



EPI Group

White Paper

# Beyond Compliance: Elevating HSE Standards in Offshore Wind Operations

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The offshore wind sector is experiencing unprecedented growth, bringing with it significant health, safety, and environmental (HSE) challenges.

Recent research has shed light on the demanding nature of offshore wind work. Comprehensive job task analysis reveals several physically challenging activities that are routine for these workers. These include:

- Transferring between vessels and turbines
- Climbing ladders, often to significant heights
- Navigating through confined spaces and hatches
- Performing mechanical tasks, such as torquing
- Conducting emergency rescues, including casualty hauling

Additionally, these offshore wind workers must contend with a range of environmental challenges, including:

- Elevated noise levels
- Constant vibrations
- High humidity
- Extreme temperature fluctuations (both cold and heat)

These findings underscore the unique and often harsh conditions faced by workers in the offshore wind industry, highlighting the need for specialised training, safety measures, and equipment to support their demanding roles.

Recent data reveals that incidents in offshore wind operations nearly doubled in 2023, with the Global Offshore Wind Health and Safety Organisation (G+) reporting 1,679 incidents, representing a 94% increase from 2022. While this rise partly reflects the sector's remarkable expansion - with hours worked increasing by 39% to 61.9 million hours - it emphasises the critical importance of comprehensive HSE services tailored specifically to the unique challenges of offshore wind farms.

This white paper explores the current HSE landscape in offshore wind farms, examines key risk areas, outlines best practices, and discusses how specialised HSE services can mitigate risks while supporting the sustainable growth of this vital renewable energy sector.

## The Offshore Wind HSE Landscape

The HSE landscape in offshore wind presents a complex picture of progress amid persistent challenges. As the industry undergoes rapid expansion - with increasingly larger turbines being installed further offshore in deeper waters - safety performance metrics reveal both improvements and areas of concern.

### Current State and Incident Trends

*Exhibit 1: Offshore wind reported incidents and workhours, 2015-2023 (Source: G+)*

Year	Hours Worked	Fatalities	Lost work day injuries	Restricted work day injuries	Medical treatment injuries	Total	Total recordable injury rate (TRIR)	Lost time injury frequency (LTIF)
2015	21,220,000	0	41	32	54	127	5.99	1.93
2016	21,726,000	0	43	35	42	120	5.52	1.98
2017	26,815,000	0	49	30	78	157	5.85	1.83
2018	25,359,000	0	39	34	45	118	4.65	1.54
2019	22,374,000	0	62	23	38	123	5.50	2.77
2020	25,318,000	0	43	30	22	95	3.75	1.70
2021	32,342,000	0	50	22	34	106	3.28	1.55
2022	44,640,000	0	46	36	44	126	2.82	1.03
2023	61,900,000	1	65	33	70	169	2.73	1.07

G+ data shows that of the 1,679 incidents reported in 2023, 1,049 occurred on construction sites, while 560 happened at operating wind farms. When accounting for increased activity levels, key safety metrics present a nuanced picture. The Total Recordable Injury Rate (TRIR) saw a 3% decline from 2.82 in 2022 to 2.73 in 2023, continuing a downward trajectory. However, the Lost Time Injury Frequency (LTIF) increased by 3%, from 1.03 in 2022 to 1.07 in 2023.

High-risk activities continue to account for a significant proportion of incidents. The top three work processes recording the most incidents were lifting operations (207 incidents), vessel operations including jack-ups and barges (169 incidents), and routine maintenance (109 incidents). Particularly concerning was the inclusion of the first fatality in G+'s reporting history, involving an individual who lost his life while working on turbine assembly onshore.

The initiation phase typically produces several key deliverables that guide subsequent development. These include a formalised business case that quantifies expected benefits and costs, preliminary scope statements that define project boundaries, stakeholder registers that document key influencers and decision-makers, and milestone schedules that outline major project phases and approval points. Technical

consultants assist in developing these deliverables by applying specialised expertise and industry best practices that enhance quality and thoroughness.

