



SAFETY INFORMATION

For access to and work in Siemens Gamesa Renewable Energy wind turbine generators

BASIC HEALTH AND SAFETY RULES

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1 Preface

The purpose of this set of rules is to function as a reference and supplement to existing instructions and manuals for Siemens Gamesa Renewable Energy wind turbine generators.

The following safety rules outline the conditions for safe operation and are to be followed by all personnel, subcontractors, and others accessing or working on wind turbine generators and sites.

These "Basic health and safety rules" are the generic rules referred to in all Siemens Gamesa Renewable Energy original manuals and instructions.

- Installation manuals
- User Manuals
- Maintenance manuals
- Dismantling Manuals

The technical instructions must always be followed but cannot overrule the "Basic health and safety rules".

Pictures and drawings of turbines are examples. Variations may occur in different turbine types. Paper editions are to be considered as uncontrolled, always refer to the updated version.

This set of rules is to be considered as the minimum requirements for safety for employees and subcontractors when performing tasks within the wind industry. Country-specific regulations must be addressed in the site-specific HSE plans which are to be issued by the legal operator.

Any individual performing a work task is obliged to stop the work if in doubt about the procedure or if feeling unsafe in the work situation.

2 Abbreviations

Abbreviations	
SGRE	Siemens Gamesa Renewable Energy
ERP	Emergency Response Plan referred to as Safety Card Booklet
HSE	Health, safety and environment
POI	Point of isolation
POV	Point of verification
PPE	Personal protective equipment
SCADA	Supervisory Control and Data Acquisition
SDS	Safety Data Sheet
WTG	Wind turbine generator

3 General turbine access requirements

3.1 General turbine access requirements

Basic mandatory PPE				
				
Helmet	Safety glasses	Gloves	Closed high-ankle safety footwear	Long pants
- There may be tasks that require additional task specific PPE and certain minimum PPE may need adjustment to the task. - If it is assessed relevant to exclude certain elements of the minimum PPE a Pre-Task Plan must be completed, to document whether the hazard is eliminated, or the associated risk reduced to an acceptable level.				

To access the WTG, the WTG must be brought into safe mode for safe access in accordance with the instructions stated in the Operation Manual for the specific WTG type.

Before entering, you must consider and acknowledge the following:

- When entering the WTG, you are responsible for your own safety and the safety of others
- Do not enter the WTG unless you are competent and approved
- Do not enter the WTG unless you are physically and mentally fit
- Do not start any work before you have read and understood the Safety Card Booklet (ERP)
- Respect all prohibition and warning signs placed inside the WTG

Always wear appropriate and type approved personal protective equipment (PPE) in conformance with local rules.

Safety harness and relevant additional fall protection must always be used whenever there is a risk of a fall likely to cause injury.

Always wear the harness when using the turbine lifts and follow vendor's directions for attachment.

3.2 Evacuation equipment

For evacuation equipment permanently installed in the nacelle, personnel accessing the turbine have to be trained in the use of such equipment before accessing the WTG.

For evacuation equipment not installed permanently in the turbine, a set of approved equipment familiar to the personnel must always be brought. The evacuation equipment must be brought to the nacelle immediately after entering the nacelle.

3.3 Visitors

Individuals without basic safety training who access a turbine are considered to be visitors and must follow the access requirements described by the legal operator of the WTG who is responsible for their health & safety in accordance with the document SI545781 part 1/3 Conditions for safe operation.

Before accepting visitors to turbines, rescue and emergency personnel must be on alert.

3.4 Training and safety instruction

Prior to entering any turbine, the safety requirements must be complied with as stated in the WTG original instruction manuals.

Only personnel who have received appropriate instruction in accordance with the WTG original instruction manuals may be allowed access to a turbine site.

Injunctions	
	Smoking is not allowed in in the WTG - this also includes the use of e-cigarettes.
	No open fire is permitted in the WGT, unless special circumstances with a valid hot-work permit.

4 Working in the turbine

4.1 General turbine access requirements

A turbine can only be accessed when accompanied by a technician with competence to control and secure the specific turbine model being accessed. Such competence shall include:

Technical and safety training requirements:

The relevant turbine type-specific technical manuals and instructions must always be accessible when working in a turbine. Check whether the work is covered by work instructions and risk assessments or if other safety documentation is relevant. Make sure that the relevant safety documentation is available before starting the work.

In case of an evacuation, and to facilitate rescue, always bring your fall-protection equipment to these work locations:

- Tower platform
- Yaw section
- Nacelle
- Hub
- Inside blade

Whenever a fall-arrest system is installed, it must be used as protection against potential falls.

4.2 Two-person teams

Normally, tasks are assigned to teams of minimum two persons. Working alone is only permitted in special and very restricted circumstances. See Working alone (on page 49).

If team members, however, are to separate briefly from each other and get outside hearing distance, they must maintain communication to ensure one another's safety. If the two persons are so far from each other that they are out of shouting range, other means of communication must be established,

e.g. two-way radio or mobile phone. Functional test of the communication must be performed prior to separation of work parties.

One member of the team must under no circumstances halt the work or leave the area without informing the other.

4.3 Disconnect from remote control

Task specific PPE
 Ear protection

Access from ground level: Before climbing above the power unit level, position and lock the turbine remote control switch at the tower ground level in the "LOCAL CONTROL" position in accordance with the original Operation Manual.

Access via helicopter: Turbines accessed by helicopter must be designed for such purpose. Turbine helicopter access mode must be activated and confirmed by remote control system (SCADA). Place the turbine in "LOCAL CONTROL" immediately after accessing the turbine.

The computer control system is **not** fail-safe. Setting the turbine in local control mode does **not** mean that the turbine energy sources are controlled and as such the turbine cannot be in a generally safe and de-energized state for work.

Identify, disconnect, de-energize, and lock all energized systems before commencing any work on them. Refer to the de-energizing, lockout/tagout procedure described in Hazardous energy (on page 22).

Detailed information regarding the above topics can be found in the original Operation Manual for the type-specific WTG.

4.4 Maintenance and repair

Before carrying out any kind of maintenance work, the WTG must be brought to a complete stop and secured:

Control of hazardous energies

1. Electrical main switch must be switched off, locked, and secured.
2. Pneumatic valve must be switched off, locked, and secured.
3. Hydraulic systems must be switched off, locked, and secured.
4. Perform zero energy state verification of the energies locked off.

Be aware that some of the pneumatic and hydraulic systems must be depressurized before safe work can be performed on them.

Locks:

1. Only one interlock key shall be available for each turbine; personal interlock keys are prohibited.
2. Removal of fixed guards is only allowed after setting the rotor locks.

Detailed information regarding the above topics can be found in the original Maintenance Manuals for the type-specific WTG.

4.5 Ascending & descending the tower

Task specific PPE
 Harness

Take appropriate consideration of the weather and the weather forecast. See Weather forecast (see page 32) and consider both work scope and clothing accordingly.

Switch on the tower lights.

Hearing protection must be worn when stopping (and starting) the turbine.

Position and lock the turbine control switch in "LOCAL CONTROL" and stop the turbine before ascending/descending.

If necessary, for example during troubleshooting, the turbine can be started via the hand terminal from the nacelle. Ascending/descending via ladders and lift is not allowed between the nacelle and the main control platform when the turbine is in operation.

Listen and look for irregularities and check the status on the display before stopping the turbine.

Stop the turbine in accordance with the instruction stated in the type specific user manual. This action shall not be substituted by turning off the main switch or by activating emergency stop, which are for emergency purposes only.

Study the turbine logbook to identify potential abnormalities listed after the previous visit to the turbine. *Type-specific instructions are in the original User Manuals*

Consult the turbine "Safety Card Booklet" (ERP) to study the safety features of the specific turbine and bring required safety equipment as identified in the booklet.

Check your means of communication and ensure that a redundant system is operational. See Communication (page 17)

Make sure that you have at least three points of contact when climbing on the ladders.

Minor loads can be carried in an approved, closed tool transportation bag, either fastened to the harness or hanging over the shoulder with a carrying strap placed diagonally across the body. Do not carry loose items or tools in pockets.

Larger items and any load heavier than 5 kg must be hoisted in closed lifting bags using the service crane (for smaller turbines use hoisting solution, e.g. rope and pulley).

Due to the potential risk of minor objects falling from above, wearing a helmet with chin strap is mandatory during climbing.

In towers with long ladder runs, the first person climbing must be out of sight before the next person starts climbing.

Maximum load on platform must be evenly distributed; maximum loads for the individual WTG are stated in the relevant WTG original manuals and instructions.

- Climb slowly. Take a break on one of the platforms if necessary.

4.6 Entering and working in the nacelle, hub and spinner

Restrictions	
	The maximum number of persons in WTG is specified in the type specific manuals. Remember to mount the casement stay locks, if available, for the nacelle hatches when they are opened (see the operating instructions in the specific Maintenance manual). Take note of the wind conditions.

See following topics regarding wind:

- Weather forecast (on page 32)
- Thunderstorms (on page 38)
- Wind impact during work (on page 36)
- Wind force (on page 37)

Lock the rotor using the designated rotor locks (consult the individual model-specific wind limits and requirements for operating rotor locks in the original Operation Manual).

