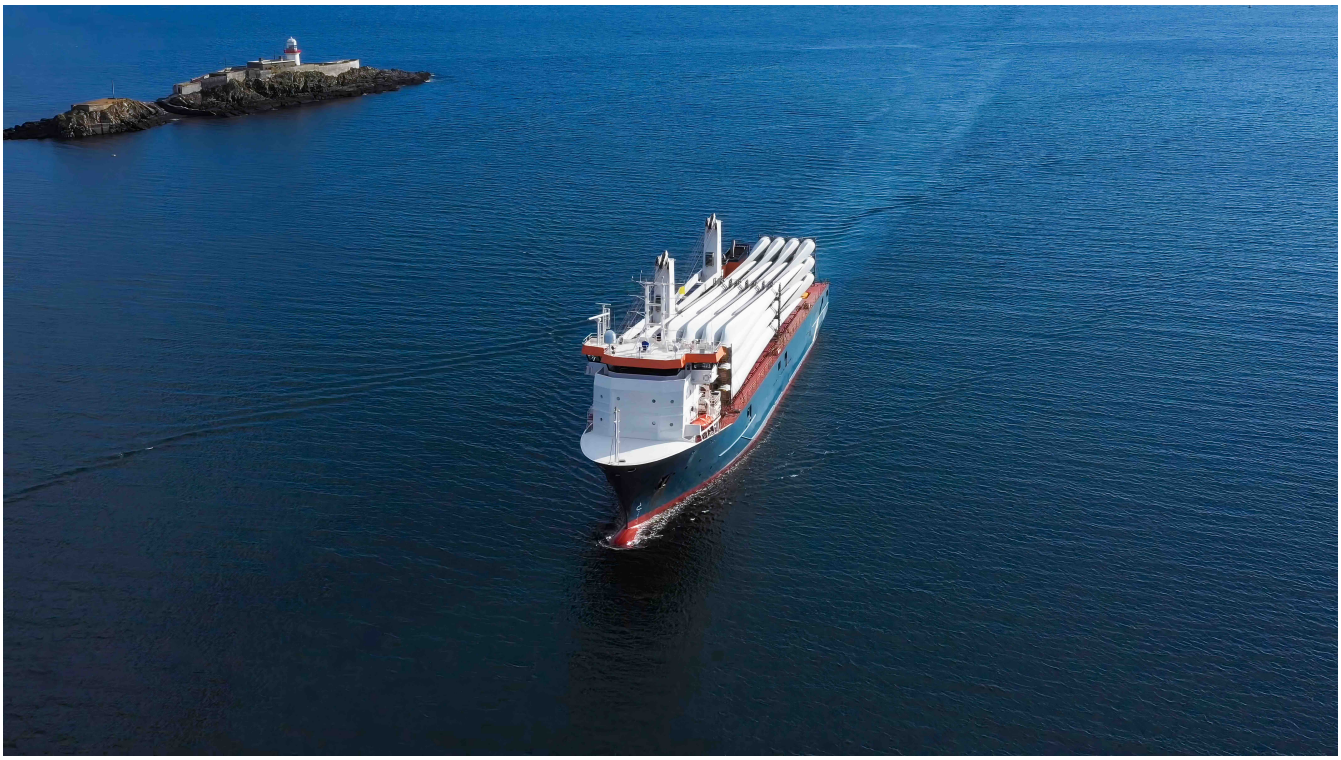

Harnessing the giants: safer wind turbine blade logistics

As wind energy deployment accelerates globally, the logistics of transporting major turbine components—particularly blades, towers, and nacelles—have become increasingly complex. Drawing on Gard's claims experience, this article explores the most common causes of damage during the carriage of turbine parts, highlighting key risks and practical steps owners and operators can take to reduce exposure.

Published 13 April 2026

According to the International Energy Agency (IEA), turbine sizes have grown substantially, with taller hub heights and larger rotor diameters now standard. This underscores the need for robust heavy-lift capability, dedicated project-cargo vessels, and more streamlined permitting and development processes. Although multipurpose vessels are generally best suited for wind-component transport, the growing use of bulk carriers for these shipments demands closer risk evaluation and tighter operational controls to ensure safe carriage.

The article summary

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Gard has significant claim experience with how technical and operational vulnerabilities manifest. The following case studies provide examples of typical failure modes, underpinning the broader issues discussed in the subsequent section.

Case Studies

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Key issues

The case studies outlined above highlight a pattern of technical and operational vulnerabilities in the sea transportation of wind-energy components. While only a few examples are presented here, Gard has been involved in several similar incidents. When assessed collectively, these incidents reveal several critical risk areas that require stronger oversight, clearer allocation of responsibility, and more robust engineering and operational controls.

