

Difficult makes us happy



Difficult makes us happy

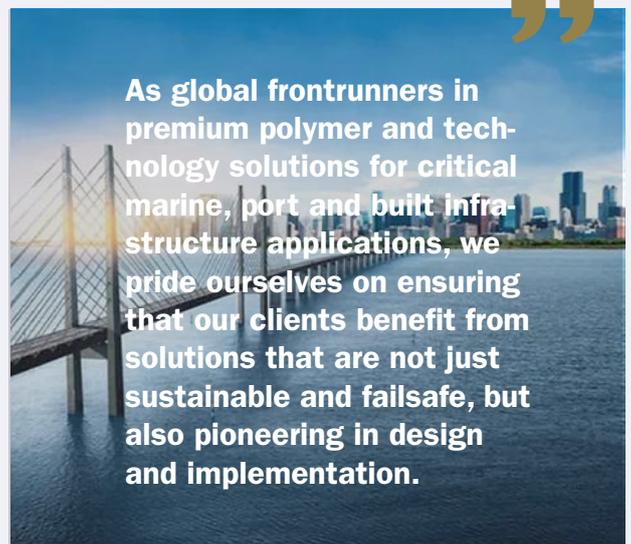


Our unique guiding philosophy

DIFFICULT MAKES US HAPPY IS MORE THAN JUST A STATEMENT

It embodies our commitment to designing, testing, and installing ingenious, tailor-made, resilient solutions that stand up to the rigors of our clients' applications. Indeed, for Trelleborg, the more difficult the challenge, the greater the opportunity for innovation and success.

Our engineering know-how, polymer expertise and ongoing dedication to R&D continue to be the driving force in pushing the envelope in product design, leveraging the latest technologies to create solutions that truly advance the industries we serve.



As global frontrunners in premium polymer and technology solutions for critical marine, port and built infrastructure applications, we pride ourselves on ensuring that our clients benefit from solutions that are not just sustainable and failsafe, but also pioneering in design and implementation.

Difficult Makes Us Happy. It not only underpins every solution we provide, but also represents our commitment to tackling the toughest challenges head-on and protecting the communities we serve.

Contents

Case study 1: Premium fender solutions for port infrastructure	4
Case study 2: Proven sealing systems for resilient water infrastructure	6
Case study 3: Sealing the world's longest immersed tunnel	8
Case study 4: Fail-safe foundation seals for offshore wind power	10
Case study 5: Advanced ship technology for enhanced carbon efficiency	12
Case study 6: Innovative floatover method ensures efficient FPU installation	14
Case study 7: A flexible approach keeps FPSO project on course	16
Case study 8: Integrated berthing solutions for optimal LNG operations	18
Case study 9: Enhancing safety and precision with SafePilot CAT MAX	20
Case study 10: SafeCaptain and CAT ROT PPU integration for improved safety and efficiency	22
Case study 11: Enhancing safety and precision with SafePilot CAT MAX	24

Premium fender solutions for port infrastructure



The expansion of Al Ain Sokhna, a key maritime facility in Egypt, located on the Red Sea Coast, sets the stage for a significant boost in trade and connectivity within the region. Serving as a gateway for international trade in Egypt, efficient and expanded infrastructure becomes paramount.

This expansion is a significant project within the Suez Canal Development Zone and includes the construction of 12 km of new quay wall. Considered the largest Greenfield development project currently underway, a reliable supplier was needed to deliver high quality fender and bollard systems within a tight timeframe to support the installation activities undertaken by 13 contractors. Trelleborg was chosen to spearhead the ambitious initiative that involved installing around 1,200 fender systems and 1,200 bollard systems.



CHALLENGE

With 13 contractors managing installation, delivering a large number of high-quality fenders within a tight timeline while avoiding disruptions to other project elements was a major challenge.



SOLUTION

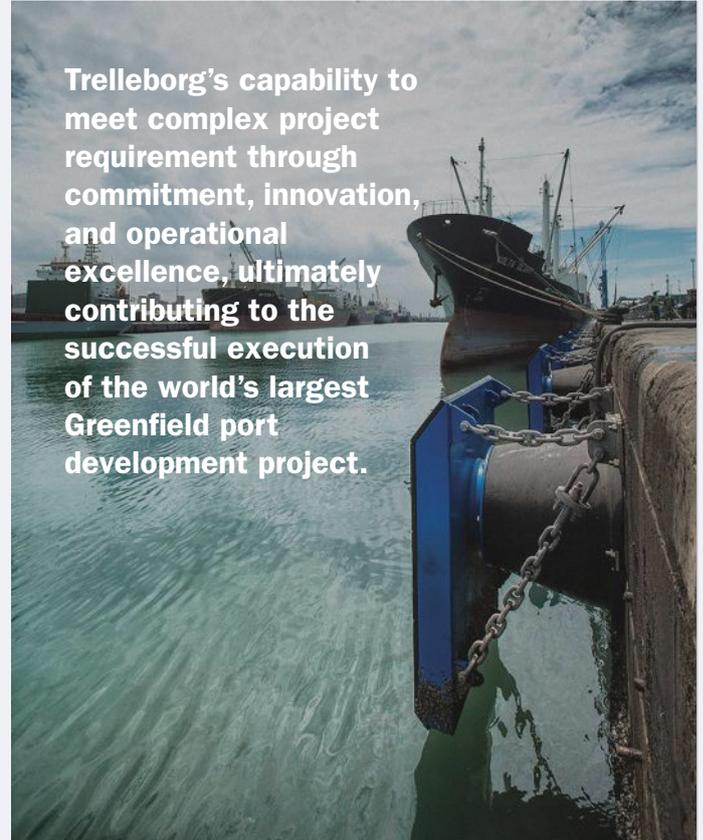
The initial phase of the project saw Trelleborg providing extensive technical support, particularly for berthing calculations and design improvements, upgrading the fender design from conventional cylindrical type to the advanced super cone SCN 950 type, thereby eliminating the need for chain systems.

Furthermore, Trelleborg invested in a new rubber fender mold for the larger SCN1400 fender size to efficiently manufacture the substantial quantity required while also catering to potential future projects. Throughout the process, there was a significant emphasis on optimizing operations within Trelleborg's manufacturing facility to enhance efficiency and reduce the manufacturing cycle duration. This was instrumental in ensuring on-time deliveries, which in turn facilitated uninterrupted progress for all 13 contractors involved in the project.

