

G+ Safe by design

Workshop report: WTG service lifts



**G+ Global Offshore Wind**  
Health & Safety  
Organisation

In partnership with



# G+ SAFE BY DESIGN WORKSHOP REPORT: WTG SERVICE LIFTS

March 2017

Published by

**Energy Institute, London**

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Registered charity number 1097899

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

Centrica  
DONG Energy  
EDF  
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ISBN 978 0 85293 984 0

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# **1 BACKGROUND AND INTRODUCTION**

## **1.1 BACKGROUND**

The G+ Global Offshore Wind Health and Safety Organisation (G+) comprises the world's largest offshore wind developers who have come together 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 of its activities in the offshore wind industry. The G+ has partnered with the Energy Institute (EI) to develop materials including good practice guidelines for the offshore wind industry in order to improve health and safety performance. Through sharing and analysis 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 their 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 particular 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.

To date three workshops have been held under the auspices of the G+ covering: marine transfer/access solutions, escape from a nacelle in the event of a fire, and lifting operations. The outputs from two of these workshops have also been made available in reports which can be downloaded from the G+ website to be used as a reference by the industry.

## **1.2 INTRODUCTION**

In September 2015 a fatal incident occurred in Germany when a service lift failed on an onshore wind turbine. Whilst the official investigation into the root causes of this incident is still ongoing, the G+ has taken a proactive approach to the sharing of service lift safety information, engagement with service lift Original Equipment Manufacturers (OEMs) and supporting further industry research to assess the fit for purposeness of service lifts. Under the direction of the G+ Focal Group, a Safe by Design workshop on Wind Turbine Generators (WTGs) service lifts was held on 22 September 2016 in London, UK.

The outputs from this workshop are documented in this report.

## 2 METHOD, AGENDA AND ATTENDANCE

### 2.1 METHOD

Following the format utilised in previous Safe by Design workshops a one-day workshop was held on 22 September 2016 in London, bringing together stakeholders from across the industry to consider the use of service lifts in the offshore environment.

After opening remarks from Kate Harvey, G+ General Manager, the workshop started with the first of two presentations.

The first presentation was on Vattenfall's Failure Mode Effects Analysis (FMEA) work with the Health and Safety Laboratory (HSL) on critical service lift components following the fatal incident which occurred in Germany. This provided details of the comprehensive FMEAs that were systematically conducted on the electrical circuit, wiring and control systems (FMEA 1) in addition to the mechanical systems (FMEA 2). It also gave an overview of the methodical steps undertaken in order to reinstate the service lifts at the Ormonde offshore wind farm back into use.

The second presentation focused on future technology developments in WTG service lifts. It also gave an insightful view of known issues causing safety concerns at various stages including, for example, installation, commissioning, maintenance, training and also safety features being defeated during service lift use.

Between the two presentations a coordination/communication on key G+ activity update following the fatal incident in Germany was delivered covering the timelines from September 2015 to date.

After the second presentation, the attendees were allocated into breakout groups.

There were a total of three facilitated breakout groups each tasked with looking at different aspects of WTG service lifts. The groups focused on;

1. Service lift design and specification.
2. Service lift operation and maintenance (including maintenance standards).
3. The human impact of climbing in the event of service lift unavailability.

At the end of the breakout sessions, each group presented their main findings and conclusions to all of the attendees in a plenary session and further discussions were held before concluding the workshop.

## 2.2 AGENDA

### **Workshop opening remarks**

*Kate Harvey*, G+ General Manager

### **Presentation 1 – Vattenfall FMEA work with the HSL**

*Sai-Man Li*, Health and Safety Specialist U.K. North – Offshore West, Vattenfall

### **Coordination/communication activity post Storkow accident**

*Andrew Sykes*, Technical Manager – Offshore Wind, Energy Institute

### **Presentation 2 – WTG Service Lift Manufacturer – Future Technology Development – WTG Lifts**

*Alan McKerns*, Head of Operations – Wind Division, Skyform

### **Exercise – workshop breakout sessions managed by facilitators**

**Group 1** – What standards are considered when specifying a lift type in a WTG? Is there a common industry design risk assessment format that exists/can be developed? (Facilitator: *Paul Taylor*, ORE Catapult)

**Group 2** – Does a performance standard exist for the lift types selected? Does it cover the life cycle of the turbine? Does a common industry checklist exist/be developed? (Facilitator: *Andy Lewin*, ORE Catapult)

**Group 3** – What are the human effects of climbing operations? How does physical and psychological fatigue affect work tasks? Can a standard risk assessment be developed for climbing offshore wind turbines? (Facilitator: *Fiona Earle*, University of Hull)

### **Plenary session – Presentation on key findings/outputs from breakout group discussions**

### **Closing remarks**

*Kate Harvey*, G+ General Manager

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## 2.3 ATTENDANCE

<b>Name</b>	<b>Company</b>
Steve Danson	Centrica
Daniel Robertson	Centrica
Kåre Søndergaard Møller	DONG Energy
Ashley Hedges	DONG Energy
Garry Bradford	EDF
Andrew Sykes	Energy Institute
Bir Virk	Energy Institute
Claire Smith	Energy Institute
François Bathellier	ENGIE
Louis Smith	Fred Olsen
Kate Harvey	G+
Beth Rawson	HSE
Matt Clay	HSL
Tim Sheehan	Innogy
Andy Lewin	ORE Catapult
Gordon Stewart	ORE Catapult
Owen Murphy	ORE Catapult
Paul Taylor	ORE Catapult
Dirk Miseur	Power Climber
Chris Streatfeild	Renewable UK
Paul Barton	ScottishPower Renewables
Javier Ibanez	ScottishPower Renewables
Jesus Blanco Juardo	ScottishPower Renewables
Rab McMillan	Siemens
Rune Therkelson	Siemens
Jonas Brauer	Siemens
Leif Rask	Siemens
Alan McKerns	Skyform
Conor Burns	SSE
Daniel McKinley	SSE
Aud Jorunn Skjørestad	Statkraft
Fiona Earle	University of Hull
Emma Platt-Lowe	University of Hull
Sai-Man Li	Vattenfall
Ray Smith	Vattenfall
Philip Merson	Windfarm Energy UK Limited

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## 2.4 BREAKOUT WORKSHOP DISCUSSIONS, RESULTS AND RECOMMENDATIONS

The notes presented in Annex A represent the discussions which occurred during the facilitated breakout sessions. They have not been edited post-workshop and as such capture the essence of the discussions which occurred.

The outputs from each of these groups included findings and recommendations for the G+ to consider and take forward as appropriate. These are summarised as follows:

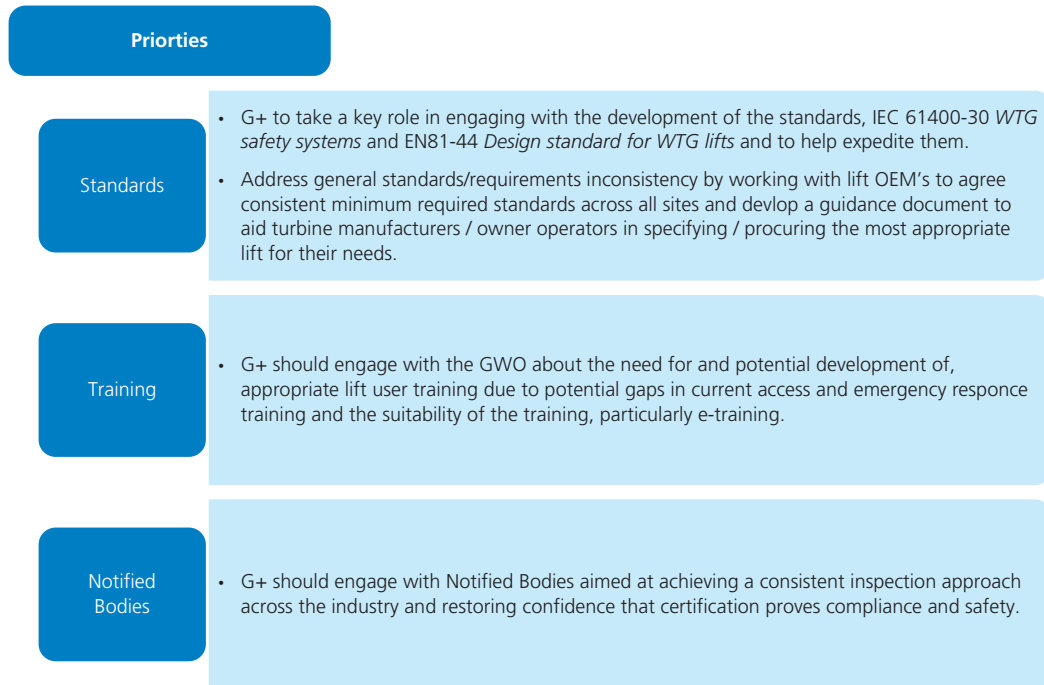
1. Establish a common format for Design Risk Assessments.
2. Develop a guidance document on key H&S considerations to assist G+ member procurement departments' decision making on the selection of WTG service lifts.
3. Investigate the potential for a workshop with Notified Bodies aimed at achieving a consistent inspection approach across the industry.
4. G+ should capitalise on its collective influence to engage with the relevant organisations in order to:
  - Expedite the development of the relevant technical standards (e.g. IEC 61400–30 *WTG safety systems* and EN 81-44 *Design standard for WTG lifts*).
  - Increase consistency from lift OEMs, for example by agreeing consistent minimum required safety standards across all offshore wind farm sites.
5. Research the benefits of sharing any safety-relevant information already in circulation within the Notified Body community Recommendation for Use (RfU) sheets<sup>1</sup>.
6. Leverage the knowledge, skills, experience and capability of technicians through e.g. a G+ member technician survey to rationalise and prioritise what is contained in pre-use checklists. Collate these from across the membership and consider a mechanism to improve/share any best practice from these.
7. Open a dialogue with the Global Wind Organisation (GWO) to review and determine the adequacy of current training available for service lift users, trainers and maintenance personnel. Subsequently, and if required, explore the need for, and potential development of, generic lift user training, to address potential gaps in current access and emergency response training.
8. Consider opportunities to address safety feature override or defeat by users.
9. Collect information from G+ members on current lift service schedules to share knowledge of current practice.
10. Address the causes of service lift unavailability and consider the merit/feasibility of installing a back-up solution should the primary service lift be unavailable.
11. Initiate an industry discussion on whether an agreed practice can be implemented for climbing e.g. the development of risk assessments/method statements for climbing activities that are differentiated for planned and unexpected lift unavailability.
12. Create a culture that values a robust, consistent approach to safe use, maintenance and reporting.
13. Reconsider the use of e-learning versus manual training for safe lift use.
14. Consider a review of the various industry standards for fall arrest systems, reflecting on any recent developments or potential to improve these through integrating best practice with training.

