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 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 via the following transfer methods:
  - vessel push on;
  - walk to work (W2W) gangways;
  - personnel transfer capsule (PTC);
  - heave compensated lifting, and
  - transfer between vessels.
- Protection against falling, including the use of a fall arrest system (FAS), e.g., self-retractable lifeline (SRL).
- Personal protective equipment (PPE) requirements.
- Protection against drowning, including a risk-based approach to the use of immersion suits.

It should be noted that PPE requirements for each transfer type are grouped together in a separate section (see section 9).

1.2 SCOPE

This guidance addresses people transfer associated with offshore wind farm operations 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

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.

on technical and equipment standards, refer to the G+ *Good practice guideline – Working at height in the offshore wind industry* annexes.

This guidance covers standard sea transfers, such as transfer from vessel to offshore structures via vessel push-on, W2W gangway, lifting via PTC, heave compensated lifting, and transfer between vessels. Alternative transfer procedures, double hooking or helicopter transfer are out of the scope of this document.

1.3 UPDATE TO GUIDELINES

This guidance document has been updated to Issue 2 in response to regulator feedback regarding lifting as a method for transfer to offshore wind structures. The update includes the following:

- Outline of recommended approach to risk reduction,
- Supervisory working arrangements and training and skills requirements guidance for:
  - lifting via PTC;
  - heave compensated lifting, and
  - example scenario-based risk assessment for each method of transfer.

The updates to this document have been made following workshops and a series of review sessions with G+ members.

2 APPROACH TO RISK REDUCTION

Key principle:

Designers and operators must identify all reasonably foreseeable hazards for the transfer and ensure that associated risks are managed, so far as is reasonably practicable, to prevent harm to personnel involved in the transfer.

This section aims to provide a framework of how to execute the risk assessment for a safe transfer in an offshore wind farm. This guidance provides consistency and good practice for any risk assessment related to safe transfer to and from offshore wind farm assets across the wind industry and allows operators and vessel owners to produce or verify their transfer procedure for safe transfers. This shall support operators and vessel owners to perform the risk assessments and, if required, amend their transfer procedures accordingly.

2.1 BACKGROUND TO GOAL-SETTING APPROACH AND ALARP APPLICATION

Operators and employers have a duty of care to protect all people, including employees, contractors, and visitors from any harm, by law in many countries. The following steps are considered as best practice and shall be executed to ensure employees meet the minimum requirements of various legislation:

– Hazard identification (scenarios where harm (fatality, injury, or illness) to personnel may occur).
– Hazard analysis (assessment of how likely the hazard is and the degree of potential harm arising to an operator or contractor from the hazard).
– Hazard evaluation and treatment (whether the protective measures are sufficient to reduce the risk to an acceptable level and if not, what further risk reduction measures are required).

It is recommended that operators and designers use an As Low as Reasonably Practicable (ALARP) approach to risk assessment and management. ALARP is a performance-based risk evaluation method, mainly used in the United Kingdom, Europe, and Australia. Other terms for ALARP are ALARA – As Low As Reasonably Achievable (e.g., Netherlands) or SFAIRP – So Far As Is Reasonably Practicable (e.g., Australia). In Australia, Norway, and the United Kingdom, ALARP is required for all offshore workplaces, which includes the safe transfer in an offshore wind farm.

By following the ALARP principles, it can be demonstrated that all reasonably foreseeable hazards are identified, and the associated risks are reduced such that the time, cost, and effort of further risk reduction measures are grossly disproportionate to the additional risk reduction achieved.

Although it is acknowledged that ALARP is not a requirement internationally, the approach to ALARP provides an industry good practice for risk assessment and hazard management.

The implementation of ALARP principles typically uses the following approach to management of hazards and risk:

- Hazard Identification (HAZID) and Scenario Development;
- Consequence and Likelihood Analysis;
- Risk Assessment, and
- Consideration of Risk Acceptance Criteria (RAC).

Where the risk is determined to not meet the RAC, further risk reduction is required.

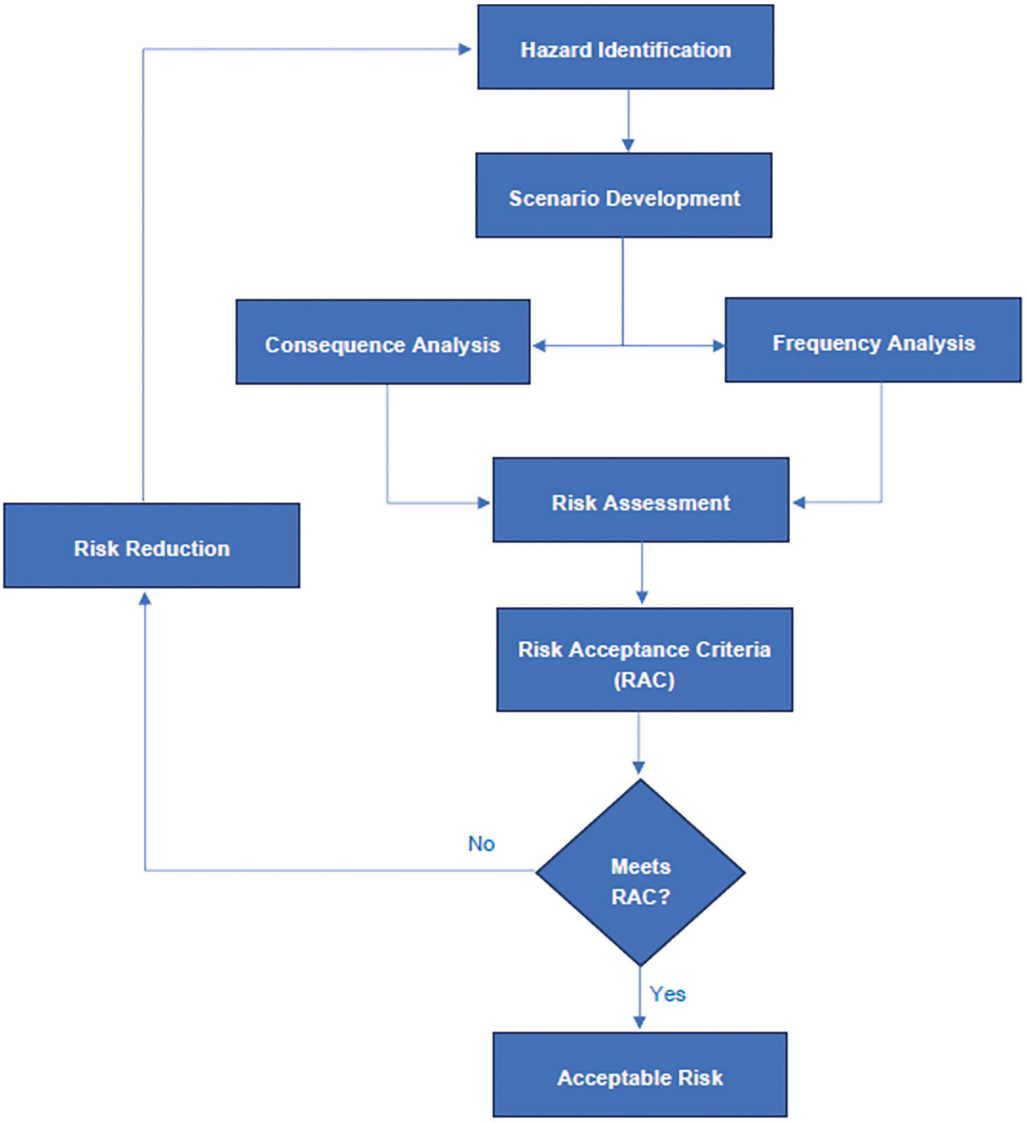


Figure 1: Approach to management of hazards and risks

2.2 APPLICATION OF APPLICABLE CODES OF PRACTICE, STANDARDS AND LEGISLATION

Designers and operators must ensure that all applicable local and international codes of practices, standards and legislation are met. Where applicable, the risk assessment and hazard management processes should be modified in line with the requirements of local and international regulators. Where operators deem that national legislation requirements are not sufficient, they should meet industry best practice.

2.3 RISK ASSESSMENT

The objective of the risk assessment is to identify, analyse, and evaluate the overall risks to people associated with hazards and thus identify credible major accident hazards (MAH).

The methodology and approach to risk assessment is dependent on the scale of installation, and the life cycle phase when the analysis is undertaken:

- For simple installation or modifications, a checklist-based approach using previous risk assessments of similar installations and operations can allow a consistent approach to MAH management compliant to applicable codes and standards.
- For new installations using existing equipment designs, the risk assessment/hazard identification for the original design may be used provided the design meets current codes of practice, standards and legislation, and the in-service performance of the existing equipment supports the ongoing validity of the assessment. Where this is not the case, the existing risk assessment may require an update in line with these changes.
- For new installations using a modified or new design, a hazard identification exercise is required to ensure that all hazards, including MAH, are identified and adequately managed.

The risk assessment shall take into account the whole lifecycle (from installation to decommissioning).

It is recommended that designers and operators identify suitable personnel for the risk assessment process through a Responsible, Accountable, Consulted and Informed (RACI) matrix, or similar tool. This will ensure that suitably qualified and experienced personnel are identified for the following positions:

- Responsible:
  - Person(s) who are responsible for the delivery of the risk assessment process.
- Accountable:
  - Person(s) who are accountable for ensuring that the risk assessment process has been delivered in line with the requirements of applicable codes of practice, standards, and legislation.
- Consulted:
  - Person(s), often industry experts, who are suitably experienced and qualified within the relevant disciplines in the industry to make accurate judgements to inform the risk assessment process.
- Informed:
  - Person(s) who are not directly involved in the risk assessment process but should be updated on relevant findings and outputs.

2.4 HAZARD IDENTIFICATION AND DETERMINATION OF PROTECTIVE MEASURES

The objectives of the HAZID are to use structured review techniques to identify all reasonably foreseeable hazards associated with a transfer to an offshore wind farm asset (WTGs or OSPs). This includes the concept, design, operation, and the activities involved in the transfer, including initiating causes, and hazard consequences.

During the HAZID it is critical to identify all reasonably foreseeable hazards that have the potential to lead to a major accident. For this reason, a team-based workshop approach for the HAZID is recommended. This is normally in the form of a workshop with a multidisciplinary team involving all relevant competencies needed to identify and evaluate all reasonably foreseeable hazards.

Additionally, the protective measures (safeguards), which reduce the risk of releasing a hazard, shall be identified. The protective measures in place shall be derived from national laws, international codes/standards, common practice of the offshore wind industry, or internal company guidelines. Protective measures should be prioritised based on the hierarchy of risk controls, as set out in Section 2.5.

2.5 HIERARCHY OF PROTECTIVE MEASURES

Transfers in an offshore wind farm can involve working at height (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.

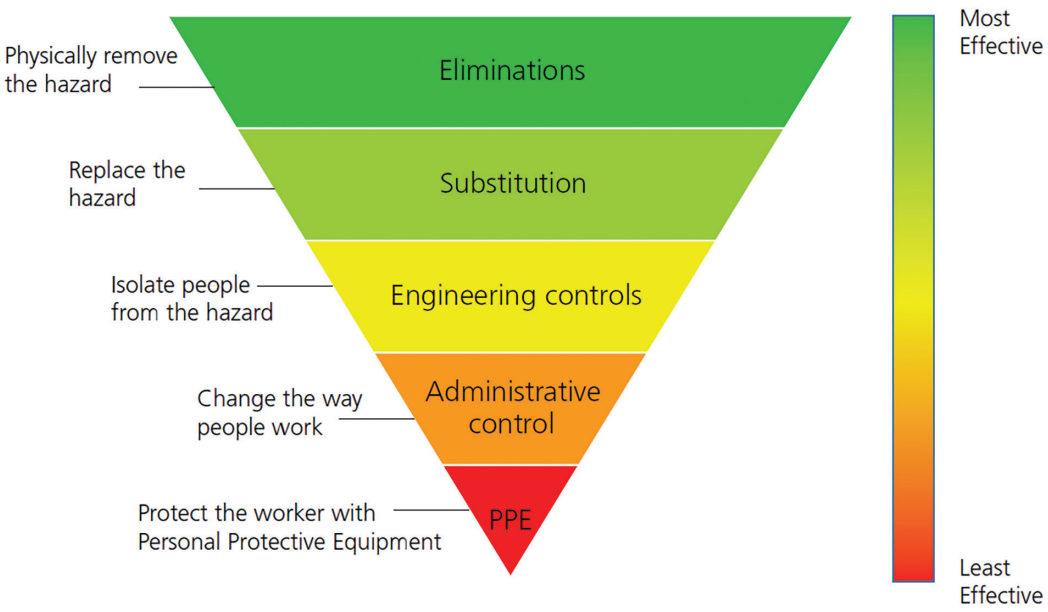


Figure 2: Hierarchy of protective measures

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

2.6 CONSEQUENCE AND LIKELIHOOD ANALYSIS

To evaluate the hazards and evaluate whether additional risk reduction measures are required, a risk matrix can be utilised to assess the worst-case severity of each hazard, and the likelihood that severity occurs. Most risk matrices use the following parameters:

– Severity of the consequence (S)
– Likelihood of the event reaching that severity (L)

An example of a risk matrix that is used in the example risk assessments can be found in Annex B.

If further severity and likelihood analysis is required, a quantified assessment, such as an event tree, may be used. An event tree is a quantitative assessment of a sequence of events following an initiating event and provides an analysis for the likelihood of each outcome. An example event tree for entry into water during a vessel push-on transfer is shown in Annex A.

Where a probabilistic assessment is required, an event tree analysis should be considered.

The assessed risk of each hazard can then be compared to a defined tolerability threshold and RAC, for further details see Section 2.7.

2.7 RISK ACCEPTANCE CRITERIA (RAC)

Based on the consequence and likelihood analysis, the tolerability of risk of each of hazard can be determined. The tolerability of risks is based on the RAC, which defines the level of risk that is considered acceptable and must meet the minimum legislative requirements. Each hazard can be divided into the following groups:

– Acceptable: Further protective measures may be required to reduce the risk if the time and effort to do so is not disproportionate to the safety gain.
– Tolerable: The level of risk is considered tolerable to the industry. Further risk reduction measures should be considered, unless the cost to implement the measures is grossly disproportional to the risk reduction.
– Intolerable: Further risk reduction measures are required to reduce the risk to a tolerable level.

When determining the tolerability criteria, qualified methods, such as bowtie analysis, may be used. A bowtie analysis allows the user to determine if there are sufficient protective measures in place to manage the risk, in line with the RAC.

A bowtie analysis is a simple, diagrammatic way to illustrate what happens when control of a hazard is lost, what can cause that loss of control and the consequences. It is recommended that bowties are facilitated during a workshop and might be linked to an event tree on the consequence side.

An example of a bowtie for a top event of fall into water from height during a vessel push on transfer is shown in Annex A.

It is recommended that a bowtie analysis is conducted to assess the effectiveness of protective measures for any MAH.

2.8 FURTHER RISK REDUCTION

Where the risk associated with hazards does not meet the RAC, further risk reduction measures must be implemented to reduce the risk to a tolerable or acceptable level. See Section 2.5 for further details. The process outlined should be repeated for any hazards where further risk reduction is required. Note that further risk reduction should not be achieved by transferring risk to other activities or disciplines. When considering a risk reduction measure, the residual risk of that measure must be assessed and reviewed against the overall risk reduction achieved.

2.9 EXAMPLE RISK ASSESSMENT

An example of a risk assessment for offshore transfer methods is included in Annex B. Note that designers and operators have their own due diligence to undertake a thorough risk assessment based on their own design and operations; the risk assessments provided within this document are intended to act as a guide and are not considered exhaustive.

The following methods of transfer have been considered within the example risk assessments:

- Vessel push-on and transfer to boat landing ladder via crew transfer vessel (CTV) or daughter craft.
- Lifting of personnel via PTC.
- Heave compensated individual personnel lifting system.
- W2W gangway from Service Operations Vessel (SOV).

Note: Helicopter operations are not considered within these example risk assessments. Instead this is covered in the G+ Safe Helicopter Operations in Support of the Global Offshore Wind Industry.

The following assumptions were made when producing the example risk assessments:

- Wind turbine generators (WTGs) or offshore substation platforms (OSPs) are fixed and not floating.
- The transfer vessel when using boat landing ladders will be a CTV or daughter craft of fixed hull design (RIBs and STBs are not considered as part of the assessments).
- The risk assessment is generic for all offshore wind farms. For the assessment, overall dimensions of approximately 400 km^2, 175 MW WTG were considered. Note that as WTG sizes increase, the method of transfer will change only marginally and is more dependent on the type of support structure (jacket vs monopile).
- The transfer is assumed to start when the vessel is approaching the WTG, therefore the following are not considered:
  - Ingress or transfer onto vessel prior to transfer onto WTG;

  - Voyage to WTG vicinity before final approach;
  - Voyage away from WTG vicinity after transfer back to vessel, and
  - Egress from transfer vessel after transfer from WTG, i.e., at harbour side.
- Vessel to vessel transfers are not considered as part of the assessments.
- Only safety risk to personnel involved in the transfer is considered.

The risk assessments are high-level and generic; therefore operators and designers must consider any site-specific aspects when completing a risk assessment.

2.10 HAZARD MANAGEMENT

2.11 SAFETY JUSTIFICATION

A safety justification is required to show that all reasonably foreseeable hazards have been identified and associated risks objectively assessed. This must include a demonstration that risks are adequately reduced such that the time, cost, and effort of further risk reduction measures are grossly disproportionate to the additional risk reduction achieved.