## Areas of Concern

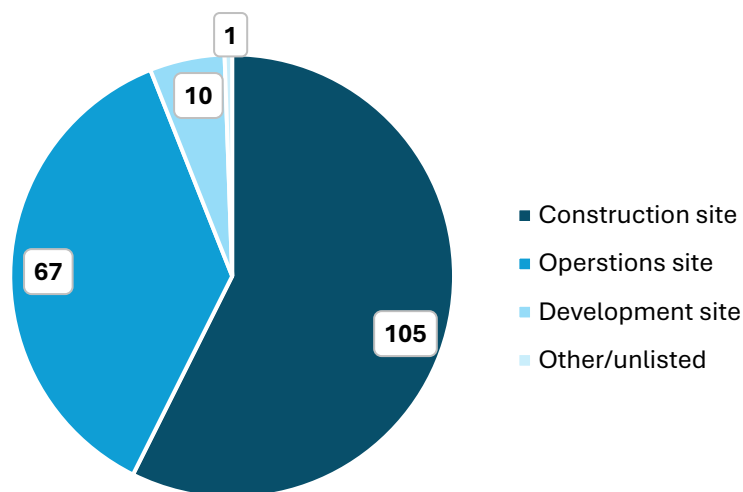
Three specific areas have shown troubling incident increases based on 2023 data:

1. Substations (both onshore and offshore), where non-hazard incidents more than doubled.
2. Service operation vessels under construction, which saw non-hazard incidents more than triple.
3. Onshore turbine assembly, which experienced a 75% increase in non-hazard incidents.

These trends highlight that while offshore operations receive significant HSE attention, onshore elements of offshore wind projects also require focused HSE management. As emphasised by G+ chair David Griffiths, "while we are working on offshore projects, the onshore element of some of these projects is significant and also needs our focus".

EPI Group responds to these industry needs by providing comprehensive HSE services that address both offshore and onshore aspects of wind farm development. With personnel having extensive experience in marine environments and specialised expertise in areas such as offshore heavy lifting, vessel operations, and crisis management, EPI offers valuable support in navigating the complex HSE landscape of offshore wind farms.

*Exhibit 1: Offshore wind high potential incidents by site type, 2023 (Source: G+)*



## Key HSE Challenges in Offshore Wind Farms

Offshore wind farms present unique health, safety, and environmental challenges that require specialised approaches and expertise to address effectively.

### Environmental Challenges

Offshore wind farms operate in some of the world's most demanding environments. Workers face extreme weather conditions, including strong winds, high waves, intense cold, and limited visibility due to fog or precipitation. As noted in research, "Wind farms are often constructed far away from land, at great depths, and in choppy seas. This creates a hazardous environment for workers tasked with constructing and maintaining these giant turbines".

These environmental factors not only pose direct risks to personnel but also complicate operations and maintenance activities. The corrosive saltwater environment accelerates equipment degradation, potentially creating unforeseen hazards if not properly managed through regular inspection and maintenance.

To ensure safety in extreme offshore conditions, personnel require specialised protective equipment. This includes insulated outerwear, durable gloves, buoyancy aids, safety helmets, and additional gear designed to shield against harsh temperatures and powerful ocean currents. However, even with appropriate personal protective equipment (PPE), the environmental conditions remain challenging and unpredictable.

