













AREA	Wind farm
POST	Operation and maintenance
TASK	AW1500 wind turbines


Operation/Equipment	Before to access
Risks	Measure to take
	<p><b>ACCESS BY UNAUTHORISED PERSONNEL IS STRICTLY FORBIDDEN!</b></p> <p>Risk of falling loose objects, falls from heights, electrical risk, trapping, etc.</p> <p>Access to the installation is allowed only to personnel who are properly informed of the installation's risks, duly trained in the access and work techniques and suitably equipped with the obligatory PPE.</p> <p>Before starting any operation on the farm, visit the SET or control building or, in its absence, communicate with the Farm Manager/person responsible for the installation.</p> <p>CECOER must be notified prior to accessing any wind turbine.</p>
    	<p>Mandatory use of personal protection equipment required (PPE) for each task:</p> <p>a) Helmet with chinstrap and safety boots in ground level.</p> <p>b) For working at height:</p> <ul style="list-style-type: none"> <li>• Helmet with chinstrap</li> <li>• Safety boots with non-slip soles.</li> <li>• Harness, CAMBAX or VI-GO fall arrester, double anchor line with energy absorber <sup>(1)</sup></li> <li>• Anti-trauma steps</li> <li>• Mechanical gloves protection</li> </ul> <p>c) To go outside the nacelle, hub or roof, follows the work procedure described in the technical safety instruction.</p> <p>d) Safety goggles in tasks with a risk of flying particles or fluids.</p> <p>e) Minimum respiratory protection A2 for the organic vapours from inside the gearbox and P2 for dust in suspension during cleaning of the slip ring.</p> <p>Additional PPE must be used in operations where the working procedures, chemical product safety sheets and tool manuals require them.</p> <p>Head lamp is required when working at height in the wind turbine.</p> <p>It's necessary to have rescue device in all cases that we are working in the nacelle. This system should be next to the exit door/hatch.</p> <p>Fire extinguisher or fire inhibitor only necessary when Hot Works are doing in the wind turbine.</p> <p><sup>(1)</sup>2 metres retractable lanyard (EN360) with energy absorber also are suitable for working in WTG like a regular lanyard.</p>



Operation/equipment	Access to wind turbine
Risks	Measures to be taken
<p>Persons falling at the same level.</p> 	<p>Take care on entering the wind turbine, especially on very windy days and when the steps are icy or covered with snow.</p> <p>Help yourself with the handrail.</p>
<p>Trapping by the door.</p> 	<p>Take care on entering the wind turbine, especially on very windy days.</p> <p>Maximum wind speed for entering the ground floor is <b>25 m/s</b>.</p> <p>Secure the door with the available retaining device to prevent its slamming shut.</p>
<p>Trapping by or between objects.</p> 	<p>Do not start work without first blocking the wind turbine's remote and local operation as per the LOTO sheet.</p>
<p>Chunks of ice/snow falling from the rotor and blades.</p> 	<p>Nobody must ever approach a wind turbine in a vehicle or on foot when it is shedding chunks of ice/snow.</p>
<p>Storm</p>	<p>In a thunderstorm, do not enter the turbine or leave it immediately.</p> <p>Leave the area of the wind turbine and take refuge in a vehicle or in the sub-station building.</p>
<p>Access by unauthorised persons</p> 	<p>Place a sign on the wind turbine door indicating that personnel are working and warning of the prohibition of access to unauthorised persons.</p> <p>Do not keep the turbine door locked while personnel are working inside.</p> <p>When left the turbine, the door must be locked!</p>




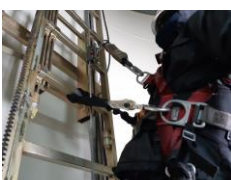
Operation/equipment	Access to wind turbine
Risks	Measures to be taken
Falling objects	<p>Before carrying out load suspension maneuvers or work with the risk of falling objects that must be baliated and signal the area with a safety perimeter:</p> <ul style="list-style-type: none"> <li>- Lifting of loads, use of the hoist.</li> <li>- Major corrective.</li> <li>- Exit to the outside of the basket, hub or blades.</li> <li>- Works inside the hub or blades, etc.</li> </ul>

Operation/Equipment	Access to foundation (steel tower)
Risks	Measures to take
Colliding or impacts against objects	The reduced dimensions of the enclosure do not permit comfortable movement. Extreme precautions must be taken to prevent collisions and impacts.
Electric shock 	Access is prohibited with power applied to the line.
Falling to the same level	Access to the manhole will be made using a ladder. The removed tramex must be replaced immediately when all tasks inside the manhole have been completed. It must be clearly indicated that the tramex has been removed.
Falling objects	The task of removing and replacing the tramex must be performed by two persons. The part weights approximately 15 kg.


