Good practice guidelines

G+ Offshore wind farm transfer

G+ Global Offshore Wind
Health & Safety
Organisation

In partnership with

energy institute

GOOD PRACTICE GUIDELINES

G+ OFFSHORE WIND FARM TRANSFER

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1 INTRODUCTION AND SCOPE

1.1 INTRODUCTION

This guidance aims to provide a framework of how to execute a safe transfer in an offshore wind farm. The goal is to provide consistency and good practice regarding transfer across the wind industry and allow operators and vessel owners to produce or to verify their transfer procedure up against a set of industry standard guidelines. It should be noted that each of the sections, and the combined contents of this document, should be considered as the minimum requirements to execute a safe transfer.

This guidance considers:

- transfer from vessel to offshore structure;
- transfer between vessels;
- transfer using walk to work (W2W) gangways;
- protection against falling, including the use of self-retractable lifeline (SRL);
- personal protective equipment (PPE) requirements, and
- protection against drowning, including a risk-based approach to the use of immersion suit.

For all transfers where there is a risk of falling from height, the transferee should be continuously attached to a fall arrest system (FAS).

It should be noted that PPE requirements for each transfer type are grouped together in a separate section (see section 6).

1.2 SCOPE

This guidance addresses people transfer in an offshore wind farm globally and puts forward a consensus approach, taking account of existing and emerging industry good practice. The document draws inputs from the G+ *Good practice guideline – Working at height in the offshore wind industry*.[1] It is also based on a report commissioned by Ørsted and Siemens Gamesa Renewable Energy (SGRE) entitled *A review of the mandated use of immersion/ dry suits* and a study that RWE (formerly E.ON) commissioned Professor Mike Tipton to produce entitled *A consideration of the use of immersion suits in E.ON's offshore wind farms*. Additionally, the guidance builds on the letter sent by the UK Health and Safety regulator, the Health and Safety Executive (HSE) in 2015 and the G+ response.

This document is intended to work alongside the G+ *Good practice guideline – Working at height in the offshore wind industry* and *Good practice guideline – The safe management of small service vessels used in the offshore wind industry*. For details on European Union (EU) directive and national regulations, work at height regulations outside Europe and guidance on technical and equipment standards, refer to the G+ *Good practice guideline – Working at height in the offshore wind industry* annexes.

1 There will be a 3rd edition of the working at height good practice guideline to reflect that some of the content has been moved into this document.

This guidance covers standard sea transfers, such as transfer from vessel to offshore structures, transfer between vessels and W2W gangway transfer. All alternative transfer procedures, such as sliding access, Pict Offshore – The Get Up Safe system, double hooking or helicopter transfer are out of the scope of this document.

2 HIERARCHY OF PROTECTIVE MEASURES

Key principle:

Where working at height (WAH) cannot be avoided, tasks should be planned carefully, applying the hierarchy of protective measures to minimise the risk from falls.

Transfers in an offshore wind farm can involve WAH. All consideration of WAH should start with the hierarchy of protective measures. A lower level on the hierarchy should only be adopted if it is not reasonably practicable to take the approach given in a higher level.

Under the conditions in which W2W systems are managed, it is seen as a safer transfer method, eliminating the risks associated with WAH and climbing. Whereas transfers from vessel to structure and vessel to vessel introduce WAH and rely heavily on administrative controls and PPE, these types of transfers therefore have a higher risk.

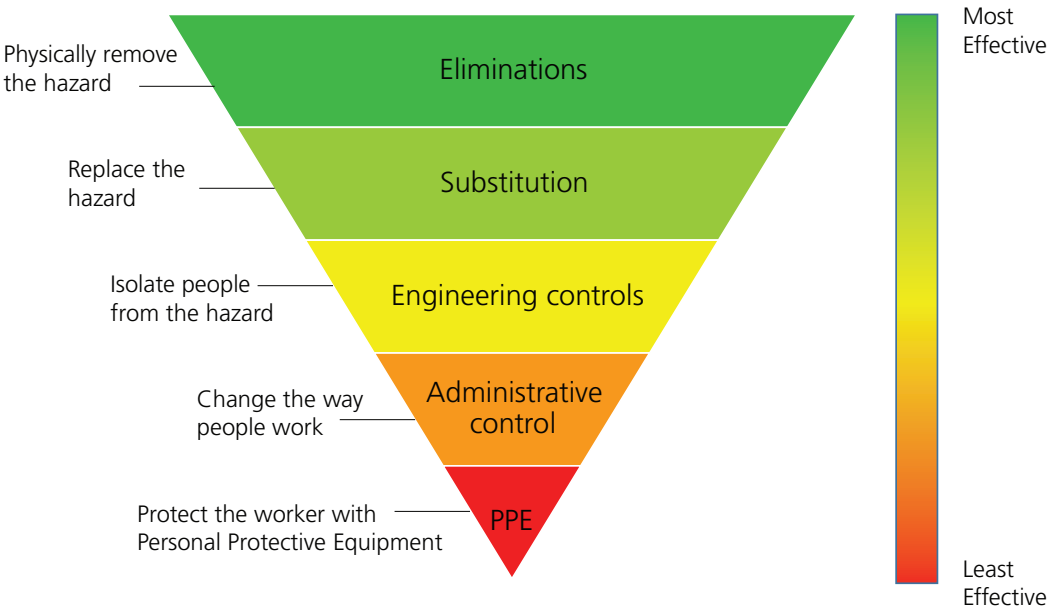


Figure 1: Hierarchy of hazard controls

For further details on hierarchy of protective measures, see G+ *Good practice guideline – Working at height in the offshore wind industry*.

3 TRANSFER FROM CREW TRANSFER VESSEL (CTV) TO OFFSHORE STRUCTURE

Key principle:

The aim should be to ensure that people do not fall into the sea, or become trapped between the vessel and any part of the offshore structure during transfers. This should be achieved through a combination of foundation design, vessel selection, operating procedures, training and competence. Residual risks should be mitigated by using suitable protective equipment.

This section covers personnel transfer from the deck of a CTV to the external platform on the transition piece (TP), or equivalent position on other offshore structures. It is assumed that this transfer involves stepping from the vessel onto a stationary vertical (or near vertical) boat landing ladder while continuously attached to an FAS, then climbing to the external platform on the offshore structure, with the operation being reversed for transfer back to the vessel. Although floating wind turbine generators (WTGs) are not fixed to the seabed, the hazards and protective measures can be applied, subject to the standard risk assessment process. This section covers:

– supervisory working arrangements;
– training and skills, and
– potential hazards at each stage of the transfer process.

3.1 SUPERVISORY/WORKING ARRANGEMENTS

3.1.1 Responsibilities of wind farm or offshore substation operators and vessel charterers

The wind farm and offshore substation operators are responsible for sourcing vessels that are compatible with the boat landings. See G+ *Good practice guideline - The safe management of small service vessels used in the offshore wind industry*.

3.1.2 Roles of vessel Captain, deckhand and transferee

It is the right of all parties (Captain, deckhand and transferee) to call for a stop to a transfer if they view it to be unsafe. The focus of all parties should be on the transfer, and distractions avoided.

The vessel Captain has overall responsibility for the safety of the vessel and all personnel aboard. Specific duties generally include, but are not limited to:

– ensuring that the transferee is instructed according to site-specific transfer procedure;
– carrying out communications check with the transferees before and immediately after transfer to structure;
– authorising transfer, based on stable positioning of vessel, and
– maintaining weather watch and notifying the marine coordinator/working parties of how this can affect offshore work.

The deckhand has a key role on CTVs, with responsibilities generally including, but not limited to:

- Ensuring the safety of personnel on board the vessel and during transfers, including carrying out induction/briefings, physical training and managing the movement of personnel between areas of the vessel.
- When a transferee is on the boat landing ladder, the deckhand counts down the remaining rungs and once it is safe, communicates to the transferee to step back onto the vessel or vice versa.
- Assisting the transferee back onto the vessel.
- Should the site procedure assign any other responsibilities to the deckhand, then training and competence assessment in these tasks will also be necessary, and the responsibility interfaces will have to be agreed between the different employers involved. Typical activities at this interface include, but are not limited to:
  - confirming that the transferee's PPE is correctly fitted for transfer;
  - carrying out pre-use checks on the ladder SRL;
  - pulling down the SRL and attaching/offering it to the transferee;
  - assisting the transferee with disconnection from the SRL;
  - assisting with recovery of injured personnel being lowered to vessel deck, with or without a stretcher, from the external platform, hub or other levels of an offshore structure;
  - ensuring that everyone is seated during landing and leaving the boat landing, and
  - keeping transfer area clean from obstacles and ensuring it is not a slippery surface.

As can be seen from this list, the deckhand may have many important and simultaneous responsibilities; these must be realistic, to avoid creating overload.

The responsibilities of the Captain and deckhand must be clear and appropriate, particularly as the Captain has access to the vessel public address (PA) system, so may be able to communicate to the transferee more effectively than the deckhand, even though the deckhand is closer.

Transferees being transported on vessels also have specific responsibilities including, but not limited to:

- compliance with vessel safety policies and instructions;
- making sure they are familiarised with the site-specific transfer procedure;
- wearing correct PPE, ensuring that it is properly fitted, within its inspection date and in good condition;
- verification that there are no loose objects in open pockets. See G+/DROPS *Reliable securing booklet for offshore wind* for further guidance on this subject;
- ensuring that PPE 'buddy checks' are carried out before proceeding to the vessel transfer point;
- ensuring large bags, such as backpacks that could interfere with PPE, are not carried;
- confirming correct operation of ladder FAS;
- deciding if transfer is within personal capabilities, at the time of transfer, and communicating this decision, and then
- transferring without delay onto ladder, once attached to FAS.