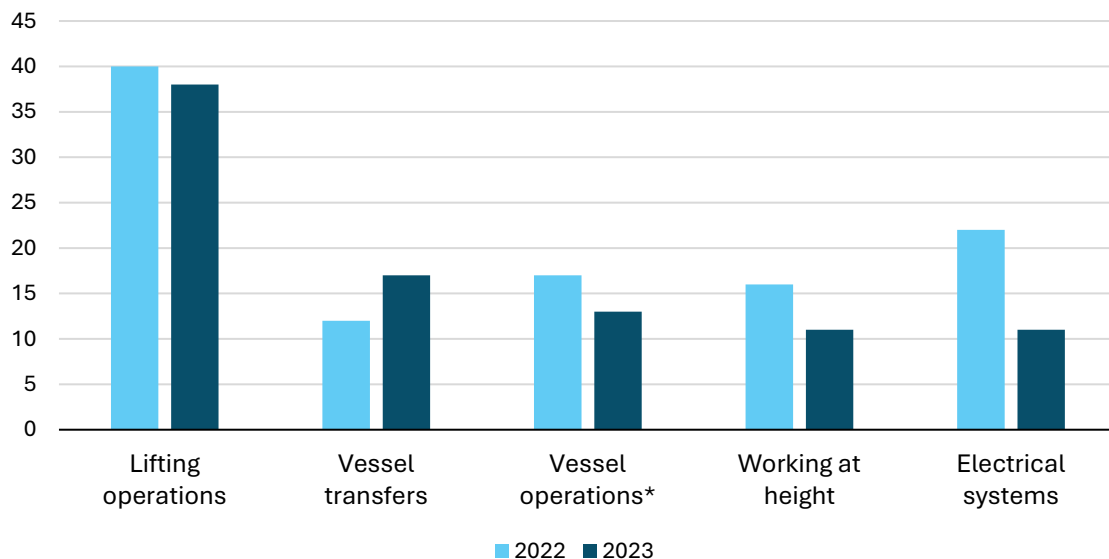
### Operational Risks

The nature of offshore wind farm construction and operation involves numerous high-risk activities:

- **Working at Heights:** Technicians frequently work at significant heights when installing, inspecting, or maintaining wind turbine components. Modern offshore wind turbines can exceed 100 meters in height, with blades spanning over 80 meters. Falls from height represent one of the most severe risks in the industry.
- **Lifting Operations:** The assembly of wind turbine components requires complex lifting operations involving extremely heavy loads. In 2023, lifting operations accounted for the highest number of reported incidents (207) in the G+ data. These operations are further complicated by environmental factors such as wind and vessel movement.
- **Vessel Operations:** Personnel transfers between vessels and wind turbine structures present significant risks, especially in rough seas. Vessel operations, including jack-ups and barges, accounted for 169 incidents in 2023, making it the second highest risk activity in offshore wind farms.

- **Electrical Hazards:** High-voltage electrical systems are integral to wind farm operations, presenting risks of electric shock, arc flash, and fires.

*Exhibit 1: Offshore wind work processes by high potential incidents, 2022 and 2023 (Source: G+)*



## Human Factors

Human factors significantly influence safety performance in offshore wind farms:

- **Fatigue:** The demanding nature of offshore wind farm operations, characterised by extended work periods in challenging conditions, poses significant risks related to worker fatigue. Prolonged shifts in this harsh environment can lead to physical and mental exhaustion, potentially impairing judgment and increasing accident risk. Beyond productivity concerns, fatigue can critically compromise adherence to safety protocols.
- **Training and Competence:** The offshore wind sector demands highly specialised skills and knowledge due to its unique operational environment. Inadequate training or insufficient experience can significantly increase the risk of errors and accidents in this complex and hazardous setting. Comprehensive training and competence development programs can be implemented to ensure that all personnel, from newcomers to experienced professionals, are fully aware of and adhere to essential safety protocols specific to offshore wind operations.
- **Isolation and Psychological Wellbeing:** Extended periods in remote locations can affect mental health, potentially impacting safety performance and decision-making. Limited connectivity in offshore environments can hinder team coordination, particularly during emergencies or high-risk operations. This

isolation poses significant risks to operational safety and effective crisis management.

EPI Group addresses these challenges through specialised HSE consultation services delivered by personnel with many years of experience in the marine environment. Their expertise in critical areas such as offshore heavy lifting, vessel operations, and crisis management enables clients to identify and mitigate these challenges effectively, ensuring the safety of personnel and the protection of assets and the environment.

## Risk Assessment and Management Strategies

Effective risk assessment and management form the cornerstone of HSE programs in offshore wind farms. By systematically identifying hazards, evaluating risks, and implementing appropriate control measures, operators can minimise the likelihood of incidents and mitigate their potential consequences.

### Risk-Based Methodologies for Offshore Wind

The offshore wind industry increasingly adopts risk-based approaches that consider both the probability and consequences of potential failures. Unlike traditional approaches that examine either the probability of failure or the consequence in isolation, risk-based methodologies integrate these factors to direct resources toward the highest-risk areas.

Traditional decision-making methods often focus on either the probability of component failure or the consequences of such failures independently. In contrast, risk-based maintenance strategies adopt a more comprehensive approach. These strategies integrate both the likelihood of failure and its potential impact, enabling organisations to develop more effective and efficient maintenance solutions. By considering these factors in tandem, companies can optimise their resources, prioritise critical areas, and enhance overall operational safety and reliability in offshore wind farm environments.

