G9 Safe by design

Workshop report: Marine transfer/access systems

G9 Offshore Wind
Health & Safety
Association

In partnership with

energy institute

G9 SAFE BY DESIGN

WORKSHOP REPORT: MARINE TRANSFER/ACCESS SYSTEMS

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1 BACKGROUND AND INTRODUCTION

The G9 Offshore Wind Health and Safety Association (G9) comprises nine of the world's largest offshore wind developers who came 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 G9 is to create and deliver world class health and safety performance across all of its activities in the offshore wind industry. The G9 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 G9 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 G9 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 G9 work programme, the G9 aims to explore industry operations and technologies with a focus on Safe by Design principles. The G9 workshops will 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. The outputs from these workshops will be made available on the G9 website in reports to be used as a reference by the industry.

The first workshop was held on 30 September 2014 on marine transfer/access systems, and explored a number of key topics associated with the transfer of personnel (including design of the transfer connector, new designs in access systems and boat landing design). The outputs from this workshop are documented in this report.

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2 METHOD, AGENDA AND ATTENDANCE

2.1 METHOD

A one-day workshop was held on 30 September 2014 In London, United Kingdom. After opening remarks from Frank Monaghan (Health & Safety Director, ScottishPower Renewables and G9 Focal Group member), the workshop started with the first of three presentations focusing on particular aspects relating to marine transfer.

After the first presentation, a mini hazard identification study (HAZID) using a pre-prepared crew transfer diagram (see Figure 1) was undertaken by the workshop attendees. Each attendee was asked to identify the top three hazards for each stage of the marine transfer/ access process highlighted on the diagram. The results of this exercise were then assessed and used to inform the work of the breakout groups in the second part of the workshop.

After the final presentation, the breakout groups (using the information gathered from the first exercise) were tasked with looking at three different aspects of the marine transfer/ access process: ladder and fender design; climbing and transfer (access and egress), and crew transfer vessel (CTV) design and equipment. Using a pre-prepared recording sheet, the breakout groups were tasked with reviewing and discussing current design control measures, the associated benefits versus hazards and whether there were alternative ideas, concepts or design controls that could be utilised to reduce the health and safety risk.

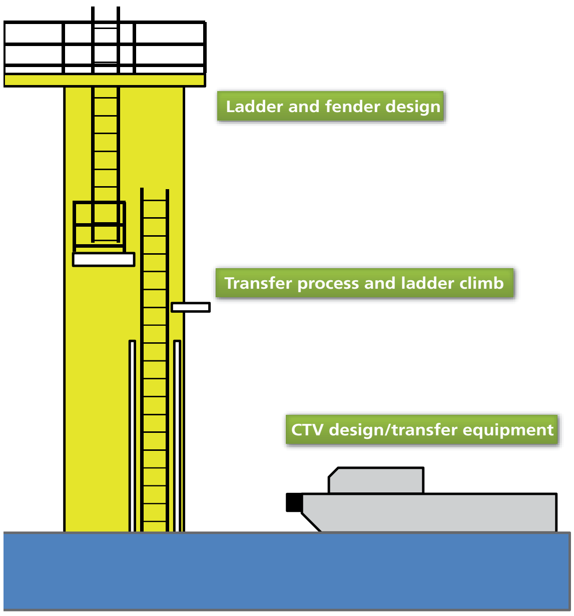

Figure 1: Pre-prepared crew transfer diagram

2.2 AGENDA

Opening remarks, welcome from the G9, scene setting

Frank Monaghan, Health and Safety Director, ScottishPower Renewables and *Anne Marit Hansen*, Leader Safety & Sustainability, Statoil ASA

Presentation – Transfer between CTV and transfer piece (TP): introduction of Siemens transfer connector

Jesper Haaning, Siemens Wind Power

Reflect on morning session/preparation for first exercise

Euan Fenelon, Offshore Health and Safety Manager, ScottishPower Renewables

First exercise

Presentation – The Carbon Trust, Offshore Wind Accelerator access systems

Marc Costa Ros, Manager Offshore Wind – Innovations, The Carbon Trust

Presentation – IMCA Boat landing standardization project

Alan MacLeay, Engineering Director, Renewables, Seaway Heavy Lifting

Preparation for second exercise

Frank Monaghan, ScottishPower Renewables and *Anne Marit Hansen*, Statoil ASA

Second exercise – breakout group sessions

Group 1 – Boat landing/ladder design (facilitator: *Glynn Fereday*, SSE)
Group 2 – Access/egress methodology (facilitator: *Anne Marit Hansen*, Statoil ASA)
Group 3 – CTV design/access systems (facilitator: *Euan Fenelon*, ScottishPower Renewables)

Collect in the results of second exercise

Outputs, closing remarks

Frank Monaghan, ScottishPower Renewables

2.3 ATTENDANCE

Name	**Company**
Jerry Gilmour	Centrica
Ben Simpson	CTruck
Bruce Clements	CWind
Stuart Richardson	CWind
Dominic Evans	DONG Energy
Karsten Bjerre Kristensen	DONG Energy
Niels Peter Olsen	DONG Energy
Jody Plaister	E.ON
Les Atkinson	E.ON
Andrew Sykes	Energy Institute
Bir Virk	Energy Institute
Claire Smith	Energy Institute
Owen Nutt	Iceni Marine
Mark Ford	IMCA
Chris Streatfeild	RenewableUK
Euan Fenelon	ScottishPower Renewables
Frank Monaghan	ScottishPower Renewables
Graham Farrant	ScottishPower Renewables
Alan MacLeay	Seaway Heavy Lifting
Jesper Haaning	Siemens
Glynn Fereday	SSE
Kevin Smyth	SSE
Mats Lund	Statkraft
Thomas Eriksen	Statkraft
Anne Marit Hansen	Statoil
Dan Kyle Spearman	The Carbon Trust
Marc Costa Ros	The Carbon Trust
Philip Woodcock	Workships Contractors

2.4 SECOND EXERCISE – BREAKOUT GROUP SESSIONS

After the first presentation, a mini HAZID using a pre-prepared crew transfer diagram (see Figure 1) was undertaken by the workshop attendees. Each attendee was asked to identify the top three hazards for each stage of the marine transfer/access process highlighted on the diagram. The results of this exercise were then assessed and used to inform the work of the breakout groups in the second part of the workshop.

The results of the mini HAZID showed that the following issues were viewed as key design considerations:

Group 1: Boat landing/ladder design

1. Ladder design.
2. Boat landing design.
3. Rest platform design.

Group 2: Access/egress methodology (transfer process and ladder climb)

1. Safe step over distance.
2. Transfer in marginal conditions.
3. Standardized transfer systems.

Group 3: CTV design/access systems

1. Standardized vessel design.
2. Fender/bow design (for push on).
3. Cargo transfer.
4. Walk to work (W2W) systems.

2.5 BREAKOUT GROUP DISCUSSIONS, RESULTS AND CONCLUSIONS

The notes presented in Annex A capture the discussions which occurred during the breakout sessions. They have not been edited post-workshop and so capture the essence of the discussions which occurred and consequently demonstrate that there is a level of inconsistency across the industry on the subject of marine transfer/access systems, which need to be discussed further in order to improve standardization and harmonisation of working practices and designs. It is also recognised that innovation resulting in differing designs of transfer and access solutions will result in reducing the health and safety risk when transferring personnel offshore.

Following on from the breakout sessions an assessment of the information and discussions collected was used to prepare a bow tie analysis, which identified the key controls and mitigations for the transfer of personnel from CTV to the TP – this is presented in Figure 2.

Going forward, and in response to some of the comments and suggestions that have been made in these breakout sessions, the G9 will aim to:

- Work with Siemens WP to ensure that the appropriate testing and certification have been undertaken on the FROG transfer connector with a view to roll out in the industry.
- Assess the need for a standard inspection protocol for wind turbine generator (WTG) boat landings.
- Engage with other organisations e.g. The Carbon Trust and the ORE Catapult on new CTV fender designs and new access systems.
- Support IMCA in the development of their research work on WTG boat landing standardization.
- Review information and research on the combination of forces and stresses on the boat landing structure whilst under load from a CTV.
- Investigate potential new procedures and competency frameworks for personnel involved in the transfer operation.