Upon entering the hub, the pitch hydraulics must be locked by closing the safety valve for each blade. Before entering a blade, the manual pitch lock must be engaged following the product-specific manual.

Before working on the rotor, blades, hub, spinner, hydraulic system or the drive system, always follow the safety precautions and energy isolation procedures.

Remember the presence of nitrogen-pressurized accumulators in the hub and follow task-specific risk assessments before entering the hub.

Always wear a harness in combination with the relevant fall protection when work involves a risk of sustaining any fall likely to cause injury.

Always use yaw lock and rotor lock when working on the outside of the turbine or in the yaw system.

Type-specific task details are described in the relevant original manuals.

4.7 Restricting access/marketing of the area

Whenever working with nacelle covers/hatches open, on the outside of the turbine, or performing comprehensive repair work in the nacelle when the canopy is removed, the risk of objects falling is relevant.

The area surrounding the tower must be marked off, for example with poles or signs, and access restricted within a radius of 1/5 of the tower height / minimum 20 m.

Vessels floating or jacked up around the drop zone must take the safety precautions necessary in accordance with the evaluated risks. (Falling objects)

Clearly mark the area, primarily at likely access roads, with signs reading:

Restrictions		
	Work area! Work at height is in progress in the turbine. Authorized access only. Safety helmets must be worn.	

4.8 After work in the turbine

Ensure that the WTG is cleaned and that all loose items have been removed or secured before leaving the turbine. Be especially careful to remove all loose items from rotating equipment like, but not limited to, the hub and generator. Close and secure the blade cover plates before leaving the hub and ensure that hub hatches are closed and secured correctly.

All waste materials must be removed and disposed of according to local regulations. Clean away oil, grease and other dirt from the nacelle, ladders and safety equipment, etc.

Ensure all covers on rotating and moving parts are in place. If this is not possible, signage must be posted at the ground entrance of the lift, for example, and at the tower ladder to indicate that the turbine is not fully functional. In any case, when a turbine is not fully functional, this must be noted in the turbine logbook and notified to the operational management.

Close and lock the nacelle hatches.

Reverse all lockout/tagout equipment before climbing down.

Ensure that all tools and parts are accounted for before climbing down.

Enter date, time, purpose of access, and the ID of personnel into the turbine logbook together with remarks for the next team accessing the turbine.

Note: In the event of unforeseen circumstances or tasks being prolonged beyond one work shift, all points above must be executed at the end of the shift to the extent reasonable and practicable to ensure safety and the integrity of the turbine.

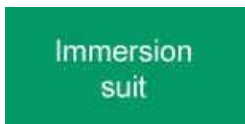
Task specific PPE
 Ear protection

Start the turbine in accordance with the procedure described in the type-specific original operation manuals. Switch off the lights in the tower and lock the door when leaving the wind turbine.

5 Working offshore

5.1 Precautionary measures

The operational management must plan all work, including, ensuring the availability of but not limited to, survival kit "Stay over equipment" and rescue equipment to cover the number of individuals in the turbine at all times.

Task specific PPE		
 Life jacket	 Immersion suit	 Personal Locator Beacon

When working offshore, special consideration must be given to training & PPE requirements addressing the hazards presented by:

- Risk of falling into water
- Evacuation conditions
- Weather conditions
- Sea state
- Ice
- Dropped objects
- Transfers

We recommend to follow the G+ good practice guidelines at <http://www.gplusoffshorewind.com/>.

Considering legal and site-specific requirements, the marine coordinator specifies the offshore procedures and coordinates offshore operations with the vessel masters.

When planning and performing work offshore, special attention must be given to weather forecasting covering the planned scope of work and transportation. Within the forecasted conditions it must be ensured that personnel can exit from the WTG before weather conditions deteriorate to a degree which can compromise safety.

When accessing a WTG offshore, the vessel impact on the TP/foundation can cause ice build-ups on the WTG/foundation to fall. For maximum safety under such conditions, observe from a distance and stay indoors during TP "dockings". See Working in cold weather (see page 35)

Before attempting to access a WTG for transfer, always notify personnel potentially already on the WTG.

5.2 Preparedness "Stranded on turbine"

The requirements for, and location of, survival equipment ("Stay over equipment") for use if stranded on the TP can, depending on customer decisions, be found in the layout plan for the turbine. A plan for stranded personnel on a turbine must be addressed in the Site HSE Plan.

5.3 Offshore crane operations

Unless otherwise stated in the product-specific manual, the nacelle service cranes are not approved as offshore service cranes and cannot be used for dynamic lifts from vessels. TP crane operations must be considered according to vendor's specifications and site-specific requirements. In general, offshore crane operations must be considered in relation to the sea state (see Wind force (on page 37)), and in general crane capacity must be reduced according to sea state based on crane documentation and lifting plans.

5.4 Weather conditions

Prior to any offshore operation, the weather conditions at the location of work must be evaluated based on an updated weather forecast covering the expected period of operation. It is the responsibility of the vessel master and the marine coordinator constantly to update themselves on the weather forecast for the period of operation. See Weather forecast (on page 32).

5.5 Sun

Bear in mind that the effect of the sun can be multiplied offshore and consider appropriate protection.

5.6 Thunderstorms offshore

If thunderstorms are forecast once technicians are deployed to the turbines, the vessel master must evaluate if they can be safely extracted or if the technicians must retreat to a turbine safe area. Any such decision must be communicated to and acknowledged by the personnel at the turbines.

For further details of procedures and safe areas, see Thunderstorms offshore (on page 40).

5.7 State of sea

It is the responsibility of the vessel master to evaluate the state of sea (wave height, wave pattern, and current) at the given location. The master must compare the circumstances to the capability of the vessel and his experience in order to decide if transfer can be performed under safe conditions.

5.8 Falling objects

On offshore turbines, safety helmets must be worn during all traffic on the TP when work is performed with nacelle covers/crane hatches opened. Safety helmet is mandatory when on deck of vessels closer to turbines than 1/5 of tower height / minimum 20m.

5.9 Special safety rules

Special safety rules can be relevant for various offshore turbines, based on location and customer requirements. Such special safety rules will be described in the site-specific HSE plan and communicated in the site induction.

6 Communication

6.1 Communication

Communication	
	Effective and reliable communication is vital when working in wind turbines.

When planning work tasks, technicians must always have two independent means of communication; a primary and a secondary means of activating emergency dispatch, and to establish contact according to the local Emergency Response Plan.

Technician teams in the turbine must be able to communicate internally either direct or through relays. The planning must include intervals for communication checks based on the reliability of the means of communication.

If the line of communication to the emergency response backup is compromised, the lead technician is responsible for stopping the work.

If the primary means of communication is compromised, but the alternative means of communication to emergency response backup is still effective, the lead technician can decide, based on a Pre-Task Plan/Task Risk Assessment and after having consulted with the site management, to continue the work task.

Means of communication may include, but are not limited to:

- Landline phone
- IP phone
- Cell phone
- Satellite phone
- Two-way radio
- Onshore turbines only: "Using a three-man team to facilitate a messenger/guide function"

Offshore: The basic requirements for an offshore wind farm for emergency communication are:

- Primary and secondary means of communication must be available to establish contact from WTG to the crew transfer vessel (CTV) to request assistance in an emergency and vice versa
- The CTV must always be able to communicate with the person responsible for search & rescue (SAR) and marine coordination
- Communication checks minimum every two hours (depending on the risk associated with the activity, this period can be shortened).

7 Clothing when working in a turbine

7.1 Clothing when working in a turbine

Always wear appropriate clothing suitable for the activities. Long-sleeved shirts, long pants, closed high-ankle safety boots and appropriate arc-rated clothing are mandatory.

Clothing and clothing accessories that poses a safety risk such as:

- compromising the function of PPE
- getting stuck / entangled
- restrict visibility
- limit orientation – sound and vision

are not permitted to wear unless it belongs to the category of approved PPE, while staying or performing work tasks in a work area. (examples of clothing that can pose a safety risk: loosely hanging scarves & caps, hoodies, laces)

When working at height, the effects of exposure to actual weather and wind conditions can be very different compared to ground level.

The wind-chill factor will typically be far greater.

Before climbing the wind turbine, make sure that personnel are wearing or bringing suitable protective clothing considering temperature, wind and precipitation.

