G+ Safe by Design workshop report: Material handling equipment

G+ Global Offshore Wind
Health & Safety
Organisation

In partnership with

energy institute

G+ SAFE BY DESIGN
WORKSHOP REPORT: MATERIAL HANDLING EQUIPMENT

July 2024

Published by
Energy Institute, London
The Energy Institute is a professional membership body incorporated by Royal Charter 2003
Registered charity number 1097899

The Energy Institute (EI) is the chartered professional membership body for the energy industry, supporting over 23 000 individuals working in or studying energy and 200 energy companies worldwide. The EI provides learning and networking opportunities to support professional development, as well as professional recognition and technical and scientific knowledge resources on energy in all its forms and applications.

The EI's purpose is to develop and disseminate knowledge, skills and good practice towards a safe, secure and sustainable energy system. In fulfilling this mission, the EI addresses the depth and breadth of the energy sector, from fuels and fuels distribution to health and safety, sustainability and the environment. It also informs policy by providing a platform for debate and scientifically-sound information on energy issues.

The EI is licensed by:
– the Engineering Council to award Chartered, Incorporated and Engineering Technician status, and
– the Society for the Environment to award Chartered Environmentalist status.

It also offers its own Chartered Energy Engineer, Chartered Petroleum Engineer, and Chartered Energy Manager titles.

A registered charity, the EI serves society with independence, professionalism and a wealth of expertise in all energy matters.

This publication has been produced as a result of work carried out within the Technical Team of the EI, funded by the EI's Technical Partners. The EI's Technical Work Programme provides industry with cost-effective, value-adding knowledge on key current and future issues affecting those operating in the energy sector, both in the UK and internationally.

For further information, please visit **http://www.energyinst.org**

The EI gratefully acknowledges the financial contributions towards the development of this publication from members of the G+ Global Offshore Wind Health and Safety Organisation:

bp
Corio Generation
EDF Renouvables
Equinor
Iberdrola
Ocean Winds
Ørsted
RWE
Siemens Energy
SSE
Total Energies
Vattenfall

However, it should be noted that the above organisations have not all been directly involved in the development of this publication, nor do they necessarily endorse its content.

ISBN 978 1 78725 435 0

Published by the Energy Institute

Hard copy and electronic access to EI and IP publications is available via our website, **https://publishing.energyinst.org**.
Documents can be purchased online as downloadable pdfs or on an annual subscription for single users and companies.
For more information, contact the EI Publications Team.
e: **pubs@energyinst.org**

Cover image credits: Scotish Power/Iberdrola, Julian Claxton/CHPV

CONTENTS

LIST OF FIGURES

Page

Figures

LIST OF ABBREVIATIONS

HSE	Health and Safety Executive
GWO	Global Wind Organisation
KPI	Key performance indicator
O&M	Operations and maintenance
OEM	Original equipment manufacturer
TP	Transition piece
WTG	Wind turbine generator

1 EXECUTIVE SUMMARY

On 23rd November 2023, The G+ Global Offshore Wind Health and Safety Organisation (G+) facilitated a Safe by Design workshop which brought together industry experts to assess the hazards and management of risks related to materials equipment handling in offshore wind. The purpose of the workshop was to: 1) identify improvements that could be made within the constraints of current practices and technologies, and 2) assess how the equipment handling could be managed in the future.

1.1 RECOMMENDATIONS

A range of topics were discussed during the workshop which has led to the following key recommendations for the industry:

1	Structured design process	G+ should implement a design process to ensure an end-to-end material equipment handling system is developed. To achieve this, a task-based analysis should be carried out with a documented description of the material equipment handling methodology.
2	Contingency planning	Asset owners should develop processes considering contingency and emergency planning. This should include the competency requirements for non-routine activities.
3	Management of change	Asset owners should review their management of change procedures, and their application, and ensure they adequately cover modifications to the material handling equipment installed on the asset, the use of mobile and temporary equipment, processes and procedures.
4	Equipment design and selection	Asset owners should ensure equipment is designed and selected based on the specific functional requirements of offshore wind. That should include features such as the inability to defeat safety protection systems and monitoring of the equipment usage to assist in its through-life management.
5	Lifting bag integrity management	Asset owners should ensure that lifting bags are considered to have the same importance as the lifting equipment, and there are specific plans to manage their integrity.
6	Hoist management	Asset owners should record usage of hoists to assess how its deployment differs from the use case assumed at the design stage.
7	Improve richness of data	G+ should improve the granularity in the data to allow data driven assessment and conclusions and ensure the industry efforts are targeted on the areas of highest risk.
8	Joint industry project to assess increased automation	G+ should initiate a joint industry project to unlock some of the possible benefits of greater automation and the use of new technology such as drones.

2 BACKGROUND AND INTRODUCTION

2.1 BACKGROUND

The G+ comprises the world's largest offshore wind developers, established to form a group that places health and safety at the forefront of all offshore wind activity and development. The primary aim of the G+ is to create and deliver world-class health and safety performance across all its activities in the offshore wind industry. The G+ has partnered with the Energy Institute (EI) to develop materials including good practice guidelines to improve health and safety performance.

Through sharing and analysing of incident data provided by G+ member companies, an evidence-based understanding of the risks encountered during the development, construction and operational phases of a wind farm project has been developed. This information has been used to identify the health and safety risk profile for the offshore wind industry.

In 2014, the Crown Estate asked the G+ to take over the running and delivery of its Safe by Design workshops. The Crown Estate had run a number of these previously, covering topics such as diving operations, lifting operations, wind turbine design and installation, and the safe optimisation of marine operations.

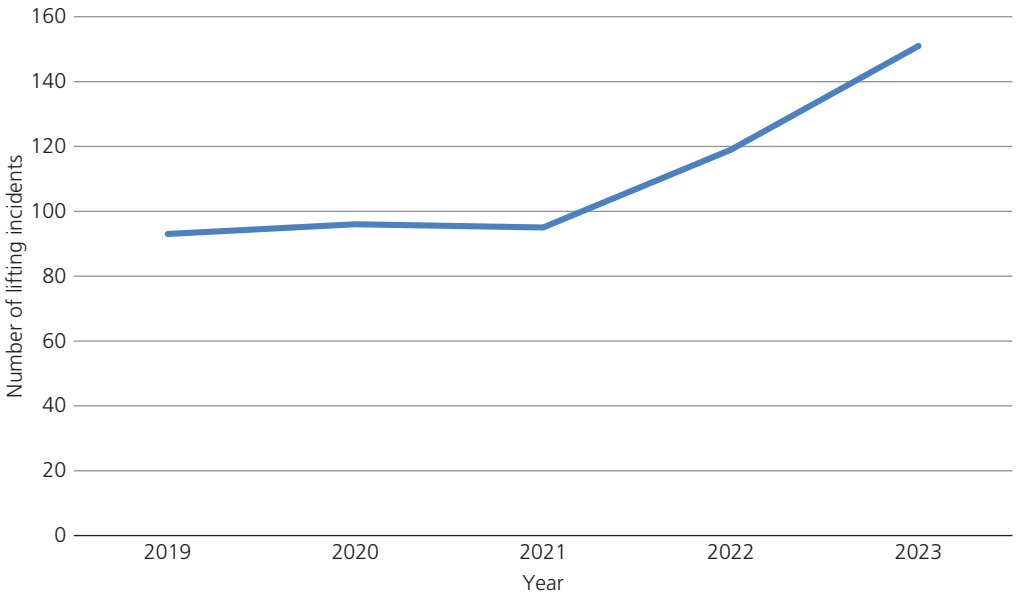
By bringing the Safe by Design workshops into the G+ work programme, the G+ aims to explore industry operations and technologies with a focus on Safe by Design principles. The G+ workshops examine the current design controls relating to a topic, discuss where current design has potentially failed, identify opportunities for improvement and then seek to demonstrate the potential risk reduction to be gained from these new ways of thinking and operating.