Operation/Equipment	Access to the foundations (concrete tower)
Risks	Measures to take
Electric shock	<p>To access the transformer position requires work clearance to be applied to the installation.</p> <p>To access to the ground controller position tee turbine must stopped.</p> <p>To access to the medium-voltage switchgear position requires work clearance to be applied in the facility.</p>


Operation/Equipment	Lifting loads with the hoist
Risks	Measures to take
<p>Falling loose objects</p> 	<p>Before using this equipment, check that it is in good condition. Visually check that the hook, casing, securing arm and the support fibre are in good condition. Also, visually check the cable and equipment control button unit.</p> <p>While the hoist is in use, it is strictly prohibited for personnel to remain within the vertical projection of the loads. The area must be cordoned off to prevent access to third parties.</p> <p>The support person on the ground may only enter the hazardous area in order to attach or release loads. This person must remain outside the hazardous area for the rest of the operation.</p> <p>For lifting loads tool bags suitable for the size and shape of the loads and in good condition, with a closing system, will be used. In the case of material that does not fit inside the bags, have a procedural slinging system.</p> <p>Before starting the operation, check that the loads are well fixed and properly inserted in their tool-carrying containers to prevent them from falling.</p> <p>The hoist operator must not start the operation before checking that there are no persons within the hazardous area. He will monitor the load at all times and never leave the control device unattended.</p> <p>Take great care when passing loads through the rear door to prevent the sacks from catching or tipping. Make as many trips as are necessary to lift the load safely.</p> <p>In high winds, it will be necessary to secure the loads with a guide line to prevent their hitting the tower. It is forbidden to lift small loads in strong winds without an effective system for securing them from the ground.</p> <p>It is forbidden to leave the area while there are suspended loads.</p> <p>It is strictly forbidden to leave loads suspended from the hoist hook.</p> <p>The person guiding the load must remain outside the hazardous area and well away from the projection of possible falling objects. He must never wrap the line around any part of his body.</p>


Operation/Equipment	Stay on the ground
Risks	Measures to take
<p>Falling loose objects</p> 	<p>It is <b>forbidden to remain on the ground while work is being undertaken at higher levels</b> or loads or tools are being handled in the tower, especially in concrete towers.</p> <p>The horizontal net installed in the central corridor of the ground and permanently protects only against the risk of falling objects like talkies and proper objects.</p>
<p>Sulphur hexafluoride intoxication</p> 	<p>If there is a sulphur hexafluoride (SF<sub>6</sub>) leak, open the door to ventilate the enclosure.</p> <p>Since this gas is denser than air, if there is a leak it will accumulate at floor level, displacing the oxygen. Therefore, do not crouch down in the event of a hexafluoride leak. Abandon the enclosure and leave the door open to encourage ventilation.</p>