Temperature in °C / °F					25/77	20/68	15/59	10/50	5/41	0/32	-5/23	-10/14	-15/5	-20/-4	-25/-13	-30/-22	-35/-31	-40/-40	-45/-49
Wind speed																			
km/h	m/s	knots	mph																
0	0	0	0		25/77	20/68	15/59	10/50	5/41	0/32	-5/23	-10/14	-15/5	-20/-4	-25/-13	-30/-22	-35/-31	-40/-40	-45/-49
7	2	4	4		25/77	20/68	15/59	9/50	5/41	-1/30	-6/21	-11/12	-16/3	-21/-6	-26/-15	-31/-24	-36/-33	-41/-44	-46/-51
14	4	8	9		23/73	17/63	12/54	5/41	0/32	-6/21	-12/10	-18/0	-24/-11	-30/-22	-36/-33	-42/-44	-48/-54	-54/-65	-60/-76
22	6	12	13		23/73	16/51	10/50	3/37	-3/27	-10/14	-16/3	-23/-9	-29/-20	-36/-33	-42/-44	-49/-56	-55/-67	-62/-80	-68/-90
29	8	16	18		22/72	15/59	8/46	1/34	-6/21	-13/9	-19/-2	-26/-15	-33/-27	-40/-40	-47/-53	-54/-65	-61/-68	-68/-90	-75/-103
36	10	19	22		21/70	14/57	7/45	0/32	-7/19	-15/5	-22/-8	-29/-20	-36/-33	-43/-45	-50/-58	-58/-72	-65/-85	-72/-98	-79/-110
43	12	23	27		14/57	6/	-1/30	-9/16	-16/3	-23/-9	-31/-24	-38/-33	-46/-51	-53/-63	-61/-68	-68/-90	-75/-103	-83/-117	
50	14	27	31		13/55	6/	-2/28	-10/14	-17/1	-25/-13	-32/-26	-40/-40	-47/-53	-55/-67	-63/-81	-70/-94	-78/-108	-85/-121	
58	16	31	36			6/	-3/27	-10/14	-18/0	-26/-15	-33/-27	-41/-44	-49/-56	-57/-71	-64/-84	-72/-98	-80/-112	-87/-125	
65	18	35	40					-11/12	-19/-2	-26/-15	-34/-29	-42/-44	-50/-58	-58/-72	-65/-85	-73/-99	-81/-114	-89/-128	
72	20	39	45							-27/-17	-35/-31	-43/-45	-50/-58	-59/-74	-66/-87	-74/-101	-82/-116	-90/-130	
79	22	43	49										-51/-60	-59/-74	-67/-89	-75/-103	-83/-117		

OK to work

Take breaks

Take longer breaks and consider safety

Stop work

8 Working at height

8.1 Planning

Task specific PPE
 Harness

The maximum allowed total weight of individuals, including equipment, ascending a turbine where use of fall-arrest system is required is 136 kg (300 lbs).

Pregnancy disqualifies employees from working at height due to health concerns related to potential falls.

Always plan assignments at height carefully and estimate the volume of tools and materials needed.

Check whether the work is covered by work instructions and risk assessments or if other safety documentation is relevant. Make sure that the relevant safety documentation is available before starting the work.

Ensure that all participants are qualified and that all PPE is within inspection date and appropriate for use.

The appropriate fall protection precautions must always be considered in order to protect individuals whenever there is a risk of sustaining a fall likely to cause injury.

Whenever a fall-arrest system is installed, it must be used as protection against potential falls.

Climbing ("double hook/twin tail climbing") is not a general SGRE-approved method of access, and can only be considered based on individual and documented risk assessments:

1. For egress in situations when an already installed fall-arrest system is identified not to be operational.
2. Access to repair or to change an already installed, but not operational, fall-arrest system.
3. Access to install a permanent fall-arrest system where one does not exist.

Any deviation from above requires management approval.

Make sure that the task is performed by skilled and trained employees regarding these topics:

- Safety training
- Rescue equipment (for example Milan hub A-024)
- Rescue kit
- First aid kit
- Blade rescue kit
- Rescue preparedness
- Visitors in turbines

8.2 Falling objects

Before you start work, check your work area for any items that could constitute a risk of becoming a dropped object during your task, future tasks or operations.

Working at different levels must be avoided; special measures shall be taken, and all work must be planned according to this requirement. If this is not reasonably practical, the risk of falling objects, for example, must be eliminated by using safety nets or establishing safety zones. Climbing must be eliminated by using between platforms on an individual ladder section is only allowed for one person at a time.

Tools and other loose objects must be tethered using appropriate tethers (individual tool lanyards) designed to carry the weight of the load/tool. The tether must be secured to hand wrist, harness/tool belt or a suitable part of the WTG to prevent the object from falling.

Tower hatches must remain closed to protect individuals and prevent objects from falling. Service lift openings must be covered or fenced off when service lift systems are not in place in order to protect against falling/dropped objects if stay on tower platform is warranted.

All hatches and covers must remain closed when not in use or actively being worked on.

Storing of tools, equipment, parts or items, including personal belongings, must be at a safe distance from open hatches or other unprotected openings that expose the items to risk of falling from height.

When it is not possible to keep tools, equipment and parts a safe distance away from any unprotected opening or edge, the items must be secured by using tethers, bags, pouches, trays, holders or equivalent to ensure safe tool handling or storing.

Do not tether tools that exceed 4.5 kg in weight to a person.

Do not use tool lanyards/tethers in situations where machinery entanglement is a risk.

All unnecessary items, including loose nuts, bolts, unused parts, etc., must be removed from the work area or placed in a secure location. When leaving the workplace, ensure that no loose parts are left behind (for example bolts, nuts, brackets, tools, etc.).

8.3 Working on the outside of the tower, nacelle, and blades

Task specific PPE
 Harness

The nacelle covers must not be opened at high wind speeds. Individual WTG wind speed limitations are specified in the relevant manuals.

When working on the outside of the tower, nacelle, or on the blades, the yaw lock and rotor lock must always be applied unless otherwise described in the original work instruction.

Additionally, a safety perimeter with a radius of 1/5 of the tower height / minimum 20 m. must be indicated around onshore WTGs. Signs must be conspicuously posted, warning against potentially falling objects. Vehicles must be parked outside of this safety perimeter. At offshore turbines, the TP platform is out of bounds during overhead work, unless this is safely coordinated with the work in progress.

Vessels floating or jacked up around the drop zone must take the safety precautions necessary in accordance with the evaluated risks.

8.4 Rope access

Rope access work requires specially trained and certified rope access technicians (SGRE aligns with the Society of Professional Rope Access Technicians (SPRAT)). Rope access work is performed under special safety rules, using specially described methods exclusively for this particular type of work.

9 Hazardous energy

9.1 Hazardous energy

Work on equipment exposing the employee to hazardous energies requires the energy source to be properly identified, isolated, locked out, and a zero-energy state verified. Only qualified personnel are to perform construction, commissioning, maintenance, troubleshooting, or repair on equipment representing a risk of exposure to hazardous energy.

The turbine design involves various types of hazardous energy sources:

- Electrical
- Pressurized systems:
 - Hydraulic
 - Pneumatic
- Rotating and moving parts

This chapter outlines the minimum requirements for safety for employees, subcontractors, and others. Country-specific regulations are to be addressed in the site-specific HSE plan.

9.2 Risk assessment

Work involving hazardous energies must always be planned, and a risk assessment performed. Planning to perform a zero-energy verification procedure requires identification of:

- The work area
- Points of isolation
- Measuring points and/or method to verify the zero-energy state
- Safe re-energization

9.3 Zero energy state and live work

All systems must be treated as energized/live until verified to be in zero energy state.

Zero energy state means that there is no remaining energy in the system, component, or in the area where work is to be performed.

De-energize equipment by following the zero energy verification procedures in the sections below describing each type of energy.

9.4 Energy isolation preparedness

Prerequisites in connection with of planning of site activities:

- An approved competent person must approve isolation procedures to be used on the site
- A person must be appointed (in writing) to manage and control the isolation procedure system on site
- The appointed person must accept the appointment (in writing)
- Applicable energy isolation procedures for the tasks to be performed
- If an approved energy isolation procedure must be planned, a plan must be requested from the approved competent person by following the procedure in the relevant market unit or segment. Until this procedure is in place, the task in question must be suspended.

9.5 Energy isolation procedure

Energy isolation procedure:

1. Identify work area according to relevant isolation procedure
2. Identify point(s) of isolation (POI) according to the relevant isolation procedure
3. Identify points of verification (POV) and verification method according to the isolation procedure
4. De-energize equipment (in accordance with written and approved energy isolation procedure)
5. Lock and tag POIs
6. Verify zero energy state
(High voltage works only; earthing and short circuiting of the installation is a part of the mandatory procedure for statement of zero energy)
7. Document in the isolation procedure: The POI lock-out point(s) and POVs verified in isolation procedure
8. Perform work task
9. Release equipment for operation
10. Remove tags and locks from POIs
11. Re-energize equipment

A skilled person must verify the applicability and accept the energy isolation procedure before performing the steps in the isolation procedure.

A zero-energy state must always be approved by the skilled person in charge of the work task.

Identification information for points of isolation (POI) and points of verification (POV) is specified in the original manuals for the type-specific WTG.

10 Electrical

10.1 Electrical

Electrical work is work near or on electrical installations. This concerns both:

- **High-voltage installations** (voltage above 1,000 VAC or 1,500 VDC).
- **Low-voltage installations** (voltage below or equal to 1,000 VAC or 1,500 VDC).

Note: 1,000 VAC is a phase-to-phase value. 1,500 VDC is the difference between minus and plus.

This set of rules covering electrical work within Siemens Gamesa Renewable Energy wind turbines is the minimum requirements for electrical awareness and safety.

Be aware of escalating risks when performing work related to electrical cabinets and installations.

Perform risk-assessed work in relation to isolation class, e.g. IP2X and arc flash rating. For every safety barrier you remove, the risk of getting in contact with live electric parts increases, e.g. starting when opening a cabinet door.

Country-specific regulations are addressed in the site-specific HSE plans.