3.1.3 Procedural arrangements

Clear decision criteria must be in place for conditions under which transfer can take place. As these are dependent on each vessel type's 'theoretical limits' and actual infield performance, a site-specific procedure should be drafted to include each vessel type used, with its limitations, and this should be evaluated in the field. It is not as simple as setting a wave height limit; other important variables include, but are not limited to:

– the wave direction and wave period (relative to the vessel);
– vessel performance – different vessels may have different levels of movement in similar conditions, and
– the condition of the ladder, especially the level of contamination, excessive marine growth or presence of ice, which can affect the safety of the transferee.

There should also be suitable arrangements in case of problems arising:

– A rescue plan must be in place, and all personnel (both vessel crew and offshore structure personnel) must be familiar with the plan and competent to fulfil their roles – regular practice is necessary in order to combat skill fade; this includes rescue from any position on the ladder, and from the sea.
– Effective personnel tracking, marine coordination and emergency response systems must be operated, so that the locations of all personnel and vessels are always known.

When reviewing decisions about whether conditions were suitable for transfer, or investigating incidents that occur during transfer, the use of vessel closed circuit television (CCTV) can provide evidence of the situation that faced the personnel involved, and the actions taken, and can also be useful in sharing lessons learned.

3.2 TRAINING AND SKILLS

3.2.1 Standard qualifications

Transferees should have fulfilled the baseline training requirements, such as Global Wind Organisation (GWO) sea survival training. The Captain and deckhand have key responsibilities in enabling safe transfer. While there are recognised qualifications for vessel Captains and deckhands/crew, and some of the qualifications are specific to workboat personnel and typical workboat operations, there is no specific, recognised training relating to transfer of personnel onto offshore structures. In the absence of such qualifications, operators will have to conduct their own assessment of competence. See G+ *Good practice guideline - The safe management of small service vessels used in the offshore wind industry*.

3.2.2 Site-specific requirements

In addition to standard training that is needed to work on any site, some site-specific training and familiarisation is necessary, such as:

– Instruction and familiarisation of detailed transfer procedure – taking account of vessel/ladder/FAS interfaces. It is recommended that a specific transfer induction, as well as familiarisation, is provided to all transferees.
– Training for deckhand and vessel Captain, roles in procedure, use of FAS and roles in ladder rescue situation.

- Man overboard (MOB) training for Captain, deckhand and offshore structure personnel (if vessel crew is just Captain and deckhand, then the offshore structure personnel may need to assist in any rescue of the deckhand).
- Regular practice should be carried out, including:
  - practice in darkness if transfers are ever carried out in the dark;
  - practice with doll thrown from the ladder and vessel pushing on (as transfer situation);
  - practice in realistic sea conditions;
  - utilising MOB tracking systems as well as visual contact, and
  - training in site emergency arrangements.

Each site should provide each transfer contractor with all the required details of the boat landing and site-specific details. Each transfer contractor should present each site with their vessel project-specific transfer induction, which must be bridged to the site-specific transfer procedure.

3.3 HAZARDS DURING SPECIFIC ACTIVITIES

Table 1 identifies some of the principal hazards relating to WAH that may be present in a typical transfer process, and recommends measures that can be taken to reduce the associated risks. In cases where the basis for the recommendations may not be obvious, this is outlined in the relevant column. This table could be used as an input to a hazard identification and risk assessment process but is not a comprehensive risk assessment on its own.

Table 1: Hazards during transfers by stepping over to boat landing ladder

Activity	Hazard	Recommended risk control	Basis of recommendations
Movement on vessel prior to start of transfer process	Slip/fall on vessel or overboard	Prevention: – Housekeeping: keep walkways clear of obstructions and free from contamination (especially oils / greases) – Use suitable footwear – non-slip soles, and avoid oil contamination – Vessel design: provide suitable walkways, guardrails and anchor points – Suitable area for donning immersion suit and harness – best not to wear immersion suit for duration of passage on vessel – Do not move around on vessel unless essential – Vessel crew and transferee competencies Mitigation: – Do not leave cabin unless wearing PFD and personal locator beacon (PLB) (depending on sea conditions)	Wearing immersion suits during passage can lead to overheating[2], increased risk of seasickness, and sweating reducing thermal efficiency of clothing worn beneath suit
Transfer from vessel to boat landing ladder	Fall into sea, between vessel and boat landing ladder	Prevention: – Combination of detailed design of vessel and operating procedure should ensure that no person is in a location from which they could fall into sea – i.e. remain within guardrails until stepping forward to attach to ladder FAS (presumed to be an SRL)	

2 IMO guidance on wearing immersion suits in totally enclosed lifeboats is given as Annex A of: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440770/MGN_396.pdf

Table 1: Hazards during transfers by stepping over to boat landing ladder (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
		– Deckhand to remain within area protected by guardrails, or wear a harness and be in work restraint, so that they cannot fall overboard. For this to be effective, the anchor point on the vessel may need to be higher than the attachment point on the deckhand's harness – this should be checked when selecting a vessel. If effective work restraint is not possible, then a fall arrest lanyard should be attached to a suitably rated anchor point; the risk assessment should also consider the potential position of the deckhand if suspended, to ensure they will not be suspended in front of the vessel fender, which would introduce a risk of crushing. The position of the anchor point should not impede the deckhand from moving back from the bow, such as if an object falls from the person transferring. Use of a combined harness/PFD may be beneficial – Each person should confirm fitness to transfer and climb, prior to transfer commencing, taking account of seasickness etc. – Vessel crew and transferee competencies – SRL and functionality requirements – MOB reaction times	

Table 1: Hazards during transfers by stepping over to boat landing ladder (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
		Prevention: – Attach to SRL before stepping off vessel	Recommendation to attach to SRL before stepping off vessel is based on: – Transfer taking place in suitable conditions – vessel holding steady position against boat landing – speed and distance of any movement should be much less than SRL lock-on limits; – Vessel and ladder/boat landing are compatible, i.e. sufficient safety zone to prevent crushing – Design and operation of SRL allows for limited vessel movement without activation – Connector between SRL and harness allowing easy one-handed connection /removal, while wearing gloves
		Prevention: – Do not climb ladder if it is iced/severely fouled – Ensure ladder is regularly cleaned at low tide – Use suitable footwear and gloves to provide good grip – Maintain continuous attachment during climbing (ladder SRL, or scaffold hooks/lanyards if SRL not available)	
		Mitigation: – Always wear a suitable PFD during transfer	

Table 1: Hazards during transfers by stepping over to boat landing ladder (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
		Mitigation: – Do not attach any bags to harness or body – Ensure harness (and all other PPE such as PFD, immersion suit) is correctly fitted – carry out buddy check before going on deck	Bags can result in: – Climbing being impeded, increasing the probability of a fall – Added weight (casualty floats lower in water, increasing risk of drowning due to water inhalation) – Added buoyancy in wrong position relative to casualty's centre of mass (casualty may not self-right to bring face out of water, increasing risk of drowning)
		Mitigation: – Ensure casualty's position can be located – PLB and light to be worn on (preferably integrated with) PFD	Locating PLB on PFD ensures that it is always in the same location on the person, irrespective of whether an immersion suit is worn, and ensures that the inflated PFD does not obstruct access to a PLB worn on the immersion suit. However, the PLB mounting arrangement must be compatible with the inflated PFD – manufacturer approval may be needed
		Mitigation: – Wear suitable immersion suit when conditions require	

Table 1: Hazards during transfers by stepping over to boat landing ladder (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
	Fall between vessel and boat landing ladder, remaining attached to either, resulting in impact with, or crushing between, vessel and boat landing ladder/bumper bars	Prevention: – Only attempt transfers in suitable conditions Mitigation: – Eliminate risk of crushing between vessel bow and boat landing ladder by ensuring vessel and boat landing structure are compatible – after arresting a fall, the FAS should suspend the climber in the safety zone formed by the bumper bars – include in vessel specifications and surveys – Step over from vessel to ladder as soon as attached to SRL/detach immediately after stepover from ladder to vessel – Use FAS so that if a fall occurs, casualty remains in safety zone between ladder and vessel – If deckhand is attached to vessel, they should be in restraint, so that they cannot be suspended over bow fender – this may require the provision of an anchor point above harness dorsal attachment point height – Vessel Captain to monitor transfers, and manoeuvre vessel to safe position in the event of a failed transfer	
	'Picked up' by SRL due to vessel movement	Prevention: – Only attempt transfers in suitable conditions – Step over from vessel to ladder as soon as attached to SRL/detach immediately after stepover from ladder to vessel – Design and operation of SRL allows for limited vessel movement without activation – If the procedure involves the deckhand introducing slack into the system prior to connection, then this must not exceed the allowable limits for the type of SRL	

Table 1: Hazards during transfers by stepping over to boat landing ladder (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Climbing boat landing ladder	Slip/loss of grip on ladder, leading to fall, resulting in injury of climber and/or deckhand	Mitigation: – Climber to be attached to SRL while climbing	
Transfer from boat landing ladder to additional ladder(s) of TP/ jacket	Fall from height during transfer between FAS	Mitigation: – Attach to designated anchor point while transferring between FAS	
Climbing additional ladder(s) of TP/ jacket	Slip/loss of grip on ladder, leading to fall	Mitigation: – Attached to FAS while climbing	
Work on external platform	Fall from height	Prevention: – Do not leave any unprotected edges on completion of any tasks that require opening of hatches or guardrails – Work in restraint, to prevent falls if hatches or guardrails have to be opened (e.g. open section of guardrail for lifting loads to / from external platform)	

Table 1: Hazards during transfers by stepping over to boat landing ladder (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Transfer from boat landing ladder back to vessel	Fall from ladder (Other hazards and risk controls are the same as for transfer from vessel to boat landing ladder – see above)	Prevention: – Clarity of deckhand and Captain's roles – Count climber down last few steps, and then instruct when to step back – Having a standard communication protocol can help to avoid misunderstanding e.g. '4-3-2-1-Yes' (avoid words that could be mis-heard, such as 'step/stop', 'go/no'.) – Vessel PA can help with audibility – Deckhand to be ready to assist climber in establishing stable position on vessel and detaching from SRL	

4 TRANSFERS BETWEEN VESSELS

Key principle:

Transfers between vessels should maintain the same level of safety as transferring to an offshore structure, and should therefore only take place under conditions that permit safe transfer; these include limiting the allowable extent of relative movement between the vessels. For transfers where there is a risk of falling from height, the transferee should be continuously attached to an FAS.