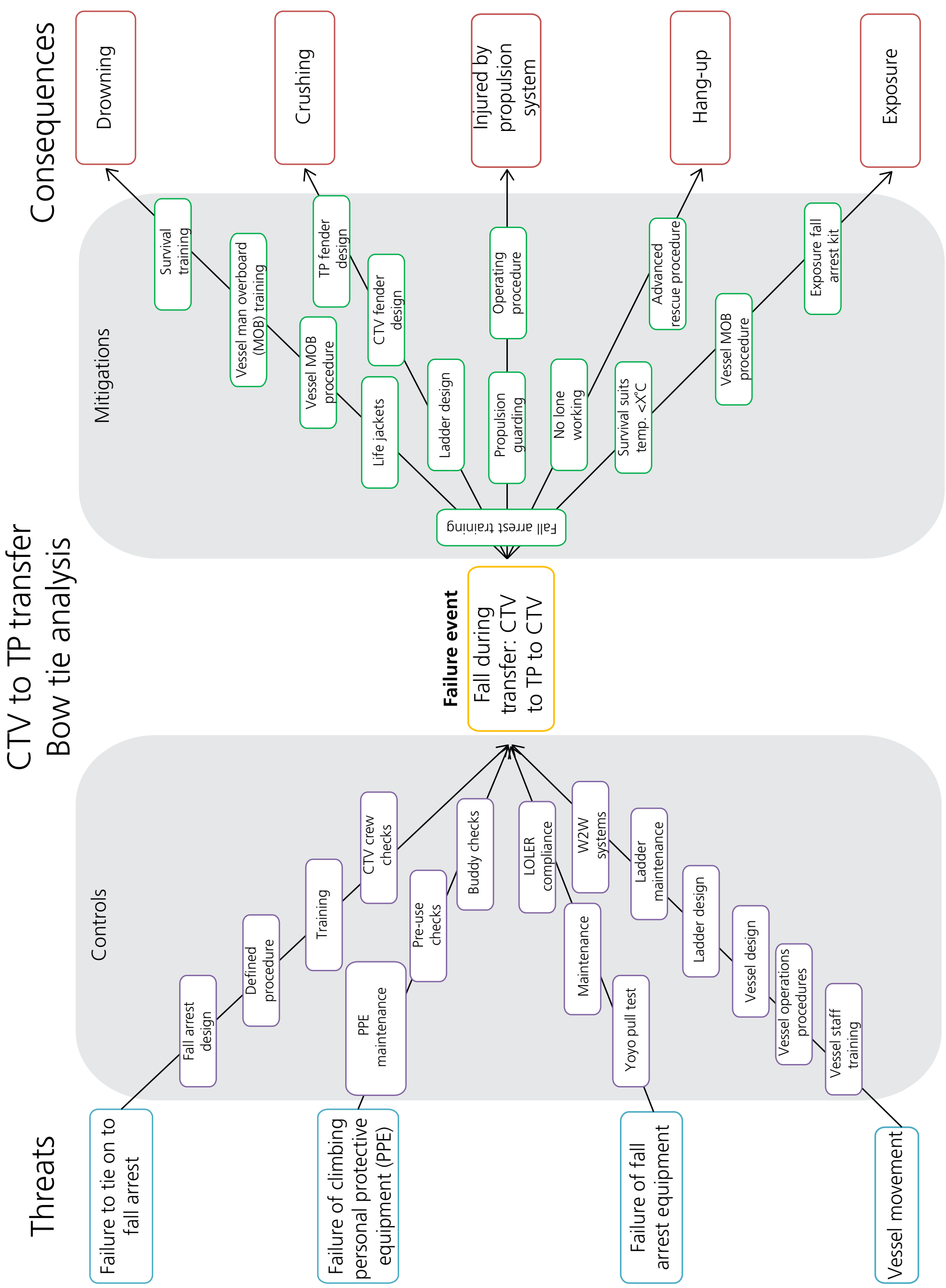

Figure 2: Bow tie analysis – transfer of personnel from CTV to TP

ANNEX A
WORKSHOP OUTPUTS AND PRESENTATIONS

A.1 BREAKOUT GROUP OUTPUTS

Table 1: Group 1 – Boat landing/ladder design (facilitator: *Glynn Fereday*, SSE)

Standardized ladder design		
Current design controls	***Potential design controls***	***Nature of potential risk reduction***
Existing design standards	G9/ORE Catapult feeding into design process with vessel operators to deliver a more standardized ladder design for use in offshore wind industry. Industry agreed inspection regime for assessing impact damage on boat landing/ladder structure (e.g. non-destructive testing [NDT]). Reduction of vessel movement (and consequent impact on movement of personnel) during transfer operation. Improved disconnect mechanism for fall arrest system. Consider use of staircases as opposed to ladders for access/egress?	Improved ladder design/access design.
Pressure hoses		Improved reduction of marine growth and ice on ladder/boat landing structure.

Table 1: Group 1 – Boat landing/ladder design (facilitator: *Glynn Fereday*, SSE) (continued)

Standardized fender/boat landing design		
Current design controls	**Potential design controls**	**Nature of potential risk reduction**
Existing design standards BMO Offshore research (push on force) and structural design codes (e.g. DNV GL design code)	Can be used with other current research studies/reports (e.g. IMCA boat landing standardization study) to agree standardized design limits for boat landings. Design plates/reinforcement on boat landing structure.	Increased standardization/reduced costs. Increased structural integrity of boat landing steel structure.
Safe step over distance	Regulatory authorities to recommend/enforce an agreed safe distance, or industry apply an agreed standard. Bespoke coatings on fender to give better 'sticking'. Alternative design for rope attachment, to allow for vessel to be anchored.	Reduced wear and tear on boat landing.
DNV GL design code – specifies impact forces (however, design codes are open to interpretation)		
Safety zone between vessel fender and boat landing Friction compensated roll		Improved control of vessel movement (resulting in increased friction and reduced movement).
Orientation of ladder with respect to (wrt) position of boat landing	Ladder may not need to be parallel to boat landing structure? Could be at a 45°/90° angle?	
Positioning of boat landing	wrt to tidal movement – using operations and maintenance (O&M) operating experience to influence boat landing designs for future wind farm projects.	
Other considerations: – Current fleet of WTGs versus next generation WTGs – opportunity to incorporate feedback on design into next round of technology. – Monopile versus jacket technology – will introduce new considerations wrt boat landing and vessel fender design.		

Table 1: Group 1 – Boat landing/ladder design (facilitator: *Glynn Fereday*, SSE) (continued)

Standardized rest platforms		
Current design controls	***Potential design controls***	***Nature of potential risk reduction***
9 m height for rest platform – appears to be accepted industry standard Design standard – EN ISO 14122-1 *Safety of machinery. Permanent means of access to machinery. Choice of a fixed means of access between two levels*	Does not specify/define a set height for rest platforms. Standard could be improved with guidance on principles/key considerations for determining a safe rest platform height, rather than specifying a set number of steps/metres. Tidal movement can influence/change height of rest platform relative to reference point on TP. Drop down rest platforms.	

Table 2: Group 2 – Access/egress methodology (transfer process and ladder climb) (facilitator: *Anne Marit Hansen*, Statoil ASA)

Safe step over distance		
Current design controls	***Potential design controls***	***Nature of potential risk reduction***
Safe zone for individual on a ladder	Have a standardized safety distance which cannot be compromised and where there is no risk of individual being swept off the ladder. For future build, potential to harmonise design of boat landings with outcomes of IMCA boat landing standardization research. A level of variability in designs currently. Incorporate 540 mm < safe distance < 600 mm into future designs. Note the distance chosen should not be so far it compromises safety. Use experience from the oil and gas industry e.g. design criteria used on offshore platforms and rigs.	Dependent on safety parameters of TP, vessel, fender, etc.
Design specification on TP and fender Design depends upon: – Shape of fender. – Resistance between fender and TP. Consensus reached on need for standardization, but difficult to achieve	Improved design of fender safety clearance and stepping distance. Different configurations affect TP design and can compromise distance safe distance. Minimum safety clearance of 550 mm. Harmonisation of vessel fender design by vessel operators (note care is required to ensure innovation in technology is not stifled.) Fender design incorporating a step over platform. Safe zone to have hard wearing and anti-slip surface. Fender straight surface mooring boards - friction or not friction? Nipple may not be ideal design of vessel fender when configuring safety zone. Flat balm preferable? Shark tooth fender can help guide the vessel into position and remove obstacle. Design provides a flat surface once in position.	Ultimate responsibility rests with TP designer – design criteria can provide conditions. For future projects it will be easier to standardize and modularise for TP new builds.