10.2 Roles and responsibilities

Electrical work is only to be performed by a trained and nominated, electrically qualified person with:

- General electrical awareness
- Type specific knowledge of electrical circuits
- Technical and safety training
- Zero energy kit training (or similar training relevant to the equipment selected by the sub- contractor).

Note: High-voltage is work only to be carried out by specifically authorized persons.

When performing electrical work, there must always be one individual nominated as responsible at the site to administrate the safe system of work for electricity, including the correct issuing of isolation procedures.

Instructed personnel must be supervised by skilled authorized personnel.

Extra care must be taken to prevent items being dropped into the space below the work area and onto potential live circuits nearby the work area.

Prior to energization (including re-energization) or switching operations, establish an "All Clear Protocol":

- No persons are near equipment
- Grounding protocols have been signed off
- WTG cable insulation measurements have been done and are deemed ok
- Lightning protection measurements have been done and are deemed ok
- All equipment is complete and in a ready state for switching
- All electrical cabinet doors closed/secured with LOTO in place

10.3 Low voltage

Task specific PPE:			
 Gloves approved for live electrical work	 Face shield	 arc-rated clothing	
Electricity		No access for unauthorized persons	
			

Live voltage work is only allowed for these tasks:

- Voltage testing, current measurement, and discharging
- Error detecting/troubleshooting
- Replacing and handling of UPS batteries

When performing live work in a wind turbine, you must be duly trained and only use approved equipment, tools, and PPE.

The zero-energy verification procedure (electrical) shall ALWAYS be followed:

1. Disconnect completely
 - Disconnect to ensure the necessary equipment is isolated and any stored energy is dissipated (zero energy state).
 - Stored energy from for example capacitors must be dissipated.
 - Disconnection must always be physical; disconnection by pushing push button is not acceptable.
2. Secure against re connection
 - Lockout/tagout must be applied to prevent restart or re-energizing of the equipment. Ensure that each person has a personal lockout/tagout device that prevents re-energizing the equipment/system.
3. Verify absence of operating voltage
 - Check instrument. Make a hot measurement on a known live energy source to check the functionality of the instrument.
 - Prove zero energy state. Identify correct measuring points in EIP and measure to verify zero energy state at work area.
 - Check instrument. Make a hot measurement on a known live energy source to check the functionality of the instrument.

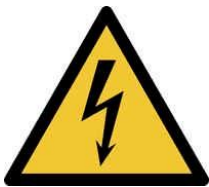
4. Carry out grounding and short-circuiting

- Based on a risk analysis, evaluate the need for grounding and short-circuiting and set this up if necessary
- Grounding may be required in low-voltage systems (□ AC 1.000 V or DC 1.500 V) if:
 - Work is carried out near or on (main) power transformer.
 - System (turbine) might be energized by external sources e.g. power generators.

5. Provide protection against adjacent live parts.

If multiple energy isolation procedures are utilized at the same time and have shared isolation points, then all shared isolation points must be supplied with double locks.

10.4 High-voltage systems

Task specific PPE	
 Face shield	 Gloves approved for live electrical work
 Arc-rated clothing	
Electricity	No access for unauthorized persons
	

Employees are only allowed to work with high voltage (HV) if they are authorized and covered by a safe system of work, including necessary management systems and authorizations.

Appoint a competent person to carry out electrical work.

Use only electrical connections (plugs and sockets) which are approved to local regulations, rated and have built-in potential earth (PE).

Task specific protection equipment must to be in place in due time before work start.

11 Pressurized systems

11.1 Roles and responsibilities

Work on the WTG pressurized systems and components must be performed by duly trained or supervised personnel.

Instructed personnel must be supervised by a skilled person.

A zero-energy state shall always be verified by the authorized skilled person in charge of the work. It is not allowed to initiate disassembly of an energized system or component where there is a risk of being exposed to any effect of an uncontrolled release of pressure.

Extra care must be taken to prevent exposure to possible moving parts when repressuring the hydraulic system.

Always keep at a safe distance and direction when repressuring a system or component.

11.2 Zero energy state

All pressurized systems shall be treated as pressurized until verified to be in zero energy state.

Zero energy state means that there is no remaining pressure in the system or component. Zero energy state shall be established in order to perform disassembly/repair in a safe manner.

De-energizing of equipment shall be done by following the **zero-energy verification procedure**: Zero energy verification procedure (hydraulics):

1. Disconnect the energy source (for example: close hydraulic control valves).
2. Lockout/tagout (for example: make sure that the locks are in place to prevent reopening of the valve and that tags are clearly visible).
3. Neutralize stored pressure (for example: bleed the remaining pressure in the isolated part of the system).
4. Check instrument (for example: make a manometer measurement on a known source of energy).
5. Prove zero energy state (for example: measure the disconnected source to make sure it is de-energized)
6. Recheck instrument (for example: make a manometer measurement on a known source of energy).

Note: In some situations, it can be relevant to substitute the above steps 4-6 by a function test to ensure that pressure has been neutralized.

11.3 Work near pressurized systems

Any work performed near pressurized systems must be assessed for possible damage to the pressurized system from tools or equipment during the work process which could result in an unsafe situation.

12 Rotating and moving machinery

12.1 General rules

When working on rotating parts, it is prohibited to wear loose clothing, harness, or jewellery that can get entangled in the rotating part.

12.2 Rotating and moving parts

Only remove covers over rotating and moving parts when it is absolutely necessary and only when all energy sources have been identified, de-energized and appropriately locked. Reinstall removed covers before re-energizing the equipment.

Some work tasks can involve exemptions requiring rotating parts to be unlocked. For such tasks, an appropriate work instruction detailing safe working requirements must be adhered to. Be particular with housekeeping and eliminate risks of entanglement, draw-in, squeezing, and cutting.

Harness must be removed if there is no risk of falling to a lower level. Keep tools, rags, clothes, hair, gloves, and all parts of your body far away from rotating parts and any parts which have the potential to move when manually rotating the rotor.

12.3 Zero energy state (rotating or moving machinery)

All rotating and moving machinery must be treated as energized or potentially storing energy until verified to be in zero energy state.

Zero energy state regarding rotating and moving machinery means:

- All stored energy has been neutralized or isolated by applying appropriate locking devices suitable for preventing the equipment/component from moving/rotating.

Do not remove any guards and do not access parts of the turbine where individuals can be exposed to hazards caused by moving parts, before the equipment has been appropriately locked in safe position preventing it from moving.

Apply guards and remove personnel from the area before removing mechanical locks.

For correct isolation of rotating or moving machinery, refer to and follow the applicable LOTO procedure for the specific turbine design in question.

Step 1 Stop the unit that you have to work on

- Follow the stop procedure as described in the type-specific manuals.

Step 2 Lockout/tagout

- Make sure the locks are in place and tags are clearly visible at the position referred to in the type-specific manuals.

Step 3 Prove zero energy state

- Ensure engagement of mechanical locks.

Note: In some situations, it can be relevant to substitute the above step 3 by a function test to ensure engagement.

13 Permanent magnets

13.1 Permanent magnets

WARNING	
 Electricity	 Magnetism

The direct drive technology incorporates the use of strong permanent magnets inside the generator.

The design of the generator limits the magnetism to be only in the gap between the magnets inside the generator. This applies both in operation and in stop mode.

The magnets inside the generator do not add to the magnetic fields outside the generator or at spaces inside the generator where normal work is to be performed.

The magnets are not serviceable in the field, so no handling or service precautions are required. When working on/in, or when inspecting, the generator, the following precautions must be taken:

- When performing electrical isolation on circuits in direct connection with the generator, the rotor lock must be applied to eliminate production of power coming from the generator in idle mode. Such isolation can only be performed by a person who is competent to perform this task.
- Permanent magnets will release nonionizing radiation which can affect the function of implantable medical devices in the human body.

14 Electronic magnetic fields

14.1 Electronic magnetic fields

WARNING	
	Nonionizing radiation hazard When staying in a power-producing turbine, keep a safety distance according to the warning signs in the wind turbine generator.

SGRE wind power turbines generate electromagnetic fields like all other electronic equipment. Our turbines are developed and protected against such fields.

Some turbines can under certain circumstances, and only when generating power, experience low value emission inside the turbine. Upon entering the turbine, a pictogram will be posted and if safe distances are to be kept as a precaution, these will be stated.

There is no radiation exposure to personnel or public when staying outside the turbine.
In production mode, the wind turbine will release nonionizing radiation which can affect the function of implantable medical devices in the human body.

15 Environment

15.1 Waste

All waste must be collected in adequate labelled bins or containers with appropriate spill containment to ensure that contamination of soil, groundwater, surface water, or air is avoided.

Only waste management companies approved according local legislation can be accepted to dispose of waste produced on site.

If no local legal requirements exist, the waste must be disposed of in accordance with international law agreements related to international transport and disposal of hazardous waste; information to be found in the HSE plan issued by the legal operator.

Waste must be separated in accordance with the site waste disposal plan or as a minimum into these four categories:

- Combustible
- Household garbage
- Hazardous
- Special (for example oil, batteries, aerosols, chemicals). Burning of waste or other materials is forbidden.

Waste is not allowed to be stored in turbines and must be transported to the site waste storage area according to site-specific requirements.

Note: It is prohibited to bring waste across international borders without permission.

15.2 Pollution

Any pollution of the air, land, and waters is prohibited. See "Emergency Procedures" in case of incidents.