To date, ten workshops have been held under the auspices of the G+ covering: Marine transfer/access systems; Escape from a nacelle in the event of a fire; wind turbine generator (WTG) service lifts and follow up; Davit cranes; WTG access and egress; WTG access to the transition piece below airtight deck; Hydraulic torquing and tensioning systems; Blades; and Floating Offshore Wind-Transfers, access and egress, and material handling. The outputs from all of these workshops have been made available in reports which can be downloaded from the G+ website, to be used as a reference by the industry. In June 2024, the G+ also published a good practice guidance on applying Safe by Design in the offshore wind industry.

Details of the workshops and the good practice guidance can be found at the following link: Safe by Design workshops | G+ Offshore Wind Health and Safety Organisation (gplusoffshorewind.com).

2.2 INTRODUCTION

Material handling is an integral part of the management of offshore wind assets. G+ had previously delivered a workshop on the use of davit cranes which focused on the design and operation of the WTG and transition piece (TP) mounted davit cranes.



NOTE: *2023 data does not include Q4*

Figure 1 – Number of lifting incidents in G+ data set (excluding heavy lifts)

Figure 1 shows the number of incidents, including hazard observations and near misses, reported in the G+ since 2019. It should be noted that as data presented is purely the number of reported incidents, it does not necessarily indicate that the incident rate (i.e. incidents per lifting/handling operation) has changed in the same manner especially considering the rise in workhours reported over the same period. The data includes the period where COVID restrictions may have reduced the level of maintenance carried out during the first part of the data set and conversely the number of assets in operation has increased since. The available data does not allow the impact of these factors to be quantified and used to generate a reliable incident rate, and therefore draw conclusions about how much better or worse the industry is performing in terms of the management of hazards associated with lifting and material handling activities. However, the industry performance regarding the management of the hazards associated with lifting does not appear to be improving from the available data.

Figure 2 shows the breakdown of incidents at the various stages of the overall logistics process and some of the common themes.

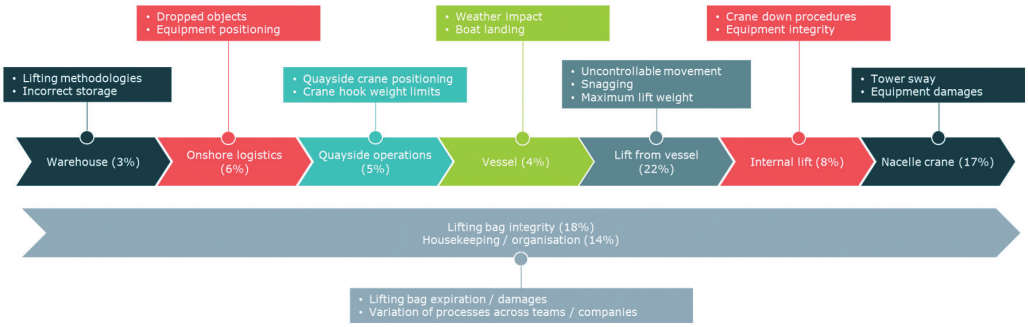


Figure 2 – Breakdown of lifting incidents and different stages of the overall logistics process

3 METHOD, AGENDA AND ATTENDANCE

A one-day, in-person workshop was held on the 23rd of November 2023 at the EI in London which was attended by industry professionals from the offshore wind industry including developers, operators, health and safety professionals, training providers and risk management consultants. The workshop focused specifically on material handling equipment.

The event began with an opening remark from Marcus Peters, Global Head of HSE Offshore, RWE Offshore, and then followed by a presentation from Steve Hillier, Director of Asset Management, Worley. This presentation outlined the objectives for the day and the purpose, additionally exploring the importance of managing risk at design stage in a floating offshore wind context.

The introduction session started with a video that showed the process of lifting an oil barrel from the warehouse to the nacelle. The video displayed an example of good practice, but it highlighted some of the constraints the permanent design places on the operations team.

After the video, the attendees separated into two breakout rooms for a deep dive into the topics relating to material handling equipment. After each session, all groups returned to the main discussion area to communicate key points and topics discussed in their group.