OUTCOME

The optimized SCN950 fender design without chain systems, successfully decreased installation time for contractors. Besides incorporating best practices in project management, leveraging procurement and manufacturing excellence to meet the client's needs, the project also showcases Trelleborg's capability to meet complex project requirements through commitment, innovation, and operational excellence, ultimately contributing to the successful execution of the world's largest Greenfield port development project.

RESOURCES



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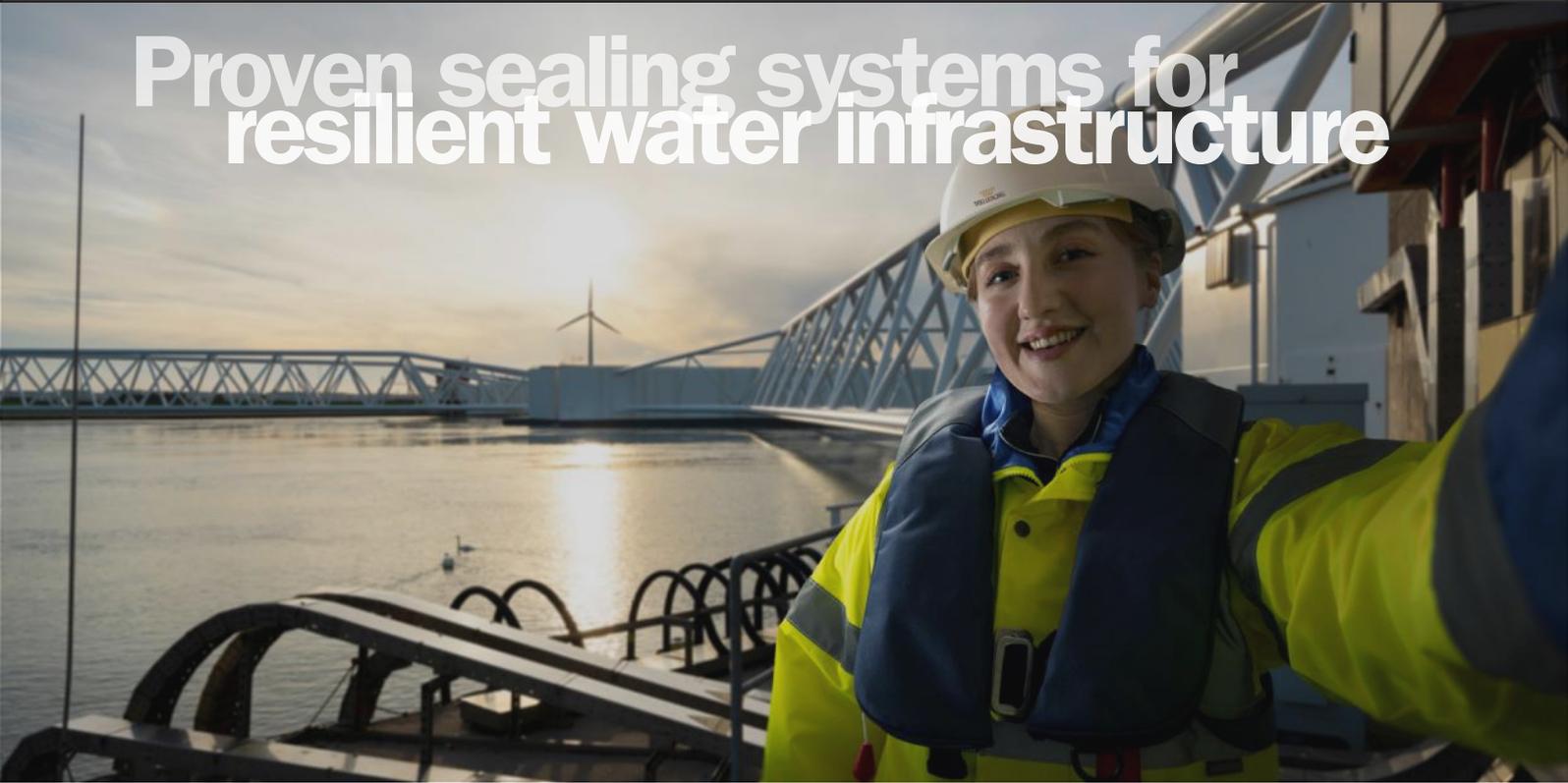


DISCOVER OUR WHOLE SYSTEM APPROACH TO FENDER PERFORMANCE

Explore Trelleborg's best-practice approach to fender system design and how a whole system approach can help reduce construction costs, downtime, operating expenditure and contribute to more efficient berthing operations.

DOWNLOAD WHITEPAPER →

Proven sealing systems for resilient water infrastructure



The Afsluitdijk, spanning the provinces of North Holland and Friesland, separates the IJsselmeer from the Wadden Sea, protecting a significant portion of the Netherlands from flooding risks. Recently, this vital infrastructure underwent substantial reinforcement to bolster its protective capabilities. Trelleborg played an integral role in this project, partnering with the construction consortium to design and supply essential seals for various components.

We successfully managed various aspects of seal design, manufacturing, and implementation. This collaboration underscores our commitment to enhancing infrastructure resilience and safety.



CHALLENGE

When designing the seals, Trelleborg had to ensure they met a couple of critical parameters - permitted leakage rate and durability. Aside from these requirements, the design criteria also included easy disassembly, appropriate spring characteristics, the use of rubber sturdy enough for sustained functionality, and resistance to specific environmental factors. The form of the seals had to be meticulously engineered so that it is capable of enduring extreme environmental conditions. A well-thought-out backup plan was also essential to facilitate the repair or replacement of the seal segments, if necessary.

SOLUTION

From the design phase onwards, Trelleborg played a pivotal role in the project. Collaborating closely with the construction consortium, our team guided their designers in understanding the seal specifications, features, expected lifespan, and installation methods, among other critical aspects. Trelleborg's engineers also provided frequent on-site support, leading to a successful project execution.

Several constructions within the renowned Dutch water barrier, are all equipped with Trelleborg compression seals tailored to meet the specified sealing requirements. Trelleborg additionally designed and manufactured a customized damping solution for the check valve system of the pump slides, ensuring both efficient damping and secondary sealing.

OUTCOME

The project highlights Trelleborg's expertise and commitment to delivering tailored engineering solutions for critical infrastructure projects, underlining our position as a trusted partner in safeguarding vital assets against environmental risks.