15.3 Spills

All spills must be contained and collected according to the specific local spill containment plan and reported to the supervisor/site manager to facilitate prompt remedial action. See Environmental accident in the Safety Card Booklet. (ERP)

Incidents must be reported to prevent repetition and ensure that proactive action is taken.

16 Weather forecast

16.1 Weather forecast

Always monitor an updated weather forecast before starting any work in a WTG and monitor developments throughout the duration of the work task.

The site manager/supervisor/lead technician is responsible for evaluating whether work can be carried out in a safe manner according to the expected weather condition. The weather forecast must be an essential element in the final planning of work in a WTG.

Access to or work in a WTG can be compromised by extreme weather conditions like, but not limited to:

- Thunderstorms
- High winds
- Risk of ice/snow falling from WTG
- Extreme temperatures (hot/cold)
- Sun
- Sea state

Weather conditions compromising access cannot be limited to the ones mentioned and must always be considered in relation to the site-specific conditions.

Weather forecast providers must be mutually agreed prior to site execution/O&M activities. If for any reason different stakeholders in the work task planning utilize different weather forecast providers, a conservative approach must be taken, using the most restricting weather forecast as the planning factor. The relevant stakeholders must mutually agree to act according to one specific weather forecast.

17 Working in hot weather

17.1 Working in hot weather

Warm and humid weather can affect the body. High temperatures and humidity mean that the body is more likely to dehydrate and suffer from low blood sugar and minerals such as salt.

Avoid drinking sodas or caffeinated drinks and ensure that you drink plenty of water. Eat smaller meals with plenty of water and avoid fatty foods. Consider using electrolyte supplements under extreme conditions.

When possible, take breaks in shade and adjust your work/rest ratio. Remember that the "hard work" (changing gearboxes and main shafts etc.) requires a greater rest/work ratio than "easy work" (meetings, adjustments, and measurement of equipment etc.).

If feeling exhausted, take longer breaks and consider stopping work. Individuals who are not accustomed/acclimated to the heat must take extra precautions in adjusting their work to rest ratio. It may take several days or weeks to become accustomed/acclimated to the hot environment.

Remember that wearing barrier suits (Tyvek or "painter overalls") will increase the stress on the body, and extra precautions should be taken for individuals unaccustomed/unacclimated to the heat before allowing them to use the suits.

Do not attempt to ascend/descend a turbine if not feeling well.

As a guide to assessing the combined impact of heat and humidity, use the following matrix, and use an instrument that can measure both. Always remember that the impact of heat and humidity is individual. These readings are just guidelines and individuals should use their own judgment when assessing actual risk to themselves and others when managing heat stress.

17.2 Sun

Exposure to extreme sunlight for longer periods (individually conditioned) can cause sunburns and potentially sunstroke.

17.3 Sunstroke

Wear long sleeves and pants to protect from extreme sunlight.

Use high-factor sunscreen and protect eyes with sunglasses. Wear a hat/helmet to protect head from the sun.

17.3.1 Heat index table (apparent temperature)

		Relative humidity (%)													
Air temperature	°C/°F	40	45	50	55	60	65	70	75	80	85	90	95	100	
	43/110	58/136													
	42/108	54/130	58/137												
	41/106	51/124	54/130	58/137											
	40/104	48/119	51/124	55/131	58/137										
	39/102	46/114	48/119	51/124	54/130	58/137									
	38/100	43/109	46/114	48/118	51/124	54/129	58/136								
	37/98	41/105	43/109	45/113	47/117	50/123	53/128	57/134							
	35/96	38/101	40/104	42/108	44/112	47/116	49/121	52/126	55/132						
	34/94	36/97	38/100	39/103	41/105	43/110	46/114	48/119	51/124	54/129	57/135				
	33/92	34/94	35/96	37/99	38/101	41/105	42/108	44/112	47/116	49/121	52/126	55/131			
	32/90	33/91	34/94	35/95	36/97	38/100	39/103	41/106	43/109	45/113	47/117	50/122	53/127	56/132	
	31/88	31/88	32/89	33/91	34/93	35/95	37/98	38/100	39/103	41/106	43/110	45/113	47/117	49/121	
	30/86	29/85	30/87	31/88	32/89	33/91	34/93	35/95	36/97	38/100	39/102	41/105	42/108	44/112	
	29/84	28/83	29/84	29/85	30/86	31/88	32/89	32/90	33/92	34/94	36/96	37/98	38/100	39/103	
	28/82	27/81	28/82	28/83	29/84	29/84	28/85	30/86	31/88	32/89	32/90	33/91	34/93	35/95	
	27/80	27/80	27/80	27/81	28/82	28/82	28/82	29/83	29/84	29/84	29/85	30/86	30/86	30/87	

	Heat index (°C/°F)	Risk level	Protective measures
	Less than 33/91	Lower (caution)	Basic heat safety and planning
	33/91 to 39/103	Moderate	Implement precautions and heighten awareness
	39/103 to 46/115	High	Additional precautions to protect workers
	Greater than 46/115	Very high to extreme	Trigger even more aggressive protective measures

18 Working in cold weather

18.1 Working in cold weather

Cold weather can affect the body, causing exhaustion, frostbite, and potentially hypothermia. Avoid getting excessively sweaty and dress in multiple-layer clothing.

Take regular breaks in sheltered and preferably heated locations. Drink warm beverage and eat frequently. If feeling exhausted, take longer breaks and consider stopping.

Pay attention to fingers and feet potentially getting numb and to loss of ability to control extremities like fingers and feet.

Do not attempt to ascend/descend turbines if not feeling well.

See Clothing when working in a turbine (on page 18) for guidance.

18.2 Ice and heavy snow

During cold weather and heavy snow, there is a risk of ice or large clusters of snow falling from the blades or the nacelle, especially when a turbine has been stopped in a period with cold weather.

Evaluate weather conditions, and if icing risks are deemed relevant, have the turbine stopped remotely from a safe distance (> 400 m). Use binoculars (recommended > 10x50 magnification) to inspect the turbine for ice, standing at a safe distance (1/5 tower height / minimum 20 m.). Do not approach a turbine if there is any risk of falling snow or ice. (If reduced visibility prevents verification of a risk of falling ice in conditions where such risk is suspected, refrain from access).

When a turbine has been stopped during weather conditions posing an icing risk, have the turbine restarted remotely from a safe distance (> 400 m).

Keep the nacelle hatches closed if it is necessary to perform work in the nacelle during weather conditions posing a risk of ice gathering on the blades.

The risk of falling ice can also be relevant around office buildings, containers, and other high equipment like cranes and similar.

Ice also causes slippery conditions, generating various slip hazards for both personnel and vehicles. During such conditions, it is recommended to bring gravel and a shovel to mitigate risk.

It is the responsibility of the site management/line manager to make a proper risk analysis and to implement appropriate safety barriers ensuring safety during cold-weather periods.

19 Wind impact during work

19.1 Wind impact during work

Wind is a hazard which under certain circumstances can have a serious impact on safety in relation to work in operating turbines, during construction, and in general for work and transport at site.

During storms, hurricanes, and extreme wind in general, access to the wind turbine and site area must be forbidden and can in specific situations be restricted.

Wind must always be a special consideration during lifting operations using external cranes. The lifting supervisor and the crane operator must jointly estimate each sequence and evaluate safety. Lifting plans must always be consulted to verify wind limitations.

The wind impact will vary depending on the type of work performed and must be assessed as a risk factor in relation to all work, addressing relevant restrictions. If the wind is rising, reassess the wind impact. If wind is risk assessed to compromise being in control of the work task, mitigating precautions must be taken. If the risk is assessed high, the work must be stopped.

19.2 General for work at sites

Specific limitations for work outside the turbines must be defined as a part of the legal operator's site- specific HSE plan.

19.3 For work in wind turbines

Monitoring and assessments of wind speed are always based on measurements made by the individual turbine measuring systems. To ensure accurate measuring of wind, it is recommended to use the average speed of the wind, measured over the last 10 minutes (600 seconds), for the assessment.

If available as a part of the design, always remember to mount the locking system on hatches when they are opened.

Work related to maintenance must be restricted due to wind, in accordance with the limitations stated in the type specific user manuals. In worst case situations, stop working and leave the turbine.

19.4 For installation work and replacement of main components

Management of wind related restrictions during the installations process and replacement of main components; must be outlined as a part of the HSE plan for projects.