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<sup>1</sup> For further information see: [http://ec.europa.eu/growth/sectors/mechanical-engineering/machinery\\_en](http://ec.europa.eu/growth/sectors/mechanical-engineering/machinery_en)

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Given the number of recommendations, the most significant have been identified and prioritised in Figure 1.



**Figure 1: Priorities**

## 2.5 BREAKOUT GROUP EXECUTIVE SUMMARIES

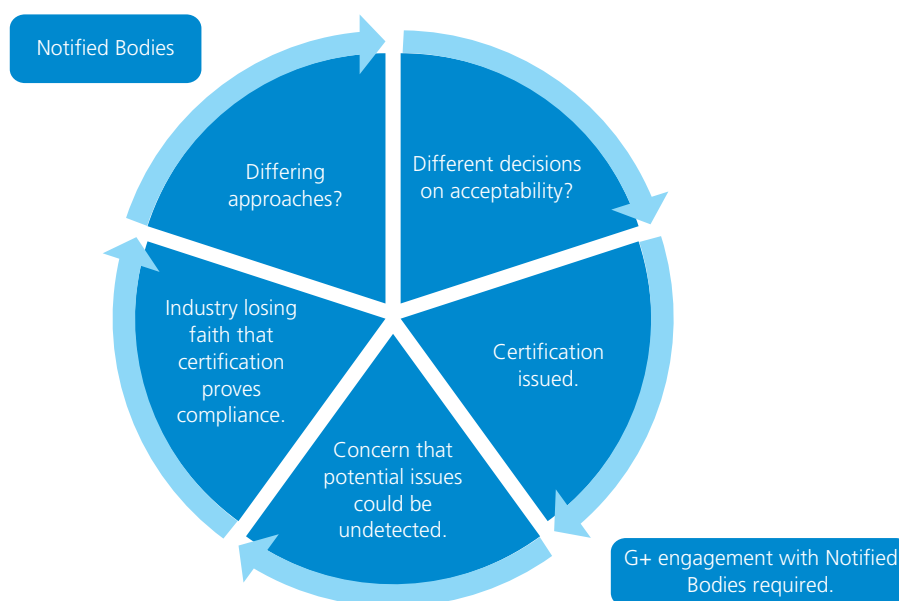
### 2.5.1 Group 1 – executive summary

This group identified that there is not a common industry design risk assessment format in use for service lifts in WTGs and that the sharing of the design risk information can be inhibited by Intellectual Property (IP) concerns. The G+ and its wider stakeholders are a large group and represent a considerable proportion of the offshore wind industry; as such they may be able to facilitate and drive the development of a common design risk assessment format and the best practice for sharing this information. Other significant areas of discussion/output from this breakout group are documented in this section.

#### *Notified Bodies:*

Particular observations were made around different Notified Bodies exhibiting different approaches to inspection decision making and ultimately different decisions being taken regarding Machinery Directive compliance. This is leading to a lack of confidence that it provides total compliance and thus minimum safety requirements.

The G+ should leverage its collective influence to address this difference, achieve commonality and bring greater confidence into the industry.



**Figure 2: Notified bodies**

#### *Focus on lifts:*

Over the past few years lessons learned have been fed back to the WTG OEMs and these are being incorporated into the design process for new WTGs. In the past, WTG OEMs were less focused on service lift considerations but now there's significant learning and collaboration between the WTG and service lift OEMs to improve lift design and safety performance. One challenge still present however is the time it takes for improvements to be realised and implemented due to the design life cycle for a WTG being typically five years.



***Key findings and insights:***

- Design risk assessments are not in a common format.
- Different methods are applied regarding the selection of WTG service lifts.
- Differing standards are being applied by Notified Bodies.
- There is no common approach to the training available for lift users, trainers and maintenance personnel.

**2.5.2 Group 2 – executive summary**

This breakout group highlighted that the standards landscape, or at least the development and improvement of standards relating to service lifts in wind turbines, is disparate and is not moving forward with much momentum. The G+ and its wider stakeholders are a large group and represent a considerable proportion of the offshore wind industry, and as such they should be able to exert some influence to accelerate the development and delivery of up to date standards.

*The behaviour of lift system suppliers:*

Particular observations were made around a suppliers' responsibility for subsystems supplied by other companies and the nature of information sharing on these systems. The G+ should leverage its collective influence to improve the level of information sharing. Establishing a consistent set of minimum standards across all offshore wind farms has the potential to bring the quality and performance of all suppliers up to those that are currently considered to represent best practice. This should include ensuring that product updates, revised documentation or other recommendations are always being fed from the system integrator through to the end user.

*Training of lift users:*

At present there is not a consensus about what constitutes appropriate training for lift users. There may be an opportunity to engage with relevant training standards organisations (such as GWO) to explore the potential benefits of defining a consistent and generic lift user training. Related to this, some sites are also providing enhanced training of some technicians sufficient to enable basic repair (component exchange) and inspection of lifts. This approach may help to reduce the amount of visits offshore associated with service lift O&M.

*Behaviours, standards and the pre-use checking of lifts:*

Concern was raised regarding the training of technicians and the individual requirements of different lift systems. There is an opportunity to drive improvement by empowering technicians and leveraging their knowledge and expertise, specifically by rationalising pre-use checklists, to ensure safe operation through consistent application.

*Future designs:*

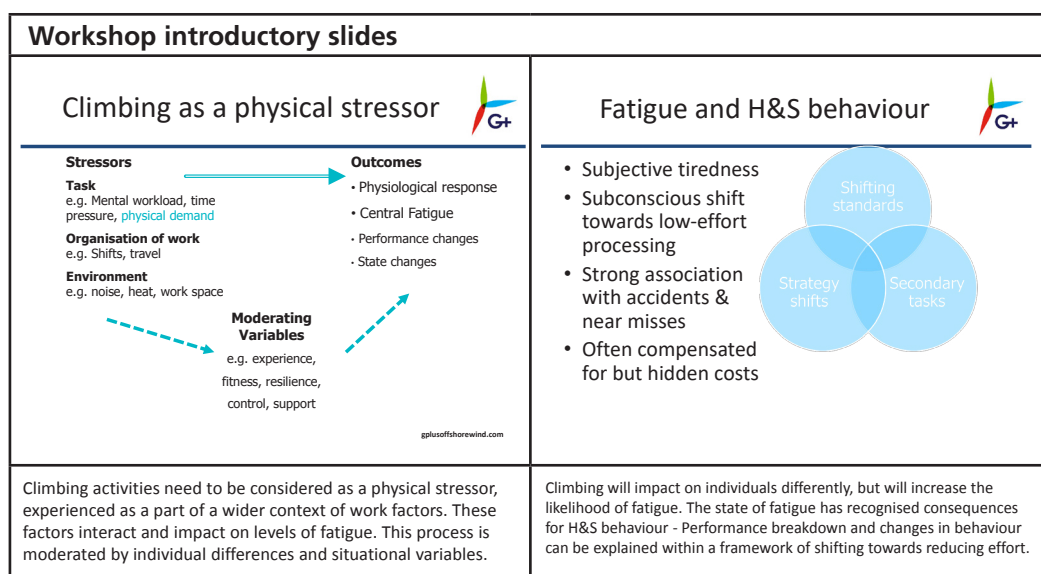
Future designs could potentially be improved by including features such as monitoring systems, interlocks or safety features which are more robust and more difficult to disable. Such features would be instrumental in helping to reduce service activity whilst maintaining a high standard of safety, which will also reduce operational expenditure.

**Key findings and insights:**

- It is considered fundamental to move towards adoption and use of a comprehensive technical standard i.e. EN 81-44, which encompasses design, integration, operation and repair or replacement of service lifts and associated subsystems.
- Presently technicians generally have only a basic training in lift use. There is an opportunity to increase the understanding within site teams by providing training in inspection and repair as well. This could increase appreciation of the importance of lift safety, improve maintenance efficiency and reduce the number of offshore visits.
- Ownership of subsystems within lift OEMs and poor information sharing was raised as a concern. There is significant room for improvement in communicating revised manuals, procedures and/or other key information to the lift end users.
- An opportunity exists for greater remote monitoring and supervision of lift use and asset condition. This could be used to define an appropriate maintenance strategy, with the objective being fewer visits offshore and also to influence and improve lift user behaviour.

**2.5.3 Group 3 – executive summary**

The human impact of climbing activities resulting from lift unavailability was addressed by this breakout group. Areas of discussion focused on understanding the different circumstances leading to lift unavailability and their distinct consequences for fatigue and risk, represented in Figure 3.



**Figure 3: Climbing, fatigue and H&S behaviour**

*Service lift availability:*

Service lifts were considered to be typically available. However, there are a number of reasons why a particular lift may be unavailable, and, in some cases, these circumstances were considered to be avoidable. As the impact of climbing was considered to be significant, there is scope to reduce the risks associated with climbing by addressing avoidable lift unavailability. Areas to consider include: improved communication of fault status, improved management of lift inspection processes, and potential installation of lift back-up systems.

*Impact of climbing activities:*

Climbing activities were considered to impact on health, safety, safety behaviour and morale. Direct health effects include musculoskeletal strain and physical tiredness. Industry standards for fall arrest systems were one of the suggested areas for potential risk reduction in climbing. The indirect effects of climbing are more complex – the impact of fatigue on the full range of activities which follow should be considered when establishing organisational principles for limiting climbing activities.

