

SCALE **AQ**

Net



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ScaleAQ is a leading global technology provider that supplies and manufactures complete sites for 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.



Complete solutions reduce the risk of escape

ScaleAQ started supplying technical components to the aquaculture industry in the world's toughest and most demanding ocean areas more than 40 years ago. We currently supply complete locations; pens, nets, mooring systems, cameras, barges and software; as a package or individual elements.

The starting point of our recommendations is that everything is connected. The climate both above and below the water at the given location sets the premises for the choice of solution and composition of elements in a secure facility.

Research and development takes place in close collaboration with customers and leading research institutions, and we have our own Marine Engineering department. This is how we ensure better products – while helping to solve the industry's challenges.



A thorough analysis of the conditions at the location is crucial for us to find the safest solution for your facility

Quality in every aspect

The forces of nature leave no room for error. At sea, you cannot allow yourself to compromise on basic safety requirements. That is why our work is always based on a pre-defined plan – a chronological process. These efforts are conducted by people with experience in and knowledge about aquaculture, climate and offshore structures and using modern analysis tools.

The process ensures a good result

Regardless of whether you are ordering a complete system with a pen, mooring, net, camera and barge, or whether you are just looking for one of the components, our recommendation will be well justified and made on an individual basis, and all factors will be assessed and taken into account.



The challenge
Size. Scope.
Conditions.



Analyses
Current. Wind.
Waves. Depth.



Suggested net design
Based on analyses.
Type of netting.



Order confirmation
We make an agreement.
Price. Progression.



Production
Final material selection
and assembly.



Quality assurance
Packing. Shipment.
Delivery.



Installation
Net in the water.
Everything works.



Net service
Follow-up. Inspection.
Maintenance.

The perfect net

A net that functions perfectly at one location and at one facility doesn't necessarily mean that it will work just as perfectly at another location. If you order a Midgard system, the net is specially adapted to the pen and mooring system; it doesn't get any better. For other types of facilities, we suggest nets that are as close to perfect as possible based on the relevant conditions.

New times – new requirements

New locations and climate change combined with larger, heavier and deeper nets increase loads and place stricter requirements on the robustness of the net. Requirements from the authorities are also getting stricter, and the today's perfect net may not meet tomorrow's standards. Durability, service life and service needs also have to be taken into consideration.

Fish health and the environment

In addition, customers and society are more concerned about fish health and the environment than ever before. The perfect net must therefore also reduce the risk of escape to a minimum, while providing the fish with the best possible living conditions. Quality has never been as important as it is right now.



Hand-stitched nets fit perfectly right from day one



No machine can sew such heavy-duty rope as we need.

It has long been standard practice in the Norwegian aquaculture industry to provide nets with oversized dimensions to ensure they fit the facility after multiple rounds of shrinkage following washing/cleaning. This results in nets being too large for almost their entire service life. We also know that oversized dimensions cause chafing against the crowfeet and pen, thereby increasing the risk of damage to the net. Hand-stitched nets reduce this risk to a minimum.

Less risk of escape and easier maintenance

Most nets delivered by manufacturers are slightly oversized. The industry's normal oversized dimensions are approximately 6 % for netting and 2 % for rope. ScaleAQ currently delivers an oversized dimension of 2% for netting and 0% on lengths of rope. It reduces the risk of chafing, reduces wear and tear, and results in easier maintenance and savings on antifouling treatment.



An internationally leading partner

King Chou is one of the world's leading producers of quality nets for the fishing industry. Established as far back as 1978, the Chinese company currently delivers fishing nets and aquaculture nets around the world.

One of the main reasons why ScaleAQ has chosen King Chou as the production site for its handmade nets is that they are skilled in quality management, research and innovation.

King Chou has a streamlined and efficient production line for both hand sewing and machine sewing, and a large staff of experienced, well-qualified and dedicated workers. They sew nets using all types of netting and are certified for most international quality standards.



King Chou has efficient production lines for both hand sewing and machine sewing.



We only use high quality netting certified by the quality assurance system NS 9415.

Strong netting in all materials

The nets being currently produced are larger, deeper and heavier than before, and are therefore exposed to completely different loads than before. As a result, the requirements for inspections, maintenance and service have also become stricter. It is therefore more important than ever to choose the right netting. At ScaleAQ, we work closely with customers and subcontractors to find the best solutions.

Nylon

- ▶ The most commonly used material for aquaculture nets
- ▶ Cost-effective
- ▶ Easy to work with and repair
- ▶ Treated with either antifouling or coating in order to reduce fouling and ensure more straightforward maintenance/rinsing
- ▶ Supplied both as nodal line and non-nodal line
- ▶ Considered the 'standard netting' in Norway and used by most customers at present

Polyester

- ▶ A good deal heavier than nylon
- ▶ Good against UV
- ▶ Good shape stability
- ▶ Less shrinkage than nylon
- ▶ Treated with either antifouling or coating in order to reduce fouling and ensure more straightforward maintenance/washing
- ▶ Supplied both as nodal line and non-nodal line
- ▶ Resistant to wear

HDPE

HDPE has been tested under extreme stresses and demonstrates excellent properties in terms of fracture strength and wear. Third-party tests document the superior strength of HDPE. Ekstrem slitestyrke

- ▶ Extremely durable
- ▶ Withstands high frequency of washing
- ▶ Environmentally friendly – no antifouling
- ▶ Long service life and low service costs
- ▶ Reduced escape risk
- ▶ Designed to ensure better sinkability
- ▶ Better water flow than traditional nets, which provides a better environment inside the net
- ▶ Less deformation and inflation of the netting

UHMWPE

Stronger netting which has very good properties with regard to breaking strength and wear. It has undergone rigorous testing, withstanding high-stress conditions and repeated net cleaning, surpassing traditional netting in both wear resistance and breaking strength. Improved water flow provides a better environment for the fish.

- ▶ Extremely durable
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- ▶ Less deformation and inflation of the netting

When interplay follows the principles of weather

What makes one net better than another? When the details from the thickest rope down to the smallest stitch are coordinated and designed with each other in mind.

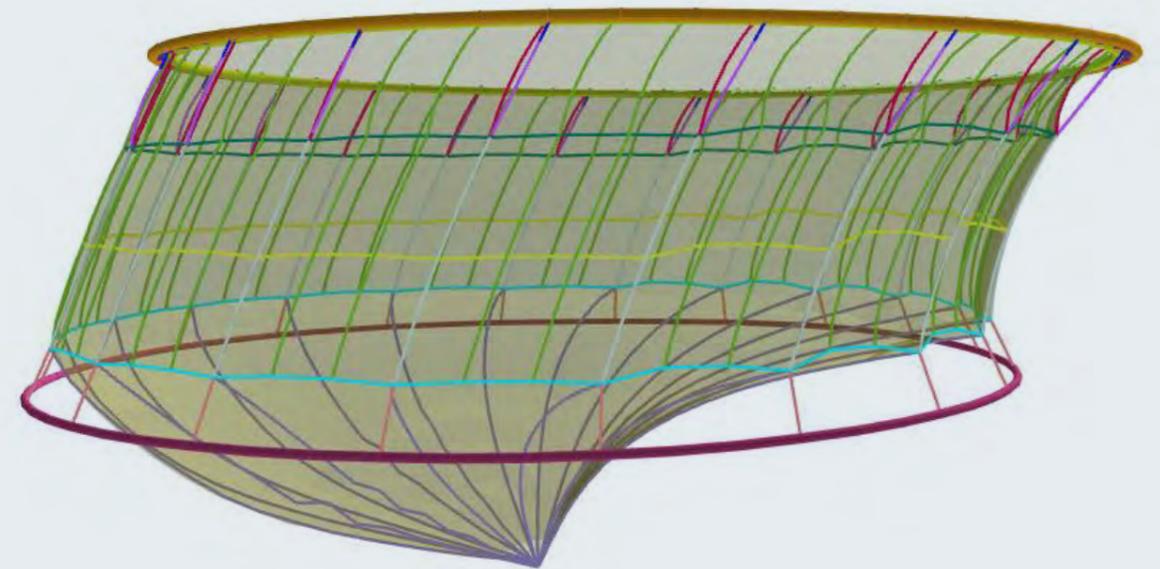
Through years of operational experience and extensive use of analysis tools and visits to the Marintek tank in Trondheim, ScaleAQ has compiled a series of maps showing how each individual net design behaves at any given location. In consultation with the fish farmer, we can use this tool to recommend which net to use at the different locations. The net matrix shows the different and important aspects of behavior, declines in volume that result in poorer fish welfare, and risks related to escape. Documentation of interplay is a requirement according to NYTEK23 and NS9415:2021.

The net is an important part of the entire system and should be best adapted to the rest of the facility. At the same time, we know that prerequisites and preferences vary, and that not everyone is looking for a complete facility or requires the most expensive and robust options. This does not mean that we compromise on quality and requirements, but that we recommend designs and materials based on the prerequisites that apply in each individual case.

