose leg loops (2) around the thighs from the inside towards the outside.
4. Insert the leg loops (2) in the belt buckle (4) and pull them tight.
5. Push the free ends of the belt into the belt loops (5).
6. Lock the narrow chest harness (6).
7. Adjust the belt using the central belt adjustment (7) until it fits correctly.

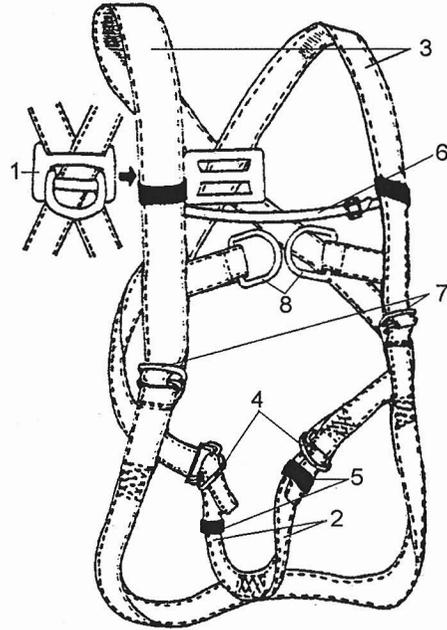


Fig. 1: Safety harness

6.2.2 Putting on the Safety Harness – Example 2 - RKA 18

1. Hold up the harness by the arrest eyelet on the rear, so that it can be opened out.
2. Pull the harness slightly apart by the orange shoulder straps. At the same time, the back ring moves away from you.



Fig. 2



Fig. 3

3. Pull the orange shoulder straps over your shoulders without twisting the belt straps.



Fig. 4



Fig. 5

4. Place the blue leg loops around the thighs and pull the ends of the blue belt straps with frames through the frames of the ends of the orange belt straps.

Care must be taken that the leg loops are adjusted in such a way that the open hand can be pushed between the belt straps and the thighs!



Fig. 6



Fig. 7



Fig. 8

5. When adjusting the leg loops, first of all pull the belt strap taut from the rear to the front, so that a loop forms. Then pull the loop through the fastening by the loose end of the blue belt strap.



Fig. 9



Fig. 10

6. After adjustment of the leg loops, lock the breast strap with the plastic snap buckle.



Fig. 11

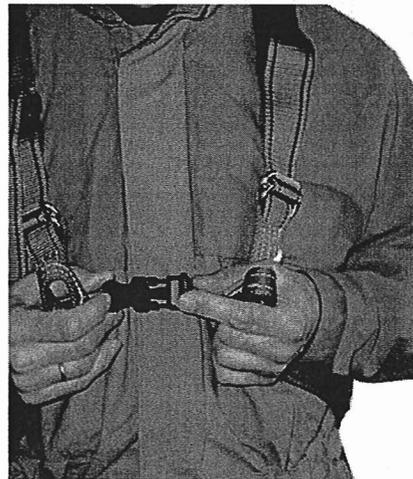


Fig. 12

7. The breast strap is adjusted in the same way as for the straps for the legs: the belt material is first pulled taut through the frame from the rear to the front, so that a loop forms. The loop is then pulled tight by pulling on the free end of the belt strap.

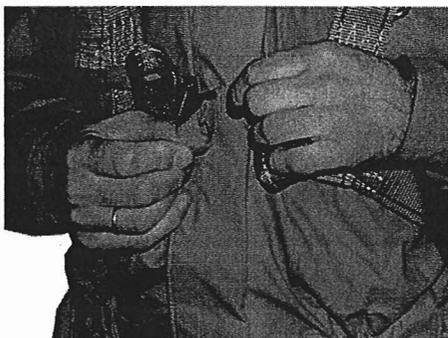


Fig. 13

8. Adjustment of the shoulder straps.  
Pull the shoulder straps taut at the sliplock buckle from the rear to the front, so that a loop forms at the sliplock buckle.



Fig. 14

9. The harness must fit comfortably, i.e. although the belt material must be pulled taut, it may not restrict the freedom of movement and may not pinch.



Fig. 15

10. Ensure that the straps for the legs are located under the buttocks at the rear and that the back distribution plate is arranged in the center of the back. The shoulder straps may not slide down during movement. The arrest eyelets must be located in the center on the breastbone.



Fig. 16

### 6.2.3 Putting on the Safety Harness – Example 3

1. Hold the safety harness in such a way that you can see in which way it is going to be put on at a later stage.

(Fig. 17)

Ensure that the loops are not twisted.



Fig. 17: Preparing the safety harness

2. Insert your arms through the yellow shoulder straps and place the safety harness on your shoulders like a rucksack.

(Fig. 18 and Fig. 19)



Fig. 18: Insert your arms through the shoulder straps

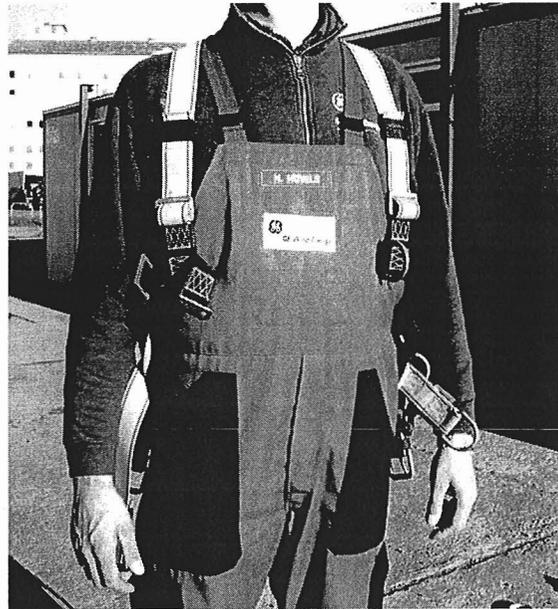


Fig. 19: Safety harness on the shoulders

**3. Closing the stomach strap**

Take the two loops positioned at stomach height. Pull the right-hand loop (1) through the eyelet (2) and guide the end of the loop through the rectangular frame (3). (Fig. 20)  
Adjust the strap to ensure a close fit.

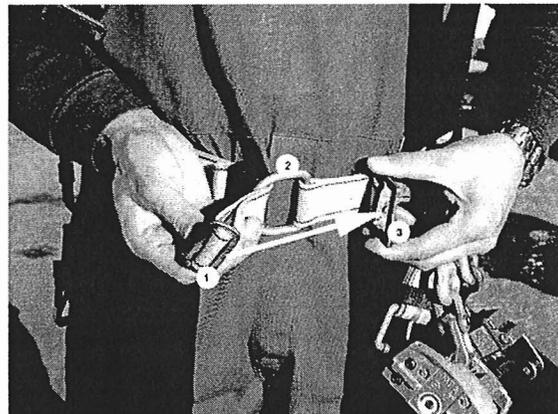


Fig. 20: Closing the stomach strap

**4. Closing the chest strap**

Take the two straps positioned at chest height. (Fig. 21)  
Pull right-hand strap (1) through the eyelet (2) and insert its end through the rectangular frame (3) also located on the right-hand strap.  
Adjust the strap to ensure a close fit. (Fig. 22)

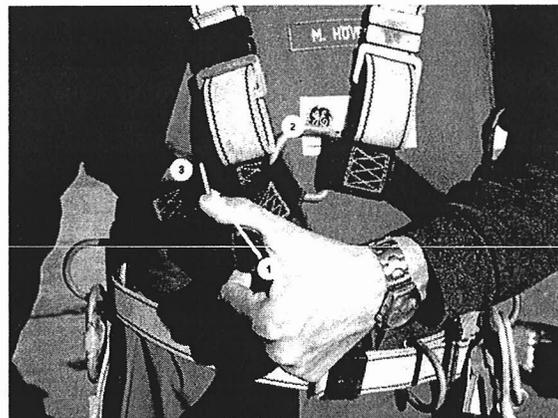


Fig. 21: Closing the chest strap

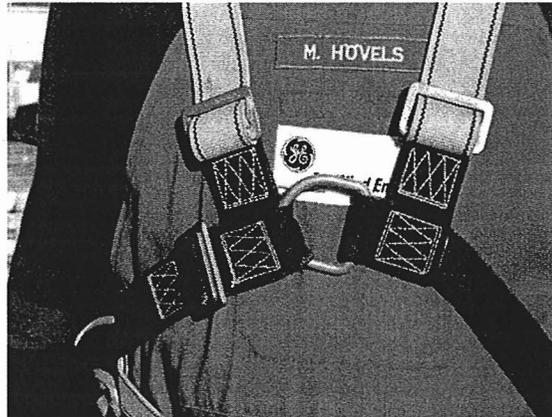


Fig. 22: Closed chest strap

**5. Closing the leg loops**

Push both loose leg loops from behind through the legs and to the front.