*Approaches to climbing practices:*

Significant organisational differences were reported in approaches to climbing practices. Current recommendations ranged from only *one climb per day* to *no imposed limit*. Most commonly the decision to climb is currently at the discretion of the technician. However, health and safety concerns were raised about this approach, as technicians may consider themselves able to climb, but may be less able to evaluate the broader risks associated with the impact of climbing on the activities following. Working towards an industry standard for climbing practices may contribute towards enhanced safety across the full work package.

*Risk assessment:*

The practicality of an industry-standard risk assessment for climbing activities was discussed. Although this was considered to be a challenging task, it was generally agreed that any risk assessment should incorporate the fatigue-related risks to activities which follow climbing, as well as distinguishing between planned and unexpected lift unavailability.

**Key findings and insights:**

- The likelihood of lift unavailability is relatively low; however, where it occurs, impact is high, and can be chronic (e.g. prohibition).
- Large variability between organisational approaches to climbing limits.
- Exploration of risks within the causal risk chain (the impact of one activity on the activities that follow) is required. Risks are different for the climb up and down.
- Concerns about the suitability of an e-learning approach to training.

## ANNEX A

### WORKSHOP DISCUSSION NOTES AND PRESENTATIONS

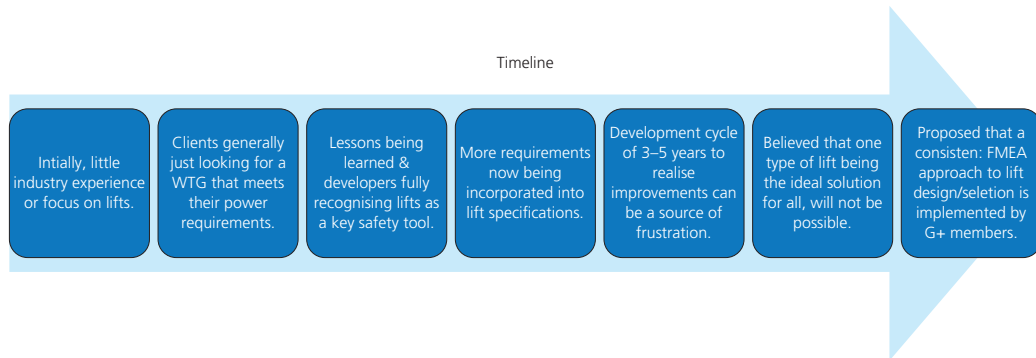
#### A.1 DISCUSSION NOTES

##### Group 1 (Facilitator: *Paul Taylor, ORE Catapult*)

##### **Objective 1: To determine if there is a common and consistent approach to specifying a lift type?**

- Some of the group felt that there is the perception of a 'seller's market.' The lifts fitted to different turbine models are decided by the OEMs and are based on the most appropriate lift for that turbine model. At the design or purchasing stage there is not enough consideration given to the type of lift by any of the stakeholders but if the developer/operator does decide it's unsuitable, they will replace the lift retrospectively if possible.
- Initially in the industry there was little experience of lifts, developers were just looking for a final solution i.e. a WTG that meets their power output requirements. Things have progressed and for example, it's now a component in one OEM's procurement strategy although if a repeat order, it's likely it will just be as supplied previously.
- In the past, WTG OEMs just received what they were provided but now there's lots of learning and collaboration with the WTG and service lift OEMs to improve lift performance and safety.
- The type of turbine tower has a large impact on the type of lift i.e. what can be fitted into the space available. However developers are now starting seeing lifts as a key safety tool and putting more requirements into the specification.
- It was also noted that although a lot more consideration is given now around the lift type it is likely that the type of lift supplied is not going to stop the procurement of the turbine.
- A guidance document on key H&S considerations to help G+ member procurement departments identify things to consider when choosing a lift and the right questions to ask at the right time, would be useful.
- A challenge expressed within the group was the development time for new lift designs- the lift development cycle is on average three to five years and the time taken to realise changes and improvements can therefore be a slow process.
- In order to help make these decisions about the type of lift, a WTG service lift design standard would be very useful; whilst acknowledging that EN 81–44 would meet this purpose, it was acknowledged this would not be in the near term.
- It was proposed that an FMEA approach to lift design/selection could be taken but again this would take time and a concerted effort would need to be introduced to new lift variants.
- It was identified during the session that there is a difference in terminology used, with some stakeholders referring to lifts as hoists. This is largely based on the design and function of the equipment as it operates as a hoist although it is now becoming more 'lift' like and now more commonly referred to as a lift.

- A discussion around the type of lift that would be ideal concluded that one type of lift being the ideal solution for all wind farm operators will not be possible.
- The concluding remarks in this section of the discussion were that the wind farm developer doesn't stipulate the type of lift, it's what comes with the turbine but sometimes there's a choice and therefore associated cost considerations.



**Figure A.1: Lessons learned – determining the requirements and specifications and the final decision on the lift type**

#### **Legal guidance requirement, manufacturing/operational standards and best practice**

- The group were concerned that by the time standards such as EN 81–44 are released, changes in design and technology may result in them not being fully relevant.
- At this moment in time compliance with the Machinery Directive is taking precedence over compliance with EN 1808 *Safety requirements for suspended access equipment. Design calculations, stability criteria, construction. Examinations and tests* as the hoist is no longer considered a 'moving platform' but becoming more like a traditional 'passenger lift'.
- It is believed that the industry recognises the Machinery Directive is what is used for satisfying regulatory requirements, and that it points to other standards as required and where appropriate.
- To demonstrate full compliance companies need to ensure they comply with the Machinery Directive. Stakeholders should ensure competent suppliers are contracted and they should obtain the necessary certification and inspection documents whilst also complying with the relevant national and European regulations.
- The thoughts of the group were that every turbine with tower heights over 80 m should have a lift installed.
- With the lack of detailed knowledge on lifts across the industry there is a question of how will end users get the evidence that all regulations have been met?
- The point was made to the group by one of the members that following installation the developers will receive the appropriate certification but will need to confirm that everything that's required has been received and demonstrates conformance.
- The Machinery Directive also allows flexibility to make choices based on a risk assessment approach. This allows for interpretation and subsequently can result in designs being compliant.

- There may need to be a choice as to the type of lift required, dependent on its use e.g. how many personnel is it required to carry and how often it will be used?
- There was a strong view that a responsible supplier should provide a product that conforms to all necessary regulations and a responsible company should provide a safe place of work.
- Lifts may be designed for low frequency use but in practice are actually being used almost every day, and this is effectively a change of use and may be outside the stated design criteria.
- It was the opinion of some of the group that there is no gap in design standards, issues arise mostly due to a developers' expectations of these requirements.
- The group as a whole agreed that the WTG OEMs have learned lessons now on safety and have much more focus on lifts, as do all the stakeholders.
- As the market has grown, there has been a trend towards suppliers requesting wind industry bespoke lifts.
- The specification for the lift can be lacking in detail. These specifications should be very clear and include items such as e.g. two to three persons travelling simultaneously, 80 m vertical travel, frequency of use, etc. These specifications should then be put out to tender to competent lift suppliers.
- One member of the group reported that lifts can be used on two/three days in a month, and also several times on those days. Often this is more than was thought at the time lifts were designed.
- Some countries require statutory inspection of lifts every 12 months whilst others are every six months.
- In the UK, the statutory six-month inspection for general passenger lifts is extended to every 12 months for WTG service lifts due to their low volume of use through risk based assessment/ justification.

**Objective 2: Is there a common industry design risk assessment format that exists/can be developed?**

**Design risk assessments**

- In general, suppliers are not providing the full service lift risk assessment information, they are only sharing residual risk information.
- The group expressed concerns about intellectual property and this can cause issues when wanting to share risk information.
- Following the fatal incident in Germany there has been a shift in the approach to sharing risk information. WTG OEMs are more willing to talk customers through the design risk management process and share the subsequent design risk information in a face-to-face meeting.
- OEMs need to satisfy themselves that the design decisions that affect safety taken by the lift OEMs were the correct decisions, and as highlighted previously where the information is not easy to come by, this can cause problems.
- Not all Notified Bodies are equally competent and there are concerns that they don't all detect potential issues. This was also highlighted previously regarding differences observed/experienced between different Notified Bodies.
- Some members of the group stated that faith has been lost that Notified Body certification demonstrates total compliance and a safe product.

- The group felt that different Notified Bodies are exhibiting different approaches/decisions on what's acceptable or not and that instead they should be more aligned. It was suggested these Notified Bodies could come together to agree a standardised approach to decision making.
- It was felt that it would be beneficial to develop a standardised way of displaying risk information that is also acceptable to the regulators. It would be useful to build the requirement for providing/obtaining the necessary risk information from the appropriate parties into contracts.
- There are Non Disclosure Agreements (NDAs) in place between lift suppliers and some WTG OEMs but not with others which makes the sharing of information more challenging.

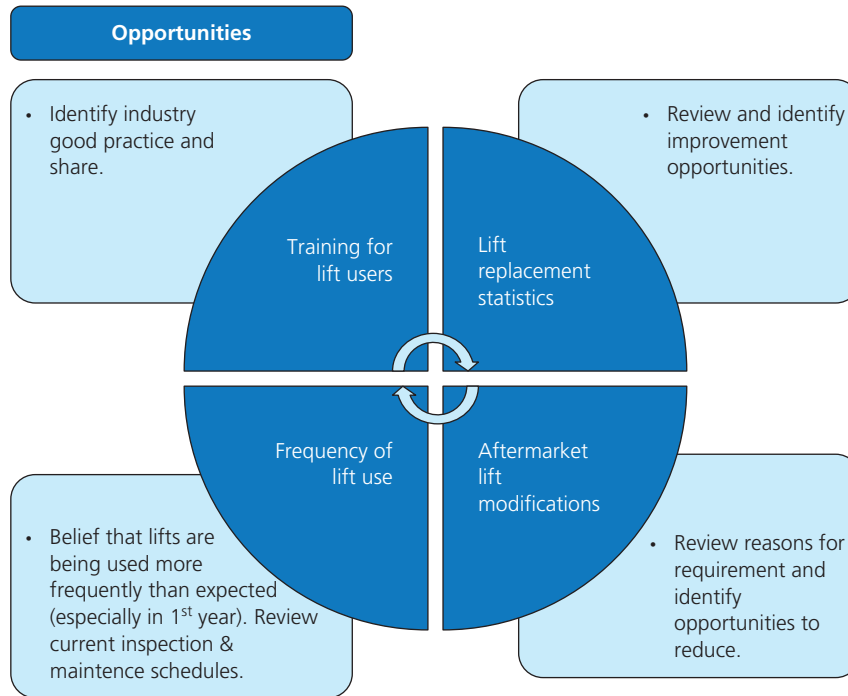
### **Risk management methodologies**

- It was clear from the discussions that different risk management methods are used by different companies across the industry.
- Members of the group voiced their preference for not having too prescriptive an approach on risk management. The output is the most important aspect of risk management: how it's derived is up to the individual company.
- Members of the group stated that they would like to see greater transparency in this area and this needs to be improved.
- There were concerns raised during the discussions that too much available risk information could lead to a loss of competitive advantage.
- WTG OEMs are keen to host wind farm operators and share information on site, face-to-face, but not deliver a large document as part of their operational manuals.
- An Owner Operator is using a document called a 'Design Decision Log' which is a high level record of decisions. This can be viewed by interested parties but only in face-to-face meetings.
- Members of the group stated that their responsibility is to have a safe product when it is released to market e.g. with a CE mark and ensure the wind farm developers are confident in the system.
- An overwhelming message from all those involved in the discussion was that it is vital that all stakeholders work together to resolve issues for mutual benefit.

