



SCALE **AQ**

Vortex[®] and Subsea System

An underwater photograph showing a school of fish swimming in dark blue water. The water is filled with numerous small, light-colored bubbles, likely from a nearby surface. The lighting is dim, creating a moody atmosphere. The fish are silvery and appear to be moving in a coordinated pattern.

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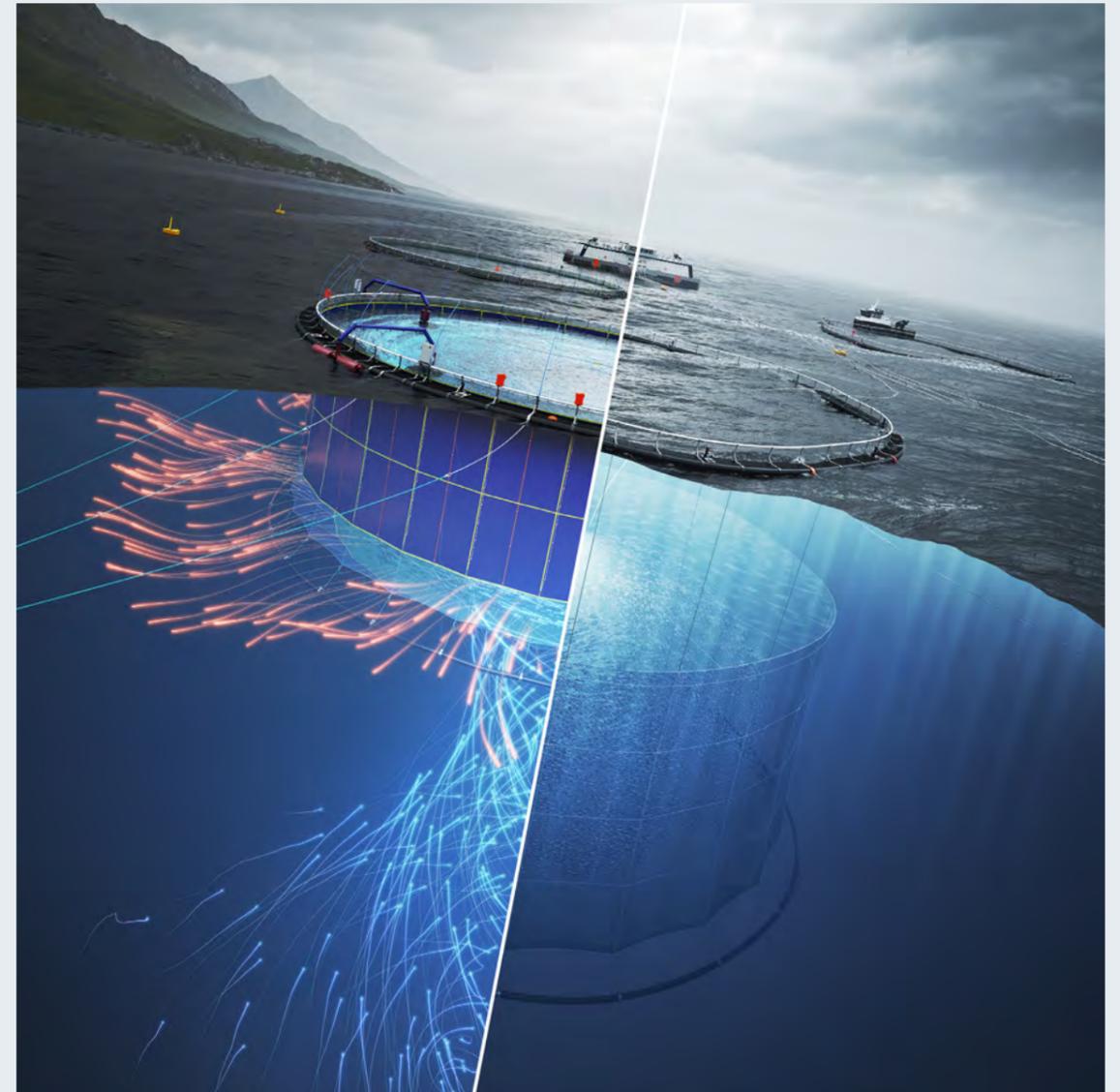
ScaleAQ is a leading global technology provider that supplies and manufactures complete sites for the aquaculture industry in more than 40 countries. The company has approximately 900 employees and offices in Norway, Scotland, Poland, Iceland, Chile, Canada, Tasmania and Vietnam. Through focus on sustainability and biology, ScaleAQ has taken a clear role in ensuring the development of technology on the terms of biology and the environment. We do this by producing and delivering technology, infrastructure and services in a solid, sustainable and innovative way.

