

Case story | VLT® HVAC Drive FC 102

Only the finest snow for the Beijing 2022 Winter Olympics

Without perfect snow, competitors will not be able to compete at their best: So, to ensure the optimal sporting conditions at Beijing's 2022 Winter Olympics, Danfoss VLT® AC drives will help shift 330,000 m³ of water that will be turned into perfect snow using TechnoAlpin SpA's snow-making plant.

330,000

m³ of water
converted into
700,000 m³ of snow
in 70 hours



The most exciting competitions demand perfect race conditions

The organizers of world-class sporting events are well aware of this and can't risk abnormal weather conditions compromising the spectacle and attraction of their events.

The Winter Olympics are a perfect example: Organizers simply cannot risk years of planning being jeopardized by weather conditions – which can only be predicted with any certainty, just days before a competition.

The universally adopted solution for the alpine disciplines is the preventive preparation of a snow mantle on the race tracks. By using a programmed snow-making system using the only natural elements available at any particular moment, which are water and air, they can guarantee optimal quality snow for competitions.

New Yanqing Olympic area

In the Yanqing district, about 90 km from Beijing, the new Xiaohaituo mountain ski area is being built to host the alpine skiing competitions of the XXII Winter Olympic Games.

To ensure perfect snow conditions along the 23 km of planned race and connecting tracks, the Chinese Olympic Committee launched an international competition to select the most suitable technical partner to carry out such an ambitious project.

The Italian company, TechnoAlpin was chosen thanks to its nearly 30 years' experience in building snow-making systems and creating turnkey solutions for ski resorts.

Markus Pfeifer, Head of Process Engineering of TechnoAlpin, says:

"The Chinese Olympic Committee has recognized and appreciated

our specific skills in the field of programmed snow-making, gained by providing solutions to over 2,400 customers worldwide. Our approach is always collaborative: The customer knows his mountains well, and we know how to produce good snow on schedule.

A joint study, together with the client, of the orography and local environmental conditions is absolutely necessary and this has always been the added value provided by TechnoAlpin.

Understanding the local air flows and the raw water supply capacities available on site makes it possible to carefully define the best type of plant for each area: Each mountain has its specific conditions, which must be understood and enhanced to arrive at an optimal snow-making solution."



Reconstruction of the orography of the Xiaohaituo mountain, on which 23 km of race tracks will be built.

Perfect snow, where and when it's needed

Snow is a natural phenomenon. What the programmed snow-making systems do is recreate natural conditions, so that the snow is formed at the right time, and distributed evenly where it is needed on the slopes.

Mr. Pfeifer explains: *"The ingredients to make the snow itself are very simple and absolutely natural: water and air. In our fan or lance snow generators, compressed air and water are carefully combined by nucleators and nozzles that reproduce the crystallization conditions of snowflakes falling from the sky. It's a process that seems simple, but every tiny detail makes a critical difference. It's our wealth of precise technological expertise in the creation of these machines and our long experience in controlling the variables of the snow generation process that allows us to successfully face every environmental situation. Even in so-called 'marginal' temperature conditions, we ensure the creation of good quality snow."*

In the Xiaohaituo mountain area, TechnoAlpin is building a snow-making system capable of creating a perfect 1 m deep snow base on the competition slopes for alpine skiing in the Olympics. These began operating in the fall 2019, ready for the first sporting events to be held in the area.

Mr. Pfeifer says: *"Our project involved the installation of 130 fan-driven snow generators, which will be fed by water collected in an artificial basin located near the valley station at 1,300 m."*

The water, when appropriately refrigerated, will reach all fan generators, up to the highest mountain station at 2,150 m, using a distribution network that includes three pumping stations located at different altitudes and connected in series between them.

The Xiaohaituo plant is one of the largest made by TechnoAlpin in a single season, as it is a completely new area - with all the logistical and organizational complications that this entails."

For the snowmaking on the 23 km of slopes on the Xiaohaituo mountain, a collection basin capable of containing 330,000 m³ of water has been created, with the aim of transforming it into 700,000 m³ of snow over a period of about 70 hours.

TechnoAlpin has chosen Danfoss VLT® HVAC Drive FC 102 to pilot the numerous pumps that distribute the chilled water to the fan-driven snow generators.

The main pumping room downstream of the plant houses 15 500 kW machines flanked by five backup machines.

The second intermediate pumping station houses four 400 kW machines flanked by four backup machines, while the third pumping station houses three 400 kW machines flanked by two backup machines. There are also pumps driven by 45 kW drives in the eight water

cooling towers, flanked by two backups.

In total, it's a water circulation system with a combined electrical power of 20 MW which, although it operates for only a few hours a year, must absolutely guarantee a high level of reliability and efficiency.



View of the main pumping station, located downstream of the plant.

Compact and reliable drives

The choice of VLT® HVAC Drive FC 102 for driving water circulation pumps is the result of an effective collaboration between the technical capabilities of TechnoAlpin and the local Danfoss organization, who selected and optimized the most suitable solutions to meet the demanding requirements of this plant.

“In our plant, we need drives that on the one hand guarantee exceptional reliability requirements - for example they can restart without problems, even after long months of non-use in rarely manned, unconditioned environments - and on the other, that are extremely compact, as they are always installed in inaccessible, difficult to reach areas,” says Mr. Pfeifer.

Another critical challenge that has been successfully addressed in the Xiaohaituo plant is the reduction of perturbation impact on the electricity supply network. The power supply lines used here, although they are high power, are relatively weak, as they are distant from, and only partially integrated with the rest of the national electricity grid. Therefore, the harmonic disturbances introduced by drives during their operation must be reduced to a minimum to avoid compromising the correct operation of a structurally delicate electrical network.

“High efficiency combined with the harmonic reduction capability introduced into the network were

factors that made the difference when choosing Danfoss drives,” confirms Mr. Pfeifer. “Another feature of Danfoss drives that we greatly appreciate is their compatibility with every type of motor and their open communication protocols, which allow us to access all the internal variables that we need to optimize our control algorithms for snowmaking.”

For example, the layout of the water distribution network in Xiaohaituo, which includes a main pumping station downstream and two booster pumping stations at higher altitudes, required particular attention to the optimization of the control algorithms of the intermediate stations, because they must simultaneously feed the fan-driven snow guns and the delivery lines to the upstream station.

Co-operation and trust

The collaboration between Danfoss and TechnoAlpin was not limited to the consultancy and project optimization phase, but involved wider and longer-term activities, which allowed TechnoAlpin technicians to acquire all the necessary skills to carry out first-level assistance activities on the drives installed in their plants.

Mr. Pfeifer concludes: “Skiing is a very pleasant activity, and it’s made even more so when the snow mantle is of optimal quality. This is the reason why practically all the major ski areas have been equipped with programmed snow-making systems - of which we are one of the main suppliers in the world, with more than 110,000 snow generators produced since 1990. The districts trust us, because they know that

we help them guarantee customer satisfaction by snowing the slopes at the right time. In turn, we place the same trust in our strategic suppliers, like Danfoss Drives, who help us efficiently operate our plants, all over the world and whenever they are needed.”