



HOW DANGEROUS ARE WIND TURBINES IN COLD CLIMATE AND CAN WE DO SOMETHING ABOUT IT?

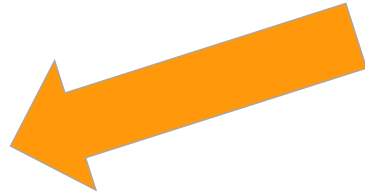
Winterwind, Skellefteå 8 February 2012
Bengt Göransson, Pöyry SwedPower

ARE WIND TURBINES DANGEROUS?



HAZARDS IN COLD CLIMATE

- Ice throw
- Noise increase
- Slipping
- Trapping
- Freezing



THE MACHINERY DIRECTIVE SAYS...

DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 17 May 2006
on machinery, and amending Directive 95/16/EC (recast)

”Machinery must be designed and constructed so that it....can be operated, adjusted and maintained without putting persons at risk”

Risks due to falling or ejected objects

Precautions must be taken to prevent risks from falling or ejected objects.

RISK

Risk = probability of a hazard x consequence of failure



EN 50308 REVISION BY CENELEC

EUROPEAN STANDARD

EN 50308

NORME EUROPÉENNE

EUROPÄISCHE NORM

July 2004

ICS 27.180

Incorporates Corrigendum February 2005

English version

**Wind turbines –
Protective measures –
Requirements for design, operation and maintenance**

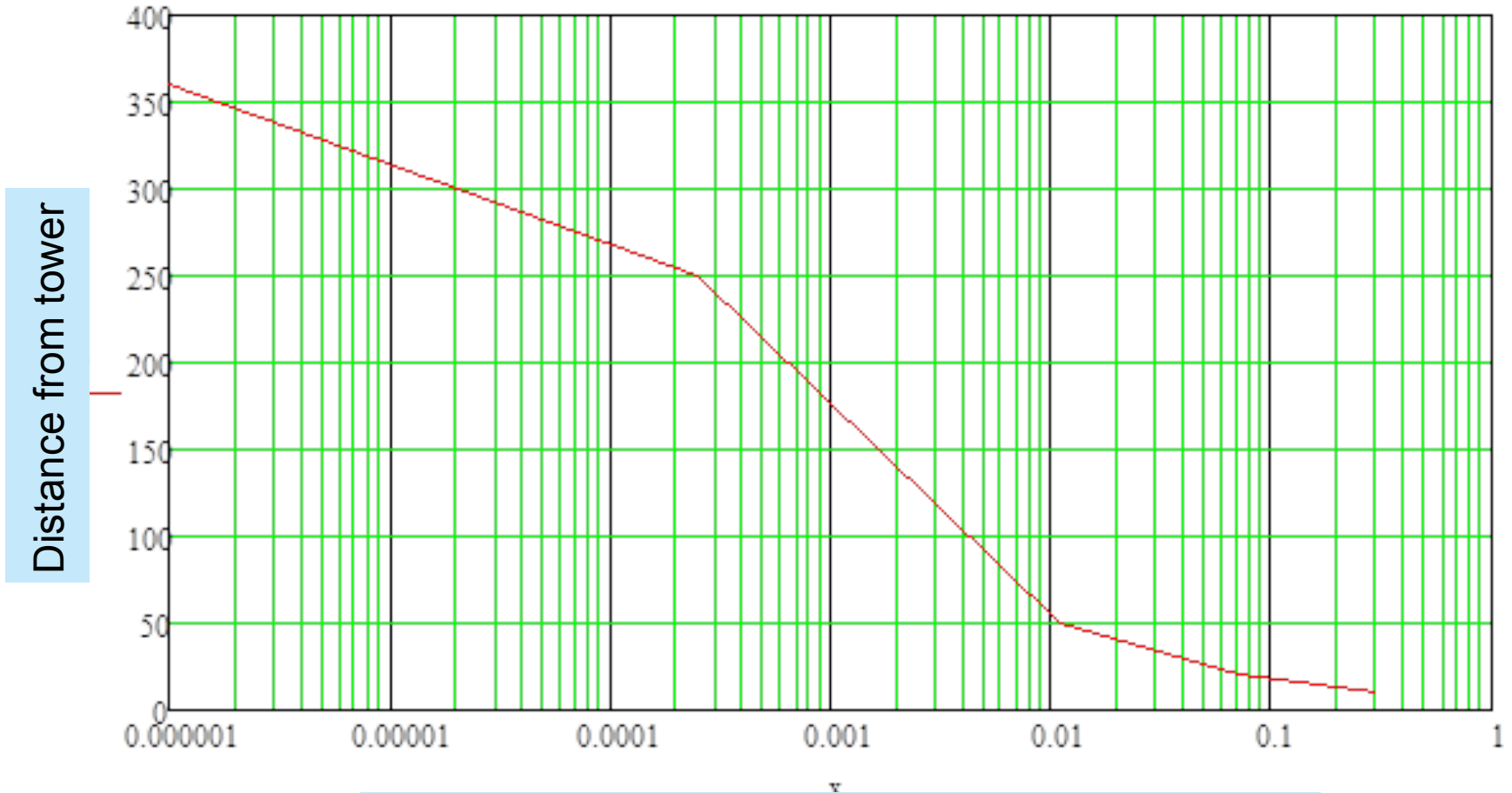
Aérogénérateurs –
Mesures de protection –
Exigences pour la conception,
le fonctionnement et la maintenance