RESOURCES

The following seals were supplied for the water barrier reinforcement project:

Compression Seals:

These seals were used in the sliding mechanisms of both existing and newly installed level gates, pump valves, and bulk-head seals as part of the Afsluitdijk project. The forces are all well calculated to stand the weight of the structure and also to be watertight as soon as possible.

Custom Damping Solutions:

For the pump slide's check valve system, Trelleborg developed and produced bespoke damping solutions that served the dual function of load dampening and sealing.

Self-activating Seals:

Specialized self-activating profiles were cleverly built into the structures, creating space to move the gates and with the calculated water pressure the gate will be watertight.



SMART & SUSTAINABLE WATER INFRASTRUCTURE SOLUTIONS

Your one-stop-shop for water infrastructure needs, from saving St.Petersburg to keeping California moving, our tried-and-tested systems have been applied to multiple high-profile projects across the globe and guarantee a lifetime of functionality and performance

[WATCH VIDEO](#) →



Sealing the world's longest immersed tunnel

Connecting Rødbyhavn in Denmark to Puttgarden in Germany, the 18-kilometer long Fehmarnbelt Fixed Link will be the world's longest immersed tunnel.

Carrying a four-lane motorway and two electrified rail tracks, it will significantly reduce travel times between Scandinavia and central Europe. Perhaps more importantly, this new transport link will decrease annual CO₂ emissions by 200,000 tons, making a sizeable contribution to meeting EU sustainability targets.



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CHALLENGE

Water tightness is integral to immersed tunnels, and with the record-breaking length of the Fehmarnbelt project, designing sealing systems that could meet its unique size, scope and performance needs was a challenge.

The 79 standard elements — each 217 meters long — and the ten special elements that make up the tunnel construction are all being sealed by Trelleborg Marine and Infrastructure's industry-leading Gina gaskets, Omega seals, Double injectable Waterstop seals, Bulkhead seals and clamping systems.

Trelleborg was chosen for this complex, long-term project for several reasons. First was a track record of innovating to produce high-performance, customized solutions at scale and on time, such as the seals for the tunnel sections of the Hong Kong-Zhuhai-Macau Bridge. Trelleborg's long-term stability, and the commitment to invest in expanded manufacturing capacity in existing production facilities were also influential factors. It was also essential for all suppliers to meet the strict sustainability criteria set by project owner Femern A/S, which comply with UN Global Compact standards. With its sheer magnitude and significance, the Fehmarnbelt tunnel represents Trelleborg's most significant project to date, building on our successful track record of successfully completing 60 tunnel projects worldwide.

SOLUTION

Landmark projects require landmark solutions. At 42 meters deep and built on loose Paleogene clay with the potential for ground movement, the tunnel requires sealing systems that have a greater flexibility factor designed, to eliminate the risk of leakage. Trelleborg's polymer engineering expertise proved crucial in developing an optimized sealing system that suits the ground conditions and depth of the Baltic Sea. A new, patented Waterstop solution, which seals segment joints and withstands concrete expansion and shrinkage as well as large movements between segments, was developed especially for the project. It can be injected at four points to fill up any air entrapments after concrete pouring. Waterstop W-29CUI is a plug-and-play solution, making it quick to deploy to ensure project efficiency, and adaptable to work alongside both Gina gaskets and Omega seals.

Another highly significant innovation was the use of Omega seals in the development of fully removable bulkheads. This enabled the seals to be reused, helping Trelleborg to contribute to the overall sustainability of the project.

RESOURCES



OUTCOME

As a global leader in providing high performance sealing systems for immersed tunnels, Trelleborg was able to bring its in-depth polymer engineering expertise to the Fehmarnbelt Fixed Link — the world's longest immersed tunnel.

Altogether, Trelleborg will produce 89 Gina gaskets and 89 Omega seals, closure joint with a bespoke M-seal and inflatable gasket as well as the new Waterstop solution developed specifically for this project. These will combine to prevent water ingress within challenging design tolerances and ensure the tunnel's integrity is maintained throughout its lifetime. With its flexibility, durability, and an expected lifespan of 120 years, Trelleborg's sealing systems stand out as one of the few solutions available in the market that effectively safeguard against water ingress and extreme movements.

With its sheer magnitude and significance, the Fehmarnbelt tunnel represents Trelleborg's most significant project to date, building on our successful track record of successfully completing 60 tunnel projects worldwide.

TAILOR-MADE SEALING SYSTEMS FOR THE FEHMARNBELT IMMERSSED TUNNEL

Trelleborg's marine and infrastructure operation has been awarded the contract to supply its tunnel seals to Fehmarn Link Contractors (FLC) for the construction of the 18-kilometer long Fehmarnbelt tunnel. Connecting Rødbyhavn in Denmark and Puttgarden in Germany, once completed it will be the world's longest immersed tunnel

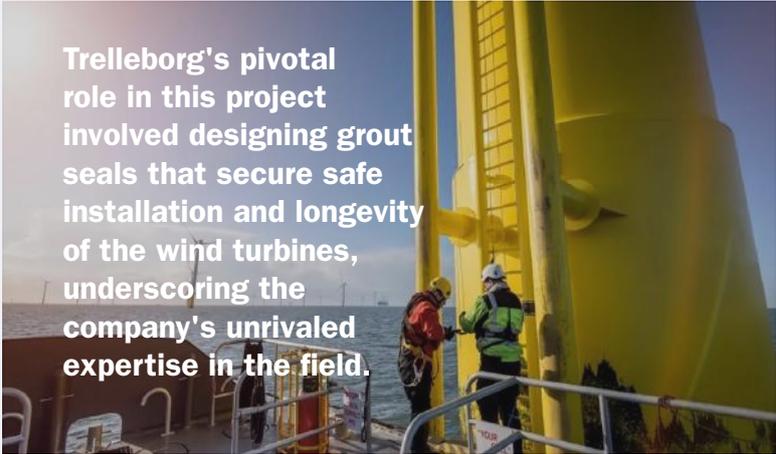
WATCH VIDEO →



Fail-safe foundation seals for offshore wind power

Trelleborg Marine and Infrastructure was commissioned to supply its grout seals to one of Europe's largest energy transition projects. This subsidy-free offshore wind farm project in Europe, a pioneering initiative that combines renewable energy generation with cutting-edge technology, is a testament to the growing importance of offshore wind farms in meeting global clean energy demands.