Innovative technology for future aquaculture

As one of the world's largest suppliers of equipment for aquaculture, ScaleAQ feels a strong responsibility to contribute to developing solutions to the industry's challenges and promoting sustainable growth. Our vision is to provide solutions that are both sustainable and cost-effective, improving aquaculture production while ensuring fish welfare and environmental preservation.

Salmon lice: A critical challenge

Salmon lice are one of the most pressing challenges in the aquaculture industry. It leads to significant losses in production and has negative effects on both fish welfare and the environment. The problem is complex, and there are no simple solutions. Therefore, at ScaleAQ, we believe that a multidimensional approach is necessary. Our two new concepts, Vortex® and ScaleAQ Subsea System, have been developed and tested to address these challenges.



Innovative solutions

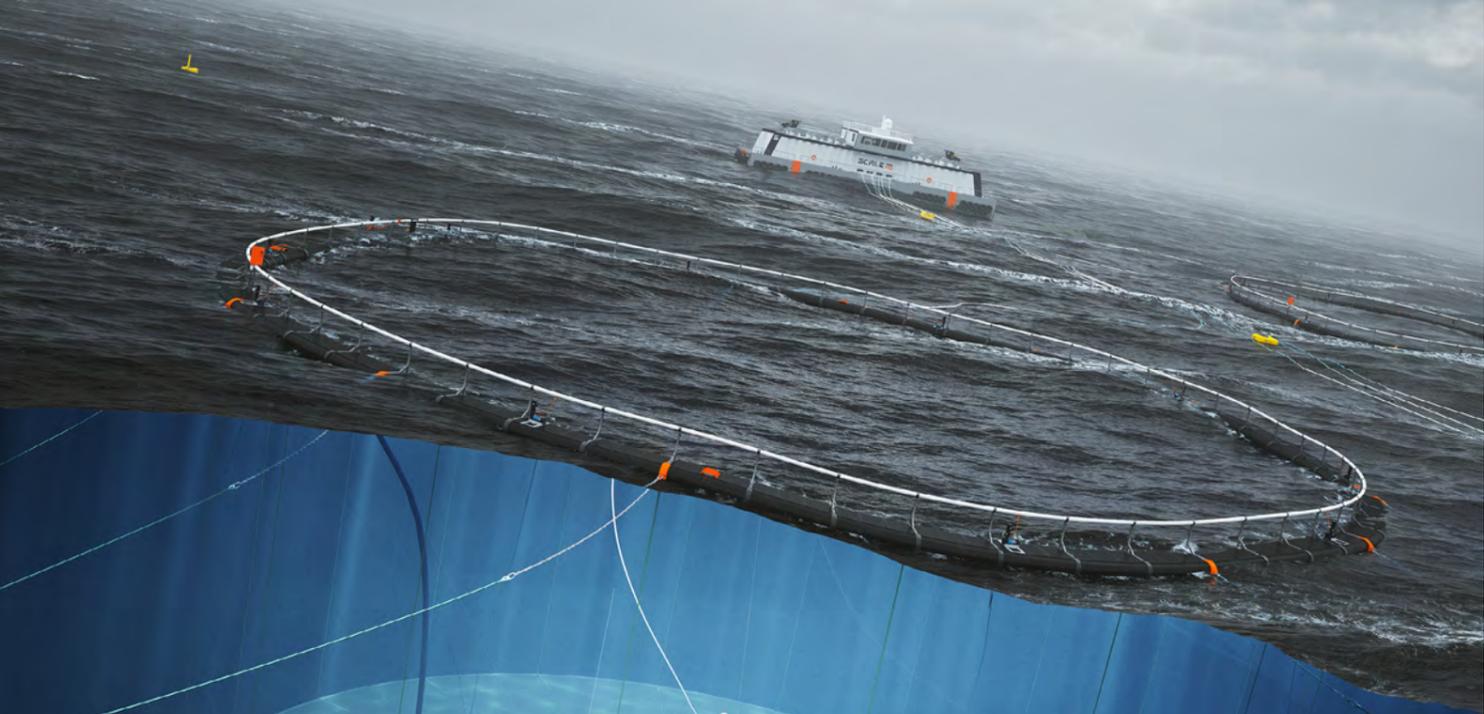
ScaleAQ Subsea System was developed in 2016 when we applied for development licenses for a submerged operational solution with flexible pen technology. This pioneering work has provided us with a technology that effectively addresses the challenges of salmon lice and other environmental impacts. The system can be used globally in various locations, provided that the current, wave, oxygen, and depth conditions allow for it.