A comprehensive risk-based approach typically involves:

- **Hazard Identification:** Systematically identifying all potential hazards associated with offshore wind farm operations, including environmental, operational, and human factors.
- **Risk Assessment:** Evaluating the likelihood and potential consequences of each hazard to determine the level of risk. This process assesses the probability and potential impact of hazardous events, quantifying risks to personnel, assets, and the environment.

- **Risk Mitigation:** Implementing appropriate control measures to reduce risks to acceptable levels, following the hierarchy of controls (elimination, substitution, engineering controls, administrative controls, and personal protective equipment).
- **Monitoring and Review:** Continuously monitoring the effectiveness of control measures and reviewing risk assessments as conditions change or new information becomes available.

EPI Group employs this comprehensive approach in its HSE consultation services, providing clients with pragmatic and effective solutions to manage risks in offshore wind projects. Our personnel, with extensive experience in the marine environment, bring valuable insights into hazard identification and risk assessment specifically tailored to offshore wind operations.

## Identification of Critical Risks and Failure Mechanisms

Based on incident data and industry experience, several critical risk areas have been identified in offshore wind farms:

- **Lifting Operations:** The assembly of wind turbine components involves complex lifting operations with extremely heavy loads, often in challenging environmental conditions. Risk assessment for lifting operations must consider factors related to the load (weight, dimensions, stability), the environment (wind speed, visibility, sea state), and proximity hazards (personnel, structures, vessels).
- **Vessel Operations:** Activities involving vessels, including personnel transfers, present significant risks, especially in adverse weather conditions. Risk assessments must consider vessel specifications, weather limitations, personnel competence, and emergency response capabilities.
- **Working at Heights:** Maintenance and inspection activities often require working at significant heights on wind turbine structures. Comprehensive risk assessments should address access methods, fall protection systems, weather conditions, and rescue arrangements.
- **Structural Integrity:** The structural integrity of offshore wind turbines can be affected by environmental conditions, material degradation, and operational stresses. Regular assessment of structural risks is essential for ensuring the long-term safety and reliability of offshore wind farms.

EPI Group offers specialised expertise in many of these critical risk areas, including offshore heavy lifting supervision, vessel inspections, and structural risk assessment. Our personnel, including Master Mariners and Offshore Heavy Lift Supervisors, bring valuable experience and insights into identifying and managing these risks effectively.

## Regulatory Compliance Frameworks

The offshore wind industry operates within a complex regulatory landscape that encompasses international standards, national regulations, and industry guidelines. Compliance with these frameworks is not only a legal requirement but also essential for ensuring the safety of personnel, the protection of the environment, and the sustainable operation of offshore wind farms.

### International and National Regulations

At the international level, organisations such as the International Labour Organization (ILO) and the International Renewable Energy Agency (IRENA) provide guidance on health and safety standards for renewable energy projects, including offshore wind farms. These organisations establish foundational principles and best practices that inform more specific regulations and standards.

While specific regulations vary by jurisdiction, all offshore wind farm operators and contractors must comply with applicable health and safety laws. Regulatory bodies oversee compliance through monitoring activities and have the authority to impose penalties for violations. This regulatory framework forms a critical foundation for ensuring safety standards across the offshore wind industry.

Authorities actively monitor offshore wind operations through inspections, audits, and investigations to ensure adherence to safety regulations and identify improvement areas. Non-compliance carries significant risks, including financial penalties, operational sanctions, or project suspensions. This underscores the critical importance of maintaining robust safety management systems and demonstrating an ongoing commitment to enhancing safety performance in offshore wind farms.

EPI Group provides comprehensive support for regulatory compliance, including the development and implementation of HSE policies and management strategies that align with applicable regulations. Our expertise in planning, updating, and auditing HSE Management Systems helps clients navigate the complex regulatory landscape and maintain compliance throughout the project lifecycle.

### Industry Standards and Guidelines

In addition to formal regulations, the offshore wind industry benefits from a range of technical standards and guidelines developed by organisations such as:

- **International Organization for Standardization (ISO):** ISO standards such as ISO 9001 (Quality Management), ISO 14001 (Environmental Management), and ISO 45001 (Occupational Health and Safety Management) establish frameworks for integrated management systems that address key aspects of HSE.