Trelleborg's pivotal role in this project involved designing grout seals that secure safe installation and longevity of the wind turbines, underscoring the company's unrivaled expertise in the field.



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CHALLENGE

The effectiveness of grout seals in wind turbines heavily relies on offshore installation tolerances and permissible production tolerances of the enormous steel piles during fabrication. It is in this tight playing field between fabrication and installation specification that the grout seals need to perform even in the harshest and most unfavorable conditions. This emphasizes the importance of using high-quality materials, careful design and skilled manufacturing and quality control.

SOLUTION

With a keen understanding of the project's unique requirements, Trelleborg designed grout seals that can accommodate an exceptionally large tolerance window, suitable for offshore installation from a floating vessel. Our unique approach and bespoke design allow the seal to maintain its effectiveness even in the most unfavorable conditions. This innovation is crucial for ensuring a reliable grout seal and securing the structural integrity of the foundation for decades of operation.

This innovation is crucial for ensuring a reliable grout seal and securing the structural integrity of the foundation for decades of operation.

RESOURCES



OUTCOME

Challenging conditions such as floating vessel installation of offshore wind foundations typically increase the tolerance window in which the grout seals need to operate.

Additionally, the ever-increasing size of steel foundation piles following increasing turbine sizes and energy output, yields challenges of its own. By developing a customized grout seal that can handle this large tolerance window, Trelleborg provided a reliable and durable solution for safe installation of the wind turbine foundations and to secure their longevity, contributing to the production of renewable energy.

DISCOVER OUR BESPOKE SOLUTIONS TO SEAL YOUR FOUNDATIONS TODAY

Our expertise lies in delivering reliable solutions, providing customers with the assurance that our seal designs will perform effectively during the critical and costly offshore installation process and throughout the entire lifespan of the structure

WATCH VIDEO →

Advanced ship technology for enhanced carbon efficiency



Arkas Holding, a prominent player in the maritime and logistics industry embarked on a comprehensive fleet modernization project aimed at ship performance monitoring across its extensive fleet of vessels, enhancing ship operational efficiency, reducing carbon emissions, and meeting compliance requirements. The company has been diligently bolstering its fleet of vessels since 1996, culminating in a formidable fleet comprising 50 container vessels, making it Turkey's largest container operator.

Arkas Holding partnered with Trelleborg as part of their strategic initiative to enhance fleet performance, create a carbon-efficient operating environment, and ensure compliance with the Energy Efficiency Existing Ship Index (EEXI) and Operational Carbon Intensity Indicator (CII), adopted by The International Maritime Organisation (IMO), which aim to reduce carbon emissions in the shipping industry to net zero by or around 2050.

This deadline, agreed upon in 2023, represents a significant step towards sustainability in the maritime sector, paving the way for a greener future.



Arkas Holding partnered with Trelleborg as part of their strategic initiative to enhance fleet performance and ensure compliance with the Energy Efficiency Existing Ship Index (EEXI) and Operational Carbon Intensity Indicator (CII).

CHALLENGE

Trelleborg was onboarded as a partner to supply its TSX5 shaft power meters, to be integrated into the Arkas' fleet performance software, allowing real-time performance monitoring that can then be used to improve ship operational efficiency and reduce carbon emissions, which will enable their ships to meet the year-on-year improvements needed to comply with Carbon Intensity Indicator (CII) regulations and their own internal decarbonization targets.

SOLUTION

Trelleborg's initial provision of 5 shipsets of TSX5 delivered for EEXI compliance laid the foundation for a broader partnership with Arkas Holding. Subsequently, a tender was issued for an additional 37 ships that required shaft power meters. The TSX5 system offers a comprehensive suite of features, including real-time monitoring of shaft power, shaft torque, and shaft RPM, as well as over-torque alarm and cumulative power recording.

It ensures compliance with Energy Efficiency Existing Ship Index (EEXI) rules when fitted with a ShaPoLi alarming device and is an essential device required for any ship performance software. TSX5, when combined with fuel flow measurement and speed/distance data, provides vessel operators with actionable insights and recommendations to enhance energy efficiency across the fleet, thereby resulting in reduced operational costs, a reduction in carbon emissions, and a positive impact on the bottom line.

RESOURCES



OUTCOME

With Trelleborg successfully concluding the delivery of the final batch of shaft power meters, the equipment is slated for installation across the Arkas fleet in 2024. This marks a pivotal moment in the realization of Arkas' vision for an advanced, technologically equipped fleet, poised to navigate the evolving demands of the maritime industry with heightened ship operational efficiency, a carbon-efficient operating environment, and industry compliance. Trelleborg's partnership for this fleet modernization project highlights the pivotal role of advanced ship technology in shaping a sustainable and profitable future for the maritime industry.

TSX5, when combined with fuel flow measurement and speed/distance data, provides vessel operators with actionable insights and recommendations to enhance energy efficiency across the fleet, thereby resulting in reduced operational costs, a reduction in carbon emissions, and a positive impact on the bottom line.

TSX5 SHAFT POWER METER WHITEPAPER

The TSX5 Shaft Power Meter from Trelleborg helps to reduce fuel consumption and emissions, helping to create a more sustainable operating model

DOWNLOAD WHITEPAPER →

Innovative floatover method ensures efficient FPU installation



The Scarborough Field, located off the coast of Western Australia, is a crucial natural gas resource with the potential to meet growing energy demands both locally and beyond. Thanks to its strategic position and advanced infrastructure, it is a key player in the energy supply chain. A leading energy company awarded an engineering and construction firm a contract to provide engineering, procurement, construction, installation, and commissioning (EPCIC) services for a Floating Production Unit (FPU) to extract natural gas from this field. The Scarborough FPU was designed specifically to extract, process, and transport natural gas from the Scarborough Field.

Trelleborg collaborated closely with the construction firm on the newly built Scarborough Floating Production Unit project to ensure the safe and efficient installation of the unit's hull.



Trelleborg collaborated closely with the construction firm on the newly built Scarborough Floating Production Unit project to ensure the safe and efficient installation of the unit's hull.

CHALLENGE

Installing heavy topsides onto hulls is a critical operation that demands innovative solutions. In the case of this project, the Floating Production Unit (FPU) featured a substantial topside weighing 30,000MT. Traditional lifting methods were not feasible for such a large and heavy structure, prompting the need for an alternative installation method that could ensure safety and structural integrity.