For locations unsuitable for Subsea operation, we have developed **Vortex®**. This semi-closed pen system makes it more challenging for salmon lice to thrive. A robust barrier in the upper water layer prevents the lice from entering, and fresh seawater is pumped up from the depths.

The continuous water exchange helps improve oxygen conditions and significantly reduces lice infestation. The concept also mitigates seasonal temperature variations by incorporating deep water.

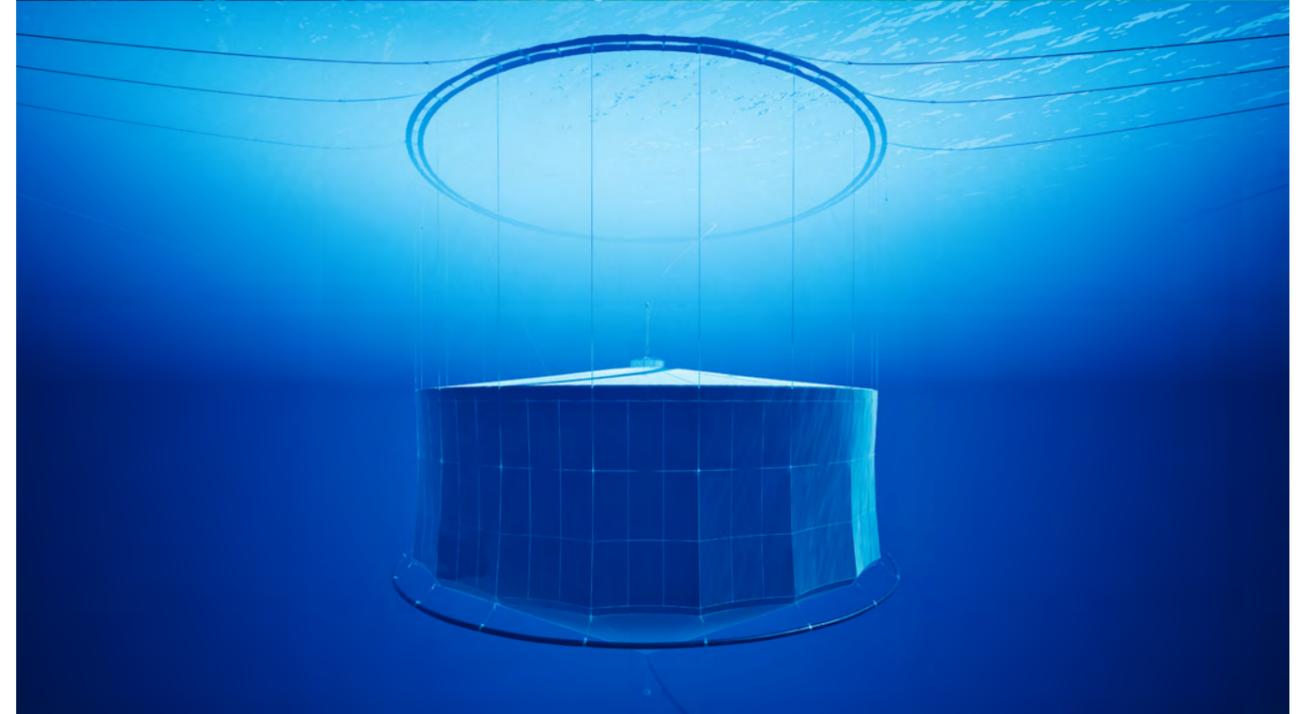
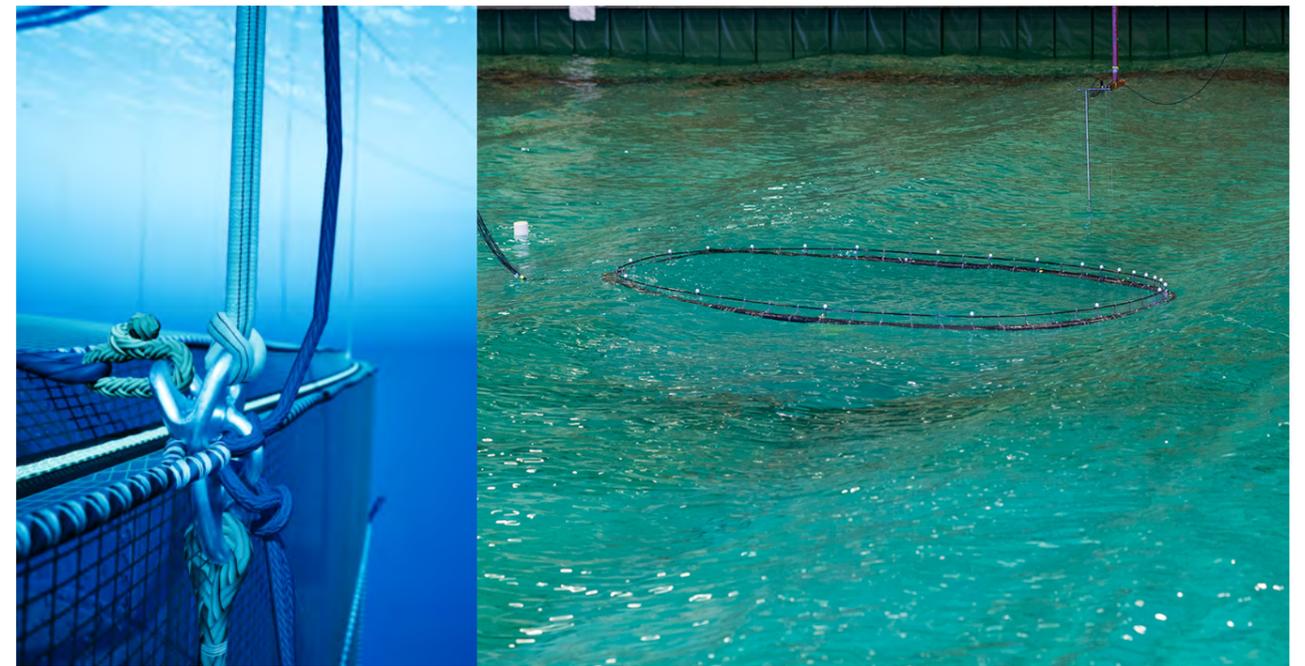
Our engagement