- **International Electrotechnical Commission (IEC):** IEC standards specific to wind turbines address design requirements, safety considerations, and testing methodologies.
- **Det Norske Veritas (DNV):** DNV has developed specific codes for fixed-bottom and floating installations that address structural design, safety features, and operational considerations.
- **American Petroleum Institute (API):** Recently, API released "API Recommended Practice 75W" (API RP 75W), which "sets a new benchmark for safety and environmental management in the offshore wind industry, upholding the highest standards of safe and sustainable operations".

Industry-specific organisations such as the Global Wind Organisation (GWO) have developed training standards and certification programs tailored to the needs of offshore wind farm personnel. These standards cover essential safety training topics such as working at height, manual handling, first aid, and emergency response.

EPI Group's auditors, qualified to industry-recognised standards such as IMCA/OVID, provide valuable support in implementing and verifying compliance with these standards. Our expertise in ISO standards 9001, 14001, and 45001 implementation and auditing helps clients establish integrated management systems that address all aspects of quality, environmental protection, and occupational health and safety.

## HSE Best Practices for High-Risk Activities

Based on industry experience and incident data, certain activities in offshore wind farms consistently present higher risks. Implementing specific best practices for these high-risk activities is essential for preventing incidents and protecting personnel, assets, and the environment.

### Lifting Operations

Lifting operations account for the highest number of reported incidents in offshore wind farms, with 207 incidents reported in 2023 according to G+ data. These operations involve handling extremely heavy and often awkwardly shaped components in challenging environmental conditions, creating significant risks of dropped objects, structural failures, and personnel injuries.

Best practices for lifting operations include:

- **Comprehensive Lift Planning:**
  - Detailed assessment of load characteristics, lifting equipment capabilities, and environmental limitations
  - Clear definition of roles and responsibilities
  - Identification of potential hazards and implementation of control measures
  - Development of contingency plans for foreseeable problems
- **Competent Supervision:**
  - Engagement of qualified lifting supervisors (such as EPI Group’s Offshore Heavy Lift Supervisors)
  - Verification of operator competence and certification
  - Regular briefings and toolbox talks before lifting operations
  - Effective communication protocols during lifting activities
- **Equipment Selection and Maintenance:**
  - Use of appropriate lifting equipment with sufficient capacity and suitable design features
  - Regular inspection and certification of lifting equipment
  - Thorough pre-use checks and function testing
  - Preventive maintenance programs based on manufacturer recommendations and operational experience
- **Weather Monitoring and Limitations:**
  - Establishment of clear weather limitations for different types of lifting operations, considering factors such as wind speed, wave height, and visibility
  - Continuous monitoring of weather conditions before and during lifting activities
  - Procedures for suspending operations when conditions exceed defined limitations
  - Planning of lifting operations during favourable weather windows when possible

EPI Group’s specialised personnel, including Offshore Heavy Lift Supervisors with extensive marine environment experience, provide valuable expertise in planning and supervising complex lifting operations in offshore wind farms, helping clients implement these best practices effectively.

## Vessel Operations

Vessel operations, including personnel transfers, accounted for 169 incidents in 2023, making them the second highest risk activity in offshore wind farms. These operations involve navigating often harsh sea conditions, transferring personnel between vessels and structures, and coordinating complex maritime activities.

Best practices for vessel operations include:

- **Vessel Selection and Verification:**
  - Selection of vessels appropriate for the intended operations and expected environmental conditions
  - Verification of vessel certifications, capabilities, and condition
  - Regular vessel inspections and audits (such as those conducted by EPI Group’s IMCA/OVID qualified auditors)
  - Assessment of vessel crew competence and experience
- **Personnel Transfer Protocols:**
  - Establishment of clear procedures for personnel transfers between vessels and structures
  - Definition of weather and sea state limitations for transfer operations
  - Provision of appropriate transfer equipment and personal protective equipment
  - Training of personnel in transfer techniques and emergency procedures
- **Navigation and Positioning:**
  - Detailed planning of vessel routes and positioning relative to offshore structures
  - Implementation of collision avoidance measures and protocols
  - Coordination with other vessels operating in the area
  - Continuous monitoring of vessel position and movement
- **Emergency Response Capabilities:**
  - Development of vessel-specific emergency response plans
  - Provision of appropriate life-saving appliances and emergency equipment
  - Regular emergency drills and exercises
  - Coordination with shore-based emergency services

EPI Group’s Master Mariners and vessel inspection specialists bring valuable expertise to vessel operations in offshore wind farms, helping clients select appropriate vessels, verify their condition and capabilities, and implement effective operational protocols.

