

1 in Denmark and a PhD in Mechanical Engineering Mechanics from Michigan Technological
2 University.

3
4 Q Please describe your employer, your position, occupation and profession?

5
6 A I work for Vestas Wind Systems A/S in Denmark. Vestas is the largest manufacturer of wind
7 turbines in the world and has been in the business of designing, manufacturing and constructing
8 wind turbines and turnkey wind power projects since 1979. At Vestas, I have held various
9 positions over the last 13 years in Research & Development, product design, manufacturing and
10 overall product management. These positions have included being Project Manager and the
11 Mechanical Design Manager in R&D for 7 years and the Chief Product Engineer for new
12 turbine designs for 6 years. Presently, I am Vice President of Technology. I am a member of
13 the Danish Society of Engineers, which is, in essence, the equivalent of being a Professional
14 Engineer in the United States.

15
16 Q What are your primary duties and responsibilities?

17
18 A As the Project Manager and Mechanical Design Manager in R&D my responsibilities included
19 design analysis and load and stress calculations for several lines of Vestas turbines. My duties
20 included ensuring compliance of turbine designs in accordance to multiple international codes
21 and standards in order to obtain third party design certification for safety and reliability prior to
22 the release of any new turbine design for manufacture and operation.

23
24 As Chief Product Engineer at Vestas, I was responsible for defining the design standards for
25 turbines according to commercial market conditions, regulatory requirements and normative

1 requirements that set standards and codes for safety. I ensured that the Vestas R&D department
2 integrated these design standards into the development of final manufacturing designs and
3 technical specifications of the turbines. My current position at Vestas is Vice President of
4 Technology, which involves increased management responsibilities and oversight of not only
5 wind turbines, but also of turnkey wind power project construction work.

6
7 Q Please summarize and briefly describe your work experience in the wind turbine industry.

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9 A I have worked on the design, testing and manufacture of wind turbines since 1991. I have been
10 the lead engineer on 7 versions of Vestas wind turbines starting with the V39-500kW and then
11 the V42-600kW, V44-600kW, V47-660kW, V66-1.65MW, V80-1.8MW and V90-3MW.

12
13 Q Please describe the number of wind turbines that have been installed by Vestas during your
14 tenure with the company and how many wind turbines are in the Vestas fleet.

15
16 A In 1991 Vestas had approximately 3,500 turbines in operation, and as of December 31, 2003 we
17 had 13,494 turbines worldwide. Therefore, during my tenure at Vestas, there have been
18 approximately 10,000 Vestas turbines installed and operated.

19
20 Q Please briefly describe the type of work that goes into ensuring a turbine design is safe.

21
22 A The first exercise is to determine general turbine blade geometry and design based on
23 aerodynamic performance, manufacturability, material behaviors and adequate overall strength
24 to withstand the load requirements set forth by a number of standardizing institutions and
25 agencies including the IEC (International Electrotechnical Commission), ISO (International

1 Organization for Standardization), DIN (Deutsche (German) Industry Norms), ANSI
2 (American National Standards Institute) to name a few. Vestas first designs the blades and
3 other components on a computer and analyzes them using a proven aeroelastic modeling
4 software. This software has been used in the design of turbines since 1992 starting with the
5 V42-600kW turbine and has been verified with actual field measurements of turbine loads.
6 These loads are then used in the design of systems and components. We perform critical
7 element analysis and verify that all critical load carrying components of the wind turbine
8 meet the strength and fatigue load endurance requirements set forth by the standards to
9 ensure that they do not fail in the event of loads such as those imposed by peak wind gusts,
10 and fatigue loads beyond the design life of the turbine which is 20 years. All of the
11 calculations and verification testing work are reviewed and scrutinized by a qualified and
12 experienced, independent, third party approval agency such as RISØ of Denmark, Det Norske
13 Veritas (DNV) of Norway or Germanischer Lloyd (GL) of Germany.

14
15 Q What is the peak gust survival wind speed for Vestas turbines?

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17 A The peak 3 second gust survival wind speed for IEC Class 1 Vestas turbines is 70 m/s, or 157
18 mph and for our IEC Class II it is 59 m/s or 132 mph.

19
20 Q Please describe the risk of a modern wind turbine losing a full blade or portion of a blade during
21 operation..