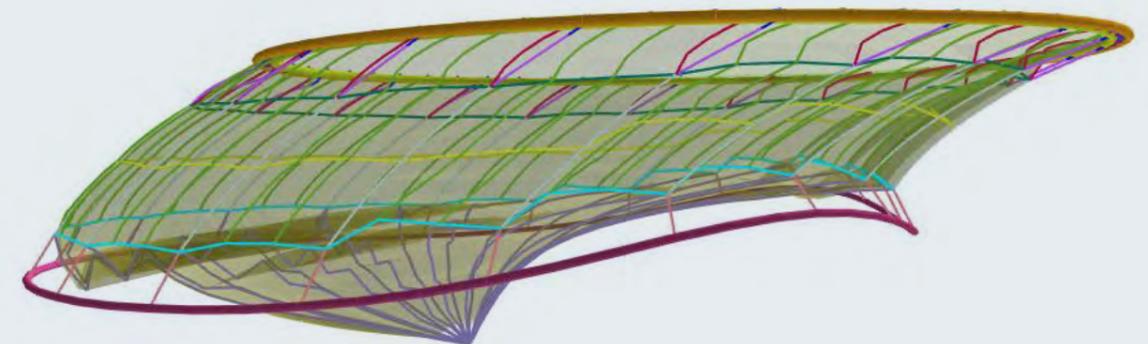
Read more about our tests in the Marintek tank on page 37.

Ask our advisors about ScaleAQ's net matrix.

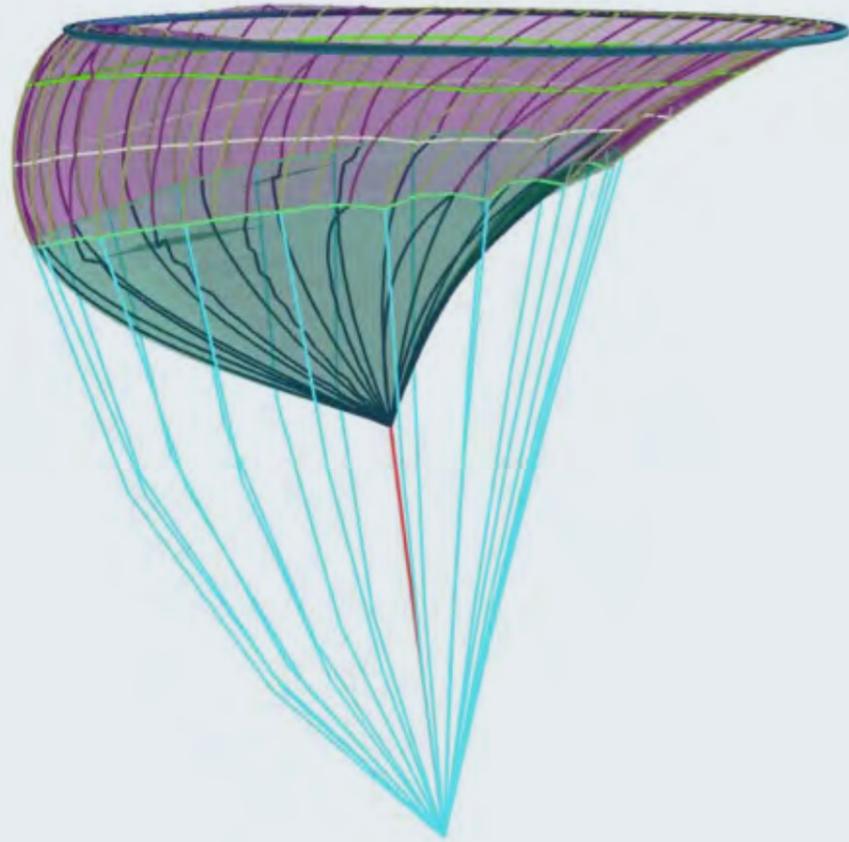
Pen constructions under tough conditions



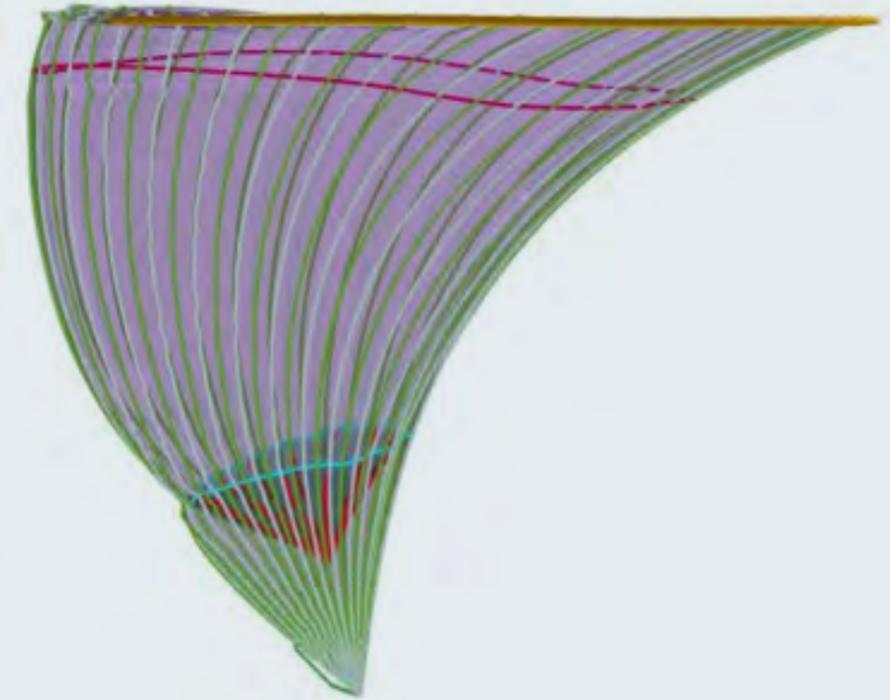
Midgard net: "0.5 m/s, with 85% remaining net volume"



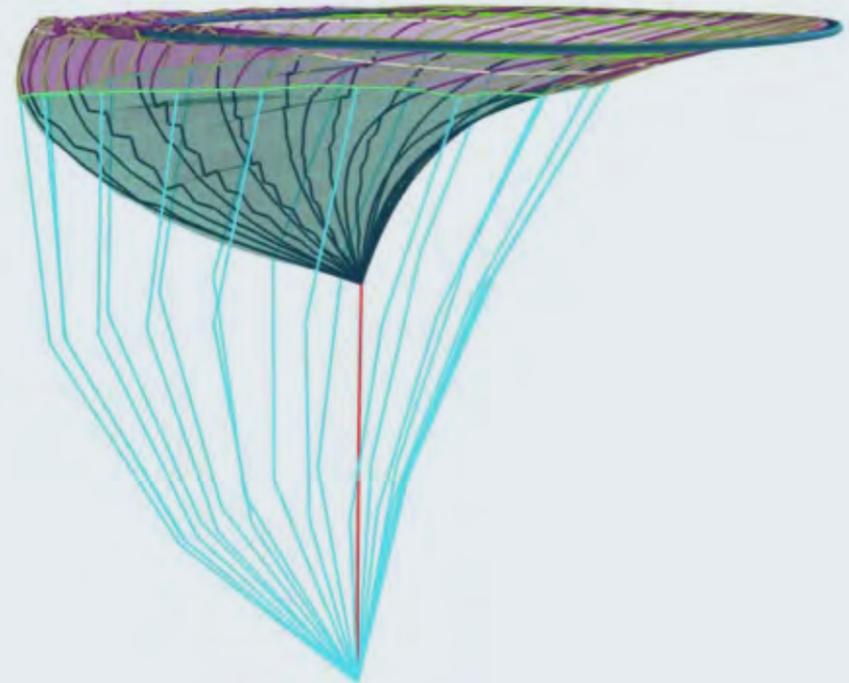
Midgard net: "1.0 m/s, with 77% remaining net volume"



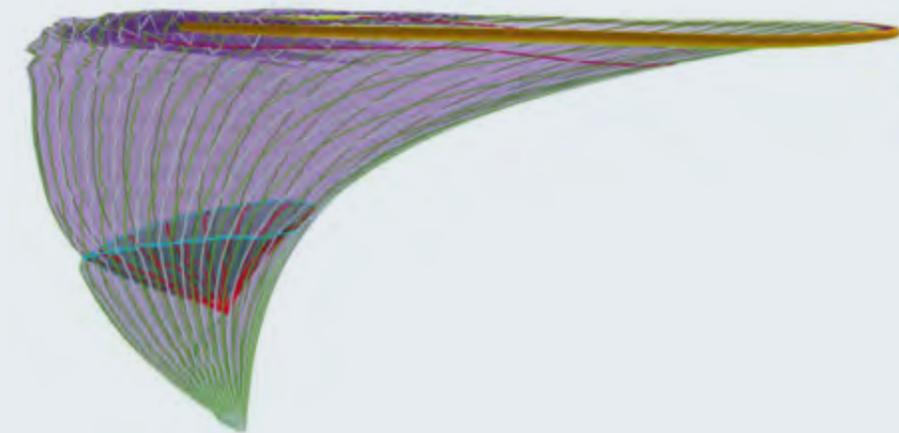
Spaghetti net: "0.5 m/s, with 69% remaining net volume"



Pointed net: "0.5 m/s, with 79% residual net volume"



Spaghetti net: "1.0 m/s, with 37% remaining net volume"