### **Standardisation and continual improvement (see also Figure A.2)**

- Service lifts are designed to meet WTG OEM requirements but sometimes they haven't considered everything and this results in aftermarket modifications. These should be avoided where possible or kept to a minimum due to the significant resources required to implement these.
- The group was informed that the Health & Safety Executive (HSE) have looked into lift replacement statistics. Results have shown that there is variation in the types of lifts being replaced, with some types being replaced more frequently than others. There was an opinion that it would be beneficial to look at the lifts that are being replaced less frequently and learn/identify opportunities for the industry.
- It was highlighted that lifts are used more frequently in the first year of the wind farm operations. It was subsequently put to the group whether this could be considered in the schedule of inspection and maintenance for the wind farm?
- The group also raised the concern that the approach to the training available for lift users, trainers and maintenance personnel differs across the industry and may not be

to the level required. It is believed that there are pockets of good practice but these have not been fully identified and shared.







**Figure A.2: Opportunities**



## Group 2 (Facilitator: *Andy Lewin*, ORE Catapult)

### Objective 1: Does a performance standard exist for the lift types selected?

Existing types of lifts and suppliers 	Standards landscape 
 <ul style="list-style-type: none"> <li>• Rope guided</li> <li>• Ladder guided</li> <li>• Sliding door</li> <li>• Hinged door</li> <li>• Roller door</li> <li>• Climb assist</li> </ul> 	<ul style="list-style-type: none"> <li>• <b>BS EN 81-X</b> Safety rules for the construction and installation of lifts</li> <li>• <b>BS 5655-X</b></li> <li>• <b>BS EN 61400</b></li> <li>• <b>BS 8486-1:2007+A1:2011</b> Examination and test of new lifts before putting into service</li> <li>• <b>EU directive 2014/33/EU</b></li> <li>• Health and Safety Executive: <ul style="list-style-type: none"> <li>– Lifting Operations and Lifting Equipment Regulations 1998 (<b>LOLER</b>)</li> <li>– Thorough examination and testing of lifts</li> <li>– Provision and Use of Work Equipment Regulations 1998 (<b>PUWER</b>)</li> </ul> </li> <li>• Insurance requirements? Certification body guidance? Others?</li> </ul>

**Figure A.3: Lifts and standards**

#### International context

- There should be a recognition that WTG OEMs and lift OEMs will be influenced and feel a push/pull of requirements varying across geographies, e.g. in the USA regulations are different.
- A specific example was given: in the UK the Lifting Operations and Lifting Equipment Regulations (LOLER) requires a six-month inspection of man-riding equipment, in Germany the equivalent is 12 months and in other regions can be as frequent as three months.
- There is a new EN standard being worked on but it is anticipated to take two years before it is released.
- Could there be an industry standard TSA Clause, set of clauses or similar which would drive consistency in what lift OEMs are being asked for?
- As part of a procurement process it may reasonably be assumed that engineering/design risk assessments have been reviewed/proven to have been evidenced as part of developer/operator processes; in reality it could be the case that the team who will end up with responsibility for operating the system have limited visibility or oversight of the selection and specification of the equipment they will eventually end up owning/operating. Detail in risk assessment at this stage may represent an opportunity for improvement.
- How does CE marking apply to subcomponents and assemblies? Are there EU or other regulations which apply but are being ignored?

#### Information sharing and collaboration

- Lift systems are designed/assembled of components and sub-assemblies, then installed across a variety of turbine types, heights, and applications. There may at times be incomplete understanding of the intricacies or differences between different applications of the same system.
- The developer/operator could/should take more responsibility for FMEA/HAZOP activity; they could ask more frequently to review/be involved with these at the design stage. Or perhaps they could be more proactive in seeking to understand the asset. All blame may not lie with the WTG or lift OEMs, as the developer/operator should/could also be more alert to these issues. Lack of a standard to drive consistency

could mean that risk assessment and technical specifications could actually be more onerous than necessary as well as posing the risk of missing some key maintenance considerations on some projects.

- Information sharing, particularly in the service and maintenance community was something which group members thought could be improved, although accepting that for service providers part of this may represent competitive advantage. For example, if in other industries new guidance is issued, parts recalled or some other important new information produced then manufacturers actively push updates to all known developers and the wider community. Some members of the group stated that information is generally provided when a lift OEM is approached, but that there is scope for something more proactive in information sharing, particularly around maintenance advice/bulletins.
- The most recent ITT from a WTG OEM for lift suppliers provides information on next generation of lifts and is understood to be more prescriptive than what has been issued previously. Generally it seeks to give more specific instructions, give more detail and put more responsibility on the supplier of lift systems. This may lead to a significant step up in the quality and behaviour of the suppliers of lifts and subsystems as this is a definition for a significant proportion of the market.

### **Design for maintenance**

- All issues could potentially be mitigated by adding additional layers of redundancy. A simple reaction could be to add additional components, but this also has maintenance/inspection implications.
- A dilemma for a lift system OEM is that they must provide guidance to the operator/purchaser on what parts should be inspected/replaced after a certain period of time/amount of use but they have to build this up from advice they receive from subcomponent manufacturers. For example, if inspection is recommended after 10 000 cycles, how does a lift OEM know what the typical (or extreme) use cases of the system will be? For safety-critical inspections there is effort put into this to try and get the schedule correct, but not for all parts.
- There was a consensus that the G+ should in some way get linked into the various technical standards being developed relating to the area of lift specification and lift maintenance. Could standards be used more robustly to require a lift OEM to define what maintenance requirements are?
- A discussion proposed that a 'Recommendation for Use'<sup>2</sup> document be used more by the industry. Although this is not a standard, it is a potential source of useful information or guidance and does provide key points to consider. It may be useful to ensure that G+ members are linked up with this potentially valuable source of information in the interim.
- EN 1808 was recommended as a standard which contains a lot of useful information on lifts.
- Statement made that information on lifts/hoists from standards related to onshore, factory type environments should still be applicable offshore.

### **Statutory inspections**

- A comment was made that statutory inspections can vary in quality/results whilst still being deemed compliant with regulations. This suggests varying levels of thoroughness (some inspectors may go above and beyond statutory requirements?) but in fact it

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<sup>2</sup> Coordination of Notified Bodies. Machinery Directive 2006/42/EC + Amendment: Recommendation for use. Reference number CNB/M/09.318 revision 00.

also gives the operator a challenge in seeing inconsistency – how do they know an inspection is as good if it is reported differently by different inspection contractors?

- A statutory inspection cannot, by definition, require the dismantling of any parts; it should be possible to be sufficiently thorough with a visual inspection only: does this have any design implications?

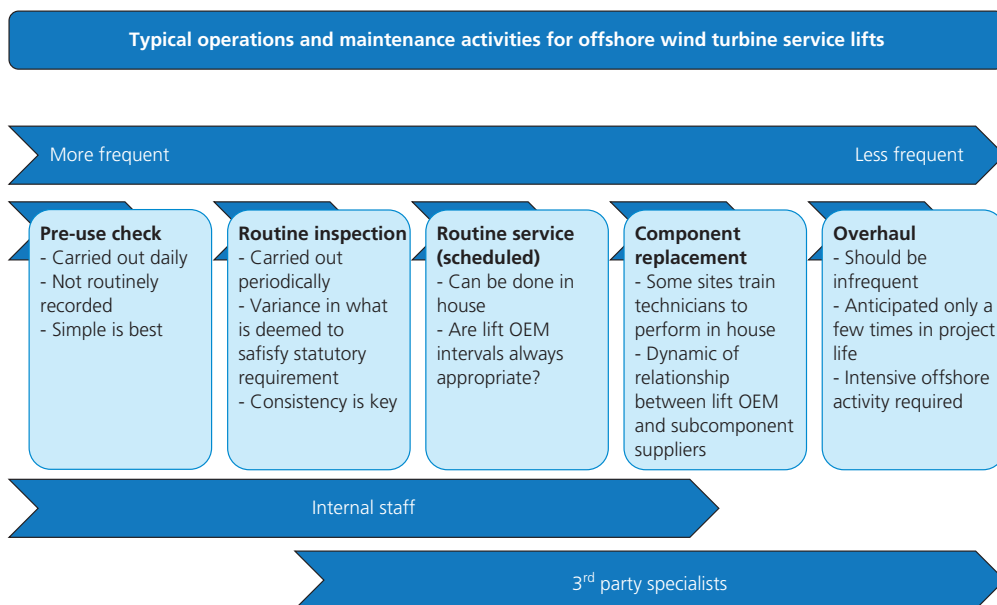
**Operations and maintenance (see also Figure A.4)**

- There were varying experiences in the group of what maintenance guidance and procedures are provided even within a single lift OEM.
- Some lifts currently have analogue counters or similar means to record the amount of operation. An average of seven to eight hours use per year was anecdotally offered and appeared consistent with the level of use seen by others. The maintenance area is particularly challenged for offshore lifts by the variability or infrequency of use.
- Lift and safety system use in the construction phase is much more intensive and potentially damaging.

