



Real-size test bench located at ERREKA's facilities

Smarter bolting technology for a bigger future

As offshore wind turbines grow larger and project scales expand, the demands on every component, especially bolted connections, are intensifying. Gaizka Arregi, Commercial Manager at ERREKA Smart Fastening, discusses how decades of experience, digital monitoring and automation are reshaping joint integrity, driving efficiency and defining the future of offshore engineering.

PES: Thank you for joining us Gaizka, at a time when the offshore wind industry is scaling up rapidly. From your perspective, what are the biggest technical challenges around bolted connections as turbines and structures get larger?

Gaizka Arregi: Larger turbines are subject to greater static and dynamic loads. The challenge lies in optimizing the bolted connection from different perspectives: size, cost and handling.

This optimization must consider component handling and the tooling required, as these

operations are time-consuming in offshore environments. A holistic approach is needed, covering joint design, tightening tools, handling procedures and the reliability required to meet increasing load demands.

PES: ERREKA has decades of experience in bolting across multiple sectors. How has this heritage shaped the way you approach the specific demands of offshore wind?

GA: We have over 64 years of experience in critical bolted joints and, for the past 25 years, have focused on engineering solutions that optimize the design, tightening and

maintenance of demanding wind industry connections. Our service-oriented approach includes field teams who work closely with customers to achieve safer flange connections while reducing both component and installation costs. We manufacture and sensorize in-house, streamlining the process for our customers.

PES: Offshore environments are notoriously harsh. How do marine conditions specifically influence joint design and maintenance strategies?

GA: The design must reflect the environment in which the joint will operate.

At ERREKA, we use advanced coatings to protect against corrosion in marine conditions. Our expertise in protection methods is key to defining specifications that ensure reliable performance in such demanding environments.

PES: The East Anglia THREE (EA3) project off the coast of England will deliver 1.4 GW of capacity, making it one of the world's largest offshore wind farms. It also requires some of the biggest bolted connections ever attempted. What does this tell us about the direction of offshore engineering? Are we reaching a ceiling on bolt dimensions, or is there still room for scale?

GA: The growing size of bolted connections in projects like EA3 is pushing the limits of logistics and handling. The challenge now is designing more compact joints that can withstand the same mechanical loads. Direct monitoring systems such as the ERREKA Digital Bolt (EDB), combined with innovative flange designs, play a crucial role.

By providing accurate, real-time data on bolt preload, EDB allows designers to reduce traditional safety factors in flange design. This enables lighter, more compact, and cost-effective flanges without compromising structural integrity.

The future of offshore engineering lies not just in scaling up, but in optimizing through smarter, data-driven solutions.

PES: In EA3, more than 13,000 M90 bolts are being installed, which is only the second time in history that fasteners of this size have been used offshore. What lessons from developing and implementing them could influence future projects?

GA: One key lesson from EA3 is that true offshore installation costs often lie in logistics, particularly the time needed to transport and deploy tooling for bolt handling at the TP-MP interface.

ERREKA developed an engineering solution that significantly reduces the time needed for temporary assembly of the transition piece (TP) onto the monopile (MP), streamlining operations and minimizing offshore exposure.

PES: Sensor-enabled fasteners are gaining traction in offshore wind. Beyond load monitoring, where do you see digitalisation adding value to joint integrity?

GA: Digitalisation can greatly enhance joint integrity beyond load monitoring. By providing real-time insight into bolt performance, systems like EDB enable more efficient and compact flange designs optimized for actual load conditions.

This precision reduces material use and manufacturing complexity while supporting predictive maintenance strategies. In turn, corrective maintenance costs drop, improving both reliability and lifecycle efficiency of offshore structures. EDB technology is now cost-effective with Erreka.

PES: Simulation and digital modelling played a role in your tightening strategy for EA3. How do you see computational methods reshaping the way the sector approaches structural connections?

GA: We use simulation to define the optimal tightening strategy, not only for preload quality but also time efficiency. Before offshore deployment, the strategy is validated on a full-scale test bench to ensure reliability under real conditions.

Computational methods let us anticipate joint behavior, reduce uncertainty and fine-tune the installation process, making offshore operations safer, faster and more predictable.