2.12 CONTINUOUS IMPROVEMENT

Safety management is a continuous task which does not stop after installation and commissioning. As part of the safety management, it is the duty of the operators of the offshore wind farm to re-evaluate the risks and hazards at regular time intervals. The lengths of the intervals are dependent on the company safety management system and national legislation requirements. During the re-assessment, the following shall be considered (but not limited):

- new legislation and regulations;
- knowledge about new accidents and incidents during safe transfer, which has not been considered before;
- new or updated industry and company guidelines;
- updated internal and industry accident statistics, and
- feedback and competence from operators and contractors working in the offshore windf arm.

Based on these inputs, the re-assessment shall be performed, and if needed, new protective measures shall be implemented.

3 GENERIC REQUIREMENTS FOR ALL METHODS OF TRANSFER

This section covers the generic requirements of all transfer methods considered in this document. Sections 4 to 8 cover the specific requirements of each transfer method.

3.1 GENERIC 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 Generic personnel roles

The roles and responsibilities of all personnel must be appropriate, well defined, documented and understood. Personnel may have many important and simultaneous responsibilities; these must be realistic and manageable, to avoid creating overload.

All personnel must have suitable and relevant experience for the transfer method being performed, as well as the relevant training and qualifications where applicable (see Section 3.2 for further details).

It is the right and responsibility 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.

For any lifting operations, a lift plan must be approved by a competent and authorised person prior to commencement of the transfer. This person shall be nominated in line with the requirements of industry standards and national legislation.

Inspection, maintenance and testing of all lifting equipment shall be conducted by competent and authorised person(s) prior to the commencement of the lift.

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

– Ensuring that all personnel are instructed according to site-specific transfer procedure.
– Carrying out communications check with all personnel before and immediately after transfer to structure.
– Authorising transfer, maintaining weather watch, and notifying the marine coordinator/working parties of how this can affect offshore work.

The generic requirements of Deckhands are to:

– Ensure 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, specifically around the transfer zone.

– 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

Transferees being transported on any vessel are also expected to:

– Comply with vessel safety policies and instructions.
– Ensure they are familiarised with the site-specific transfer procedure;
– Wear correct PPE, ensuring that it is properly fitted, within its inspection date and in good condition.
– Verify that there are no loose objects in open pockets. See G+/DROPS Reliable securing booklet for offshore wind for further guidance on this subject.
– Ensure that PPE 'buddy checks' are carried out before proceeding to the vessel transfer point.

3.1.3 Generic procedural arrangements

Clear decision criteria must be in place for conditions under which transfer can take place.

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

– A rescue plan for all emergency scenarios must be in place. This includes, but is not limited to the following:
  – personnel in the water;
  – fall from height, and
  – personnel suspended/unable to egress.
– 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 to combat skill fade
– 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 are suitable for transfer, or investigating incidents that occur during transfer, the use of vessel closed circuit television (CCTV) can provide evidence of the situation faced by the personnel involved, and the actions taken, and can also be useful in sharing lessons learned.

3.1.4 Emergency management

All personnel involved in transfers must be aware of the emergency procedures, should any personnel:

– Fall from height;
– Enter the water, or
– Become suspended (hang-up) or be incapacitated during any climbing activities.

Man Overboard (MOB) drills should be conducted regularly, and the water recovery team should be briefed and ready for retrieval of personnel from the water.

MOB equipment should be always carried on the vessel. Personnel are required to wear an approved lifejacket, including the potential use of a personal locator beacon (PLB).

Transferees must have completed appropriate WAH training and, if applicable, all personnel should be competent in recovery procedures for a suspended or incapacitated transferee.

In the event of a loss of power supply to vessel or gangway, the transferee should make safe before receiving instructions on recovery.

When considering alternative/back-up transfer methods, the availability for transfer should be analysed and appropriate selection conducted based on this analysis.

3.2 GENERIC TRAINING AND SKILLS

3.2.1 Generic training and qualifications

Transferees should have fulfilled the baseline training requirements, such as sea survival training and relevant transfer training. Transferees should also have completed relevant WAH training. In addition, personnel should be trained on the risks of and protective measures against dropped/falling objects. For lifting operations, slinger/signaller training should be conducted.

The Captain, Deckhand and (as applicable) lift/gangway operator 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. It is good practice for operators to conduct a training needs analysis to fully understand what training/qualifications may be required for their personnel.

Any lift or gangway operators should be trained and certified in line with relevant national regulations and certifications, such as Sparrows Stage 3 or equivalent, and must complete familiarisation training on specific lift or gangway type in operation. Operators should be appropriately experienced and competent in the methods, equipment and safety devices being used for the transfer. Any lifting activity must be planned by the lift operator and approved by a person with sufficient knowledge and experience of the lift, and with the required authority as determined by the operator.

It is recommended that vessel crews are proficient in a common language with common and consistent terminology for commands, to prevent misdirection and/or confusion during the transfer.

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. It is recommended that a specific transfer induction, as well as familiarisation, is provided to all transferees.
– MOB training for all personnel.

- Regular practice should be carried out, including:
  - practice in darkness if transfers are ever carried out in the dark;
  - practice in realistic sea conditions;
  - utilising MOB tracking systems as well as visual contact, and
  - training in site emergency arrangements

Each operator should provide each transfer contractor with all the 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 EXAMPLE RISK ASSESSMENT

An example of a risk assessment for each method of transfer considered within this document can be found in Annex B. This includes a high-level non-exhaustive list of generic hazards that may be associated with each stage of transfer. Note that designers and operators have their own due diligence to undertake a thorough risk assessment based on their own design and operations; the example risk assessments provided within this document are intended to act as a guide and are not exhaustive.

4 TRANSFER VIA VESSEL PUSH ON 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 vessel pushed on to the boat lander, 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 WTGs are not fixed to the seabed, the hazards and protective measures can be applied, subject to the standard risk assessment process.

4.1 PERSONNEL ROLES

In addition to the generic roles of the Captain stated in Section 3.12, it is also expected that the vessel Captain will:

- Ensure stable positioning of vessel prior to authorising transfer.
- Have 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.
- Maintain weather watch and notify the marine coordinator/working parties of how this can affect offshore work.

The Deckhand has a key role on vessels, with responsibilities above those described in Section 3.12 generally including, but not limited to:

- 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.
- Typical site-specific additional activities 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 FAS.
  - Pulling down the FAS and attaching/offering it to the transferee.
  - Assisting the transferee with disconnection from the FAS.
  - 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.
  - Keeping transfer area clean from obstacles and ensuring it is not a slippery surface.

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

– 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.
– Transferring without delay onto ladder, once attached to FAS.

4.2 PROCEDURAL ARRANGEMENTS

The following procedural arrangements shall be followed for a vessel push-on transfer:

– The decision criteria for transfer 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. The variables to be considered 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.
– 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.

When reviewing decisions about whether conditions were suitable for transfer, or investigating incidents that occur during transfer, the use of vessel 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.

In addition to the generic procedural arrangements stated in Section 3, there should be suitable arrangements in place to recover transferees in the event of a hang-up from the FAS.

5 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 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.

5.1 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.

5.2 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).
– If the boat landing is positioned to allow beam-on transfers, then this can be used to create a leeside, 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 applied to avoid relative movement of the vessels at the boat landing, and to avoid the larger vessel being pushed out of position.

5.3 HAZARDS DURING SPECIFIC ACTIVITIES

The hazards associated with transfer between vessels are similar to the hazards associated with a vessel push-on to a fixed or floating structure. As such, the example risk assessment for transfer via vessel push-on, which may be found in Annex B, can be used a baseline for this risk assessment.

6 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.

6.1 PERSONNEL ROLES

In addition to the generic roles and responsibilities outlined in Section 3, specific duties of the Captain may also include, but are not limited to:

- Conducting appropriate planning of operations prior to departure from port and transfer.
- Ensuring that DP is established on arrival at location.
- Carrying out a communications check prior to the commencement of gangway connection.
- Giving permission for gangway operator to connect gangway.

In addition to the generic roles and responsibilities outlined in Section 3, specific duties of the gangway operator include, but are not limited to:

- Establishing communications with the bridge deck prior to gangway connection.
- Testing the gangway operation delay, including an alarm test.
- Confirming working limits with regards to vessel footprint and gangway telescope extension.
- Ensuring the gangway is correctly connected prior to commencing the transfer including the set-up of handrails.
- Controlling the transfer of personnel across the gangway and monitoring in case of emergency.
- Confirmation of numbers of POB on both sides of the gangway and ensuring all personnel are clear of gangway prior to disconnection and stow of the gangway.

6.2 PROCEDURAL ARRANGEMENTS

The gangway shall 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 shall 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.
– 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 needs to be clear procedures in place 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.

6.3 EMERGENCY MANAGEMENT

In addition to the generic procedural arrangements outlined in Section 3, transferees should be given a gangway induction and be familiar with visual and audio alarms that sound during an emergency retraction. All transferees should be aware of the procedures for making safe should an emergency retraction occur.

In the event of a loss of power supply to the gangway, the 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.

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 to transfer these people back to the vessel.

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.

7 TRANSFERS USING LIFTING VIA PERSONNEL TRANSFER CAPSULE (PTC)

Key principle:

Safeguarding against the risk of falls from height and into the water is by the safe design of lifting systems and PTCs.

This section covers the lifting of personnel in a PTC directly onto a fixed or floating structure/asset. This section covers a variety of different capsule types and sizes on a generic level. A capsule is considered to be a liftable structure that one or multiple transferees are positioned inside or connected onto. It is assumed that the PTC will be lifted via a crane, either on a ship or on a fixed or floating structure/asset.

7.1 PERSONNEL ROLES

In addition to the generic roles and responsibilities outlined in Section 3, specific duties of the Captain may also include, but are not limited to:

- Conducting appropriate planning of operations prior to departure from port and transfer.
- Ensuring, if applicable, that DP is established on arrival to location.
- Carrying out a communications check prior to the commencement of transfers.
- Ensuring that the transferee and all relevant crew are instructed and briefed 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.
- Maintaining weather watch and notifying the marine coordinator/working parties of how this can affect offshore work

Additional duties of the Deckhand generally include, but are not limited to:

- Preparation and testing of PTC prior to transfer.
- Ensuring that all transferees have correct and functioning PPE including an approved lifejacket.
- Ensuring that transferees are harnessed properly into seats and given instructions that they are not to remove harnesses until instructed to do so.
- Securely loading bags and luggage to ensure that objects cannot be dropped from height.
- Ensuring that the lifting load of the PTC and crane are not exceeded.
- Ensuring that MOB equipment is on standby.
- Communicating with the lift director that the PTC is ready for lifting.
- Maintaining stability of the PTC once lifted, using tag lines.

The crane operator responsibilities include, but are not limited to:

- Establishing communications with the bridge and Deckhand prior to transfer.
- Testing the crane operation and conducting a pre-use inspection.
- Controlling the crane and lifting procedure.
- Maintaining constant line of site with the PTC at all times throughout the transfer.

The duties of the deckhand are expected to include, but not limited to, the following:

- Induction on specific equipment and transfer acceptance, and
- Reporting weight to the lift operator/deckhand.

7.2 EMERGENCY MANAGEMENT

In addition to the generic emergency management requirements outlined in Section 3, based on FMEA, PTC and crane 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 PTC 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 PTC is affected, a risk analysis must be carried out to make the decision whether to transfer these people back to the vessel.

8 TRANSFERS VIA HEAVE COMPENSATED LIFTING

Key principle:
Safeguarding against the risk of falls from height and into the water is by the safe design of lifting systems.

This section covers the transfer of personnel via heave compensated lifting, using a dedicated lifting system, onto a fixed or floating structure/asset. This section covers a variety of different heave compensated lifting systems on a generic level.

8.1 PERSONNEL ROLES

In addition to the generic roles and responsibilities outlined in Section 3, specific duties of the Captain may also include, but are not limited to:

- Ensuring stable positioning of vessel prior to authorising transfer.
- Having 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.

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

- Testing and inspection of the lifting system prior to use.
- Ensuring that all transferees have correct and functioning PPE including an approved lifejacket.
- Assessing of metocean conditions prior to commencing transfer.
- Guiding transferee at low level of suspension to avoid excessive movement and to ensure transferee lands in lifting zone when egressing.
- Additional activities often include, but are not limited to:
  - Confirming that the transferee's PPE is correctly fitted for transfer.
  - Assisting the transferee with connection and disconnection from master link/ karabiner.
  - 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.
  - Keeping transfer area clean from obstacles and ensuring it is not a slippery surface.

The duties of the lift operator may include, but are not limited to:

- Establishing communication with the Deckhand and vessel Captain prior to commencement of transfer.
- Monitoring the lift and ensuring the safety of the transferee and other personnel involved in the transfer.

Additional responsibilities for Transferees being transported on vessels may include, but are not limited to:

– Ensuring large bags, such as backpacks that could interfere with PPE, are not carried.
– Deciding if transfer is within personal capabilities, at the time of transfer, and communicating this decision.
– Ensuring the master link/karabiner are connected correctly.
– Disconnecting from the master link/karabiner, when safe to do so.
– Opening/closing access gate at the top of the structure.

9 PPE AND SYSTEM REQUIREMENTS FOR TRANSFER

Key principle:

PPE is the last protective measure in the hierarchy of control. As PPE is often limiting to 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 adopted, 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 vessel push-on transfer.
- Drowning – mitigated by using approved life jackets that are International Convention for the Safety of Life at Sea (SOLAS)-approved, PLBs and, in some instances, immersion suits.

9.1 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. If 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.

9.2 PROTECTION AGAINST DROWNING: IP LOCATION

PLBs can assist in locating an injured person (IP) 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 an IP 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, if the PFD is worn.
  - The inflated PFD will not obstruct the IP'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.
- It can be accessed by the IP 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 IP'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 IP.
- 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 IP. The coordinates are refreshed every five minutes, making this an effective method of tracking casualties.

9.3 PROTECTION AGAINST FALLING: FAS ON BOAT LANDING LADDER

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 FASs 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 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.
  - Speed and distance of any vessel movement should be much less than FAS lock-on limits:
    - When selecting an FAS, the specifier should identify the range and speed of vessel movement that will be within acceptable limits for transfer procedure and ensure that the FAS will not lock on within these limits. This may involve obtaining information on lock-on characteristics from the FAS manufacturer.
    - Data on the speed and range of bow movement can be captured using accelerometers, to quantify the demands on the FAS.
- Anchorage point should be positioned above the transferee to avoid exceeding FAS angle.
- Vessel and ladder/boat landing are compatible, i.e., sufficient safety zone to prevent crushing.
- Design and operation of FAS 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 FAS manufacturer, to ensure that it does not increase the height of a fall to the extent that the energy absorption capacity of the FAS is exceeded.

– Connector between FAS 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 FAS, while still on the vessel.

For other transfer methods than vessel push-on, protection against falling is considered to primarily be design of the systems, as falling from height is considered to only occur due to a human error in operation or a catastrophic failure of the system.

9.4 OTHER PPE FOR TRANSFER

Suitable clothing and PPE for transfer should include:

– Gloves must provide good grip on wet/slippery ladder or handrail, protect hands, maintain dexterity, 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.
– Where required by the risk assessment, safety helmets or hats should be worn to protect against dropped objects.
– Where there is potential for equipment to be under tension in front of personnel's face, e.g., push-on from vessel and heave compensated lifting, face and/or eye protection should be considered.
– Clothes worn under the immersion suit should provide sufficient insulation for prevailing weather conditions, given that the immersion suit itself is not insulated.

10 USE OF IMMERSION SUITS DURING STANDARD VESSEL PUSH ON TRANSFERS

Key principle:

During a standard vessel-push on transfer, and with the use of an FAS, 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 vessel-push on 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 vessel during daylight hours where there is good/unrestricted visibility, meaning that transfers in darkness is not considered.

10.1 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.

10.1.1 Likelihood of water entry

Since the end of 2016, there have been two recorded incidents of a person performing a standard transfer entering the water. Whilst the likelihood of this occurring is present, it is acknowledged that the overall likelihood is low when compared to the number of transfers (estimated to be in the hundreds of thousands) that have taken place globally in that timeframe. It is therefore suggested that the likelihood of unplanned water entry whilst undertaking a standard vessel push-on transfer, is extremely low. It is assumed that the transferee is clipped on to an FAS 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. 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, they 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 world wide, 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.

10.1.2 Risk of fatality due to water entry

Section 10.1 has considered the risk of water entry. This section looks at the potential impact of water entry, see Annex A. There are two main considerations that need to be understood when assessing the risk of a fatal outcome from an unintended water entry during vessel push-on transfer:

– Cold shock-induced heart attack or drowning may cause a fatality within a relatively short time after water immersion (minutes).
– 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 1: 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

10.2 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 vessel 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 shows a basic bowtie diagram indicating typical controls and mitigations that could be available on individual wind farms. Annex B 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.
– The time taken to remove a IP from the sea should ideally be less than 15 minutes.

10.3 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 IP'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
EVENT TREE – WATER ENTRY

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

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:

A. The likelihood of falling into the water during ascent or descent is roughly: **9,5E-7/ transfer** or one time per 1 million transfers or 0,000 000 95 % per transfer.

B. 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, they 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 their 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 of 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 an 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 the same for two different vessels.

Based on results from the event tree, it can be observed that the risk of falling into water is distributed as can be seen in Table 2.

Table 2: 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 descent: 1,3E-07/9,5E-07 = 14 %

The distribution of transfer between the different weather conditions is listed in Table 3. It means that it is assumed that 60 % of all transfers take place in calm weather conditions –

i.e., conditions which will mean highly predictable movements of the vessel during transfer.

Table 3: Assumed distribution of occurrence 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 to keep the assessment simple.

