



The third in the sequence of turbine collapses in Nebraska. Photo: LuAnn Schindler

Top GE engineer lifts lid on wind turbine collapse probe findings

Major investigation suggests variety of factors rather than 'single systemic issue' behind first four of five incidents

by **Andrew Lee**

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GE's investigation into a string of collapses of its wind turbines in 2019 suggests a variety of factors rather than "a single systemic issue" is behind the first four, the engineer leading the probe revealed to *Recharge*.

Ed Hall, engineering leader, onshore wind, at GE Renewable Energy said the sequence of five collapses – three in the US and two in Brazil (*see panel at foot*) – had sparked a major response involving more than 100 people and drawing in expertise from the wider General Electric group.

While the latest incident in Brazil on 3 September is still too recent for any conclusions, Hall gave *Recharge* an exclusive insight into the manufacturer's findings of the root causes behind the first four topplings, which began in New Mexico in February.

They suggest two distinct categories of cause – two related to blades and two to control systems – but all ultimately resulting in machine instability and collapse.



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"Two of the incidents involved blades coming apart during the operation of the turbine in high wind speeds, but resulting from different contributing factors," Hall said.

"The other two incidents of the first four appear to be related to how our control systems responded to a sequence of events in the field.

"It does not appear that a single, systemic issue that affects the whole fleet is at play here. We've got separate areas that we need to investigate and resolve."

Hall confirmed that unusually high wind speeds occurred before several of the collapses.

"That is correct. The reason [high winds] are important is that the higher the wind the more energy content is available in the operation of the machine. Just having that high energy content increases the potential for something to happen."

The investigations and subsequent response have seen Hall and his colleagues reach out to experts in GE's Power, Aviation and Research businesses, as they worked to understand the incidents that have made their turbines the subject of intense industry focus.

"It is unusual for us to see five in a relatively short time."

Hall said: "It's not unknown for these types of incidents to happen in the industry. The industry overall documents around 90 incidents since 2011."

But he added: "It is unusual for us to see five in a relatively short time."

The company's wide-ranging response so far to the various issues uncovered, including blade inspections, supplier and manufacturing record checks, software updates and technical communications to operator and service personnel, has been done in a way to minimise

impact on the GE operating fleet, he said. "I don't believe there is a customer impact to production."

A blade monitoring analytic has been developed in an effort to predict failures before they happen. "That analytic is now in place at over 150 wind farms, we will continue to propagate that worldwide," said Hall.

Hall, a 17-year GE veteran, said all the investigations "are ongoing and will not be closed until we are satisfied solutions are fully identified and implemented".

So can current and potential customers have confidence in GE Renewable Energy wind turbines?

"The industry can count on us to bring all our resources to bear to investigate and ultimately resolve these issues," said Hall.

THE COLLAPSES AND WHAT WE KNOW

February 2019. 51MW Casa Mesa Wind Energy Center, New Mexico. Turbine: GE 2.5-127. Operator: NextEra Energy.

Ed Hall on what we know:

"A combination of multiple factors while the turbine was in operation. A mechanical issue combined with an electrical issue led to the control system being a little slow to respond, the turbine progressed to an unstable operation and ultimately a blade struck the tower."

May 2019: 65MW Chisholm View 2, Oklahoma. Turbine: GE 2.4-107. Operator: Enel Green Power.

What we know:

"During the restart of a turbine, a hard reboot was performed. During the reboot while some of the protection systems were still coming online, the turbine progressed to an unstable operating condition."

July 2019: 200MW Upstream Wind Energy Center, Nebraska. Turbine: GE 2.5-116. Operator: Invenenergy.

What we know:

"A blade that was damaged prior to installation was evaluated and repaired using our standard procedures. What was unknown was that there was additional damage hidden inside the blade that was not detected and that damage ultimately resulted in a crack and the blade detached near the point of repair. Under high wind operating conditions, that led to an imbalance and overwhelmed the tower."

July 2019: 216MW Ventos de São Clemente wind complex, Pernambuco, Brazil. Turbine: GE 1.7-103. Operator: Echoenergia.

What we know:

"The turbine had been operating for some time and in the course of that operation a crack developed in the blade. It was not detected during normal inspections, and ultimately grew larger and resulted in the blade detaching."

September 2019: 54MW Delta 6 wind park, Maranhao, Brazil. Turbine: GE 2.7-116. Operator: Omega.

What we know:

"It's too early to comment or speculate on the root cause. It's known technicians were at the turbine and performing some service on the turbine at the time. One of the technicians was injured and we're doing everything we can to support that person and his family."