SOLUTION

The specific requirements outlined by the customer called for a floatover installation approach, and Trelleborg's Leg Mating Unit (LMU) equipped with the sandcan system emerged as the optimal solution for this purpose. By integrating the sandcan system with the LMU, engineers and operators can accurately monitor and control the mating process, ensuring that the legs are aligned and inserted into the slots within specified tolerances. This helps to prevent any misalignment or structural issues that could affect the stability and integrity of the offshore platform. The sandcan system is engineered such that it effectively prevents sand from getting trapped, thus allowing the LMU to be lowered when the sand is released.

OUTCOME

Trelleborg conducted a rigorous modeling and testing process to create a prototype that could withstand a maximum load of 7,500 metric tons while also withstand high compressive stress. The primary focus was on ensuring the LMU's ability to withstand heightened loads without deformation or failure while also optimizing weight, cost-effectiveness, and manufacturability. This process involved close collaboration with both the end customer and the main constructor to achieve the desired results.

By utilizing Finite Element Analysis and adhering to international standards like the American Petroleum Institute's RP WSD guidelines, Trelleborg ensured that the LMU met strength and stability criteria, a testament to its robust engineering capabilities and design expertise.



A full-scale testing was conducted at Trelleborg's Singapore testing facility using the 183MT test press to validate the design and confirm the system's viability. This groundbreaking test was the first of its kind and aimed to ensure the product's performance and compliance with relevant

standards and customer specifications by testing the design calculations and prototype against the actual product application. Overall, using the Leg Mating Unit (LMU) equipped with the sandcan system proved to be a game-changer for the floatover installation of the 30,000MT topside onto the hull.

Several key parameters were considered during the design of the LMU and sandcan system to ensure their effectiveness in facilitating the floatover installation:

Sand Selection:

Sand selection is a crucial process for the sandcan system. The selected sand needed to withstand high compressive pressures and enable seamless flow for complete drainage from the sandcan. It is subjected to rigorous quality control measures to ensure it met the specified grain size and maintained structural integrity, even under high compressive stress. Following this, the sand is sent to a reputable third-party laboratory for comprehensive mechanical and chemical testing, before being transported directly to Trelleborg manufacturing facility.

Material Selection:

Selecting the right materials that offer the necessary strength, durability, and resistance to environmental factors is a crucial aspect. Factors such as solid steel receptor, fatigue resistance, lubrication, and corrosion resistance based on the operational conditions had to be carefully considered as the materials chosen directly impacts the overall performance and reliability of the LMU.

Assembly and Disassembly:

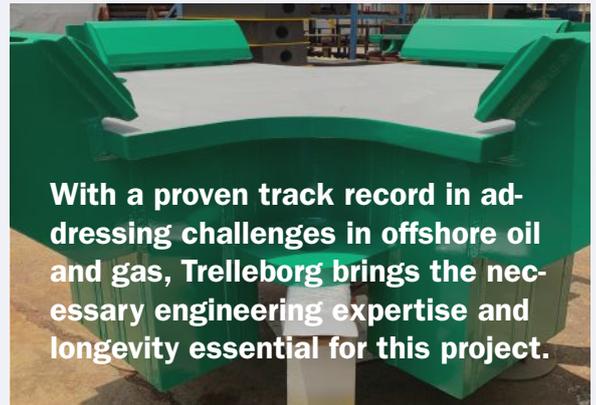
Given that each LMU weighs 100 tonnes, streamlining the assembly and disassembly process was an essential consideration. Ensuring that this aspect was well thought out contributes significantly to the practicality and efficiency of deploying the LMU.

A flexible approach keeps FPSO project on course



MISC Offshore (Singapore) Pte Ltd (MOSPL), a wholly owned subsidiary of MISC Berhad, required a high-performance structural elastomeric bearing solution for its new Floating Production, Storage and Offloading (FPSO) project in South America.

With a proven track record in addressing challenges in offshore oil and gas, Trelleborg brings the necessary engineering expertise and longevity essential for this project.



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CHALLENGE

FPSOs are often preferred to fixed platforms due to their rapid deployment and cost efficiency. The siting of this new FPSO in a remote offshore area in 2 km deep waters prone to tropical storm conditions, including strong currents and large swells, as well as saltwater corrosion, brought challenges. These elements place significant strain on the structural elastomeric bearings responsible for supporting the topside modules crucial for the FPSO's essential operations.

SOLUTION

Trelleborg is delivering specially designed and manufactured structural elastomeric bearings with a design life of over 120 years to meet the unique project design requirements of MOSPL's FPSO.

Plans were devised to accommodate the anticipated significant axial, lateral and rotational movements of the vessel, along with the necessary vibration isolation and shock absorption for module operation. Advanced modelling techniques, including Finite Element Analysis, were employed to predict stress-strain characteristics, ensuring sustained performance over the long term. This innovative design methodology is enhanced by Trelleborg's proficiency in highperformance elastomeric materials. Specifically formulated elastomer compounds, resistant to oilbased process liquids, paired with corrosion-resistant marine-grade carbon steel, synergise to create module bearings designed for optimal functionality throughout their operation lifespan.

OUTCOME

As can happen in complex projects, unexpected adjustments in the specifications meant that a change order was issued within a few months of the agreed delivery date. Understanding how essential timely completion is in FPSO projects, and working closely with MOSPL at every stage, Trelleborg was able to pivot quickly to help keep the project on track. Using its global capabilities to divert additional resources, the order was fulfilled within the originally specified timeframe. Crucially, Trelleborg's offshore industry experience and flexibility helped ensure this FPSO project stayed on schedule and met existing deadlines.

Advanced modelling techniques, including Finite Element Analysis, were employed to predict stress-strain characteristics, ensuring sustained performance over the long term.

Integrated berthing solutions for optimal LNG operations



Trelleborg Marine and Infrastructure was engaged as a partner to provide a comprehensive range of berthing solutions for a major LNG terminal in northern France. The project aimed to enhance operational efficiency and secure the berthing process for the first-ever FSRU floating terminal at this significant port, which serves as a key hub for maritime trade and transportation. Ultimately, this initiative is expected to increase France's regasification capacity.



CHALLENGE

The berthing process is a critical operation that requires the utmost efficiency to avoid delays, maintain safety, and ensure smooth operation, benefiting the port, vessel operators, and the environment.