22
23 A. A modern, well maintained turbine has a probability of less than one in a million (1/1,000,000)
24 of losing a full blade or having part of a blade coming loose or collapsing. The 1/1,000,000 is a
25 standard which is part of the codes used to determine the load cases for the design of the wind

1 turbines. The highest potential cause is an over speed condition of a gross enough nature to
2 present sufficient forces to cause blade damage and partial separation. During the design
3 process a full-size blade is built and tested to ultimate strength to ensure that the design and
4 construction methods meet requirements to avoid this potential even under severe conditions.
5

6 Q Please describe safeguards and systems in wind turbines that prevent this from occurring.
7

8 A Current wind turbine designs utilize multiple, independent and redundant safety systems to
9 prevent over speed situations. Speed control limits are normally monitored and controlled by the
10 main control system. A second, fully independent system called the Vestas Over-speed Guard
11 (VOG) is also constantly active which will automatically halt the turbine in the event of a main
12 controller failure or other critical alarm fault. Each system can halt the turbine completely
13 independent of the other. Each system will prevent the turbine from operating unless they are
14 both operating properly and communicating with each other. On all of our megawatt class
15 turbines, each blade is equipped with an independent pitch system and nitrogen accumulator
16 which is like a compressed air tank. Even if only one blade can be pitched, it will prevent the
17 rotor from being able to enter into an over-speed condition. In the event of power loss or a loss
18 of hydraulic system pressure, the nitrogen accumulators instantly deploy to pitch the blades into
19 the neutral position and halt the rotor. Under a full stop condition, the turbine is able to halt the
20 rotor in less than 3 revolutions. The blades are also designed with a safe-pitch aerodynamic
21 configuration which means that even if all of the braking systems fail that the blades will
22 naturally pitch to a neutral position to prevent rotation. Essentially the blades need to be held in
23 place with the hydraulic system in order to maintain rotation. If that hydraulic pressure is lost,
24 the blades will feather back simply due to their aerodynamic design.
25

1 Q Do you have any knowledge of incidents where the turbines blades have come off?

2
3 A Yes. This happened once with a Vestas V39-500kW turbine in Denmark in 1992. The failure
4 analysis determined that the blade to hub fastening system had failed due to a combined
5 manufacturing and design defect. The blade fastening system was immediately redesigned and
6 the manufacturing system was modified to remedy the problem and the entire fleet of V39s was
7 retrofitted.

8
9 Q How far did the blade get thrown?

10
11 A The blade was thrown approximately 50 to 75 meters.

12
13 Q Have there been any blade throw incidents with Vestas turbines since the design modifications?

14
15 A No.

16
17 Q During your tenure at Vestas, have any of their turbines experienced a tower collapse?

18
19 A Yes. In France, a V39 collapsed due to delinquent operational procedures and, in Germany, a
20 prototype V80 machine on a 100 meter tall tower collapsed.

21
22 Q Please describe the conditions which affected these tower collapses.

23
24 A The V39 turbine in France was without power for more than 3 months and the rotor blades were
25 being held in the neutral position by the hydraulic system. Since the blades were not locked into

1 position on this particular machine as they should have been, the blades were released from the
2 neutral position after about 3 months once the hydraulic pressure was slowly released over such
3 a long period. The Vestas operations manual indicates that if the turbine is ever without power
4 for more than 48 hours that the blades need to be locked into the park position. This release
5 combined with a high wind event caused the rotor to start spinning and an over-speed condition
6 occurred which ultimately caused the collapse of the turbine.

7
8 The V80 turbine in Germany was a very new machine configuration with the very first 100
9 meter tall tower which is the tallest tower for a Vestas wind turbine. On this particular machine,
10 the tower flange had a weak weld which broke and caused the tower to collapse. The tower was
11 not manufactured by Vestas, but by a sub-supplier and the quality defect was very rare.
12 Normally all tower welds, especially the tower base flange weld, are inspected by ultrasonic
13 equipment to ensure that the weld has no voids and is fully homogeneous.

14
15 Q Have there been any subsequent Vestas turbine tower collapses other than these two?

16
17 A No.

18
19 Q Please describe the risk of a wind turbine experiencing a full tower collapse..

20
21 A Other than the rare occurrence of a tower base flange weld defect, extreme over-speed
22 conditions would be the primary concern which might create the forces needed to cause a tower
23 collapse.

24
25 Q Please describe the risk of a wind turbine catching on fire.

1 A Turbine fires are extremely rare on modern turbines. This happened on turbines in the 1980s
2 primarily due to disc brake problems which deployed and overheated. Newer Vestas turbines do
3 not have a high speed disc due to the adequacy of the other redundant braking systems. Modern
4 turbines are equipped with additional fire safeguards such as lightning arc detection and
5 specially engineered grounding systems and transformer arc detectors, and all electrical
6 equipment meets or exceeds local and international electrical safety standards set forth by the
7 National Fire Protection Agency (NFPA) and National Electric Code (NEC). Almost all types
8 of modern wind turbines, including Vestas, are also equipped with multiple temperature sensors
9 mounted on parts of the turbine machinery prone to higher temperatures. If the control system
10 detects temperatures outside acceptable limits it will trigger the automatic shutdown of the
11 turbine and send an alarm to the central computer system which will in turn alert on-call service
12 technicians of the fault location, fault code and turbine location. The turbines are designed with
13 a special lightning protection system which includes lightning receptors in the blades which
14 divert lightning strikes through the tower to the base flange and into a special grounding system
15 consisting of copper rods and conductors buried around the foundation of the towers. Special
16 varistors also protect the electrical and control systems of the turbines from stray lightning
17 surges which can cause damage to these components.