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

There are two main scenarios to consider regarding 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 4, the risk related to water entry has been broken down into these two categories. Under each category, several 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 4: 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.

Table 4: Risk related to water entry (continued)

2 – Drowning and hypothermia due to prolonged rescue time		
Scenario	**Risk**	**Elaboration**
Risk that a person overboard 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, 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 3, one scenario from the event tree is illustrated.

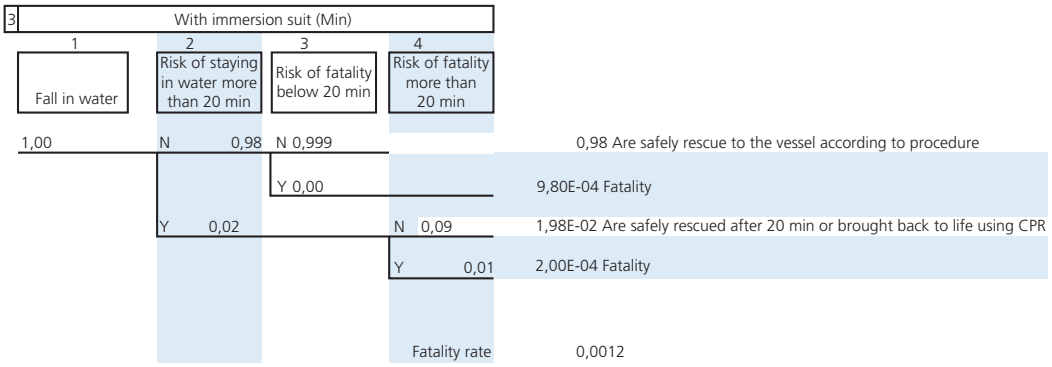


Figure 3: Event tree for risk of a fatality in water for one of the four cases

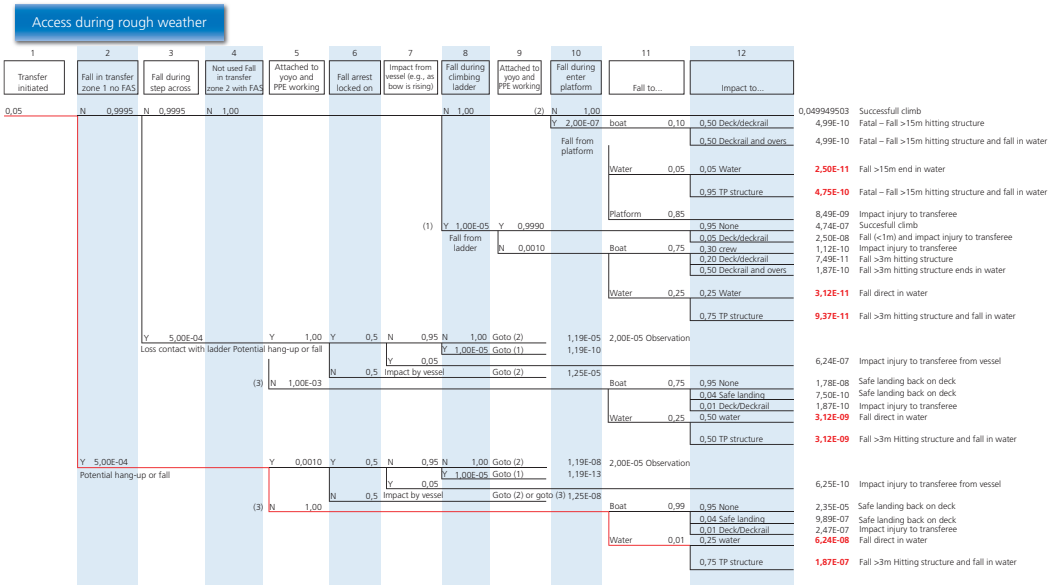
The range of the risk based on the numbers in Figure 3 is illustrated in Table 5.

Table 5: 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

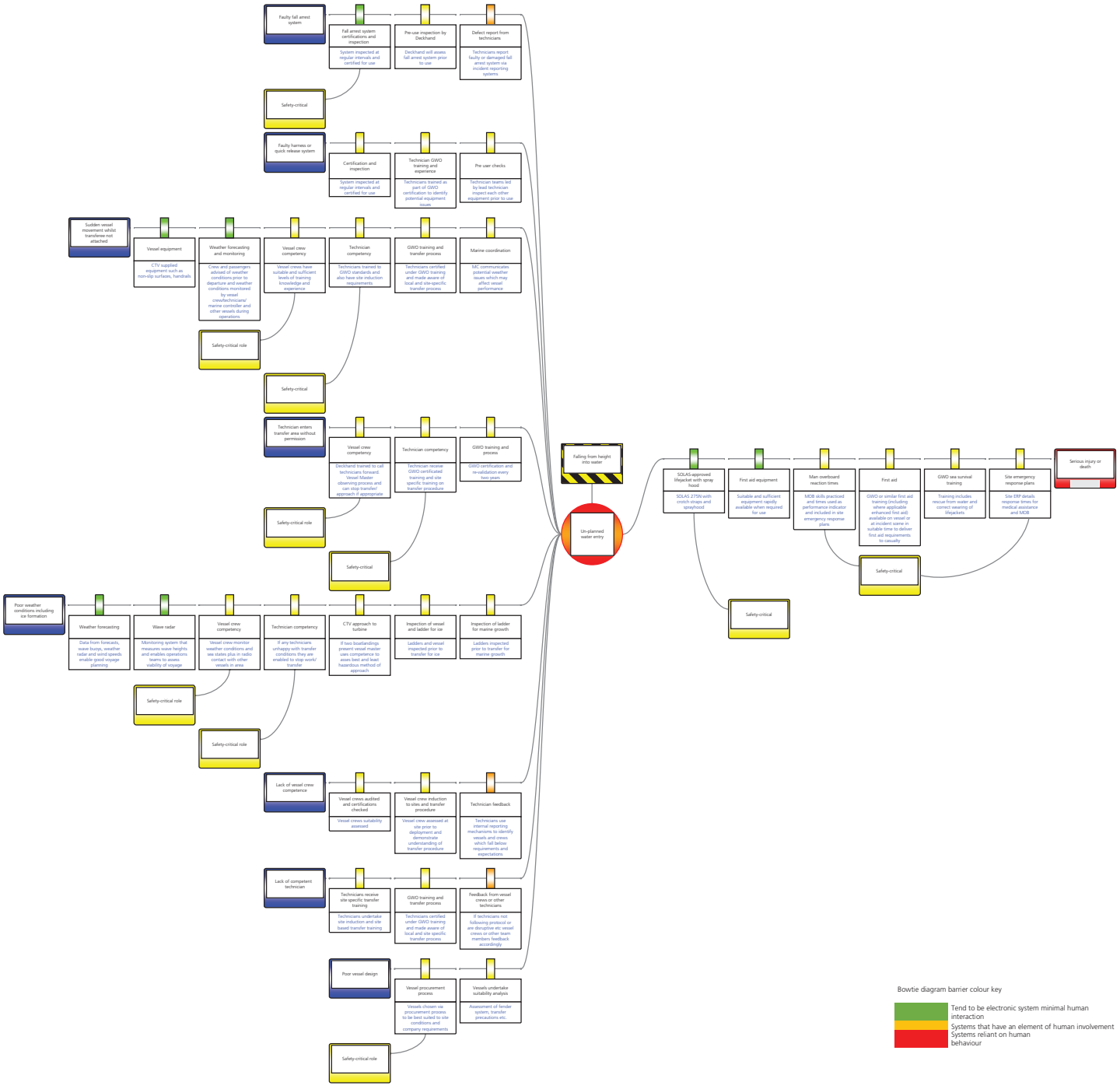
The risk of a fatal outcome related to water entry during a transfer is slightly higher when immersion suit is not used. The benefit of wearing an immersion suit is between 1/100 to 1/1 000 water entries which equates to an increase in risk of fatality per transfer of 9,5E-9 to 9,5E-10.

4. Event tree diagram



5. 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

ANNEX B
EXAMPLE RISK ASSESSMENTS

Example risk assessments here.

1. VESSEL PUSH-ON

Ref	Access/Egress	Stage	Hazard/Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-1.01	Access	Planning of marine operations	Incompatible equipment/boat collision	Specified vessel unavailable or modifications to vessel, leading to incorrect boat landing geometries/stepping distances (from G+ guidance)	Incorrect design of vessel/fender/boat landing	Occupational injury, fall into sea, damage to vessel or boatlanding area. Major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller – Crushing risk between vessel and structure due to insufficient space	4	2	8	Modifications to equipment to ensure safe stepping distance is met – in accordance with G+ parameters (G+: Workshop report on marine transfer/access systems). Additional controls to limit ability of person to fall between boat and landing (to be determined by operator). Procurement process for vessel selection at tender stage. Vessel and systems designed and built to applicable codes of practice and standards and subject to relevant tests and analysis (e.g. FAT, HAT, SAT, FMEA). Vessel and systems installed as per the manufacturers, guidance/ instruction. Compatible PPE.	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented. Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE. Training (GWO Sea Survival, GWO transfer, induction to site and vessel). Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives – for egress this should be completed before vessel arrives. MOB equipment onboard vessel. Head protection.	4	1	4		
H-1.02			On-water transport	Assessment of external influencing conditions	Metocean conditions	Excessive vessel motion, unable to maintain station, vessel aborts approach/transfer No safety consequence										
H-1.03			Poor organisation and job design	Incorrect or failure to make assessment of external influencing conditions	Metocean conditions	Excessive vessel motion, unable to maintain station – for further consequences see hazards where 'vessel movement' is a cause (H-1.06/7/8/9/10/11/13/14/18/32/36)				Review of metocean data prior to vessel leaving port (three-day forecast). Delay to operation. Pre-push on condition assessment. Allowable weather windows. Selection and use of appropriate vessel, taking account of known environmental conditions. Master, transferee and marine coordinator have the overriding authority to abort transfer. Requirement for marginal and limiting criteria for transfer inline with the Small Commercial Vessel Good Practice Guidelines (Section 2.3.3) to be established prior to commencement of transfer. When onsite conditions are expected to deteriorate CTV Masters will perform regular push on tests so as to accurately judge when the vessel will reach safe limits for transfer. Technicians should be given as much notice as possible if earlier than planned egress is necessary. Apply and support no blame culture – crew should be encouraged to make decisions in the interest of safety rather than considering time/ cost pressure. Vessel monitoring system.					Not assessed individually as cause of other hazards
H-1.04	Access	Permission request to marine coordination	On-water transport	Denial of access	Failure to meet requirements of operating company	Inability to access fixed asset No safety consequence										
H-1.05	Access/Egress	Boat push-on to boat lander	On-water transport	Inability to maintain safe access during push-on	Vessel power failure, due to poor maintenance and inspection	Occupational injury, fall into sea, damage to vessel or boatlanding area. Major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller – Crushing risk between vessel and structure due to insufficient space	4	3	12	Selection and use of appropriate vessel, designed and testing according to relevant codes and standards. Defined maintenance management system for vessel. Master, transferee and marine coordinator have the overriding authority to abort transfer. Pre-departure checks confirming vessel functionality. Requirement for marginal and limiting criteria for transfer inline with the Small Commercial Vessel Good Practice Guidelines (Section 2.3.3) to be established prior to commencement of transfer. Competent vessel crew. Before vessel is allowed on site a compatibility test is conducted to confirm vessel design is acceptable. Vessel FAT/SAT.	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented. Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin. PPE. Training (GWO Sea Survival, GWO transfer, induction to site and vessel). Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives. MOB equipment onboard vessel.	4	2	8		
H-1.06	Access/Egress	Boat push-on to boat lander	On-water transport	Inability to maintain safe access during push-on	Environmental parameters (e.g. sea state, reflected waves)	Occupational injury, fall into sea, damage to vessel or boatlanding area. Major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller – Crushing risk between vessel and structure due to insufficient space	4	4	16	Pre-push on condition assessment. Allowable weather windows. Selection and use of appropriate vessel, taking account of known environmental conditions. Master, transferee and marine coordinator have the overriding authority to abort transfer. Monitoring current and forecast weather conditions (vessel and marine coordinator). Monitor tidal currents and their likely impact on transfer (especially to vessels on DP which might not be able to provide a lee from strong tidal flow). Requirement for marginal and limiting criteria for transfer inline with the Small Commercial Vessel Good Practice Guidelines (Section 2.3.3) to be established prior to commencement of transfer Boat landing design. Vessel crew competencies.	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented. Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin. PPE. Training (GWO Sea Survival, GWO transfer, induction to site and vessel). Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives. MOB equipment onboard vessel.	4	2	8		

Ref	Access/Egress	Stage	Hazard/Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-1.07	Access/Egress	Deckhand preparation for transfer and movement on deck	On-water transport	Person falls into water from vessel	Movement of vessel prior to transfer Objects on vessel deck Ice on vessel deck Trip, slips, falls on vessel deck caused by ice, material build-up, objects, etc. on deck Poor vessel design (easy to fall overboard, etc.) Fall whilst donning PPE	Fall into sea causing major injury or fatality from: – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers – Crushing risk between vessel and structure due to insufficient space	4	5	20	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards. Fitness to work declared by persons. Relevant Medical Certificate. Vessel crew and Master continually assess sea condition for suitability for transfer. Buddy check by individual with support from crew for loose items. Transferee follows guidance from Deckhand and Master. Call for a stop if required. Walkways to be kept clear of obstructions and free from contamination (especially oils/greases) and ice. Use suitable footwear – non-slip soles, and avoid oil contamination Vessel specified as fit for purpose including suitable walkways, guardrails and anchor points, suitable area for donning immersion suit and harness, etc. Transferee and crew keep hands free to hold hand railings etc. Personnel required to remain seated while vessel in motion with seatbelts fastened.	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented. Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin. PPE. Training (GWO Sea Survival, GWO transfer, induction to site and vessel). Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives. MOB equipment onboard vessel.	4	2	8		
H-1.08			Motion sickness	Motion sickness	Vessel movement due to motion of vessel on sea	Depending on severity and length of exposure, motion sickness may cause reduced cognitive processing, fatigue, reduced performance, and sickness, leading to occupational injury, e.g. slips, trips and falls	2	4	8	Toolbox talk at pre-transfer briefing to discuss issues. Selecting a fast vessel for long transits or consider a change in logistics strategy from CTVs to SOVs for sites further from shore. Transfer should be cancelled if transfer experiences sea sickness – process for this should be understood and documented. If sickness is experienced during climbing, arrangements should be made to recover transferee as soon as is practicable. Choice of vessel to minimise motion through good design. Navigate vessel in such a way as to minimise motion (e.g. reduce speed or angle to incoming waves). Vessel layout should take account of the need for personnel on board to be able to see the horizon, including considering where loads are positioned. Personnel encouraged to raise sickness at earliest opportunity.	Personnel take short break from task if feeling sick to get fresh air, look at horizon, etc. if feeling sick. All personnel should have awareness of peer health and wellbeing throughout transfer. Buddy check system to be used to ensure personnel can check that each other are content to continue transfer. Personnel given training for awareness about the early signs of motion sickness and how to treat it.	2	2	4		
H-1.09				Impact of taking motion sickness tablets on cognitive abilities	Personnel taking motion sickness tablets to combat effects of vessel motion on sea	Motion sickness tablets can cause drowsiness and dizziness. Impact on cognitive abilities and increased risk in personnel making mistakes during safety critical tasks				Use of motion sickness tablets should be adequately risk assessed and controlled to prevent major impact to cognitive abilities of personnel. Transfer should be cancelled if personnel severely impacted by motion sickness.					Consider use of other mechanisms for treating sickness e.g. acupressure bands	Scenario not risk assessed due to difficulty in assessing likelihood and consequences
H-1.10	Access	Transferee preparation for transfer and movement on deck	On-water transport	Person falls into water from vessel	Movement of vessel prior to transfer Fall whilst donning PPE Objects on vessel deck Ice on ladder or vessel deck Trip, slips, falls on vessel deck or from ladder caused by ice, material build-up, objects, etc. on ladder or deck Inconvenient design/construction of vessel	Fall into sea causing major injury or fatality from: – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers – Crushing risk between vessel and structure due to insufficient space	4	3	12	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards. Fitness to work declared by persons and Relevant Medical Certificate. Vessel Crew and master continually assess sea condition for suitability for transfer. Buddy check by individual with support from crew for loose items. Transferee follows guidance from Deckhand and Master. Call for a stop if required. Walkways to be kept clear of obstructions and free from contamination (especially oils/greases) and ice. Use suitable footwear – non-slip soles, and avoid oil contamination Vessel specified as fit for purpose including suitable walkways, guardrails and anchor points, suitable area for donning immersion suit and harness, etc. Transferee and crew keep hands free to hold hand railings, etc. Personnel advised not to walk around whilst vessel is in motion. PPE to be donned prior to walking onto vessel deck. Transferees only called forward to transfer stage just before transfer is due to commence. SRL in date and pre transfer checks conducted, including visual inspection for anomalies, check lanyard locks when pulled sharply and SRL shock loading indicator has not been activated. No bags to be carried during personnel transfer (with possible exception of a rope bag during commissioning or if the asset crane is not functioning). Transferees have read and understand RAMS and transfer procedure. Automatic connectors to minimise time during connection.	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented. Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin. PPE. Training (GWO Sea Survival, GWO transfer, induction to site and vessel). Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives. MOB equipment onboard vessel. Head protection.	4	1	4		
H-1.11	Access/Egress	Transferee accessing landing stage	Fall into water	Person falls into water from vessel	Movement of vessel prior to transfer Objects on vessel deck Ice on vessel deck Trip, slips, falls on vessel deck caused by ice, material build-up, objects, etc. on deck Inconvenient design/construction of vessel	Fall into sea causing major injury or fatality from: – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers – Crushing risk between vessel and structure due to insufficient space	4	5	20	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards GWO Working at Height training for transferee Fitness to work declared by persons and Relevant Medical Certificate Vessel Crew and master continually assess sea condition for suitability for transfer Buddy check by individual with support from crew for loose items Transferee follows guidance from Deckhand and Master Call for a stop if required No lifting of equipment to take place during transfer Walkways to be kept clear of obstructions and free from contamination (especially oils/greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Vessel specified as fit for purpose including suitable walkways, guardrails and anchor points, suitable area for donning immersion suit and harness, etc. Transferee and crew keep hands free to hold hand railings, etc. Personnel required to remain seated while vessel in motion Deckhand to be ready to assist transferee in establishing stable position on vessel and attaching/detaching from SRL Personnel to don PPE in vessel cabin Only one transferee at a time shall be present at the landing point Pre transfer toolbox talk by deckhand instructing transferee on where to stand prior to transfer	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives MOB equipment onboard vessel	4	2	8		Wearing of survival suit during transfer not recommended due to bulk of suit leading to other occupational hazards (slips, trips and falls)
H-1.12	Access/Egress	Assessment of immediate conditions prior to transfer (decision to transfer between deck crew and transferee)	Weather	Conditions not suitable for transfer	Failure to meet requirements of operating company	Inability to access fixed asset No safety consequence										