This section considers transfer between CTVs and large vessels such as hotel ships, construction vessels or service operations vessels (SOVs), i.e. transfers from large to small vessels and the reverse. Several different types of transfer can be undertaken; the hierarchy of protective measures should be used when assessing different transfer options. The same requirements regarding supervisory arrangements, procedure, training and competence as for the vessel-to-structure transfer are applicable here.

4.1 LEVEL STEP-OVER

Some hotel vessels or SOVs are equipped to enable a CTV to push on amidships, adjacent to a shipside door, allowing level (or near level) transfer, without any climbing being involved. As this minimises the risk of a fall from height, it is a preferred solution.

4.2 TRANSFER BY STEPPING OVER ONTO A BOAT LANDING LADDER

Some large vessels have purpose-designed boat landings which CTVs can push against, allowing personnel to step over to the ladder and climb up to the deck, in a similar manner to accessing an offshore structure. The design of the boat landing should satisfy the same requirements as landings on offshore structures, with respect to key safety features such as stepover distance, protection against falling and against risks caused by vessel movement. See G+ *Safe by Design workshop report: Marine transfer/access systems* for further details. This includes the provision of an FAS where there is a risk of falling from height; given that this is a modified application of the standard approach used when transferring to fixed offshore structures, vessel-specific hazard identification should be undertaken to identify any additional hazards, so that these can be eliminated or mitigated.

The optimal position for a boat landing depends on the type of vessel, and the circumstances under which transfers are to be undertaken:

– the larger vessel may be at anchor or holding position using dynamic positioning (DP), and
– if the boat landing is positioned to allow beam-on transfers, then this can be used to create a lee-side, giving more sheltered conditions.

The means of positioning of the larger vessel needs to be suitable to allow for the push-on force of the CTV, which can exert a bollard push force in the order of 5 – 10 tonnes. Careful coordination between the two vessels will be necessary, both to ensure that sufficient force is

applied to avoid relative movement of the vessels at the boat landing, and to avoid the larger vessel being pushed out of position.

4.3 HAZARDS DURING SPECIFIC ACTIVITIES

Table 2 identifies some of the principal hazards that may be present in a typical transfer process between vessels and recommends measures that can be taken to reduce the associated risks. These risks are additional to those present in transfers between CTVs and fixed structures. In cases where the basis for the recommendations may not be obvious, this is outlined in the relevant column. This table could be used as an input to a hazard identification and risk assessment process, but is not a comprehensive risk assessment on its own.

Table 2: Hazards during vessel-to-vessel transfers

Activity	Hazard	Recommended risk control	Basis of recommendations
Transfer beam-on	Larger vessel pushed out of position	Prevention: – Coordination of vessels – in particular, if using DP, the DP operator needs to be ready to respond to a CTV push-on – Limitation of allowable thrust to be applied by CTV, but force must still be sufficient to avoid relative movement of the CTV bow and the boat landing Mitigation: – Undertake transfers at a location where some loss of station-keeping is not hazardous – No simultaneous operations involving the larger vessel, such as lifting or gangway transfers, while the CTV transfer is in progress	
Transfer at stern, under way	Fall into water, with additional hazard of propeller wash of larger vessel, which could result in being swept under CTV, with potential exposure to CTV propellers Recovery will also be more challenging, as the vessel will be moving relative to a casualty who is in the water, which may make it more difficult to maintain visual contact with the casualty	Prevention: – Use FAS on boat landing to prevent a person who falls during transfer from entering the water Mitigation: – Procedure: CTV to stop propellers if a person falls when not attached to the FAS. (Note that this will immediately result in relative movement of the CTV against the boat landing, so may not be appropriate if a person falls and is suspended by the FAS.)	– Design of boat landing, and compatibility with bow of CTV, provides a safe space where the climber can be suspended without risk of impact against the CTV – FAS will arrest a fall from bow height sufficiently quickly that a person suspended by the FAS is largely clear of the water. This should be checked, particularly if the transfer procedure introduces some slack into the system

5 TRANSFERS USING W2W GANGWAYS

Key principles:

A key part of mitigating the risk associated with transfer using W2W gangways is by ensuring that there is an appropriate design for the interface between the gangway and the platform. The gangway design should mitigate the risk of falling into the water to be at the same level as walking onboard a vessel.

The use of W2W gangways for access from a vessel to the external platform of an offshore structure aims to eliminate the hazards relating to WAH and immersion in the sea, which must be considered when stepping over to a ladder. However, other hazards exist when using this transfer method, therefore the risks need to be assessed and minimised. Some of the key hazards to consider, and potential protective measures, are reviewed in the following sections.

5.1 GANGWAY OPERATION

The gangway needs to be installed on a suitable vessel, with appropriate positioning capability to hold station with the required accuracy under anticipated operating conditions, taking account of wind, waves and currents.

The gangway needs to be properly integrated with the vessel, including aspects such as:

– positioning of the gangway for maximum stability;
– DP vessel to allow a stable and predictable footprint within the workability limits of the gangway, and
– power supply arrangements, to minimise the probability of an interruption.

Workability limits are identified when a gangway is integrated during vessel construction. However, for vessels where a gangway is retrofitted, after integration, a test is required to confirm the actual workability limits of the system on a specific vessel.

It is important to allow enough time for the DP model to build and excursions to settle down before transfer commences. Communications between bridge and gangway are crucial. The training and competence of all crew involved in the operation is critical to its success.

In preparation for transfer, there need to be clear procedures for the vessel and gangway operation. In particular, the procedures should focus on the roles of the DP and gangway operators in establishing and maintaining gangway positioning, and providing early warning of positioning limits being reached, which could result in the gangway retracting.

If a W2W gangway is correctly integrated, maintained and operated, then the probability of emergency retraction is minimised. However, personnel undertaking transfers still need to be trained in correct use of the gangway under normal conditions (through a transfer induction and a training session with the equipment), and how to respond in the event of emergency retraction occurring.

5.2 HAZARDS DURING SPECIFIC ACTIVITIES

Table 3 identifies some of the principal hazards relating to WAH that may be present in a typical transfer process, and recommends measures that can be taken to reduce the associated risks. In cases where the basis for the recommendations may not be obvious, this is outlined in the relevant column. This table could be used as an input to a hazard identification and risk assessment process, but is not a comprehensive risk assessment on its own.

Table 3: Hazards during W2W transfers

Activity	Hazard	Recommended risk control	Basis of recommendations
Initial positioning of gangway	End of gangway moving relative to offshore structure resulting in open gap or collision between gangway and structure	Prevention: – Clear procedures for vessel positioning and gangway operation – No personnel to be on gangway until it has established a fixed position and is confirmed to be safe for use – Gangway to be positioned under the control of a remote operator – Establish an exclusion zone around the position of the interface between the gangway and the offshore structure, so that if people are already on the structure, they are not at risk from movement of the gangway	
Opening/ closing of gangway access gates on structure	Fall from height	Prevention: – Design of gates to enable opening/closing from a safe location Mitigation: – Use PPE to prevent falls if it is necessary to approach open gates – If the risk of falls cannot be eliminated, then minimise the consequences: position of opening should not create the risk of a fall onto lower parts of the structure, and wear PFD and PLB for protection in the event of falling into the sea	Common industry practice is to require the wearing of PFDs during W2W transfers, to provide protection in the unlikely event of a fall into the sea However, if a fall could result in a person hitting lower parts of the structure (such as jacket legs, boat landings or concrete foundations), then this would result in severe injury, therefore the location at which the gangway connects with the structure should be selected so as to avoid this hazard

Table 3: Hazards during W2W transfers (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Emergency retraction of gangway	Fall from height	Prevention: – Minimise number of emergency retractions by ensuring that the gangway and vessel are suitable for use under foreseeable transfer conditions, and are suitably operated and maintained Mitigation: – Alarm to warn users prior to retraction occurring, so that any person undertaking a transfer can avoid being at the outer end of the gangway when it retracts – If the risk of falls cannot be eliminated, then minimise the consequences: the position where the gangway meets the platform should not create the risk of a fall onto lower parts of the structure, and wear PFD and PLB for protection in the event of falling into the sea – Train users how to respond to the alarm – procedure may differ between vessels, so provide briefing on the vessel and carry out periodic drills. A typical response is to move away from the end of the gangway (either onto external platform, or further onto the gangway), and if remaining on the gangway, adopt a braced position to avoid slipping when the gangway rises to a steeper gradient – If an emergency retraction occurs, investigate why it happened and use the learning to reduce future occurrences	Common industry practice is to require the wearing of PFDs during W2W transfers, to provide protection in the unlikely event of a fall into the sea However, if a fall could result in a person hitting lower parts of the structure (such as jacket legs, boat landings or concrete foundations), then this would result in severe injury, therefore the location at which the gangway connects with the structure should be selected to avoid this hazard
	Entrapment in/crushing between moving parts	Prevention: – Design to avoid creating shear/crush hazards where gangway sections move relative to each other – Safe handholds to be provided throughout gangway Mitigation: – Alarm to warn users prior to retraction occurring, so that any person undertaking transfers can be ready for sudden movement – Procedure for response when the alarm is given – Training (gangway-specific induction) and warning signs and markings to warn users of any residual risks and show how to avoid them	

Table 3: Hazards during W2W transfers (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
	Trip / stumble when stepping between moving sections of gangway	Prevention: – Gangway/vessel suitability to minimise relative movement – Design to minimise height difference between moving sections – Flooring to have clear markings and non-slip surfaces – Safe handholds to be provided throughout gangway Mitigation: – Procedure for response in the event of a person falling over – Gangway operator to monitor personnel transferring	
	Uncontrolled movement of load being transferred along gangway if gangway luffs to a steep angle	Prevention: – Transfer loads using crane, rather than gangway – Do not carry heavy objects by hand while transferring Mitigation: – People to be positioned at side of load which will be higher in the event of emergency retraction, and no personnel to be at other side, so that if the emergency retraction alarm sounds, they can safely let go of the load and brace with both hands. (e.g. person is always at WTG side of load, either pushing of pulling), if the gangway should slope up towards the WTG during emergency retraction	
Gates left open following (emergency) gangway retraction	Fall from height	Prevention: – Minimise number of emergency retractions (see above) Mitigation: – Procedure / operational restriction to inform teams accessing structure by other methods (such as CTV or helicopter) that gates may have been left open – Routine hazard-spotting checks on arrival at structure – Use PPE to prevent falls when closing open gates	
Accessing platform without gates	Fall from height due to climbing over guard rail	Prevention: – Fit gates to all structures that will be accessed using W2W Mitigation: – Modify end of gangway to enable climbing between gangway level and platform floor without risk of falling. This must not interfere with the emergency retraction function	

5.3 EMERGENCY MANAGEMENT

5.3.1 Loss of power supply to the gangway

Gangway design should include a power reserve or non-vessel-dependent emergency power mode. In case of complete failure of power supply to the gangway this should allow for a safe disconnection and return of any transferee on the gangway to the vessel deck.