We understand how crucial it is to adapt to the unique challenges in the aquaculture industry, and our team of technicians, engineers, and experts has worked systematically and continuously to develop both the Subsea System and Vortex®. These products are the result of innovation, research, and a deep commitment to making a positive impact on the future of sustainable aquaculture.



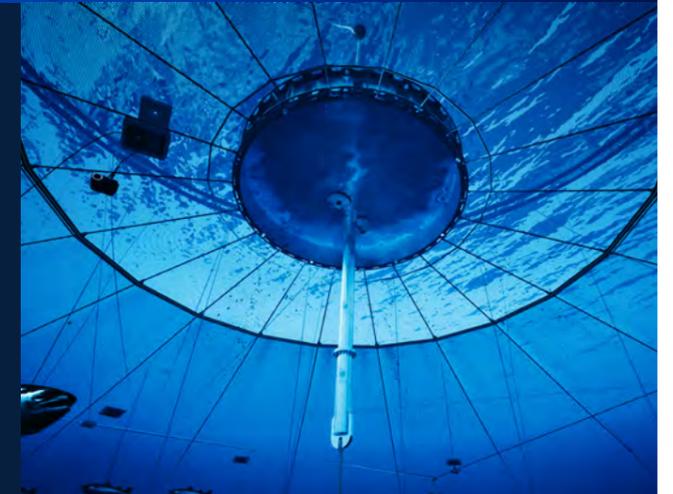
Subsea System: Submerged technology adapted to exposed and deep locations

