EXPLOSION IN THE PITCH SYSTEM BATTERY BOX

acciona Energía

QSE Alert

Non-Conformity Code associated: NC20150000849

This document includes information of public knowledge and its goal is to share the lessons learnt that comes from incidents or dangerous conditions and that can be of interest for the people working in the business operated by Acciona Energía.
This document could have future updated versions because of a better collection and analysis of the information, the proper improvement of the technology and proposed actions, etc… So that, it is important to consult to Acciona Energía for the up-to-date version of our Alerts.

SCOPE

☒ Worldwide ☐ Local. Country:

☐ All Business ☐ Construction ☒ Production

☐ All Technologies ☒ Wind ☐ Hydraulic ☐ Thermoelectric

☐ Solar ☐ High Voltage

FACTS

Acciona Energía wind farm, December 2014.

During maintenance on a failed turbine in an Acciona Energía wind farm a large explosion occurred in the hub that seriously injured one engineer and slightly injured his companion.

Turbine specifications: h = 100 m, electric pitch, with lift.

Location of the explosion: battery box

Time of accident: 20:20 (completely dark due to the time of year).

Description of the injuries: open fractures in both legs that completely immobilized the victim; his workmate´s injuries were not serious (impacts and contusions to one leg) that did not impede his mobility.

The situation in which the accident occurred:

The turbine had been shut down for approximately two days due to pitch system failure. During the first day of shutdown, various jobs (battery and motor replacement, wiring modification, etc) were carried out on the pitch system, but the control system problem persisted. Work continued on the machine during the second day, but again without any success. The batteries were repeatedly charged and discharged during all these attempts to resolve the fault.

There were five people in the turbine at the time of the accident: two in the hub, two in the nacelle and one below.

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Accident description:

At a given moment there was a large explosion in the pitch battery box. When this occurred, one of the engineers was sitting on the box operating one of the pitch system control panels for one of the blades (the box had its cover fitted, but was not locked with its key). This engineer was violently sent flying by the explosion, which caused the previously described fractures. His companion only suffered minor injuries.

Causes:

Everything points to the repeated charging cycles that the batteries underwent causing damage to some of them producing an unusual release of hydrogen gas with an extremely low inflammability limit. The hydrogen mixed with the oxygen in the air, together with a still unknown ignition source, caused the explosion. This ignition source may have contact of a tool with some metal part of the hub.

Rescue description:

The technicians that were in the nacelle put the emergency plan into operation, they called 112, provided first aid for the injured parties (stopped bleeding, etc.), removed the engineer with the fractures from the hub, fitted him with a harness and used the hoist to lower him to the ground. The other injured engineer was able to go down in the lift unaided.

It should be pointed out that at the time of the accident there was no emergency descent equipment in the nacelle, although before evacuation using the hoist two rescue devices were brought up. The decision to evacuate the victim using the hoist was taken because technicians considered that, as victim had broken his legs and night had fallen, it would be easier to control the rate of descent and to avoid the crash of his legs against the ground.

By 21:10 the victim was transferred to hospital by ambulance.

LESSONS LEARNED

FROM A TECHNICAL POINT OF VIEW:

- When fault resolution is taking more time than expected, the attempted operations are not successful or the exact cause is unknown, a specialist support engineer should be contacted to assist in resolving it without any risks. To stubbornly insist when the situation is not clear can be counter-productive.
- The electric pitch hub batteries may release hydrogen, a highly inflammable gas. The following general recommendations must be taken into account to prevent it:
  - → In case of a problem, the entire block must be replaced; under no circumstances should batteries be changed individually.
  - → Do not subject the batteries to repeated charge and discharge cycles because this could damage them.
  - → Check the battery technical specifications and use them according to the manufacturer's instructions (do not force or handle them internally and respect their usage limits, etc).
- The following should be specifically performed:
  - → Assess each electrical pitch turbine for the actual risk of hydrogen being produced in the hub batteries and define a specific work protocol.
  - → Ensure that the battery boxes are not sealed. If their design includes membranes to allow battery cabinet aeration, verify their correct operation.
  - → Prepare a list of alarms per turbine that could indicate possible release of hydrogen. If hydrogen release is suspected in the hub, disconnect the auxiliary services to the pitch system and establish a waiting time to allow for aeration before entering.
  - → Do not carry out hot-working processes inside the hub without first having discarded the possibility of hydrogen being present using adequate measuring equipment.

REGARDING THE RESCUE ACTION:

- NEVER, UNDER ANY CIRCUMSTANCES, USE THE HOIST TO EVACUATE AN INJURED PERSON EVEN WHEN HIS WEIGHT DOES EXCEED THE MAXIMUM EQUIPMENT LOAD. The reasons are as follows:
  - → There could be a power failure leaving the victim stranded in mid-air in a location that is impossible to access without an elevator platform or specialist rescue equipment.
  - → The hoist is designed and certified only for lifting loads, not persons, which means it will not comply with the design (safety factors) and test requirements and certifications that are legally required for officially-approved material when working at height (PPE, ropes and emergency descent equipment, etc).
  - → Because although the hoist was up-to-date with the maintenance established by the manufacturer, there could have been defective internal components in the kinematic chain of the hoist that were visually unappreciable (Ferodo (brake pad), clutch or gearbox, etc), which could cause sudden hoist failure and falling load.
- THERE MUST ALWAYS BE A RESCUE DEVICE AVAILABLE WHEN WORKING IN THE NACELLE.

- THE ESTABLISHED TRAINING PLAN MUST GUARANTEE THAT ENGINEERS ARE FULLY AWARE OF THE SAFE NACELLE EVACUATION METHODS AND ARE ABLE TO APPLY THEM.

- IT MUST BE TAKEN INTO ACCOUNT THAT AN EMERGENCY IN HOURS OF DARKNESS IS MORE LIMITED THAN DURING THE DAY AND, FOR THIS REASON, NIGHTTIME WORK MUST BE KEPT TO THE BARE MINIMUM.

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