A central aim for the breakout sessions was to identify practical steps that can be implemented to address the issue. For example, a focus on the operational phase of the design process is a regular theme for initiatives such as this one but the discussions in the workshop attempted to define an approach where this could be practically achieved in the context of material equipment handling.

The workshop was attended by representatives from Iberdrola, RWE, Equinor, Vattenfall, Worley, G+, SRC and IMCA.

Although some data analysis was completed prior to the workshop (see section 2.1) only the high-level statistics were available, therefore it was not possible to create a link between the incident rates and the recommendations. It would be preferable if the data had greater granularity to allow the expected improvements from the recommendations to be quantified, support prioritisation of the topics, and use the data to support the identification of causes. In the absence of this, the workshop relied on the knowledge and experience of the attendees, although improving the data was identified as an area for improvement.

4 BREAKOUT GROUP DISCUSSION

This section describes the key discussions during the breakout sessions and the industry recommendations identified. The summary below has combined topics under various 'themes' but some topics (such as lifting bags) appear in multiple areas.

4.1 PREVIOUS G+ REPORT

The first topic in the breakout session was the previous G+ report on davits and if the findings and recommendations had been implemented and if not, were still relevant.

The following table contains the four main recommendations in the report and comments.

Recommendation	Comments
A new part three of the EN 13852 Cranes. Offshore Cranes suite of standards is being drafted which would be directly applicable to davit cranes used in offshore wind. It is recommended the G+ takes part in the consultation exercise to help shape this standard to ensure the requirements of the whole industry are addressed.	There have been updates to EN 13852 It is understood that G+ were not included in the consultation process.
In addition to formal standards, the G+ should consider developing some supplementary guidance to support the specification and procurement of davit cranes in offshore wind.	This is still relevant and required. See section 4.2.
Issues associated with the operation of davit cranes should be captured from across the industry to support the development of future standards and supplementary guidance.	This is still relevant. The data supplied to the G+ does not have sufficient granularity. See section 4.9.
The G+ should consider developing guidance to support the operation of davit cranes. The scope of this guidance should be the entire component journey (from warehouse to turbine) rather than just the lifting operation itself.	This is still relevant. The workshop considered this in the context of how development projects could ensure the design process adequately covers the end-to-end process. See section 4.2.1.

The previous G+ report included several other recommendations which have to date now been progressed by the industry.

4.2 INTEGRATED DESIGN

4.2.1 Design process

It was recognised that the current design process was disjointed and not structured in a way that is likely to lead to optimum outcomes in relation to the control of hazards associated with lifting equipment and its use. Specifically, it was noted that the overall 'system' (i.e. the end-to-end process shown in Figure 2) was essentially a side effect of other siloed design objectives and decisions, and not something that is not deliberately managed. This leads to several suboptimal design features and interfaces that unnecessarily introduce hazards, and/or increase risk levels.

A typical approach to asset design that determines the 'material handling system' was considered to be the following sequence of discrete activities:

1. Selection of the WTG which includes a standard nacelle crane/hoist and layout with little input from the developer.
2. Foundation supply contract generally based on a high-level functional specification that is limited to safe working load, outreach, colour, and corrosion protection requirements, without adequately covering operational factors such as line of sight and unimpeded movement.
3. Procurement of a vessel services.
4. Development of onshore operations and maintenance (O&M) base and port load out arrangements.
5. Procurement of standard lifting bags and lifting equipment.
6. The O&M organisation tasked with 'making it work'.

It was clear that key decisions were delegated to the WTG supplier and the foundation designer, yet generally yield insufficient management of interfaces.

It was considered important that there was a greater emphasis on operations and 'system thinking' in the process. Within the context of the industry, where assets are developed with multiple design interfaces, a practical way of achieving this was explored. Two key issues emerged. Firstly, the developer is the only entity that is able to control the end-to-end process and ensure the interface points are effectively considered and designed. And secondly, task- based analysis needs to be an integral element of the design process with appropriate gateways and reviews of proposed methodologies.