Ref	Access/Egress	Stage	Hazard/Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-1.13	Access/Egress	Deckhand creates slack in line, presents SRL to transferee and transferee connects SRL	Objects under tension	Personnel lifted up whilst holding onto SRL	Movement of vessel downwards	Fall to sea or vessel deck/railings causing major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers – Crushing risk between vessel and structure due to insufficient space	4	3	12	Personnel let go of SRL to prevent being lifted up Assessment of conditions prior to transfer Vessel Master awareness of sea conditions Safety gloves worn Deckhand to only create slack in SRL just before a transfer is due to take place Deckhand controls SRL tether line Situational awareness of conditions, likely impact on vessel, position relative to tether line (deckhand should stand upwind if possible) Use SRL with high locking speed to reduce likelihood of SRL locking due to vessel heave Use of connectors to minimise time during connection Design of vessel and equipment to minimise likelihood of person being trapped between vessel and structure	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives MOB equipment onboard vessel	4	1	4		
H-1.14			Objects under tension	Burn on hand from SRL latching as vessel moves down	Movement of vessel downwards	First aid injury (burns to hand)	2	4	8	Personnel let go of SRL to prevent burn Assessment of conditions prior to transfer Vessel Master awareness of sea conditions Gloves worn Safety gloves worn Only create slack in SRL just before a transfer is due to take place Control SRL tether line Situational awareness of conditions, likely impact on vessel, position relative to tether line (deckhand should stand upwind if possible) Prevent any entanglement with the SRL pulldown cord (no turning around hand or arm, awareness where the pulldown cord is located on CTV floor)	First aid kit CTV first aid trained	2	3	6	Ensure gloves are worn by personnel handling SRL line	
H-1.15			Slips, trips and falls	Trip hazard from slack in tether line	Slack in SRL tether line on deck	Fall from deck into sea causing major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers – Crushing risk between vessel and structure due to insufficient space	4	2	8	Transferee follows guidance from deckhand and Master Walkways to be kept clear of obstructions and free from contamination (especially oils/greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Vessel specified as fit for purpose including suitable walkways, guardrails and anchor points, suitable area for donning immersion suit and harness, etc. Transferee and crew keep hands free to hold hand railings, etc. Deckhand to be ready to assist transferee in establishing stable position on vessel and attaching/ detaching from SRL SLR and rope management by the deckhand to avoid loose SRL retrieval rope loops on deck or overboard SRL and retrieval rope not tied on the vessel Situational awareness of both transferee and deckhand SRL retrieval rope yellow colour for increased visual identification Good lighting condition on the deck landing point Deckhand aware of risk and adequately trained in how to mitigate/ reduce risk	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives MOB equipment onboard vessel	4	1	4		
H-1.16	Access/Egress	Transferee immediately steps from landing stage to boat landing ladder	Working at height	Person falls from boat landing ladder platform	Ice on ladder or platform Trip, slips, falls on platform or from ladder caused by ice, marine growth build-up, objects, etc. on ladder or deck Inconvenient design/construction of platform Mistimed step across Deckhand pulls transferee back if they determine it is unsafe for transfer, causing fall of transferee	Major injury or fatality from: – Vessel striking personnel in water – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Crushing risk between vessel and structure due to insufficient space Suspension trauma – see G+ Working at Height Good Practice Guidelines	4	5	20	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards GWO Working at Height training for transferee Fitness to work declared by persons and Relevant Medical Certificate Vessel crew and Master continually assess sea condition for suitability for transfer Buddy check by individual with support from crew for loose items and correctly worn PPE including SRL Transferee follows guidance from Deckhand and Master Communication maintained between deckhand and transferee – call for a stop if required Removal of safety-compromising algae, seaweed and bird guano from boat transfer ladder according to SMA – do not transfer if ladder is not clear Ladder to be kept free from contamination (especially oils/greases) and ice Use suitable footwear – non-slip soles Vessel design (non-slip- surface,. non-slip fenders, correct boat landing stepping distances, vessel design to ensure maximum chance of transferee staying on deck in case of trip or fall) Master continually monitors and makes assessment of conditions to ensure suitability for transfer Vessel propulsion system helps maintain station keeping during transfer Boatlanding ladder designed for a range of sea states and weather conditions Transferee does not connect to SRL until immediately before transfer commences Transferee only called to transfer area immediately prior to transfer Use of quick release connector by the transferee	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives MOB equipment onboard vessel	4	2	8		

Ref	Access/Egress	Stage	Hazard/Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-1.17	Access/Egress	Transferee climbs to the top of the ladder and on to the intermediate platform (if applicable)	People at height	Fall from boat landing ladder into sea whilst climbing up/ down	Trip hazard on retraction line Loss of grip on ladder due to weather (e.g. wet and windy) or build up of sea life, etc. on ladder Movement of vessel whilst stepping off	Major injury or fatality from: – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Fall onto vessel – Fall between vessel and ladder (crushed by vessel) – Crushing risk between vessel and structure due to insufficient space	4	6	24	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards GWO Working at Height training for transferee Fitness to work declared by persons and Relevant Medical Certificate Vessel crew and Master continually assess sea condition for suitability for transfer Communication maintained between Deckhand and transferee – call for a stop if required Ladder to be kept free from contamination (especially oils/greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Attach to SRL before stepping onto ladder Do not climb ladder if it is iced/severely fouled Use suitable footwear and gloves to provide good grip Maintain continuous attachment during climbing Removal of safety-compromising algae, seaweed and bird guano from boat transfer ladder Design of boat landing in line with Carbon Trust – Recommended Boat Landing Geometry (OWA-A-RBD-ATK-DWG-000 4)	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives MOB equipment onboard vessel	4	2	8		
H-1.18				Suspended transferee hit by vessel	Loss of contact with ladder or sudden vessel motion	Major injury due to trauma from striking vessel	3	3	9	Transferee does not connect to SRL until immediately before transfer commences Vessel Crew and Master continually assess sea condition for suitability for transfer GWO Working at Height training for transferee Ladder to be kept free from contamination (especially oils/greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Deckhand pulls slack in SRL prior to transfer to prevent accidental hang ups resulting from small movements of vessel Design of boat landing in line with Carbon Trust – Recommended Boat Landing Geometry (OWA-A-RBD-ATK-DWG-000 4) Use quick operation carabiner/connection device Master and crew are familiar with the limitations of the SRL type and factor this in when assessing suitability of conditions for transfer		3	2	6	Ensure suitable mitigations are in place to remove vessel from vicinity of suspended transferee in event of loss of contract with boat landing ladder	
H-1.19				Suspended transferee uncon-scious	Loss of contact with ladder due to transferee incapacitation or Loss of contact with ladder due to weather conditions, marine growth, etc,.followed by impact of transferee with structure causing unconsciousness	Not assessed in this risk assessment – refer to G+ Working at Height Good Practice Guidelines										
H-1.20			Overhead equipment	Dropped objects striking vessel crew or transferee	Objects fall from person climbing ladder or from platform Ice build up on ladder breaks off and hits personnel	Major injury or fatality from falling objects	4	5	20	Tools and equipment not necessary for the transfer should be lifted in tool bags using the davit crane; small items (camera/ torch) should be secured in closed pockets, radio should be secured in pocket or tool SRL No transfers to take place when lifting operations are in progress No bags to be carried during personnel transfer (with possible exception of a rope bag during commissioning or if the asset crane is not functioning) Transferee shall not carry any backpack whilst climbing the ladder Radios to be located in holsters and tethered to transferees Structure inspected for ice build up prior to transfer – if ice build up present, consideration for cancelling transfer should be given Training so transferees are aware of risks from falling objects	Deckhand and transferee wears head protection during transfers and lifting	4	2	8		
H-1.21			People at height	Transferee becomes entangled in SRL retrieval system	SRL retrieval system	Jamming of system preventing transferee from continuing climb and transferee is stuck on ladder for prolonged period until rescue can be completed	2	2	4		Double hook lanyard and work positioning lanyard required to unblock/release the jammed system	2	1	2		
H-1.22			Objects under tension	Transfer connector hits trans-feree's face or head	Transfer connector being right in front of face when climbing and can hit face	Injury to face, head or eyes	2	3	6	Specification of harness to be determined suitable for operation accounting for differing body geometry and safe ergonomic principles All transferees made aware of risk and advised to keep head and face away from Transfer Connector when climbing Protection system (rubber type) to be placed around the SRL connector helping to protect Transferee face from direct contact with the SRL hard connector Sacrificial weak link on SRL retrieval rope Deckhand releases slack in SRL in a controlled manner to prevent the transfer connector from swinging into the transferee's face	First aid kit carried on vessel Eye protection	2	2	4	Consider use of face protection for transferees	
H-1.23				SRL breaks under tension	Damage to SRL	Failure of a safeguard – not assessed										
H-1.24			Mismatch of work to physical capabilities	Exhaustion from climbing the ladder	Personnel climbing boat ladder	Personnel has to take rest break whilst climbing ladder	1	3	3	All persons must be physically fit enough to undertake the allocated work assignments GWO Working at Height training for transferee Fitness to work declared by persons and Relevant Medical Certificate Ladder design allows for rest to be taken at mid stage platform if transferee becomes fatigued or exhausted Planning of workload to ensure that transferees do not get exhausted from conducting too many transfers in one day		1	2	2		
H-1.25			Mismatch of work to cognitive capabilities	Human error (Rule-based mistake)	Certain level of unfamiliarity with routine could cause personnel to descend too quickly or inadvertently do the incorrect action for an instruction	Mis-step that could lead to hang-up or injury	2	3	6	Training/competency of personnel Instructions from deckhand supporting transfer Offshore induction to be completed prior to being granted permission to access site, familiarising transferee with the equipment (SRL) and layout of boat landing Pre transfer toolbox talk delivered by vessel crew Supervisor in the technician team to supervise their team	Personnel attached to SRL to prevent fall	2	2	4	Ensure procedures are in place to rescue transferee in case of hang-up incident	
H-1.26			Biological hazards	Presence of marine growth – particularly on lower ladder rungs at low tide – increased risk of slips, trips and falls Cause of hazards associated with falls from height												
H-1.27				Presence of bird guano on ladder rungs	Guano deposits	Potential for disease/ infection from bacteria and viruses present in bird guano (e.g. psittacosis) – can be ingested, inhaled or absorbed through the skin	2	3	6	Regular cleaning and maintenance to remove/prevent build-up of guano Safety glasses provided for transferees in line with standard PPE issue and should be worn if bird guano present Gloves mandatory during transfer Use of appropriate antifouling paint		2	1	2		Consider supply of extra gloves on vessel for transferees so contaminated gloves can be changed after climb/descent

Ref	Access/Egress	Stage	Hazard/Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-1.28	Access/Egress	Transferee switches from boat landing ladder to additional ladders of TP/jacket (if applicable)	People at height	Fall from boat landing ladder or additional ladder whilst climbing up/down	Slip/trip/fall when transferring between ladders Transferee fails to hook onto asset via their twin tail lanyard prior to unclipping from the lower SRL	Major injury or fatality from: – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Fall onto vessel – Crushing risk between vessel and structure due to insufficient space	4	5	20	GWO Working at Height training for transferee Fitness to work declared by persons and Relevant Medical Certificate Ladder to be kept free from contamination (especially oils/greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Do not climb ladder if it is iced/severely fouled Ladder is regularly cleaned at low tide Use suitable footwear and gloves to provide good grip Maintain continuous attachment during climbing Removal of safety-compromising algae, seaweed and bird guano from boat transfer ladder	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives MOB equipment onboard vessel	4	2	8		
H-1.29			People at height	Failure of SRL	Failure of SRL line Failure of SRL hooks	Major injury or fatality from impact or fall in sea Failure of a safeguard										
H-1.30	Access/Egress	Communications check between transferee and vessel crew	Communication	Crew and transferee unable to communicate	Radio/communications device failure	Inability to communicate leading to confusion No safety consequence										
H-1.31		**Egress operations are as access but reversed in order. Refer to previous for hazards excluded the following**														
H-1.32	Egress	Deckhand counts final five ladder rungs to inform transferee of position relative to deck	Fall into water	Person falls into water from vessel, boat landing ladder or platform	Movement of vessel prior to transfer Objects on vessel deck Ice on ladder or vessel deck Trip, slips, falls on vessel deck or from ladder caused by ice, material build-up, objects, etc. on ladder or deck Inconvenient design/construction of vessel Mistimed step across	Major injury or fatality from: – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Crushing risk between vessel and structure due to insufficient space	4	5	20	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards GWO Working at Height training for transferee Fitness to work declared by persons and Relevant Medical Certificate Vessel Crew and master continually assess sea condition for suitability for transfer Buddy check by individual with support from crew for loose items and correctly worn PPE including SRL Transferee follows guidance from deckhand and Master Communication maintained between deckhand and transferee – call for a stop if required Removal of safety-compromising algae, seaweed and bird guano from boat transfer ladder Ladder to be kept free from contamination (especially oils/greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Vessel design (non-slip surfaces. non-slip fenders, correct boat landing stepping distances, vessel design to ensure maximum chance of transferee staying on deck in case of trip or fall) Master continually monitors and makes assessment of conditions to ensure suitability for transfer Vessel propulsion system helps maintain station keeping during transfer Boatlanding designed for a range of sea states and weather conditions Deckhand counts transferee down last few steps, and then instruct when to step back	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives MOB equipment onboard vessel	4	2	8		
H-1.33	Egress		People at height	Hangup on SRL line	Transferee steps back too early due to inexperience or lack of communication	Transferee left suspended on SRL	3	3	9	Design of boat landing and platform should reduce likelihood that stepping too early would result in an SRL hangup Vessel crew and Master continually assess sea condition for suitability for transfer GWO Working at Height training for transferee Use suitable footwear – non-slip soles, and avoid oil contamination Design of boat landing in line with Carbon Trust – Recommended Boat Landing Geometry (OWA-A-RBD-ATK-DWG-000 4)	Procedure for recovering transferee in hang-up scenario should be well defined and understood practiced by all transferees	3	2	6		
H-1.34	Egress			Transferee steps back too late	Transferee steps back too late due to inexperience or lack of communication	Potential for injury to personnel, e.g. broken ankles	3	3	9	Design of boat landing and platform should reduce likelihood that stepping too late would result in a major injury Vessel crew and Master continually assess sea condition for suitability for transfer GWO Working at Height training for transferee Design of boat landing in line with Carbon Trust – Recommended Boat Landing Geometry (OWA-A-RBD-ATK-DWG-000 4)		3	2	6		
H-1.35	Egress	After transfer complete, transferees move inside CTV and take seats (including seatbelts – build into prior to transfer)		No credible hazards identified												