Operation/Equipment	Stay on the ground
Risks	Measures to take
<p>Electric shock</p> 	<p>Work with electric shock risks must only be carried out by authorised or qualified personnel, in accordance with RD 614/2001 on electric shock risk (or required qualification according to the country's legislation).</p> <p>Strict application of the Five Golden Rules:</p> <ol style="list-style-type: none"> <li>1. Disconnect power supplies.</li> <li>2. Prevent any possible reconnection.</li> <li>3. Check the absence of voltage.</li> <li>4. Connect to earth and put in short-circuit.</li> <li>5. Cordon off the work area.</li> </ol> <p>Make use of personal protection equipment (PPE) according to the voltage ratings in tasks when required by legislation and when there is a risk of electric shock or arcing: dielectric gloves according to voltage rating, gloves providing thermal protection (worn under the protective ones), inactive face-screen, clothing providing protection against arcing (gloves, jacket and trousers or overalls) and a hard hat for electrical work.</p> <p>The equipment required for electrical work must be checked according to the manufacturer's maintenance specifications and current legislation.</p> <p>Other material for electrical work: mats, detector and hot sticks must also be in accordance with the voltage range and inspected according to the maintenance manuals.</p>
<p>Explosion (switchgear operation)</p> 	<p>The switchgear panel operating sequence established by the manufacturer must be followed at all times.</p> <p>Do not force the mechanism more than normal. Do not operate switchgear panels with low SF<sub>6</sub> levels. Report the issue!</p> <p>Follow the established switchgear panel reset protocol.</p>
<p>Trapping by the switchgear panel control operating mechanism</p>	<p>Only remove the front protection when the springs are mechanically released.</p>
<p>Fire (wiring short-circuit)</p>	<p>In the event of fire, try to put it out with hand-held extinguishers provided this does not involve a serious risk for the personnel. If this is not possible, activate the Emergency Plan for the wind farm.</p>
<p>Trapping by the lift</p> 	<p>Take extreme precautions to avoid being trapped by the lift. Do not enter the vertical projection of the lift at ground level.</p> <p>If it is absolutely necessary (for example, lifeline inspection), the lift must be blocked in accordance with the corresponding LOTO procedures so that others cannot put it into operation.</p>
<p>Fall from heights</p> 	<p>Install anchor points in the ground beams according to the procedure to carry out work at height.</p> <p>To work statically on the vertical ladder, use the fall arrester on the lifeline and the adjustable lanyard.</p>

Operation/equipment	Connection switchgear/ground converter cabinet/auxiliary services transformer input area
Risks	Measures to be taken
Exposure to electromagnetic fields.	<p>The performed measurements give values of <math>&gt;100 \mu\text{T}</math> and <math>&gt; 5,000 \text{ Vm}</math> in the following areas:</p> <ul style="list-style-type: none"> <li>• Switchgear panel</li> <li>• Ground cabinet</li> <li>• Transformer input area</li> </ul> <p>Sensitive personnel, such as pregnant women, personnel with pacemakers, Stent insulin pumps and other types of implanted electronic devices, may suffer interference. This is why they must notify their situations and must have authorisation from the medical staff to enter the turbine.</p>


Operation/Equipment	Ascending to and descending from the nacelle
Risks	Measures to take
<p>Falling to a different level</p> 	<p>The preferred method for ascending to and descending from the nacelle is by the lift, with the ladder only to be used in emergency situations and lift problems etc.</p> <p>Lifts may only be used by personnel who have been duly trained in the instructions on use and procedures in case of an emergency.</p> <p>Before using a lift, ensure that it is up to date with its inspections (check the information on the relevant adhesive label). Also check that the life line has been inspected in case it has to be used.</p> <p>Carry out all the necessary checks before the equipment is used.</p> <p><b>It is strictly forbidden to travel outside the cabin.</b> Personnel must always travel inside the cabin with all doors and hatches closed.</p> <p>Personal protection equipment against falling from a height (harness, double anchor line and fall arrester) must be worn at all times.</p> <p>The maximum lift load must be respected at all times and the safety devices must never be altered.</p> <p>To travel worker and material is only possible if the material can be lifted and anchored on a rung in such a way that the lower hatch is free.</p> <p>The maximum wind speed for working in the tower or nacelle is <b>20 m/s</b></p> <p>The ascent and descent of the cabin is carried out using the vertical step that the cabin has. Do not step on the motor covers.</p> <p>Extreme environmental temperatures could be conditioned the use of the equipment. The operating ranges are: environmental temperature: between <math>-10^{\circ}\text{C}</math> and <math>+ 40^{\circ}\text{C}</math>. Relative Humidity: 90% at <math>35^{\circ}\text{C}</math>.</p>
Falling objects	<p>Ensure all precautions are taken to prevent loose objects from falling inside the tower.</p> <p>Work must not be carried out on different levels inside the tower.</p>
Trapping	<p>Do not use the ladder without first ensuring that the lift is blocked and cannot be operated, according to the corresponding LOTO procedure.</p> <p>Both the upper and lower hatches exceed <math>90^{\circ}</math> in the open position. In addition, the upper one has a magnet or latch that fixes it.</p> <p>However, travel with caution since a blow can make it fall</p>




Operation/equipment	Stay on intermediate platforms
Risks	Measures to be taken
Persons falling to a different level. 	PPE against falling from height must be used whenever there is no collective protection in place or it is not in good condition.