Lashings

Lashings are among the most critical safety components in the transport of wind-energy cargoes. In practice, lashing materials and securing operations are often supplied and executed by charterer-appointed stevedores, which can limit the vessel owner's direct oversight of procurement and quality control. As a result, there is a risk that certified lashing materials may not meet the actual strength requirements for the voyage. Several incidents have also shown that vessels did not carry sufficient spare lashings to replace damaged gear during the voyage, increasing the risk of escalation once failures were detected at sea.

Fire safety

The unauthorized use of hot work by shore personnel - without proper permits, fire‑watch arrangements, or crew notification, represents a significant and recurring risk. These events can escalate rapidly, often necessitating the release of fixed CO_2 systems and the mobilization of external firefighting assistance. The consequences are frequently severe, particularly where high‑value components such as nacelles are exposed to fire, heat, or smoke damage.

Insufficient engineering controls, structural design & installation quality

Several incidents were linked to shortcomings in engineering discipline and execution. These included missing or inadequate acceleration assessments, improvised load‑spreading arrangements that overstresses hatch covers, and transport frames that were not structurally suited to the actual loading configuration.

Installation quality further compounded these issues. Misaligned blade‑transport frames created uneven load paths and localized stress concentrations, ultimately resulting in structural deformation and blade damage. Taken together, these cases point to gaps in engineering verification, load‑path assessment and installation controls. Furthermore, ship's crew often lack the technical means to verify the structural integrity of the transport frames, such as the ones showed in Case Study 4. Such knowledge usually remains with the shipper and the charterer, leaving the crew with limited oversight during loading.

Weather-induced failures

The carriage of large, high‑surface‑area components such as turbine blades can expose the vessels to extreme dynamic forces in heavy weather. Many of the failures observed fall into the category of design‑capacity overloads, where rolling and acceleration forces exceed the structural limits of hatch‑cover cleats, securing arrangements, or supporting frames.

Once cargo movement occurs, these failures often develop into a chain reaction, compromising both the cargo and the vessel's primary sea‑keeping integrity. Experience from heavy‑weather incidents, including container stack collapses , demonstrates that the absence of defined wind, wave, and acceleration thresholds during voyage planning is a key factor exposing vessels to damaging conditions.

Cargo handling by stevedores

Damage during loading and discharge remains a significant risk, particularly where visibility, communication and control are compromised. In several cases, blades were damaged due to rough handling by stevedores, inadequate control of tag lines, contact with fixed obstacles and movement of blades during hoisting or lowering during strong winds. Limited or obstructed crane‑operator visibility further increases the risk of uncontrolled movements.

Navigation bridge visibility

Although not addressed in the case studies above, it is important to highlight bridge visibility requirements. Deck stowage must not compromise SOLAS V/22 bridge visibility requirements or impede safe navigation. Visibility constraints should be assessed at the planning stage. It is worth highlighting that some port states, such as AMSA and USCG , might not recognize Flag State dispensations for breach of SOLAS bridge visibility requirements. Reference can be made to our article 'The importance of ensuring navigation bridge visibility' for further details.

Contractual considerations

Clear and well-structured contractual clauses is key to determine how responsibilities, approvals, liabilities and operational controls are allocated during the carriage of wind turbine blades. The following considerations consistently influence outcomes in claim scenarios:

Bills of lading and legal framework

When wind turbine blades are intentionally carried on deck, Members should ensure that the contractual documentation accurately reflects the physical mode of carriage. In such cases, particular attention should be paid to the allocation of responsibility for loading, stowage, securing and discharge operations, especially where multiple parties are involved.

Where blades are carried on deck, the Bill of Lading should clearly record this fact. Failure to expressly identify deck carriage may result in the Hague Visby rules not applying to the contract of carriage, which may not only preclude Owners from various potential defences to cargo claims, but also preclude them from relying on their P&I cover. Experience from prior cases shows that ambiguity in deck□cargo wording, particularly where the number or identity of units carried on deck is unclear, tends to be construed against the carrier.

Hence, we recommend that the applicable Bills of Lading are claused accordingly, for example as follows:

"(....) OUT OF (...) (PACKAGES / CONTAINERS / BUNDLES / UNITS ETC) SHIPPED ON DECK AT CHARTERERS'/SHIPPER'S/RECEIVERS RISK, RESPONSIBILITY AND EXPENSE AND WITHOUT ANY LIABILITY TO THE VESSEL AND/OR HER OWNERS FOR ANY DELAY AND/OR LOSS OF OR DAMAGE TO CARGO AND/OR SHIP WHATSOEVER AND HOWSOEVER CAUSED."