Table 2: Group 2 – Access/egress methodology (transfer process and ladder climb) (facilitator: *Anne Marit Hansen*, Statoil ASA) (continued)

Safe step over distance (continued)		
Current design controls	***Potential design controls***	***Nature of potential risk reduction***
Design specification on TP and fender (ontinued) One CTV operator: 550 mm nipple fender helps interlocking nib. Nib helps hold in without slipping and provides a 550 mm critical zone Once locked in it helps stay in	Potential to have an agreement with vessel owners that the nib is the best option, but currently different opinions still exist. Design of fender is not the most important factor; how the safe distance is achieved is the most important factor. Specifying types of fenders may be too demanding and may stifle innovation in technology. Existing boat landing structures - limits need to be understood in any proposed retrofit: – What is currently in place? – How difficult will it be to retrofit? – How much will it cost to get a safe distance? – What will be the maximum vessel loading conditions?	
Dock on method – friction, sliding, etc.	Some technicians/maritime crew prefer push on/friction grip for transfer. Sliding method may be considered for transfer of technicians working on future projects.	Development that needs to be controlled.
Weight calculation	Is the industry comfortable that the correct weight figures are used? Weight figure needs to factor in PPE weight. If factored in, consequences for making numerical decisions may lead to: – An increased step over distance. – Limiting/restricting overweight workers stepping over over from CTV to the boat landing.	Ensure that offshore wind PPE and workers fit criteria specified.

Table 2: Group 2 – Access/egress methodology (transfer process and ladder climb) (facilitator: *Anne Marit Hansen*, Statoil ASA) (continued)

Transfer in marginal conditions		
Current design controls	***Potential design controls***	***Nature of potential risk reduction***
Design aim: to widen weather window a technician can work in		
Marginal condition definition No standard guidance on deciding what marginal conditions are.	Define what a marginal condition is and standardize as currently different from vessel to vessel. Marginal conditions are completely different depending on vessel size, type, etc. and a Master's judgement may be called into question.	May reduce potential for technicians to undermine the Master's authority.
Gangway systems Currently two types: active and passive systems Gangway issue – is a mechanical component. What fail-safes exist if a component fails when a technician is halfway across?	Many suitable larger vessels, some suitable smaller vessels. Specify safety factors of failure mode and protection to back the system up. Not a single point of failure. A redundancy system to assist to 'stay elevated'. Establish what is the current technology. Requirement for the scenario of technicians stranded on a turbine to be made part of the site emergency plan.	Potential to extend the operational window.
Vessel motion monitoring system	Introduce a motion monitoring system – individually set up for each vessel. Repeat for vessel by vessel or each turbine site.	Assists Master on judgement/ decision-making.
Procedures to determine marginal conditions	Engagement in policy arrangement between different parties. Set up clear lines of accountability.	

Table 2: Group 2 – Access/egress methodology (transfer process and ladder climb) (facilitator: *Anne Marit Hansen*, Statoil ASA) (continued)

Standardized transfer systems		
Current design controls	***Potential design controls***	***Nature of potential risk reduction***
Fall arrest system Self-retracting lifeline (SRL)	Other options: – Back support. – Doppler backing. Maintenance is an important factor in choosing preferred solution. Noted that there is confidence in using an SRL. Not all solutions will be appropriate for offshore wind.	
Freeline and pulley system	Standard recommended design way in the pulley and tether system. Standard requirement on the quality of the retrieval line. **Renewed focus on how to design out transfer.** Increase in reliability of the turbine leading to a reduced number of transfers. Improved maintenance plans. Minimise repair uncertainty. Design tasks to be: – Executed better. – More harmonised. – Using better quality materials/components.	Reduced number of transfers.

Table 3: Group 3 – CTV design/access systems (facilitator: *Euan Fenelon*, ScottishPower Renewables)

Standardized vessel design		
Current design controls	***Potential design controls***	***Nature of potential risk reduction***

Vessel design criteria/standards/ codes	– Improvements in existing vessel design codes to optimise designs and have a perfect vessel design?
	  – standardization of vessels by size (load line length) rather than design, and
	  – standardization of boat landing height (relative to TP structure) to vessel design parameters.
	– When sitting, reduced body vibrations due to improved seating design (motion compensated).
		Improved standardization/ harmonisation.

	– More advanced seat technology/temperature control/ increased stability of vessel: resulting in reduced potential for sea sickness – Noise dampening technology (dissipating hull noise). – Increased vessel stability.	Reduced injury/lost work potential.
	– Improved bridge design/deck separation/communications systems. – Could have a third crew member for communications – as vessels get bigger engineers could also take on some crew responsibilities (this would be dependent on vessel size).	Master has ability to stop personnel from entering bridge area/can work without distraction.

Table 3: Group 3 – CTV design/access systems (facilitator: *Euan Fenelon*, ScottishPower Renewables) (continued)

Fender/bow design (for push on)		
Current design controls	***Potential design controls***	***Nature of potential risk reduction***
Vessel fender design	– Deeper nipple fender design will stabilise the vessel when pushed on to the turbine and also reduces movability/increase friction. – Flat/square fenders in some cases may cause more damage. Friction can create too much heat in the fender and cause damage. – Weight of the vessel is also a factor. – Flat fender easier to 'stick' to boat landing (too much surface area equals no release). – Preferable to have a high bow fender; however, this may cause an issue with existing boat landing designs. – SWATH design vessels have jets 1.5 m under the water (converse to having a high bow fender). – New fender designs 'stick' better to boat landings. – Issues with older vessels/softer fender designs which do not stick as well. **Operational controls** Have tide behind the vessel as this assists with engaging the boat landing. Can be impacted by location of site and local tidal conditions.	

Table 3: Group 3 – CTV design/access systems (facilitator: *Euan Fenelon*, ScottishPower Renewables) (continued)

Cargo transfer		
Current design controls	***Potential design controls***	***Nature of potential risk reduction***
Fuel transfer	Improved tank designs/procedural controls to reduce the probability of loss of containment/spillage.	
Deck size	Optimise deck size for storage of different cargos.	
Lifting procedures	**Liftbags** Reduce size and weight so bags can be disassembled and transferred. Would have to think about how to get the components in and out. Need to have dialogue with bag manufacturers. **Inspection regimes** Standardize equipment inspections to every three months.	

Table 3: Group 3 – CTV design/access systems (facilitator: *Euan Fenelon*, ScottishPower Renewables) (continued)

W2W systems		
Current design controls	***Potential design controls***	***Nature of potential risk reduction***
Trial systems	– Optimise available deck space so appropriate for W2W system. – Some W2W systems require a dedicated technician to operate. Installation of W2W system may impact on the design and operation of the vessel. – have to consider carefully the vessel to ensure the systems put on are fit for purpose. – Go/no go system – traffic light system: green for safe to go and red for stop. Hard to retrofit these systems onto some vessels due to cost implications.	
Dynamic positioning (DP) systems	– Need to ensure that use of DP system is not impacted by installation of W2W system. Alignment between the systems is needed.	

ANNEX A

A.2 PRESENTATION INTRODUCTIONS AND SLIDES

Presentation 1: *Jesper Haaning*, Siemens Wind Power: Transfer connector

Executive summary

When analysing transfer incident notifications in a two-year span and the transfer concept in general, Siemens identified the main concerns of influence on the level of safety to be:

1. Loss of friction to a structure, causing a transfer vessel to drop uncontrolled and unexpectedly to drop in the swell.
2. The 'human factor' and the fact that the transfer operation traditionally relies heavily on the interaction between the transferee and the Deckhand.
3. The time connected to the SRL prior to the moment of transfer during access and after transfer during egress (primarily egress).

Based on the CTV and TP configurations already in service realising that vessel and structure improvements will take a long time and involve considerable resources, items one and two have not been considered in this presentation/topic. In relation to item three, the analysis determined a requirement for an immediate improvement of the transfer concept.

Based on this study, Siemens revised their transfer procedure and introduced a 'one-hand operated quick release' transfer connector to facilitate:

– minimal assistance and involvement of the Deckhand;.
– minimal time of connection to the SRL prior to access;
– instant release from the SRL in the moment of egress, and
– the option to perform a 'cut away' in the event of equipment failure.

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Siemens instruction for transfer between CTV & TP using a Self Retracting Lifeline (INS 17871 & INS 17871 Ap. 1.)

"TRANSFER CONNECTOR"
G9 briefing September 30. 2014

Agenda:
1. Why revise and update the CTV / TP transfer concept?
2. Why did we chose the "FROG" connector and developed the Transfer Connector?
3. Details on the Transfer Connector
4. Details on Siemens "Transfer instruction"
5. Video!
6. Questions & answers

Answers for energy.

