

Caithness Windfarm Information Forum

Wind Turbine Accident data to December 31st 2005.

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The attached table includes all documented cases of wind turbine accidents which could be found and confirmed through press reports or official information releases up to 31 December 2005. The wind industry is extremely reluctant to make such data available, and because of this, data has been extremely difficult to obtain. Several Consultants from the UK and US wind industry have confirmed difficulty in obtaining such data, and CWIF believe that this compendium of accident information may be the most comprehensive put together to date.

Data in the detailed table attached is by no means comprehensive – it has little data from Denmark and Holland – two of the biggest wind turbine operators in the world. CWIF believe that what is attached may only be the “tip of the iceberg” in terms of numbers of accidents and their frequency. However, the data gives an excellent cross-section of the types of accidents which can and do occur, and their consequences.

It is noticeable that since about 1999/2000 data has been easier to find – presumably since the wide distribution of media via the internet. Numbers of accidents in the data reflect this, with an average of 30.1 accidents found per year from 1999 to 2004 inclusive, and only an average of 5.0 accidents found per year in the previous nine years (1990-1998 inclusive). With few exceptions, before about 1997, only data on fatal accidents has been found. Hopefully, future legislation will require operators to report all fatal and near miss accidents on an annual basis, as with other industries.

Data attached is presented chronologically. It can be broken down as follows:

Number of accidents

Total number of accidents: 273

By year:

| Year | 70s | 80s | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|------|-----|-----|----|----|----|----|----|----|----|----|----|----|
| No | 1 | 8 | 2 | 1 | 3 | 3 | 3 | 3 | 9 | 16 | 5 | 32 |

| Year | 00 | 01 | 02 | 03 | 04 | 05 | 06 |
|------|----|----|----|----|----|----|----|
| No | 25 | 11 | 52 | 32 | 33 | 34 | |

Fatal accidents

Number of fatal accidents: 34

By year:

| Year | 70s | 80s | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|------|-----|-----|----|----|----|----|----|----|----|----|----|----|
| No | 1 | 8 | 2 | 1 | 1 | 1 | 1 | | 2 | 4 | | 1 |

| | | | | | | | |
|-------------|----|----|----|----|----|----|----|
| Year | 00 | 01 | 02 | 03 | 04 | 05 | 06 |
| No | 3 | | 1 | 3 | 2 | 3 | |

Fatal accidents include 4 transport/driver distraction accidents and 2 unconfirmed accidents from 1996.

These resulted in 35 fatalities:

- 29 were wind industry workers (maintenance/engineers, etc). Most common cause - falls from turbines.
- 6 were public fatalities, of which three were from road accidents attributed to “driver distraction of turbines” by police, one was from a road accident in which a driver was killed in collision with a turbine transporter, one was from an aircraft accident which hit a new and unmarked anemometer, and the remaining accident was the collision of a parachutist with a turbine.

Human injury

A further nine accidents regarding human injury are documented. Six accidents involved wind industry workers, and a further three involved members of the public. One was hit by thrown ice, one fell from 100m metre tower during an accompanied visit, and one flew his aircraft into a windfarm site.

Blade failure

By far the biggest number of incidents found were due to blade failure. “Blade failure” can arise from a number of possible sources, and results in either whole blades or pieces of blade being thrown from the turbine. A total of 91 separate incidences were found:

By year:

| | | | | | | | | | | | | |
|-------------|-----|-----|----|----|----|----|----|----|----|----|----|----|
| Year | 70s | 80s | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
| No | | | | | 1 | 1 | 1 | 3 | 3 | 6 | 1 | 18 |

| | | | | | | | |
|-------------|----|----|----|----|----|----|----|
| Year | 00 | 01 | 02 | 03 | 04 | 05 | 06 |
| No | 3 | 5 | 15 | 11 | 14 | 9 | |

Nine incidents were reported in 2005. This data makes nonsense of the operator’s statement regarding “a one off event” for the incident at Crystal Rig, Berwickshire, Scotland.

Pieces of blade are documented as travelling over 400m, typically from much smaller turbines than those proposed for use today. In Germany, blade pieces have gone through the roofs and walls of nearby buildings. This is why CWIF believe that there should be a minimum distance of at least 1km between turbines and occupied housing – and preferably about 5km to address other problems such as noise.