5.3.2 Gangway failure

Based on failure mode and effects analysis (FMEA), gangway design must allow for redundancy of critical parts so that a technical failure of any one component never leads to unacceptable risk to transferees. When such a failure occurs, transfers need to be terminated as soon as safely possible, and the gangway returned to the vessel deck where it can be repaired so that redundancy is re-established. If there are personnel stuck on offshore installations and the redundancy of the gangway is affected, a risk analysis must be carried out to make the decision whether or not to transfer these people back to the vessel.

5.3.3 Operator incapacitated

Gangway user interface (UI) and control design should allow critical functions of the gangway to be automated, so that in case the operator is incapacitated or 'frozen' when facing a scenario in which they are unable to take the appropriate actions, the safety of the transferee is not negatively affected. For instance, the reaction to a redundancy failure should be automated, with an option for the operator to temporarily override the automatic reaction.

6 PROTECTION AGAINST FALLING – SRL ON BOAT LANDING LADDER

Key principle:

Attachment to an SRL before stepping from the vessel to the ladder, and remaining attached while stepping from the ladder to the vessel, will ensure that people do not fall into the sea or onto the vessel deck.

Transferring from the bow of a vessel to a boat landing ladder presents a risk of falling, either when stepping over or when climbing the ladder. There are concerns about how SRLs interact with heaving vessels, as this can lead to people being 'picked up' if the vessel suddenly moves down. The following conditions need to be satisfied in order to enable safe transfer with continuous attachment:

- Transfer is taking place in suitable conditions, defined as:
  - vessel is holding steady position against boat landing during step-across, and
  - speed and distance of any vessel movement should be much less than SRL lock-on limits:
    - When selecting an SRL, the specifier should identify the range and speed of vessel movement that will be within acceptable limits for transfer procedure and ensure that the SRL will not lock on within these limits. This may involve obtaining information on lock-on characteristics from the SRL manufacturer.
    - Data on the speed and range of bow movement can be captured using accelerometers, to quantify the demands on the SRL.
- Anchorage point should be positioned above the transferee to avoid exceeding SRL angle.
- Vessel and ladder/boat landing are compatible, i.e. sufficient safety zone to prevent crushing.
- Design and operation of SRL allows for limited vessel movement without activation:
  - If an operating procedure is proposed that involves manually introducing slack into the system, then this should be checked with the SRL manufacturer, to ensure that it does not increase the height of a fall to the extent that the energy absorption capacity of the SRL is exceeded.
- Connector between SRL and harness should enable easy and fast one-handed connection/removal, while wearing gloves. This minimises the time during which a person is connected to the SRL, while still on the vessel.

7 PPE AND SYSTEM REQUIREMENTS FOR TRANSFER

Key principle:

PPE is the last protective measure in the hierarchy of control. As PPE is often limiting the mobility of a person during transfer and because a transfer can involve using multiple items of PPE, a risk-based approach to PPE should be adapted, as well as a check of the compatibility, to ensure that the combination of PPE will function effectively.

The following PPE is specific to transfer in an offshore wind farm. A risk-based approach should be taken for the use of additional WAH PPE. The key hazards associated with the absence of PPE are:

– falling – mitigated by using FAS during transfer, and
– drowning – mitigated by using PFDs that are International Convention for the Safety of Life at Sea (SOLAS) approved, PLBs and, in some instances, immersion suits.

7.1.1 Protection against drowning: PFD

As transfer involves moving around on the deck of a vessel, and stepping over water, a PFD must be worn, providing at least 275 N of buoyancy. PFDs with automatic inflation are used; hydrostatic triggering of inflation avoids the potential for unintentional inflation, which can occur due to moisture ingress on PFDs that are simply triggered by the presence of water. Note that PFDs for use in helicopters must not inflate automatically, so this can affect PPE provision on sites that use both vessel and helicopter access. A full risk assessment would be required if there are simultaneous operations on a site.

7.1.2 Protection against drowning: casualty location

PLBs can assist in locating a casualty who is in the water. Several types are available, with different functions, therefore correct selection is important. PLBs must be compatible with systems used on the site where they are to be worn, to ensure that a casualty can be located effectively and without delay.

PLBs are generally integrated into PFDs, which has several benefits:

– it avoids an inappropriately mounted PLB interfering with the inflation of the PFD;
– it ensures that the PLB antenna is correctly positioned;
– it ensures that the PLB cannot be mislaid or dropped, as long as the PFD is worn, and
– the inflated PFD will not obstruct the casualty's access to the PLB in case manual activation is required.

Where PLBs are not integrated into PFDs, it is important to ensure that:

– it does not interfere with PFD inflation;
– it is positioned such that the antenna is as high as possible in event of activation, and
– it can be accessed by the casualty when PFD is inflated.

PLBs can work in several different ways:

- Homing signals can be transmitted on 121,5 MHz; rescuers can use this to determine the direction of the casualty's location, but not its distance.
- ID and location information can be transmitted on 406 MHz to the Cospas–Sarsat satellite network. The information from the satellites is transmitted to a mission control centre, which verifies that the signal is from a genuine distress call (rather than an accidental activation) before passing information to the nearest rescue control centre, which will broadcast emergency information to vessels and activate emergency response resources such as search and rescue (SAR). However, this verification stage typically takes about 60 minutes. This method is therefore of little benefit in situations where potential rescuers (such as CTVs) are already close to the casualty.
- Personal automatic identification system (AIS) beacons.
- Beacons with very-high frequency (VHF) digital selective calling (DSC) broadcast a DSC distress alert (Mayday), which can be received by all standard VHF DSC marine radios within range, together with an identification (ID) number and global positioning system (GPS) coordinates of the casualty. The coordinates are refreshed every five minutes; therefore, this can also be an effective method of tracking casualties.

7.2 OTHER PPE FOR TRANSFER

Suitable clothing and PPE for transfer should include:

- Gloves must provide good grip on wet/slippery ladder, protect hands, maintain dexterity for attaching to/detaching from FAS, and not be degraded by saltwater.
- Footwear must be well-fitted, with good grip:
  - Bulky integrated boots may impede climbing.
  - Thick integrated waterproof socks, worn inside normal safety footwear, can also impede climbing – either use an immersion suit with ankle seals (although these are easily damaged), or thin integrated socks that fit comfortably in normal safety footwear.
- Clothes worn under the immersion suit should provide sufficient insulation for prevailing weather conditions, given that the immersion suit itself is not insulated.

8 USE OF IMMERSION SUITS DURING STANDARD CTV TRANSFERS

Key principle:

During a standard CTV transfer, and with the use of an SRL, the risk of falling into the water is extremely low and if a fall into water does occur, and provided a suitable PFD is worn, the risk of fatality is even lower. A risk-based approach should therefore be adopted when evaluating the use of immersion suits.

The immersion suit has until recently been a fixed PPE for every transferee when the sea temperature falls below locally defined limits. However, with:

– the mandated use of FAS on offshore WTGs;
– improved levels of training;
– detailed transfer procedures;
– associated transfer equipment, including the implementation of quick release devices;
– improved vessel and vessel fender design, and
– better forecasting and weather monitoring technology,

the risk of falling into the water, whilst conducting a standard CTV transfer has been so significantly reduced when compared to historical 'free climbing' operations, that the requirement to wear immersion suits dependent on sea temperatures only, is no longer applicable. A risk-based approach should be used when evaluating the use of immersion suits and if certain conditions are met, a safe transfer can be executed without the use of an immersion suit.

It is not intended to remove the option to wear an immersion suit, which can still be worn if the individual technicians or teams prefer to do so. There is always a requirement to have a PFD available on the offshore structure in case of escape and abandonment, as well as it being industry best practice to have an immersion suit available when the water temperature is below locally defined limits.

This guidance is based on various studies, see Annex B.2, which have been made with the aim of assessing the risk of transfer without use of an immersion suit. The scope of this guidance is limited to any transfer from a CTV during daylight hours where there is good/ unrestricted visibility, meaning that transfers in darkness is not considered.

8.1 RISK OF WATER ENTRY

To understand the risk when transferring without use of immersion suit it is important to understand:

– the likelihood of water entry during transfer, and
– the risk of fatality due to water entry.

8.1.1 Likelihood of water entry

Since the end of 2016, there is no record of any person performing a standard transfer entering the water. It is therefore suggested that the likelihood of unplanned water entry, whilst undertaking a standard CTV transfer, is extremely low. It is assumed that the transferee is clipped on to an FAS/SRL during transfer.