A design process that was considered appropriate was the following:

1. Identify foreseeable lifting activities necessary for operations and maintenance including the size and weight of components and the expected frequency. This process should include the consideration of unplanned activities (see section 4.8).
2. The completion of a task-based analysis to assess how the required equipment could be transported to the point of work.
3. The proposed methodology is documented and included as part of the design review process.

This should be an iterative process through the design phase, and it should become more detailed as the design matures and becomes more defined. This requires the project developer to have sufficient knowledge and awareness to provide adequate reviews of the proposed methodologies.

It is common that technicians are required to drag bags from one lifting area to another, or up the steps to the WTG entry door. This was considered to be an example of a poorly considered process which places physical stress on the technicians but also causes damage to the bags which increases the risk of them failing during a lifting activity.

It was further identified that the role of technicians executing work is also part of the 'material handling system' so human factors should be a central consideration. This means that it should be easy to carry out work in the safest way, the design should be error-proof as far as practicable, and it should not be possible to defeat safety devices. To ensure that this occurs at the right level within a project development environment, it should be demonstrable that human factors have been considered and the outcome has been reviewed and determined to be adequate.

It was recognised that designers may not have sufficient awareness of the issues relating to materials handling and often have not been exposed to, or witnessed, lifting offshore. This was considered to be a potential issue; thus, effort should be increased into raising awareness of real-world issues regarding lifting equipment, such as the lack of line of sight, awkward positioning, and muti-handling. It was however recognised that there are challenges providing offshore visits, so the use of technology such as videos, 3D modelling, and AI should be used.

It was also considered important to raise the profile of the design for lifting in the design phase. One achievable approach that was identified was a KPI on the expected numbers of lifts during the operational life of the asset. This could be forecasted based on the information that was already available such as WTG reliability assessments, scheduled maintenance requirements, the task-based analysis described above, and lifting bags. It is obvious that reducing the number of lifts will have a direct impact on the number of incidents, so encouraging projects to look at ways to achieve this will also contribute to the safety performance of the asset when it is in operation.

4.2.2 System level thinking

A key element of the design process is the adoption of 'system-level thinking' to ensure that the end-to-end logistics activity is considered. An example of this was the use of standard lifting bags which are commonly used. These provide a flexible solution, but they are not site-specific designs. Including items such as the lifting bag in the design process may generate a more suitable way of carrying and storing equipment. Alternatives that were considered are cases or boxes that are designed to interface specifically with the lifting arrangements for the site and, for example, have the right distance from the hook of the davit to avoid interference with handrails.

4.2.3 Inherent safety

It was noted that there are opportunities to use technology to control risks that are not fully exploited. For example:

- It should not be possible to defeat safety devices.
- The exclusion zone should be monitored and it should not be possible to undertake a lifting operation if personnel are within it.
- All exclusion zones should be marked so it is clear to personnel where they are.
- There should be specific areas in the nacelle for bags and equipment to be stored while work is being completed to help general housekeeping and avoid trip hazards. There should also be designated areas for any gas bottles that may be required.

- Misuse of equipment should be considered in the design and assurance processes.
- 'Design for maintenance techniques' using technology such as ultrasonic bolt monitoring to avoid the need for heavy hydraulic equipment.
- A lighting study should be carried out to ensure appropriate lighting throughout all stages of the logistics process.
- The handling process should not require technicians to drag bags or carry them up the WTG entry steps.

It was recognised that technicians would be able to provide more detailed feedback and insights into the design issues that create challenges, and they should be involved in a focus group to discuss, record, and address their concerns.

4.3 REDUCTION IN LIFTING OPERATIONS

It was recognised that reducing the number of lifting operations will have a direct impact on the number of incidents. This is partially described in 4.2.1, which described how a KPI can be used in the design stage to raise the profile of this in development. There are also opportunities to consider this in the operational phase. Any activity to remove unnecessary maintenance, or leverage efficiencies, will assist in the reduction of the number of lifting operations. This could be supported through the application of risk-based inspection and maintenance, the use of technology to increase scope of remote monitoring, and possibly leaving some tooling on the turbine.

Similar to the KPI suggested in the development stage, a metric for the number of lifting activities in the operational phase will increase the profile and drive initiatives to reduce the frequency.