Pull the leg loops through the strap closure and pull the leg loops tight. (Fig. 23)



Fig. 23: Closing the leg loops

6. Check that all straps are straight and close fitting and that the buckles are closed correctly.  
(Fig. 24)



Fig. 24: Safety harness correctly fitted

#### 6.2.4 Travelling Safety Hook

As a rule, the WTG is provided with two travelling safety hooks, which are stored together with the safety harness.

The manufacturer's instructions for use of the travelling safety hook are to be followed.

In combination with the safety harness, the travelling safety hook is a safety device for ascending/descending the tower via the ladder. Should somebody slip off the ladder, the travelling safety hook clamps on tightly to the safety rail and prevents a fall. The system consists of a fixed guide, fastening elements, and a travelling arrestor device. A steady straight-line ascent and descent of the ladder without the user leaning back in the harness is best way to ensure that the travelling safety hook runs freely.



**Warning!**

**Beware of hand injuries!**

A free running travelling safety hook can crush your hands if you grasp the device or the safety rail.

Keep your hands on the sides of the ladder during the ascent/descent.

Using the travelling safety hook

1. Insert the travelling safety hook into the retaining eyes of the safety harness.
2. Push the travelling safety hook into the guide rail mounted on the ladder.
3. Ascend and descend the ladder slowly and carefully.



Fig. 25

6.3 Protective Equipment for Measurements on Live Components



Danger!

**Danger! Electricity!**

Contact can cause extremely serious injuries and even death.

**Life-threatening hazard!**

Special PPE is required for measurements on live components. This provides protection against electricity flowing through the body, e.g. as a result of touching live components in operation. Furthermore, it provides protection against accidental arcs caused by insulation breakdowns e.g. as a result of switching operations under load.

There are 5 danger classes, which require different protective clothing.

Danger class	Cal/cm <sup>2</sup>	Clothing
0	1.2	Untreated cotton
1	5	Fire-resistant shirt, fire-resistant trousers
2	8	Cotton underwear, fire-resistant shirt, fire-resistant trousers
3	25	Cotton underwear, fire-resistant shirt, fire-resistant trousers, fire-resistant overalls
4	40	Cotton underwear, fire-resistant shirt, fire-resistant trousers, fire-resistant overalls, double-layer protective jacket and trousers

Cal/cm<sup>2</sup> denotes the unit up to which the PPE resists the released energy.

A hard hat with a full-face visor and safety gloves are also required for each danger class.

## 6.4 Hooking Points

As a rule, the hooking points are marked in yellow and are designated with a statement of the permissible safe work load. These hooking points are to be used with a safety harness and lanyard with a fall arrest block to provide protection in areas where there is a danger of falling.



Attention!

### Exchange of the rail

The nose cone rail and nacelle rail must be exchanged after any fall!

## 6.5 Abseiling Device

Not all wind turbine generator systems are supplied with an abseiling device. There is sometimes only a certain number of devices, especially in larger wind farms.

The abseiling device (e.g. abseiling device AG 10 K – RK Sicherheitstechnik) has a rope which is long enough for the respective height of the tower of the WTG.

The abseiling device is stored in a lead-sealed equipment bag, which is located in a net beside the hatchway to the roof of the nacelle.



Fig. 26: Equipment bag in the net

The abseiling device is used by the personnel to abseil from high workplaces. It is not a fall arresting device, instead it is used primarily for the rescue of personnel in the event of an accident or fire. In case of fire, it can be used to abseil from the roof of the nacelle of the WTG as a 2nd escape route.

As a rule, the hooking points for the abseiling device are marked in yellow and are designated with a statement of the permissible safe work load. The abseiling device is attached to the hooking point by means of a snap hook or to the roof rail by means of a sling rope and a snap hook.



Attention!

#### **Danger of accident with a defective abseiling device!**

**In an emergency, your life could depend on the abseiling device working properly!**

As a result, check the integrity of the seal of the equipment bag on each visit to the nacelle. The abseiling device is pre-assembled and is ready for use immediately after it has been removed from the equipment bag.

Carry out an additional visual inspection of the abseiling device immediately before use.



It is easy to operate the abseiling device incorrectly in emergency situations. As a result, ensure that you know how to operate the device and are familiar with the abseiling operation. Please also read the operating manual.

This is the only way to ensure that the correct maneuvers are carried out in an emergency.

### **6.5.1 Abseiling from the Roof of the Nacelle**

Abseiling can take place individually or in pairs. The abseiling device may be loaded with a maximum of 225 kg up to a rope pitch of 100 m. Abseiling takes place at a speed of 0.7 m/s. The abseiling speed is regulated by means of a centrifugal brake.

A typical abseiling operation is described in the following. The procedure described may vary depending on the abseiling device. As a general principle, always follow the instructions of the manufacturer of the respective abseiling device!

1. Put on your safety harness correctly.
2. Secure yourself against falling by means of the lanyard. Step out on the roof of the nacelle.
3. Close the roof hatch.
4. Break the lead seal on the equipment bag.
5. Remove the abseiling device from the equipment bag.

Leave the rope in the equipment bag.

6. Attach the abseiling device to the roof rail of the nacelle by means of the sling rope and the snap hook.
7. Secure the snap hook with the clamping nut.
8. Throw down the equipment bag with the rope.

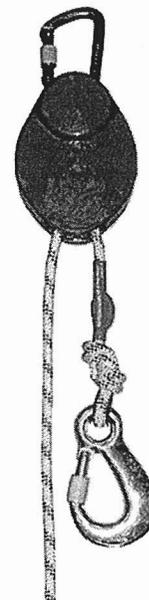


Fig. 27: Abseiling device

9. Check the condition and the correct functioning of the device.
10. Check the rope for loops and knots.



**Danger!**

**Interruption of abseiling through loops or knots!**

Loops or knots in the rope prevent abseiling, since the rope cannot run through the abseiling device if it has a knot. As a result, always check the rope carefully!

**REMOVE ALL LOOPS AND KNOTS FROM THE ROPE BEFORE YOU START ABSEILING!**

11. Hook the snap hook on the short end of the rope into the two textile chest rings of your safety harness.
12. Sit in front of the roof rail on the edge of the nacelle.
13. Ensure that the length of rope between the chest rings of your safety harness and the abseiling device is pulled taut.
14. Release the lanyard attached for your safety.
15. Slowly put your weight on the rope of the abseiling equipment.

After you have let go of the nacelle and the roof rail, you will abseil at a speed of 0.7 m/s.

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16. After you have reached the ground, immediately release the snap hook from the chest rings of your safety harness.
17. A second person waiting on the roof can then hook in the snap hook of the end of the rope which is now at the top and abseil as described.  
The rope may have to be pulled through until the snap hook arrives at the top.
18. The device must be inspected by a technically competent person after a rescue or an abseiling exercise.

### 6.5.2 Care and Maintenance of the Abseiling Device

The textile components of the abseiling equipment may only be cleaned by the manufacturer.