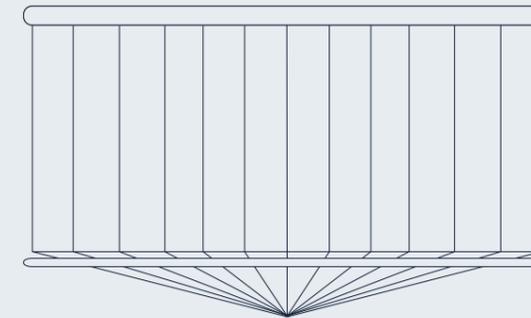
Pointed net: "1.0 m/s, with 51% residual net volume"

Net table

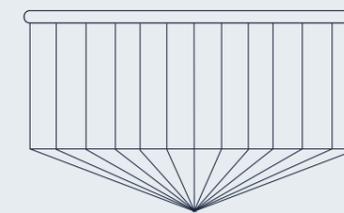
NYLON

Thread no.	Half mesh size mm	Omfar	Full mesh size mm	Breaking strength kg
20	15,5	40	26,2	79
20	16,5	38	28,2	79
20	17,5	36	30,2	79
20	19,5	32	34,2	79
24	15,5	40	26	96
24	16,5	38	28	96
24	17,5	36	30	96
24	19,5	32	34	96
24	22,5	28	40	96
24	25,0	25	45	96
24	28,5	22	52	96
28	15,5	40	25,8	105
28	16,5	38	27,8	105
28	17,5	36	29,8	105
28	18,5	34	31,8	105
28	19,5	32	33,8	105
28	22,5	28	39,8	105
28	25,0	25	44,8	105
28	28,5	22	51,8	105
32	15,5	40	25,6	117
32	16,5	38	27,6	117
32	17,5	36	29,6	117
32	19,5	32	33,6	117
32	22,5	28	39,6	117
32	25,0	25	44,6	117
32	28,5	22	51,6	117
36	19,5	32	33,1	136
36	22,5	28	39,1	136
36	25,0	25	44,1	136
36	28,5	22	51,1	136
40	19,5	32	32,5	152
40	22,5	28	38,5	152
40	25,0	25	43,5	152
40	28,5	22	50,5	152
46	19,5	32	32,1	170
46	22,5	28	38,1	170
46	25,0	25	43,1	170
46	28,5	22	50,1	170

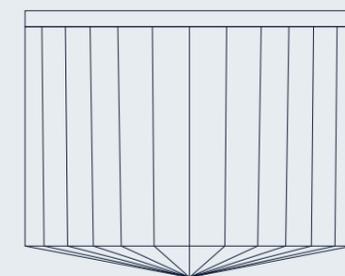
MIDGARD NET



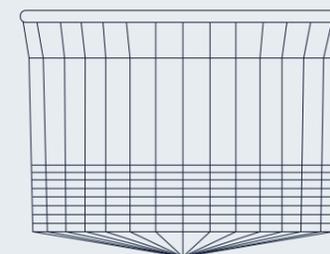
CYLINDER NET



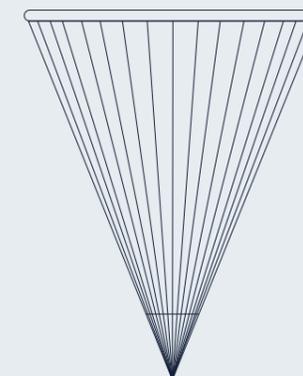
SQUARE NET



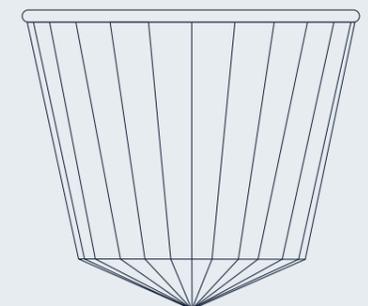
COMBI NET



POINTED NET



SPAGHETTI NET



Service and antifouling

Different locations place different requirements on the choice of antifouling and coating. Generally speaking, the trend is that more and more people choose ASC environmental certification and use environmental coating. ScaleAQ has more than 40 years of experience in choosing the most environmentally friendly products that best suit different nets and locations.

Although our nets are of the highest quality, they need to be serviced and maintained. We have developed good and efficient disinfection, reparation and antifouling routines so that your nets receive the longest service life possible.

State-of-the-art facilities

At Hestnes in Hitra, ScaleAQ has a state-of-the-art washing and cleaning facility with roots stretching all the way back to the 1950s. All types of net services are carried out at this facility, and we have a separate dehumidifying system that dries the nets before antifouling treatment.

Courses

In order to keep the nets in the best possible condition for as long as possible, proper treatment and handling are important. ScaleAQ offers courses and training in all matters related to installation and maintenance. Please contact us for further information.

Service and repair

We have invested heavily in state-of-the-art washing and cleaning facilities that meet the requirements regarding environmentally friendly emissions. Our facilities have been upgraded and developed in recent years, and they are now modern, efficient and adapted to the requirements of a future-oriented and quality-conscious aquaculture industry. Together with experienced employees and good routines, these investments further improve the quality of the products we deliver to our customers.

Quality products since the 1970s

In our premises at Frøya, nets and other quality equipment have been produced for the aquaculture industry since the 1970s. Today, nets of all sizes are produced based on customer specification; from 60 meters wide up to 200 meters.

Our net service and maintenance routine

- ▶ New nets are checked upon arrival.
- ▶ Old nets are washed, inspected and repaired.
- ▶ If required, nets are immersed in an antifouling treatment bath.
- ▶ Nets are vacuum treated in the impregnator.
- ▶ Surplus antifouling following all treatments is fed back into the antifouling bath
- ▶ Nets are dried.
- ▶ Nets are packed, re-roped and sent to the customer.

What happens after a net cycle?

1.

Retrieval of the net and transportation to the service station

2.

Arrives at the service station's 'dirty' zone

3.

The net is prepared for washing

4.

Washing

5.

Removed from the washing machine for drying

6.

The net is checked for defects/damage

7.

The net is repaired and re-roped

8.

The net is prepared for antifouling

9.

Antifouling treatment takes place approx. 1 week before delivery and a new cycle



Midgard® System

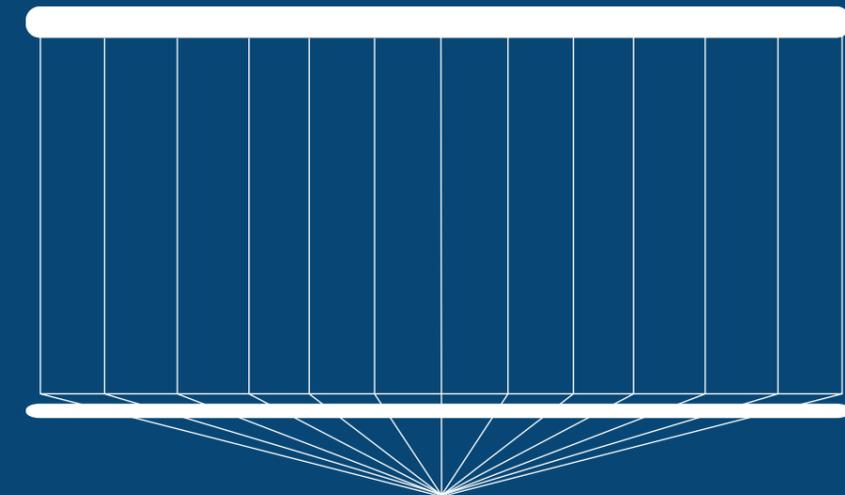
The Midgard net-pen system is built with a focus on optimal interplay between the main components of the pen, net and sinker tube. The system is the result of many years of experience and product development in collaboration with leading salmon farmers around the world. The main focus of development has been net-pen environment and safety.

Developed, tested and operated in collaboration with the largest salmon farmers in the world over many years, the Midgard system is continuously evolving as net-pens are moved into rougher and more challenging waters.

Many of the most demanding locations currently in use would not have been feasible without the assurance of reliability and habitable volumes for fish provided by the Midgard system. The combination of a pen, net and sinker tube adapted to each other and designed as one unit provides flexibility in the toughest conditions. This system is and will continue to be a success for ScaleAQ and our customers.

The Midgard system provides a stable and predictable net volume even under strong current conditions. The cylindrical shape allows the fish to swim deeper in the net-pen without increasing the number of kilograms of fish per cubic meter of water, which is a major advantage for rearing fish below the louse belt.

Several competitors have tried to copy our solution, without understanding that the extensive and cost-intensive work of analyses, tests, customer collaboration and associated documentation is crucial for the system to be delivered, installed and operated as the safest fish farming solution in open net-pens at sea.



Net and sinker tube

The ScaleAQ Midgard® System is an integrated net deployment system where the sinker tube is suspended directly from net baseline rope. It provides a taut net that makes cleaning much easier. This results in better conditions and improved fish welfare.

Winch

The winch evenly raises and lowers the sinker tube in one operation without requiring multiple workboats with cranes.

Attachment

The lift rope hangs loosely and independently from the rest of the system during normal operation. It eliminates the risk of chafing and damage to the net.



How does the Midgard® System work?