4.4 COMPETENCE REQUIREMENTS

It was recognised that standard competence requirements do not include rigging training. This contrasts with other sectors where there is a need for dedicated competence levels. It was noted that many of the lifting activities are repetitive and standard processes. Although this may provide adequate familiarity for 'normal' activities, there is a concern that: 1) there may not be sufficient competence to plan a non-routine lifting process, and 2) the response to an issue in a lifting operation may be inappropriate. It was therefore considered necessary to review the training requirements.

If the current level of training is maintained, then it was noted that:

1. the requirement to ensure the equipment is appropriately designed, considering human factors, is critically important (see section 4.2), and
2. robust management of change processes and specialists need to be engaged when appropriate (see section 4.8.2)

It was felt that the GWO training should cover the range of crane scenarios a technician may encounter. There should be additional familiarisation training.

The group identified that several lifting operations are considered 'routine', and this is used to avoid higher training requirement. There were concerns that there is no definition or description of 'routine', and this should not be used as a means of reducing competency levels.

4.5 WORK DELIVERY

4.5.1 Lift plans

Typical lift plans were discussed, and it was noted that they lack consistency, at times are too complex, and are all different. This raised concerns about credibility and issues for technicians working across multiple sites. It was considered necessary for the industry to develop guidance on lifting plans, to provide consistency.

4.5.2 Time pressure

It was noted that technicians involved in loadout activities and riggers are generally under time pressure and supporting multiple activities. This increases the chance of error and creates undue stress and fatigue.

It was proposed that fatigue monitoring should be carried out to generate data and understand the size of the issue.

4.6 EQUIPMENT MANAGEMENT

4.6.1 Hoists

Concerns regarding the management of hoists were raised. The attendees did not feel that the original design risk assessment carried out by the equipment supplier was available, therefore it was not possible to assess the operating conditions it had been designed for, and how these differ to the application on their assets. Specific concerns raised included the specific design use case, the utilisation level, and the extent to which side loading, dynamic/shock loading and number of operations had been considered. It was felt that the whole-life management of hoists needed to be significantly improved, but the lack of design information was a key barrier. A further issue was that the factors that impact the usable life of the hoist, such as usage and loading regimes aren't recorded. It was clear that the rate of life consumption is unknown, and therefore the magnitude of the risk is also uncertain due to the lack of information and the absence of management strategies to manage the lifespan of the hoists.

It was acknowledged that asset management principles need to be applied to hoists, specifically as there are many offshore wind farms approaching the end of their original design life.

The specification of the hoists was also discussed in the context of its use to evacuate a casualty. Hoists are not generally specified for this situation, but it is a critical component in the process. Contingency planning is described in section 4.8.

Chain hoists were a particular concern given the possibility that the chain may not be contained and there are examples of it falling out of the collection system. It was considered preferable to use a fully contained unit and/or remove the chain and use wire hoists.

There were also concerns that the hoists were considered to be portable equipment but in reality, are consistently used in one position. It was felt that this warranted a bespoke system.

4.6.2 Slings and strops

Slings and strops are used extensively in offshore wind. They are standard items and not designed to be specific to tasks, so the technicians adapt the arrangements to the slings and strops that are available. The consequence of this is that it can result in suboptimal lifting arrangements where lifting height is necessarily used up.

It was identified that designing site- and task-specific slings and strops would provide more effective lifting arrangements and reduce risk.

4.6.3 Lifting bags

Lifting bags were identified as items that required attention in various contexts through the sessions. The main concern was that they were considered perishable consumable items and weren't subjected to a management or maintenance strategy. There are examples where damage to the lifting bags has been the cause of incidents. There were two themes during the lifting bag discussions: firstly, they should be specifically designed to appropriately interface with the rest of the system (see section 4.2.2), and secondly, their management should be improved. To achieve this, lifting bags should be included on the asset register with an appropriate inspection frequency and scope. QR codes could be used to help track their usage and there should be robust quarantine processes to ensure those deemed unsuitable for use are not used for lifting activities.