Ref	Access/Egress	Stage	Hazard/Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-1.36	Access/Egress	Crew on vessel prior to or after transfer	On-water transport	Slips/trips/falls on vessel deck	Objects on deck of vessel Vessel movements	Minor injuries	2	5	10	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 as increase risk of trips and falls Anti-icing chemicals on vessel deck surface Personnel keep hands free to hold hand railings Personnel advise not to walk around whilst vessel is in motion Anti slip surface on deck	First aid kit	2	3	6		
H-1.37			Exhaust fumes	Exhaust fumes from vessel whilst pushing-on	Exposure to potential harmful fumes	Short term impacts – coughing or unpleasant sensation from inhalation Long-term health impacts of frequent exposure (e.g. particulates)	2	3	6	Appropriate vessel design to minimise personnel exposure to fumes		2	2	4	Consider use of vessel that produce lower volumes of harmful gas (e.g. diesel vessel with filters on exhaust, alternative fuel sources)	
H-1.38			Low temperature	Personnel cold from weather conditions	Cold outside air temperature or wind chill	Reduce efficacy of safety equipment, operational delay in not being able to disconnect, fall from height if not clipped in properly	4	2	8		Personnel given suitable PPE (gloves, etc.) to ensure that they are protected from weather	4	2	8	To determine suitable limits for cold weather transfers and develop procedures for transfers in cold weather to reduce the impact of cold weather on transferees (e.g. providing warm shelters, etc.)	
H-1.39			High temperature	Wearing immersion suit in hot weather	Personnel heat up in immersion suit due to sun and hot weather	Exhaustion, dehydration	2	3	6	Personnel keep well hydrated Immersion suit not required in certain conditions When immersion suit is required, it should not be donned until required		2	1	2		
H-1.40			Lighting	Transfer at night or in low visibility adds additional risk of fall into water	Personnel transfer at night – see additional causes from other activities	Fall into sea or from height causing major injury or fatality	4	2	8	Master checks conditions are suitable for transfer Deck and transfer area well lit Head torch attached to helmet; batteries checked Deck free from obstructions Light should be assessed to confirm it is sufficient to allow for a safe transfer	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives MOB equipment onboard vessel Immersion suits worn at night	4	1	4	Consider undertaking a lighting assessment for low lighting/ nighttime transfers	
H-1.41			Objects under compression	No credible hazard/scenario identified												
H-1.43			Equipment with moving or rotating parts	No credible hazard/scenario identified												
H-1.44			Manual handling	No credible hazard/scenario identified												
H-1.45			Noise	Engine room	Engine room noise	Injury to hearing to personnel	3	3	9	Consideration in deck layout Radio communication equipment is compatible with hearing protection	PPE (hearing protection)	3	1	3		
H-1.46			Humidity	No credible hazard/scenario identified												
H-1.47			Vibration	No credible hazard/scenario identified												
H-1.48			Workstations	No credible hazard/scenario identified												
H-1.49			Awkward location of work	No credible hazard/scenario identified												
H-1.50			Incompatible equipment	No credible hazard/scenario identified												
H-1.51			Marine crew sufficient manning	No credible hazard/scenario identified												
H-1.52			Psychological impact	No credible hazard/scenario identified												
H-1.53			Post-traumatic stress	No credible hazard/scenario identified												
H-1.54			Emergency preparedness	No credible hazard/scenario identified												

Ref	Access/Egress	Stage	Hazard/Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
Miscellaneous hazards																
H-1.55	Access/Egress	All stages	Poor organisation and job design	Slip, trip or fall from vessel or height (into sea or onto vessel), or missing steps in process due to rushing to 'get the job done'	Poor safety culture	Occupational injury, major injury, or fatality				Implementation of a no-blame culture Competence management Competent personnel who understand their limitations and their roles and responsibilities						
H-1.56				Shortcuts taken, task steps not safely carried out	Unclear procedures	Occupational injury, major injury, or fatality				Work as done is reflected in procedure, so shortcuts are less likely to be taken, permit to work would enable you to understand the procedure, PPE requirements, means of access, etc.						
H-1.57				Lack of competency in safety-critical roles and no analysis of training needs	Poor understanding of training needs and lack of provision	Occupational injury, major injury, or fatality				Training needs analysis conducted for job roles to fully understand what training/qualifications are required for them, including refresher training to account for skill fade						
H-1.58			Communication	Transfer personnel and vessel crews may speak different languages and have difficulty conversing in non-native tongue	Language difference between crews	Personnel mis-directed when transferring, potentially leading to serious accident				Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards All crew required have a minimum standard of proficiency in common language Verify vessel crew, work crew and operators all meet minimum acceptable language proficiency in the agreed lingua franca						
H-1.59				Uncertainty on roles and command structure	Difference in roles/commands between vessels/organisations	Ineffective teamwork and leadership, leading to potential increased risk of other scenarios or delayed response in emergency situation				Clear definition of roles and commands communicated for all crew/transferees involved in transfer Toolbox talk prior to transfer						
H-1.60				Lack of commonality used between transferees and vessel crews	Difference in training requirements	Personnel mis-directed when transferring, potentially leading to serious accident				Having a standard communication protocol can help to avoid misunderstanding e.g. '5-4-3-2-1-Step Back' (avoid words that could be mis-heard, such as 'step/stop', 'go/no'.) Vessel PA can help with audibility deckhand has the following commands: ABORT, UP, DOWN						
H-1.61			Weather	Transfer in adverse weather adds additional risk of fall into water	Personnel transfer during adverse weather – see additional causes from other activities High winds, waves and swell causing more vessel movement	Fall into sea or from height causing major injury or fatality				Review of metocean data prior to vessel leaving port (three-day forecast) Delay to operation Pre-push on condition assessment Allowable weather windows	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives MOB equipment onboard vessel					
H-1.62			Sea state	Transfer in incorrect sea state adds additional risk of fall into water	Personnel transfer during incorrect sea state – see additional causes from other activities Additional swell at extremes of tides, greater vessel movement, higher build up sea life on ladder at low-tide areas	Fall into sea or from height causing major injury or fatality				Review of metocean data prior to vessel leaving port (3 day forecast) Delay to operation Pre push on condition assessment	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE – for egress this should be completed before vessel arrives MOB equipment onboard vessel					
H-1.63			Long and/or irregular working hours/shifts	Long/irregular shifts	Fatigue due to physical exertion after long shifts	Personnel has to take rest break whilst climbing ladder Personnel has loss of concentration and slips/misses rung leading to hang up or occupational injury				Adequate rest periods between shifts Opportunity to raise issues at a pre-transfer briefing Training/competency of personnel Instructions from deckhand supporting transfer	Personnel attached to SRL to arrest fall					
H-1.64			Fatigue	Fatigue	Physical exertion, long shifts, underlying health condition	Personnel has loss of concentration and slips/misses rung leading to hang up or occupational injury				Adequate rest periods between shifts Toolbox talk at pre-transfer briefing to raise potential issues Implementation of no-blame culture Fitness to work declared by persons and Relevant Medical Certificate Ladder design allows for rest to be taken at mid stage platform if transferee becomes fatigued or exhausted	Personnel would be attached to a safety harness and fall arrest system Use rest platform if required. Appropriate footwear					
H-1.65			Medical unfitness	Personnel physically unable to climb ladder	Medical unfitness	Personnel may become stuck on ladder Potential to exaggerate medical conditions by effort required to climb ladder				Fitness to work declared by persons and Relevant Medical Certificate	Access to medically trained personnel and first aid kit					

2. LIFTING VIA PTC

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-2.01	Access	Planning of marine operations	On-water transport	Specified vessel unavailable or modifications to vessel	Incorrect design	Unable to conduct lift No safety consequence										
H-2.02			On-water transport	Assessment of external influencing conditions	Metocean conditions	Excessive vessel motion, unable to maintain station Unable to conduct lift – no safety consequence										
H-2.03	Access	Vessel approach	On-water transport	Inability to approach structure	Power failure Vessel failure Vessel design Environmental parameters (e.g. sea state)	Inability to access fixed asset Unable to conduct lift – no safety consequence										
H-2.04	Access	Preparation and testing of PTC prior to transfer	Manual handling materials	Rigging handling	Handling of lifting rigging prior to commencement of operations	Injury to personnel Damage to equipment Risk of snagging	3	3	9	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards (including manual handling) PTC rigging should be designed to minimise requirement to handle wire rope. Only connection of master link to the crane hook is required		3	2	6	Consider use of gloves when handling rigging	
H-2.05	Access	Trained deck crew to ensure that transferees have full PPE including SOLAS-approved lifejacket and that they are harnessed properly into the seats. Instructions given to transferees not to remove harnesses until clearly instructed		No credible hazard/ scenario identified					0							
H-2.06	Access	Bags/luggage loaded and secured in a manner that they cannot fall from height. Check that MOB equipment is on standby, lifebuoys, lines, etc.		No credible hazard/ scenario identified					0							
H-2.07	Access	When directed by the lifting supervisor, the crane operator will lift the PTC	Mismatch of work to cognitive capabilities	Human error (slip)	Press the wrong button/operate in wrong direction	Operational delay, possible equipment damage, injury to transferees	2	3	6	Competent procurement personnel and robust procurement procedure, physical barrier management (safety gate, red/green lights, etc.), competent operator and training process Ergonomic design of control panel Dedicated lifting/landing area Training on systems and dry runs		2	2	4		
H-2.08			Communication	Banksman is unable to communicate with crane operator	Failure of communication equipment	Information can't be passed to crane operator which could result in the PTC being lifted or lowered incorrectly Injuries to personnel	2	3	6	Communication devices are suitable for environment and tested regularly Radio communication established prior to lift Banksman and crane operator are both working in close proximity on the deck	Spare communication device Spare batteries (if applicable)	2	1	2		
H-2.09	Access	The deckhand keeps the stability of the PTC using tag lines	Mismatch of work to physical capabilities	Personnel on vessel unable to keep control of tag lines at start of lift	PTC motion at start of lift is significant	PTC hits personnel on ground causing injury	3	4	12	Lift supervisor, crane operator and banksman in constant communication monitoring the lift Establish and follow defined weather criteria Tag lines using during the first few metres of lift to prevent loss of control of PTC Tag lines sufficiently long in order to not require going under capsule during active lift to pick up the end of the rope Tag lines are anti-snagging type (stiff line construction) Boat hooks should be made available in case it is required to retrieve the tag line from a lifting zone Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Fitness to work declared by persons and Relevant Medical Certificate Lift not carried out unless lifting plan and permit in place	Personnel working on deck wear head protections	3	2	6		

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-2.10	Access	The PTC is lifted up to the platform	People at height	Fall from PTC	Personnel fall out of PTC during transfer due to: – Excessive motion of PTC – Impact against vessel or structure	Personnel fall into water or onto structure below Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	5	5	25	Defined maintenance and inspection management system for vessel and PTC Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Certified crane operator (certification to allow for personnel transfers) Deckhands check all transferees are correctly clipped into harness Lift not carried out unless lifting plan and permit in place prior to commencing transfer Defined and allowable weather windows Crew to be seated/restrained in PTC (where fitted) as per manufacturers operations guidelines Landing zones sufficiently sized and clear of obstacles	Emergency rescue team in place and readied on deck in case rescue is required Transferees ensure that they have SOLAS-approved lifejacket and potential use of PLB on person before transferring PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection Transferees are in constant communication with the Crane Operator and Emergency Rescue team	5	3	12		
H-2.11				PTC falls	PTC falls due to: – Failure of integrity of PTC – Failure of rigging equipment	Personnel fall into water or onto structure below Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	5	5	25	Defined maintenance and inspection management system for vessel and PTC Certified crane operator (certification to allow for personnel transfers) All lifts provided with certified rigging and shackles Visual check for wear and tears on lifting gear before lifting Pre-use inspection and test Third-party certification of PTC Banksman observing lift Crane operator remains in line of sight of PTC throughout PTC to used in accordance with PTC manufacturer's use manual/instructions Lift not carried out unless lifting plan and permit in place Periodic replacement of rigging are required, pre-use checks should also require that rigging component is checked	Emergency rescue team in place and readied on deck in case rescue is required Transferees ensure that they have SOLAS-approved lifejacket and potential use of PLB on person before transferring PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel PTC floats Head protection	5	2	10		
H-2.11A					PTC falls due to: – Lifting load is exceeded (e.g. hang up)	Personnel fall into water or onto structure below Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	5	5	25	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Certified crane operator (certification to allow for personnel transfers) PTC never loaded beyond maximum load (factor of safety included in maximum load) Banksman observing lift PTC to used in accordance with PTC manufacturer's use manual/instructions Lift not carried out unless lifting plan and permit in place Lift path and landing zones free of obstructions	Emergency rescue team in place and readied on deck in case rescue is required Transferees ensure that they have SOLAS-approved lifejacket and potential use of PLB on person before transferring PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel PTC floats Head protection	5	2	10		
H-2.12				PTC impact with turbine blade	Turbine blades turning whilst PTC transfer takes place	Major injury or death due to fall from PTC or trauma from being struck with blade	5	3	15	Turbine motion isolated prior to vessel entering area Procedure to set the WTG to the correct heading and locking the yaw prior to the vessel approach (where possible) to avoid any risk of collision between the vessel and PTC Lift not carried out unless lifting plan and permit in place Dead zone programming included in crane design		5	1	5		
H-2.13				Personnel suspended in PTC	Electrical/mechanical failure of crane leaving PTC suspended	Personnel suspended over water requiring emergency rescue. Risk of exposure to weather/ sun, with no access to supplies of facilities	3	2	6	Defined maintenance and inspection management system for vessel and PTC Installed emergency descend in the transfer capsule UPS implemented, allowing for lowering and slewing to safe position	Emergency rescue team in place and readied on deck in case rescue is required	3	1	3		
H-2.14				Vessel motions causes load to swing	Sea or weather causes additional vessel movement not compensated for by crane operator	PTC hits structure or vessel Injury to personnel in PTC or on structure/vessel	4	3	12	Empty run with dummy PTC Master and superintendent advisory Defined and allowable weather windows Lift not carried out unless lifting plan, lifting limits and permit in place	Lifting zones clear of personnel PPE – head protections	4	2	8		
H-2.15			Overhead equipment	Falling tools and equipment from PTC	Tools and equipment are not tethered correctly Tools and equipment could fall from personnel pockets	Object strikes personnel on deck Major injury or fatality	4	5	20	Confirmation that all tools and equipment are tethered prior to lift Personnel not permitted to carry tools and equipment in pockets during lift Chin straps added to helmets in bad weather to prevent dropping Tag lines sufficient length to allow personnel to be well way from the lifting zone Radios to be located in holsters and tethered to transferees Luggage should be transferred by separate means (lift bags, transfer bag for luggage, etc.)	Lifting zones clear of personnel PPE – head protections	4	2	8		
H-2.16				PTC being lowered hits personnel on vessel deck	Communication breakdown between banksman and crane operator/lift supervisor Error by crane operator Personnel inside lifting zone	Personnel potential crushed Major injury or fatality	5	2	10	Lifting zones clear of personnel Banksman required in PTC at all times Competency of crane operator Lift supervisor must be present for duration of lift Lift not carried out unless lifting plan and permit in place	Lifting zones clear of personnel PPE – head protections	5	1	5		
H-2.17				PTC hits obstacles	Obstacles in the way of lifting path	PTC strikes obstacles causing injury to personnel	3	3	9	Banksman required in PTC at all times Competency of crane operator Lift supervisor must be present for duration of lift Lift not carried out unless lifting plan and permit in place Soft contact panels to prevent transferring impact energy to passengers, and to protect external assets		3	2	6		
H-2.18			Equipment with moving or rotating parts	Hands trapped	Hands become trapped in clips, etc. when clipping into harness or PTC	Trapped finger Minor injury	2	5	10	Gloves always worn Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Three-point harness is adjusted after strapping into it, so there is not risk of finger trapping or pinching	First aid kit	2	2	4		
H-2.19			Weather	Loss of control of PTC when lifting	Wind causes adverse movement of PTC	PTC hits structure or vessel Injury to personnel in PTC or on structure/vessel	3	3	9	Lift supervisor, crane operator and banksman in constant communication monitoring the lift Tag lines using during the first few metres of lift to prevent loss of control of PTC Lift not carried out unless lifting plan and permit in place Metocean limiting criteria should be established in line with guidance included in G+ Good Practice Guidelines Conduct checks in line with IMCA guidelines Soft contact panels to prevent transferring impact energy to passengers, and to protect external assets		3	2	6		
H-2.20				Adverse weather	Weather unsuitable to make lift (rain, ice, snow, etc.) or poor visibility	Weather causes PTC to lose control, etc. Injury to personnel in PTC	2	3	6	Infield assessment (TRA) by vessel master and banksman Permit to work Defined and allowable weather window and sea state Soft contact panels to prevent transferring impact energy to passengers, and to protect external assets		2	1	2		
H-2.21			Mismatch of work to physical capabilities	Personnel unable to reach hook on points, etc.	Hook on points in unsuitable location Personnel not adequately assessed for physical fitness to do job	Unable to conduct lift Potential strain injuries if attempted	1	2	2	Medical suitability assessment of all personnel Hook on points ergonomically designed Deckhand to assist personnel with attaching to hook on points		1	1	1		
H-2.22			Motion sickness	Motion sickness during transfer	Motion of PTC during transfer	Personnel become unwell Depending on severity and length of exposure, motion sickness may cause reduced cognitive processing, fatigue, reduced performance, leading to occupational injury, e.g. slips, trips and falls,	2	4	8	Toolbox talk at pre-transfer briefing to discuss issues Transfer should be cancelled if transferee experiences sea sickness If sickness is experienced during climbing, arrangements should be made to recover transferee as soon as is practicable Choice of vessel to minimise motion through good design Vessel layout should take account of the need for personnel on board to be able to see the horizon, including considering where loads are positioned	Personnel take short break from task if feeling sick to get fresh air, look at horizon, etc. if feeling sick	2	2	4		
H-2.23				Impact of taking motion sickness tablets on cognitive abilities	Personnel taking motion sickness tablets to combat effects of vessel motion on sea	Motion sickness tablets can cause drowsiness and dizziness. Impact on cognitive abilities and increased risk in personnel making mistakes during safety critical tasks				Use of motion sickness tablets should be adequately risk assessed and controlled to prevent major impact to cognitive abilities of personnel Transfer should be cancelled if personnel severely impacted by motion sickness						Scenario not risk assessed due to difficulty in assessing likelihood and consequences