Operation/Equipment	Stay in the transformer enclosure
Risks	Measures to take
Electric shock 	All electrical work must be carried out in accordance with RD 614/2001 on electric shock risks (or necessary qualification according to the country's legislation). See the preventive measures against electric shock risk when on the ground.  The transformer enclosure must remain closed and interlocked with the switchgear panel when it is energised.
Fire (wiring short-circuit)	In the event of fire, try to put it out with hand-held extinguishers provided this does not involve a serious risk for the personnel. If this is not possible, activate the Emergency Plan of the wind farm.
Persons falling to a different level (steel tower)	Always remain anchored to a fixed point since there is no hatch.  The transformer cage roof must be accessed as shown in the technical safety instruction.








Operation/Equipment	Stay in the yaw platform
Risks	Measures to take
Falling when moving from the ladder to the yaw platform 	Do not release the fall arrester from the lifeline until you are connected by the anchor line. In the reverse movement, do not release the anchor line until you are connected to the lifeline with the fall arrester. Anchoring to a fixed point is also a valid option.  Do not leave the platform hatch open when this is not necessary.  Always remain anchored to a fixed point while the platform hatch is open or positioned on the hatch cover. The anchor point is located on the tower wall.
Fall objects (from yaw platform) 	Store material and tools on the side opposite the hatch. Whenever possible, store the small tool in the tool bag.  If objects are capable of tipping them into their most stable position.  If work is carried out in this area of the wind turbine, preventively cover the gaps: closing the hatch and covering the central hole.








Operation/Equipment	Stay in the yaw platform
Risks	Measures to take
<b>Trapping</b> 	<p>The hatch exceeds 90° in the open position. However, travel with caution since a blow can make it fall.</p>
<b>Fall objects (from nacelle)</b>	<p>Keep objects and tools away from the nacelle opening.</p> <p>Do not work near the nacelle opening while the personnel are on the yaw platform (working or simply ascending to or descending from the WTG).</p> <p>Keep the hatch properly closed whenever possible.</p>


Operation/equipment	Stay in nacelle
Risks	Measures to be taken
<b>Falling when moving from the yaw to the nacelle and vice versa.</b> 	<p>Take great care when moving from the crown platform to the nacelle and <i>vice versa</i>:</p> <ul style="list-style-type: none"> <li>Do not keep your hands occupied with tools or objects that make it difficult to hold on.</li> <li>Support yourself on firm and reliable structural elements only.</li> </ul> <p>Close the hatch after passing from the yaw to the nacelle.</p>
<b>Falling to the same level</b>	<p>Maintain cleanliness and tidiness. All oil or grease spills likely to cause slipping must be cleaned up.</p> <p>Walk only on the tramex sections in the side passageways.</p>
<b>Collisions and impacts against objects.</b> 	<p>Take great when moving in the nacelle since its small size especially increases the risk of impacts.</p> <p>Maintain cleanliness and tidiness and move around the nacelle carefully and without haste.</p>
<b>Falls to a different level and falling of detached objects: use of hoist.</b> 	<p>Before opening the rear door to use the hoist:</p> <ul style="list-style-type: none"> <li>Anchor yourself to a fixed point with the safety line.</li> <li>Move tools away to avoid the falling of detached objects.</li> </ul> <p>The two horizontal bars are not an effective anti-fall element.</p>