It was noted that technicians have to drag bags across platforms and up the turbine entry level steps. This wear has the potential to cause a reduction in their capacity, introducing a hazard. It is also not considered good practice from a material handling perspective.

There were concerns raised that the bags are all the same colour regardless of their capacity, and introducing different colours, or clearer identification of their capacity, may help to avoid overloading them.

Although the lifting bags are CE marked, it was not clear if they are designed in accordance with an offshore standard.

4.7 WAREHOUSE MANAGEMENT

The design and management of the O&M warehouse was discussed. It was felt that there were opportunities to improve warehouse layout and management, particularly as the O&M warehouse is an area that is easy to control. There may be opportunities to review how the distribution and logistics sector organises warehouse operations and adopt some relevant lessons. Key areas are: 1) the good inwards process, 2) storage and use of racking, 3) the process to load the lifting bags, and 4) the process for transporting those to the dockside load out area.

It was also recognised that the O&M warehouse is the first stage of the process to transport equipment offshore, and there may be opportunities to introduce improvements that will reduce risks offshore. For example, the efficient arrangement and distribution of parts of equipment may allow the consolidation of lifting bags to minimise the number of lifting activities.

Furthermore, the way equipment is packed may help to avoid unnecessary hazards when the bags are accessed offshore.

The warehouse was considered to be a busy environment, with forklifts operating often without appropriate line of sight, and there are opportunities to improve their management. This includes the review of ergonomics and human factors.

4.8 CONTINGENCY PLANNING AND MANAGEMENT

4.8.1 Load recovery

The recovery of a load following equipment malfunction or a power outage was considered to be an issue. Although this is a foreseeable scenario, it is generally not proactively planned for, and the design of the system does not take this into consideration. The resolution of these situations therefore requires activities outside normal practice. It was considered necessary to ensure that contingency arrangements are included in the design process (see section 4.2.1).

4.8.2 Management of change

As described in section 4.4, there is no industry requirement for specific rigging training. The repeatable nature of the lifts and standard equipment is therefore relied upon to ensure personnel are familiar with the tasks and procedure. There are considered to be issues when a variation is required, such as the load recovery topic discussed in section 4.8.1. These need to be considered a management of change topic as the level of competence needed to assess the situation and develop a safe and acceptable method is often higher than a typical O&M team.

In these situations, it is considered important that there is a hold point and the requirement for additional competence and specialist support is assessed.

Management of change issues also apply more broadly with opportunities for improvement in the areas of asset modifications, the use of new equipment, and changes to new procedures suggested. Strengthening management of change processes, and their implementation, was considered to be necessary.

4.9 DATA MONITORING

Throughout the workshop, it was observed that the industry data is not rich enough to identify a logical link between the issues raised and the incident data to, for example, quantify the safety improvement each improvement opportunity would make. Although the workshop included informed participants and the conclusions are valid, it was considered to be advantageous if it was possible to generate improved data regarding root cause of incidents then the impact of the proposed improvements could be quantified and prioritised.

4.10 FLOATING

There were considered to be specific issues with material handling on floating concepts due to the need to transfer equipment from one dynamic structure to another.

This topic was also discussed in G+ SBD workshop: Floating Offshore Wind – Transfers, access and egress, and materials handling (G-Safe-by-Design-workshop-Floating-Offshore-Wind.pdf (gplusoffshorewind.com)).

4.11 FUTURE STATE

Possible future states were considered with the aim of 'reimagining' the whole process to remove people from lifting activities in a fully automated process. This is shown conceptually in Figure 3.