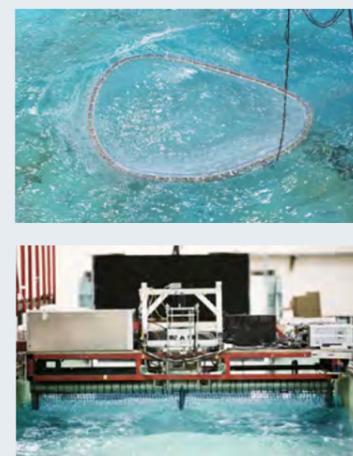
The Midgard system features a tailor-made net system that is dimensioned for our pen and sinker tube solution. With regard to ropes and nets, we focus on minimizing oversized dimensions in order to ensure that contact between the pen and the deployment system is kept to a minimum.

The net is dimensioned and designed to carry the total weight of the sinker tube through the support ropes. This is a significant load, which is often between 11-17 tons, depending on the circumference of the net-pen. The Midgard sinker tube has a much more rigid design than traditional sinker tubes, with a diameter between 400mm or 500mm, depending on the circumference of the net-pen.

This contributes to optimal deployment of the net and a predictable and high volume for the fish to swim in, even when there are high waves and strong sea currents.

In addition to ensuring a good net-pen environment, which is a fundamental aspect that must always be prioritized, this design results in a greatly reduced risk of wear between the net and the deployment system. This is highlighted in the illustration on the left.

The net wall holds loads from the sinker tube (light blue rope), and the sinker tube suspension (dark blue rope) is kept slack during operation and cannot damage the net.



Through several years of extensive analysis work, system testing in the Marintek Laboratory in Trondheim and full-scale solutions, in addition to the full operation of the system since 2013, our claim is that the Midgard system has been and continues to be the most well-documented net-pen system for open fish production, which safeguards the net-pen environment in the best possible way and has the lowest risk of escape on the market.

Why use the Midgard® System?

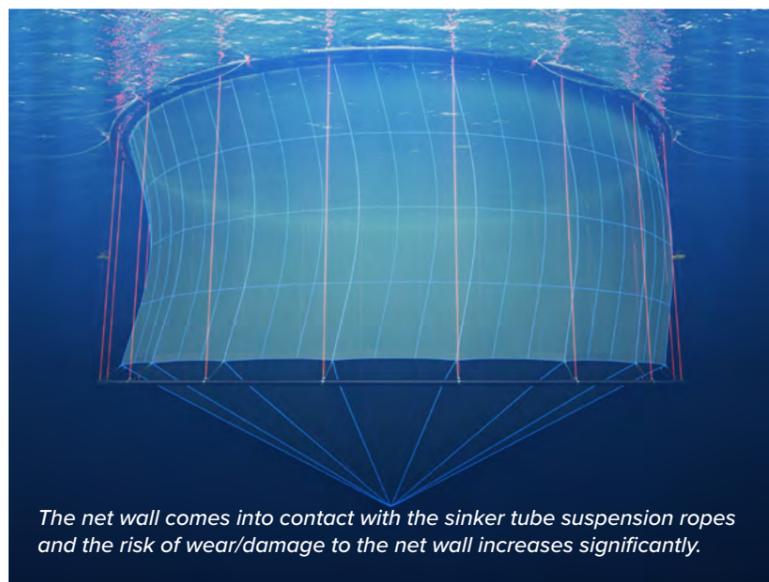
There have been and continue to be many different net solutions for farming salmon on the market. These have been successfully used for many years, but recently, the challenges facing traditional solutions regarding greater exposure have become increasingly evident.

Our experience is that traditional net solutions have usually been the result of a focus on low investment costs and easy/efficient handling for personnel and boats on and around the net-pen during operations such as delousing and slaughter.

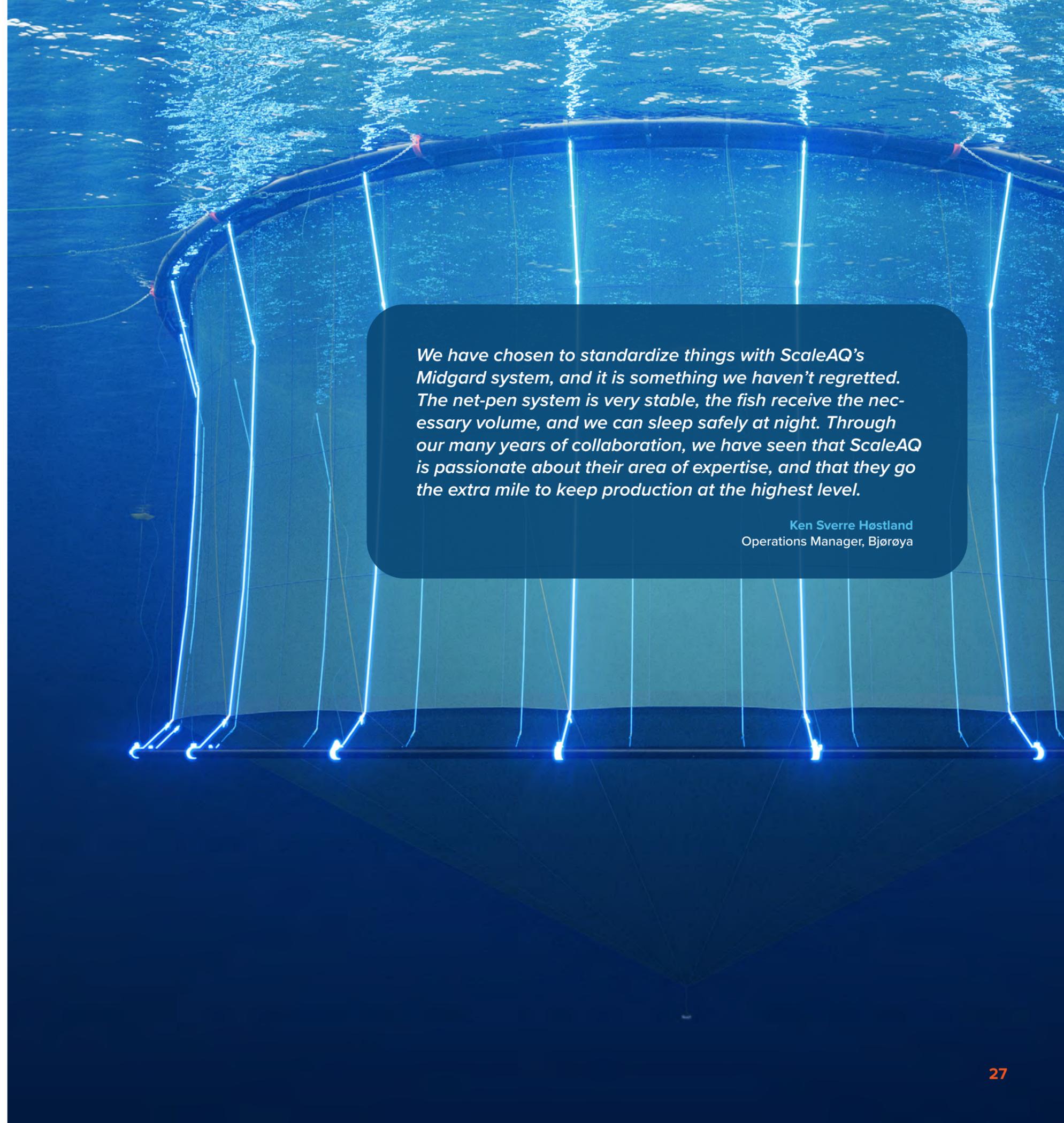
With the climate change we are experiencing in the form of more storms and rough weather throughout the year, as well as new locations being further out in more exposed waters where waves are high and ocean currents strong, the inadequacy of traditional net solutions becomes very clear regarding the interplay between the pens and the sinker tube, as well as unpredictable and reduced net volume (net-pen environment/fish welfare) during strong currents and high waves.

The Midgard system continues to use a sinker tube in order to achieve maximum deployment of the net that ensures predictable and high volumes for the fish swimming in the net-pen. This also enables fish farming at sites located in shallow waters.

Other net solutions where sinker tubes are used have problems with contact between the net and the deployment system, either in the form of direct contact with the sinker tube suspension or the sinker tube itself. This becomes especially apparent when large volumes of water flow through the net-pen, as shown in the illustration below. Here, the net makes contact with the sinker tube suspension ropes that run between the pen and the sinker tube, where the load from the sinker tube is connected to the pen.