1. WHY (1): PROCEDURE IMPROVEMENT PRE-STUDY

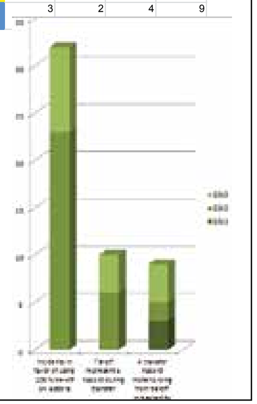
SIEMENS

Statistics by 2 Q FY-13:

Year	2011	2012	2013	Total
Incidents in favor of using 100 % tie-off on ladders	0	23	9	32
Tie-off represent a hazard during transfer	0	6	4	10
A transfer hazard materializing from tie-off mitigated by procedure	3	2	4	9

Disclaimer:
The statistical material is unofficial, intended for internal use and serves the only purpose of indicating, the relationship between offshore transfer "CTV drop in swell" KRIMA notifications and KRIMA notifications related to "falls, trips & slips on the access ladders in WTG".

NOTE:
Approximately 85 % of the reported incidents occurred during egress!



Remarks:
All the reported incidents were "near misses" or "dangerous situations" – no injury has been reported.
The statistical material must be evaluated with the following reservations:

2010 KRIMA information is not included as E W & E S SR WP split KRIMA reporting databases primo 2011 and the workload of retrieving info will be immense!

Vessel design and quality continuous has improved in the period 2011 - 2014.

Siemens KRIMA Reporting culture has improved significantly over the latest two years.

1. Why (2): Siemens conclusions based on pre-study

SIEMENS

Risk Assessment executive summary:
Aspects of transfer in general: Considering ALARP the risk related to all hazards of CTV/TP transfers are in general evaluated to be mitigated to an acceptable level; *EXCEPT* the primarily environmental and CTV design conditioned hazard of:

- *vessels relatively unpredictably loosing friction on a TP and unexpected drop an undefined distance in the swell.*

The primary hazardous consequence is:
That transferees connected to TP mounted SRL will be uncontrolled suspended above the vessel deck when the SRL locks - assessed as potentially fatal (5).

The likelihood is assessed to be: *Very dependent on "human factors" and weather limitations as "unlikely /possible" (3). (C and L combined and unmitigated = Risk: H)*

Mitigation perspective:
1. Refrain from CTV/TP transfer / Substitute with different vessel design / An alternative method or Alternatively limit occurrence by setting strict weather limitations.
2. PPE.
3. Training, procedures & Instructions.

Result of current mitigation: **Most entrepreneurs operate at a residual risk level "in the high end of M" based on an accepted operational risk to obtain maximum WTG accessibility!**

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1. Why (3): Siemens conclusions based on pre-study

(As the majority of offshore operations currently are anchored in UK the setoff has been the conditions applicable in UK!)

SIEMENS

1. There is no individual set of legislation setting requirements for the combined process of transferring OF between a vessel and a structure (TP).
2. A TP is a structure planted in the sea bed – consequently WAH is governed by the relevant UK WHA legislation & requirements.
3. A vessel a float, and all activity on it. is governed by the Maritime legislation and requirements.
4. Transfer between vessels and structures are addressed by IMCA guidelines which under the Maritime legislation is considered "best practice". IMCA refers WAH on structures to the local WAH regulations.
5. Siemens statistics indicates a clear incitement to apply effective fall arrest when climbing TP ladders (WAH).
6. Siemens has not been able to identify any suitable alternative to the use of SRL as an operational and effective fall arrest during transfer between CTV and TP.
7. Siemens statistics clearly indicate that connecting to a SRL, while on a vessel, represent a significant hazard requiring additional mitigation.

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2. Transfer Connector: Based on the conclusion – what can we do?

SIEMENS

1. Reduce impact of "human factors" to the lowest possible level!

2. Reduce the time connected to a SRL device, while on deck, to the shortest possible.

3. Define procedures and implement a single hand operated "quick release" connector to facilitate bullets 1&2:
   I. Connection to the SRL without the involvement of a Deck Hand - and TP access *immediately* when connecting to the SRL ensuring that the transferee can maintain 3 points of contact and proceed relatively fast up the ladder.
   II. Disconnection from the SRL during egress from the TP - without the involvement of a Deck Hand.

4. Enhance competence and the individual awareness during transfer by defining clear and unambiguous procedures together with clearly defined roles and responsibilities.

Siemens INS 17871 and introducing the Transfer Connector facilitates the bullets 1- 4.

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2. Transfer Connector: What did we do?

SIEMENS

1. Reached out to business partners with no productive result (2012 / *At that time we had an aspiration to complete the process on a very short deadline aiming to introduce the product mid 2013!).*
2. Scanned the market for PPE solutions in cooperation with "ICM ArSiMa" (2013) Requirements:
   a. Single hand operated.
   b. EN 362 approved
   c. Ability to give sufficient clearance to life vests.
   d. Easy to operate – also with heavy gloves.
   e. Compatible to Siemens global range of approved PPE & safety equipment.

1. Tested various products – decided on the connector "FROG" from the manufacturer "Kong".
2. Developed and tested procedure(2013-14) .
3. Preformed field trials without any incidents and only very positive feed back (2014).
4. Released procedure – communicated to customers, contractors and training providers.
5. Rollout and implementation ongoing

Siemens wind dialogue

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3. Transfer Connector:

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I. Siemens patented connector to facilitate singel hand operated quick connection to SRL during access & quick release from SRL during egress, in transfer operations between vessels and structures – Without direct interference from the Deck Hand!..
II. The connector facilitates 100 % tie-off & fall arrest during transfer WAH.
III. Use of the Transfer Connector in combination with INS 17871 Ap. 1 mitigates the risk of being suspended on a locked SRL, if a vessel unexpected drops in the swell during the transfer, to a likelihood assessed as "*very unlikely" (L).*
IV. The Transfer Connector combines the elements: 1 FROG connector (EN 362;04/A/T), 1Trippel Action self-locking karabiner (EN362;04/A) and 1 standard webbing strap (EN 354), into one piece of PPE.

Spec: **Breaking load:** >22 KN **Length:** 24 cm (9, 45 in)
Max. Opening: 13 mm (0, 51 in). **Price range:** <50 EUR

Transfer Connector Steel Karabiner:
Triple action self locking steel karabiner (EN 362;4/B) facilitate Transfer Connector connection to work pieces with a diameter > 13 mm

Total length of Transfer Connector in combination with Steel Karabiner: 33 cm (12, 99 in).

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4. INS 17871 & INS 17871 Appendix 1:

SIEMENS

Outlines a clear and unambiguous step by step procedure.

Strict conformance to the procedure will effectively reduce the risk of a transferee getting suspended by a locking SLR if a vessel should unexpected drop in the swell during the transfer operation:
a. When SRL connection is performed during access the transferee will be in the process of stepping on to the ladder and will quickly gain balance and can commence climb to relatively safety immediately - while attached to the fall arrest.
b. When disconnecting from the SRL during egress the transferee will be in the process of stepping on to the vessel – the transferee can potentially experience a "fall on a level" onto the vessel deck.

Enhances focus and awareness due to:
a. A clear and unambiguous communication procedure.
b. Unambiguous split in roles & responsibilities allowing the Transferee to focus on the transfer and the Deck Hand to focus on the transfer conditions.

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Presentation 2: *Marc Costa Ros*, The Carbon Trust: Offshore Wind Accelerator access systems

Executive summary

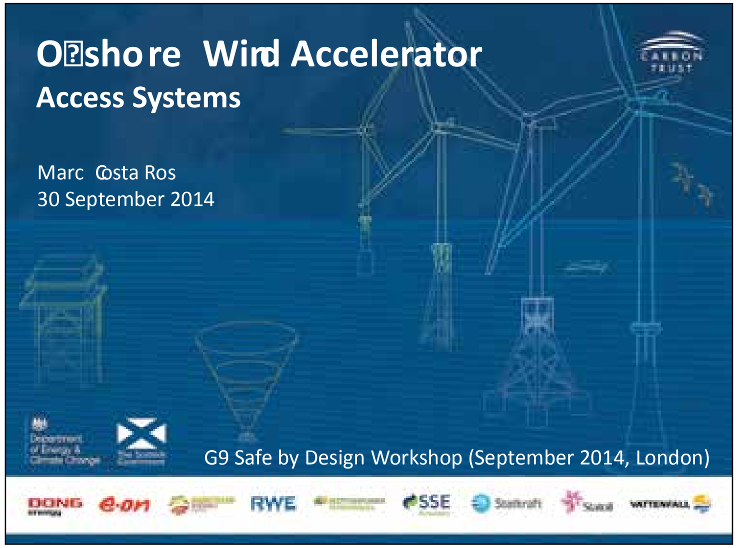
The Offshore Wind Accelerator (OWA) is The Carbon Trust's flagship collaborative research, development and demonstration (RD&D) programme. Set up in 2008, the OWA is a joint industry project, involving nine offshore wind developers with circa three-quarters of the UK's licensed capacity, which aims to reduce the cost of offshore wind by 10 %, in order for cost savings to be realised in time for Round Three projects. Cost reduction is achieved through innovation, i.e. bringing new concepts to the market through technology de-risking. Technology challenges are identified and prioritised by the OWA members in a market pull approach, based on the likely savings and the potential for the OWA to influence the outcomes. The OWA is structured around five research areas: access; cable installation; electrical systems; foundations, and wakes and wind resource.