Operation/equipment	Stay in nacelle
Risks	Measures to be taken
<p>Falls to a different level: breakage of the fibre.</p> 	<p>The fibre casing must be visually inspected prior to moving out on to it in order to abandon access if any cracks or damage are discovered that raise doubts as to its structural integrity.</p> <p>It is mandatory to take precautions against falling from height when two or more persons are located on the fibre or a single person with 10 kg of load.</p>
<p>Trapping in the shaft/slow hub joint.</p>	<p>The tub in the slow shaft – hub joint can only be accessed when the power train is mechanically blocked.</p> <p>It must be locked out and tagged out according to the LOTO procedure established by ACCIONA.</p>
<p>Trapping in the brake disc.</p>  	<p>It is forbidden to remove any safety guard without first blocking the power train mechanically.</p> <p>Only lock the rotor by trained personnel according to the corresponding instructions.</p> <p>Lockout and tag out as established in the LOTO file of the technology developed by ACCIONA.</p> <p>Maximum wind speed to block the rotor: <b>15 m/s</b>.</p> <p>Wear mechanical protection gloves.</p>
<p>Falls to a different level: nacelle hatch.</p> 	<p>Keep the nacelle hatch closed when not in use.</p>
<p>Inhaling or ingesting harmful substances.</p>  	<p>Cleaning the ring body and inspection of the gearbox involve exposure to chemical pollutants (dust particles and organic vapours).</p> <p>Open the nacelle hatches to promote the enclosure ventilation.</p> <p>Make use of suitable breathing protection (minimum A2 for gearbox and P2 for slip ring).</p> <p>Employ vacuum cleaning methods and use disposable covers while cleaning the slip ring.</p>
<p>Forced postures.</p>	<p>All tasks that require non-ergonomic postures for long periods should be accompanied by rest stops to alleviate the physical effort caused by the task.</p> <p>It is recommended to do stretch exercises before starting work.</p>
<p>Falling from outside nacelle</p> 	<p>Asegurarse contra las caídas de altura según el protocolo de seguridad establecido para la tecnología.</p> <p>Maximum wind speed for exiting to the nacelle exterior: <b>12 m/s</b>.</p>

Operation/equipment	Stay in nacelle																									
Risks	Measures to be taken																									
Falling from the hub exterior. 	Secure against falls from heights according to the safety protocol set for the technology. Maximum wind speed for exiting to the nacelle exterior: <b>12 m/s</b> .																									
Fire	In machines with nacelles not equipped with fire extinguishers or anti-fire system, it is obligatory to take a fire extinguisher when carrying out tasks with a risk of fire. In the event of a fire, try to suffocate it with the available manual extinguishing means, but without risking yourself at any time. If it is not possible to extinguish it, leave the nacelle immediately, either on the ladder (preferably) or with the emergency descent device. Remember that there is a real risk of suffocation, so breathing should be as gentle as possible. Protect your mouth and nose with a rag, shirt or similar.																									
Splashes 	Everyone who is to handle the hydraulic unit must be familiar with the hydraulic distribution schematic. Release the pressure before handling and check with a pressure gauge immediately before starting the operation. Wear suitable protective gloves to avoid damage by skin contact with oil and wear safety goggles. Nitrogen accumulators are also a source of energy. Block their activation according to the set procedure.																									
Electrical contacts 	All electrical work must be carried out as per Royal Decree 614/2001 on electrical risk (or the necessary qualification as per the country's regulations). See the electrical contacts preventive measures in the ground area.																									
Noise	Average noise values expressed in decibels on the turbine components (data collection: 1 minute using a sound level meter). The LAeq datum includes two points of uncertainty. <table border="1" data-bbox="742 1467 1385 1702"> <thead> <tr> <th>System</th><th>LAeq</th><th>Lpico</th></tr> </thead> <tbody> <tr> <td>Ground cabinet</td><td>76.8</td><td>95.1</td></tr> <tr> <td>Hydraulic unit</td><td>93.3</td><td>105.3</td></tr> <tr> <td>Yaw drive hydraulic unit</td><td>80.1</td><td>100.1</td></tr> <tr> <td>Gearbox intercooler</td><td>86.1</td><td>105.8</td></tr> <tr> <td>Generator intercooler</td><td>81.1</td><td>103.8</td></tr> <tr> <td>Amenabar 250 kg hoist</td><td>69.9</td><td>87.8</td></tr> <tr> <td>Goian lift</td><td>80.8</td><td>112.4</td></tr> </tbody> </table> Use of ear defenders as per the country's local regulations.		System	LAeq	Lpico	Ground cabinet	76.8	95.1	Hydraulic unit	93.3	105.3	Yaw drive hydraulic unit	80.1	100.1	Gearbox intercooler	86.1	105.8	Generator intercooler	81.1	103.8	Amenabar 250 kg hoist	69.9	87.8	Goian lift	80.8	112.4
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Nitrogen	Since it is a denser gas than air (although inert), in the event of a leak it will accumulate in the machine's bath, displacing the oxygen in that area. In the event of accidental nitrogen leakage from the accumulator, open the rear door and hatch for ventilation.																									