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
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H-2.24	Egress	PTC lowered onto vessel deck	People at height	Hard landing of PTC	Communication breakdown between banksman and crane operator/lift supervisor causing PTC to be lowered too quickly Excessive vessel motion causing vessel to move up and hit PTC	Injury to personnel (whiplash, broken bones tec.)	4	3	12	Banksman required in PTC at all times Competency assessment performed on crane operator prior to being permitted to conduct transfer operations Lift supervisor must be present for duration of lift Pre-lift assessment of metocean conditions Lift not carried out unless lifting plan and permit in place Carrier equipped with suspension system to absorb energy from vertical impacts Ergonomic design of seats to help prevent whiplash from side impacts		4	2	8		
H-2.25	Access/ Egress	All stages	Low temperature	Transferees waiting in cold for PTC to return if multiple transferees	Cold outside air temperature or wind chill	Hypothermia, frost bite, etc. and subsequent fatality	4	4	16		Personnel given suitable PPE (gloves, etc.) to ensure that they are protected from weather	4	2	8		
H-2.26				Extreme low temperature	Extreme low temperatures can reduce dexterity, e.g. making it more difficult to clip onto safety equipment, grasp PTC, etc.	Safety harness/SRL not worn correctly reducing safety – could cause fall into water/onto vessel. Inability to grip the PTC could lead to fall into water/onto vessel, leading to multiple fatalities	5	2	10		Personnel given suitable PPE to ensure that they are protected from weather, e.g. gloves, immersion suit, etc.	5	1	5		
H-2.27			High temperature	Wearing immersion suit in hot weather	Personnel heat up in immersion suit due to sun and hot weather	Exhaustion, dehydration	2	3	6	Personnel keep fluids on their person to maintain hydration Immersion suit not required in certain conditions Immersion suit not required when assessment of sea temperatures determines that it is not necessary		2	1	2		
H-2.28			Lighting	Insufficient lighting when lifting at night	Night working	Personnel unable to see equipment properly which increase risk of slips, trips and falls or incorrectly clipping harnesses, etc. Increase potential for human error leading to loss of PTC and multiple fatalities	5	2	10	Strobe lighting carried by personnel as PPE requirement Deck lighting Minimise night working where possible Light should be assessed to confirm it is sufficient to allow for a safe transfer	Emergency rescue team in place and readied on deck in case rescue is required Transferees ensure that they have SOLAS-approved lifejacket and potential use of PLB on person before transferring PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel PTC floats Head protection Immersion suits worn at night	5	1	5	Consider undertaking a lighting assessment for low lighting/ nighttime transfers	
H-2.29			People under water	No credible hazard/ scenario identified												
H-2.30			Objects under tension	No credible hazard/ scenario identified												
H-2.31			Objects under compression	No credible hazard/ scenario identified												
H-2.34			Exhaust fumes	No credible hazard/ scenario identified												
H-2.35			Noise	Engine room	Engine room noise	Injury to hearing to personnel	3	3	9	Consideration in deck layout Radio communication equipment is compatible with hearing protection	PPE (hearing protection)	3	1	3		
H-2.36			High temperature	No credible hazard/ scenario identified												
H-2.37			High humidity	No credible hazard/ scenario identified												
H-2.38			Vibration	No credible hazard/ scenario identified												
H-2.39			Workstations	No credible hazard/ scenario identified												
H-2.40			Awkward location of work	No credible hazard/ scenario identified												
H-2.41			Marine crew sufficient manning	No credible hazard/ scenario identified												
H-2.42			Post-traumatic stress	No credible hazard/ scenario identified												
H-2.43			Psychological impact	No credible hazard/ scenario identified												
H-2.44			Shift work	No credible hazard/ scenario identified												
H-2.45			Emergency preparedness	No credible hazard/ scenario identified												

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
Miscellaneous hazards																
H-2.46	Access/ Egress	All stages	Poor organisation and job design	Slip, trip or fall from vessel or height (into sea or onto vessel), or missing steps in process due to rushing to 'get the job done'	Poor safety culture	Fall from height, fingers trapped, equipment damage				Implementation of a no-blame culture. Competence management. Competent personnel who understand their limitations and their roles and responsibilities						
H-2.47				Shortcuts taken, task steps not safely carried out	Unclear procedures	Occupational injury, major injury, or fatality				Work as done is reflected in procedure, so shortcuts are less likely to be taken, permit to work would enable you to understand the procedure, PPE requirements, means of access, etc. Toolbox talks prior to lift	Using Best Practice in Procedure Formatting from HPOG (Human Performance in Oil & Gas)					
H-2.48				Lack of competency in safety critical roles and no analysis of training needs	Poor understanding of training needs and lack of provision	Occupational injury, major injury, or fatality				Training needs analysis conducted for job roles to fully understand what training/ qualifications are required for them, including refresher training to account for skill fade Toolbox talks prior to lift						
H-2.49				Lack of clarity of roles during lift	Difference in training requirements	PTC lifting is not properly controlled PTC could lose control and cause injury to personnel				Lift supervisor must be present and at their station for the entire duration of the lift Toolbox talk prior to lift clearly define roles for crew and all personnel prior to lift						
H-2.50			Long and/or irregular working hours/shifts	Fatigue	Not preparing the PTC correctly, difficulty maintaining grasp on PTC, loss of concentration	Increased risk of slips, trips and falls, minor injuries, trapped fingers,				Rest periods between shifts. Opportunity to raise issues at a pre-transfer briefing						
H-2.51			Medical unfitness	User being lifted becomes incapacitated due to injury or illness and is at risk of not receiving timely medical attention	Unexpected injury or illness	Unable to attend to unwell personnel Potential for further injury or illness				Training advises that transfers should be avoided if there is the onset of any illness Fitness to work declared by persons and Relevant Medical Certificate	Training for transfer operator includes guidance on rescuing personnel in such circumstances (generally lowering the casualty to the vessel is the best course)					
H-2.52			Psychological impact	Psychological impact from nervousness in being transferred via PTC	Perception of dangers of PTC transfer	Personnel unwilling to make transfer				Passenger briefing to highlight safety features of PTC, personnel to familiarise with the capsule prior to mobilisation onshore						
H-2.53			Communication	Language difference between crews	Transfer personnel and vessel crews may speak different languages and have difficulty conversing in non-native tongue	Personnel mis-directed when transferring, potentially leading to serious accident				Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Verify vessel crew, work crew and operators all meet minimum acceptable language proficiency in the agreed lingua franca						
H-2.54				Uncertainty on roles and command structure	Difference in roles/commands between vessels/organisations	Ineffective teamwork and leadership, leading to potential increased risk of other scenarios or delayed response in emergency situation				Clear definition of roles and commands communicated for all crew/transferees involved in transfer Toolbox talk prior to transfer						
H-2.55				Lack of commonality used between transferees and vessel crews	Difference in training requirements	Personnel mis-directed when transferring, potentially leading to serious accident				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 has the following commands: ABORT, UP, DOWN						

3. HEAVE COMPENSATED LIFTING

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-3.01	Access	Planning of marine operations	On-water transport	Specified vessel unavailable or modifications to vessel	Incorrect design of vessel/ fender	Occupational injury, fall into sea, damage to vessel or boatlanding area. Major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	4	3	12	The tender process and pre-charter inspection is designed to ensure only fit for purpose vessels are selected for marine operations Use of alternate access system Clear handover procedure, clear permit to work/isolations system Vessel and systems designed and built to applicable codes of practice and standards and subject to relevant tests and analysis (e.g. FAT. HAT, SAT, FMEA) Vessel and systems installed as per the manufacturers guidance/instruction	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLASapproved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		
H-3.02	Access		On-water transport	Assessment of external influencing conditions	Metocean conditions	Excessive vessel motion, unable to maintain station No safety consequence										
H-3.03	Access	Permission request to marine coordination	On-water transport	Denial of access	Failure to meet requirements of operating company	Inability to access fixed asset No safety consequence										
H-3.04	Access	Boat push-on to boat lander	On-water transport	Inability to maintain safe access during push-on	Power failure Vessel failure Vessel design	Occupational injury, fall into sea, damage to vessel or boatlanding area. Major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	4	2	8	Pre push on condition assessment Selection and use of appropriate vessel Defined maintenance management system for vessel Valid man-riding certification	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individua with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		
H-3.05	Access				Environmental parame-ters (e.g. sea state)	Occupational injury, fall into sea, damage to vessel or boatlanding area. Major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	4	3	12	Pre push on condition assessment Selection and use of appropriate vessel, designed and testing according to relevant codes and standards Allowable weather windows Selection and use of appropriate vessel, taking account of known environmental conditions Valid man-riding certification Requirement for marginal and limiting criteria for transfer inline with the Small Commercial Vessel Good Practice Guidelines (Section 2.3.3) to be established prior to commencement of transfer Transfer takes place 2.5-4m into CTV deck, making it less likely a fall into water will occur Vessel FAT/SAT	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		
H-3.06	Access	Deckhand prepa-ration for transfer and movement on deck	On-water transport	Person falls into water from vessel	Movement of vessel prior to transfer Objects on vessel deck Ice on vessel deck Trip, slips, falls on vessel deck caused by ice, ma-terial build-up, objects, etc. on deck Inconvenient design/ construction of vessel	Fall into sea causing major injury or fatality from: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	3	12	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Fitness to work declared by persons and Relevant Medical Certificate Vessel crew and Master continually assess sea condition for suitability for transfer Buddy check by individua with support from crew for loose items Transferee follows guidance from Deckhand and Master Call for a stop if required Walkways to be kept clear of obstructions and free from contamination (especially oils/ greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Vessel specified as fit for purpose including suitable walkways, guardrails and anchor points, suitable area for donning immersion suit and harness, etc. Transferee and crew keep hands free to hold hand railings, etc. Personnel required to remain seated while vessel in motion Valid man-riding certification Transfer takes place 2.5-4m into CTV deck, making it less likely a fall into water will occur	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, under-stood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		
H-3.07			Motion sickness	Motion sickness	Vessel movement due to motion of vessel on sea	Depending on severity and length of expo-sure, motion sickness may cause reduced cognitive processing, fatigue, reduced performance, and sickness, leading to occu-pational injury, e.g. slips, trips and falls	2	4	8	Sea sickness tablets Toolbox talk at pre-transfer briefing to discuss issues Selecting a fast vessel for long transits or consider a change in logistics strategy from CTVs to SOVs for sites further from shore Transfer should be cancelled is transfer experiences sea sickness Choice of vessel to minimise motion through good design Navigate vessel in such a way as to minimise motion (e.g. reduce speed or angle to incoming waves) Vessel layout should take account of the need for personnel on board to be able to see the horizon, including considering where loads are positioned	Personnel take short break from task if feeling sick to get fresh air, look at horizon, etc if feeling sick	2	2	4		
H-3.08				Impact of taking motion sickness tablets on cognitive abilities	Personnel taking motion sickness tablets to combat effects of vessel motion on sea	Motion sickness tablets can cause drowsi-ness and dizziness. Impact on cognitive abili-ties and increased risk in personnel making mistakes during safety critical tasks				Use of motion sickness tablets should be adequately risk assessed and controlled to prevent major impact to cognitive abilities of personnel Transfer should be cancelled if personnel severely impacted by motion sickness						Scenario not risk assessed due to difficulty in assessing likelihood and consequences
H-3.09	Access	Deckhand access landing stage	On-water transport	Person falls into water from vessel	Movement of vessel prior to transfer Objects on vessel deck Ice on vessel deck Trip, slips, falls on vessel deck caused by ice, ma-terial build-up, objects, etc. on deck Inconvenient design/ construction of vessel	Fall into sea causing major injury or fatality from: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	3	12	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Fitness to work declared by persons and Relevant Medical Certificate Vessel crew and Master continually assess sea condition for suitability for transfer Buddy check by individua with support from crew for loose items Transferee follows guidance from Deckhand and Master Call for a stop if required Walkways to be kept clear of obstructions and free from contamination (especially oils/ greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Vessel specified as fit for purpose including suitable walkways, guardrails and anchor points, suitable area for donning immersion suit and harness, etc. Transferee and crew keep hands free to hold hand railings, etc. Personnel required to remain seated while vessel in motion Valid man-riding certification Transfer takes place 2.5-4m into CTV deck, making it less likely a fall into water will occur	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-3.10	Access	Transferee preparation for transfer and movement on deck	On-water transport	Person falls into water from vessel	Movement of vessel prior to transfer Fall whilst donning PPE Objects on vessel deck Ice on ladder or vessel deck Trip, slips, falls on vessel deck or from ladder caused by ice, material build-up, objects, etc. on ladder or deck Inconvenient design/ construction of vessel	Fall into sea causing major injury or fatality from: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	3	12	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Fitness to work declared by persons and Relevant Medical Certificate Vessel crew and Master continually assess sea condition for suitability for transfer Buddy check by individual with support from crew for loose items Transferee follows guidance from Deckhand and Master Call for a stop if required Walkways to be kept clear of obstructions and free from contamination (especially oils/ greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Vessel specified as fit for purpose including suitable walkways, guardrails and anchor points, suitable area for donning immersion suit and harness, etc. Transferee and crew keep hands free to hold hand railings, etc. Personnel advised not to walk around whilst vessel is in motion Valid man-riding certification Transfer takes place 2.5-4m into CTV deck, making it less likely a fall into water will occur	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		
H-3.11	Access	Transferee accessing lifting area	On-water transport	Person falls into water from vessel	Movement of vessel prior to transfer Objects on vessel deck Ice on vessel deck Trip, slips, falls on vessel deck caused by ice, material build-up, objects, etc. on deck Inconvenient design/ construction of vessel	Fall into sea causing major injury or fatality from: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	3	12	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards GWO Working at Height training for transferee Fitness to work declared by persons and Relevant Medical Certificate Vessel crew and Master continually assess sea condition for suitability for transfer Buddy check by individuals with support from crew for loose items Transferee follows guidance from Deckhand and Master Call for a stop if required No lifting of equipment to take place during transfer Walkways to be kept clear of obstructions and free from contamination (especially oils/ greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Vessel specified as fit for purpose including suitable walkways, guardrails and anchor points, suitable area for donning immersion suit and harness, etc. Transferee and crew keep hands free to hold hand railings, etc. Personnel required to remain seated while vessel in motion Valid man-riding certification TBT and read and understand site-specific transfer procedure Transfer takes place 2.5-4m into CTV deck, making it less likely a fall into water will occur	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		
H-3.12	Access	Assessment of immediate conditions prior to transfer (decision to transfer between deck crew and transferee)	Weather	Conditions not suitable for transfer	Failure to meet requirements of operating company	Inability to access fixed asset - no safety consequence										
H-3.13	Access	Transferee connects safety karabiner to master link	Low temperature	Extreme low temperature	Extreme low temperatures can reduce dexterity, making it more difficult to clip onto the system correctly or at the top disconnecting from safety equipment	Reduce efficacy of safety equipment, operational delay in not being able to disconnect, fall from height if not clipped in properly	4	2	8	Active heave compensation function Suitable connection means, e.g. Frog, dual action carabiner	Personnel given suitable PPE to ensure that they are protected from weather, e.g. gloves, immersion suit, etc.	4	2	8		
H-3.14			Objects under tension	trapped fingers in linkage equipment	Personnel get hands or fingers trapped in equipment/linkages under tension	Loss of fingers	3	4	12	Personnel to keep hands clear of equipment under tension Guard fitted to prevent fingers being trapped User manual includes warning of crush hazard training and manual for maintenance transferees explicitly warns against this risk	Personnel wear suitable PPE (gloves)	3	3	9		