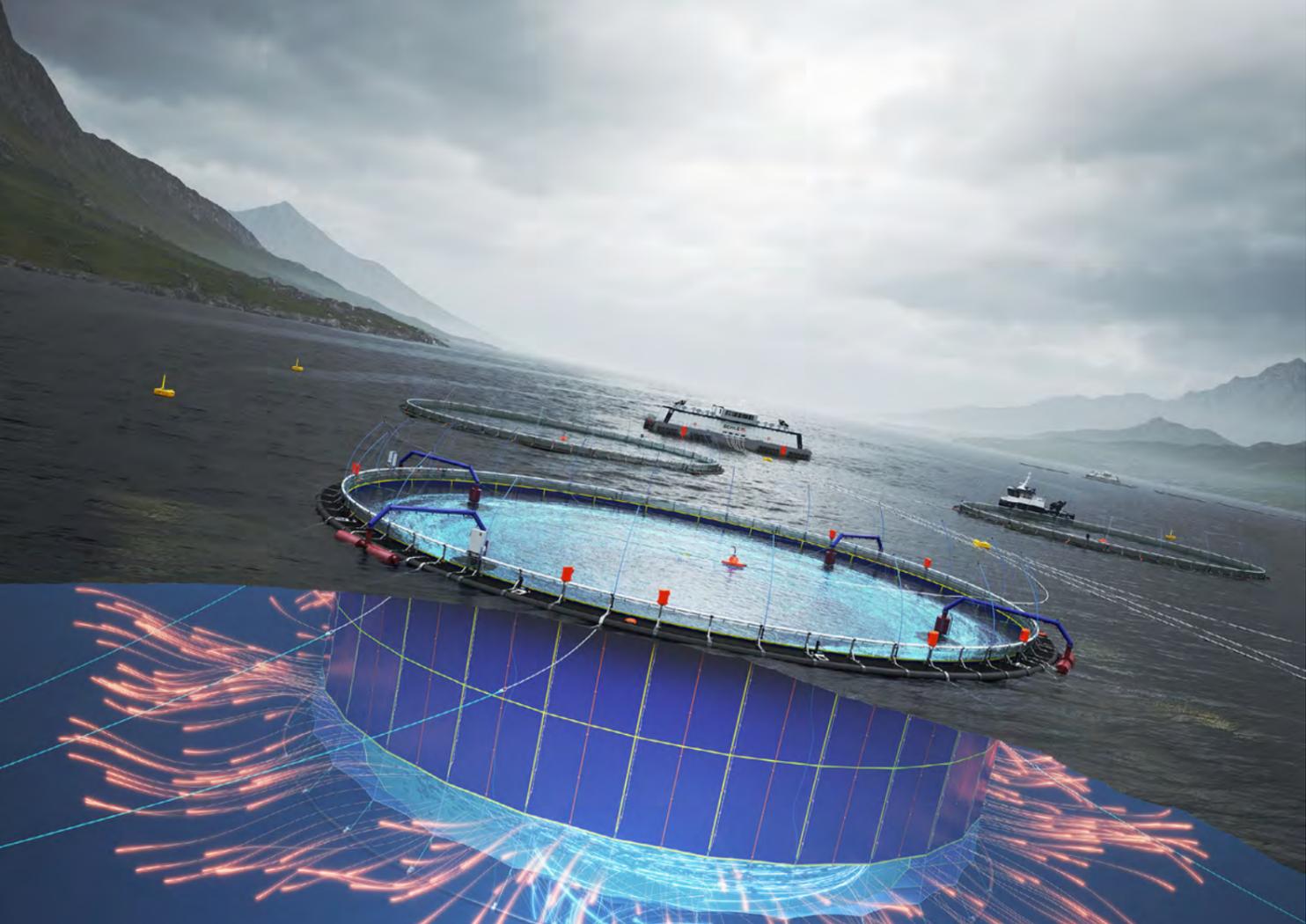
Take control of the lice problem with ScaleAQ Subsea System. We have developed a comprehensive pen concept for submerged operations that takes responsibility for the entire system, ensuring proper interaction and synergy between main components and additional equipment. Tailored for deep and exposed locations, it reduces wave forces and provides stable temperatures. Submerged to approximately 25–30 meters.



Submerged system

- ▶ 157 and 160 meters Midgard rings
- ▶ Net on total 40–50 000 m³
- ▶ Air dome included in the net roof
- ▶ Suitable for exposed environments
- ▶ Integrated dead fish system
- ▶ Camera and sensors for monitoring the water environment and fish behaviour