Fire

Fire is the second most common accident cause in incidents found. Fire can arise from a number of sources – and some turbine types seem more prone to fire than others. A total of 38 fire incidents were found in the data:

By year:

| Year | 70s | 80s | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|------|-----|-----|----|----|----|----|----|----|----|----|----|----|
| No | | | | | | | | | | 1 | 1 | 2 |

| Year | 00 | 01 | 02 | 03 | 04 | 05 | 06 |
|------|----|----|----|----|----|----|----|
| No | 3 | 1 | 16 | 6 | 3 | 5 | |

The biggest problem with turbine fires is that, because of the turbine height, the fire brigade can do little but watch it burn itself out. While this may be acceptable in reasonably still conditions, in a storm it means burning debris being scattered over a wide area, with obvious consequences. In dry weather there is obviously a wider-area fire-risk.

Structural failure

From the data obtained, this is the third most common accident cause, with 37 instances found. "Structural failure" is assumed to be major component failure under conditions which components should be designed to withstand. This mainly concerns storm damage to turbines and tower collapse. However, poor quality control and component failure can also be responsible – the collapse in May 2005 of a brand-new 300 foot turbine in Oklahoma during light winds are a good example of this.

By year:

| Year | 70s | 80s | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|------|-----|-----|----|----|----|----|----|----|----|----|----|----|
| No | | | | | | | | | | | 3 | 6 |

| Year | 00 | 01 | 02 | 03 | 04 | 05 | 06 |
|------|----|----|----|----|----|----|----|
| No | 9 | 2 | 8 | 3 | 2 | 3 | |

While structural failure is far more damaging (and more expensive) than blade failure, the accident consequences and risks to human health are most likely lower, as risks are confined to within a relatively short distance from the turbine.

Ice throw

Twenty incidences of ice throw were found (one of which has been classed as "human injury" above, in italics below):

By year:

| Year | 70s | 80s | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|------|-----|-----|----|----|----|----|----|----|----|----|----|----|
| No | | | | | | | | | 4 | 3 | | 3 |

| Year | 00 | 01 | 02 | 03 | 04 | 05 | 06 |
|------|----|----|----|----|----|----|----|
| No | 1 | | 2 | | 4 | 3 | |

Ice throw has been reported to 140m.

These are indeed only a very small fraction of actual incidences – a report* published in 2003 reported 880 icing events between 1990 and 2003 in Germany alone. 33% of these were in the lowlands and on the coastline.

**("A Statistical Evaluation of Icing Failures in Germany's '250 MW Wind' Programme – Update 2003, M Durstwitz, BOREAS VI 9-11 April 2003 Pyhänturi, Finland.)*

Transport (non-fatal)

Nine reported accidents – the worst being when a 45m turbine section rammed a house while being transported. Most involve turbine sections falling from transporters.

By year:

| Year | 70s | 80s | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|------|-----|-----|----|----|----|----|----|----|----|----|----|----|
| No | | | | | | | | | | | | |

| Year | 00 | 01 | 02 | 03 | 04 | 05 | 06 |
|------|----|----|----|----|----|----|----|
| No | 1 | | 3 | | 2 | 3 | |

The "2000" incident refers to a newspaper report which reports 73 accidents over 4 years along a 4km piece of road, and attributes them to driver distraction by turbines and thrown ice and blade pieces landing on and over the road.

Environmental damage

Very few cases of environmental damage have been reported – the majority in the past three years. This is perhaps due to a change in legislation or new reporting requirement. All involved damage to the site itself, or reported damage to or death of wildlife.

By year:

| Year | 70s | 80s | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
|------|-----|-----|----|----|----|----|----|----|----|----|----|----|
| No | | | | | 1 | | | | | | | |

| Year | 00 | 01 | 02 | 03 | 04 | 05 | 06 |
|------|----|----|----|----|----|----|----|
| No | | 1 | | 4 | 1 | 3 | |

Other

Other types of accident are also present in the data. Component failure has been reported under "other" if there has been no consequential structural damage. Lightning strikes have been included under "other" only when a strike has not resulted in blade damage or fire. A separate 1996 report** quotes 393 reports of lightning strikes from 1992 to 1995 in Germany alone, 124 of those direct to the turbine, the rest are to electrical distribution network.

*** (Data from WMEP database: taken from report "External Conditions for Wind Turbine Operation – Results from the German '250 MW Wind' Programme", M Durstewitz, et al, European Union Wind Energy Conference, Goeteborg, May 20-24, 1996)*

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