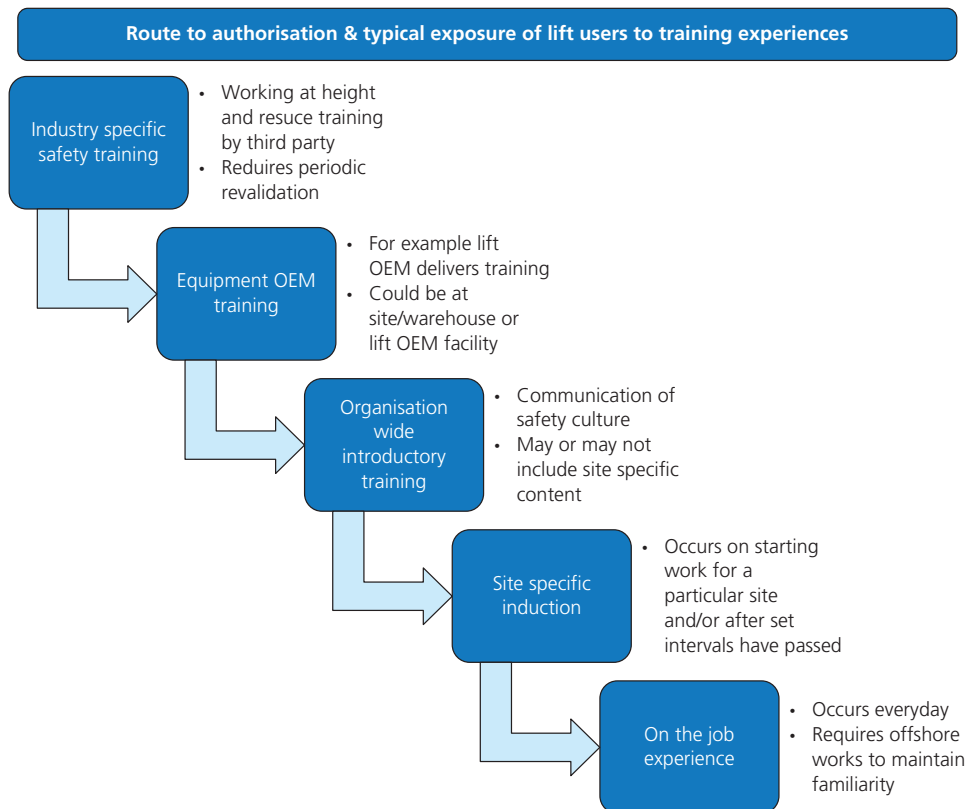
**Definition of minimum requirements**

- If the G+ can agree that they will all have some key basic requirements of lift system suppliers which are consistent then they may achieve some of the benefits of standardisation earlier. For example, if all users make similar requests to lift OEM for basic service schedules, document updates or training then it would be easier to push suppliers to provide a consistent and quality product/service to all users. The G+ could exercise its influence for collective benefit. The sharing of knowledge amongst the G+ members (for example a survey on current lift service schedules) could help to drive consistency through sharing of current practice.

**Objective 2: Does it cover the life cycle of the turbine?**



**Figure A.4: O&M activities**



**Figure A.5: Training**

**Training (see also Figure A.5)**

- Lift user training at present is likely to come with a validity of two years and may require a refresher if no hands-on lift use is provided in any three to six month period.
- Some operators have experienced technicians who had not operated a lift recently, having difficulty remembering how to use it correctly.
- It may be difficult to maintain offshore practical experience at all times.
- There has been a drive by many towards video or online lift training course delivery. The group questioned the suitability of video learning (online training) for such a manual/practical activity.
- The opinion in the group supported the view that there are likely sufficient commonalities in the types of equipment and systems in lifts to see some value in a cross-industry basic lift user training course, through an organisation such as GWO. Considering that work at heights and rescue training is a common requirement and does provide value even though it covers a wide variety of turbine architectures, fall arrest and emergency descender technologies.
- Another example which was suggested and may be in use on some sites already is having some team members equipped to provide training, for example being trained trainers who can give a more comprehensive and site-specific introduction to the use of lifts to transient technicians or new team members.

### **Pre-use checks**

- There is typically no record of pre-use checks and no supervision of them being carried out.
- One site added a simple to follow visual aid to their lifts to remind users of their training at a glance when in the lift.
- One operator discussed the management and recording of offshore work on tablets, and agreed there was good potential to include daily pre-use safety checks into this type of works management system.
- Pre-use checks should be as brief as possible in order to encourage use, a long winded pre-use check dilutes the function. They should not (but do in many cases at present) require the users to dismantle, inspect then reassemble some subsystems, including emergency systems. Long-term it would be desirable to make these quicker/less onerous and consequently give more confidence that they were always being carried out.
- A response to issues around lift safety issues has been to deliver extremely detailed and overly thorough pre-use checks.
- It is important to get users (technicians) really involved/engaged with lift safety. An example was given that not all technicians knew that increased pre-use checks were in response to incidents (including a fatality). There was an expectation that if more of this type of information was shared more proactively then the technicians would have increased appreciation for the potential of this type of hazard and risk.
- Asking for technician input on what makes a good or bad pre-use check or checklist could help to improve and build behaviours. Technicians may be more likely to carry them out if they have been empowered to contribute to writing them.

### **Inspection**

- Currently separate visits are required to repair and to inspect lifts in accordance with statutory requirements. It was agreed that these could potentially be done by one team (two people during a visit); however, this requires appropriate training and record keeping.
- When considering the commissioning phase, the level and weight of use is comparably very light in the operation and maintenance phase; do inspections change?

### **Maintenance**

- In-house site maintenance requires annual recertification of technicians, so while avoiding sending specialist/lift OEM contractors offshore, bringing the maintenance in-house by training their own teams can still be expensive/resource intensive for developer/operators.
- A view was expressed that it would be good for qualified and experienced maintenance technicians and engineers, who are responsible for maintaining the whole plant, to have some level of trust to be able to make a (robustly justified) call on planning reduced maintenance in circumstances where lifts see little use.
- Accepting that unplanned maintenance will at times be required (but is difficult to predict) there was some discussion about whether it was possible to reduce offshore work on lift systems by combining inspection and maintenance work. At present it was described that these are at times (typically when in warranty) combined into single campaigns by turbine OEMs, but that at other times, (typically once out of warranty) still conducted separately by operators.

#### **Data on lift use and condition**

- SCADA integration or some online recording of data relating to the lift system could be used to justify a risk based approach to reduced inspection when in lighter use.
- In an ideal world an operator would like to conduct only statutory inspections and planned maintenance.
- Those with hands-on experience felt that prescriptive behavioural controls should only be used where absolutely necessary – for example on equipment critical to safety or systems. Overly restrictive systems can tend to drive undesirable behaviours and/or culture and lack of trust.

#### **Development of site procedures**

- There is a need for operators to proactively go and seek out views, experience and feedback from their site teams e.g. via a G+ member technician survey.

### **Objective 3: Looking to the future, how could this area of the industry be developed?**

#### **Lift design**

- The design of lifts could easily be improved in order to make defeats of safety systems more difficult (and hence less likely). A key release based system was suggested as being robust and difficult to defeat.
- A statement was made that the HSE has intervened in the past when concerns were raised about service lifts and the design of service lifts. For example, clear expectations were set around the design of safety gates and other common practices. This did not become a standard but was circulated to raise awareness.

#### **Culture and behaviours**

- The consensus in the group was that greater misuse of lifts (and safety systems) is more likely during the high intensity installation and commissioning phase. This may be due to e.g. time pressures, work cultures and the level and quality of supervision.
- A discussion of this topic brought out a related theme that it is generally challenging to be an excellent supervisor/people manager in an offshore wind function. It is a physically involving role, and requires isolated work in relatively small teams. It is often inherent that whilst being named as the supervisor or lead for a certain task a technician will justifiably end up working as part of the team and may not get time/space/environment to be able to step back and take a more managerial/supervisory role. This seemed to be an important consideration, particularly for those seeking to set standards and design systems who are not familiar with the working practices and day to day environment of working in offshore wind.
- There are some basic sensors for safety systems at present in most designs (e.g. for overload protection); however, these can be overridden, with evidence that this happens when running with defeated safety cut-outs is considerably more convenient.
- Tamper-proof seals, other similar design features and/or potential design changes that are easy to implement are also a possible simple route to an improvement, but ultimately any improvement in behaviours needs to be brought about by cultures and ethos in a workplace.

- A discussion took place around the variance of whether automatic or call mode from top to bottom is available and/or whether users are authorised to use it. Perhaps if travelling technicians saw consistent rules on all sites it would be easier to enforce a certain practice.

### **Monitoring systems**

- The theory of using telemetry, measurement or modern telecommunications technology to monitor the use of lifts was discussed.
- A greater degree of monitoring/intelligence/telematics is possible but any application should be considered carefully. For example it is important to consider the effect of such monitoring on the attitude of technicians.

### **Inspection**

- There is ongoing discussion and consultation about the nature and frequency of inspections.
- Any changes to inspection regimes would have to be backed by a robust risk assessment and written scheme of examination.

### **Innovation**

- A potential technology innovation may be in using descent energy to charge battery/capacitors such that in the event of power failure lift systems can remain in use to complement new or existing manual descent functions. Some new lifts are expected to have revised or improved manual descent/emergency options included in their design.
- There may be situations where climb assist devices could be justified, but it is difficult to risk assess and justify the provision of climb assists as the primary access system.
- In future, perhaps driven by taller turbine towers, operators could see two systems installed to have redundancy in powered access systems.
- The retrofitting of climb assist devices either temporarily or permanently may also introduce additional or previously non-existent risks, these or other access systems need to be justified and clearly demonstrate an acceptable level of risk when in combination with all the parameters of the environment in which they are installed.