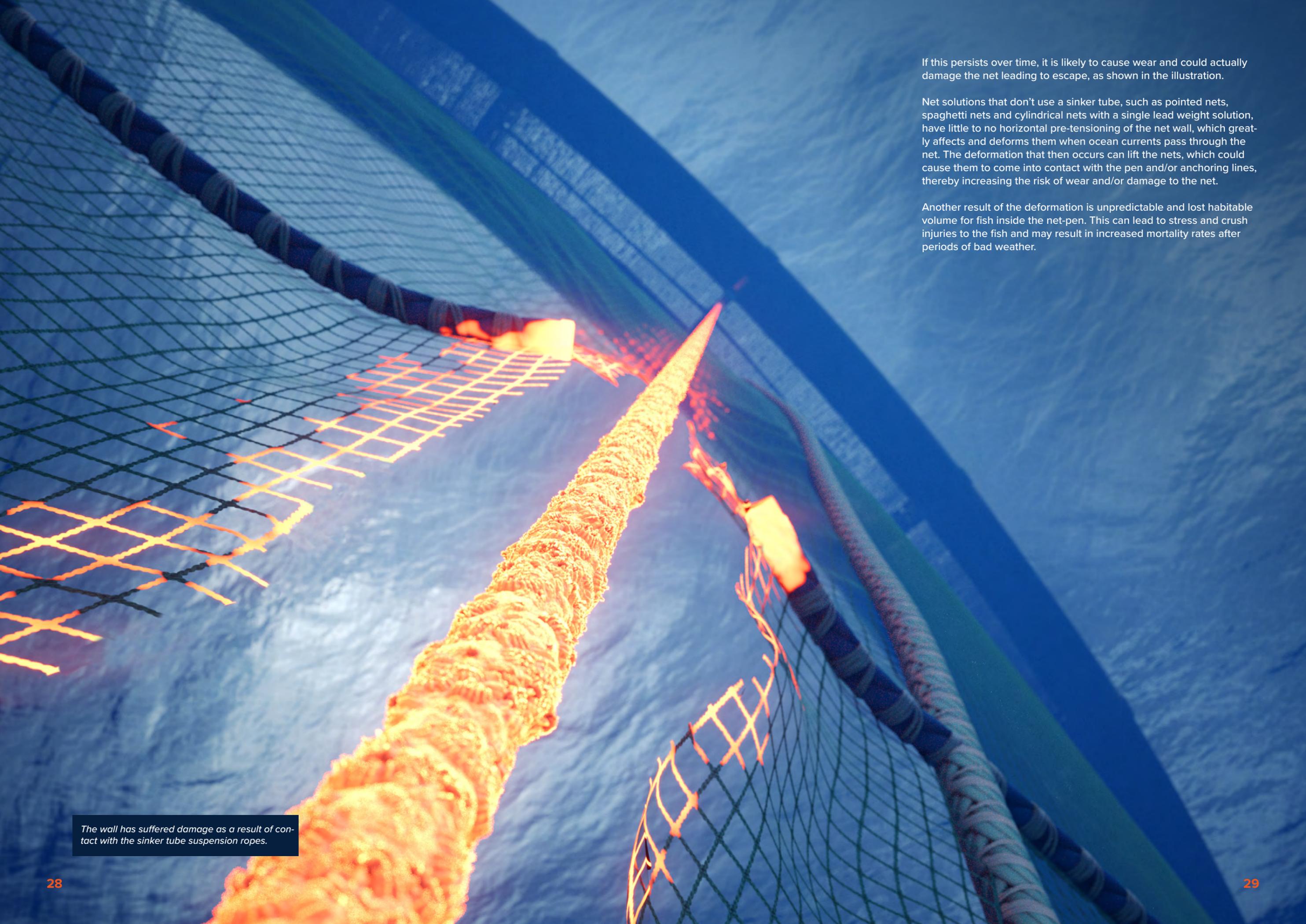


The net wall comes into contact with the sinker tube suspension ropes and the risk of wear/damage to the net wall increases significantly.



We have chosen to standardize things with ScaleAQ's Midgard system, and it is something we haven't regretted. The net-pen system is very stable, the fish receive the necessary volume, and we can sleep safely at night. Through our many years of collaboration, we have seen that ScaleAQ is passionate about their area of expertise, and that they go the extra mile to keep production at the highest level.

Ken Sverre Høstland
Operations Manager, Bjørøya



If this persists over time, it is likely to cause wear and could actually damage the net leading to escape, as shown in the illustration.

Net solutions that don't use a sinker tube, such as pointed nets, spaghetti nets and cylindrical nets with a single lead weight solution, have little to no horizontal pre-tensioning of the net wall, which greatly affects and deforms them when ocean currents pass through the net. The deformation that then occurs can lift the nets, which could cause them to come into contact with the pen and/or anchoring lines, thereby increasing the risk of wear and/or damage to the net.

Another result of the deformation is unpredictable and lost habitable volume for fish inside the net-pen. This can lead to stress and crush injuries to the fish and may result in increased mortality rates after periods of bad weather.

The wall has suffered damage as a result of contact with the sinker tube suspension ropes.

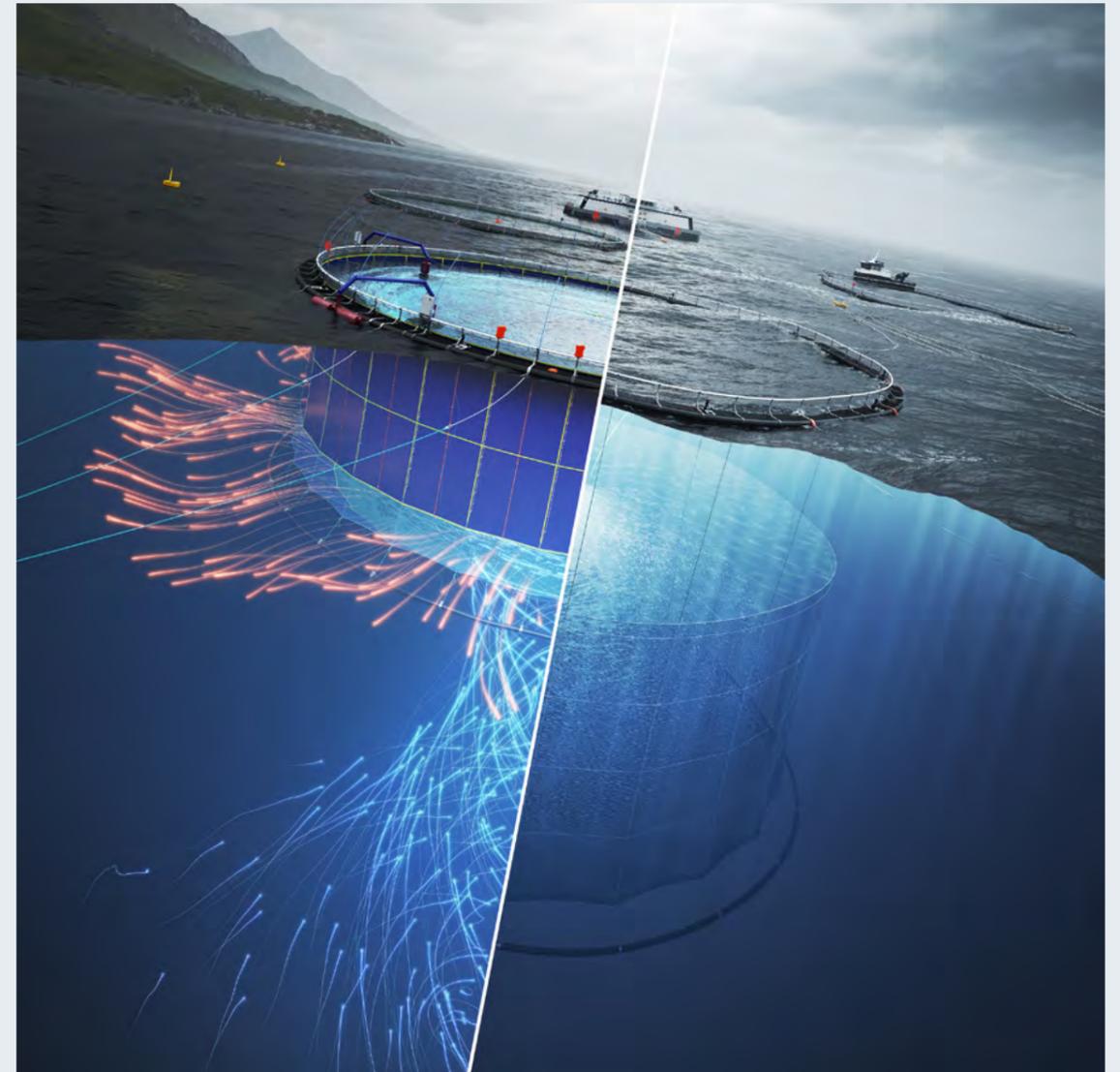


Innovative technology for future aquaculture

As one of the world's largest suppliers of aquaculture equipment, ScaleAQ feels a strong responsibility to help develop solutions to the industry's challenges and promote sustainable growth. Our vision is to provide solutions that are both sustainable and cost-effective, and that improve fish farming production while safeguarding fish welfare and the environment.

Salmon lice: A critical challenge

Salmon lice pose one of the most pressing challenges in the aquaculture industry. They lead to significant losses in production and have 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 the ScaleAQ Subsea System, have been developed and tested to meet these challenges.



