



## Reliable snow over Östersund Biathlon stadium with VLT® AQUA Low Harmonic Drive

**Östersund has a long history as a centre of outdoor activities with its modern cross-country ski stadium. Östersund hosted several World Championships in various sports such as biathlon, speed skating and ski orienteering along with Swedish National Championships in cross country skiing and snow-cross.**

Although Östersund is located in the middle of Sweden, snow does not come with a guarantee. To allow the many outdoor activities to take place, multiple snow guns ensure that sufficient snow is always present at the stadium and pistes around Östersund during the winter season.

### **The snow canon solution**

The many snow canons spray pressurized water out through a set of nozzles. The thin water particles formed in the air are then pushed forward by an air fan. The water fog becomes snow if the temperature is close to freezing point. Each snow canon has its own water pressure actuator but the water is supplied by one large centrally installed pump which feeds the snow canons whenever they are connected to the piping system.



### **Harmonics**

Due to the long distances from the power supply to the loads and because of the multiple small motors consuming power, the supply is weak and harmonic distortion becomes an obvious problem. The Östersund local authority has consequently imposed a maximum current THiD (total harmonic current distortion) of 5%. This limitation is set to keep the voltage pollution low, maintain cable

and transformer loading at a minimum but most important, to ensure a reliable power supply and so snow for future snow events around Östersund.

### **The VLT® AQUA Low Harmonic Drive**

As part of a more extensive renovation to bring Östersund stadium up to date for the Biathlon World Cup this winter, Areco Snowsystem AB, one of the largest manufacturer of snow guns in the world, purchased a new

VLT® AQUA Low Harmonic Drive for a new feed pump that will be part of the new fully automated snow system. The drive has to maintain a constant flow of water through the hundreds of meters of pipes. The pump and drive system are installed in a movable hut near the stadium allowing the installation to be moved quickly and easily during tournaments.

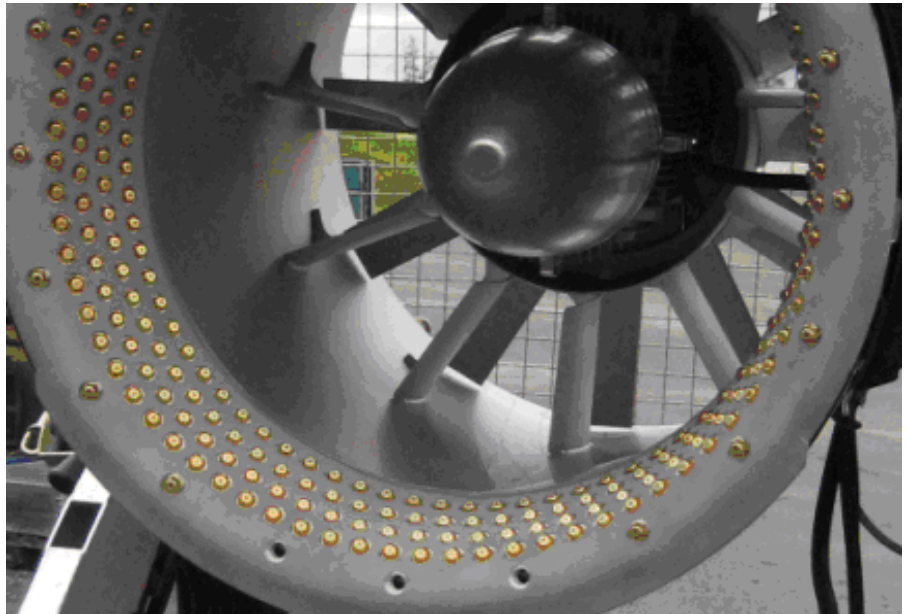
**Test results**

In this application the drive, a 200kW Low Harmonic Drive, was tested with and without the active filter to see the impact of the harmonic currents on the grid. The background voltage distortion of the grid was 1,3% during the testing period.

Due to instability in the water system, the load continuously changed and no perfect steady state conditions could be achieved. That adversely influenced the measurements and the THiD reading were up to 8-9% with full filter mitigation.