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-3.15	Access/ Egress	Transferee is lifted to the top of the structure	People at height	Deckhand knocked by suspended transferee	Motion of the vessel/ wind causes suspended transferee to knock into the Deckhand	Major injury or fatality if deckhand pushed into sea, due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	3	12	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Vessel crew and Master continually assess sea condition for suitability for transfer Call for a stop if required Vessel specified as fit for purpose including suitable walkways, guardrails and anchor points, to prevent Deckhand falling into sea Transferee is stabilised by Deckhand Valid man-riding certification Transfer to take place at centre of vessel so if fall occurs, it is onto the same deck Vessel fitted with guardrails on side Transfer takes place 2.5-4m into CTV deck, making it less likely a fall into water will occur Vessel crew stand away from lifting area where possible	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	2	8		
H-3.16			People at height	Potential for transferee to become entangled in rope	Slack built up in rope due to vessel motion, or machine operation	Minor injury as transferee susceptible to hitting structure	1	3	3	Deck tracking automatically prevents slack rope from developing Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards (training guidance is for user to clip onto rope immediately prior to transfer (by which time the deck hand will have confirmed that it is safe to do so, including no slack in line) Slack wire detection System prevents rope from being spooled onto deck to reduce risk of rope entanglement		1	2	2		
H-3.17			People at height	Sudden stop of system results in user travelling upwards then falling on slack rope	E-Stop on cabinet pressed in error Loss of power to system	Injury due to whiplash, etc.	3	3	9	System safe deceleration prevents slack wire and brings drive to a safe stop		3	1	3		
H-3.18			People at height	Unexpected motion of rope relative to deck or turbine could cause injury to user	User or Deckhand places hand or foot in front of deck sensor target area, hence changing distance measurement very quickly	Potential injury to personnel	2	4	8	Exclusion zone for deck sensor specified on vessel and clearly demarcated Vessel selection and procurement ensures a suitable area is available for the exclusion zone (no grating) without features that could impact sensor height readings Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards (Training for transfer operators and transferees highlights location of deck target(s)) If the laser deck sensor is obscured in such a manner, system logic ignores the erroneous signal and uses MRU signal only System continuously monitors deck sensor reported data safety limited speed and acceleration features prevent excessive motion		2	2	4		
H-3.19			People at height	Transferee falls from height	Harness fails Hoist line fails Not clipped in correctly Connector opens inadvertently Connector attached to lifejacket instead of harness Physical failure of mechanical part, e.g. shaft or linkage	Major injury or fatality due to fall to sea, due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers – Falling transferee hits personnel on deck (potential multiple fatalities)	5	3	15	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Safe rope management should ensure wire vibration and end of line movement is eliminated Commissioning checks at installation ensure the line does not contact or abrade against objects Transferee follows guidance from deckhand and Master Call for a stop if required Crane and hoist line designed to applicable codes and standards Regular inspection and removal of marine growth and removal according to SMA Valid man-riding certification Planned maintenance	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	5	1	5	Consider conducting proof test load carried out prior to transfer	
H-3.20			People at height	Transferees snag on the grab-handles and small external platform during the lift or lower operation	Lifting too close to the structure to enable an ergonomic step-gap	Injury to personnel	2	3	6	Platform and grab handles designed with no sharps or snag risk Grab-handles are spaced wide enough to be outside the lifting zone Automatic safety limited slow speed during the ascent and descent near the external platform	First aid kits carried on vessel	2	2	4		
H-3.21			Overhead equipment	Transferees have items in their pockets which could fall out and land on the deck of the vessel	Lack of training to ensure transferee don't have loose items on them Hoisting above the deck	Objects hit personnel below, potentially causing major injury or fatality	4	5	20	All personnel involved are WAH trained which includes education regarding the hazards of falling objects Training and user manual include caution about loose items in pockets, etc. Transfer process is such that the transfer controller should not be in the area directly under the user when they are out of arms reach Radios to be located in holsters and tethered to transferees Only one transferee to transfer at a time - reduced risk of personnel being hit by dropped objects	Deckhand wears head protection	4	2	8		
H-3.22				Potential for end of line weight to hit transferee/ Deckhand/other crew	Operator error Personnel on vessel don't see the end of line weight Wind-loading/vessel movement could cause rope to swing and contact crew	Weight or suspended personnel hit vessel/ deck causing them to fall over board, leading to major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	5	20	Deck hand calls rope down and catches hold before transferee steps forward to clip onto rope End of line weight is in high-vis red jacket Marked exclusion zone around lifting/landing zone Bumper weight is fitted sufficiently above the attach point that it cannot impact user when hoisting or lowering	Deckhand wears head protection MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	2	8		
H-3.23			Objects under tension	Moving rope could cause rope burns	If rope is retracted and running through transferees hands	Rope burn, injury to hands	2	4	8	Basic operating function of machine is that safety line is static relative to user in active heave Transferee wears protective gloves Training to ensure users are aware of potential rope burn	First aid kit	2	2	4		
H-3.24			Equipment with moving or rotating parts	Counter-balance mechanism moves too quickly making the system jumpy or too abrupt	Mechanism is a gravity based mechanical system, without the control of a powered lever mechanism	Injury to personnel whilst lifting, hitting deck hard, whiplash, etc.	3	3	9	Dampeners limit the swing arm movement and absorb the energy of the swing arm Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards		3	1	3		
H-3.25				Transferee hoisted into drive unit or top pulley mounted at top of hoist path	Operator error System malfunction Wireless control sends hoist signal	Major injury or death	4	2	8	When end of rope reaches 'max hoist' position, retraction is halted. No hoisting beyond this position with load on the line Safety Limited Position prevents rope being taken in beyond a safe point Training cautions deck hand against hoisting and potential misuse End of line weight would engage with home position buffer bars, overload protection will cut-out at ~200kg, brake will slip at ~400kg of line tension		4	1	4		
H-3.26				User left suspended in the air	System error Loss of power	Person left suspended for period of time, potential injury	2	3	6	Regular inspection and maintenance of system Testing of system prior to use	Use of battery to release the break Use of personal evacuation device which should be attached before every lift	2	2	4		
H-3.27				Finger trap, or drawing in hazard when hoist is operating and wire rope is travelling	Exposed travelling wire from the drive unit which is positioned at a convenient height for inspection and hence is at a height for finger trapping	Injury e.g. loss of finger	3	4	12	Drum and exit are fully enclosed and locked, preventing entrapment in the mechanism Users have no requirement to be in vicinity of the drum User manual includes warning of crush hazard training and manual for maintenance transferees explicitly warns against this risk Personnel to keep hands clear of equipment under tension	Personnel wear suitable PPE (gloves)	3	1	3		

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-3.28			Weather	Master is not able to maintain a steady position against monopile, causing the vessel to move more than within specification for deck tracking or outwit deck sensor target area and resulting in user contacting the deck	High sea state, wind, tidal conditions No buffer bars to keep boat aligned to laser deck sensor	Personnel hit deck hard causing injury	3	2	6	Sea state conditions the system can be used in are specified in the user manual Motion reference unit on deck continues to provide deck position even if laser signal is lost Pre push on condition assessment Allowable weather windows Selection and use of appropriate vessel and fender design, taking account of known environmental conditions Monitoring of live and forecasted weather data Vessel Master has overriding responsibility to halt marine operations Remote control provides realtime information on sea state conditions and allows further assessment of whether transfers should take place Back up deck tracking sensor (MRU) takes over deck tracking function even if laser sensor is outwith normal sensor exclusion zone		3	1	3		
H-3.29				Wind loading causes wire to climb out of the final pulley groove, getting caught between pulley wheel and frame	Wind loading results in large fleet angles on wire Large swinging motion due to user error	Personnel fall from height Major injury or death	4	2	8	Fairlead maintains good fleet angle inboard of the end pulley End pulley design does not have enough space for rope to fit between pulley sheave and pulley frame Wire form is fitted to end pulley to prevent rope from escaping correct location on pulley Allowable weather windows		4	1	4		
H-3.30			Medical unfitness	Suspended user becomes incapacitated due to injury or illness and is at risk of suspension trauma and not receiving timely medical attention	Unexpected injury or illness	Unable to attend to unwell personnel Potential for further injury or illness				Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Fitness to work declared by persons and Relevant Medical Certificate	SOV with heave compensated gangway may be deployed to give a rescue team access to the platform if necessary and available Crews trained in recovery of incapacitated personnel Bosuns chair and work positioning belt (conscious casualty) could be used to prevent, or extend the onset of suspension trauma					Risk not assessed for this scenario due to difficulty in quantifying the impact of not attending to ill or injured personnel

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
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H-3.31	Access	Transferee steps onto platform and walks through gate	People at height Fall into water	Transferees can't step across to the step access platform from the top hoist position	Top hoist position set too high - transferees differ in height so what may suit one transferee may not suit another Step-gap too large	Strain injury	1	2	2	Top hoist position based on HSE report 'Revision of body size criteria in standards Protecting people who work at height' Different SRL lengths supplied for different heights of transferee Step gap sized according to HSE report 'Revision of body size criteria in standards Protecting people who work at height'		1	1	1		
H-3.32				Transferee falls from height	Harness fails Hoist line fails Not clipped in correctly Connector opens inadvertently Connector attached to lifejacket instead of harness Structural weakness in boom due to marine growth Physical failure of mechanical part, e.g. shaft or linkage	Major injury or fatality due to fall to sea, due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers – Falling transferee hits personnel on deck (potential multiple fatalities)	5	5	25	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Safe rope management should ensure wire vibration and end of line movement is eliminated Commissioning checks at installation ensure the line does not contact or abrade against objects Components of the connection SRL are certified PPE items Transferee follows guidance from Deckhand and Master Call for a stop if required Crane and hoist line designed to applicable codes and standards Regular inspection and removal of marine growth Main structure designed to exceed Clause 4.1.2.3 to 4.1.2.5 and 6.1.1 of the Machinery Directive 2006/42/EC Valid man-riding certification GWO training	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	5	2	10		
H-3.33	Access	Transferee closes the access gate and disconnects the master link	People at height	Gate does not close automatically	Salt corrosion offshore reduces performance of the self-close mechanism Disconnecting from line too early (before gate has closed) Transferee forgets to close gate	Personnel fall onto vessel or water. Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	3	12	Design of gate mechanism is functional in the offshore environment and is be easy to maintain and operate Training, user manual and signage advise transferees not to open gate unless clipped into harness Transferees are WAH trained Gate is self closing Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Transferee follows guidance from Deckhand and Master Transferee to ensure gate is closed before removing clips Planned maintenance inspections	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	2	8		
H-3.34	Egress	Transferee approaches the access gate and reaches over to grasp the master link	People at height	Transferee falls from structure	Transferee forgets to connect to safety harness Failure of railings/gate due to corrosion in marine environment Transferee slips/trips due to ice or objects on structure platform	Personnel fall onto vessel or water. Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	3	12	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Regular inspection and removal of marine growth and for signs of corrosion on railings/gate Good housekeeping on structure platform Walkways to be kept clear of obstructions and free from contamination (especially oils/greases) and ice Use suitable footwear – non-slip soles, and avoid oil contamination Magnetic interlock on the gate (in addition to the mechanical latch), to prevent its opening without following a set procedure, which requires being connected to the lifting system	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		
H-3.35	Egress	Transferees connect the master link	People at height	Fall from structure during 'clipping in' process	User not backed up when clipping in User does not clip in correctly	Personnel fall onto vessel or water. Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	3	12	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Working at height training and OPTS user training to ensure transferees competent in this 'buddy' checks on all SRLs before first/last use Signage at the platform warn that user must be behind closed gate prior to unclipping and must clip on before opening gate	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	2	8		
H-3.36	Egress	Transferees open the access gate	People at height	Transferee falls through the open gate	User does not clip in correctly	Personnel fall onto vessel or water. Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	3	12	Training, user manual and signage advise transferees not to open gate unless clipped into system Transferees are WAH trained Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Magnetic interlock on the gate (in addition to the mechanical latch), to prevent its opening without following a set procedure, which requires being connected to the lifting system	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		
H-3.37	Egress	Transferee applies tension to the line by bending their knees and stepping through the access gate		No credible hazards identified												
H-3.38	Egress	The access gate is closed by the transferee	People at height	Gate does not close automatically	Transferee forgets to close gate Salt corrosion offshore reduces performance of the self-close mechanism (if fitted)	Personnel still on platform fall onto vessel or water Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	2	8	Design of gate mechanism is functional in the offshore environment and is be easy to maintain and operate Training, user manual and signage advise transferees not to open gate unless clipped into harness Transferees are WAH trained Gate is self closing? Training, user manual and signage advise transferees not to open gate unless clipped into system Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Planned maintenance inspections	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		
H-3.39	Egress	Transferees put their whole weight on the line while keeping feet on access platform		No credible hazards identified												This procedure is part of the loading of the line prior to use that is a form of proof loading that mitigates likelihood of failure while in use

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H-3.40	Egress	The lift operator will lower the transferee down from the platform	People at height	User is lowered below the boat deck resulting in crush or immersion risk	User error Error in laser measurement Deck Delta values incorrect Wireless fault causes erroneous 'down' command to be sent	Personnel crushed leading to serious injury or fatality	4	4	16	Control system logic prevents rope from being lowered below deck when in deck tracking, With user on system control system automatically provides active heave deck avoidance Press to run functionality so button would need to be continuously pressed for continuous lower function, Laser error is reported via beacons and training instructs not to use in these circumstances Deck delta figures entered by competent personnel and verified during commissioning process Lowering to the foredeck removes the crush hazard at the bow of the vessel MRU provides redundant active heave monitoring Master and deckhand continually monitor transfer and can move position of the vessel quickly in an emergency Transfer takes place 2.5-4m into CTV deck, making it less likely a fall into water will occur		4	2	8		
H-3.41				Transferee could impact against vessel handrails when being lowered back onto the vessel	Some vessels have a narrow access way at the bow of the boat, with handrails either side	Injury to personnel	4	4	16	Clear lifting and landing zone identified on vessel deck and exclusion zone marked Training to ensure the transferee and transfer operator are aware of any obstructions on the vessel that may interfere with the transfer method Transfer process includes a 5-4-3-2-1 countdown given by transfer operator to inform the transferee when approaching the deck which should make them more aware of their proximity to deck Tender and pre-charter inspections		4	2	8		
H-3.42			Sea state	Deck sensor doesn't reflect off the deck parallel to the monopile so the area of the deck it targets will differ according to the tidal height (changing with the distance between deck and sensor)	Angular alignment in the deck sensor means that the factory setup could be outwit specification	Personnel hit deck hard causing injury	4	4	16	Tolerances between mating parts are compatible and design allows for limited adjustment Final Inspection at manufacturing site plus commissioning at dockside and on off-shore platform include specific check on deck sensor alignment Pre push on condition assessment Allowable weather windows		4	2	8		
H-3.43				During higher sea states the system does not maintain real-time deck tracking, which could lead to slack rope and potential hoisting of transferee off the vessel deck	Feedback loop from deck measurement to servo speed and direction command is too slow Sensor error or failure Communications failure between sensors and PLC Software logic Deck moving outwit operating envelope of system Vessel moves off monopile and lasers loose target resulting in system remaining stationary	Personnel hit deck hard causing injury	4	4	16	Regular feedback loop ensures that the data processing is always done in time to keep pace with the expected movements of the deck The servo drive is configured via parameters which are set and verified at the factory If the deck is moving outwit the design limits, the system highlights this to the user in the form of a warning on the status indicator beacons MRU data provides redundant technology providing active heave data if the laser signal is lost Monitoring of live and forecasted weather data Vessel master has overriding responsibility to halt marine operations		4	2	8		
H-3.44	Egress	When just above the deck, the Deckhand will guide the transferee onto the landing stage	People at height	Deckhand knocked by suspended transferee	Motion of the vessel/ wind causes suspended transferee to knock into the deckhand	Major injury or fatality if deckhand pushed into sea, due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	2	8	Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Vessel crew and Master continually assess sea condition for suitability for transfer Call for a stop if required Vessel specified as fit for purpose including suitable walkways, guardrails and anchor points, to prevent deckhand falling into sea Transferee is stabilised by Deckhand Vessel crew deployed to act as 'wave watcher' to monitor for waves of significant height	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	1	4		
H-3.45			Overhead equipment	Potential for end of line weight to hit transferee/deckhand/other crew	Operator error Personnel on vessel don't see the end of line weight Wind-loading/vessel movement could cause rope to swing and contact crew	Weight or suspended personnel hit vessel/ deck causing them to fall over board, leading to major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves - lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propellers	4	3	12	Deckhand calls rope down and catches hold before transferee steps forward to clip onto rope End of line weight is in high-vis red jacket Marked exclusion zone around lifting/landing zone Bumper weight is fitted sufficiently above the attach point that it cannot impact user when hoisting or lowering Transfer takes place 2.5-4m into CTV deck, making it less likely a fall into water will occur	Deckhand wears head protection MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Head protection	4	2	8		
H-3.46	Egress	The transferee will disconnect the master link and walk away from the landing stage		No credible hazards identified												
H-3.47	Access/ Egress	Crew on vessel prior to or after transfer	Exhaust fumes	Exhaust fumes from vessel	Exposure to potential harmful fumes	Short term impacts - coughing or unpleasant sensation from inhalation Long-term health impacts of frequent exposure (e.g. particulates)				Appropriate vessel design to minimise personnel exposure to fumes						No risk ranking due to difficulty in assessing long and short term health impacts

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H-3.48			High temperature	Wearing immersion suit in hot weather	Personnel heat up in immersion suit due to sun and hot weather	Exhaustion, dehydration	2	3	6	Personnel keep fluids on their person to maintain hydration Vessel Master and crew to manage times when Immersion suit is required, depending on conditions (including sea and air temperature). Donning of immersion suits can be done immediately prior to transfer operations		2	1	2		
H-3.49			Lighting	Transfer at night or in low visibility adds additional risk of fall into water	Personnel transfer at night - see additional causes from other activities	Fall into sea or from height causing major injury or fatality	4	2	8	Master checks conditions are suitable for transfer Deck and transfer area well lit Head torch attached to helmet; batteries checked Deck free from obstructions Conservative condition assessments and requirement for PLBs	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Immersion suits worn at night	4	1	4		
H-3.50			People under water	No credible hazard/ scenario identified												
H-3.51			Objects under compression	No credible hazard/ scenario identified												
H-3.52			Boat collision hazard	No credible hazard/ scenario identified												
H-3.53			Manual handling of materials	No credible hazard/ scenario identified												
H-3.54			Noise	Engine room	Engine room noise	Injury to hearing to personnel	3	3	9	Consideration in deck layout Radio communication equipment is compatible with hearing protection	PPE (hearing protection)	3	1	3		
H-3.55			High humidity	No credible hazard/ scenario identified												
H-3.56			Vibration	No credible hazard/ scenario identified												
H-3.57			Workstations	No credible hazard/ scenario identified												
H-3.58			Awkward location of work	No credible hazard/ scenario identified												
H-3.59			Mismatch of work to physical capabilities	No credible hazard/ scenario identified												
H-3.60			Mismatch of work to cognitive capabilities	No credible hazard/ scenario identified												
H-3.61			Long and/ or irregular working hours/shifts	No credible hazard/ scenario identified												
H-3.62			Marine crew sufficient manning	No credible hazard/ scenario identified												
H-3.63			Post-traumatic stress	No credible hazard/ scenario identified												
H-3.64			Psychological impact	No credible hazard/ scenario identified												
H-3.65			Shift work	No credible hazard/ scenario identified												
H-3.66			Emergency preparedness	No credible hazard/ scenario identified												
Miscellaneous hazards																