Innovative solutions

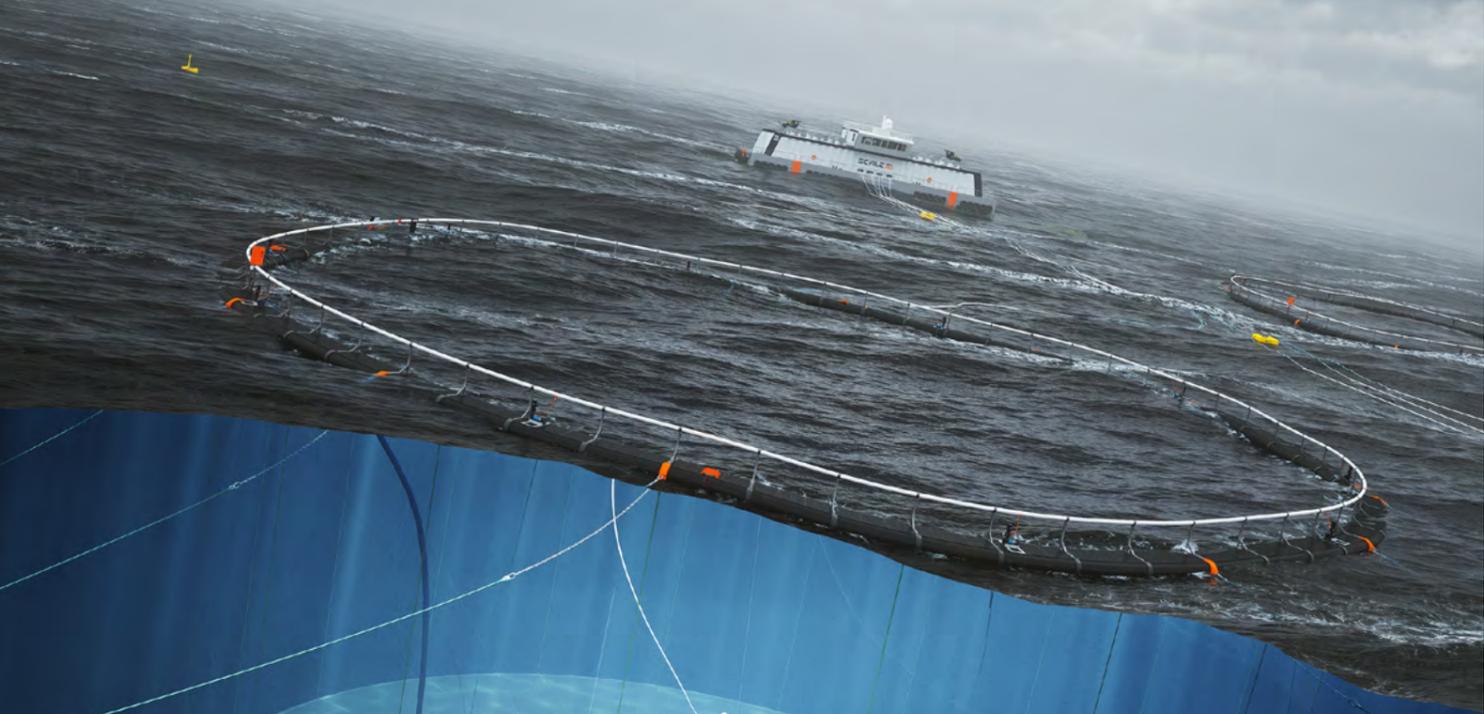
The **ScaleAQ Subsea System** was developed in 2016 when we applied for development licenses for a submerged operating solution with flexible net-pen technology. This pioneering work has provided us with a technology that effectively addresses the challenges of salmon lice and other environmental impacts.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

For locations that are not suitable for Subsea operation, we have developed **Vortex®**. This semi-closed net-pen system makes it harder for salmon lice to thrive. A solid cover in the upper water layer prevents the lice from entering, and

fresh seawater is pumped up from the depths. The continuous replacement of the water helps to improve oxygen conditions and significantly reduces lice infestation. The concept evens out seasonal temperature variations by utilizing water from the depths.

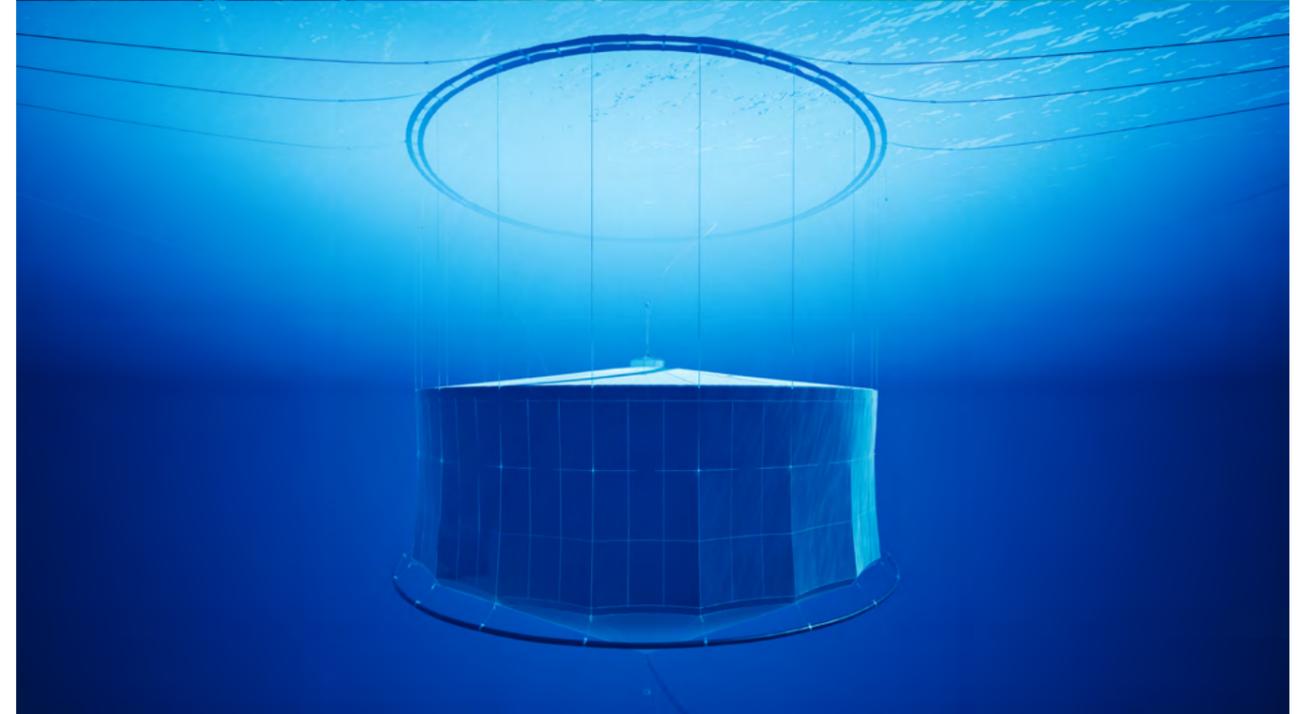
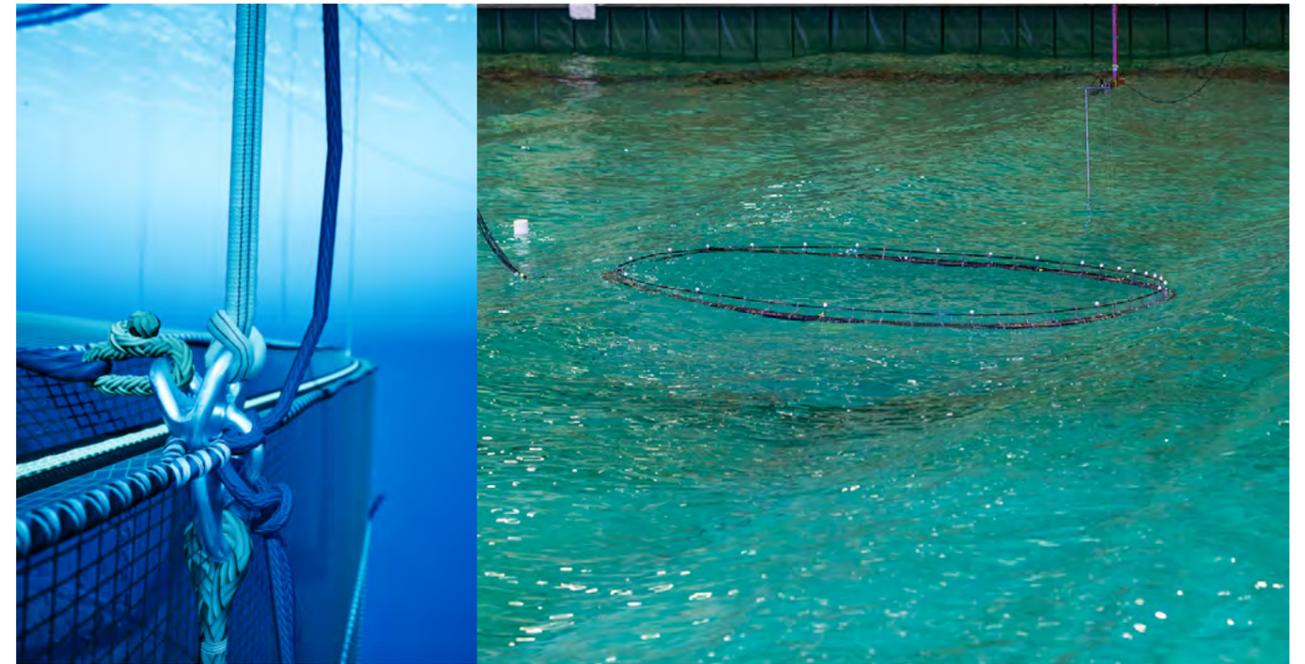
Our commitment

We understand the importance of adapting to the unique challenges facing the aquaculture industry, and our team of technicians, engineers and experts have 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 create a positive impact on the future of sustainable aquaculture.