## Routine Maintenance

Routine maintenance activities accounted for 109 incidents in 2023, highlighting the significant risks associated with these seemingly regular tasks. Maintenance activities often involve working at heights, in confined spaces, with electrical systems, or with rotating machinery, creating multiple hazard scenarios.

Best practices for routine maintenance include:

- **Risk-Based Maintenance Planning:**
  - Development of maintenance schedules based on risk assessments and manufacturer recommendations
  - Prioritisation of maintenance activities according to safety criticality
  - Coordination of maintenance activities to minimise risks and optimise resources
  - Consideration of weather conditions and operational constraints in maintenance planning
- **Permit-to-Work Systems:**
  - Implementation of robust permit-to-work processes for high-risk maintenance activities
  - Clear definition of hazards, control measures, and emergency procedures
  - Verification of personnel competence and equipment availability
  - Regular auditing of permit-to-work (the formal system stating exactly what work is to be done and when, and which parts are safe)

## Conclusion

As the offshore wind sector continues its rapid expansion, the importance of robust Health, Safety, and Environmental (HSE) practices cannot be overstated. The challenges presented by the harsh marine environment, complex operations, and evolving regulatory landscape demand a proactive and comprehensive approach to HSE management.

The data from recent years, including the significant increase in reported incidents in 2023, underscores the critical need for specialised HSE services in offshore wind farms. While the industry has made strides in certain safety metrics, such as the declining Total Recordable Injury Rate, other areas like lifting operations and vessel management continue to present significant risks.

To address these challenges effectively, offshore wind operators must:

- Implement risk-based methodologies that consider both the probability and consequences of potential failures
- Focus on critical risk areas such as lifting operations, vessel management, and routine maintenance
- Ensure compliance with evolving international and national regulations
- Adopt industry best practices and guidelines
- Invest in specialised training and competence development for personnel

Companies like EPI Group play a crucial role in supporting these efforts. With over 30 years of experience in the energy sector and a team of seasoned professionals, EPI offers tailored HSE services that address the unique challenges of offshore wind farms. Our team's expertise in areas such as offshore heavy lift supervision, vessel

inspections, and HSE management system implementation provides valuable support for companies navigating the complex HSE landscape of offshore wind.

As the offshore wind industry continues to grow and evolve, a commitment to excellence in HSE practices will be essential for ensuring safe, sustainable, and efficient operations. By leveraging specialised expertise, implementing comprehensive risk management strategies, and fostering a culture of safety, the offshore wind sector can continue its vital contribution to the global energy transition while protecting its workforce, assets, and the environment.

## About EPI Group

EPI Group is a leading provider of specialist geoscience, environmental and technical services for a wide range of industries. Established in 1987, our passionate, practical and highly knowledgeable team has been delivering independent, intelligent, and commercial solutions for clients for decades.

EPI Group operates worldwide, headquartered in the United Kingdom, with representative offices in North America, Europe, and Asia Pacific. Our reach for projects is global.

We deliver specialist technical solutions and serve as a collaborative workforce partner. Our services are locally delivered by a team of highly experienced technical experts, problem solvers and value creators, supplemented by a trusted network of associate consultants.

EPI Group specialises in supporting both the hydrocarbon and renewable energy sectors, but our experience also extends to mining and capital infrastructure projects.

Contact our team to discuss how we can support your capital projects worldwide.

## Sources:

### About the authors



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Lee has 25 years of experience in the energy industry, covering various executive management, commercial, operational, strategic, and consulting roles. His experience includes working for major investor-owned utilities and in the consultancy sector, holding numerous leadership positions and leading significant renewable energy development projects. Lee joined EPI Group in 2024 as Managing Director of Sustainable Energy Services, responsible for building and optimising the firm's services and solutions for clients in the renewable energy and carbon net-zero sectors.



**Edward Moller**

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Edward has over 25 years of diverse experience in the energy industry, both offshore and onshore. With a degree in Hydrography and Marine Technology, he began as an offshore surveyor and moved into commercial, operational, strategic, and senior management roles. Edward joined EPI Group in 2024 as Commercial Director, Sustainable Energy Services, with responsibility for driving business development.

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