Windenergieanlagen –
Schutzmaßnahmen –
Anforderungen für Konstruktion,
Betrieb und Wartung

PROCEDURE FOR RISK ASSESSMENT ACCORDING TO MACHINERY DIRECTIVE

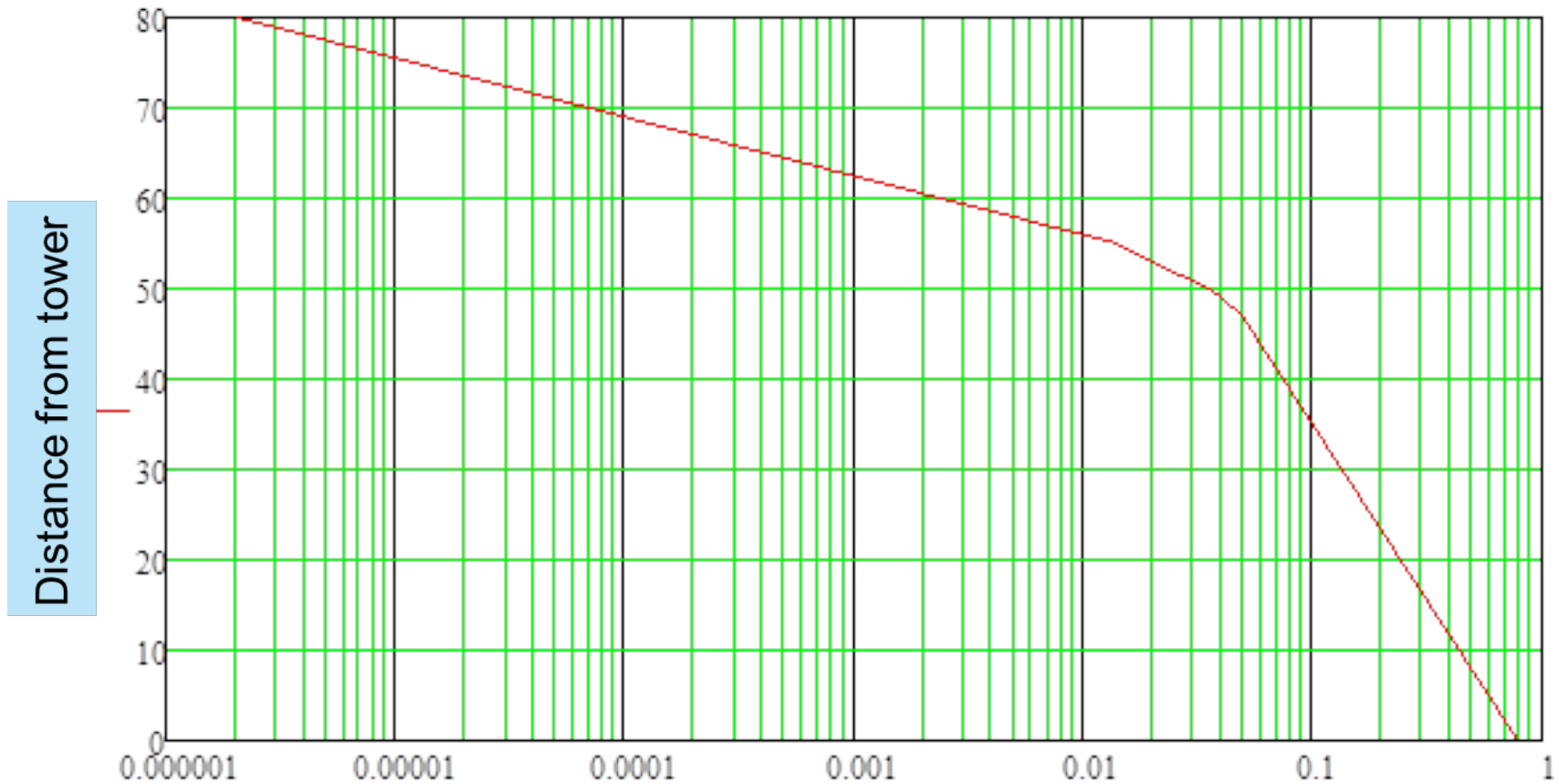
- 1 Determine the limits of the machinery
- 2 Identify the hazards
- 3 Estimate the risks
- 4 Evaluate possible design solutions
- 5 Eliminate the hazard or reduce the risks
- 6 Inform about residual hazards