If Members are held liable for loss or damage to the cargo, despite having claused the Bills of Lading in accordance with the suggested wording, cover will remain in place up to the Hague-Visby limits, always under the condition that the carriage is approved by Class.

Clarity on responsibilities for stow, securing and operational oversight

It is essential that contractual wording clearly assigns responsibility for the engineering of the securing provisions, provision of lashing equipment, removal/ disposal of materials, operational supervision, and compliance with Class approved arrangements. Clear delineation of obligations helps avoid disputes when allegations of improper stowage or operational unseaworthiness arise.

Structural modifications, welding and on deck fittings

Pad eyes, stoppers and additional support may have to be installed to facilitate blade carriage. However, it must exclude welding on tank tops or fuel tanks. Contracts should specify responsibility, timing and acceptance criteria for removal, including requirements for Class approved welding procedures and non-destructive testing where appropriate. Any temporary structures should be removed and reinstated, including coating and surface protection before redelivery.

Surveyor engagement and evidence preservation

Contracts should allow for independent surveyor attendance wherever necessary, especially during loading, securing, stow verification, and damage assessments. This protects the evidentiary position on structural condition, compliance with approved securing plans, and the adequacy of stowage. Parallel involvement of qualified loading surveyors or Port Captains ensures operational discipline and reduces the risk of later disputes regarding execution. Agreement between the parties on the costs would also be worthwhile.

Key recommendations

• Define responsibilities clearly in contracts.Ensure charterparties and related contracts clearly allocate responsibility for the engineering and approval of securing arrangements, provision and quality of lashing equipment, appointment of surveyors, and reinstatement of vessel structures after discharge. Bills of lading should also expressly state when windmill parts are carried on deck.
• Use expert surveyors and notify insurers.Appoint an experienced, independent marine surveyor to oversee the entire loading and securing process. Consider notifying insurers before carrying wind turbine components on deck of non-specialised vessels as it can be considered as an alteration of risk.
• Follow Cargo Securing Manual (CSM) and involve Class early.Ensure all securing follows the approved Cargo Securing Manual. For bulk carriers, early engagement with a Classification Society is essential. Class societies do issue approvals after reviewing and verifying certain aspects, such as:

- Strength assessments of decks and hatch covers on which cargo is to be stowed.
- Verification of connection points, including cargo securing arrangements, bed frames, and their attachments to hatch covers or deck structures.
- Assessment of loads and accelerations, taking into account vessel characteristics, cargo weight, centre of gravity, and expected dynamic forces.

• Verify lashing equipment quality.Use only verified lashing and securing gear with proper markings and documentation. Reject any equipment showing signs of wear or lacking certification, and maintain an adequate stock of spare lashing materials onboard.
• Carry out engineering assessments.Each voyage should be supported by a cargo specific engineering assessment reflecting the vessel's characteristics and route to be taken. Motion and acceleration calculations should consider hatch cover cleats, expected sea conditions and strength of the lashings. The design and stiffness of blade racks, structural integrity of transport frames, maximum permissible height of stow, load transfer points and acceptable deflections should be verified, and OEM transport requirements considered where applicable. Hatch cover maintenance, including bearing pads, should also be reviewed.
• Ensure careful cargo handling.Use experienced stevedores and crane operators with approved lifting plans. Ship's crew should document any rough or incorrect handling, issue protests where appropriate, and inform charterers without delay.
• Hot work and fire prevention.Limit hot work near cargo and ensure it is managed under a formal permit to work system with a cargo specific risk assessment. Where structural modifications or additional securing points are required, these should be completed before loading and approved by Class.
• Check visibility and stability.Deck stowage must comply with SOLAS V/22 bridge visibility requirements and there must be calculations done to support this. If long blades obstruct sightlines, the stowage plan should be modified rather than relying on Flag State dispensations. Vessel stability, including GM, trim, and wind-heel calculations, must be assessed to ensure adequate margins remain with the deck cargo in place.

• Plan voyages conservatively.Avoid heavy weather where possible, and use cautious route planning, especially in known high-risk areas and seasons.
• Monitor cargo throughout the voyage.Conduct regular lashing inspections (when safe), keep photographic records, and document/report any issues promptly.

Relevant Gard articles

• Weather hot spots off South Africa
• High waves, high claims: New study on container losses
• The importance of ensuring navigation bridge visibility
• Deck Cargo - A Summary of English and US Law