If damage to the rope, snap hook or abseiling device is discovered, the escape equipment must be withdrawn from use and inspected by the manufacturer.

Under normal service conditions, a service period of 4-6 years can be assumed for the textile ropes.

The abseiling device must be inspected by a technically competent person or by the manufacturer after a rescue or an abseiling exercise or at the intervals recommended by the manufacturer at the latest.

## 6.6 Fire Extinguishers (optional)

Fire extinguishers are optional in the wind turbine generator systems (WTG). If fire extinguishers are supplied, the WTG is normally provided with a fire extinguisher in the tower and in the nacelle.



The locations of the fire extinguishers are identified by this sign.



### **Danger: Electricity!**

De-energize the installation before using the fire extinguisher.

After actuation of the medium-voltage circuit-breaker, keep a safe distance of at least one meter from the fire when extinguishing!

**The fire extinguisher may only be used on electrical installations up to 1000V!**



Ensure that you are familiar with the function and the operation of the fire extinguisher. Only thus can you act quickly and purposefully in emergency situations.

The use of fire extinguishers must be practiced. The personnel deployed in the WTG must therefore be trained in fire-fighting at regular intervals.

The fire extinguishers must be regularly inspected by a technically competent person in accordance with the national regulations. A record of the check with the date must be permanently affixed to the appliance in an easily visible location. The directions for use (on the fire extinguisher) must be followed before fire-fighting.

6.6.1 Operating principle of the fire extinguisher - An example

As a general principle, always follow the instructions of the manufacturer of the respective fire extinguisher.

1. Remove the safety tab (1).
2. Press down the fire-extinguishing button (2).
3. The perforating disk of the CO<sub>2</sub> cylinder (3) is opened and the CO<sub>2</sub> released for charging the tank. The appliance is ready for use.
4. The extinguishing agent, which is under pressure, flows through the riser pipe (4) to the valve armature.
5. After the fire-extinguishing button has been pressed, the extinguishing agent flows through the hose line to the spray fog nozzle (5).
6. The jet of extinguishing agent can be interrupted at any time by releasing the fire-extinguishing button.

(Contents of the fire extinguisher: 5 kg)

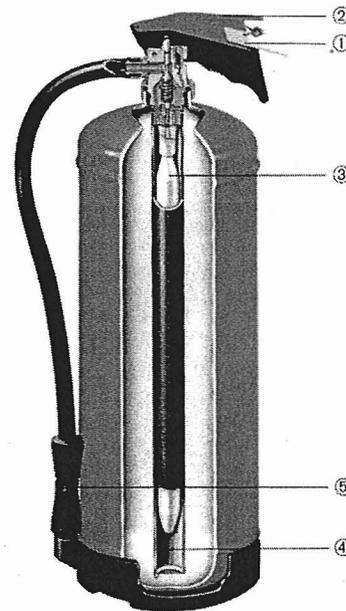


Fig. 28: Fire extinguisher - An example

6.6.2 Types of Fire Extinguisher

		Substances to be extinguished			
		Solid, glowing substances	Liquid substances or substances becoming liquid	Gaseous substances, also under pressure	Flammable metals (use only with a powder nozzle)
Types of Fire Extinguisher	Dry powder extinguisher with ABC dry powder	+	+	+	-
	Dry powder extinguisher with BC dry powder	-	+	+	-
	Dry powder extinguisher with metal fire powder	-	-	-	+
	Carbon dioxide fire extinguisher	-	+	-	-
	Water extinguishers (also with additives, e. g. wetting agent, antifreeze or corrosion inhibitor)	+	-	-	-
	Water extinguishers with additives which also extinguish liquid substances or substances becoming liquid in combination with water	+	+	-	-
	Foam extinguisher	+	+	-	-

## 6.7 First Aid

First aid is used for the initial treatment of an accident victim until the arrival of a doctor or until transport to a hospital, in order to avert a life-threatening situation or to prevent secondary injury.



There is a legal obligation to carry out rescue measures provided that this is possible without considerable self-endangerment.

The plant may never be entered alone, so that a second person can send an emergency call. If the interphone has a landline connection, the emergency call can be made via the interphone. An operational cellphone is to be carried at all times, in order to be able to ensure rapid assistance in an emergency.

Proceed as follows in the case of an accident:

1. Keep CALM!
2. In the case of serious accidents and injuries, notify a rescue-center by interphone or cellphone.
3. Render first aid immediately.
4. Secure the scene of the accident.
5. Report all accidents (near-accidents, minor accidents, serious accidents) to your immediate supervisor. Also notify the EHS department of GE Energy.



ATTENTION!

**Keep access to the WTG clear!**

The access roads to the plant must be kept clear at all times and be negotiable by car, in order to guarantee rapid and problem-free first aid in an emergency.

### First Aid Box (Optional)

The provision of wind turbine generator systems (WTG) with first aid boxes is optional.

A first aid box is located in the nacelle of the wind turbine generator system for the treatment of minor injuries. Any material removed is to be replaced immediately after use.



This sign identifies the location of the first aid box in the nacelle.

## 7 Safety Devices

The safety devices of the WTG comply with the requirements of the following standards:

- DIN EN ISO 13857: 2008 - 06 – Safety distances to prevent danger zones from being reached by the upper limbs and lower limbs.

The unauthorized removal or the overriding (by-passing) of safety devices is a punishable offence. Any liability claim is invalid in the case of damage.

Any point at which danger can arise and all drive units are provided with protective covers, which can only be undone and removed by means of tools. These protective covers may only be removed by qualified staff and only for the performance of service and maintenance or repair work. The protective covers are to be refitted immediately after completion of the work.

The owner / user of the WTG and the personnel deployed by him for operation, maintenance and repairs bear the responsibility for an accident-free work process.

### 7.1 Emergency Stop Pushbuttons

Any power-operated work equipment with dangerous movements must have one or - if necessary - several emergency control units for the prevention or reduction of an imminent or arisen danger, by means of which the dangerous movements can be stopped or rendered ineffective in another manner.

The emergency stop pushbuttons are not dependent on electronic logic.

Emergency stop pushbuttons (red mushroom pushbutton on a yellow base) are located on the control cabinet, the top box in the nacelle and the control cabinet in the hub.



Fig. 29: Emergency stop pushbutton



The EMERGENCY STOP pushbutton may only be pressed in situations, in which the safety of personnel or the WTGS and its components is threatened.

Pressing the emergency stop pushbutton causes the safety chain to open, and the rotor of the WTG is brought to a standstill via emergency braking. Initiation of the safety chain causes the rotor blades to travel to the feathering position in the [emergency] battery mode! In addition to this, the WTG is de-energized except for the control voltage.

### 7.2 Rotor Lock

The GE 1.5 series plants are equipped with two rotor locks.

### 7.2.1 Rotor Lock on the High-speed Shaft

The rotor lock on the high-speed shaft is located on the brake disk of the outgoing shaft of the gearbox. It must be engaged during all regular maintenance work on the drive train and for the physical inspection of the rotor hub.

Maintenance work on the drive train which requires the rotor shaft to be locked may only be carried out at wind speeds up to 15 m/s.

Maintenance work in the rotor hub may only be carried out at average wind speeds of less than 15 m/s. In this connection, the rotor lock on the high-speed shaft must be engaged. The rotor lock on the low-speed shaft **must not** be engaged.

If the turbine is unable to idle after a malfunction, the lock on the high-speed shaft must be engaged. It must be ensured that all three rotor blades are in the feathering position.

#### Engaging the Rotor Lock on the High-speed Shaft

1. Manual stop
2. Remove the locking pin of the rotor lock and advance the rotor lock as far as possible by means of the crank
3. If necessary, briefly actuate the "rotor brake" switch on the top box, in order to disengage the brake for a short time, thereby placing the brake disk in a better position.
4. Fully engage the rotor lock until the locking pin locks home again at the lower position.