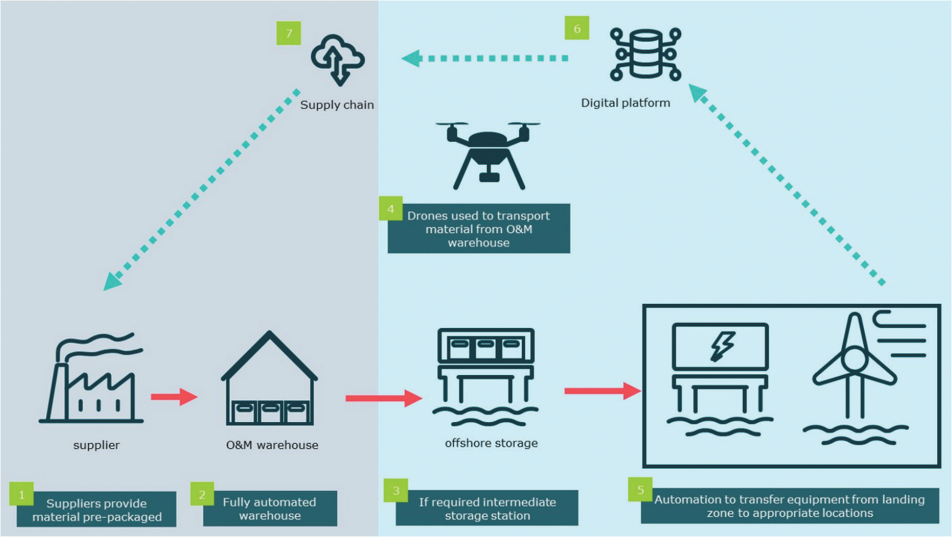


Figure 3 – Conceptual model of a fully automated process

Stage	Description
1	Supplier packages components so they can go directly offshore
2	The O&M warehouse is fully automated using technology used in state-of-the-art distribution centers
3	If necessary, an offshore storage station is used
4	Drones transport equipment offshore, either to the offshore storage station or directly to the asset
5	Offshore substations and WTGs include automation technology to allow equipment to be moved around the asset to the point of work
6	A digital platform uses asset condition information to identify the maintenance requirements
7	Items are automatically ordered from the suppliers based on the asset condition information

Although it was recognised that the fully automated process may not ultimately be desirable or feasible, there are elements that may be possible to operationalise in the near term. For example, it was known that drones are being used in logistics activities and moving to things such as pre-packed service kits. However, the discussion highlighted the need for various stakeholders to work together to deliver any of the opportunities. For example, introducing drone-based logistics to transport items offshore will need specifically designed wind turbines with landing zones and also means of moving those items inside the asset to the point of work.

It is recommended that the industry initiates a project to explore automation and develop a means of effectively managing the interfaces. This should include experts in logistics, drone technology, WTG OEMs, the equipment suppliers, and foundation designers.

5 RECOMMENDED ACTIONS

The workshop identified the following recommendations. These are provided in summary form and the context and background is provided in Section 4.

1	Structured design process	G+ should implement a design process to ensure an end-to-end material equipment handling system is developed. To achieve this, a task-based analysis should be carried out with a documented description of the material equipment handling methodology.
2	Contingency planning	Asset owners should develop processes considering contingency and emergency planning. This should include the competency requirements for non-routine activities.
3	Management of change	Asset owners should review their management of change procedures, and their application, and ensure they adequately cover modifications to the material handling equipment installed on the asset, the use of mobile and temporary equipment, processes and procedures.
4	Equipment design and selection	Asset owners should ensure equipment is designed and selected based on the specific functional requirements of offshore wind. That should include features such as the inability to defeat safety protection systems and monitoring of the equipment usage to assist in its through-life management.
5	Lifting bag integrity management	Asset owners should ensure that lifting bags are considered to have the same importance as the lifting equipment, and there are specific plans to manage their integrity.
6	Hoist management	Asset owners should record usage of hoists to assess how its deployment differs from the use case assumed at the design stage.
7	Improve richness of data	G+ should improve the granularity in the data to allow data driven assessment and conclusions and ensure the industry efforts are targeted on the areas of highest risk.
8	Joint industry project to assess increased automation	G+ should initiate a joint industry project to unlock some of the possible benefits of greater automation and the use of new technology such as drones.

Energy Institute
61 New Cavendish Street
London W1G 7AR, UK

t: +44 (0) 20 7467 7100
e: pubs@energyinst.org
www.energyinst.org

ISBN 978 1 78725 435 0
Registered Charity Number: 1097899