To get a more realistic picture for future conditions, where the water supply is more stable, all interharmonics around the fundamental were subtracted from measurements, as it is not expected to have them for steady state operation, thus lowering the THiD to 3,1%.

A quick overview in the table shows the significant reduction of line-side current harmonics from a THiD of 41 % without the active filter down to 3.1 % with the active filter. This proves all the aforementioned benefits required by Östersund authorities, of lower losses in the cables and transformer (see RMS), lower voltage distortions (see THvD), thus ensuring the reliability of the power system.



The snow canons spray pressured water out through a set of nozzles. The thin water particles formed in the air are then pushed forward by an air fan.

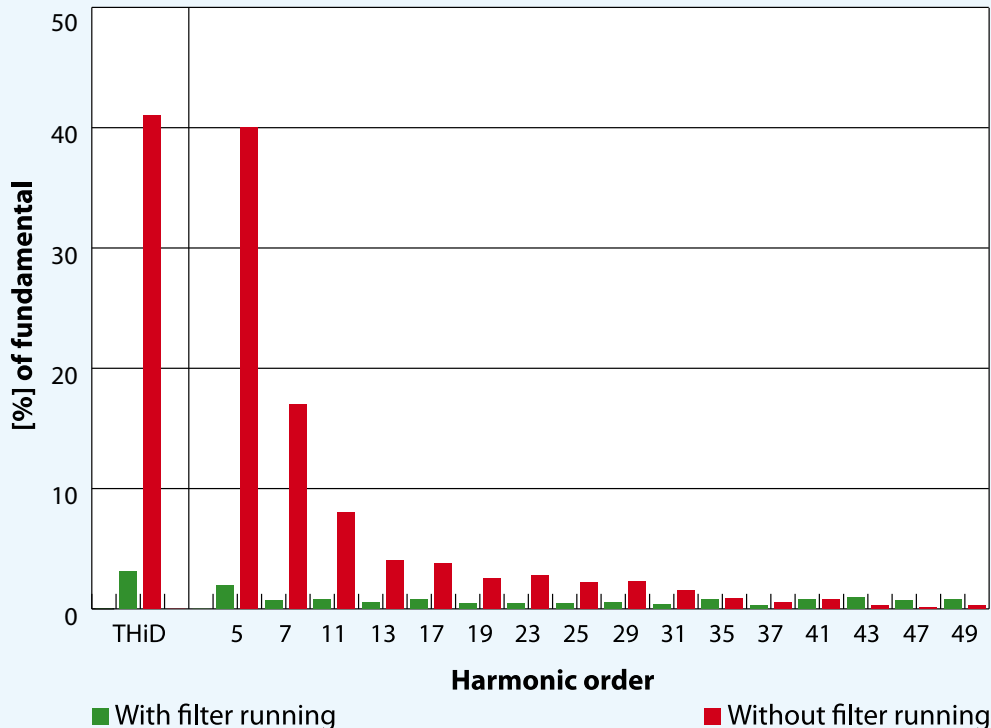


Installed 200kW VLT® AQUA Low Harmonic Drive controlling a new feed pump and maintaining a constant flow of water through the hundreds of meters of pipes

Measure ID	Drive running	
	without filter	with filter
THiD	41%	3,1%
THvD	2,40%	1,40%
RMS	170A	163A

Post-processed THiD including harmonics from 3<sup>th</sup> to 50<sup>th</sup>

## Harmonic Spectrum



### Why Danfoss Low Harmonic Drive

Besides the obvious lower harmonic content and compliance with the local authority, the installed VLT® Aqua Low Harmonic Drive also reduces the RMS current thus increasing system efficiency. The transformer stress is dramatically reduced, due to the huge THiD drop, allowing the transformer to supply more loads and so allowing more snow guns to secure optimal conditions for future winter events.

The Low Harmonic Drive was easy to specify and simple to install. Power cables are easily connected and the unit can be up and running quickly, even after the hut is moved. Also the LCP is simple and has a logical operation structure.

The reduced potential for contamination inside the drive and filter via the backchannel cooling concept, together with coated PCBs improv-

ing immunity against moisture and dust, was essential. Danfoss' excellent reputation was instrumental in securing the order.

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