Smoke generation in a wind turbine nacelle

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France

Wind turbine
Choice of materials
Restart
Alarm
New risk

THE ACCIDENT AND ITS CONSEQUENCES

At 3 p.m., technicians working on a wind farm observed smoke coming from a wind turbine nacelle. They alerted the fire department and the operator, which shut down the entire farm. The power grid manager shut off the high-voltage grid to power down the wind turbine.

Damage on the ground

Smoke was visible and debris fell at the foot of the wind turbine and burned approximately 20m² of vegetation at the foot of the wind turbine.

The fire department worked to extinguish various small brush fires. The smoke dissipated on its own in 15 minutes.

At 5 p.m., the wind farm was started up again except for the affected wind turbine. The operator put security in place. They inspected all the blades visually.

No damage to the blades was observed. The internal damage remained focused on the generator in the nacelle:

- Rubber seal between the generator fairing and destroyed stator windings,
- Melted Perspex protection elements,
- Soot deposits on stator windings.

The wind turbine remained shut down for 7 weeks, causing operating losses.

The soot found around the generator was cleaned over the following days with dry ice.

ORIGIN AND CAUSES

Seal catching fire:

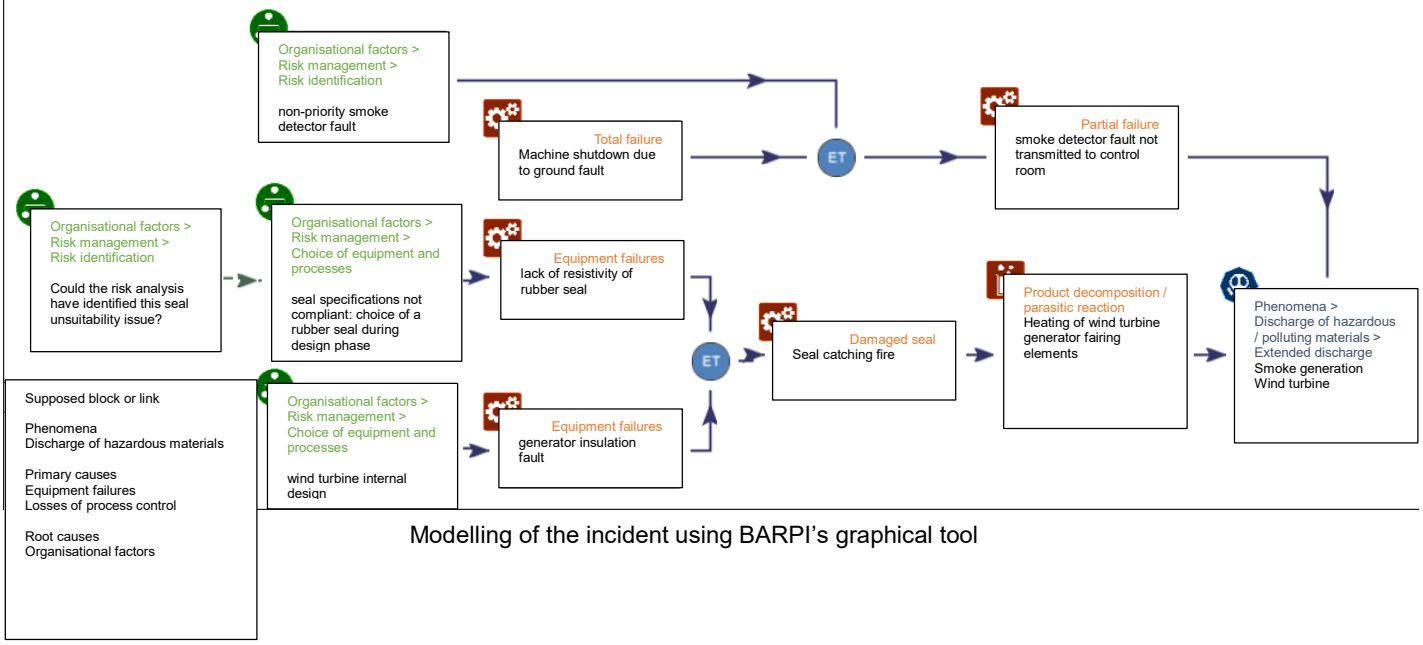
On restarting the machine, a rubber seal between the generator fairings and stator windings caught fire. The heat given off by this fire caused the wind turbine generator fairing protection elements (varnish, Perspex housing, rubber body) to heat up, which caused smoke to be generated.

After analysis, the operator observed that the specifications of the rubber joint, designed for the type of wind turbine involved, and which serves to direct the air flow onto the generator, did not match the properties ultimately expected. **The characteristics of the seal combined with a local generator insulation weakness** triggered a resistive electrical fault that caused sufficient heating to make the seal catch fire.

No fire alarm during the event:

The wind turbine smoke detector signalled a fault that was not transmitted to the control centre, because a higher priority alarm, i.e., a ground fault, had been detected beforehand. This first electrical fault caused the machine to be shut down before the smoke was generated. The smoke generation was detected by operators working on another machine.

ARIA 55984 - Smoke generation in a wind turbine nacelle



Modelling of the incident using BARPI's graphical tool

NEXT STEPS TAKEN

Close monitoring of this event was set up by the inspection authorities for classified facilities including several telephone meetings with the operator. This event demonstrates two major issues:

- 22 wind turbines in France are affected by the rubber seal issue,
- all the manufacturer's turbines need to have their alarm prioritisation modified.

A solution has been rolled out nationwide. The manufacturer has reported this incident to professional organisations in the industry.

LESSONS LEARNT

The operator has corrected the smoke detector fault. The priority of "ground fault" alarms over "fire" ones is an issue that had been identified. The manufacturer is continuing to roll out the scheduled alarm processing update to all machines to modify their alarm prioritisation.

Generator insulation has been reinforced.

The rubber seals have been removed until they can be replaced with seals meeting the required specifications. The wind turbine can operate without a seal because the only risk is a temperature increase. If a temperature increase is observed, power may be limited. During the wind turbine restart process, the operator has reinforced supervision by monitoring various parameters manually.

The rubber seals in the 22 affected wind turbines have been replaced with silicon seals, used on machines commissioned since 2017.