The focused effort on research and development (R&D) driven by the OWA has accelerated the commercialisation of many of the innovations identified and supported by the OWA, for example, the *Windserver* from Fjellstrand or the *WaveCraft* from Umoe Mandal, and many others are ready to be commercialised. However, there is still a major question to be answered which not only affects new innovations but also any access solution: how do you measure and compare access performance?

Current selection methods for vessels or transfer systems for specific sites are highly subjective and comparative measured data of their performance is largely not available. The result of this lack of information is uncertainty of wind farm accessibility in project business cases and the selected combination of vessels, fenders and transfer systems for the site will probably be less than optimal.

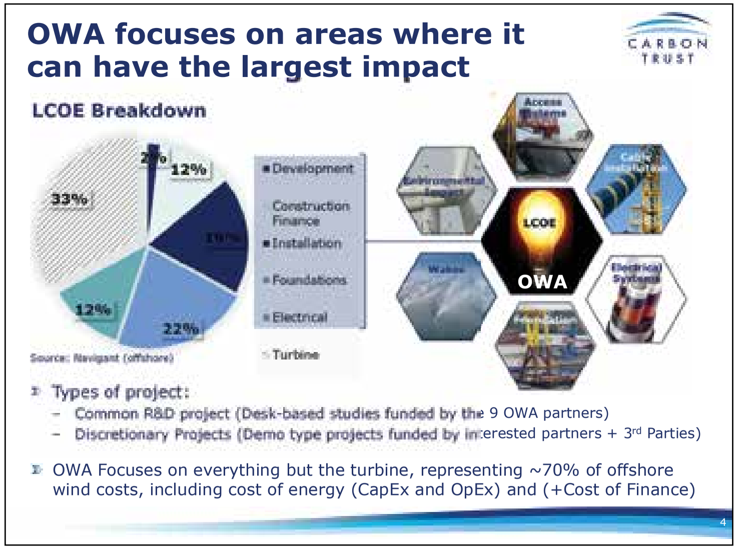
In order to address this, the performance metrics validation project was initiated; it aims to develop the access performance of four initial baseline vessels that are representative of the current vessels used today in the offshore wind industry. There are a wide range of factors that need to be taken into account when looking at the performance of a vessel; these include met-ocean conditions (wave direction, H_s, period), current, speed, capacity, comfort, safety, fuel economy and charter cost, among others.

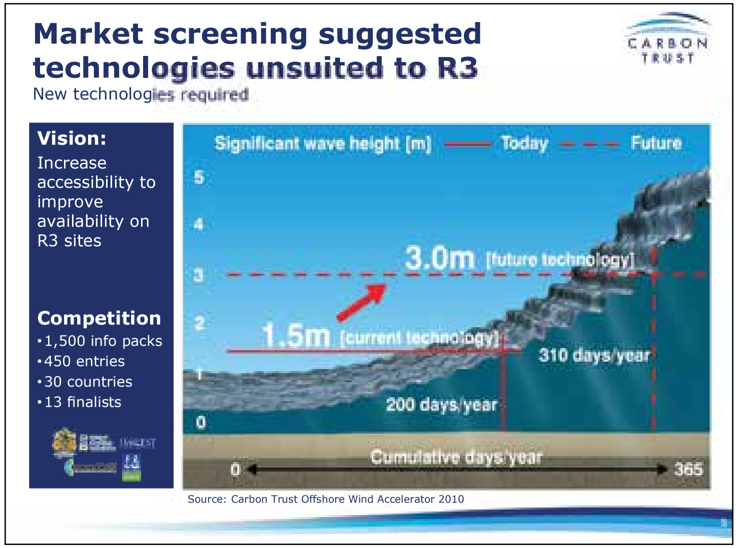
The performance will be determined through a combination of numerical modelling, tank testing and full-scale sea trials to provide baseline performance plots of vessels used in the offshore wind industry. The expected outcome of the study will be a set of performance plots that will define how vessels perform in different sea states, hence providing input for better operations and maintenance modelling and fleet definition.


Offshore Wind Accelerator
Access Systems
Marc Costa Ros
30 September 2014
G9 Safe by Design Workshop (September 2014, London)


The Carbon Trust has accelerated sustainable, low carbon development for more than 12 years
We are independent experts with a mission to accelerate the move to a sustainable, low carbon economy
What we can do for you
Advice
We advise businesses, governments and the public sector on opportunities in a sustainable, low carbon economy
Footprinting
We measure and certify the environmental footprint of organisations, products and services
Technology
We help develop and deploy low carbon technologies and solutions, from energy efficiency to renewable power
2


Offshore Wind Accelerator
Objective: Reduce cost of energy by 10% in time for Round 3
¾ of licensed capacity in UK waters
Joint industry project involving 9 developers + Carbon Trust
Only developers are members
– Commercially-focused
– International outlook for best ideas
>£60m programme
– 2/3 industry, 1/3 public (UK's Department of Energy and Climate Change – DECC)
Set up 2009, runs to beyond 2015
Value to members
– New technologies, ready to use
– Insights into best technologies for R3
– Funding for demo projects
3


OWA focuses on areas where it can have the largest impact
LCOE Breakdown
33%
2%
12%
19%
22%
12%
Development
Construction Finance
Installation
Foundations
Electrical
Turbine
Source: Navigant (offshore)
LCOE
OWA
Access Systems
Environmental Impact
Wakes
Electrical Systems
Types of project:
– Common R&D project (Desk-based studies funded by the 9 OWA partners)
– Discretionary Projects (Demo type projects funded by interested partners + 3rd Parties)
OWA Focuses on everything but the turbine, representing ~70% of offshore wind costs, including cost of energy (CapEx and OpEx) and (+Cost of Finance)
4


Market screening suggested technologies unsuited to R3
New technologies required
Vision:
Increase accessibility to improve availability on R3 sites
Competition
•1,500 info packs
•450 entries
•30 countries
•13 finalists
Significant wave height [m]
Today
Future
3.0m [future technology]
1.5m [current technology]
310 days/year
200 days/year
Cumulative days/year
0
365
Source: Carbon Trust Offshore Wind Accelerator 2010


Vessels, Transfer syst. & Motherships
Desirable vessel characteristics
– Operate in high sea states
– Fast
– Stable (no sea-sickness!)
– Fuel efficient
Desirable transfer system characteristics
– For vessels with stable platforms and good station-keeping
– Operate in high sea states
– Fast to deploy/recover
– Robust fail-safe mechanisms
– Operate on variety of vessels
Desirable mothership characteristics
– Capacity for multiple daughter-craft
– Comfortable for technicians
– Launch and recovery system: Operate in high sea states with Fail-safe mechanisms
6


WindServers
[Fjellstrand, Norway]
CARBON TRUST
Advantage
- Fast and efficient
- Stability in station-keeping
Source: Fjellstrand 2013
7


2 Play
[Nauti-Craft, Australia]
8m Demo at SeaWork 2014
Source: NautiCraft, 2013

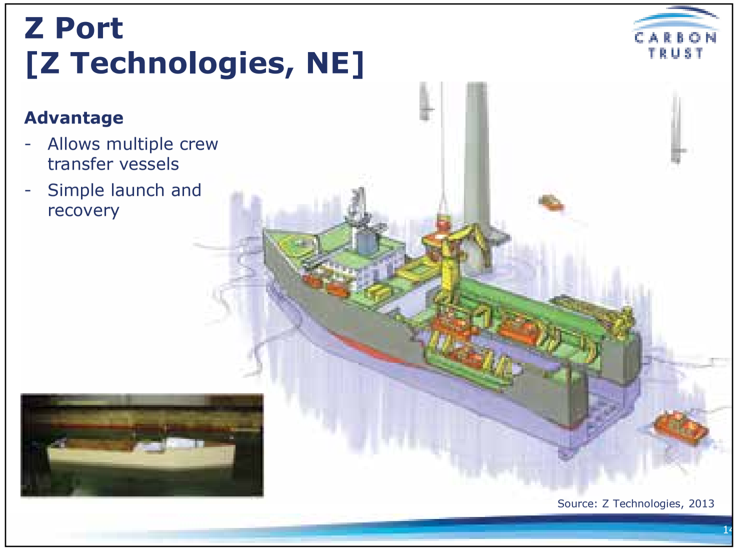

WaveCraft (Surface Effect Ship)
[Umoe Mandal, Norway]
1st Wave Craft will be built by end of 2014
Source: Umoe Mandal 2013
9