### 7.2.2 Rotor Lock on the Low-speed Shaft

A lock is located on the rotor shaft flange of the low-speed shaft. This is only used for carrying out special work on the drive train. A sliding block or a sliding bolt which is guided in a fixture on the base frame is pushed onto the shaft flange in grooves or holes. The limit switch in the safety loop is opened as a result.

The rotor lock on the low-speed shaft may only be engaged up to the following average wind speeds:

- 8 m/s in the welded frame version up to 2004 (individual gusts up to a max. of 14 m/s)
- 12 m/s in the 1.5 xle (individual gusts up to a max. of 19 m/s).
- 15 m/s in the cast frame version and in the welded frame version from 2005 (individual gusts up to a max. of 24 m/s)

The current wind speed can be read on the SCADA display!

### Engaging the Rotor Lock on the Low-speed Shaft

1. Manual stop
2. Manually turn the blades to the 0 degree position
3. Position the rotor to engage the lock
4. Engage the rotor lock on the high-speed shaft
5. Actuate the service switch to disconnect the battery in the rotor hub
6. Engage the rotor lock on the low-speed shaft
7. If necessary, release the lock on the high-speed shaft after leaving the hub.

If the wind unexpectedly freshens, any installation work must be ended immediately, and the rotor lock must be disengaged in the reverse sequence.



**ATTENTION!**

**Leaving the WTG with the rotor lock applied is strictly prohibited!**

## 7.3 Emergency Lighting

In the case of a power failure, emergency lighting provides light in the tower and the nacelle. The emergency lighting is equipped with an independent power supply (battery), which provides voltage for the lamps for approx. one hour after a power failure. The WTG must be left immediately if the emergency lighting is activated as the result of a power failure.

## 8 Residual Risks

Even if all the safety requirements are complied with, a residual risk remains during operation of the GE Energy 1.5 Series wind turbine generator systems.

Anyone who works on and with the WTG must be aware of these residual risks and follow the instructions which prevent these residual risks from resulting in accidents or damage.



**Danger!**

### Danger of injury during ascent!

The full-body safety harness must be put on and attached to the safety rail by means of the travelling safety hook during the ascent to the nacelle, in order to prevent the person ascending from falling. Any oil or grease deposits on the ladder must be removed immediately to prevent anyone from slipping while using the ladder.

Ensure that your footwear is clean!



**Warning!**

### Falling objects hazard warning!

An object may be unknowingly and unintentionally dropped and hit and cause injury to somebody.

For this reason, only one person at a time may climb a section of the ladder between two platforms. The hatch covers must be closed again immediately after they have been passed through.



**Danger!**

### Life-threatening hazard - working under suspended loads!

Never stand under suspended loads.



**Danger!**

### Danger of falling from the nacelle!

The nacelle has a roof hatch for accessing the hub. You are exposed to strong winds when climbing out through the hatch. Attach your lanyard to the outside rail from inside the nacelle. Climbing out is only allowed at wind speeds up to 15 m/s.

As a general principle, there is a falling hazard at all higher locations / workplaces.

## 8.1 Special Dangers – Electric Power

Note the following rules when carrying out any work on the electrical components of the plant, e.g. assembly, connection, opening of a device, maintenance:

1. DISCONNECTION
2. SECURE against re-connection
3. Ascertain safe isolation from supply
4. Ground and short-circuit
5. Cover up adjacent live components or provide them with barriers

In addition, ensure that all drives are at standstill.



### Caution! Danger from electrical voltage!

When switched on, electrical installations and machinery have live exposed conductors or rotating parts. They could therefore cause personal injury or death and material damage if the cover and the prescribed safety devices are removed, or in the event of incorrect handling and maintenance and in the case of improper use. The above stated safety regulations must therefore be complied with, particularly when removing a cover.

In addition to this, electrical energy is still present in devices with power electronics even after the supply voltage to the device has been switched off. These devices are secured against unauthorized access. After waiting an appropriate time for the device to discharge (e.g. capacitors), always check for residual voltage before starting work.

FOLLOW THE RESPECTIVE LOCKOUT/TAGOUT INSTRUCTIONS! (cf. Chapter 13)

In the case of malfunctions of the energy supply of the wind turbine generator system, actuate the EMERGENCY STOP button immediately if the plant has not already been switched off by the automatic control system.

Only use original fuses with the prescribed amperage!

In the case of repairs, care should be taken that design features are not modified, so that safety is compromised (e.g. leakage distances and sparking distances in air) and that distances are not reduced by insulation materials.

As a general principle, maintenance work may only be carried out by two persons, so that the second person can actuate the EMERGENCY STOP button in an emergency.

Only use insulated and approved tools.

The control system and interlocking as well as the monitoring and protective functions (thermal motor protection, speed monitoring, overcurrent, fault to ground, etc.) may not be set out of function, even during a test run.

## 8.2 Special Dangers – Hydraulic System

For maintenance work on the hydraulic system, maintenance staff must be completely acquainted with the hydraulic circuit diagram and must have been instructed about its function and the possible consequences of an operating error.

Prior to any work on the hydraulic accumulators, it must be ensured that the accumulator circuits have been depressurized. The shut-down device is clearly marked and independent of the system management.



Danger!

**Danger through stored residual hydraulic energy!**

FOLLOW THE RESPECTIVE LOCKOUT/TAGOUT INSTRUCTIONS! (cf. Chapter 13)

## 8.3 Special Dangers - Noise

The A-weighted equivalent continuous sound intensity level in the tower and the nacelle exceeds the permissible 70 dB(A) during operation. For some work, it may be necessary to place the WTG in operation or carry out a test run while personnel are in the nacelle.



**Anybody carrying out work in the tower or the nacelle when the WTG is in operation must wear hearing protection as part of their personal protective equipment.**

## 8.4 Special Dangers - Icing

### 8.4.1 Ice Build-up on the Rotor Blades

Ice build-up on wind turbine generator systems (WTG) and, in particular, the shedding of ice from rotor blades can lead to problems if wind turbine generator systems are planned in the vicinity of roads, car parks or buildings at locations with an increased risk of freezing conditions, unless suitable safety measures are taken.

If people or objects near the wind turbine generator system (within the distance **R\***) could be endangered by pieces of ice thrown off during operation, GE Energy always recommends the use of an ice detector.

The ice detector is installed on the nacelle. It is possible to detect the build-up of a small amount of ice by means of the ice detector. If this is the case, the ice detector sends a signal to the turbine controller. The turbine controller disconnects the wind turbine generator system from the grid and the rotor is brought to a standstill or rotates at a very low speed. A message about the icy condition is displayed on the monitor in the turbine. In addition, a message is sent to the service station and the operator via modem. The turbine does not

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restart until the detector is free of ice or the operator has satisfied himself of the ice-free condition of the rotor blades, has acknowledged the ice alarm message and restarts the plant.

However, ice may form on the rotor blades considerably more quickly than on the ice sensor on the nacelle. As a result, there is a residual risk for the reliable detection of ice build-up on the rotor blades.

The detector on the nacelle must be set relatively sensitively, in order to ensure that the time from when ice starts to build up on the rotor blades until the detector sends a message about the build-up of ice is as short as possible. As a consequence, a certain number of spurious trippings cannot be excluded. Loss of energy yield may occur as a result of the spurious trippings.

If an ice detector is not used, it is advisable to cordon off an area around the wind turbine generator system with the radius  $R^*$  during freezing weather conditions, in order to ensure that individuals are not endangered by pieces of ice thrown off during operation (cf. also Section 11.1).

$*R = 1.5 \times (\text{hub height [m]} + \text{rotor diameter [m]})$   
(Recommendation of the German Wind Energy Institute DEWI 11/1999)

#### 8.4.2 Icy Condition of the Access Route

During the winter months, access to the plants may be very slippery due to ice or hard-packed snow. There is an increased danger of slipping.

cf. Section 11.1 on approaching and entering WTGs which may be frosted.

#### 8.4.3 Icy Condition of the Tread of the Steps outside the Nacelle

In the winter months, the tread of the steps outside the nacelle can be icy as a result of ice and hard-packed snow.