SOLUTION

Trelleborg supplied various critical mooring, berthing and navigation solutions, including Quick Release Hook Units, an Environmental Monitoring System, SmartDock Docking Aid System, Central Integrated Monitoring System, SafePilot CAT PRO, and SafePilot Pro Navigation with Docking software.

Furthermore, upgrades were carried to streamline terminal operations, such as upgrading the Ship-Shore Link system to the more advanced Gen3 Ship-Shore Link system, reconfiguring the central monitoring system as well as installing bespoke designed Pneumatic Fenders and inverted Superior Cone Fenders (SCN) to secure the quay walls of the terminal.

OUTCOME

The integration of multiple berthing solutions significantly reduced the margin for error, resulting in smoother and safer berthing operations, as well as safe vessel approach and product transfer. This improvement in berthing operations also helped to reduce downtime for vessels and the associated loading and unloading processes, resulting in increased productivity.

RESOURCES

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LNG SOLUTIONS EXPLORER

Featuring high-quality LNG solutions across a range of applications, our LNG Solutions Explorer platform will provide you with an in-depth look into how our products are operationally compatible and flexible in today's changing environment

VIEW MORE →



Enhancing safety and precision with SafePilot CAT MAX

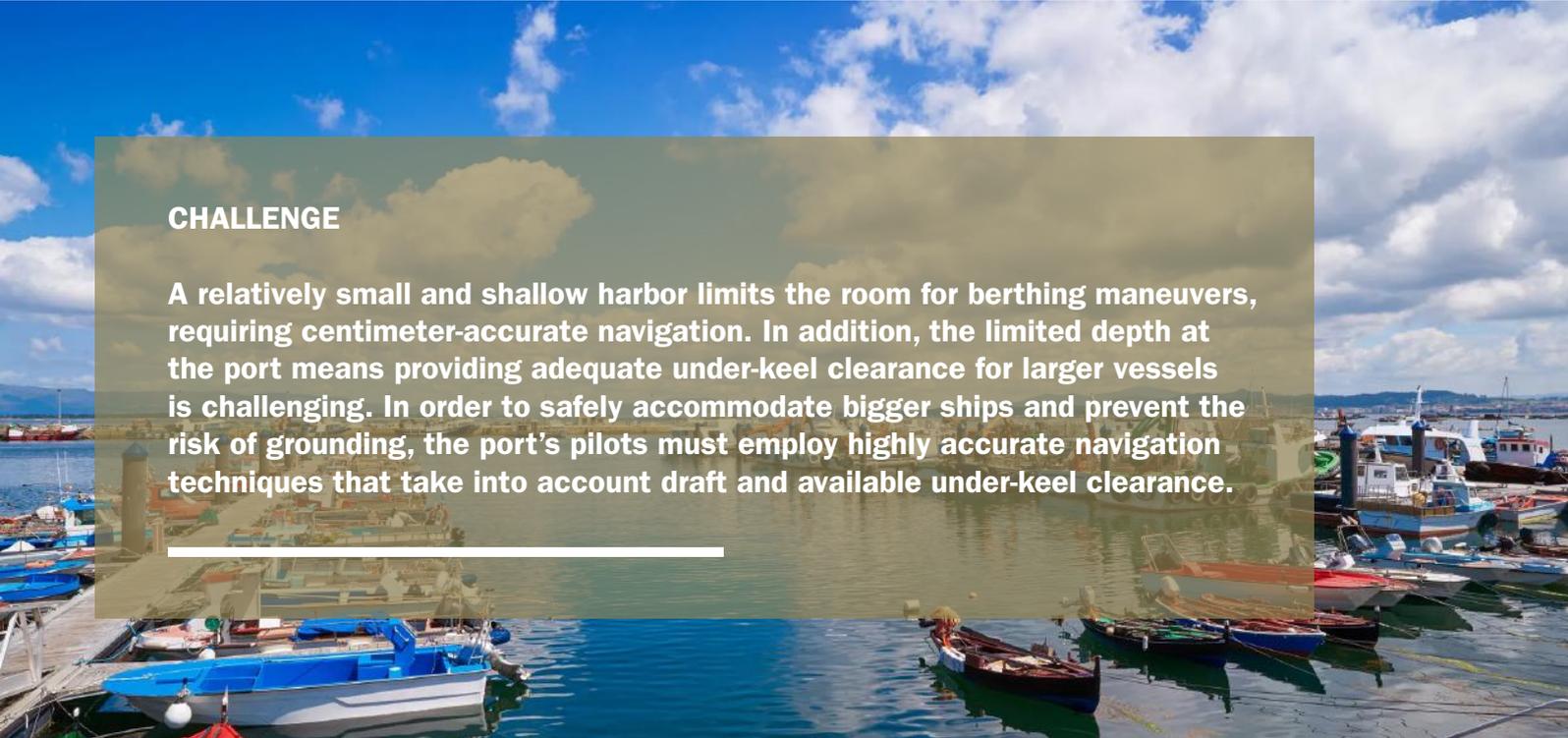
Situated on the eastern Pacific coast of New Zealand's South Island, the Port of Timaru is a major cargo hub and is especially important for the country's agricultural export business.

The increase of larger container ships in recent years presents an opportunity for Timaru, and the amount of freight the port handles is significantly increasing.



CHALLENGE

A relatively small and shallow harbor limits the room for berthing maneuvers, requiring centimeter-accurate navigation. In addition, the limited depth at the port means providing adequate under-keel clearance for larger vessels is challenging. In order to safely accommodate bigger ships and prevent the risk of grounding, the port's pilots must employ highly accurate navigation techniques that take into account draft and available under-keel clearance.



SOLUTION

PrimePort, who operates Timaru, has a strong, long-term working relationship with Trelleborg. The port's fender systems and bollards are provided by Trelleborg, and the two companies also partnered to upgrade Timaru's navigation and piloting processes, with Trelleborg's SafePilot CAT ROT navigation system performing flawlessly in piloting smaller vessels. Given this track record, PrimePort chose the state-of-the-art, SafePilot CAT MAX system to make sure Timaru could handle the Rio class vessels that would take their port to the next level.

