ENGINEERING
TOMORROW

Case study | VACON® NXP drives

Electric workboat says **goodbye to emissions**

This is one of the world's first fully electric work boats – designed and built by Grovfjord Mekaniske Verksted, Norway. It makes no engine noise, exhausts no diesel fumes, releases zero emissions, and performs with exceptional maneuverability. It's electrification at sea – and AC drives from Danfoss have helped make it happen.

900 kg
NOx emissions eliminated annually

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The future is **electric**

North of the polar circle in Grovfjord, Norway, salmon fish farming is a motor in the local economy. Locals have grown accustomed to seeing the circular sea cages where the salmon grow – just like people living in country farmland see barns or grain silos as an almost natural part of the scenery.

But now something stands out – not as much to the eye as to the ear. It's the new workboat used by the fish farm company Northern Lights Salmon. The boat makes not a sound when its crew takes off in the morning to tend the salmon. All you hear is the noise from water hitting the bow. And this marks quite a difference compared to earlier when a loud knocking echoed through the air as the crew ignited the diesel engines.

81-year-old owner of Grovfjord Mekaniske Verksted Arnold Hansen took the role of skipper during one of the first sea-trails in late 2017. "Sailing silently in a boat this size is pure magic," he said.

The boat is named Astrid Helene. And it is silent because it has no diesel engines – it's all electric.
As a result, Northern Lights Salmon saves the atmosphere of up to 90 t CO_2 and 900 kg of NOx gases annually – the average emission of a diesel-powered fish-farm workboat.

Now there is only clean air

There are no longer any diesel fumes on deck either. For crew, the fumes could be quite annoying – particularly if the wind was blowing it in their direction. Now, there is just clean air. 54-year-old Chairman of Northern Lights Salmon Søren Balteskard (photo) has known fish farming since the age of nine when his dad founded the family business. And according to him, fully electric work boats such as Astrid Helene will play a key role in the industry's future.

"Electric work boats are perfect for fish farming. The lack of engine noise is not only an advantage for the crew, but also for the salmon. It actually reduces stress levels in the fish. And the environmental benefits are obvious. This is key for us. Our aim has always been to run our business in as green a way as possible."

Explains Søren Balteskard,
Chairman of Northern Lights Salmon

The disadvantages? According to Søren Balteskard there really aren't any. Electric boats are easy to maneuver and go from zero to full speed extremely fast. And the typical concern about lack of charging possibilities during long distance sailing, is not a problem as fish farms are located close to shore.

"We can use Astrid Helene for a whole workday and still have about 45 percent power left when we return to shore. Charging is easy, too. We simply plug her to the grid overnight. And the next morning, she is fully charged – at only a fraction of what it costs to fill up the tank in one of our diesel boats."

Grovfjord Mekaniske Verksted delivered Astrid Helene to Northern Lights Salmon in early June 2018. Photo from the boat's first week at work.

Where electric vision became reality

Grovfjord Mekaniske Verksted, which designed and built Astrid Helene, is Norway's leading manufacturer of aluminum workboats.

The company has delivered more than 115 boats to the fish farm industry over the last 15 years. Astrid Helene is their first fully electric one.
Others will soon follow, though. The company already has orders for another handful in the books.

Astrid Helene is a 14-meter-long and 8-meter-wide aluminum catamaran workboat. Photo from the construction phase at Grovfjord Mekaniske Verksted.

The drives are key

Astrid Helene is packed with heavy equipment, including a 32 t crane and an electric winch hauling nets that can hold 12 t of salmon. Still, it moves silently through the water at up to 10 knots, 18.5 km/h. Three types of components make it happen: A 4 m^3 big lithium-ion battery-pack, two electrical propulsion motors, and seven drives.

Drives are key components for the functionality of the vessel. Seven VACON® NXP drives control the flow of energy between batteries, motors, chargers and power in the cabin. The Corvus Orca energy storage system holds a total of 340 kWh, supplying all power on board. Two 107 kW permanent-magnet motors ensure that propulsion is silent and efficient. They are also powered by VACON® NXP drives.

Charging from onshore is controlled by a VACON® NXP Grid Converter, and the batteries are managed by an VACON® NXP DC/DC Converter. Even the hydraulics for the crane are run by the VACON® NXP drive so they can be powered by the batteries. The overall control system, known as the Energy Management System (EMS), was developed by teachers and students at the University of Tromsø.

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From fully electric to hybrid

The catamaran hull is very efficient and needs only a few kilowatts to glide through the water and reach speeds up to 6-7 knots. The energy demand increases exponentially at speeds above 10 knots. Consequently, the range of the vessel is dependent on speed, wind and currents, and the advanced EMS system gives the boat operator a good overview of these factors. A single charge can keep the vessel running throughout a long work day on the fish farm. When the vessel needs to traverse a longer stretch of water, a regular diesel generator can be hoisted onto the deck and connected directly to the charging plug. And just like that, Astrid Helene is transformed into a hybrid long-range boat.

Anders Breines, Lead Electrical Engineer at Grovfjord Mekaniske Verksted, says:

"The drives are really key components. All electricity – every single kilowatt used on the boat – passes through them. And we are not only talking electricity for the propulsion motors, but for all electric equipment – all the way down to the coffee machine."

Acting as partners

Apart from the high performance drives, there's another reason Grovfjord Mekaniske Verksted chose Danfoss drives. Anders Breines explains:

"Drives from Danfoss are high quality and perform very well. But so do the drives from the world's other leading manufacturers. What clearly sets Danfoss apart is that they allow us to make changes to their software, so we can influence how the drives work and function in our system. Most other companies lock their software and charge us extra, if we ask for changes. The Danfoss guys show us how to use their software and how to make changes. They act as partners."