18
19 Q Please describe the possibility of a wind turbine throwing ice.

20
21 A Wind turbines can throw ice from the blades and drop ice from the tower. The ice falls from the
22 blades and tower once a turbine restarts after standing still after a heavy icing condition has
23 existed for a significant period of time. The ice throwing distance is generally small due to the
24 low rotational speed of the turbine during start-up.

1 Q Please describe any safeguards that can prevent this from occurring on wind power projects.

2
3 A The wind power project's central control system can be programmed to detect icing events using
4 the wind vane and temperature sensors. When the temperature falls below or hovers around
5 freezing (0 degrees C) and the wind vane sticks to one direction, an icing event may be
6 occurring. I understand that the Project will be fitted with multiple wind vane sensors at a
7 number of locations to ensure that there is a redundant system in place for ice detection. If an
8 icing event is detected, the central control system can detect this and perform any necessary
9 action.

10
11 Q Please describe the types of fluids inside a wind turbine which might cause a hazard due to a
12 spill.

13
14 A Most modern wind turbines, including Vestas machines, utilize lubrication oil, grease and
15 cooling fluids similar to modern automobiles. Vestas wind turbines have been designed to
16 contain all spills inside the nacelle, hub and tower. I have never heard of damage caused by
17 spills from a turbine.

18
19 Q Please describe the risk of electrocution to the public from a wind turbine

20
21 A The risk of electrocution to the public is insignificant due to fact that all electrical equipment is
22 enclosed in the nacelle and the tower, and shell clad enclosures are designed to IEC codes and
23 NEC (National Electric Code) standards. All towers are secured with heavy steel doors and
24 locks. I have not heard of any damage to persons and property in this regard.

1 Q Please describe the risks of electrical and magnetic fields (EMF) to the public from a wind
2 turbine.

3
4 A The generator and transformers which are mounted in the nacelle and tower do produce a small
5 amount of EMF which is limited to the immediate enclosure. The type and strength of the EMF
6 is similar to EMF produced by electric distribution transformers, which are found in residential
7 areas all over the world. We are not aware of any instance of individuals or animals being
8 harmed by EMF from similarly sized transformers used in public utility systems, so the
9 likelihood that the EMF generated in a turbine 200 to 300 feet above the ground will harm
10 anyone or anything is minute. All turbines comply with international standards on EMF
11 emission and compatibility.
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EXHIBIT 37-1 (HKJ-1)

CURRICULUM VITAE HENRIK KANSTRUP JØRGENSEN

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Present job: Vice President - Technology at Vestas.

Education:

- 1994 – 1998 Business Administration School. Night School.
Herning Engineering & Administration School - Denmark.
- 1983 – 1987 Ph.D. in Mechanical Engineering – Engineering Mechanics.
Michigan Technological University – USA.
- 1978 – 1983 M.Sc.in Mechanical Engineering. University of Aalborg –Denmark.

Work experience:

- 1991 – Vestas Wind Systems A/S in different positions.
- 1991 - 1998 Manager for Mechanical group in R&D department.
Group responsible for loads, blades, all mechanical parts (gear, machine bed, tower and so forth), certification etc.
- 1998 - 2004 Senior Product manager and manager of Technical Group in Group Sales & Marketing.
Responsible for the technical support to Vestas subsidiaries and joint ventures.
Technical education and sales support.
Customer modification, site assessment, power production and wind resource estimation and certification lobbying.
- 1987 – 1991 Bang & Olufsen A/S. CAD/CAE consultant in the R&D department.

Working with implementation CAD/CAM/CAE and FEM.

1983 – 1987 Michigan Technological University – USA.

Graduate Teaching Assistant. Teaching: Static's, Dynamics and Design with Plastics

Other experience.

1998 Censor at Danish Technical Universities for In Mechanical Engineering subjects.

1991 Working in Wind Energy research Projects in co-operation with Risø and others.

1997 Expert group to guide on IEC 61400-1 Ed. 1 update.

1994 Wind Energy. Working Group on Renewable Energy started by the Commission of EU leading to the Declaration of Madrid.

1989 – 1998 Part of the Steering Group. Use of computers in Machine Design and Engineering. Project supported by the Danish Science Council.

1989 – 1991 Part of Steering Group. CAD/CAM in Design and Engineering.

Presentations & papers:

Numerous papers and presentations on CAD, CAE, FEM and Wind Energy.