The SafePilot system utilizes wireless heading and positioning units with integrated gyroscopic motion sensors. This provides precision data on rate of turn, pitch, roll and exact location. The system is accurate to 1cm per second for speed and 0.01 degrees for heading, making it ideal for confined harbors like Timaru. Pilots like the system because the intuitive software displays only pertinent information during each phase of pilotage. This eliminates information overload, significantly reducing the risk of accidents caused by human error.

All SafePilot systems are developed by Trelleborg jointly with active marine pilots, to maximize usability. This means that the customizable modules and clarity of relevant data at key moments make SafePilot intuitive to use on challenging maneuvers.

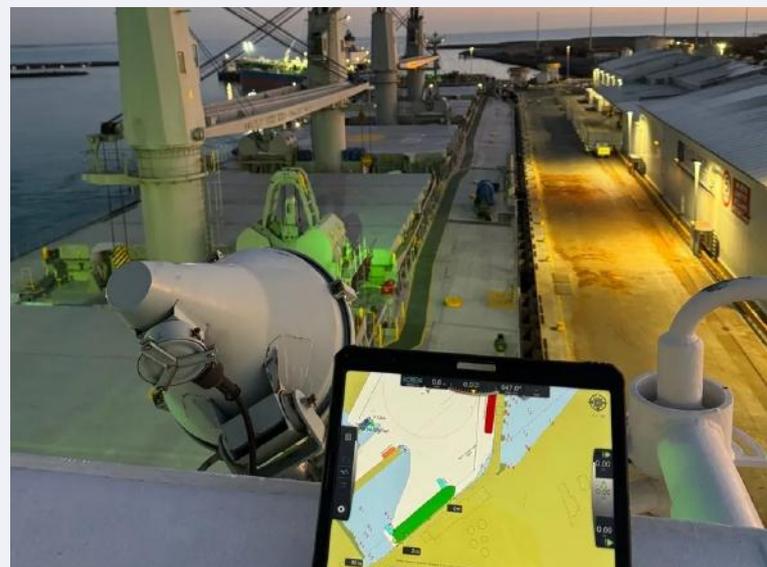
OUTCOME

The enhanced safety and efficiency from Trelleborg's state-of-the-art piloting system are supporting PrimePort Timaru's position as one of New Zealand's top ports. The ability to berth Rio-class container ships with 5,900 TEU capacity has already opened the door to increased cargo volumes and double-digit growth in bulk volume.

Navigation solutions like SafePilot CAT MAX are key components of Trelleborg's SmartPort system that connects critical interface between ships and ports. Timaru's implementation serves as a model for ports of all sizes seeking to upgrade facilities, safely accommodate larger vessels and strengthen their competitive positions.

SafePilot CAT MAX enables PrimePort's pilots at Timaru to view real-time under-keel clearance and environmental data, making all the difference in this relatively shallow harbor which is often buffeted by high winds. This innovation allows safer transit of larger vessels by is crucial for ensuring eliminating a reliable grounding grout hazards seal and potential collisions.

Powered By
SmartPort®



SafeCaptain and CAT ROT PPU integration for improved safety and efficiency



Arkas, a prominent Turkish-based holding that offers an integrated service chain in its main business lines including maritime transportation, logistics, port and terminal operations, partnered with Trelleborg Marine and Infrastructure to integrate advanced navigational tools within its container fleet as part of its strategic initiative to improve overall operational efficiencies and safety. The decision to explore a simplified AIS-based program for its container fleets that do not traverse the Panama Canal follows the previous success with SafeCaptain, which was provided alongside Trelleborg's SafePilot P3 for its vessels transiting the Panama Canal.



CHALLENGE

Despite technological advancements, navigating narrow and complex waterways remains a critical challenge in the maritime industry, particularly in scenarios involving constricted passages, unpredictable currents, outdated nautical charts and unreliable navigation tools. These factors create a high-risk environment for pilots, captains, and crew members, potentially compromising vessel safety and operational efficiency. The combination of these elements continues to pose significant challenges, underscoring the need for ongoing improvements in navigation technology and practices.

SOLUTION

To support Arkas Holdings' need for better operational efficiencies for their container fleet, Trelleborg proposed combining its SafeCaptain technology with the CAT ROT Portable Pilot Unit (PPU), both key components of the comprehensive SafePilot piloting system developed in-house. SafePilot, has been at the forefront of maritime navigation technology with its latest iteration, SafePilot P3, gaining notable recognition, becoming the first high-accuracy navigation unit to be evaluated and approved by the Panama Canal Authority (ACP). This approval underscores the system's reliability and precision in even the most demanding navigational environments.

SafeCaptain is designed to address the limitations of conventional AIS pilot plug data formats. The system enables precise monitoring in constrained waterways, employing a high-accuracy GNSS and an advanced motion sensor to track the vessel's three-dimensional movements. In the event of a blackout, SafeCaptain continues to compute the ship's position and heading using its dual GNSS antennas.

By integrating with CAT ROT, SafeCaptain significantly enhances the reliability and precision of operational data, providing pilots with a more comprehensive and trustworthy navigational tool. The CAT ROT is a small and compact pilot unit primarily designed to connect to a ship's AIS pilot plug and transmit data via Wi-Fi to the Pilot's tablet/notebook.

OUTCOME

The implementation of SafeCaptain technology with the CAT ROT Portable Pilot Unit (PPU) enabled real-time data sharing and improved decision-making. The system's chart annotation features mitigated delays and ensured safe navigation, even in areas with outdated information. During the trial, SafeCaptain's manual drawing capability proved vital when faced with uncharted harbors, showcasing its adaptability to address unforeseen challenges. By enabling pilots to supplement existing chart data in real-time, SafeCaptain proved to be a more adaptable and comprehensive navigational tool. The system is now operational on a total of 49 ships within the Arkas Holding fleet.

RESOURCES



To demonstrate the capabilities of this integrated solution, a comprehensive trial was conducted in Turkey in January 2024. The trial involved a six-hour journey from Bursa's Gemlik harbor to Kocaeli's Derince harbor, allowing for rigorous testing of various navigational scenarios. These included planned route creation, harbor approach simulations, and complex docking maneuvers, all of which showcased the system's versatility and effectiveness.

One of the notable enhancements to SafeCaptain during this trial was the addition of a feature allowing users to manually draw missing details directly on the app interface. This functionality addresses a common issue in maritime navigation - incomplete or outdated charts.