Vortex®: Permanent measures against salmon lice

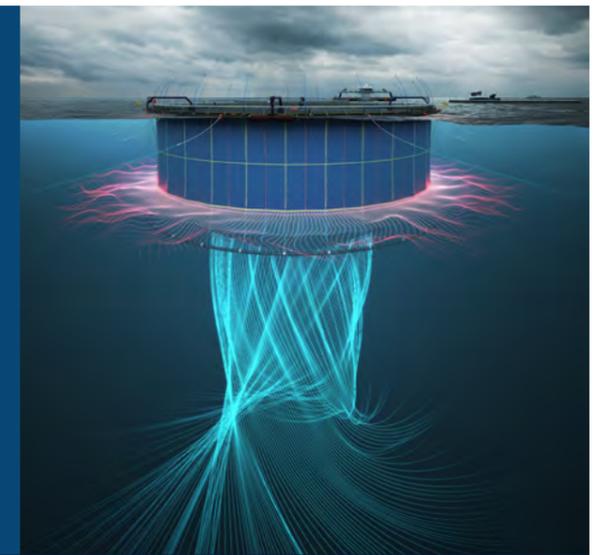
By drawing large volumes of fresh water from the depths into the pen, you ensure that the salmon has access to fresh and oxygen-rich water, while physical barriers keep the lice larvae away. Vortex® from ScaleAQ protects the fish and provides them with a better living environment.

Norwegian fish farmers today generally manage to adhere to lice limits, thanks to repeated treatment operations. However, the high burden of such operations on the fish results in reduced biological performance and production, leading to increased mortality.

This is not the case with Vortex®.

“ScaleAQ’s ambition is to provide a system that allows the fish to grow rapidly, while ensuring fish health, economics, and sustainability. We anticipate that Vortex will significantly limit lice infestation, thereby improving biology and welfare.”

Torstein Kristensen
Head of Biology, ScaleAQ



What is Vortex®?

Vortex® is a semi-closed aquaculture system. The salmon lice thrive best in the upper water layers, which is why there is a barrier in the upper water layer that prevents the lice from entering the pen. To ensure an adequate supply of fresh water, Vortex® pumps up fresh water from the depths beneath the pen.

The fresh seawater pumped in also contributes to a circular flow of water inside the pen. Vortex® ensures favorable oxygen and flow conditions. The system allows the fish farmer to actively regulate the flow rate to ideal levels where the fish thrive and grow well.

Additionally, the water brought up helps to mitigate seasonal temperature variations by incorporating deep water that is colder than surface water in the summer and warmer than surface water in the winter.

Semi-closed system

- ▶ Reduces lice infestation and lice treatment
- ▶ Reduces algae infestation and jellyfish
- ▶ Optimizes the water exchange and ensures stable oxygen values
- ▶ Evens out seasonal temperature variations by taking in deep water
- ▶ Optimizes current conditions and swimming speed
- ▶ A more even distribution of the fish in the pen