PROBABILITY OF ICE SHEDDING



Ice throw probability/m²/year with 5 icing days
Turbine in operation

PROBABILITY OF ICE SHEDDING



Ice throw probability/m²/year with 5 icing days
Turbine at standstill

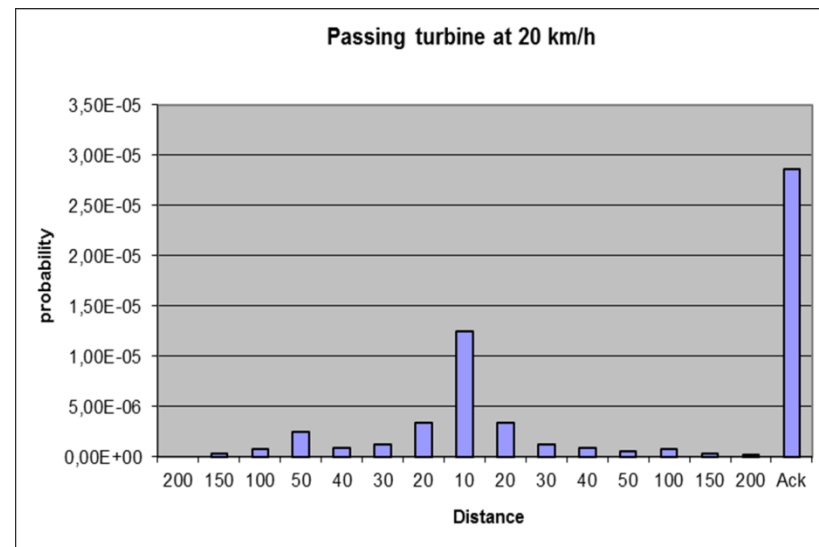
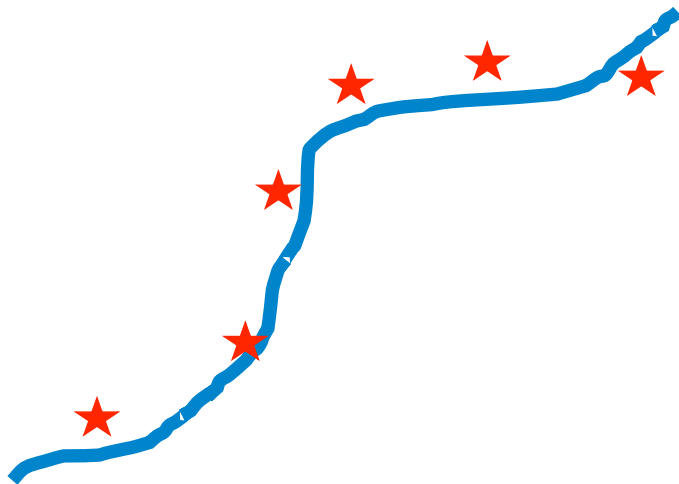
CASES

Service staff	Public
Icing occurrence	Winter season
Rotating turbine	Parked turbine

RISK LEVELS AT 5 "ICE DAYS" ANNUALLY WITH ICE

In operation

Case Service staff	Recurrence time
Parked car 1 hr / 20 m	27 years
Driving by row of turbines for 7 min	5800 years
Person staying 1 hr/10 m	530 years



WINTER SEASON (6 MONTHS)

In operation

Case Public	Recurrence time
Person 1hr/10 m	1,3 million years
Person 1hr/50 m	53 million years
Person 1 hr/100 m	143 million years

Parked

Case Public	Recurrence time
Person 1hr/10 m	19000 years
Person 1 hr/50 m	230000 years
Person 1 hr/100 m	-

ARE THESE FIGURES HIGH RISK OR LOW RISK?

- For public:

Risk of being hit by lightning in the US during one year is 7 times staying 50 m from turbine for 1 hour during winter season

Risk of being hit by ice cone in Stockholm city street equals staying 10 m for 1 hour during winter season

- Risk for service staff:

Risk for personal injury in traffic 4 times staying 1 hour 10 m from turbine at icing condition

WHAT TO DO?

- Don't build turbines in cold climate (No option)
- Do not operate from October to May (No option)
- Include ice detection/closing down
- Include active heating equipment
- Include passive deicing equipment
- Put up warning signs



CONCLUSION

- **For service staff recurrence period of 530 years – Not neglectible**
- **Active heating system solves the problem**
- **If adding passive de-icing system additional information is needed**
- **For the public warning signs are sufficient**

THANK YOU!



PÖYRY

Engineering balanced sustainability™

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