### 8.5 Exceptional Dangers - Earthquakes

In the case of an earthquake, the operator must inspect the WTG for damage. The following procedure is recommended:

- Determination of the acceleration values in the tower top which arose during the earthquake (PCH BOX).
- Contact GE Energy, in order to agree on the further procedure and possible inspection schedules.

## 9 Safety Information for Individual Plant Components

### 9.1 Downtower Assembly

The downtower assembly is the electrical cabinet lineup consisting of:

- Power distribution cabinet (PDC)
- Converter filter cabinet (CFC)
- Converter bridge cabinet (CBC)
- Main control cabinet (MCC)



**Danger!**

#### **Caution! Danger from electrical current!**

All personnel remaining in the WTG must be located between the person carrying out the measurements and the tower entrance during voltage measurements on the low voltage main distribution or on the low voltage main control panel.



**Danger!**

#### **Attention! Check the work area / control cabinet before completion of the work!**

Remove all loose parts, tools and materials from the control cabinets. Tools and materials left in the control cabinets lead to unsafe working conditions for the service technicians when the plant is put into operation again.

Close and lock the control cabinets before returning to service.

### 9.2 Anemometer and Wind Vane

The anemometer and the wind vane are intensely heated in WTGs with cold weather equipment!



**Attention!**

#### **Hot surface!**

Disconnect the anemometer and the wind vane from the supply and allow both to cool down prior to maintenance.

Physical contact may cause burns.

### 9.3 Top Box

The top box is the electrical cabinet that resides in the nacelle. The main purpose of the top box is to distribute power to the up-tower wind turbine components.



**Caution! Danger from electrical current!**

All personnel remaining in the WTG must be located between the person carrying out the troubleshooting and the nacelle exit during voltage measurements.



**Attention! Check the work area / control cabinet before completion of the work!**

Remove all loose parts, tools and materials from the cabinet. Tools and materials left in the control cabinets lead to unsafe working conditions for the service technicians when the plant is put into operation again.

Close and lock the control cabinets before returning to service.

## 10 Conduct in Emergency Situations

### 10.1 Conduct in Case of Fire

In principle the WTGS consists of fire-resistant materials. However



**Fire, naked flames and smoking are prohibited!**

If a fire does occur, however, **call the fire department immediately!**

State the following information:

- Name of the person calling
- What is on fire
- Where the fire is located (seat of the fire / location of the plant)  
(You will find the site coordinates on the nameplate)
- Wind direction and wind strength

Note the following information in the case of fire:

- Saving lives has priority over fire-fighting
- Alarm all personnel who are in the WTG

- Use the escape routes described in Chapter 10.2 – ensure that you are familiar with the various escape routes.
- Do not use the hoisting passenger suspension device.
- Burning debris can be expected to fall down if there is a fire in the nacelle or the upper part of the tower.
- If the wind turbine generator system is still in operation, it must be stopped and a large area around the plant cordoned off.
- Close the door of the plant.

### 10.1.1 Fire-Fighting

Fire-fighting may only be carried out by immediately fighting an initial fire using the fire extinguishers available in the plant. The locations of the firefighting equipment in the tower and the nacelle are marked.

If the initial fire cannot be extinguished within a short time, abandon any further attempts to extinguish the fire and call the fire department immediately.

In addition to the direct danger from the fire, a combustion toxicity hazard and the danger of asphyxia could also arise. As a result, move in a crouched position if smoke develops and also crouch down when attempting to extinguish the fire.



**Danger!**

#### **Attempts to extinguish a fire may lead to very serious burns!**

Do not make any attempts to extinguish the fire, since the appropriate fire-fighting methods cannot normally be carried out without restrictions (minimum clearances cannot be adhered to). Very serious burns could be the result.

### 10.1.2 Fire in the Tower - Person in the Nacelle

- Leave the WTG immediately via the second escape route (cf. Chapter 10.2).
- Abseiling device in the nacelle - emergency exit using the abseiling device

### 10.1.3 Fire in the Nacelle - Person in the Nacelle

- Attempt to extinguish the fire.

If unsuccessful:

- Leave the danger area immediately via the first escape route (cf. Chapter 10.2).
- Do **not** use the hoisting passenger suspension device.
- Do **not** use the abseiling device.

### 10.1.4 Fire in the Transformer



**Danger!**

Do not make any attempts to extinguish the fire – High voltage!  
Conventional fire extinguishers are not suitable.

- Leave the WTG immediately.

In the case of transformers in the tower:

- Leave the WTG via the second escape route

In the case of transformers in the transformer station:

- Leave the WTG via the first escape route

Fire-fighting may only be carried out by trained personnel.

## 10.2 Escape Routes



**Attention!**

**Keep escape routes clear!**

The escape and rescue routes must be free of obstructions (tools, equipment, rubbish, etc.), in order to ensure that the turbine can be evacuated as quickly as possible in an emergency.

### 10.2.1 First Escape Route

In case of fire, leave the plant immediately. The first escape route from the nacelle is down the ladder in the tower. The descent is facilitated and made safer by resting platforms every 6 m. Do not use the hoisting passenger suspension device.

### 10.2.2 Second Escape Route

If the descent through the tower is no longer possible, use the second escape route. (Abseiling with the abseiling device). This either leads over the roof of the nacelle (hooking point on roof rail) or through the emergency descent hatch which may be present (hooking point directly beside the winch in the nacelle, which is also present in this case).

#### **Correct use of the abseiling device:**

- Put on your safety harness correctly.
- Secure yourself against falling by means of the lanyard.



Danger!

#### Use of the abseiling device!

Your life could depend on the correct use of the abseiling device.

The abseiling device can also be used by two people to abseil.

Read the instructions before beginning the abseiling operation!

### 10.3 Information for Rescue and Emergency Personnel

The rescue services and the emergency personnel must be equipped with their own personal protective equipment (safety harness, etc.). The rescue/emergency personnel must bring with them all the equipment required for rescuing personnel from the hub, nacelle or tower.

The information stated in this safety manual must also be read by the rescue / emergency personnel.

### 10.4 Oil Spill – Immediate Measures

The objective of the immediate measures is to prevent or at least to contain a further uncontrolled escape of water-endangering substances and keep the areas of threatened or contaminated soil as small as possible, under consideration of safety engineering requirements.



Inform yourself about the oils used beforehand. The safety data sheets provide details of Water Hazard Classes and suitable measures for combatting oil pollution.

#### Measures

1. Decide and act quickly, so that the amount of oil reaching the environment is kept as small as possible.
2. Prevent further discharge (closure of valves, temporary sealing of cracks and holes, e.g. by means of sealing rags, sealing bags, sealing wedges, collection in containers, pumping out, transfer, etc.)
3. Bind the discharged oil – use approved oil binding agents and oil binder mats if the oil could not be pumped out or skimmed off in time. The damage can be limited by means of collecting containers, rolled foils and a shovel.
4. Prevent the oil from getting into the soil or bodies of water.
5. Remove contaminated soil.
6. Take the contaminated oil-absorbing materials to a local specialist waste disposal company for material recovery/conversion to energy or disposal. The national regulations are to be complied with.

## 11 Remaining in and on the Wind Turbine Generator System



Attention!

### Fire Hazard!

The storage of combustible or highly inflammable materials in the wind turbine generator system **is not allowed**.

Personnel may not remain inside the WTG, and maintenance or repair work may not be carried out in or on the WTG under power supply. There is a danger of accident and a danger to life and limb. In order to prevent accidents, the following actions are to be carried out in the following order before and on entering the wind turbine generator system:

1. Shut down the WTG and secure against an unauthorized return to service
2. Put on the personal protective equipment
3. Disable the power supply for the work to be carried out – carry out corresponding Lockout/Tagout instructions (cf. Chapter 13)

Staying in the WTG while it is in operation is unavoidable in the case of certain maintenance and repair work. In such cases, particular care is called for and hearing protection must be worn.