PES: Certification and standardisation are crucial in offshore wind. How is the industry evolving in terms of standards for fastening systems, and where are the gaps?

GA: We continuously certify our technologies and designs with DNV to meet the highest safety and reliability standards in offshore wind. This collaboration helps us align with evolving requirements and supports the development of more robust and standardized fastening solutions.

PES: Training and supervision are often underestimated in offshore assembly. With ERREKA providing 1:1 scale training and test rigs for EA3, what role does knowledge transfer play in ensuring long-term reliability?

GA: The experience of the bolting team is a vital asset. We train our staff so they can perform efficiently once offshore. Our full-scale tests provide hands-on training not only for our personnel but also for client operators.

This goes beyond ensuring joint integrity; it's about doing things safely and correctly, using the practical expertise of our team. Knowledge transfer through real-world simulation and expert guidance builds confidence, reduces errors, and ensures long-term reliability.

PES: Investment in new manufacturing and testing facilities has been highlighted. From an industry-wide view, what infrastructure is still missing to keep pace with the growing size and complexity of projects?



Gaizka Arregi

GA: We've prepared for manufacturing bolts up to M100 and beyond with a new, fully automated production line that delivers finished parts directly from raw material. This investment increases capacity and precision while ensuring repeatability and quality control, key factors as offshore projects grow in size and complexity. We also have a real-size test bench, which is crucial for saving time in offshore projects.

PES: Maintenance is a major cost driver offshore. What strategies or technologies have the most potential to cut lifecycle costs for critical joints?

GA: By installing 100% sensorized bolts, we can reduce lifecycle costs by tightening only those that require intervention, avoiding unnecessary operations on bolts already at the correct preload.

With ERREKA's custom datalogger connected to these bolts, we can remotely monitor the TP-MP joint in real time. The data integrates with the client's SCADA system, eliminating unnecessary offshore trips and enabling smarter maintenance planning.

A properly installed joint with minimal preload variation ensures longer service life and improved reliability, ultimately reducing maintenance costs and downtime.

PES: Offshore wind projects often span decades of operation. What innovations in joint monitoring or predictive maintenance do you see as game changers over the next 10 to 15 years?

GA: Data acquisition through our datalogger is a key innovation for future joint monitoring. By collecting real-time data from sensorized bolts, we enable predictive maintenance that helps operators address issues before they become critical. This reduces offshore interventions and extends joint lifespan.

With ERREKA's custom datalogger connected to these bolts, we can remotely monitor the TP-MP joint in real time.



Over the next decade, we believe such smart monitoring will be a game-changer for offshore wind.

PES: Looking ahead, what do you think the next frontier is for bolting solutions in offshore wind? Is it about size, smarter monitoring, automation or something else entirely?

GA: Monitoring and automation of both installation and maintenance will be key to the future of bolting solutions. ERREKA has already advanced in joint monitoring through sensorized bolts and real-time data acquisition, and we are actively developing new technologies to support automated installation.

This evolution will ensure consistent preload, reduce human error, and enable smarter, data-driven maintenance strategies, improving reliability and reducing lifecycle costs across offshore wind operations.

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About ERREKA

Established expertise

With 64 years of experience, ERREKA specialises in the engineering and manufacturing of high performance bolting solutions.

Major project involvement

ERREKA is supplying more than 13,000 M90 sensor bolts for the East Anglia three offshore wind project, supporting secure and monitored structural connections.

Proprietary technology: EDB

The ERREKA Digital Bolt (EDB) system uses ultrasound based sensing to provide accurate, real time data on bolt preload.

This enables consistent and traceable tightening during installation and operation.

Proven performance

So far, 50,000 bolted joints using EDB technology have been deployed globally during 2025.

The system is certified by DNV.

Integrated services

ERREKA supports clients beyond hardware through tightening strategy simulations, on site supervision and assembly training, particularly for TP to MP connections.

Ongoing innovation

Through research and development initiatives such as NEHOTOR and INTEGRIA, ERREKA continues to develop fatigue resistant large diameter bolts and digital tools to support the offshore wind sector, including floating wind.