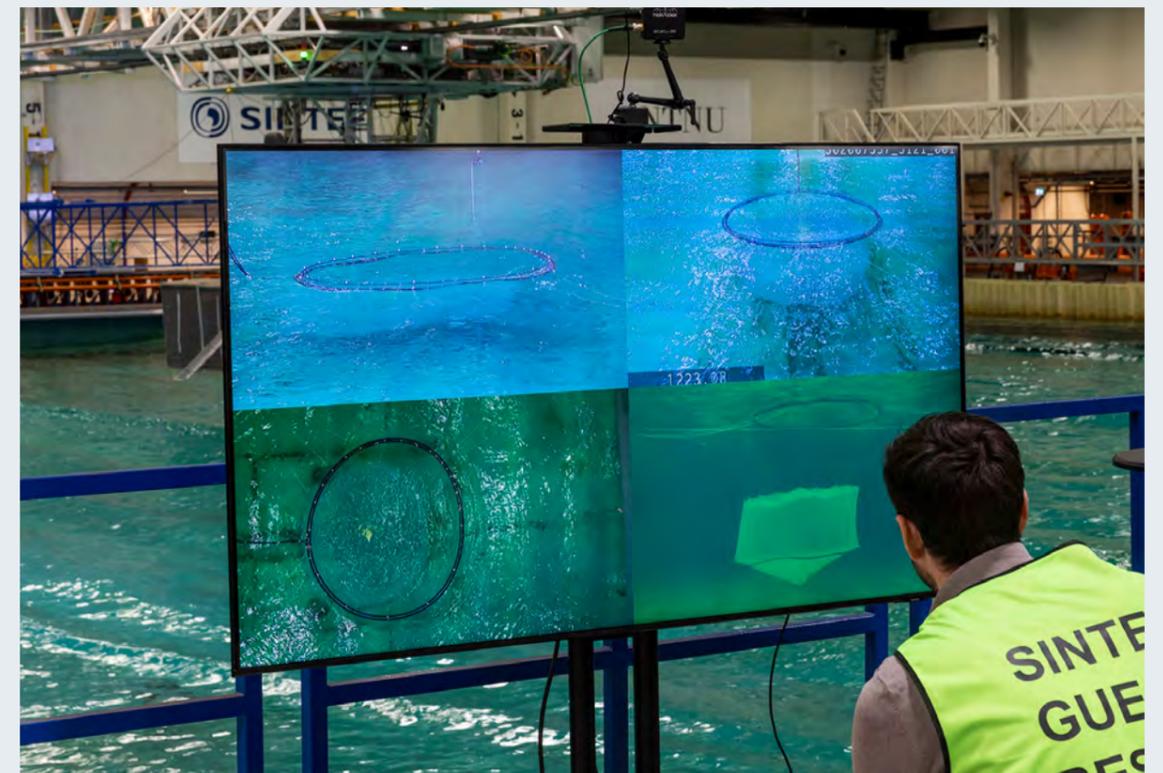
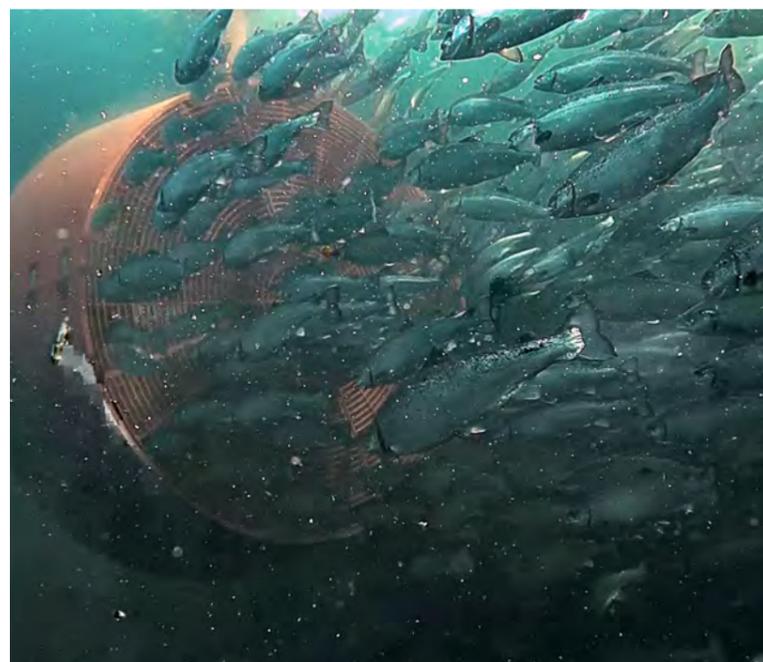
Experiences indicate that the skirt holds well in the sea and maintains the volume as expected. The customer finds that this concept stabilizes the temperature inside the pen throughout the year, with lower temperatures than surface water in the summer and higher temperatures in the winter. The large capacity for water exchange ensures good oxygen conditions and overall water quality throughout the production.

Positive welfare measure

The water velocity is highest in front of the Vortex units and along the edge of the pen, decreasing towards the center of the pen. It is also easy to adjust the water velocity based on fish size, with smaller smolt requiring lower water velocity than larger fish.

It is observed that the fish position themselves well in the current. When entering the pen, they quickly adapt and position themselves in front of a Vortex unit or along the pen's edge when not feeding.

We consider this a positive welfare measure, as the fish have the option to choose where to position themselves. If they want to exercise or be active, they can place themselves where the current is strongest. If they want to rest, eat, or have a less active day, they can position themselves in areas of the pen with lower velocities.