In addition, the following safety regulations are to be complied with without fail:

- As a general principle, no person may stay in the WTG during a gale or a thunderstorm! If a thunderstorm comes up, the WTG must be left immediately.
- The WTG may only be entered in the company of a second person who can provide assistance or call for help in the case of an accident.
- The entrance door to the tower must be kept closed. Only in this way can the door be prevented from flying open and getting warped.
- Long open hair, loose clothing (e.g. flapping coats, tops with wide sleeves or trousers with wide legs) and scarves, ribbons, headscarves or jewelry may not be worn in the WTG! There is a fundamental danger of injury as a result of getting caught, trapped or drawn in by rotating elements! Clothing must always be tailored to suit the respective work and the weather conditions.
- Switch-on and shut-down procedures in accordance with the operating manual are to be complied with for all work which concerns the operation and adjustment of the WTG and its safety equipment.
- If any changes in the operating characteristics which are relevant to safety or any faults arise in the WTG, it must be shut down immediately and the event reported to GE Energy or the customer (if a maintenance contract has not been concluded with GE Energy).

## 11.1 Approaching and Entering Frosted Wind Turbine Generator Systems

Before parking near the turbine, stop approx. 350 m from the turbine and check the rotor blades for ice by means of binoculars and the sound of the rotation of the blades. If the turbine is running and ice is present on the rotor blades, call for a remote stop.

Once the blades have come to a complete standstill, verify that none of the blades is located over the entrance door of the turbine. If this is the case, call for a remote traverse of the yaw drive in any direction, so that the rotor is positioned on the side of the turbine opposing the door. As soon as the rotor is correctly positioned, call for a remote stop of the yaw drive and ask for confirmation of this operation.

Once the above conditions have been complied with, park your vehicle at a safe distance from the WTGS (at least 100 m). Watch out for falling ice as you approach the tower. If the wind is blowing against the opposite side of the door (or into the rotor at this point), you must proceed with extreme caution, since falling ice could be blown in your direction.



**Warning!**

### **Danger of slipping as a result of icy conditions!**

There is danger of slipping as a result of the frozen ground and ice on the foundation and the stairs.

Sprinkle de-icing salt or sand over the foundation.

Use the handrail when going up the stairs.

Leave the immediate vicinity of the WTG after completing your work. Watch out for falling ice. Get into your vehicle. Do not call for a remote re-activation of the yaw drive and restart of the turbine until you are approximately 350 m away from the WTG.

## 11.2 Shut-down of the Wind Turbine Generator System

Before starting any service work, the wind turbine generator system must be deactivated. Proceed as follows:

1. Contact any remote monitoring groups that are supervising the site (before entering the wind turbine)
2. Contact any site operators or maintenance people (before entering the wind turbine)
3. Temporarily disconnect the Mark VIe controller from the site SCADA network:
  - Locate the SCADA network switch in the down tower assembly that houses the SCADA network switch
  - Disconnect the two fiber pairs (RX-TX and RX-TX) from the switch, taking the turbine off the site network
4. Press the "Stop-Reset" button to shut-down the plant manually.
5. Set the key-operated switch to "Repair".



Follow lock-out-tag-out procedures to de-energize, lock-out and tag-out equipment to ensure that unit equipment is always put in a safe condition. Wind conditions must be continuously monitored manually if LOTO procedures used mean that the unit is not capable of moving to minimum load condition.



### Danger of accident!

The WTG must remain shut down as long as personnel are in the plant. Before it is returned to service by authorized personnel, check without fail that nobody is in the plant. Otherwise there is the danger of an accident!

## 11.3 Climbing the Tower

- Only persons who are physically fit and capable of coping with the ascent may climb the WTG.
- The WTG must be shut down and secured against unauthorized start-up before the tower is ascended. The WTG must remain shut down as long as anybody is climbing the tower or is on the tower platform.
- The entrance door to the tower must be kept locked, in order to inhibit access to unauthorized persons.
- In order to avoid accidents caused by falling objects, nobody may stand under the ladder while somebody is ascending the tower. Even a small screwdriver can cause very serious injuries if it drops from a great height.



**Danger!**

#### **Danger through falling objects!**

Falling objects can cause very serious injuries irrespective of their size and weight!

Never stay in the vicinity of the ladder while somebody is ascending or descending. The ladder may only be used by one person at a time. Only after this person has reached an intermediate platform and has closed the tower hatch or has reached the ground in the tower base and stepped back from the ladder may the next person approach the ladder.

- The safety harness must always be put on correctly before ascending the tower.
- Always check the safety harness and the entire safety equipment prior to use. Damaged PPE may never be used.
- Safety shoes and a hardhat must be worn when ascending the tower. Gloves must be worn if the tower is covered with ice.
- The maximum possible fall path must be kept to a minimum by means of rope-shortening devices or similar.
- Only use marked hooking points with an adequate load-bearing capacity.
- The tower may only be ascended by means of the ladder installed inside the tower or the hoisting passenger suspension devices/service platform which may be installed. (Follow the operating instructions of the manufacturer).
- The travelling safety hook must run freely in the rail while ascending and descending the tower. Never touch the travelling safety hook, otherwise there is a danger of injury!
- Both hands must be kept free during the ascent or descent. Tools, lubricants and other material may only be transported in a suitable bag. Permanent "3-point contact" with the ladder is only guaranteed by this means.
- Greater care needs to be exercised when climbing the ladder in wet conditions or if the tower is covered in ice.
- Only unhook the lanyard after you have reached the tower platform and the access hatch has been closed.
- Ensure that you are always protected by at least one lanyard with a fall arrest block.
- The rest platforms in the tower are fitted with hatches that must be kept closed at all times. The platform hatches must therefore be opened on reaching a platform and closed again immediately after crossing to the next section of the tower.

## **11.4 Deactivation of the Yaw Drive**

Yaw stop switches are located in the tower base, below the nacelle and on the top box in the nacelle. The yaw drive and the automatic nacelle adjustment are disabled in the "Off" switch position, so that the nacelle is technically prevented from moving if there is a change in wind direction.

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## 11.5 Crossing to the Nacelle

The yaw stop switch on the uppermost tower platform must be placed in the "Off" position before crossing from the tower to the nacelle. The yaw drive and the automatic nacelle adjustment are thereby disabled.

Depending on the position of the nacelle, the available simple ladder is hooked into one of the holders to prevent the ladder from slipping. Some of the WTGs are provided with a permanently installed extension ladder.

Hooking points are available in the vicinity of every platform.

## 11.6 Entering the Rotor Hub/Walking on the Roof of the Nacelle

The roof of the nacelle may only be accessed for entering the rotor hub and for carrying out work on the wind vane, the anemometer and the obstruction light.

Only trained or instructed staff are permitted to enter the hub or walk on the roof of the nacelle. The rotor hub may only be entered at maximum wind speeds up to 15 m/s. The rotor lock on the high-speed shaft (brake disk on the coupling) must be engaged before the rotor hub is entered.

1. Place the yaw stop switch on the top box in the "Off" position.
2. Turn the rotor to the "Y" position, so that the rotor hub can be entered.
3. Engage the rotor lock on the high-speed shaft.
4. Turn the rotor blades to the 85° feathering position.



Fig. 30: Rotor in the "Y" position



**Danger!**

**Life-threatening hazard through sudden start-up of the rotor if the rotor lock (brake disk on the coupling) on the high-speed shaft has not been engaged!**

Always engage the rotor lock on the high-speed shaft before entering the rotor hub.

FOLLOW THE RESPECTIVE LOCKOUT/TAGOUT INSTRUCTIONS! (cf. Chapter 13)



Warning!

Maintenance work inside the hub may only be carried out at maximum wind speeds up to 15 m/s!

Always engage the rotor lock on the high-speed shaft. Use of the rotor lock on the low-speed shaft or only the brake on the high-speed shaft for this purpose is prohibited.