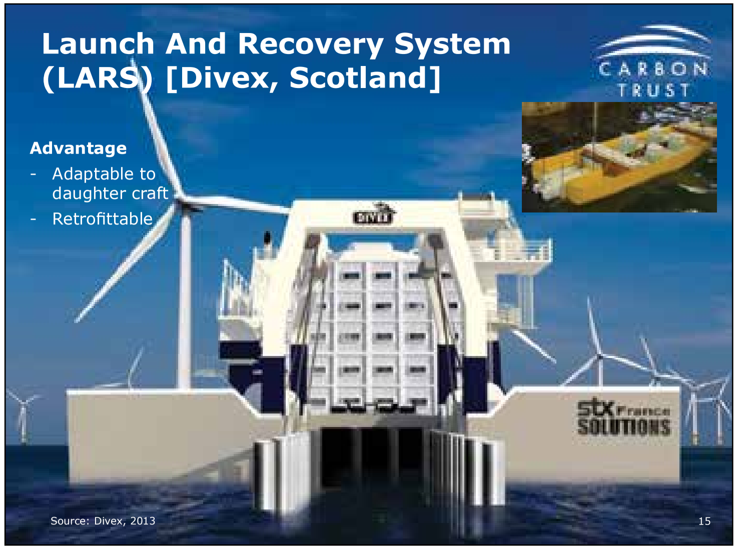

TAS
[Houlder + BMT-NG, UK]
Trials undertaken Q2 2014
- Retro-fittable
- Rollers improve performance
Source: BMT Nigel Gee and Houlder
10

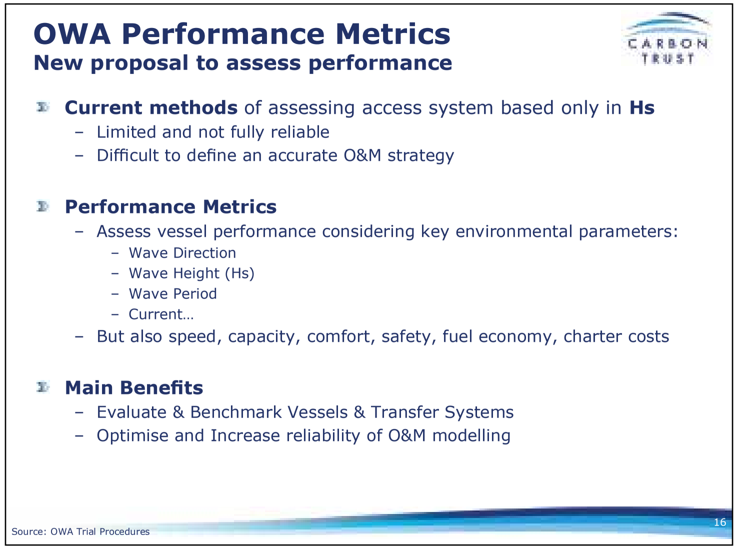

Autobrow
[OTSO, UK]
Advantage
- Simplicity
- Retro-fittable
Source: Autobrow 2013
11


MOTS
[momac, GE]
Advantage
- Full motion compensation
- Can stand-off the foundation
Source: NOS / momac


Turbine Docking Device
[Offshore Transfer Systems, Wales]
CARBON TRUST
Advantages
- Simple
- Retro-fittable
Source: Offshore Transfer Devices
13


Z Port
[Z Technologies, NE]
CARBON TRUST
Advantage
- Allows multiple crew transfer vessels
- Simple launch and recovery
Source: Z Technologies, 2013


Launch And Recovery System
(LARS) [Divex, Scotland]
CARBON TRUST
Advantage
- Adaptable to daughter craft
- Retrofittable
DIVEX
stx France SOLUTIONS
Source: Divex, 2013
15


OWA Performance Metrics
New proposal to assess performance
CARBON TRUST
Current methods of assessing access system based only in Hs
– Limited and not fully reliable
– Difficult to define an accurate O&M strategy
Performance Metrics
– Assess vessel performance considering key environmental parameters:
– Wave Direction
– Wave Height (Hs)
– Wave Period
– Current…
– But also speed, capacity, comfort, safety, fuel economy, charter costs
Main Benefits
– Evaluate & Benchmark Vessels & Transfer Systems
– Optimise and Increase reliability of O&M modelling
Source: OWA Trial Procedures
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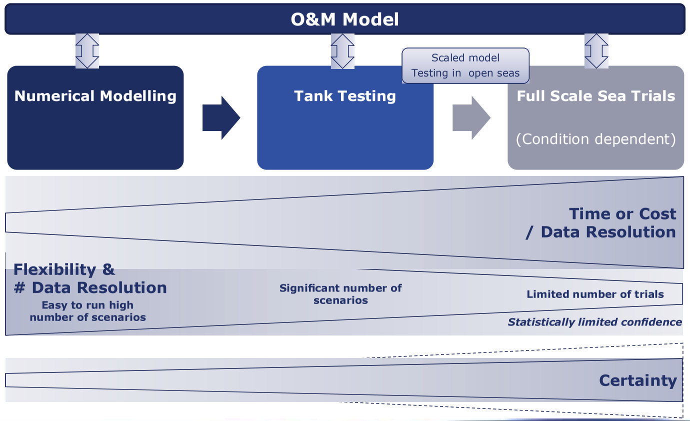
Performance Evaluation Possible sources



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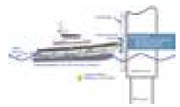
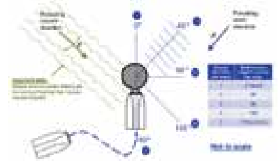
OWA Proposed Method

- **Accessibility divided in:**
  - **Transit**: Port/Safe heaven to turbine surroundings
  - **Approach**: Turbine surroundings to engagement with turbine
  - **Transfer**: Vessel totally engaged



- **Performance assessed through Numerical modelling and Tank Testing**
  - More scenarios / metocean conditions could be modelled
  - Numerical Modelling mature for free running, but under development for alongside turbine condition
  - Tank Testing
- **Challenges:**
  - Overcome uncertainties
  - Define Fender behaviour
- **Verify in full scale trials**
  - Validate already obtained Performance Data
  - Less time (and cost) necessary
  - Data collection – Data analysis



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What we measure:

Transit:

- **Goal:** Technicians must arrive at the turbine fit to work as fast as possible
- **Measure**
  - Maximum speed a CTV can achieve in a given sea state
  - Parameters: Different Wave heights, Wave directions and 2 different Wave spectra (for near offshore and far offshore sites)
  - Limit: A given Motion Sickness value

Approach

- **Goal:** Ability of the vessel to reach the turbine
- **Measures** in development

Transit:

- **Goal:** Safely transfer to the turbine
- **Measure**
  - Maximum Wave heights a CTV that guarantee a safe transfer in a given sea state
  - Parameters: Different Wave directions, Current directions and 2 different Wave spectra (for near offshore and far offshore sites)
  - Limit: A given "slip frequency" / "confidence value" for non-slip condition.

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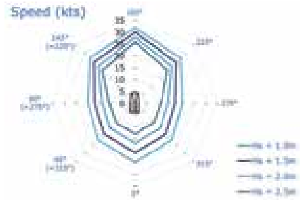
Some (illustrative) Examples:

Transit



Heading (deg)	Transit Speeds (knots) Hs = 1.0m	Hs = 1.5m	Hs = 2.0m	Hs = 2.5m
180°	32	30	28	26
225°	27	24.5	22	19.5
270°	20	17	14	11
315°	22	18.5	15	11.5
0°	25	21	17	13
45° (=315°)	22	18.5	15	11.5
90° (=275°)	20	17	14	11
145° (=225°)	27	24.5	22	19.5

Example of a Transit P-Plot and example of a Transit performance table

Transfer

Heading (deg)	Significant Wave Height (m) No Curr	Head Curr	Beam Curr	Stern Curr
180°	3.0	2.8	2.0	2.5
225°	2.5	2.2	2.0	2.3
270°	2.0	1.8	1.0	1.5
315°	2.2	2.0	1.8	1.8
0°	2.5	2.0	1.8	2.0
45° (=315°)	2.2	2.0	1.8	1.8
90° (=275°)	2.0	1.8	1.0	1.5
145° (=225°)	2.5	2.2	2.0	2.3

Example of a Transit P-Plot and example of a Transit performance table

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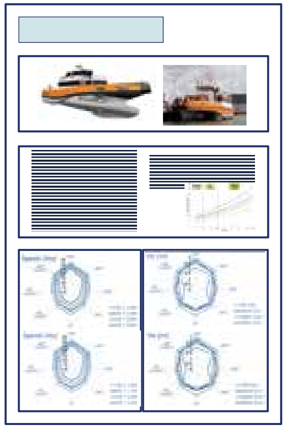
P-Plots Vision: An Industry standard



One-pager vessels specifications with:

- **P-Plots (2 Transit + 2 Transfer)**
- **Vessel Geometry:**
  - Length over all (LOA)
  - Normal Operational Displacement [lightship displacement + 10t]
- **Additional Vessel Features**
  - Number of passengers
  - Cargo Capacity / Payload
  - Type of Thrust and Installed power
  - Fuel consumption and tank capacity
  - Noise levels
- **Other information:**
  - Company details
  - Class / Flag
  - ...