SAFECAPTAIN

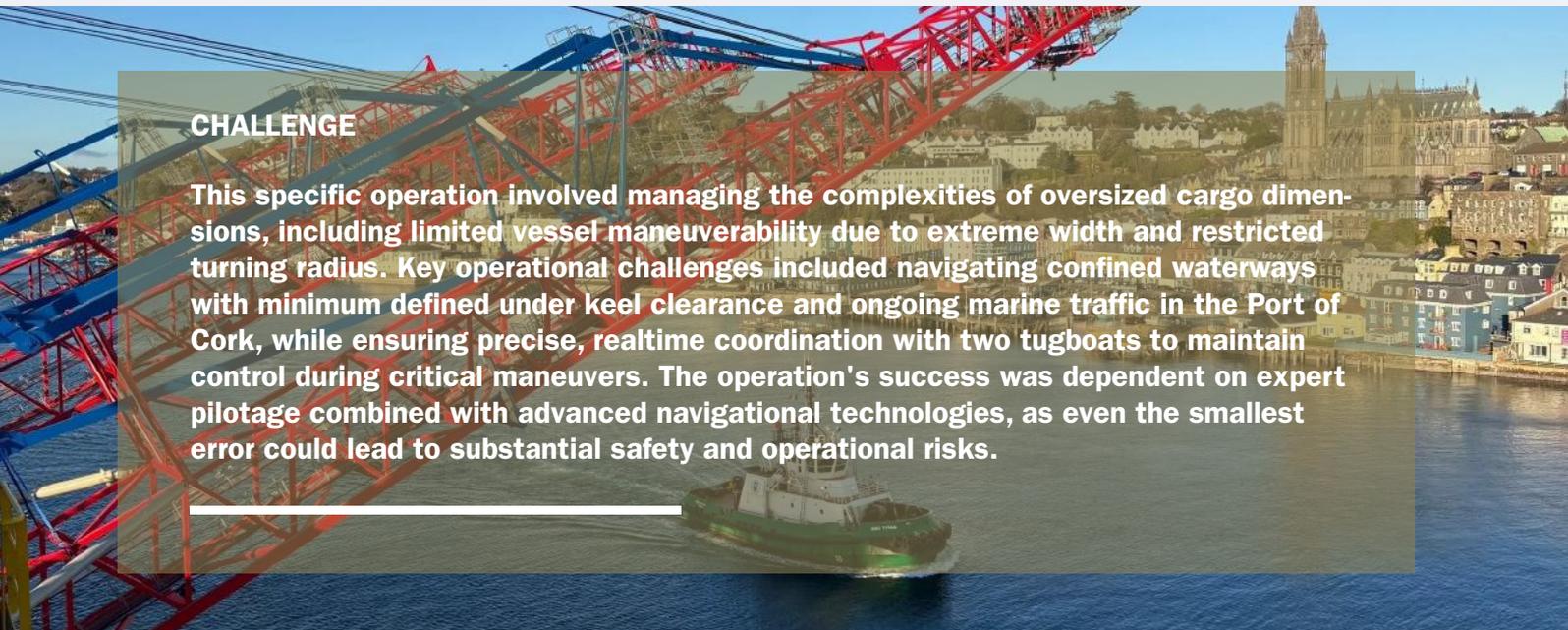
A high-accuracy navigational tool for marine captains

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Streamlining complex pilotage with CAT PRO PPU

The Port of Cork Company recently executed a complex pilotage operation involving a heavy lift vessel transporting three Liebherr Ship-to-Shore container cranes. The vessel, with an overall length (LOA) of 169 meters and a beam of 40 meters, carried these cranes as cargo, extending its effective width to 134 meters. This oversized load presented significant navigational challenges, particularly in maneuvering through the restricted waters of Cork Harbour and transitioning safely to open sea. Precise pilotage and advanced situational awareness were critical due to the vessel's restricted turning radius under load, compounded by the presence of usual maritime traffic.



CHALLENGE

This specific operation involved managing the complexities of oversized cargo dimensions, including limited vessel maneuverability due to extreme width and restricted turning radius. Key operational challenges included navigating confined waterways with minimum defined under keel clearance and ongoing marine traffic in the Port of Cork, while ensuring precise, realtime coordination with two tugboats to maintain control during critical maneuvers. The operation's success was dependent on expert pilotage combined with advanced navigational technologies, as even the smallest error could lead to substantial safety and operational risks.

SOLUTION

Trelleborg's SafePilot CAT PRO PPU was deployed, providing advanced navigation support for the pilot in this high-risk scenario. The system included two wireless sensors and a Wi-Fi Extender that seamlessly connected to the ship's Pilot Plug, enabling access to AIS data of nearby vessels for real-time traffic monitoring. Positioned on the bridge wing, the sensors provided independent data on the vessel's positioning (with SBAS corrections ensuring 0.60 m accuracy), rate of turn ($0.1^\circ/\text{min}$ accuracy), heading (0.05° accuracy), and speed (1 cm/sec accuracy). This high level of precision allowed the pilot to maintain full control and situational awareness, independent of the onboard navigation systems, ensuring the heavy lift vessel's safe maneuvering in such a complex and dynamic environment. All critical data was displayed on a user-friendly iPad interface for the pilot, providing real-time predictions of the vessel's position and safe distances to hazards. The system accounted for the vessel's oversized cargo, enabling a comprehensive overview of its footprint, and ensuring precise navigation at all times.



OUTCOME

The operation was completed successfully, with the heavy lift vessel safely navigating Cork Harbour and transitioning to open waters safely. The CAT PRO was instrumental in enabling seamless coordination between the vessel and its support tugboats. Its precise positioning capabilities allowed the pilot to anticipate and confidently execute maneuvers, even in restricted areas. This case underscores the tangible value of advanced portable navigation solutions in managing complex maritime operations. By delivering 360-degree sit-

uational awareness, independent positioning and heading accuracy down to 1 cm, the CAT PRO PPU system not only ensures operational safety but also optimizes efficiency, reducing the risk of costly delays or incidents. As maritime traffic grows in scale and complexity, tools like CAT PRO PPU are proving to be indispensable for modern pilotage. With extended battery life, superior accuracy, and an easy setup surpassing other systems on the market, it provides the accuracy and reliability needed for even the most complex piloting operations.

RESOURCES



NEXT GENERATION PORTABLE PILOTING UNIT (PPU)

SafePilot CAT PRO is a completely independent portable pilot unit designed to overcome the limitations of AIS and Wi-Fi range

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