An Event Tree has been constructed, which describes the sequence of events during transfer (ascent and descent). The Event Tree methodology provides a structured assessment, which establishes a series of events that have the potential to result in water entry, see Annex A.1. The Event Tree estimates that the average risk of water entry during transfer is 9,5E-7 transfer. This can be expressed in simple terms as:

– If a technician is doing one offshore structure transfer per day (two transfers – one up and one down) 180 days a year, he should work 5 700 years for every statistical water entry during transfer.
– If an operator is responsible for 100 000 transfers per year, the operator would statistically experience a water entry once in every 10 years.
– Statistically, for every 1 million transfers, one water entry would be expected.

For ascending the structure, the major risk contributor to the risk of water entry is standing on the vessel in the transfer zone and waiting to be allowed to transfer in moderate and rough weather. The reason for the increased risk is potential vessel movements due to weather/ wave conditions.

8.1.2 Risk of fatality due to water entry

Section 8.1 has considered the risk of water entry. This section looks at the potential impact of water entry, see Annex A.1. There are two main considerations that need to be understood when assessing the risk of a fatal outcome from an unintended water entry during CTV transfer:

– cold shock-induced heart attack or drowning may cause a fatality within a relatively short time after water immersion (minutes), and
– drowning and hypothermia because of ineffective rescue i.e. the time from immersion to rescue is too long.

PFDs, when self-turning and after inflation, ensure the face is kept free of the water. Also, it is expected that crews can perform a successful MOB rescue. In the case of transfer, the vessel will be at the scene of the incident, and therefore a rapid response time would be expected.

Average survival times are shown in Table 4. These times are for those immersed with their head out of the water. Thanks to the use of PFD and a trained vessel crew with fast rescue times, it is assessed that a fatality during transfer due to not wearing the immersion suit is close to unlikely.

Table 4: Average (50 % survive) survival times (hours) for lightly clad males, from various authors (Golden and Tipton, 2002)

Water temp.	Molnar	Hayward	Golden	Tikuisis
5 °C	1	2,2	1	2,2
10 °C	2,2	2,9	2	3,6
15 °C	5,5	4,8	6	7,7

8.2 RECOMMENDATIONS ON IMMERSION SUIT USE

A risk-based approach should be used when evaluating the use of immersion suits during standard CTV transfers. The scope of this section is strictly limited to covering the mandated use of immersion suits for a standard transfer (between a CTV and an offshore structure ladder section) when sea water temperatures fall on or below locally defined limits.

Risk assessments should be created to examine the use of immersion suits and should include active technician participation, robust consideration of local site conditions, facilitation by competent persons and appropriate 'sign off'. Annex A.2 shows a basic bow-tie diagram indicating typical controls and mitigations that could be available on individual wind farms. Annex A.3 shows an example transfer risk assessment. The duty holder and risk assessment team will need to amend and evaluate as per local conditions.

Transfer competencies of technicians and crew vessel are vital. It must be assured through training and efficient on-boarding at site level.

Performance standards should be created and included in the duty holder's emergency response plans, detailing how quickly a person in the water can be safely retrieved. MOB and fall from ladder exercises and drills should be completed at pre-defined levels. For example:

– each vessel will be able to demonstrate how often MOB drills are conducted reflecting fall from foundation ladder (suggest bi-monthly);
– all vessel crew should participate in these MOB drills prior to being allowed to operate non-supervised and any difficulties to be identified and remedied, and
– the time taken to remove a casualty from the sea should ideally be less than 15 minutes.

8.3 COMPATIBILITY AND SUITABILITY OF IMMERSION SUITS, PFDS AND HARNESSES

When an immersion suit is used for transfer, it is important to consider that the combination of immersion suit and PFD must be compatible with each other:

– The buoyancy of an immersion suit will tend to raise the wearer's legs, counteracting the action of the PFD and resulting in a horizontal position in the water, thereby reducing the clearance of the casualty's face above the water, and increasing the risk of drowning by water inhalation.
– ISO 15027-1:2012 requires manufacturers of immersion suits to state which type(s) of PFD the suit is compatible with.

The immersion suit and PFD also need to be suitable for climbing:

– They need to be compatible with the harness, such as ensuring that the attachment point remains accessible and the harness can be properly adjusted – slack leg loops can cause injury in the event of a fall.
– The collar of the suit/PFD should not prevent the transferee from looking up, when wearing a helmet.
– Immersion suits should be lightweight and flexible, so as not to impede movement.

ANNEX A

A.1 EVENT TREE – WATER ENTRY

Appendix 2 Ørsted SGRE report *A Review of the mandated use of immersion/dry suits*

Appendix 2 – Event Tree note

Contents

1. Introduction and main outcome

This memo will elaborate on some key assumptions and the central findings from the Event Tree analysis used to support the risk assessment about transfer with or without immersion suit.

The main outcomes are:

1) The likelihood of falling into the water during ascent or descent is roughly: **9,5E-7/ transfer** or one time per 1 million transfer or 0,00000095 % per transfer.
2) If you are unfortunate enough to enter the water in the North Sea you will have a 99,5 % chance of survival, providing you are wearing appropriate life vest and the vessel crew is trained to rescue you within 20 min.

To put risk for unintentional water entry during a transfer situation into more understandable terms, it is equivalent to:

– If a technician is doing one transfer per day (up and down) 180 days a year, he should work 5 700 years for every statistical water entry during a transfer.
– If an operator is responsible for 100 000 transfers per year the operator would statistically experience a water entry once in every 10 years.
– For every 1 million transfers we should experience one fall into water.

2. The Event Tree – water entry

Ørsted and SGRE do in the range of 150 000 transfers per year (174 500 in 2017) and have installed and operated offshore wind farms for over a decade. The two companies have no records of water entry related to transfer in 1he operational history. The number of transfers has increased over the years due to an increasing operational fleet as well as increasing project activity, hence the total number of transfers during the operational history is not 10 times the 2017 number. For all the members of G+, it is estimated that in the range of 700 000 transfers were conducted during three years from 2014 to 2017 and there is no knowledge about any water entries in relation to transfers.

When comparing the operational history to the risk profile established with the Event Tree, this indicates the Event Tree may predict a conservative risk profile, as the Event Tree based risk profile would suggest that water entry statistically should have already occurred in the industry.

It shall be noted that the statistical part of the Event Tree cannot be expected to provide absolute numbers,but it is very useful to understand the risk picture and how different events contribute to the overall risk. The numbers used in the Event Tree are generally very conservative assumptions. This is a deliberate approach to ensure that the assessment will be based on a principle of precaution. It means the risk related to not wearing a immersion suit is expected to be lower than calculated.

In the Event Tree, it is assumed that the immersion suit will not affect the likelihood of falling in water, neither in a positive nor negative way.

The risk of falling in water during a transfer is expected to largely depend on the weather and in particular the sea state; the Event Tree considers three different weather conditions – calm, moderate and rough. The conditions shall be considered in relation to the transfer vessel's capabilities rather than the full range of conditions which can be observed in the North Sea. This means that moderate weather may not be exactly the same for two different vessels.

Based on result from the Event Tree, it can be observed that the risk of falling into water is distributed as can be seen in Table A.1.

Table A.1: Risk of falling into water

	Conditions	**Risk of falling in water**	**Percentage of total risk***
Ascent	Calm weather	7,6E-08	7 %
	Moderate weather	**3,6E-07**	**38 %**
	Rough weather	**2,6E-07**	**27 %**
Descent	Calm weather	3,4E-08	4 %
	Moderate weather	9,1E-08	10 %
	Rough weather	**1,3E-07**	**14 %**
	Total	9,5E-07	100 %

*Calculation of the percentage of total risk.

Example Rough weather decent: 1,3E-07/9,5E-07 = 14 %

The distribution of transfer between the different weather conditions is listed in Table A.2. It means that it is assumed that 60 % of all transfers takes place in calm weather conditions – i.e. conditions which will mean highly predictable movements of the vessel during transfer.

Table A.2: Assumed distribution of occurence of transfers in different weather conditions

Conditions	Assumed distribution of occurrence of transfers in different weather conditions
Calm weather ascent	60 %
Moderate weather ascent	**35 %**
Rough weather ascent	**5 %**

One step in the transfer process contributes the greatest risk of the overall risk profile. When standing on the vessel in the transfer area waiting to connect to the fall arrest system, if the vessel moves unexpectedly, there is a small risk the technician can fall. As there is no guardrail towards the foundation and the technician is not yet hooked on to the fall arrest system, there is a slight risk the technician can fall into the water.

The combined risk of waiting to connect in the transfer area in rough and moderate conditions accounts for 60 % of the total risk profile.

In the Event Tree analysis, the focus has been on the risk of falling into water. It has been decided not to consider any injuries or fatalities which could occur during a transfer, e.g. if a technician falls from the ladder and during this fall strikes the structure or the vessel before ending in the water, the impact would likely have severe consequences and the use of an immersion suit will make little difference. This is a methodical decision in order to keep the assessment simple.

3. Risk of fatality related to water entry during a transfer

There are two main scenarios to consider with regard to fatality related to water entry during transfer between TP and CTV:

1) The cold shock producing respiratory and cardiac responses and drowning which may cause fatality within a relative short time after water immersion (0 – 20 min).
2) Drowning and hypothermia as a result of ineffective rescue i.e. if the time from immersion to rescue is too long (>20 min).

Note that in either case an appropriate lifejacket will be worn, so immersion without lifejacket is not considered.

In Table A.3, the risk related to water entry has been broken down into these two categories. Under each category, a number of conditions and assumptions have been explained; each has an important role in the outcome of an unplanned water entry. Using these assumptions, a second Event Tree has been created, which predicts the risk of fatality related to unplanned water entry during a transfer and allows comparison between water entry with or without an immersion suit.