Source: Fjellstrand / OWA Trial Procedures

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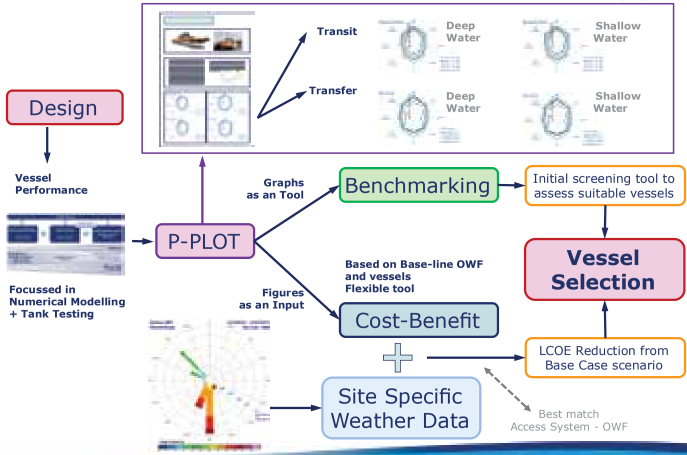
Performance Evaluation Method



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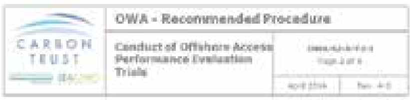
Next Steps

- Update of the **OWA Trial procedures**



- **New Sea Trials** within OWA to check approach
- Extensive **data collection** to define properly:
  - Transit limits (motion sickness dose value)
  - Transfer limits (slip)
- **Publication** for extensive industry usage.

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Key take-away points

- As we move further from shore, we need **new in-field crew transfer vessels**, more capable **transfer systems**, and **motherships**, with high potential of **increasing availability**, which will reduce cost of energy
- There a number of **innovative concepts** on the drawing board, and many of them are now close to **reaching the market** and will also improve performance in close-to-shore sites
- We need to **move beyond wave height** as a measure of performance. This will help us to improve
  - Vessel selection
  - O&M modelling
- We aim that more quantitative and objective performance evaluation will be adopted by **industry** as a **standard**

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Presentation 3: *Alan MacLeay,* Seaway Heavy Lifting: Boat landing standardization

Executive Summary

Workboat operators have been keen to see a standardized boat landing arrangement on wind turbine foundations for some time. This was perceived as desirable to improve safety and minimise costs of modifying boat fenders. At the end of 2013, Alan MacLeay, chairman of the Renewable Workgroup at IMCA took up the challenge to see if it was possible to develop a standardized arrangement.

An enquiry was sent out to wind farm developers, designers, CTV operators and other interested parties across Europe. All G9 members contributed information. A database was then compiled summarising key parameters related to the boat landing designs. Interpretation of this data showed that de facto standards exist for several key parameters and it should be possible to come up with a broadly acceptable arrangement.

The work also identified a number of interesting areas where further research is required. Perhaps the most important of these areas is the boat impact loading. Out of the 24 projects where data were collected, only two were able to provide this figure. There are two concerns here.

Firstly, the owners' operations and procurement teams need to know the limits of the boat landing system when hiring CTVs. This could be a growing issue as the trend is towards larger CTVs operating in worse sea conditions and therefore impact loads tend to be increasing.

Secondly, there is a factor of more than four difference between the two numbers provided. This suggests that there is an immaturity to the design approach. On closer investigation of the design rules it can be seen that there is an inconsistency between different design codes and a number of important variables are missing. At the same time, there is now feedback from developers that where loads and decelerations have been measured they are higher than expected.

The conclusions of this work are currently being written up and are expected to be circulated for comment in the near future.

Seaway Heavy Lifting

Boat Landing Standardisation IMCA Update 30 September 2014

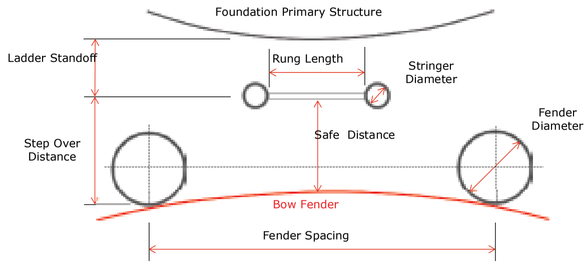
Alan MacLeay, Engineering Director, Renewables, Seaway Heavy Lifting

18 June 2014

Introduction

- Boat landings look pretty similar across offshore wind projects.
- There are now hundreds of workboats across Europe.
- There would be safety and cost improvements if the industry could agree a common arrangement for future projects.
- Consult industry to see what has been done, gather feedback and explore the feasibility of establishing a common approach.

Consultation



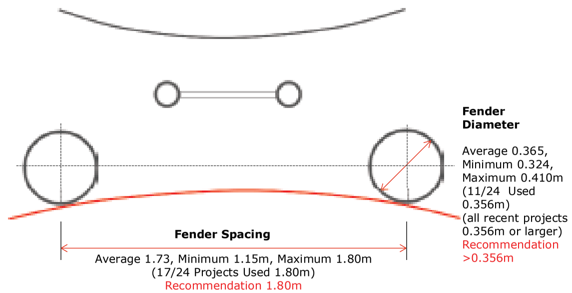
PLAN ON FENDER

Not to scale

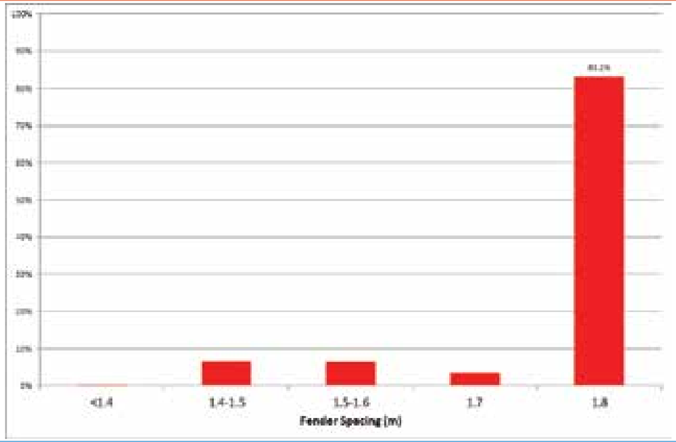
Responses: 24 Projects = 1355 Foundations

SSE, RWE, Statkraft, Statoil, DONG energy, centrica, e.on, VATTENFALL, SCOTTISHPOWER RENEWABLES, GLOBAL TECH I, enova, WindMW, EWE, renewableUK, VSMC, MCS, WORKSHIPS CONTRACTORS BV, WINDCAT, SIEMENS, ATKINS, LIC ENGINEERING A/S, Fendercare marine, RG

Fenders (26% have two, 74% one access point)



1.8m spacing recommendation



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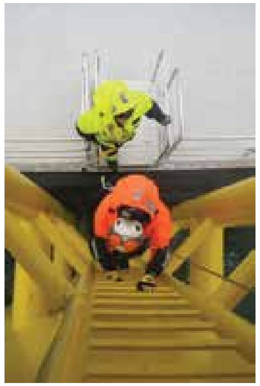
Feedback from CTV Operators



- Less than 14" diameter fenders cause high wear rates.
- Discontinuities in the fenders cause high wear rates.
- Having fender returns at top and bottom is welcomed.
- Watch clashing with landings at the top of the ladder.
- Having off vertical fenders doesn't seem to affect installation sea state.