Falling Hazard! Warning: strong wind currents!

Before climbing out of the nacelle enclosure through the roof hatch above the gearbox, the lanyard must be hooked on to the rail on the spinner.



Danger!

The roof rail is to be selected as a hooking point for all other work on the roof of the nacelle.

5. In the hub, place the battery maintenance switch and the pitch maintenance switch on all three axis cabinets in the "Off" position.

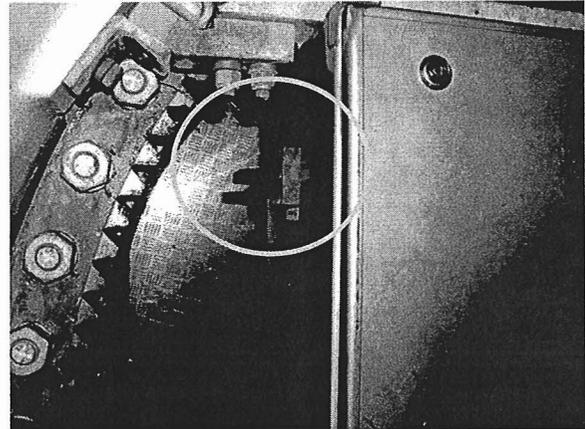


Fig. 31: Battery maintenance switch

6. Switch the pitch controller on the control cabinet to "Manual".

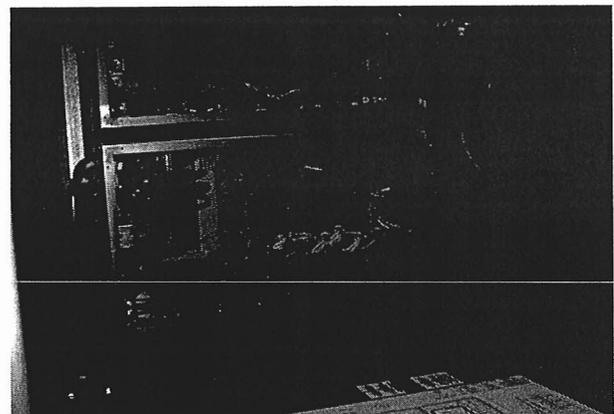


Fig. 32: Pitch controller

### Walking on the Roof with Ice and Snow

If you have to walk on the roof of the nacelle or climb into the hub, first of all ensure that the rotor blades are in the Y position before you open the hatch. Otherwise there is danger of injury from falling pieces of ice.



**Danger!**

#### **Danger of Slipping and Falling Hazard as a result of icy conditions!**

There is a high risk of slipping and falling if the roof of the nacelle and the spinner are covered by snow and ice.

Completely remove any snow and ice from the roof before walking on it. Sprinkle sand on the cleared areas

**Do not walk on the roof/spinner** if the snow and ice cannot be removed completely and the danger of slipping cannot be excluded.

## 11.7 Activation of the Wind Turbine Generator System



#### **Danger of accident!**

The WTG must remain shut down as long as personnel are in the turbine. Before it is returned to service by authorized personnel, check without fail that nobody is in the turbine. Otherwise the danger of an accident arises!

Proceed as follows to return the WTG to service:

1. Make an entry in the service life card of the WTG
2. Connect the Mark VIe controller to the site SCADA network:
  - Locate the SCADA network switch in the down tower assembly that houses the SCADA network switch
  - Reconnect the two fiber pairs (RX-TX and RX-TX) from the switch, putting the turbine on the site network
3. Set the key-operated switch to "Operation".
4. Check the alarm message panel in home web page for error messages
5. Press the "Stop-Reset" button and then the "Start" button.
6. Inform the remote monitoring division that wind turbine is back in operation
7. Inform the operator / customer that wind turbine is back in operation

## 12 Information on Maintenance and Troubleshooting

Only trained or instructed staff may be deployed!

Trainee personnel or personnel undergoing orientation or general training may only carry out work on the wind turbine generator system under the constant supervision of an experienced person.

Personnel must familiarize themselves with the work environment around the wind turbine generator system before starting work!

As it is possible to start the plant by means of the remote monitoring system, the WTG must be shut down for maintenance work as described in Chapter 11.2. In addition, the service switch on the control cabinet must be placed in the "Maintenance" or "Repair" position. Once the maintenance or repair work has been completed, the service switch must be returned to the "Automatic" position.

Maintenance/inspection of the cable winch in the tower is the responsibility of the operator and must be carried out in accordance with the operating and maintenance instructions of the supplier of the cable winch.

Time limits for recurring tests/inspections prescribed or stated in the operating manual must be adhered to.

Suitable workshop equipment is essential for carrying out maintenance measures.

Work on electric equipment of the WTG may only be carried out by a skilled electrician or by instructed persons under the guidance and supervision of a skilled electrician in accordance with the electrical engineering regulations.

Any safety equipment which has to be dismantled to carry out maintenance and repair work must be re-installed and checked immediately after the maintenance and repair work has been completed!

The wind turbine generator system, in particular the connections and bolted connections, must be cleaned of any oil, consumables and process materials, dirt or old preservative agents at the beginning of any maintenance/ repair / conservation work.

Only entrust experienced persons with the fastening of loads.

Individual components and larger modules which need to be exchanged must be carefully attached and secured to lifting gear, in order to minimize the danger that emanates from them. Only use suitable lifting gear and load suspension devices which are in a technically perfect condition and have an adequate load bearing capacity!

Follow the operating instructions of the winch manufacturer.

Never stay or work below suspended loads.

Use the specified or other safe ascent equipment and working platforms to carry out installation work above head height. Wear fall protection equipment when carrying out maintenance work at great heights. Keep all handles, steps, safety rails, platforms, stages and ladders free of dirt.

Ensure that consumables and process materials and replacement parts are disposed of safely and in an environmentally-friendly manner!

## 13 Power Disconnection and Isolation Procedures (Lockout/Tagout Instructions)

Pursuant to EN 50308, wind turbine generator systems must be equipped with devices to disconnect and isolate them from all their energy sources during inspection and maintenance work.

These disconnecting/energy-isolating devices are prescribed for all mechanical, electrical and hydraulic energy sources.

**GE Energy advises the plant operator/owner to develop specific procedures for the power disconnection and isolation of every individual subsystem.**

**Local and national regulations must be taken into account when developing workplace-specific Lockout/Tagout instructions.**

The disconnection/isolation points are marked in the plant-specific circuit diagrams and hydraulic schematics supplied with the respective WTG.

Procedures for the Lockout/Tagout of power disconnection and isolation devices must consider the following aspects:

### 13.1 Identification of Installations, Processes, Circuits

(Individual mechanical, electrical or hydraulic subsystems)

### 13.2 Preparation for Shutdown / Notification of Affected Employees

- All personnel who may be affected must be notified before Lockout/Tagout devices are installed and after they have been removed. In addition to this procedure, authorized employees must be aware of any additional safety requirements prescribed for working on this type of equipment.
- Affected employees who work on or near an installation which is about to be disconnected and on which Lockout/Tagout devices are to be mounted must be notified thereof.

### 13.3 Identification of Energy Sources and Strengths

### 13.4 Deactivation of Energy Sources and the Mounting of Energy Control Devices

- The power disconnection and isolation devices (e.g. disconnecting switches or load interrupter switches, valves etc.) must be positioned in such a way that they interrupt the energy flow to installations, processes or circuits. The authorized employees are obliged to mount and secure Lockout/Tagout devices to these. They must hereby ensure that the power disconnection and isolation devices are "locked out" until further notice and remain in their safety or "Off" position.

### 13.5 Control of Stored Energy



Attention!

**Residual risks from stored energy!**

PLEASE OBSERVE THE RESPECTIVE LOCKOUT / TAGOUT INSTRUCTIONS!