Table A.3: Risk related to water entry

1 – Cold shock		
Scenario	**Risk**	**Elaboration**
Risk of fatality after falling into water – rescued within 20 min – wearing lifejacket (not immersion suit)	0,1 – 1 %	Suitable lifejacket keeps airways free preventing drowning due to cold shock – inhalation of water due to hyperventilation etc. but do not protect against cardiac arrest caused by cold shock Hypothermia is not a concern during the first 20 min
Risk of fatality after falling into water – person is rescued within 20 min – wearing lifejacket AND immersion suit	0,1 – 0,3 %	The immersion suit reduces slightly the impact from cold shock Hypothermia is not a concern during the first 20 min

2 – Drowning and hypothermia due to prolonged rescue time		
Scenario	**Risk**	**Elaboration**
Risk that a man over board during transfer is not rescued by CTV within 20 min	1 – 2 %	The risk is estimated conservatively as the CTV will be right next to the MOB and the crew will be trained in doing MOB operations in the transfer scenario Note: this is not the risk of a fatality but the risk of a failed rescue situation. Combined with the next scenarios the risk of a fatal outcome can be predicted
Risk of fatality when falling into water during transfer – person is not rescued within 20 min – wearing lifejacket (not immersion suit)	5 – 20 %	Fatality due to hypothermia or drowning. Lifejacket is equipped with PLB (personal locator beacon) and CTV is equipped with locator unit Lifejacket does not protect against hypothermia
Risk of fatality when falling into water during transfer – from a small vessel – person is not rescued within 20 min – wearing lifejacket AND an immersion suit)	1 – 3 %	Fatality due to hypothermia or drowning Lifejacket is equipped with PLB and CTV is equipped with locator unit Immersion suit protects against hypothermia

In Figure A.1, one scenario from the Event Tree is illustrated.

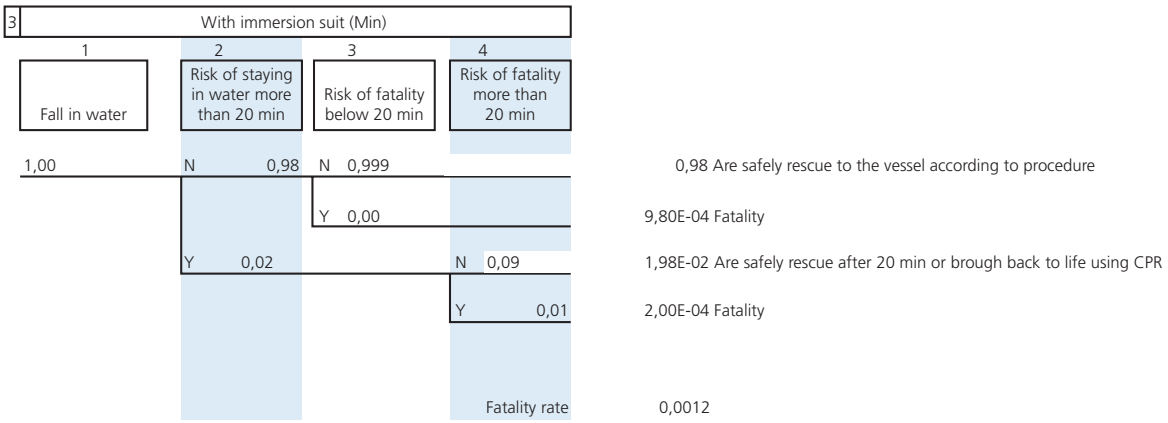


Figure A.1: Event Tree for risk of a fatality in water for one of the four cases

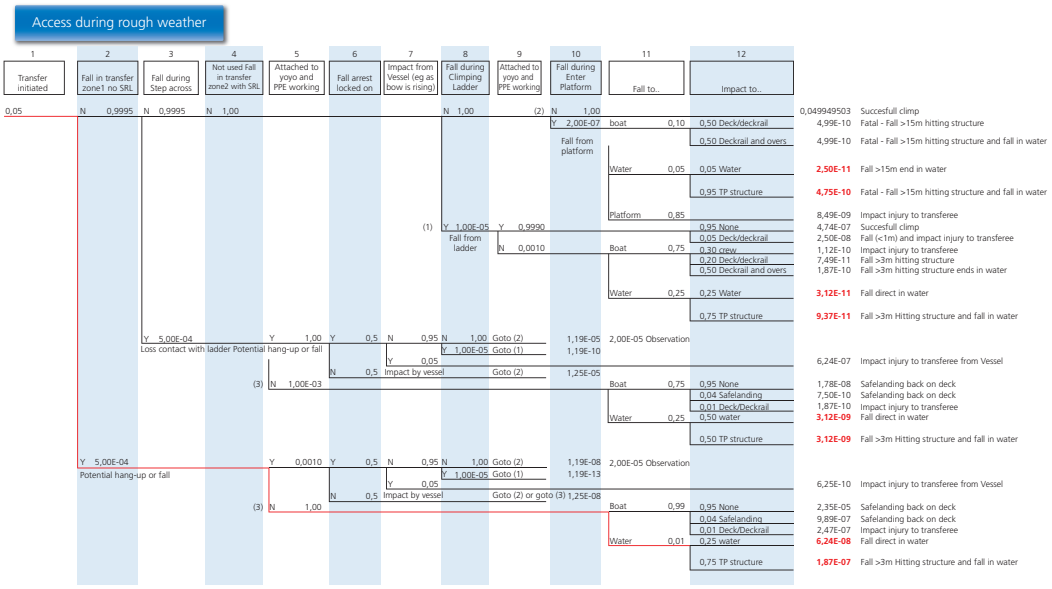
The range of the risk based on the numbers in Figure A.1 is illustrated in Table A.4.

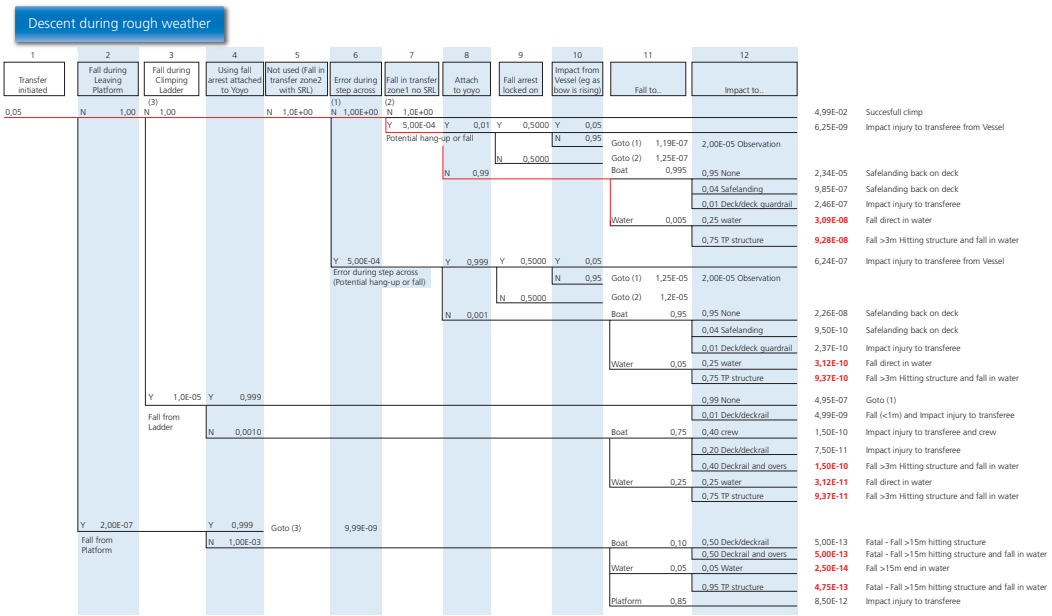
Table A.4: Range of the risk based on numbers from the Event Tree

	Min	**Max**
Fatality rate (without immersion suit)	0,002 ~ 2 per thousand water entries	0,014 ~ 14 per thousand water entries
Fatality rate (with immersion suit)	0,001 ~ 1 per thousand water entries	0,004 ~ 4 per thousand water entries
Fatality rate difference between wearing immersion suit and lifejacket or only lifejacket	0,001 ~ 1 per thousand water entries	0,010 ~ 10 per thousand water entries

The risk of a fatal outcome related to water entry during a transfer is slightly higher when immersion suit is not used. The benefit of wearing an immersion suit is between 1/100 to 1/1 000 water entry which equates to an increase in risk of fatality per transfer of 9,5E-9 to 9,5E-10.