20 Wind force

20.1 Wind force table

Beaufort scale

Beaufort scale for wind speed and approximate wave height						
Beaufort number	Description term		Wind speeds		Wave height (m)	
	Wind	Wave	Knots	M/s	Probable	Maximum
0	Calm	-	< 1	0 - 0.2	-	-
1	Light air	Ripples	1 - 3	0.3 - 1.5	0.1	0.1
2	Light breeze	Small wavelets	4 - 6	1.6 - 3.3	0.2	0.3
3	Gentle breeze	Large wavelets	7 - 10	3.4 - 5.4	0.6	1.0
4	Moderate breeze	Small waves	11 - 16	5.5 - 7.9	1.0	1.5
5	Fresh breeze	Moderate waves	17 - 21	8.0 - 10.7	2.0	2.5
6	Strong breeze	Large waves	22 - 27	10.8 - 13.8	3.0	4.0
7	Near gale	Large waves	28 - 33	13.9 - 17.1	4.0	5.5
8	Strong gale	Moderately high waves	34 - 40	17.2 - 20.7	6.0	7.5
9	Storm	High waves	41 - 47	20.8 - 24.4	7.0	10.0
10	Violent storm	Very high waves	48 - 55	24.5 - 28.4	9.0	12.5
11	Hurricane	Exceptionally high waves	56 - 63	28.5 - 32.6	11.5	16.0
12	Hurricane	Exceptionally high waves	64 - 71	32.7 - 36.9	14.0	> 16.0
13	Hurricane	Exceptionally high waves	72 - 80	37.0 - 41.4	> 14.0	> 16.0
14	Hurricane	Exceptionally high waves	81 - 89	41.5 - 46.1	> 14.0	> 16.0
15	Hurricane	Exceptionally high waves	90 - 99	46.2 - 50.9	> 14.0	> 16.0
16	Hurricane	Exceptionally high waves	100 - 109	51.0 - 56.0	> 14.0	> 16.0
17	Hurricane	Exceptionally high waves	110 - 118	56.1 - 61.2	> 14.0	> 16.0

21 Thunderstorms

21.1 Thunderstorms

During thunderstorms, there is a high risk of lightning impacting a wind turbine, despite the turbine lightning protection arrangements. No personnel are allowed to occupy the nacelle, hub, blades, and yaw section.

Weather forecasts must always be consulted with special focus on the risk of thunderstorms when planning turbine work. Due diligence is required during work taking into consideration that thunderstorms can develop unexpectedly and rapidly.

If a thunderstorm approaches onshore:

Leave the turbine. Before leaving, remember to close all doors/hatches and openings in the nacelle. If time does not permit leaving the turbine, the alternative will be to retreat to the designated safe areas of the turbine. Safe areas are identified in the turbine Safety Card Booklet (ERP).

If a thunderstorm approaches offshore:

Retreat to the designated safe areas of the turbine. Safe areas are identified in the turbine Safety Card Booklet. Before retreating, remember to close all doors/hatches and openings in the nacelle. Transfer of personnel to CTV as an alternative cannot be recommended due to the risk linked to a transfer from TP to vessel.

If work is in progress in a WTG when a thunderstorm approaches/develops (lightning can be seen, but no thunder can be heard):

- The storm is likely to be approximately 10-30 km away from the turbine.

If work is in progress in a WTG when a thunderstorm is identified near the WTG (thunder is heard):

- The storm is likely to be close, 0-15 km away from the WTG.
- Immediately proceed to one of the safe areas indicated in the Safety Card Booklet (ERP) (platforms below the yaw section and at ground level). If possible, choose a platform without electrical cabinets. On platforms with electrical cabinets, ensure that cabinet doors are closed and stand away from, and to the side of, cabinet doors.
- Sit or stand at the centre of the platform and do not touch the tower wall. Inform line manager of your actions.

In turbines designed with wooden platforms, it must be considered that such platforms are only approved for the load of maximum 3 persons.

Onshore:

A car is considered a safe area as protection against lightning strikes. If a thunderstorm is near the turbine and you cannot safely leave the turbine, stay in the tower in one of the designated safe areas (see following illustration).

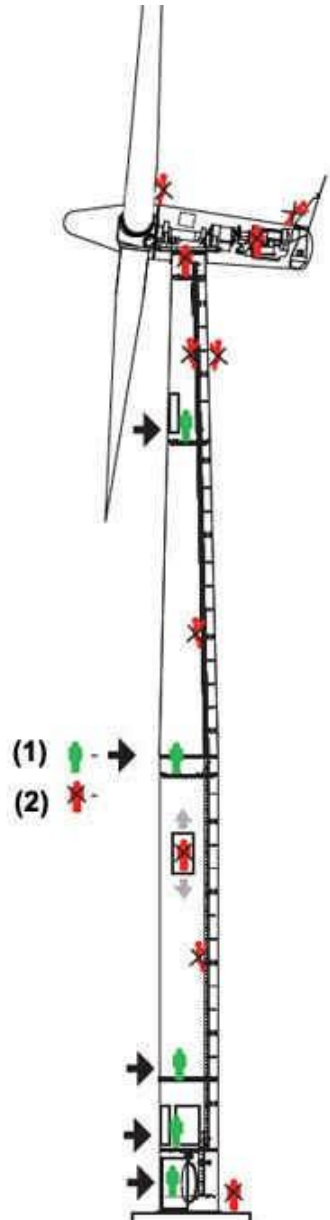
When re-entering the turbine, be aware of "crackling noise" that can possibly be heard from the blades, indicating they can still be charged with static electricity. Do not work in or on blades until they are discharged. The rest of the turbine is grounded and cannot be charged.

In case of a lightning strike during operation, a turbine will normally continue to operate.

When a turbine is in service mode and under installation, a visual inspection of the blades should be performed to identify possible damage. If damage is identified, SGRE Service department must be contacted for further handling.

21.1.1 Safe areas in the turbine

- (1) Safe area
- (2) Leve the area



Note: The tower safe areas shown in the above illustration are for guidance only, because tower configurations can vary.

All tower platforms are in general classified as safe areas. EXCEPT THE YAW PLATFORM.



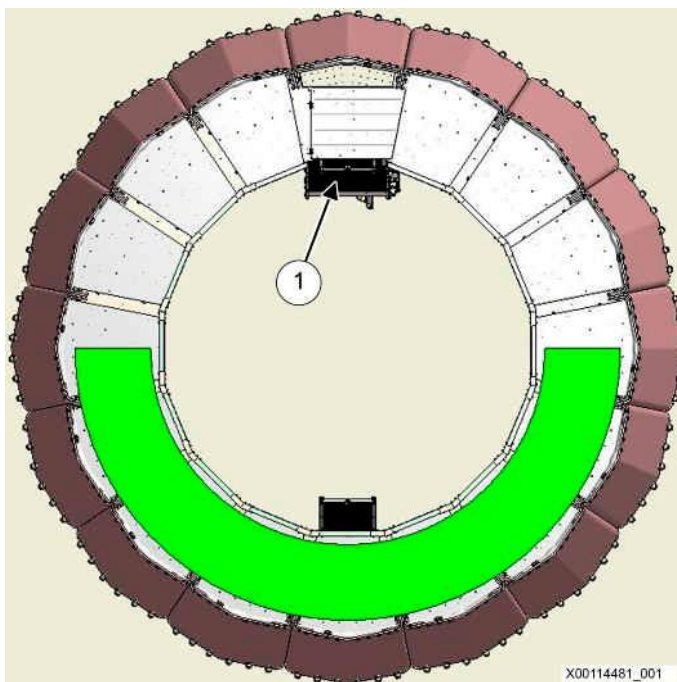
Do not touch the tower, ladder, and electrical components.

Specifically, for platforms with electrical cabinets:

- If possible, choose platforms without electrical cabinets
- Stand to the side and as far away from electrical cabinets as possible and never in front of these.
- Keep cabinet doors closed.

21.2 Specifically, for bolted steel shell tower

In bolted steel shell towers, only the one half of the platform opposite the cable ladder is considered a safe zone.



Green area is safe zone during lightning storm
(1) Access hatch

21.3 Thunderstorms offshore

In case of thunderstorms, the service vessel does not approach the turbines.



Do not touch the tower walls.

Do not under any circumstances jump into the water.

22 Working with chemicals

22.1 Hazardous effects

WTG work involves handling of various chemical products (oil, grease, cleaner, lubricants, glue, and so on). Some of these products may be hazardous to health and to the environment.

22.2 Safety Data Sheet (SDS)

Warning	
	

The SDS is provided by the chemical manufacturer and contains legally required information specific on the hazards and relevant information about storage, handling, disposal, recommended personal protective equipment, and first aid.

The SDS must according to legal requirements be up to date, and easily accessible for the users where the product is stored or handled.

The chemical provider is responsible for ensuring that the SDS is available to the end user. The SDS must be available in the national language of the country and an additional SDS must be available in another language understood by the user.

Some countries legally require a “Chemical Risk Assessment” additional to the SDS. Always consult the specific national legislation.

22.3 Precautions

Emergency	
	
First aid	Eyewash

Identify the hazards and handle the product according to the manufacturer's recommendations. Use personal protective equipment in accordance with the risks stated in the SDS.

Note: Standard nitrile work gloves are not chemical resistant. If required, use chemical resistant gloves and ensure sufficient protection for the time of use - refer to Personal Protective Equipment Specifications (PPE). First aid equipment and eyewash must be readily available where chemicals are stored and used.

22.4 Storage

Follow storage requirements according to national legal requirements and include information from the Safety Data Sheet (SDS).

Always:

- Store chemicals in well-ventilated and in appropriate spill-containing storage devices.
- Have means of spill collection (spill kit) where chemicals are used and stored.
- Store chemicals in suitable closed containers. Decantation of chemical products to other containers require re-labelling according the label information in the SDS.

22.5 Disposal

Chemical residues, rags, and clothes with oil or grease must be disposed of as hazardous waste and in accordance with the national legislation. The chemical could be dangerous goods / hazmat (US) in transportation and must be handled as such. Transportation information is available in the SDS.