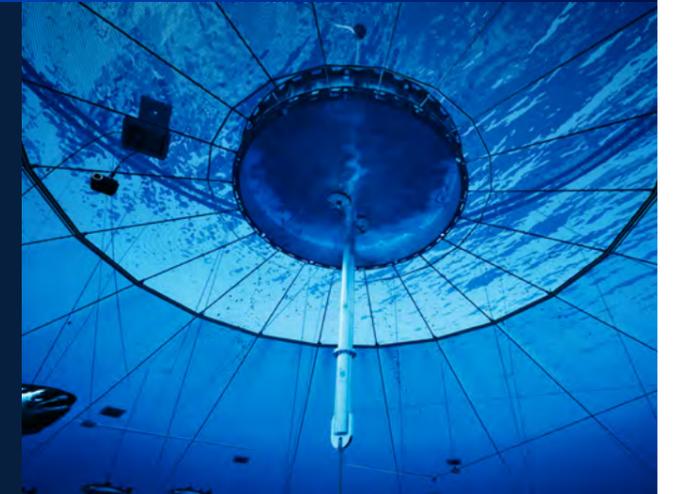
Subsea System: Submerged technology adapted to exposed and deep locations

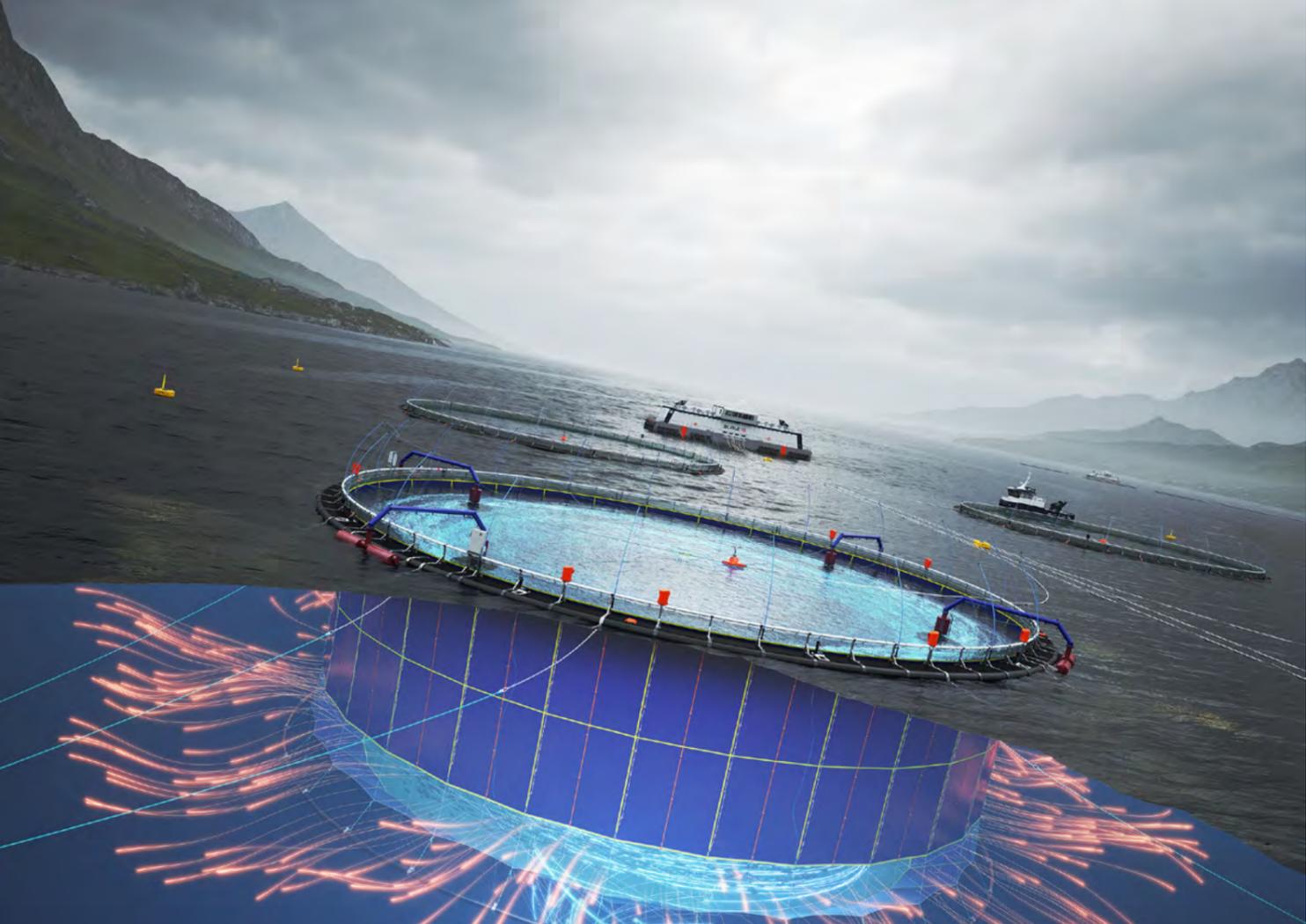
Take control of the lice problem with the ScaleAQ Subsea System. We have created a comprehensive net-pen concept for submerged operation that is responsible for the entire system and ensures correct interplay between the main components and accessories. It is adapted to deep and exposed locations, reduces wave forces and provides stable temperatures. Submerged to approximately 25-30 m.



Submerged system

- ▶ 157 and 160 meters of Midgard rings
- ▶ Total net volume of 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 aquatic environment and fish behavior





Vortex®: Permanent measures against salmon lice

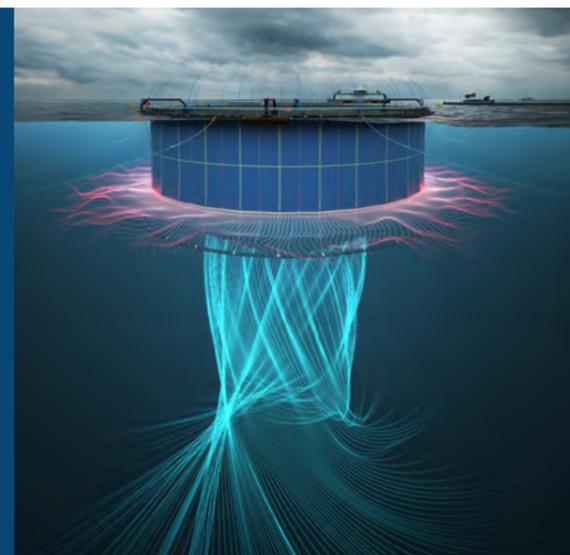
Ved å trekke store mengder friskt vann fra dypet og inn i merden sikrer du at laksen får tilgang til friskt og oksygenrikt vann, samtidig som luselarvene holdes unna av fysiske barrierer. Vortex® fra ScaleAQ verner fisken og gir den et bedre levested.

Today, Norwegian fish farmers largely manage to comply with the lice limits through the use of repeated treatment operations. However, the high levels of stress these operations impose on the fish reduce biological performance and production, leading to increased mortality rates.

This is not the case with Vortex®.

“ScaleAQ’s ambition is to offer a system that enables the fish to grow quickly, while safeguarding fish health, finances and sustainability. We expect Vortex to significantly limit lice infestation, thus improving biology and welfare.

Torstein Kristensen
Head of Biology, ScaleAQ



What is Vortex®?

Vortex® is a semi-closed fish farming system. Salmon lice thrive best in the upper layers of water, and that is why a cover is placed in this upper layer that stops the lice from entering the net-pen. Vortex® pumps water up from the depths below the net-pen in order to ensure fresh water replenishment.

The fresh seawater that is pumped in also contributes to a circular flow of water inside the net-pen. Vortex® ensures good oxygen and flow conditions. The system also enables fish farmers to actively regulate the flow rate to the ideal levels at which the fish thrive and grow well.

In addition, the water pumped up from the deep helps to even out the seasonal temperature variations because it is colder than the summer surface water and warmer than the winter surface water.