**Group 3 (Facilitator: *Fiona Earle, University of Hull*)****Understanding the fatigue-related risks associated with WTG lift failure****Problems associated with climbing**

- The impact of climbing activities on health, safety and well-being is considered to be significant and effects can be direct or indirect.
- Direct effects include immediate and delayed musculoskeletal strain. Issues have included several older technicians suffering from knee muscle strain and pain and these effects have been reported on incident/injury forms.
- Importantly, it was noted that a RenewableUK peer review<sup>3</sup> on the link between climbing and injury 'drew a blank'. No causative link particular to ladder climbing was found. This drew on generic evidence rather than that specific to the offshore wind industry. It was suggested that there potentially needs to be a longitudinal study which examines the impact in onshore/offshore wind environments.
- Anecdotal reports of physical tiredness are commonplace and also direct H&S risks associated with working at height.
- Indirect effects are more complex and it is necessary to consider the risks to activities following climbing (captured in more detail in subsequent discussions).
- Where climbing/lift unavailability is chronic, technician team morale has been affected.
- There was broad agreement within the group that it is important to consider the differing physical impacts and risks associated with ascent and descent.
- Due to a prohibition at one site, technicians have been climbing ladders for five months. This equates to a 135 m climb, (c.390 steps), including the transition piece. This climb comes at the end of up to 90 minutes' transfer time from shore.
- The impact of climbing is significantly affected by overall fitness, although the importance of particular muscle groups should not be underestimated when considering control measures, systems and processes.
- The issue of deterioration of physical fitness amongst technicians during winter months was raised. It was felt that a requirement to undertake an hour per day's fitness training (during stand down periods e.g. weather days) as part of the contract of employment, could potentially mitigate this.
- The G+ *Good Practice Guideline: Working at height in the offshore wind Industry* contains useful information and guidance on climbing.
- It was noted that the impact of climbing will always be an H&S issue at some level at an offshore wind farm, as there is always a climb up the transition piece (c.25 m).

**Lift availability**

- The consensus in the group is that lifts are 'usually available'; however, where unavailability occurs it can have a dramatic impact upon work packages, and its effects can be chronic both for physical health and morale.
- Theoretically, lifts should only be unavailable if the power trips on a turbine. In practice, the most common reason for unavailability is the deliberate electrical isolation of the

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3 Health Effects Associated with Working in the Wind Power Generation Industry: A Systematic Review



- turbine. This is often done when a turbine is being worked on, even where the task being carried out is unrelated to power supply.
- Prohibition is another obvious cause of lift unavailability, and where this occurs the impact is significant.
  - Another common reason for unavailability is the lift being overdue for its statutory inspection. The technicians should be informed of this in advance, but in reality they are often not, meaning either a climb or a second transfer to another turbine.
  - It was noted that in the near future, the industry generally expects the level of lift availability to improve significantly.

#### **Unexpected lift activity**

- It was agreed that if in the wrong position, most technicians would simply move the lift up or down or conduct manufacturer approved resets (e-stops, trip plate reset, etc.) themselves. This isn't really seen as an issue by the group, as pre-use checks were considered to 'cover' any risk.
- Technicians tend to use the 'sound' of the lift as an indicator of any potential failure.
- Training should ensure technicians understand the range of indicators of potential lift failure and be clear about the protocol for dealing with the different faults.

#### **Dealing with the risks of climbing (measures)**

- There are significant organisational differences in approaches to climbing.
  - Most commonly, the onus is placed upon technicians themselves to flag up when they do not feel able to climb. However, this approach raises two important points:
    - Fatigue and associated human factors risks i.e. technicians may consider themselves able to climb but may not make an informed decision about the impact of the climbing on the subsequent activities.
    - Cultural issues about the consequences of raising a concern in a generally male, physical environment.
  - During a prolonged prohibition, one group member reported a well-defined strategy to minimise the impact of climbing operations. This included the following:
    - Technicians are only recommended to make one climb per day (although individuals do have the option to override this).
    - Therefore sometimes that means they can't even get started on the task, as they use their first (and only permitted) climb on getting the tools/equipment to the right place and must then get back on the CTV and finish their working day.
    - Shift patterns have been adapted to seven days on, seven days off.
    - Musculoskeletal briefs have been put in place for technicians, e.g. stretches five minutes prior to climbing.
  - Other measures in place include:
    - Standard provision of fall protection equipment to reduce fall risks.
    - Climb assist equipment available to reduce strain and fatigue.
    - Temporary reduction in maintenance to the turbine to the 'bare minimum'; it was noted that this can only be a temporary strategy.
    - Technicians are only allowed to do three x 80–90 m return climbs per day.
    - When facing unexpected lift failure one supervisor explained that they would always advise a technician to move onto the next turbine. However, it was
-

pointed out that the benefit of this approach needs to be carefully balanced, given the need for another CTV transfer and the climb up the transition piece.

### **Improving current measures/practices**

- Rules around climbing should differentiate the different circumstances of lift unavailability and wider work package. Each situation requires different control measures/recommendations, i.e:
    - In the case of unexpected lift unavailability, technicians would benefit from clear decision support/recommendations.
    - In the case of prohibition, need to consider guidance around the number of climbs (considering balance of risks associated with all alternatives).
    - The nature of the task, familiarity, complexity and its position in the shift day/week are factors to consider.
  - E-learning as a training tool was discussed at length. It was a broadly held view that e-learning should NOT be used for training on lift use/safety and that this should be exclusively manual. The idea of a 'lift-rig' at each O&M site to facilitate this hands on practical learning was suggested.
  - The practice of test retake was challenged as it was considered to support a culture of 'box ticking'.
  - It was felt that there should be a standard specification for industry training on lift use, ideally through an organisation like GWO. This could have additional developer/operator 'bolt-ons' as required for their sites.
  - Generally, the culture of the developers/operators needs to support safe planning and adjustment of work routines in the face of lift unavailability. This concept (and required actions) is difficult to pin down, but felt to be of key importance.
  - Could the ability of technicians to raise an objection (i.e. flag their inability to climb that day), and/or the supervisor's responsibility to query this at the start of shift, be made a formal part of an industry climbing standard?
  - Could a standardised risk assessment on climbing assess physical factors other than general fitness, such as including weight, height and build? For example, a taller person places significantly more strain on their hips when descending the ladder due to the need to brace (push out) the arms. Could a differentiated assessment of risk based on height, weight, build, be developed?
  - Could fall arrest systems across turbines/offshore wind farms be standardised for newly-constructed turbines? There was discussion of the issues around the commercial problems this might raise. However, it was thought that a common, standardised standard/specification should be able to be drawn up which focuses upon the impact of the system used, rather than the individual technology.
  - Could users be engaged in the design of new products and systems, such as fall arrest systems (the safe by design concept), in order to better accommodate the issues arising from height, weight, build? It was noted that in theory, there is already a measure in place to cover this. Fall arrests are classed as Personal Protective Equipment (PPE) and as such, the employer is required to assess their suitability for each individual technician. However in reality, this doesn't always happen.
  - Everyone who travels in a lift should be fully trained. At present with some operators, an untrained person can travel with a trained person.
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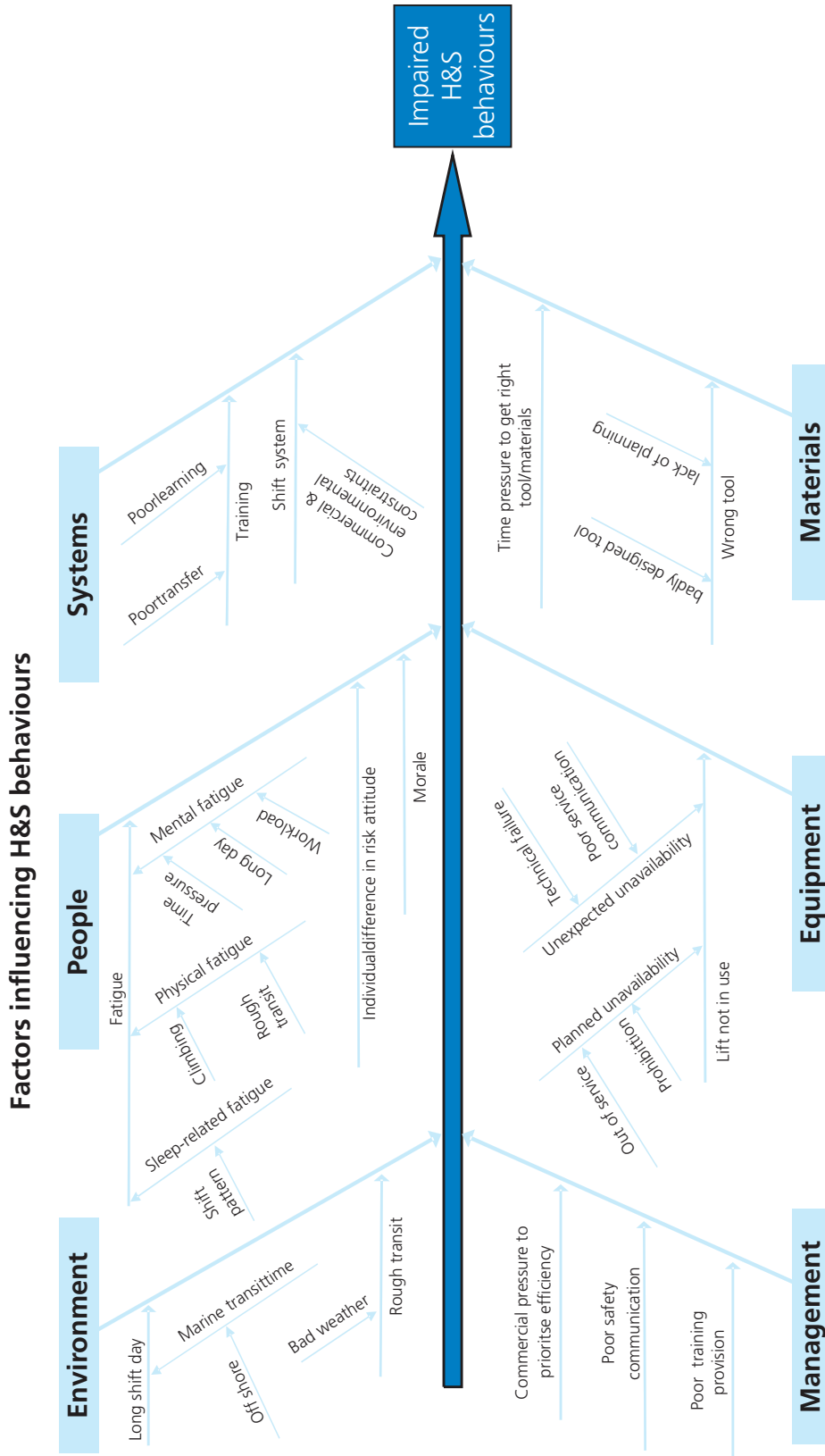


Figure A.6: Potential causes of impaired H&S behaviour

### Additional measures to prevent/reduce unavailability of lifts

- *Communication*: One key problem here is poor communication around non-availability of lifts, both from the control centre to technicians and vice versa. Could more emphasis be placed on the responsibility to communicate effectively about this (both ways) by operators?
- *Maintenance administration*: It was agreed that generally, there needs to be more emphasis placed on the importance of well planned (and well communicated) lift maintenance and also record keeping (e.g. ensuring that a lift service is logged at the turbine) to reduce unnecessary lift unavailability.
- *Work Adjustment*: Another key problem is that, although it is accepted that unavailability has an impact upon the service schedule, no adjustment is made (e.g. a time contingency) to account for it. This makes it more likely that a technician will feel 'obliged' to climb, despite not feeling able to at that point. Should a service schedule include a time contingency?
- *Redundant lift*: Although it was recognised that installing a redundant (extra) lift system within a turbine would increase the overall set-up and maintenance costs, it was considered that the financial and H&S benefits of a reliable lift system may outweigh the costs and make this feasible.