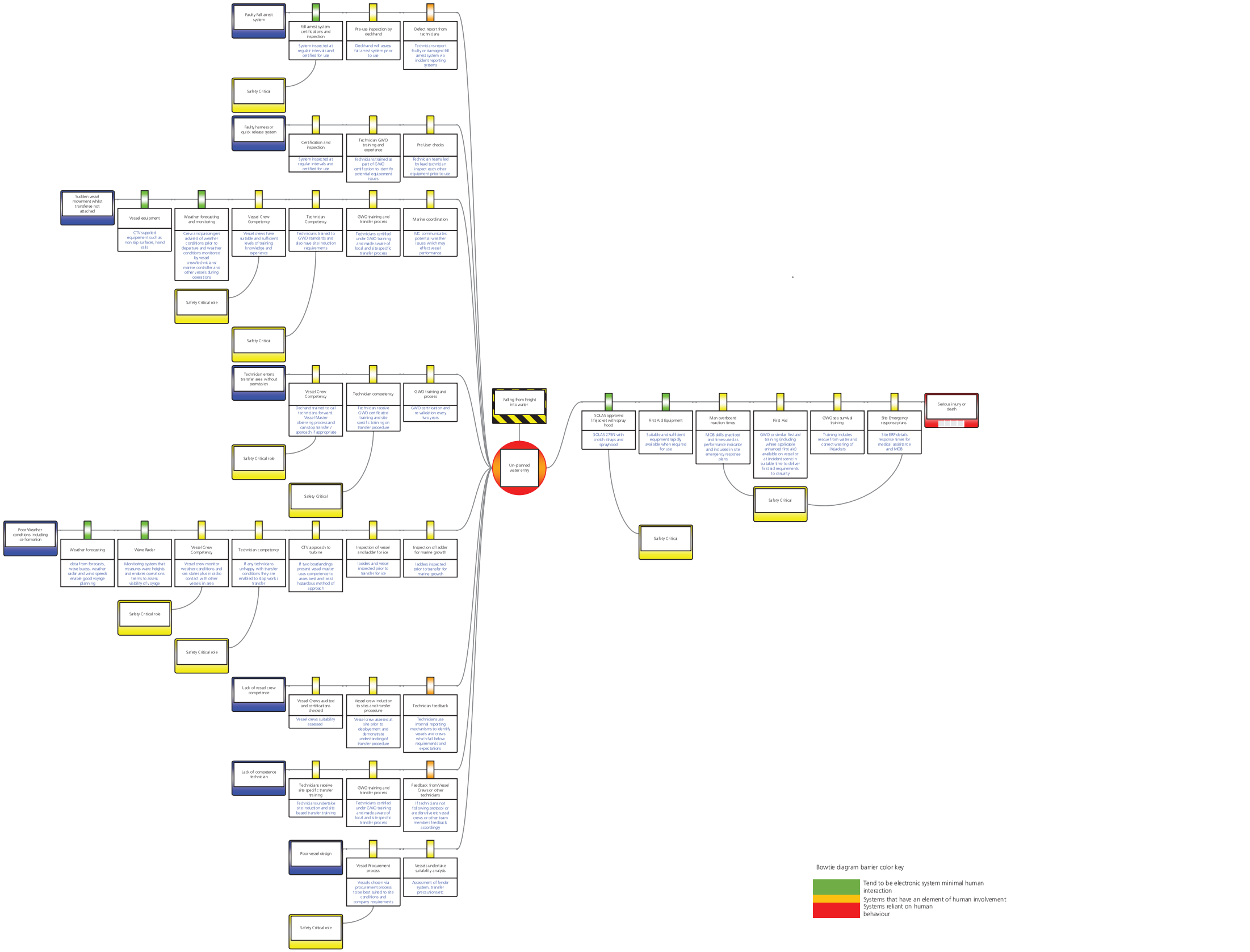
. Event Tree Diagram





A.2 BOWTIE DIAGRAM – UNPLANNED WATER ENTRY

Appendix 3 Ørsted SGRE report 'A review of the mandated use of immersion/dry suits'



For full sized image see https://www.gplusoffshorewind.com/work-programme/guidelines/documents

A.3 EXAMPLE TRANSFER RISK ASSESSMENT

Table A.5: Example transfer risk assessment

Title of this specific risk assessment: Transfer from vessel to structure and back **Location:** **Activity/task: Transfer**							**Next review:**			
Assessed by:		Approved by:	Date:	Consequence x Frequency = **Risk**			Revison No:	Consequence x Frequency = **Residual Risk**		
No.	**Hazard**	**Cause**	**People at Risk**				**Control measures**			
				C	**F**	**H-M-L**		**C**	**F**	**H-M-L**
1	Putting on PPE – vessel movements	Slips and trips, impact injuries	Transferee	C3	F3	**M**	By normal weather conditions: 10 min. before arriving at TP, vessel Captain calls transferring personnel to put on PPE. If Captain considers that weather conditions are marginal and can lead to slips and falls, he orders transferring personnel to remain seated until vessel is secured against wind or foundation and then to put on PPE. This is entirely the Captain's decision	C3	F1	**L**
2	Access to deck transfer area – vessel movements, slippery, icy, objects on deck	Slips and trips, impact injuries	Transferee, deck hand	C3	F3	**M**	Vessel Captain checks that the weather conditions are suitable (wind, wave, ice, storm etc). Transferring personnel remain seated until vessel is secured against foundation. Crew give order that they can move forward. Deck free from obstructions. Deck and ladder prepared with anti-icing chemicals, when appropriate. Transferring personnel keep hands free to hold railings	C3	F1	**L**

Table A.5: Example transfer risk assessment (continued)

3	General conditions for transfer	Man overboard (drowning), crushed between vessel and structure, hypothermia, slips, impact injury	Transferee	C4	F2	**M**	Crew members to be competent, informed and to be trained in the procedure. Transferee to be competent, informed and to be trained in the procedure. All transferees must have attended a GWO Sea Survival course, including transfer from boat to boat and from boat to offshore installation and GWO Working at Height course All persons must be physically fit enough to undertake the allocated work assignments. (demonstrated by relevant Offshore Medical certificate) Crew continually assess sea condition for suitability for transfer Body check for PPE and loose items Deckhand wears hard hat, safety footwear, gloves, life vest, PLB, safety belt with work rope for positioning Vessel equipped with crew finder MOB drills to be done regularly Transferee follows guidance from deckhand and skipper Skipper, deckhand, transferee to continuously assess if transfer is safe – also between the individual transfers. A vessel drop or if vessel is forced away from boat landing – then a reassessment must be done Make everyone aware that each individual (Skipper, deckhand and transferee) has the right to call for a stop Distance between ladder rung and outer vessel fender should be between 500 and 650 mm No lifting of equipment to take place during transfer Removal of safety-compromising algae, seaweed and bird guano	C4	F1	**M**

Table A.5: Example transfer risk assessment (continued)

4	Transfer from vessel to structure ladder – vessel movements due to waves, trip hazard due to retraction line	Man overboard (drowning), crushed between vessel and structure, hypothermia, slips, impact injury	Transferee	C4	F2	**M**	Deckhand checks yo-yo is functional, and that ladder is free from ice, slippery algae or bird guano Transferee to keep clear of the fender area until the command 'transfer' Deckhand stands with face towards wind direction. Places the retraction line over transferee's shoulder closest to him (avoiding line entangled in legs). Transferee attaches to yo-yo on vessel with suitable slack wire from deckhand (do not wrap tight round hand) and crosses to TP when deckhand allows transfer Deckhand releases yo-yo wire in controlled manner so it does not hit transferee's face Deckhand constantly observes waves for correct time of transfer 100 % concentration on transfer – no distracting talking If vessel moves begin climbing up fast	C3	F1	**L**

Table A.5: Example transfer risk assessment (continued)

5	Transfer from vessel to structure ladder – **Condition: Yo-yo not fitted or damaged**	Man overboard (drowning), crushed between vessel and structure, hypothermia, slips, impact injury	Transferee	C4	F3	**H**	Double hook lanyard technique – exceptional circumstances – only to be used if SRL is inoperable and there is a need to access to repair/replace the damaged SRL. Only other time double hooking is permitted is if rescuing someone from ladder in an emergency. Only one person on ladder at a time. Double lanyard technique: Ascent: When told to do so by deckhand, person crosses to TP, climbs approximately 2m / 5 rungs above the vessel, attaches 1st lanyard (not below chest height), climbs 2 more rungs, attaches 2nd lanyard. Vessel to back away from ladder at this point. Remove 1st lanyard and repeat. At top of ladder, or at point of work on ladder, the highest lanyard must remain attached above head height. If working on ladder to retrieve fall arrest rope/ wire or repair SRL unit, work positioning belt must be used. Lanyard must stay attached until climber has stepped onto platform and gate is closed. Vessel approaches WTG again and pushes onto ladder once person has reached platform and gate is closed. NOTE: Always maintain attachment of at least 1 lanyard with a spacing of 2 rungs, no lower than chest height and maintain 3 points of contact. Be aware of bypassing shock absorber – never leave one hook attached to body when clipped on to structure	C4	F2	**M**

Table A.5: Example transfer risk assessment (continued)

6	Access to structure platform from ladder. Egress from structure platform to ladder – moving from ladder to platform and vice versa	Fall from height, slips, impact injury	Transferee	C4	F2	**M**	Access: Transferee attached to yo-yo, check for correct operation or damage before use. Step through platform gate before disconnecting yo-yo Egress: Transferee awaits signal from deckhand, attaches to yo-yo before opening gate, slings retraction line over shoulder closest to deckhand (thus avoiding getting line entangled in legs), climbs down	C3	F1	**L**
7	Transfer from structure to vessel – vessel movements due to waves, trip hazard due to retraction line	Man overboard (drowning), crushed between vessel and structure, hypothermia, slips, impact injury	Transferee	C4	F2	**M**	Crew continually assess sea condition for suitability for transfer Use of KONG frog connector – easy release Deckhand counts down transferee from 5 steps above vessel. At 1, transferee stops, orientates towards vessel, turns halfway round, steps over on vessel deck, releases frog connector immediately when contact with vessel deck If conditions change, deckhand has the following commands: ABORT, UP, DOWN	C3	F1	**L**
8	Transfer from TP to vessel **Condition: Yo-yo not fitted or damaged**	Man overboard (drowning), crushed between vessel and structure, hypothermia, slips, impact injury	Transferee	C4	F3	**H**	Double hook lanyard technique only as an exception if fall arrest system is inoperable and there is no way to repair/replace the damaged fall arrest system. Transferee must connect 1 lanyard above chest height before stepping through top gate onto ladder Starts using double hook lanyard technique Deckhand stops him 2m/5 rungs above vessel When disconnected, transferee is counted down by crewman and steps backwards onto vessel when instructed If conditions change deckhand has the following commands: ABORT, UP, DOWN Only one person on ladder at a time	C4	F2	**M**

Table A.5: Example transfer risk assessment (continued)

9	Transfer at night or during winter – external conditions adding extra hazards to the operation	Man overboard (drowning), crushed between vessel and structure, hypothermia, slips, impact injury	Transferee	C4	F3	**H**	Skipper checks weather conditions are suitable (wind, wave, ice, storm etc). If ice identified on blades, WTG or foundation, contact Onshore Point of Contact Deck and transfer area well lit Transferring personnel wear suitable clothing for cold weather conditions. Head torch attached to helmet; batteries checked Deck free from obstructions. Deck and ladder prepared with hot water or anti-icing chemicals when appropriate Transferee keeps hands free to hold vessel railings	C3	F1	**L**
10	Transfer of tools and equipment – dropped objects	Head injury, strain, slips	Transferees on deck, Deck hand	C4	F3	**H**	Tools and equipment not necessary for the transfer should be lifted in certified tool bags using the davit crane; small items (camera/ torch) should be secured in closed pockets, radio should be secured in pocket (with possibility to monitor from pocket) or tool lanyard Body check for PPE and loose items Deckhand wears hard hat during transfer and lifting. If risk of getting dirt in eyes from structure or transferee's boots: wear safety glasses No transfers to take place when lifting operation	C4	F1	**M**
11	Transfer connector not functional and thereby not possible to release fast from yo-yo	Crushed between vessel and structure	Transferee	C4	F2	**M**	Pre-use check of transfer connector Statutory inspections of transfer connector Immediately pick up sufficient slack, then detach connector by karabiner. If not possible, use safety cutter available on deck during transfer	C4	F1	**M**