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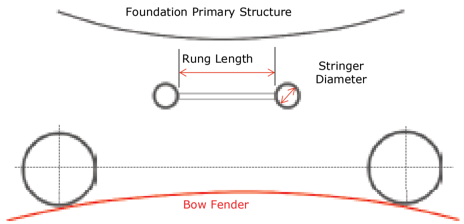
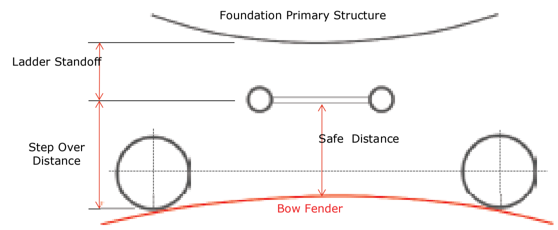
Ladder Details



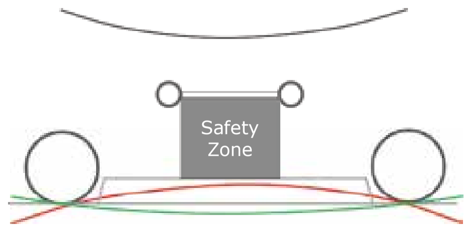
Rung Length: Av. 0.524m, Min. 0.400m, Max. 0.686m
Rung Spacing: Av. 0.270m, Min. 0.245m, Max. 0.300m
Ladder Bottom (LAT): Av. -1.51m. Min. 1.42m, Max. -4.00m

Clearances



Step Over Distance: Av. 0.709m, Min. 0.500m, Max. 0.793m
Safe Distance: Only one number provided!!!!!
Ladder Standoff: Av. 0.493m. Min. 0.184m, Max. 1.204m

Flexibility in bow fender profile is a challenge So is fender stiffness & applied force.



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12 June 2015
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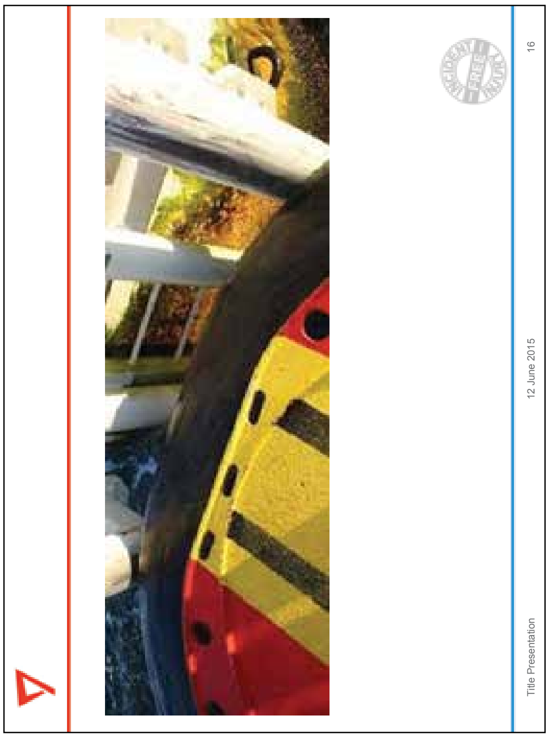
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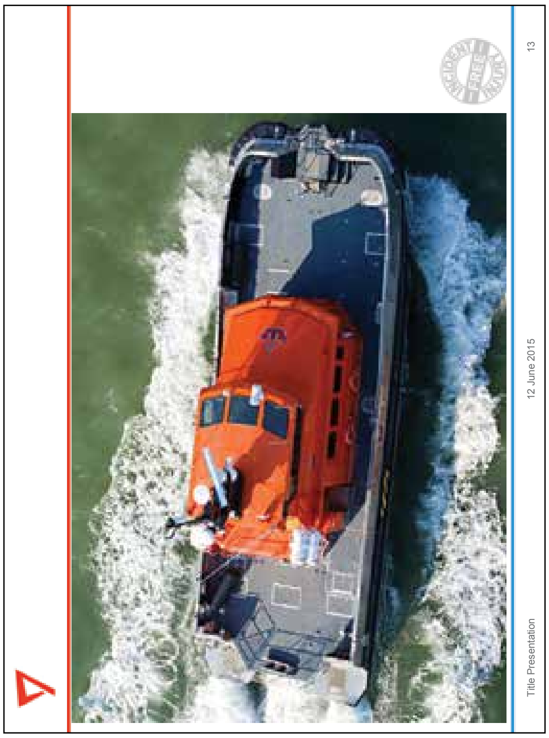
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G9: Draft Offshore Wind Working At Height Regulations

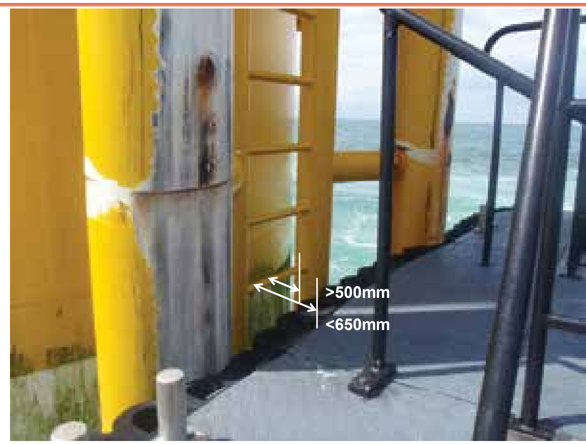
3.1.2 *Access from Vessel to External Platform*

This section addresses the work at height aspects of transfer by stepping over from a vessel to a ladder on a boat landing structure. Other access methods, such as stabilised walkways and platforms, or lifting people using manbaskets on cranes, are not considered here, but may also present risks relating to work at height. The selection of access methods and equipment should be subject to risk assessment, and apply the hierarchy of protective measures for work at height.

3.1.2.1 Boat Landing Structure

- Design of a boat landing structure must:
  - Leave a safe zone between the vessel bow and the boat landing ladder, to eliminate the risk of crushing between the vessel and the ladder;
    - The safe zone should provide:
      - A minimum of 500 mm clearance between the vessel fender and the ladder rungs; and
      - A maximum stepping distance of 650 mm between a suitable and safe non-slip surface on the vessel and the ladder on the foundation;
  - Ensure that the top and bottom of the bumper bars extend beyond the range of vessel bow heights that may be expected, taking account of tidal range, effect of waves, and foreseeable vessel types;
    - Any protrusions from the boat landing structure, such as intermediate platforms, must be sufficiently high to ensure that they do not endanger people on the vessel bow, when the vessel is in the highest foreseeable position on the bumper bars;
    - Any rest platform would also have to be positioned so that it does not interfere with the safety zone between the vessel and the ladder, or create a risk of being hit by a moving vessel;

CTV Fender Stiffness



How to work out design forces?

In the data provided only 2 projects gave limiting forces.
These were 200 and 823kN?
Very surprised this information isn't more readily available!

L.O.A. (m)	Lt/ship Disp. (te)	Deck Load (te)	Fuel Oil (m3)	Fresh Water (m3)	O&B Water (m3)	People	Displacement (te)	OS-J-101 Impact (kN)	HSLC 6/38 Impact (kN)
South Boats									
17.47	31	8	3.84	0.22	0.1	12+3	44	110	130
19.07	41	8	5	0.35	0.1	12+3	56	140	185
19.15	41	8	5	0.35	0.1	12+3	56	140	185
21.01	45	15	7.2	1	0.5	12+3	69	171	200
22.30	50	8	10	1	0.5	12+5	78	174	205
25.14	57	20	10	1	0.5	12+5	89	221	260
28.60	75	21	30	2	1	12+5	118	255	347

The scientific basis behind DnV guidance isn't clear!
How realistic is a deceleration of 0.25g?

Shouldn't this be linked to approach speed,
environmental conditions and fender stiffness / design?

Boat Landing Impact Damage

Need to think about more than just monopiles & jackets

Conclusions So far

- Designers wrapped up in NDA.
- Apparent lack of knowledge of load limits with operations teams.
- Basis of codes isn't obvious.
- Looks like heading towards consensus on main dimensions.
- Good understanding of exceptions.
- Difficult to standardise for both ship shaped and catamaran bows.
- Some interesting ideas coming through.
- Some research areas identified.
- Finish writing up summary report including a suggested standardised arrangement.

ANNEX B
ABBREVIATIONS AND ACRONYMS

CTV	crew transfer vessel
DP	dynamic positioning
EI	Energy Institute
G9	G9 Offshore Wind Health and Safety Association
HAZID	hazard identification study
HSE	Health and Safety Executive
IMCA	International Marine Contractors Association
LARS	launch and recovery system
LOLER	*Lifting operations lifting equipment regulations*
MOB	man overboard
NDT	non-destructive testing
O&M	operations and maintenace
ORE	offshore renewable energy
OWA	Offshore Wind Accelerator
PPE	personal protective equipment
R&D	research and development
RD&D	research, development and demonstration
SRL	self-retracting lifeline
SWATH	small water plane area twin hull
TP	transition piece
WAH	work at height
W2W	walk to work
wrt	with respect to
WTG	wind turbine generator

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