### Impact of climbing and the effects of climbing within the overall work package

The full causal chain of risks should be taken into account when deciding whether (or not) to climb and also in establishing appropriate control measures for the indirect effects of climbing on the activities which follow.

The chronology of the work pattern and the impact of climbing within this, was sketched out by the group as described in Table A.1.

**Table A.1: Work pattern and climbing impacts**

Stage	Comments
1. Onshore	Other factors prior to this stage could impact climbing e.g. shift pattern and other factors leading to poor quality sleep the night before
2. CTV journey and turbine transfer (c. 90 minutes on average)	Factors such as crew sleeping immediately before transferring onto the turbine are additional risk factors at this stage Seasickness during the transit is likely to impact on safety during climbing
3. Climb up	This stage is subject to the general climbing risks outlined previously This is not usually rushed but is physically taxing and can lead to significant fatigue
4. Work	The state of the technician following the climb could directly influence work capacity, working strategies and H&S related behaviour

**Table A.1: Work pattern and climbing impacts (continued)**

Stage	Comments
5. Climb down	<p>This was considered to be particularly vulnerable to the effects of fatigue:</p> <p>It is further along the fatigue risk chain</p> <p>Also, unlike ascent, the climb down is sometimes rushed due to immediate situational factors (e.g. the urgency to transfer/finish shift/go home)</p> <p>In terms of human factors, the technician is experiencing different motivations</p> <p>It takes place just before a CTV transfer process</p>
6. Return journey	<p>Consideration of sea state as an additional risk factor for the final stage</p>
7. Journey home	<p>The journey home following transit was another area of significant concern. It is at the end of the causal risk chain, therefore subject to the effects of all earlier activities. When considering H&amp;S related risks, this stage should be considered as part of the overall work package</p>

**Standardised risk assessment protocol/checklist for climbing**

- An industry-standard risk assessment was considered to be a challenging but important task – the key consideration would be defining which issues should be of concern.
- Although the work outlined in table A.1 has provided a starting point for identifying the key risk factors, further work would be required to ensure the risk factors incorporated were valid, reliable and appropriate for inter-organisational settings.
- Separate risk analyses should be devised for the different circumstances of lift unavailability e.g.:
  - Prohibition (or planned unavailability) – adjustments to the work package should be considered prior to work planning to account for the additional climbing demands.
  - Unexpected lift unavailability – decision support protocols should provide guidance as to (1) whether or not to climb, (2) how to communicate unavailability and (3) whether to adjust the wider work package for the remainder of the day.
  - Unexpected lift activity – fault assessment training and safety checks should provide clear guidance as to how to proceed when faced with unusual or unexpected lift activity.
- An extension to a standard risk assessment would be an analysis of the causal risk chains (the impact of one activity on the activities that follow) across the full work package.

## A.2 PRESENTATION INTRODUCTIONS AND SLIDES

### **Presentation 1: *Sai-Man Li*, Health and Safety Specialist U.K. North – Offshore West, Vattenfall: Vattenfall FMEA work with the HSL**

#### **Executive summary**

In November 2015 the UK Health and Safety Executive (HSE) wrote to Vattenfall and some other companies working in the offshore wind industry to communicate their concerns about the standards for selection, design, commissioning and installation of service lifts in offshore wind turbines in the UK.

Their concerns further stated that service lifts supplied and installed at UK offshore wind farms may not have been constructed or adapted as to be suitable for the purpose for which they were to be used, and that the risk assessments developed for the use of the service lifts were not suitable and sufficient.

In particular and specifically for the service lifts installed at Ormonde offshore wind farm, the HSE requested Vattenfall to:

1. Engage the services of independent competent engineers to carry out a safety-critical FMEA of the service lifts to ensure they are so constructed or adapted so as to be suitable for the purpose for which they are used or provided.
2. Define a performance standard for the service lifts to ensure they are compatible and suitable for the expected life cycle of the turbine.
3. Undertake a review of the risk assessment for the safe use of the service lifts and associated wire hoist cables.

To discharge item 1 of the HSE's request to Vattenfall, they took the decision to engage the services of the Health and Safety Laboratory (HSL) to undertake a multidisciplinary (FMEA) on the Hailo Toplift L3 installed at Ormonde, to better understand the design and construction of these lifts. This FMEA (on the electrical/control systems and the mechanical systems) was also undertaken to determine whether additional precautions would be necessary to ensure the safety of personnel using the lifts.

The pertinent results of this FMEA analysis and the subsequent recommendations to industry for the return to service of WTG lifts are covered in this presentation.

## CONTENTS

1	Overview
2	Approach
3	Headlines
4	Steps to get lifts back in operation

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## OVERVIEW

- Shortly following the very unfortunate incident at Enertrag wind farm in Storkow -Germany, Vattenfall placed a voluntary STOP on use of the Service Lifts carriers.
- As time moved on realising the risk profile was increasing as the busy service period approached, the effects of daily climbing started taking its toll on service teams, moral (hearts & minds) resulting in some minor musculoskeletal related incidents.
- Along with an intervention made by the UK HSE to Vattenfall regarding the Servion SM supplied service lifts at Ormonde, highlighting actions for assurance and safety.

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## FMEA @ ORMONDE

- Initial step was to plan a Failure Mode Effects Analysis (FMEA) at Ormonde wind farm on the Hailo L3 installed service lift carriers
- After careful consideration Health & Safety Laboratories (HSL) were appointed to help Vattenfall facilitate this
- It was agreed that resultant findings from this would help form a wider reinstatement plan for the Vattenfall fleet
- Vattenfall appointed a broad ranged internal team to complement the HSL team of specialist Engineers & set up a task team



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## FMEA TEAM

- HSL's Matt Clay chaired the multidisciplinary Failure Modes and Effects Analysis (FMEA) consisting of.....
- HSL Mechanical Engineering
- HSL Electrical / Control Engineering
- Vattenfall Engineering, Operations, H&S Specialists
- Vattenfall Technicians, Ormonde Site Safety Rep
- Certex Operations (Statutory Examinations provider)
- LiffRig (Specialist Chartered Mechanical Lifting advisor)



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## APPROACH

- Collate Documentation - Information - Hailo Lift & Tractel
- Manufactures Installation – O&M Manuals
- Operator user instructions - Training
- Service maintenance records – Examination scheme
- Technical information – Drawings etc
- HSL – Vattenfall Field visits
- HSL O&S visit to Ormonde WTG Lift
- Detailed component inspection checking took place
- Taking high resolution photo records
- HSL visited Tractel HQ for discussions and information



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## APPROACH

- Physical examination – Tractel
- Tractel Tirak Hoist - Tractel Blocstop Fall Arrest Device were sacrificed for internal examination, inspection, study and testing at the HSL laboratory to help with details of the study



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## APPROACH

- Material laboratory analysis
- Metallurgical analysis (SEM) – worm gear
- Polymer analysis – Blocstop rollers



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## OTHER KEY FINDINGS

- **Ambiguity conflicting data** with use of safety devices on Hoist between Hailo & Tractel manuals.
  - Tractel stating a return to base for service after a 20cm decent?
  - Hailo stating x 10 uses with limited decent distance & specified 5min decent rest periods?
- Vattenfall are liaising with both parties for resolution, until then have adopted a single use only policy until clarified

### Open & Honest Dialog

- Found legacy of mis use of the hoist manual decent safety devices e.g. on construction, unreported use, causes increased wear to brake linings, little or no way of telling extent until examined .
  - Tamper tags have been fitted to hoist safety devices to deter & identify if activated at pre use check.....

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## OTHER IMPROVEMENTS

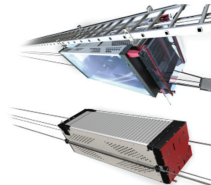
- **Updated and reviewed written scheme** for the Hailo L3 for Thorough Examination; *The top x4 high usage lifts have been brought back to 6 monthly examination period, monitor review as a precaution*
- **Safe Use and Operation Risk Assessment** has been completed using a broad based stakeholder approach
- **Hailo safe use operation training** programme reset has taken place
- **Updated pre use checking** and lift log book (recording)
- **Tamper tags fitted** to hoist to deter and monitor use
- **Tractel trained technicians** to broaden knowledge base
- **SSOW** to ensure the lifts are switched off when loading unloading and or not being used
- **Ongoing dialog** with Hailo and Tractel for improvements

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## HSL FMEA HEADLINES

- Generally the lift system is well constructed, if operated and maintained in accordance with the manufacturer's instructions
- The Hailo vertical routing design of the safety rope through the fall arrest device makes this lift type less vulnerable to sideways forces which have been known to cause deterioration in other lifts
- The manufacturers of the lifts and the hoist/Blocstop units have advised that the lifts can continue to be used providing that they are operated and maintained in line with the manufacturer's guidance.