23 **Lifting**

23.1 Planning

Whenever possible, manual handling should be avoided, and mechanical equipment should be used for lifting. All lifting must be performed in an organized and controlled manner. Standardized goods which are, intended and suitable for safe lifts are considered as simple lifts. Simple lifts are normally performed based on instruction given by a competent person. A written lift plan approved by a lifting specialist is mandatory for lifting of main components, lifting of complex shapes or offset or high centre of gravity loads where engineering input is required.

When the nacelle or foundation cranes are used, all loads must be contained in approved and closed lifting bags or appropriately rigged for lifting by a competent person.

Before lifting with crane, forklift, or other mechanical equipment, ensure that the lifting equipment is certified and within inspection period.

Only experienced competent personnel may carry out lifting of main components. Only properly trained/certified personnel may operate forklifts or other powered industrial mobile equipment.

No persons other than those involved in the lifting operation may enter the lifting area.

23.2 Lifting plan

Lifting not categorized as a simple lift must be performed according to an approved lifting plan. The lift must be planned by a competent person and supervised by an appointed lifting supervisor.

23.3 Lifting supervisor

	The lifting supervisor holds the responsibility of coordinating the lift in cooperation with the crane operator and must be able to communicate clearly to the crane operator during all sequences of the lift. The lifting supervisor is responsible for ensuring that the lift is performed according to the lift plan and the local legislation and must ensure that all personnel involved in the plan are aware of their roles and responsibilities. The lifting supervisor must be easily distinguishable by for example wearing a brightly colored vest and/or helmet. The lifting supervisor is responsible for ensuring that the lifting zone is well marked and cleared of any unauthorized personnel.
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23.4 Communication

Establish and maintain good communication between all persons involved and ensure that each person in the lift team are familiar with roles and responsibilities. Unless otherwise agreed, use internationally recognized crane signals. For lifting operations without any communication barriers (for example visibility, distance), verbal communication is the minimum requirement.

Signalmen may become hidden in the terrain or by loads, and hand signals may be indistinct over long distances or in adverse weather conditions. In these situations, two-way radios must be used. The use of cell phones as a means of communication during the lift shall be avoided, unless in extreme situations. Make sure that batteries are fully charged before the lifting operation is started.

23.5 Certified lifting equipment

Only use certified and approved lifting equipment. Do not use homemade lifting arrangements. Cranes, service cranes, hoists, and all lifting appliances must be visibly marked with their certification,

the safe working load (SWL), date of latest inspection, who has performed the inspection, and the date of next inspection.

The responsibility for using only certified and marked lifting equipment rests with the user of the equipment.

The certificate and user manual for hoists, cranes, and similar lifting equipment must be kept accessible by the equipment.

23.6 Safety during lifts



- Consider the potential impact of the weather conditions on safety before lifting.
- Make sure that all employees involved in a lift are aware of their roles and responsibilities.
- Plan the lift and communicate the plan to all employees involved.
- Only use lifting equipment suitable and designed for the task.
- Standing or walking underneath suspended loads or its radius of action is not allowed.
- Never physically touch a suspended load, always use taglines and/or tools. (lollypops)

23.7 Hoisting tools

For turbines with no service crane:

Alternative means can be used based on specific work instructions and risk assessments.

If service cranes or internal lifts cannot reasonably practicably be used to lift or lower tools internally in the tower, alternative means can be used when considered safe in all aspects of the task.

Alternative means used for lifting/lowering loads must always be equipped with a brake device controlling the rope if the person operating it lets go of the rope.

23.8 Certification for use of mobile cranes and machinery

Machine operators must have a valid and approved license for operating cranes and forklifts.

23.9 Rigging

Only competent persons may carry out rigging and slinging.

Slingers/riggers are trained and competent persons with practical and theoretical knowledge and experience who are responsible for:

- Attaching and detaching the load to and from the lifting equipment
- Correct selection and use of lifting accessories

It is important to carry out a visual inspection of the lifting equipment prior to use.

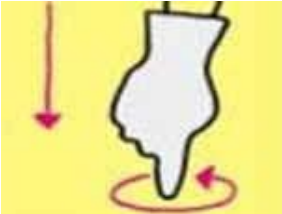
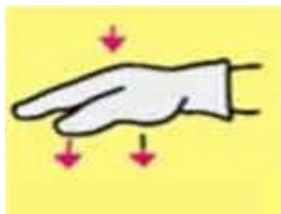
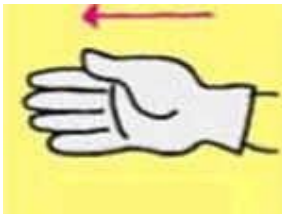
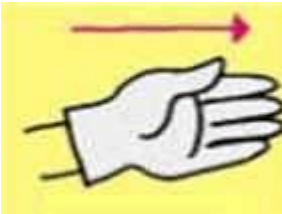
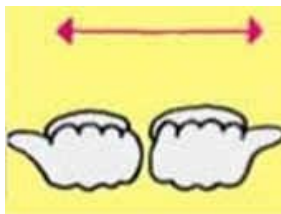
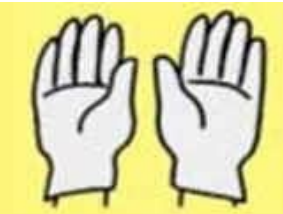
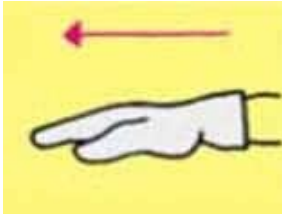
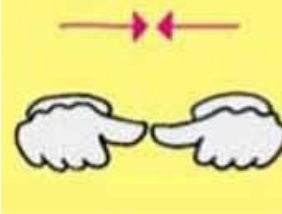
Never use defective equipment or equipment out of inspection period. Label defective equipment "DO NOT USE" and ensure that it is appropriately quarantined.

23.10 Crane signals

The pictures below show the internationally recognized and normally used signals when controlling a lift.

Only an appointed person may signal to and guide the crane operator.

23.10.1 Hand signals for crane operations

			
Hoist	Lower	Lower - used at short distances	Raise/hoist derrick
			
Swing left	Swing right	Telescope out	Stop quickly
			
Move load in this direction	Telescope in	Signal not understood	Use "lollipop" at large distances

23.11 Wind

During crane operations, special consideration must be given to wind speed in relation to the limitations stated by a Lifting Specialist in the lift plan:

- Lifting drawings and rigging details
- Work instruction
- Installation manual

The lifting supervisor decides in cooperation with the crane operator if the lift can be performed safely according to weather monitoring.

The risk of sudden gusts of high wind must always be considered.

During simple lifts using the nacelle service crane, closed certified lifting bags or other appropriately rigged loads, the wind speed and wind direction must be evaluated against the nacelle orientation, as well as the nature and the stability of the load.

During simple lifts when using the nacelle crane:

- Use suitable lifting bags, and
- certified rigging equipment

The wind speed and the direction of the nacelle and the stability of the load must always be considered.

24 Hot work

24.1 Hot work

All welding, burning, flame cutting, metal grinding, heat shrinking, or other operations capable of causing high temperatures and/or ignition must be controlled by appropriate measures to prevent unintended hazardous situations such as fire from occurring.

Fire extinguisher	
	Always bring fire extinguishing equipment of a suitable type and volume according to the scope of work.

Check that the surroundings are clean from flammable materials and substances before starting the work. Ignitable items that cannot be removed must be protected.

Take all necessary precautions to prevent fire! Cover the area surrounding the hot work zone sufficiently by means of, for example, fire blankets to prevent sparks from causing damage to installations or igniting a fire.

Ensure that technicians wear suitable clothes and PPE for the task to be performed.

Any work involving a risk of fire may only be carried out when coordinated with other work on site.

Inform the site manager that work involving a risk of fire is to be carried out in order to allow coordination with other work on site. Hot work must not be carried out before all mitigating procedures are in place in accordance with or Hot Work permit/checklist.

To avoid fire hazards, all service visits in the turbine, irrespective of purpose, must include cleaning the turbine of waste and safe disposal of the waste in suitable waste containers.

25 Excavations and confined space

25.1 Excavations

	• Any excavation work must be controlled by a work permit/checklist in order to coordinate with other nearby work. • Underground hidden installations must be identified prior to any excavation. • Appropriate control measures must be obtained if excavation is to be carried out near underground cables. • Place clearly visible barricades and warning signs around the excavation site. • Have special focus on the hazards related to vehicles or equipment getting close to the edge. Slope or support all sides deeper than 1.5 m to prevent cave-ins. • Carefully inspect after rain and/or flooding, or other hazard-increasing occurrences.
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25.2 Confined space

In European terms, SGRE wind turbine generators in normal operating conditions do not have areas classified as confined space.

Certain areas within the turbine are classified as areas of restricted access and egress and not designed for continuous human occupancy (equivalent to the American term "confined space"):

- Blades
- Hub
- Yaw section
- Under floor section
- Inside the generator (DD turbines)

Note: Any of the above-mentioned areas can be classified as a confined space area (equivalent to the American term "permit required confined space") depending on the nature of work performed. (Always consult specific national regulations.)