- The authorized employee must ensure that all potentially hazardous energy in any form (stored, residual, chemical or potential energy) is relieved, dissipated, contained, discharged or otherwise controlled. Additional measures may be necessary to prevent the re-accumulation or re-storage of energy, in order to protect personnel. Stored energy can form e.g. in batteries, capacitors, through gravity or in chemical lines.

### 13.6 Verification of Isolation

- The authorized employee must verify that the isolation and de-energization of the respective installation, process or circuit has actually been carried out before maintenance work may be started. The check must confirm that the installation, process or circuit has achieved a "zero" energy state. (Test equipment, circuit activation attempts, measuring devices, visual inspections, etc. can be used to verify the zero energy state.)

### 13.7 Reconnection of the Installation to the Supply

The authorized employee must carry out the following measures before returning the installation to service:

- Inspection of the work area to ensure that all items which are not required for the operation of the installation have been removed and that all the guards have been replaced, that the machine/installation, process or circuit is operational and that all personnel are in a safe location.
- Removal of all locks, tags and other Lockout/Tagout devices from all power disconnection and isolation devices by the authorized employee who previously attached these LOTO devices.
- Notification of affected personnel that the energy supply is about to be restored to the machine/installation, process or circuit.
- Visual inspection and/or cycle test to verify that the service or maintenance work has been successfully completed. Provided that the work has been completed, the machine/installation, process or circuit may be returned to service. Otherwise, the requisite procedural steps must be repeated.
- Correct sequential run-up of the installation, process or circuit.

WTG operators must ensure that suitable disconnection regulations are available for their plants and construction sites and that they are implemented. GE Energy has developed installation-specific Lockout/Tagout procedures for the activities listed below. This list does not claim to be complete, however. It may be advisable to develop additional procedures as a result of changes to installations or to comply with construction site-specific disconnection regulations.

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Service Jobs / Subsystems	Installations, Processes, Circuits
Gear box / gearing lubricant	Nacelle – protection of the gear lubricant flow
Work in the converter cabinet / on the generator	Isolation of converter cabinet from dangerous energy / isolation of generator from dangerous energy
Surge protector / medium voltage	De-energize power distribution cabinet (PDC) at MV transformer.
Surge protector / high voltage	De-energize power distribution cabinet (PDC) at MV transformer.
Work on the synchronization switch	Isolation of the synchronization switch. De-energize power distribution cabinet (PDC) at MV transformer.
Work on the safety isolated WTG	Disconnection of the power distribution cabinet.
Disconnection of the 400 V power supply	Disconnection of the 400 V power supply to the power distribution cabinet in the tower base and to the top control cabinet in the nacelle and to the hub.
Disconnection of the 690 V power supply	Disconnection of the 690 V power supply to the power distribution cabinet in the tower base and to the top control cabinet in the nacelle.
Work on the transformer in the DTA converter filter cabinet	Disconnection of the transformer in the DTA converter filter cabinet
Work on the UPS voltage output	Disconnection of the 230 V UPS voltage output in the main cabinet and the control cabinet, the nacelle and the hub
Disconnection of the 24 V power supply unit in the main cabinet	Disconnection of the 24 V power supply unit in the main cabinet
Isolation of the 400 V power supply from the nacelle to the hub	Isolation of the 400 V power supply from the nacelle (top control cabinet) to the hub
Nacelle hydraulics	24 V transformer / interruption of the hydraulic supply
24 V transformer in the nacelle	24 V transformer in the top control cabinet (e.g. for exchanging the transformer)
Battery charging voltage nacelle / hub	Disconnection of the battery charging voltage to the hub
230 V power supply to the nacelle	Disconnection of the battery charger, interruption of the 230 V power supply
Nacelle / motors	Disconnection of the motor
400 V motor circuit breaker in the nacelle	Disconnection of the 400 V motor circuit breaker
Work in the hub	Disconnection of the motor (hub)
Work in the hub	Back-up battery pack in the hub
Locking the high-speed shaft	Nacelle / high-speed shaft (gear box)
Locking the low-speed shaft	Nacelle / low-speed shaft (gear box)
Work on the transformer	Isolation of the transformer in WTGS with a transformer in the tower

## ANNEX: Items and Installations which are subject to Inspection pursuant to the Accident Prevention Regulations

Article to be tested	Test before the initial operation	Exceptional tests	Regular tests	Proof of test	Regulations
Winches	To be checked by a technically competent person		Regular check by a technically competent person in accordance with the manufacturer's instructions and operational conditions.	Inspect and test log book and inspection sticker	Manufacturer's instructions
Doors Emergency exits	To be checked by a technically competent person. Doors must be executed so that they are self-closing, open in the direction of escape and can be easily opened from the inside at all times without auxiliary means.		Regular check by the operator. Once a year by a technically competent person.	Documentary evidence	Manufacturer's instructions
Escape routes			In case of danger, the work areas must be able to evacuated via escape routes or escape equipment. It must be ensured that at least one escape route can also be used in the case of a power failure. Escape routes or escape equipment are: routes via ladders and abseiling devices.		
Hoisting passenger suspension device	To be checked by an expert. In addition to the experts of the Technical Inspection Association (TÜV), only experts for the inspection of hoisting passenger suspension devices who are authorized by the trade association are considered to be experts for the purposes of this safety regulation. The operator must ensure that a test run is carried out at the installation location in all directions of movement with the working load of the passenger suspension device in the presence of the supervisor before the initial operation.	The operator must ensure that hoisting passenger suspension devices are subjected to an exceptional test by a qualified person after cases of damage or particular events which could affect the carrying capacity, as well as after any repair work.	All components of the hoisting passenger suspension device must be inspected for operational safety by a technically competent person at least once a year. Shorter test intervals may arise as a result of the service conditions. The manufacturer's instructions are to be followed.	Documentary evidence	Manufacturer's instructions
Fire extinguishers			Regular check by a technically competent person or expert in accordance with the national regulations.	Inspection sticker or test report	

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Article to be tested	Test before the initial operation	Exceptional tests	Regular tests	Proof of test	Regulations
Personal protective equipment against falling (safety harness)	Check of the fall protection rail by an experienced person.		Users must check the PPE for its orderly condition and correct function before it is used. An experienced person must check the PPE for perfect condition at regular intervals. The manufacturer's instructions are to be followed.	Inspect and test log book, inspection sticker	Manufacturer's instructions
Abseiling device	To be checked by an experienced person.	To be checked by an experienced person after use.	Users must check the abseiling device for its orderly condition and correct function before it is used. An experienced person must check the abseiling device for perfect condition at regular intervals. The manufacturer's instructions are to be followed.	Inspect and test log book, inspection sticker	Manufacturer's instructions
Ladder		A technically competent person checks the orderly condition of mechanical ladders after any alterations or repairs.	A technically competent person checks the orderly condition of the ladders and steps once a year. Irrespective of this, the user must check the suitability and condition of the ladders before use. The manufacturer's instructions are to be followed.	Inspect and test log book, inspection sticker	Manufacturer's instructions
Electrical equipment	Check by a qualified electrician or under the supervision of a qualified electrician. (Also after alteration or repair) The test before the initial operation in accordance with Section 1 is not necessary if the manufacturer or installer confirms that the electrical installations and equipment are designed to comply with the provisions of this accident prevention regulation.		At specified intervals: The intervals are to be calculated in such a way that any defects which can be expected to arise are found in due time. The relevant electrotechnical regulations are to be complied with for the check. At the request of the trade association, an inspection and test log book with specified entries is to be kept. The manufacturer's instructions are to be followed.	Inspect and test log book	Manufacturer's instructions
First aid box	Pursuant to the Law on Medical Devices, which has been in force since 1st January 1995*, bandaging materials must have a CE-marking but do not have to have a use-by date. If a use-by date is stated, however, the Law on Medical Devices prohibits further use after expiry of the use-by date under penalty of a fine. First aid material without a use-by date must only be replaced in the event of soiling or damage. With the exception of plaster material, it remains usable over a long period, provided that it is stored in a clean and dry place.				