Semi-closed system

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





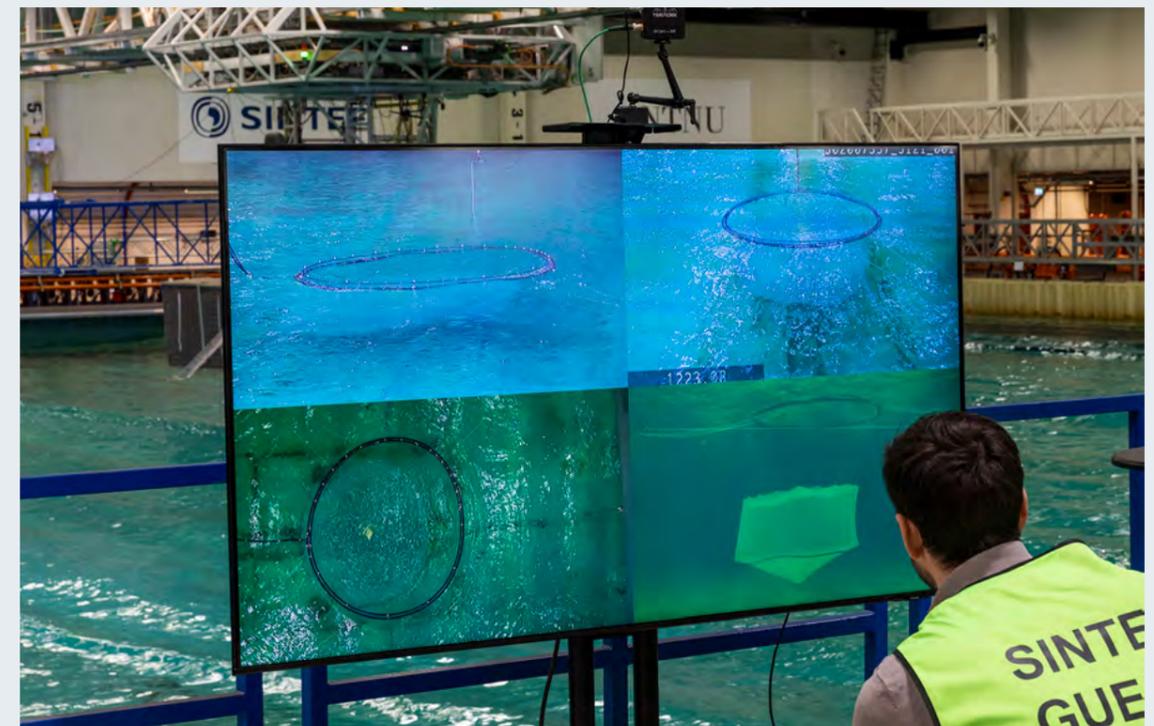
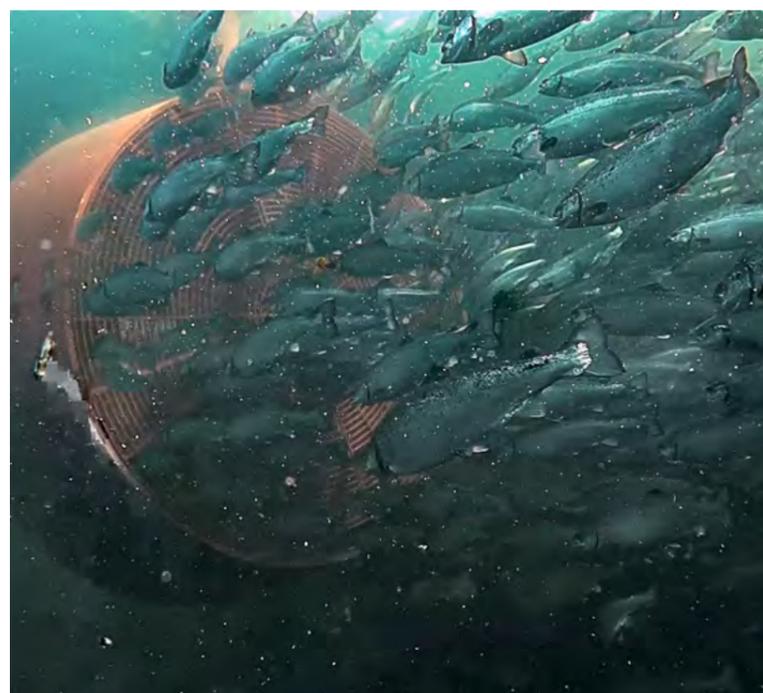
Experience shows that the skirt provides a stable barrier in the sea and maintains the volume according to expectations. Fish farmers find that this concept stabilizes the temperature inside the net-pen throughout the year, with lower temperatures than the surface water in the summer and higher in the winter. The large water exchange capacity ensures good oxygen conditions and good water quality throughout production.

Positive welfare measures

The water velocity is greatest in front of the thrusters and along the edge of the net-pen, and it decreases inwards towards the center of the net-pen. It is also easy to adjust the water velocity according to fish size. Small smolt require a lower water velocity than larger fish.

The fish thrive in the current that is created. After being introduced to the system for the first time, the salmon quickly adapt and place themselves in front of a thruster or along the edge of the net-pen when not feeding.

We consider this a positive welfare measure because the fish can choose where to position themselves. If they want to exercise or keep active, they can place themselves where the flow is strongest, or if they want to rest, eat, or simply have a bad day, they can position themselves in areas of the net-pen where there are weaker currents.



We secure the future of aquaculture through testing at Marintek

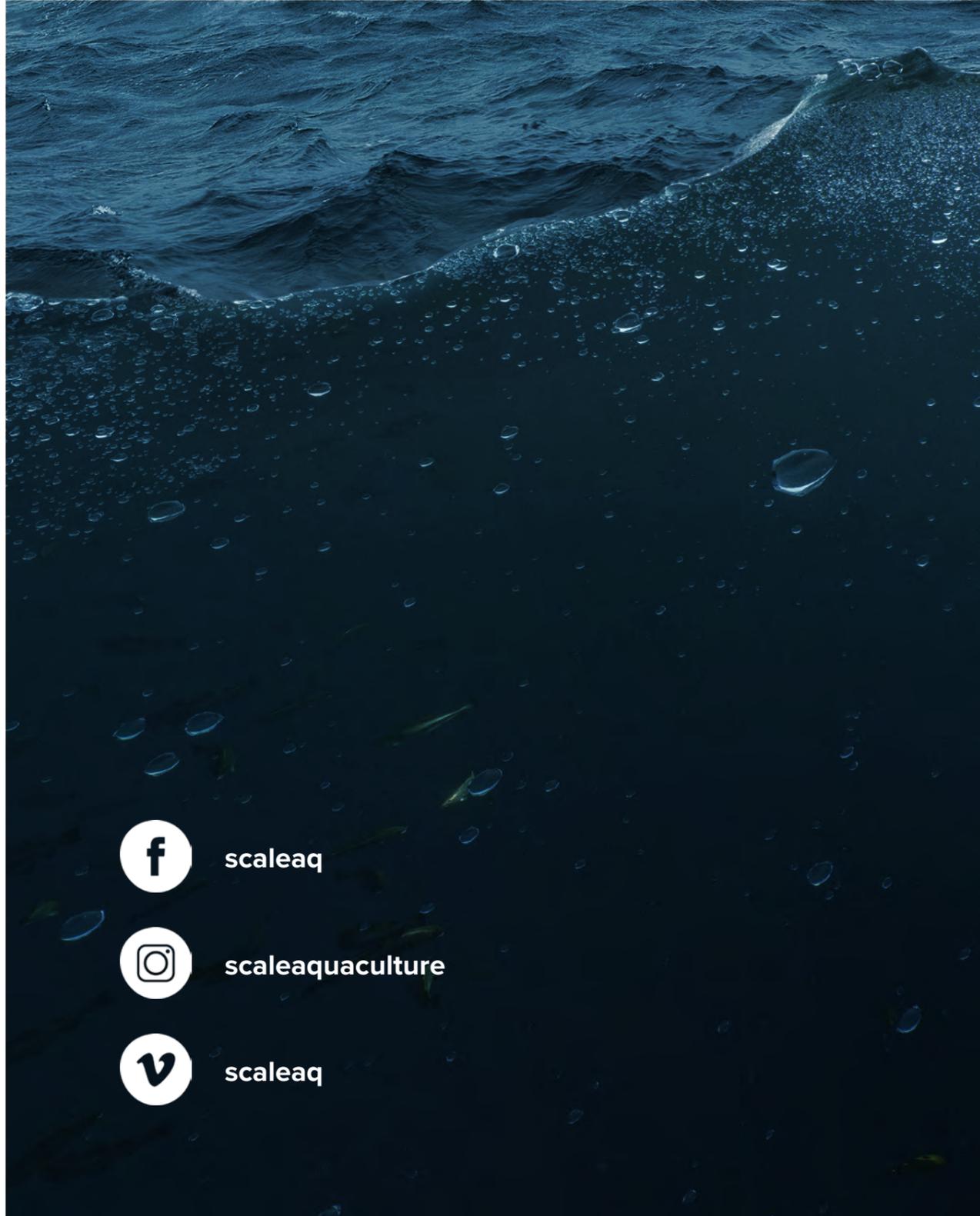
Our goal at ScaleAQ is to drive sustainable growth in aquaculture. We achieve this through innovative solutions that improve fish welfare, increase biological performance, and ensure sustainable and profitable operations for our customers.

The key to our success is model testing at Marintek (Sintef Ocean) in Trondheim, an essential process in meeting the industry's high demands. With over 40 years of experience, we have developed broad expertise in everything from analysis to production and research. Since 2012, we have been particularly focused on improving our net-pen designs 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 about several factors in the creation of an escape-proof net-pen system. Firstly, we now have exact data on the load distribution for our net-pens. This is essential when predicting behavior and loads for these flexible and de-

formation-controlled structures. Furthermore, the model tests have shown that our configuration is optimal in terms of interplay, where small changes can be made based on the results. Seen in relation to the risk landscape for submerged operations, the information we now possess is invaluable to ScaleAQ and our customers who will now take the industry several steps further.

Risk management and integrity control for aquaculture structures have now become more important than ever with the introduction of NYTEK23 and NS9415:2021, where ScaleAQ has led the work on the technical chapters of the Standard Group. The focus on the interaction between technology and biology has become key now that fish are being farmed deep below the surface of the sea.



scaleaq



scaleaquaculture



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