Turbines designed with basements in offshore foundations have a potential confined space (equivalent to the American term "permit required confined space") in the foundation.

Safety-related measures to be taken must be defined as a part of the legal operator 's site-specific HSE plan.

26 Working alone

26.1 Working alone

Only under special conditions for special simple tasks.

In general, working alone is not allowed when performing:

- Electrical work
- Hot work
- Work involving powered tools
- Lifting operations
- Heavy manual handling
- Work with chemicals
- Offshore work
- Work at height

Tasks should always be assigned to teams of minimum two persons. Work tasks must be planned to prevent or minimize the isolation of team members.

For instance, no team member should be out of sight or shouting range.

If team members need to separate during work, even briefly, they must maintain communication to assure mutual safety (for example cell phone or radio).

However, the legal operator can under restricted conditions allow simple tasks to be performed as independent work tasks, based on a specific risk assessment.

Only competent personnel are allowed to carry out work tasks independently.

26.2 Emergency procedures

Emergency procedures as well as means of communication and intervals for contact must be agreed and tested. The recommended interval between calls should be decided considering the risk associated with the work task but must never exceed 10 minutes.

If the person to be contacted is not contacted as agreed, the contacting person must:

1. Contact the individual working independently.
2. If unable to obtain contact, proceed according to the agreed emergency procedure for possible work incident/accident.

26.3 Before the work starts

Ensure that means of communication are working properly. See Communication (on page 17)

Agree on the estimated duration of the task and recapitulate the agreed emergency procedures.

26.4 During work

Establish contact upon arrival at the location of work.

Obtain contact according to the agreed intervals. Both individuals involved must log that contact has been obtained.

The contacting person must remain within a response time of 10 minutes from the independently working individual in order to assist in case of an emergency.

27 Fire prevention

27.1 Housekeeping

A high standard of housekeeping is one of the major fire-preventive initiatives!

Keep workplaces and other facilities clear of combustible material to the extent possible.

Use of open fire	
	Any use of open fire must be controlled by a hot work permit/checklist issued and reviewed before job start. Fire must be prevented at the entire site, including inside wind turbines, transformers, as well as site buildings, offices, storage buildings, and rest areas.

Smoking	
	Comply with the site-specific smoking rules and ensure that remains from smoking are properly extinguished and placed in the designated waste containers.

27.2 Heating, lighting and cooking

Do not use unauthorized heating, lighting, or cooking arrangements.

27.3 Flammable/combustible material

Do not place clothing or flammable objects/substances on or near heaters and high-powered floodlights.

Do not allow flammable material or waste to accumulate. Use waste type-specific, labelled, and approved containers.

27.4 Hot work

All welding or use of blowtorches, grinding, and other operations connected with high temperatures must be organized and controlled for safe execution by a hot work permit/checklist.

Before commencement, precautions must be taken, and all appropriate fire-preventive measures must be taken.

Use fire blankets when carrying out work with fire risk and ensure that appropriate fire extinguishing means are within reach. See Hot work (on page 47).

27.5 Vehicles

Do not park vehicles on dry vegetation. Only park on roads, designated parking areas, and hardstands.

27.6 Fire extinguisher

Fire extinguisher	
	Fire extinguishers must be suitable for the fire hazards in the area. (CO2 is recommended for the WTG, SCADA room, and storage of electrical equipment.) Fire extinguishers shall be inspected according to local legislation and at least once every 12 months. Be familiar with the location and use of fire extinguishers on site. Study the specific local emergency procedures in the Safety Card Booklet (ERP) placed in the WTG.

28 Vehicles

28.1 Site access roads

All traffic on site is restricted to designated access roads according to the site-specific regulations, see "Site induction".

28.2 Speed

The speed limit on turbine site should not be higher than 30 km/t (20 mph). By consent, the legal operator may, if justifiable, increase the speed limit provided it does not affect adjacent public areas, local fauna and wildlife, or landlords.

The speed limit may only be increased within the framework of the local regulation, and it may also be further decreased if so determined by local statutes.

Establish a designated area for fuelling and maintenance.

All fuel-operated vehicles and machines must be fuelled correctly using proper fuel-dispensing equipment.

When dispensing fuel, do not leave the vehicle or machine unattended, or set the pump handle to pump automatically.

Pay particular attention, to avoid spills during fuelling. All fuel and/or oil spills must be cleaned up immediately and reported to the site manager to facilitate prompt remedial action.

Maintenance and oil changes on vehicles are only permitted on site in emergency situations.

All replaced parts or oil used in emergency repairs must be contained, labelled, and properly disposed of.

28.3 Special-purpose vehicles

Drivers of special-purpose vehicles and extra wide or high vehicles must only drive onto the site with prior permission from the supervisor/site manager and only with the required training/certification. Site management will advise as to the preferred route and possible site risks.

The site manager must arrange for auxiliary vehicles if necessary.

Note: Always ensure that parked vehicles do not block emergency access/exit points!

28.4 Loading and offloading

It is recommended to load and offload materials in close proximity to the turbine/place of use.

28.5 Parking

Do not park inside the area that is cordoned to avoid being under suspended loads or falling objects and remain in reverse parking.

Parking must always take place at a safe distance from turbines (1/5 of tower height / minimum 20m.)

29 Welfare

29.1 General

Welfare facilities must be provided for access to:

- Water
- Drinking water must be available
- Toilets

Personnel must have access to appropriate toilet facilities. In general, this must be referred to in site- specific arrangements according to the site induction and the site-specific EHS plan. For work in wind turbines erected in small groups or in individually placed turbines outside a pronounced site area, workers must be shown directions to nearby public toilets and allowed to use service vans/company cars for transportation. Personnel must have access to facilities for cleaning and washing hands.

30 Alcohol, drugs, and other substances

30.1 Alcohol, drugs, and other substances

To ensure safe execution of any work performed in relation to installation, use, service & maintenance, or dismantling of the WTG it is a precondition that all personnel are skilled, trained, and mentally and physically fit for the performing the tasks required.

It is under no circumstances acceptable that any personnel are under the influence of drugs, alcohol or other substances which may impair job performance or effect safe execution of job tasks including driving any vehicle.

31 HSE related pictograms

This overview of pictograms reflects the generic pictograms used as signs in SGRE wind turbine generators. Wind turbine type and task specific pictograms will be stated in the turbine type specific manuals.

31.1 Safe condition signs

Pictogram	Description/Function
	To indicate the location of first aid equipment or facilities or staff
	To indicate the location of an emergency telephone
	To indicate the location of an eyewash station
	To indicate the location of an emergency stop button
	To indicate the location of survival clothing
	To indicate the location of an automated external heart defibrillator
	To indicate location of protective shelter during thunderstorm/lightning
	To indicate the location of safety tools for use in emergency

	To indicate the location of an emergency stop wire
	To indicate an escape route direction as down
	To indicate an escape route direction as left
	To indicate an escape route direction as up
	To indicate an escape route and direction as right

31.2 Prohibition signs

Pictogram	Description/Function
	To prohibit the use of a thoroughfare by pedestrians
	To prohibit people with active implanted cardiac devices from entering a designated area
	To prohibit the placing of heavy objects on a surface

	To prohibit use of lift in the event of fire
	To prohibit walking or standing on a designated area
	To prohibit the taking of photographs
	To prohibit unintended disconnection while circuit is live and under load
	To prohibit smoking
	To prohibit smoking and all forms of open flame
	To prohibit unauthorized people from entering area

31.3 Mandatory requirement signs

Pictogram	Description/Function
	To signify that the instruction manual/booklet must be read

	To signify that ear protection must be worn
	To signify that eye protection must be used
	To signify that an earth terminal must be connected
	To signify that the mains plug must be disconnected from electrical outlet for the purposes of maintenance of electrical equipment, in the case of malfunction or when left unattended
	To signify that safety footwear must be worn
	To signify that protective gloves must be worn
	To signify that the handrail must be used
	To signify that head protection must be worn
	To signify that a safety harness must be worn
	To signify that the machine or the equipment, which is not connected to mains by a plug, must be disconnected from all sources of power before carrying out maintenance or repair

	To signify that "lock out tag out" must be performed
	To signify that the tools and items must be tethered to prevent dropping when working from heights.
	To signify that mechanical parts must be locked and secured before accessing the area

31.4 Warning signs

Pictogram	Description/Function
	To warn of non-ionizing radiation
	To warn of non-ionizing radiation with minimum distance to maintain
	To warn of a floor-level obstacle
	To warn of a drop/fall
	To warn of electricity

	To warn of an overhead load
	To warn of a hot surface
	To warn of automatic activation
	To warn of moving mechanical parts
	To warn of an overhead obstacle
	To warn of a closing motion of mechanical parts of equipment
	To warn of counterrotating rollers
	To warn of a pressurized cylinder
	To warn of falling objects
	To warn of an arc flash

	To warn of moving vertical mechanical parts
	To warn CCTV in operation
	To warn of rotating mechanical parts can crush hands

31.5 Firefighting equipment signs

Pictogram	Description/Function
	To indicate the location of a fire extinguisher
	To indicate the location of a fire blanket

31.6 SGRE notification signs

Pictogram	Description/Function
	To Signify hook on to the Anchor points here
	To identify the control that enables or activates wireless communications. To indicate the operational status of the wireless communications function