Operation/Equipment	Access to the hub
Risks	Measures to take
<p>Falling from height and trapping</p> 	<p>Progress by securing yourself against falling from heights according to safety procedure for the technology.</p> <p>While working inside the hub, it is forbidden for more than one person to be on the blade root, otherwise you must be secured against falling from height. The preferred anchor points inside the hub are the blade accumulator flanges.</p> <p>Before accessing the hub cone, check for cracking and that the blade entrances are fitted with the corresponding covers etc.</p>
Falling at same level	Clean the progress path and work area eliminating possible grease, oil, etc. If necessary, also clean the soles of the footwear before continuing to progress.
Falling objects	<p>Maintain all precautions when passing material from the nacelle to the hub and from the hub to the nacelle. Do not pass tools by throwing them.</p> <p>The hub is not a sealed enclosure. Any small tool or component that falls onto the fibre may exit and fall outside the turbine.</p>
Trapping	<p>It is obligatory to mechanically block the rotor before accessing the hub and also to apply the corresponding LOTO procedure.</p> <p>The maximum wind speed for accessing the hub is <b>15 m/s</b>.</p> <p>In order to work on the blade pitch air system, the power supplies must be disabled according to the associated instruction.</p>
Electric shock risk	There are only electric circuits inside the hub that run on 24V safety voltage. If possible, these should be locked out and tagged out in order to work on them.
<p>Splashes</p> 	<p>All personnel working on hydraulic sets must be familiarised with the hydraulic distribution schematic.</p> <p>Before commencing work, the hydraulic pressure must be released and verified using the manometer prior to proceeding.</p> <p>Wear suitable protective gloves to prevent skin contact with the oil and also wear eye protection.</p> <p>The nitrogen accumulators are also a source of energy and their activation must be blocked according to the corresponding procedure</p>
	<p><b>Warning!</b> Each brand and model of hydraulic system has its corresponding or safety valve and its predefined screw.</p>
Nitrogen	<p>Since this gas is denser than air, although inert, if there is a leak it will displace the oxygen at floor level.</p> <p>In measurements performed by provoking a controlled leak, a hazardous atmosphere caused by oxygen deficiency was not registered. However, the hub must be abandoned if an accidental leak is discovered from the nitrogen accumulators.</p> <p>It can be accessed again after one hour and the oxygen level must be checked.</p>
Lighting	The hub lacks artificial lighting. It must be accessed by wearing at least frontal lights to access the interior.

Operation/Equipment	Stay inside the blade
Risks	Measures to take
<p>Confined space</p> 	<p>Access inside the blade involves working in a confined space and a Work Permit. It must be possible to measure the oxygen level. During blade access, there must be a technician in the hub and another in the nacelle.</p> <p>These technicians must possess accredited training and have the following:</p> <ul style="list-style-type: none"> <li>a specific rescue procedure for the turbine (made by the manufacturer of WTG or the owner),</li> <li>training in taking emergency action inside the hub and demonstrate practical drill experience at an actual installation. No technician who cannot demonstrate this fact may access a blade to carry out inspections or repair work; nor may this person act as an invigilator in the hub or act as a support technician in the nacelle.</li> <li>the work unit must be in possession of all the material required in order to execute a rescue. The rescue kit will include escape equipment (EN 1146:2006 breathing assistance equipment) in case it becomes necessary to access the blade and the air quality inside cannot be guaranteed.</li> </ul>
Falling to the same level	Possible presence of oil or water. The pass area must be dried before commencing any tasks.
Chemical	<p>Handling and application of chemical products may produce an explosive atmosphere.</p> <p>These chemicals can also generate in vapours that requires other preventive measures.</p> <p>Check the safety data sheet of the chemical product before handling.</p> <p>Forced ventilation always necessary when we are going to work with chemical products or repair work that generates suspended dust.</p>