Skellefteå Kraft

CCV-turbines

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Winter will come every year

Ice is a challenge!

Cold climate is more than just ice.

More than just the blades needs to be adapted.

Safety is a big issue.

We have seen improvements but there is a long way left.

Windpower in cold climate

- This is how we would like every day to be.
- Low temperature.
- High winds.
- Low humidity.
- Good production.

What is availible on the market today?

- Hotair systems in different shapes.
  - They are simple.
  - They are cheap.
- Various generations of carbonbased systems.
  - A VTT invention.
  - Still improving.
- What do they have in common?

Hotair system

Advantages:

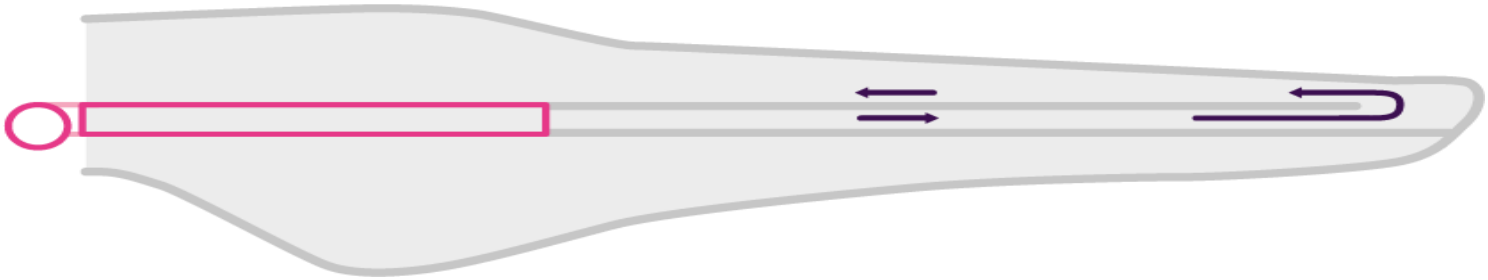
- Inexpensive construction
- Easy construction
- Easy access
- No extra risk for lightning strikes

Disadvantages:

- Low efficiancy (high energycomsumption)
- Limited function in arctic climate
- Retrofit is not possible

Suitable for light to medium ice sites, in crowded areas.

Hot air system.



- A simple construction, simple access to all mechanical part in blade root.
- Blades needs to be adapted already in factory.
- Lot of material and air to heat before surface release ice.

Carbonfibre based systems

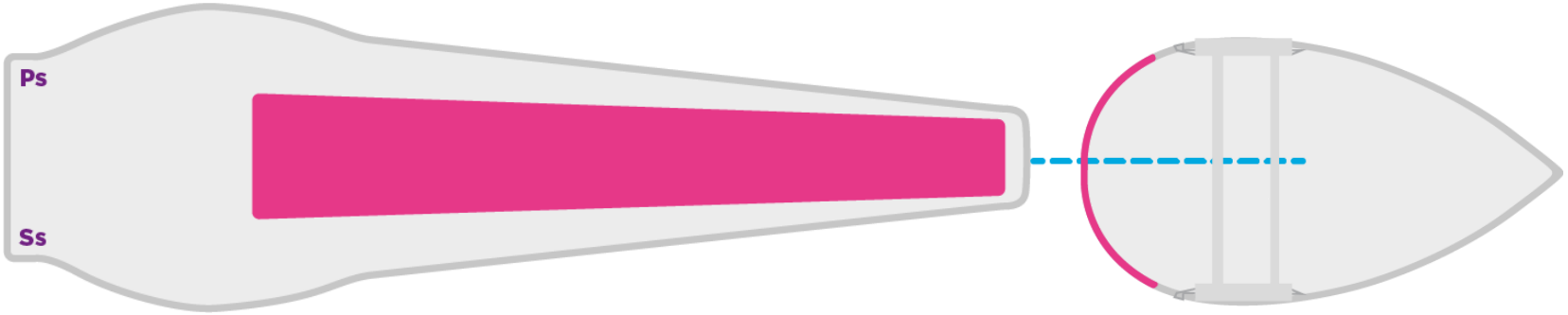
Advantages:

- Relatively energy efficiant
- Possible to make retrofits
- Good function when availiable

Disadvantages:

- Availibility problems
- Expensive and difficult to repair
- Powercables often attached in glassfibre wich give problems ahead

Illustration of todays system with carbon fibre.



- Most of the carbonbased systems have cable connector in both tip and root.
- The older system have sensors and OH-relays in tip and root and they are only availible from outside → Expensive repairs.
- In newer systems sensors are placed close to rootend is accessed from inside the blade.

What should we as owners ask for?

» Higher energy efficiancy.

» Availibility, not only for the turbine but also for the anti/deicing system.

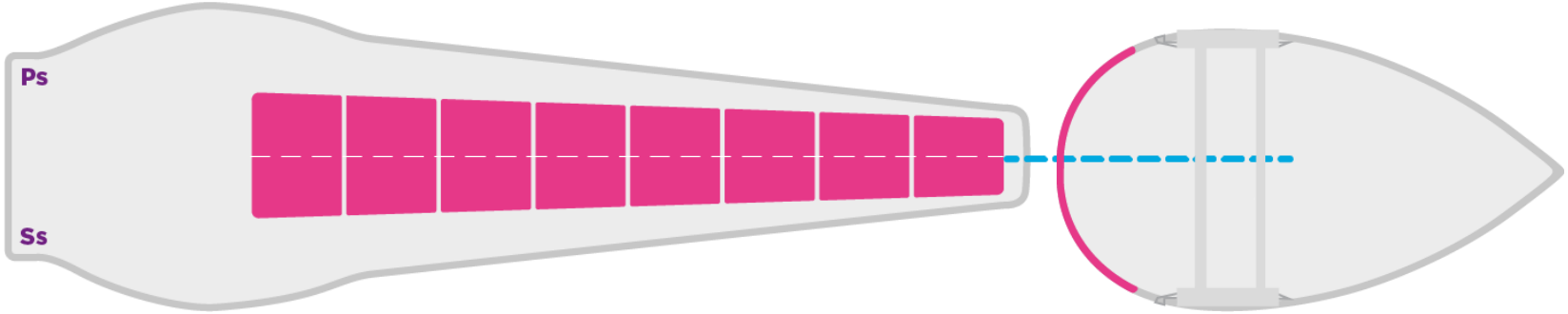
» Warranty for effect of the function not only for the function.

» Service and repair manuals even for AIS.

» Access to system data.

» Turbines certified according to standard including anti icing function.

Next generation of AIS?



- A system that allows you to have more than one section.
- A small damage on the surface will not cause standstill.
- You could adjust the system to a more even temperature.
- Better availibility.
- Higher energy efficiance.

AIS function in 3-5 years

- Made in smaller sections, extra heat on attack angle of leading edge.
- Possible to attach as retrofits, today we have seen retrofits done with carbonbasedsystem in Canada..
- Lower prices
- Easy to repair
- Low energy consumption

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Questions?

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