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## STEPS TO GET OUR SERVICE LIFTS BACK IN OPERATION

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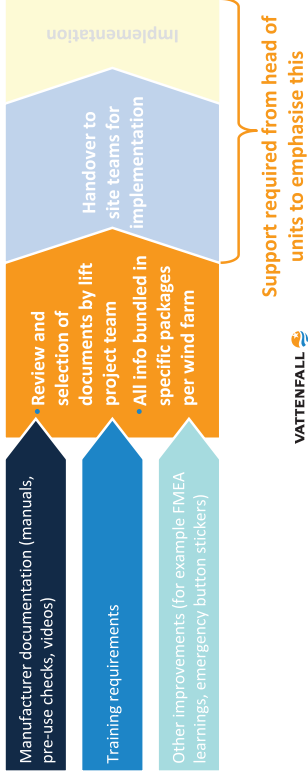
## STEPS TO GET OUR SERVICE LIFTS BACK IN OPERATION

All Vattenfall ONS & OFS WTG's with service lifts that equipped with Tractel Tirak Hoists and Tractel Blocstop Fall Arrests

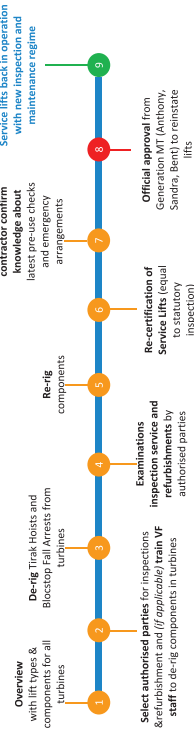
- Replace **all** Blocstop fall arrest units with factory new or refurbished units
- **Factory inspection of all** Tirak hoists and replace with new /refurbished units  
*All works need to be carried out by the manufacturer (Tractel) or authorised party.*
- Based on learnings pre use check and emergency arrangements must be reviewed to ensure a **good level of assurance about lift operation.**
- The project team will provide **updated guidelines from lift manufacturers** to all Vattenfall Sites will implement the latest guidelines in the coming year



## UPDATE OF MAINTENANCE AND INSPECTION REGIME



## STEPS TO GET OUR SERVICE LIFTS BACK IN OPERATION



## EXAMPLES OF ACTIONS

**Pre-use check video manuals**

**Safety memo for site team and logbook template @ Ormonde**

**Blocstop demo in warehouse @ Ramsgate**

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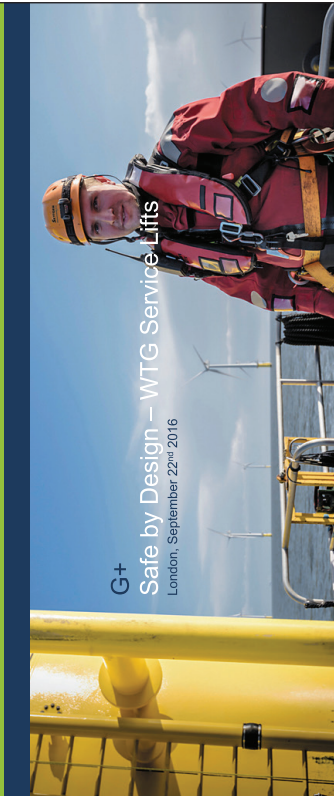
## **Presentation 2 – Alan McKerns, Head of Operations – Wind Division, Skyform: WTG Service Lift Manufacturer – Future Technology Development – WTG Lifts**

### **Executive summary**

This presentation was provided at the request of the G+ in order to identify features and challenges within the current design of service lifts (also known as tower hoists) within WTGs and review them against similar industries, new and existing technologies and to consider opportunities for design and operational improvements.

The service lift technology is mirrored in the powered access industry of which Skyform has been working in for circa 25 years. Both industries are considered in the presentation which considers and assesses the positives and negatives against each and gives an honest assessment of potential improvement opportunities. The service lifts themselves have many additional safety features, which offshore wind farm operators may not be fully aware of, and these were presented further highlighting the key technologies and minimum training requirements of which there remains a significant scope for improvement in the on- and offshore wind industry.

The presentation then goes further into current issues and in a frank and honest way presents key concerns and industry drivers which currently, and could potentially, impact upon the safe use and operation of service lifts. An overview of planned European Norm (EN) design standards for service lifts and future OEM working groups was also presented, allowing knowledge share of proposed global improvements to service lifts which may not be current knowledge within the offshore wind industry. Lastly Skyform presented its thoughts on future considerations to improve service lifts ranging from engineering controls, operational processes to human factors and the key competencies associated with service lift operators and potential drivers to move the industry forward in a positive direction.

**G+**  
Safe by Design – WTG Service-Lifts  
London, September 22<sup>nd</sup> 2016




**Introduction and Skyform Overview**

Skyform Group has 25 years experience working in Powered Access Systems and High Risk Industries and includes Skyform Wind with the last 10 years working in the renewables sector.

Skyform Wind currently maintain circa 1300 WTG's Onshore and Onshore across Europe and for many clients including:

- Siemens, General, Subsea, Exxaro, Woodside, Wipac, SPS, etc...

Skyform Group also includes:

- Skyform Access – similar to Towerhoist.
- Skyform EPC – EPC, EMI, EMI
- Skyform Roofing – Specialist Roofing coatings.
- Skyform Specialist – Construction (CDM) including Nuclear, Oil/Gas, Heavy Industry, Network Rail.




**Introduction and Skyform Overview**

Skyform Wind perform Service, Inspection and maintenance works focusing on compliance with Statutory Regulations requirements for our customers.

- Towerhoists, Nabele, Cranes, Davits, Accumulators, Anchor Points, Fire Extinguishers, Fall Arrest
- Exclusive certified service centre in the UK for Skyman performing commissioning, service, repairs and supply of parts
- Powerclimber – Partnership agreement in place with Powerclimber.

Our expertise is in working at height and man-riding equipment.  
Our engineers are committed to the highest standards and are trained accordingly.




**Introduction and Skyform Overview**

My Experience:

- Working in a Health & Safety role for almost 19years.
- Managing Equipment Experience
- Working with Skyform for almost 4years.

Other relevant experience:

- HSS Manager on Top Tier COMAH site for 7years – Safety Cases, Safety Report, Intervention Plans, High Risk Environment
- Engineering background.



**Key Safety Features of Skyman TH250**

**External**

- Bottom Plate
- Top Plate – Ladder
- Bottom/Top/Ulimate Limit Switch
- E Stops at all call stations
- Flashing Beacons / Audible
- Emergency Hand Wheel – SB Release
- Anchor Points

**Internal:**

- Operator feedback via illuminated buttons
- Emergency descent handle
- E Stops
- Interlock / Capture Key System
- Fully Enclosed with interlocked door
- Motor braking function and SB

**Procedural:**

- Trained every two years on use?
- Pre-start checks?
- Record of use?
- Record of maintenance?
- Effectiveness of Safety Alert Communication?
- Logbook and Users Guide with each Towerhoist
- Stickers/Tags indicating use and service status.




**Similar technology used elsewhere**

**Offshore Wind**

- Traction hoist with independent safety brake.
- Lifting item / SWR
- Laborer guided or wire guided by support movement and reduce
- Additional safety features such as interlock keys / A.0.093 / overload protection /
- Overhaul requirements in place Hoist / Brake

**Similar Industries**

- Typically a higher rated motor used – 500KG SWL
- 9mm F SWR used, including Safety Brake
- Typically NOT guided with the exception of Skytrack.
- Open on all sides due to nature of industries, i.e. Working from towers.
- Less safety features
- Start from 1m to 20m plus.
- SKEMAQTB training course



**Common Technical Standard**

A European Committee for Standardisation is being developed for the Towerhoists.

**CEN EN 81 – 44**  
Globally Relevant Standard for Lifts in Wind Turbines

The Ongoing New Siemens Tender for Lifts for 2017 and beyond is much more robust and rigid in design requirements. I've viewed Skyman and Powerdimber.



**Known Issues Causing Safety Concerns**

**Installation:**

- Poor installation / commissioning
- Overload limit.
- Directional Buttons

**Safety Features defeated (intentionally?)**

**Parts Change Out:**

- Manufacturer's
- Drive Wires
- Limit Switches
- Hoists/Brakes changed together - inaccessibility

**Training:**

- E-learning is Poor
- Not taking place
- Half Day Installation course inadequate.

**Written Scheme**


- Industry shift towards 12month inspection cycle

**WTG OEM's / Owners**

- Using companies whose expertise lies elsewhere or is weak



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360




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- SCADA system detailing use.
- Robust communication method – be unreliable at present
- Standardised overhead frequency including drive wires
- Overload device needs to be more robust
- Standardised overhead frequency including drive wires and intentional interference.
- Consistent installation teams following known methodology.
- GWO Standard on Safe Use and Troubleshooting of Lifts
- Not enough detail on emergency situation, escape
- Pre-Use checks to be more formalised and documented.
- Maintenance records should be provided to a centralised
- UKAS 17020 Inspection Bodies used or similar EU.

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**Thank You.  
Questions Please?**

## **ANNEX B**

### **ABBREVIATIONS AND ACRONYMS**

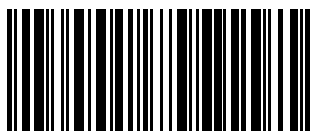
ALARP	as low as reasonably practicable
CE	Conformité Européenne
COMAH	Control of Major Accident Hazards
CRD	controlled rate descender
EI	Energy Institute
FMEA	Failure Mode Effects Analysis
FSWR	Flexible Steel Wire Rope
G+	G+ Global Offshore Wind Health and Safety Organisation
GWO	Global Wind Organisation
H&S	health and safety
HAZID	hazard identification study
HAZOP	hazard and operability study
HSE	Health and Safety Executive
HSL	Health and Safety Laboratories
PPE	personal protective equipment
OEM	original equipment manufacturer
O&M	operation and maintenance
RAMS	risk assessment and method statement
SIL	safety integrity level
SSOW	Safe System of Work
SWL	Safe Working Load
TP	transition piece
WTG	wind turbine generator





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9780852939840

ISBN 978 0 85293 984 0

Registered Charity Number: 1097899