We ensure the future of aquaculture through testing at Marintek

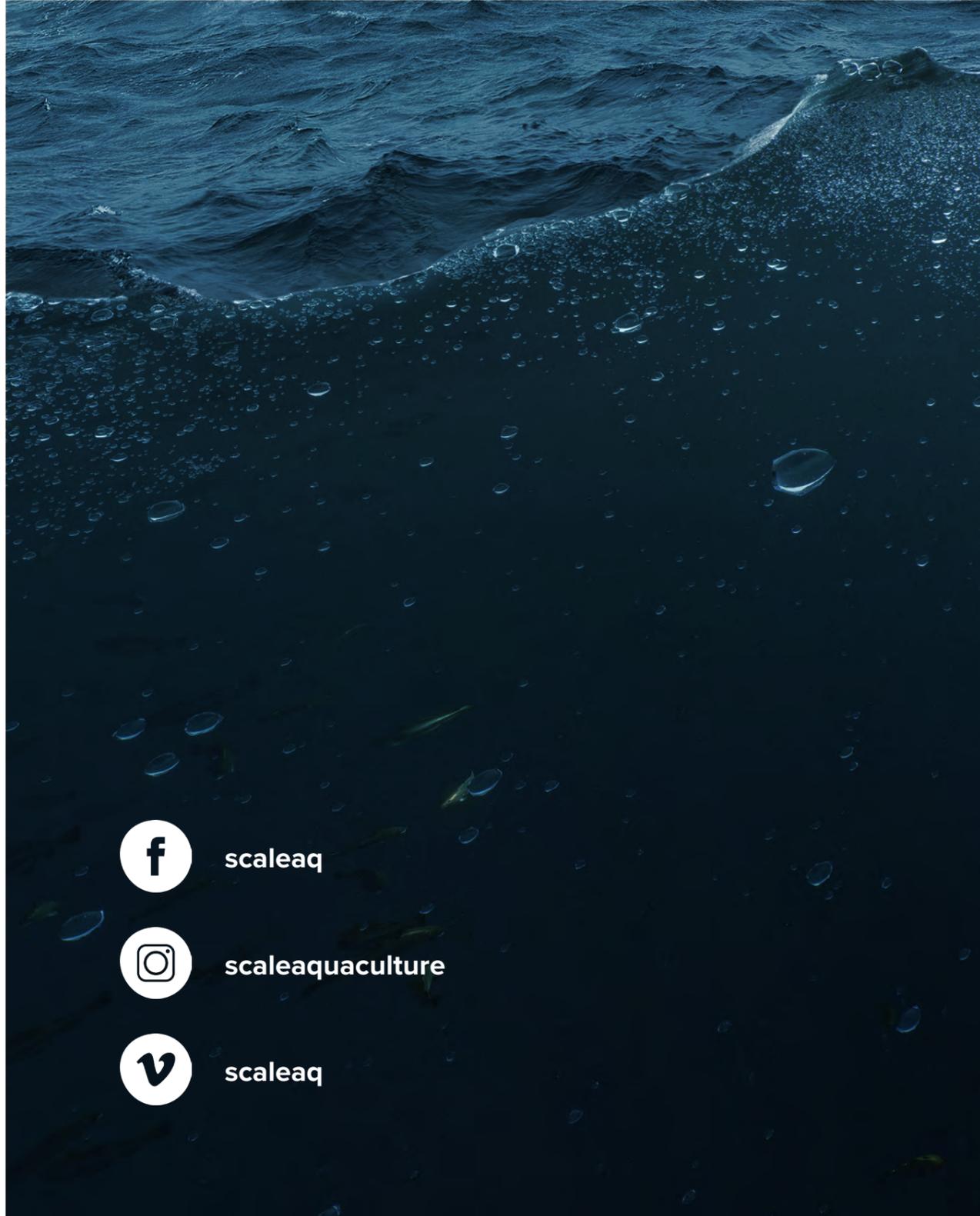
At ScaleAQ, our goal is to drive sustainable growth in aquaculture. We achieve this through innovative solutions that enhance fish welfare, improve biological performance, and ensure sustainable and profitable operations for our customers.

The key to our success lies in model testing at Marintek (Sintef Ocean) in Trondheim, a process crucial for meeting the industry's high standards. With over 40 years of experience, we have developed broad expertise in everything from analysis to production and research. Since 2012, we have specifically focused on enhancing our pen constructions through testing at SINTEF Ocean. Our collaboration with SINTEF Ocean reflects our commitment to developing a more sustainable and profitable future for the aquaculture industry.

The model tests have provided essential information on various aspects to create an

escape-proof pen system. Firstly, we now have precise data on the load distribution for the pen. This is crucial for predicting the behavior and loads for these flexible and deformation-controlled constructions. Furthermore, the model tests have shown that our configuration is optimal in terms of interaction and collaboration, with minor adjustments based on the results. Considering the risk profile for submerged operations, the information we now possess is invaluable for both ScaleAQ and our customers as we move the industry forward.

Risk management and control of integrity for aquaculture structures have become more critical than ever with the introduction of NYTEK23 and NS9415:2021, where ScaleAQ has led the work on the technical chapters in the Standard Group. The focus on the interaction between technology and biology is central now as the fish move deep beneath the surface.



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CONTACT

sales@scaleaq.com

+47 488 52 488