Table A.5: Example transfer risk assessment (continued)

12	Transfer connector being right in front of face when climbing and can hit face	Nose and mouth injuries	Transferee	C3	F5	**H**	If possible, use with harness where attachment point is below mid-point of chest Do not add additional connectors/lanyards which increase distance between attachment point and KONG FROG Transfer Connector All transferees made aware of risk and advised to keep head and face away from KONG FROG Transfer Connector when climbing	C3	F2	**M**
13	Access to turbine structure from vessel	Presence of bird guano on ladder rungs – potential for disease/ infection from bacteria and viruses present in bird guano (e.g. psittacosis) – can be ingested, inhaled or absorbed through the skin	Transferee	C3	F3	**M**	Ensure regular cleaning and maintenance to remove/prevent build-up of guano. Safety glasses provided for technicians in line with standard PPE issue and should be worn if bird guano present. Gloves mandatory during transfer. Consider supply of extra gloves on vessel for transferees so contaminated gloves can be changed after climb/descent. Consider making FFP2 face masks available for optional use	C3	F1	**L**
14	Access to turbine structure from vessel	Presence of marine growth – particularly on lower ladder rungs at low tide – increased risk of slips, trips and falls	Transferee	C3	F4	**M**	Ensure regular cleaning and maintenance to remove build-up	C3	F1	**L**

Table A.5: Example transfer risk assessment (continued)

15	Access to turbine structure from vessel	Individuals overcome by sea sickness – possible injuries and short-term illness	Transferee	C1	F3	**L**	All individuals feeling the effects of sea sickness are to stay on board vessel until effects subside. Skipper and team leader to ensure safety of individual when due to transfer	C1	F2	**L**
16	Exhaustion from climbing the ladder	Fall from height, slips, impact injury	Transferee	C1	F3	**L**	All persons must be physically fit enough to undertake the allocated work assignments Work positioning lanyard to be used to rest on the ladder, if required	C1	F1	**L**
17	Vessel to Vessel Transfer	Man overboard (drowning), crushed between vessels, hypothermia, slips, impact injury	Transferee	C4	F3	**H**	Only to take place in exceptional circumstances if absolutely necessary. Transfer agreed at the discretion of the skipper and specific procedure to be agreed and dynamically risk assessed based on weather conditions and sea state. Transferee wears hard hat, safety footwear, harness, life vest, PLB and immersion suit if applicable. Tools and equipment must be transferred separately. Transferee must be trained in GWO Sea Survival and can decline transfer if they are not confident, or are unhappy with the conditions of the transfer	C4	F2	**M**
18	Vessel to Vessel Transfer using Pilot ladder	Man over board (drowning), crushed between vessels, hypothermia, slips, impact injury	Transferee	C4	F3	**H**	Activity forbidden. Not permitted at any time	C4	F0	**M**
19	Bow to Bow Transfer	Man over board (drowning), crushed between vessels, hypothermia, slips, impact injury	Transferee	C4	F3	**H**	Activity forbidden. Not permitted at any time	C4	F0	**M**

Table A.5: Example transfer risk assessment (continued)

Risk assessment								
Location:								
Activity/task: Risk based approach to transfer from crew vessel to structure and back without immersion suit. Supplement to RA transfer								
Assessed by:	Approved by:	Date:			Revision No:			
Task description	**Hazard/risk**	**Consequence × Frequency = Risk**			**Control measures**	**Residual risk**		
		C	**F**	**High-Medium-Low**		**C**	**F**	**High-Medium-Low**
Transfer act								
Transfer from vessel to structure and back	Falling into water due to poor weather conditions or sudden vessel movement	4	2	M	Skipper and Deck hand constantly to monitor weather conditions and abandon transfer if considered too dangerous Before transfer to and from ladder, always SRL attached to harness On intermediate platform, when changing from one SRL to the next, always be hooked on to fall arrest Vessel equipped with railing of 1 m height only leaving boat landing free Anti slip layer on vessel transfer area Immediate transfer when being in potential fall zone Vessel crew and technicians to be trained in transfer procedure	4	0	M
Transfer from vessel to structure and back	Falling into water due to inconvenient design/ construction	4	2	M	Vessel equipped with railing of 1 m height only leaving boat landing free Anti slip layer on vessel transfer area TP-fence on foundation is min. 1 m high PPE: Gloves and safety shoes	4	0	M

Table A.5: Example transfer risk assessment (continued)

Transfer from vessel to structure and back	Falling into water due to faulty equipment (SRL or PPE)	4	2	M	Only certified and inspected equipment (SRL and PPE) Pre-use inspection of SRL by Deck hand before transfer Pre-use inspection of PPE by technician Buddy-check before transfer Technicians to be trained in inspecting own PPE	4	0	M
Transfer from vessel to structure and back	Falling into water due to unauthorized approach into transfer area	4	2	M	Vessel crew and technicians to be trained in transfer procedure Maintain safety culture around the transfer process	4	0	M
Transfer from vessel to structure and back	Falling into water due to lack of competence of vessel, vessel crew or technicians	4	2	M	Vessel testing and assessment prior to entering service Vessel crew and technician competences to be assessed and evaluated to sufficient standard Feedback culture on site in case safety and performance standards fall below expectations Technicians to be trained in transfer procedure	4	0	M
Fall into water								
Falling into water	Drowning due to cold shock	4	1	M	SOLAS approved life jacket (sprayhood highly recommended) always worn during transfer, will keep head above water Crew trained in MOB exercise next to foundation MOB reaction time of max. 15 min from water entry to recovery Technicians trained in GWO Sea Survival Technicians trained in GWO First Aid Vessel Crew trained in minimum STCW basic first aid First aid equipment incl. AED onboard transfer vessel	4	0	M

Table A.5: Example transfer risk assessment (continued)

Falling into water	Drowning due to waves – lost at sea	4	1	M	Measures for Cold Shock +... Life jacket equipped with PLB/AIS	4	0	M
Falling into water	Heart stroke due to cold shock	4	1	M	Measures for Cold Shock +... Everyone transferring offshore needs to have an offshore medical, which means you are fit for duty	4	0	M
Falling into water	Hypothermia	4	1	M	Measures for Cold Shock +... Vessel is right beside man overboard and can rescue within 15 minutes – risk of hypothermia is unlikely Equipment to treat hypothermia on board all vessels (i.e. blankets, isolating suits)	4	0	M
Specific WTG conditions								
Sudden evacuation from WTG into water because of e.g. fire	Drowning/ Hypothermia/ Cold shock	4	1	M	Survival suit is always brought to the WTG when sea temperature is < 10 degrees C or if risk assessment states it.	4	0	M
Immersion suit limitations								
Taking on and off the immersion suit on vessel with sometimes big vessel movements	Falling on deck	3	2	M	Leaving out the requirement of immersion suit (elimination)	0	0	L
Wearing the immersion suit	Uncomfortable/ Sweaty being 'locked' in the immersion suit especially during spring	2	5	M	Leaving out the requirement of immersion suit (elimination)	0	0	L

ANNEX B

B.1 GLOSSARY OF ACRONYMS AND ABBREVIATIONS

AIS	automatic identification system
CCTV	closed circuit television
CTV	crew transfer vessel
DP	dynamic positioning
DSC	distress selective calling
EU	European Union
FAS	fall arrest system
FMEA	failure mode and effects analysis
GPS	global positioning system
GWO	Global Wind Organisation
HSE	Health and Safety Executive
ID	identification
MOB	man overboard
PA	public address
PFD	personal floatation device (generally a lifejacket)
PLB	personal locator beacon
PPE	personal protective equipment
SAR	search and rescue
SART	search and rescue transponder
SGRE	Siemens Gamesa Renewable Energy
SOLAS	International Convention for the Safety of Life at Sea
SOV	service operations vessel
SRL	self-retracting lifeline (retractable-type fall arrester)
TP	transition piece
UI	user interface
VHF	very high frequency
W2W	walk to work
WAH	work at height
WTG	wind turbine generator

B.2 REFERENCES

Global Offshore Wind Health and Safety Organisation (G+) (https://www.gplusoffshorewind.com)

Good practice guideline – The safe management of small service vessels used in the offshore wind industry

Good practice guideline – Working at height in the offshore wind industry

G+/DROPS *Reliable securing booklet for offshore wind*

Health and Safety Executive (HSE)

HSE letter Health & Safety at Work etc. Act 1974 transfer procedures

G+ response to HSE letter

International Maritime Organization (IMO)

IAMSAR Manual

International Convention on Maritime Search and Rescue (SAR)
International Convention for the Prevention of Pollution from Ships (MARPOL)

Ørsted and Siemens Gamesa Renewable Energy

A review of the mandated use of immersion/dry suits, based upon sea temperatures, for transfer purposes from crew transfer vessel to wind turbine transition piece

Other

SOLAS Guidance on Chapter V – Safety of Navigation, www.imo.org/en/OurWork/facilitation/documents/solas%20v%20on%20safety%20of%20navigation.pdf

Convention on International Civil Aviation, Annex 12, www.airsafety.aero/getattachment/9bc6857a-0468-4b0e-824d-5ee9f2df586e/Regulation-of-Annex-12-Searchand-Rescue-(SAR).aspx

RWE Renewables International (formerly E.ON)

A consideration of the use of immersion suits in E.ON's offshore wind farms

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