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-3.67	Access/ Egress	All stages	Poor organisation and job design	Slip, trip or fall from vessel or height (into sea or onto vessel), or missing steps in process due to rushing to 'get the job done'	Poor safety culture	Occupational injury, major injury, or fatality				Implementation of a no-blame culture Competence management Competent personnel who understand their limitations and their roles and responsibilities						
H-3.68				Shortcuts taken, task steps not safely carried out	Unclear procedures	Occupational injury, major injury, or fatality				Work as done is reflected in procedure, so shortcuts are less likely to be taken, permit to work would enable you to understand the procedure, PPE requirements, means of access, etc.						
H-3.69				Lack of competency in safety critical roles and no analysis of training needs	Poor understanding of training needs and lack of provision	Occupational injury, major injury, or fatality				Training needs analysis conducted for job roles to fully understand what training/qualifications are required for them, including refresher training to account for skill fade						
H-3.70				Fatigue	Shift work or underlying health condition	Likelihood of slips, trips and falls can increase when fatigued, steps can be missed when fatigued				Adequate rest periods between shifts, toolbox talk at pre-transfer briefing to raise potential issues, implementation of no-blame culture						
H-3.71			Communication	Language difference between crews	Transfer personnel and vessel crews may speak different languages and have difficulty conversing in non-native tongue	Personnel mis-directed when transferring, potentially leading to serious accident				Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Verify vessel crew, work crew and operators all meet minimum acceptable language proficiency in the agreed lingua franca						
H-3.72				Uncertainty on roles and command structure	Difference in roles/commands between vessels/ organisations	Ineffective teamwork and leadership, leading to potential increased risk of other scenarios or delayed response in emergency situation				Clear definition of roles and commands communicated for all crew/transferees involved in transfer Toolbox talk prior to transfer						
H-3.73				Lack of commonality used between transferees and vessel crews	Difference in training requirements	Personnel mis-directed when transferring, potentially leading to serious accident				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 has the following commands: ABORT, UP, DOWN						
H-3.74			Weather	Transfer in adverse weather adds additional risk of fall into water	Personnel transfer during adverse weather - see additional causes from other activities High winds, waves and swell causing more vessel movement	Fall into sea or from height causing major injury or fatality				Review of metocean data prior to vessel leaving port (three-day forecast) Delay to operation Pre push on condition assessment Allowable weather windows	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individua with support from crew for correctly worn PPE MOB equipment onboard vessel					
H-3.75			Sea state	Transfer in incorrect sea state adds additional risk of fall into water	Personnel transfer during incorrect sea state - see additional causes from other activities Additional swell at extremes of tides, greater vessel movement, higher build up sea life on ladder at low-tide areas	Fall into sea or from height causing major injury or fatality				Review of metocean data prior to vessel leaving port (three-day forecast) Delay to operation Pre-push on condition assessment	MOB drills to be done regularly and recovery team at the ready for retrieval - recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Personnel required to wear SOLAS-approved lifejacket and potential use of PLB prior to leaving cabin PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel					
H-3.76			Low temperature	Extreme low temperature	Extreme low temperatures can reduce dexterity, e.g. making it more difficult to clip onto safety equipment and PPE, climb the ladder, etc.	Safety harness/SRL not worn correctly reducing safety - could reduce efficacy of preventing fall into water/onto vessel. Inability to grip the rungs on ladder could lead to fall into water/onto vessel leading to major injury or fatality				Personnel given suitable PPE to ensure that they are protected from weather, e.g. gloves, immersion suit, etc.						
H-3.77			Organisation and job design	Limited experience and lessons learned on person riding transfers via davit crane		Potential for increased risk of hazards due to limited experience										

4. W2W GANGWAY

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-4.01	Access	Planning of marine operations	On-water transport	Specified vessel/ gangway unavailable or modifications to vessel/gangway	Incorrect design of gangway or vessel	Occupational injury, fall into sea, damage to vessel or boatlanding area. Major injury or fatality due to: – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller Unable to conduct transfer	4	1	4	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 Vessel subjected to full Marine Assurance process to ensure it is in compliance and is safe and suitable to carry out the work assigned to the vessel The gangway system is subjected to assurance process to verify certification, maintenance records, and operator training Modifications to equipment to ensure correct geometries of vessel are met FMEA of the gangway before it is installed on the vessel SAT of gangway setup and power provision after installation Analyse of RAO data which should result in a workability assessment report Design risk management (HAZID, FMEA, etc.) Redundancy in systems designs Error detection and correction in software design Software build protocols to current standards Design and execution of gangway-vessel interface is subject to Marine Assurance, including any pedestals, powerpacks, tool containers, staircases and boom rests as required by the project Use of time domain simulations to train crew how to react when conditions are close to design limits		4	1	4		
H-4.02			On-water transport	Assessment of external influencing conditions	Metocean conditions	Excessive vessel motion, unable to maintain station No safety consequence										
H-4.03	Access	Arrival on location and establishing DP		No credible hazards												
H-4.04	Access	Communications established/checked between all parties involved in operation	Communication	Unable to establish communications	Failure of communication equipment	Unable to complete transfer No safety consequence										
H-4.05	Access	Gangway operation and functionality will be tested daily and prior to approach, including alarm system. Working limits confirmed with regards to vessel footprint and gangway telescope extension	Equipment with moving or rotating parts	Gangway not functioning correctly	Failure of gangway equipment	Unable to complete transfer No safety consequence										
H-4.06	Access	When all parties satisfied, the vessel will make the final approach in Dynamic Positioning mode, ensuring position-reference systems are reliable at all times	Slips, trips and falls	Movement of vessel approaching structure	Conditions cause excessive movement of vessel whilst approaching structure	Injury to personnel due to fall on gangway caused by motion of vessel	2	4	8	Review of metocean data prior to vessel leaving port and enroute to wind farm Monitoring of vessel motions to determine whether magnitude of motion is within safe operating limits of gangway Appropriate vessel design with handrails, etc. for personnel whilst moving around the vessel minimising stairs/steps up or down – highlighting trip points and risk of crushing between moving parts, etc. A formal transfer route/corridor to be established to the gangway Toolbox talk carried out to discuss approach, weather conditions, connection point on installation and transfer process for the specific location Use of decision support tools where available – wave radar, AI, etc. Also decision/TBT to be documented Gangway operator prevents personnel from using gangway at this time Operations with vessel's Activity Specific Operating Guidelines (ASOG)		2	2	4		
H-4.07			On water transport	Vessel hits turbine structure	Failure of DP system	Injury or fatality to personnel on vessel or structure from falls caused by striking structure	4	1	4	Safety by design – design to ensure that personnel cannot fall due a collision with the structure Design risk management (HAZID, FMEA, etc.) Redundancy in systems designs Error detection and correction in software design Software build protocols to current standards Procedure allows settling period when arriving on location to allow the 'model' to build on the DP system Where possible, procedure to set the WTG to the correct heading and locking the yaw prior to the vessel approach to avoid any risk of collision between the vessel tall structure and the WTG blades. During construction/installation, blades should be locked Vessel should as best practice, when possible, set up on the drift off side of the asset When not possible additional safety measures should be considered A blade strike analysis should be done for the specific vessel before entering the Wind Farm Follow ASOG and vessel specific DP operating manual No personnel in vulnerable positions on approach to structure – out of reach of gangway extension on structure		4	1	4		
H-4.08		Vessel bridge crew will communicate to gangway operator when in final position and give permission to connect the gangway to the structure landing point	Incompatible equipment	Gangway not connected correctly	Ergonomic design or controls (operator misses intended landing point) or Interface between gangway and landing point is not made	Equipment damage, no safety consequence										No safety consequence, therefore line not risk ranked
H-4.09			Equipment with moving or rotating parts	Part of moving gangway strikes personnel	Personnel in vicinity of moving gangway parts	Major injury to personnel	3	3	9	Protection by design – design of the gangway and interfaces prevent personnel from being in areas where they can become trapped/be crushed All pinch points are designed out The gangway operators must be fully trained, and experienced in the safe use of the system, including emergency procedures Lead technician ensures all personnel on structure are well away from gangway establishing connection No personnel on gangway whilst establishing connection Time to adjust and settle the connection move off and back on if required, to warm up the fender and remove moisture/salt, etc.)		3	1	3		

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-4.10	Access/ Egress	The gangway operator may allow the transfers to begin, in a controlled manner	People at height	Gangway collapses	Structural failure of gangway (e.g. due to overloading or corrosion due to marine environment) Failure of hydraulics or mechanical/electrical winches as the weak points within the system	Personnel fall into water or onto structure below Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	4	1	4	Design risk management (HAZID, FMEA, etc.) Redundancy in systems designs Error detection and correction in software design Software build protocols to current standards Procurement procedure for sourcing vessel and gangway Regular inspection, testing and maintenance of gangway Certification of gangway by national regulator Specified loads should not be exceeded (maximum load has safety factor built in) If gangway operations are considered as 'supported loads', inspection regimes should come under lifting plans Redundancy within the systems FAT and FMEA of the gangway before it is installed on the vessel Consider having a 'weak link' in structure that fails prior to failure of safety critical elements Make sure that the gangway fails to safe Power provision and gangway actuation and drive elements are fully redundant to allow controlled termination of operation in case of single failure Gangway interface design to allow operation at limits of operability window (V or u shaped channel)	MOB drills to be done regularly and recovery team at the ready for retrieval – recovery procedure should be well documented, understood and have lessons learned from previous incidents implemented Do not transfer unless wearing SOLAS-approved lifejacket and potential use of PLB PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Gangway operator/supervisor ensures that all transferees are wearing full PPE Gangway transferees will receive formal training in crossing and emergency procedures for each specific gangway, as there are many different designs	4	1	4		
H-4.11				Failure of motion compensating system on hovering type gangways	Failure of gangway control system	Personnel fall into water or onto structure below Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	4	5	20	Design risk management (HAZID, FMEA, etc.) Redundancy in systems designs Monitoring of vessel motions to determine whether magnitude of motion is within safe operating limits of gangway Error detection and correction in software design Software build protocols to current standards Procurement procedure for sourcing vessel and gangway Regular inspection, testing and maintenance of gangway Certification of gangway Allowable weather windows for operation of gangway The vessel bridge crew and gangway operators will remain in communication at all times and monitor the vessel and gangway movement The operation will be halted immediately if there is any degrading of the vessel position-keeping or the gangway telescope movement reaches its pre-agreed limit Review of metocean data prior to vessel leaving port (three-day forecast)	MOB drills to be done regularly and FRC team at the ready for retrieval and FRC team at the ready for retrieval Do not transfer unless wearing SOLAS-approved lifejacket and potential use of PLB PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Gangway operator/supervisor ensures that all transferees are wearing full PPE Gangway transferees will receive formal training in crossing and emergency procedures for each specific gangway, as there are many different designs	4	1	4		
H-4.12				Failure to land gangway correctly results in gap between gangway and structure	Structure not certified or de-signed for gangway connection Operator fails to land gangway correctly Gangway approach area is obstructed	Personnel fall into water or onto structure below Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	4	2	8	Location at which gangway connects to structure should be selected so a fall would not result in a person hitting the structure below The gangway operators must be fully trained, and experienced in the safe use of the system, including emergency procedures Structure certified for use of gangway The walkway approach areas will be checked on both sides and will be clear of obstructions Toolbox talk carried out to discuss approach, weather conditions, connection point on installation and transfer process for the specific location Adjustable gangway interfaces/handrails and walk to work gates on the asset A suitable work positioning point should also be made available on the gangway to allow safe opening and setup during the landing operations Design of the gate latching/opening system provides an easy to operate system in order to minimise the time spent by gangway personnel at the leading edge during transfer establishment	MOB drills to be done regularly and FRC team at the ready for retrieval Do not transfer unless wearing SOLAS-approved lifejacket and potential use of PLB PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Gangway operator/supervisor ensures that all transferees are wearing full PPE Gangway transferees will receive formal training in crossing and emergency procedures for each specific gangway, as there are many different designs	4	1	4		
H-4.12B				Gate requires opening by personnel on gangway	Personnel walk across gangway to open gate to structure, potential for slips, trips and falls off gangway	Personnel fall into water or onto structure below Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	4	2	8	Safety by design, e.g. gravity gates, spring-loaded gates or gates set back 1m from edge of TP Location at which gangway connects to structure should be selected so a fall would not result in a person hitting the structure below The gangway operators must be fully trained, and experienced in the safe use of the system, including emergency procedures Structure certified for use of gangway Toolbox talk carried out to discuss approach, weather conditions, connection point on installation and transfer process for the specific location Adjustable gangway interfaces/handrails and walk to work gates on the asset A suitable work positioning point should also be made available on the gangway to allow safe opening and setup during the landing operations Design of the gate latching/opening system provides an easy to operate system in order to minimise the time spent by gangway personnel at the leading edge during transfer establishment	MOB drills to be done regularly and FRC team at the ready for retrieval Do not transfer unless wearing SOLAS-approved lifejacket and potential use of PLB PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Gangway operator/supervisor ensures that all transferees are wearing full PPE Gangway transferees will receive formal training in crossing and emergency procedures for each specific gangway, as there are many different designs	4	1	4		
H-4.13			On water transport	Loss of station keeping	Failure of DP system or Failure of vessel or Slip off incident (no loss of DP)	Personnel fall into water or onto structure below Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	4	3	12	Procurement and certification of vessel Assessment of vessel footprint via Level 3 station keeping analysis The operation will be halted immediately if there is any degrading of the vessel position-keeping or the gangway telescope movement reaches its pre-agreed limit Review of metocean data prior to vessel leaving port (three-day forecast) Design in of engineering interfaces and automatic alarms to alert personnel transferring and the gangway operator Design to eliminate black out of vessels – redundancy in power supply ASOG Follow vessel specific DP operating manual. Planning checklist Talk back communication between DP and gangway operator Continuously monitoring of actual weather/conditions Continuously training of DP in manual handling of the vessel (drills) Push on point should be standardised in colour, geometry and structure, and also in coating used to paint	MOB drills to be done regularly and FRC team at the ready for retrieval Do not transfer unless wearing SOLAS-approved lifejacket and potential use of PLB PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel Gangway operator/supervisor ensures that all transferees are wearing full PPE Gangway transferees will receive formal training in crossing and emergency procedures for each specific gangway, as there are many different designs	4	2	8		
H-4.14			Slips, trips and falls	Transferee slips on gangway	Movement of vessel prior to transfer Objects on gangway Ice or water on gangway	Minor injury due to fall on gangway	2	3	6	Anti-ice applied to surface in ice conditions No slip shoes and all objects removed from around gangway Toolbox talk carried out to discuss approach, weather conditions, connection point on installation and transfer process for the specific location Safety induction for the transferee, with a focus on transfers at high telescoping speeds Appropriate vessel design with handrails, etc. for personnel whilst moving around the vessel minimising stairs/steps up or down – highlighting trip points and risk of crushing between moving parts, etc. A formal transfer route/corridor to be established to the gangway The vessel bridge crew and gangway operators will remain in communication at all times and monitor the vessel and gangway movement Monitoring of vessel motions to determine whether magnitude of motion is within safe operating limits of gangway	First aid kit head protection to protect from bumps to head Minimum gangway width to consider emergency response e.g. 800 mm clear width for casualty and stretcher evacuation	2	2	4		
H-4.15			Manual handling materials	Uncontrolled movement of load being transferred along gangway if gangway luffs to a steep angle	Control of load lost due to steep angle or movement of vessel	Load hits person gangway causing major injury or fatality	4	2	8	Motion compensating gangway Toolbox talk carried out to discuss approach, weather conditions, connection point on installation and transfer process for the specific location Cargo exceeding gangway specific hand carry limits in weight or size are best transferred by crane Monitoring of vessel motions to determine whether magnitude of motion is within safe operating limits of gangway		4	1	4		

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-4.16			Low temperature	Extreme low temperature	Extreme low temperatures can reduce dexterity, making it more difficult to clip onto safety equipment and PPE	Reduced efficacy of safety equipment	2	1	2		Personnel given suitable PPE to ensure that they are protected from weather, e.g. gloves	2	1	2		
H-4.17					Impact to gangway system due to extreme low temperature (e.g. ice on sensors or gangway, thickening of hydraulic oil, etc)	Unable to operate gangway Reduced efficacy of safety equipment	2	1	2	Design specification and risk assessment FMEA and appropriate component selection Winterised system via insulation and heat tracing (including application of relevant winterisation guidelines and requirements)		2	1	2		
H-4.18			Lighting	Lighting on gangway insufficient to see	Night or low visibility working	Risk of slips, trips and falls increases	1	3	3	Sufficient lighting provided by SOV to reduce risk of slips, trips and falls (including shading for traffic light system to maintain visibility) Night working avoided where possible Suitability to transfer assessed by crew	First aid kit	1	2	2		
H-4.19			Motion sickness	Motion sickness	Gangway movement due to motion of vessel on sea	Sickness Depending on severity and length of exposure, motion sickness may cause reduced cognitive processing, fatigue, reduced performance, leading to occupational injury,	2	4	8	Sea sickness tablets Motion compensating gangway Fitness to work declared by persons and Relevant Medical Certificate The vessel bridge crew and gangway operators will remain in communication at all times and monitor the vessel and gangway movement Stop the job logic and the ability to speak up as needed Where possible, adjust the ship's loading condition, use the anti-roll tanks or stabilisers Choice of vessel to minimise motion through good design Vessel layout should take account of the need for personnel on board to be able to see the horizon, including considering where loads are positioned	Personnel take short break from task if feeling sick to get fresh air, look at horizon, etc if feeling sick	2	2	4		
H-4.20				Impact of taking motion sickness tablets on cognitive abilities	Personnel taking motion sickness tablets to combat effects of vessel motion on sea	Motion sickness tablets can cause drowsiness and dizziness. Impact on cognitive abilities and increased risk in personnel making mistakes during safety critical tasks				Use of motion sickness tablets should be adequately risk assessed and controlled to prevent major impact to cognitive abilities of personnel Transfer should be cancelled if personnel severely impacted by motion sickness						Scenario not risk assessed due to difficulty in assessing likelihood and consequences
H-4.21			Emergency scenario	Emergency retraction of gangway whilst transfer is taking place	Failure of DP system Excessive motion of gangway during transfer	Transferee falls from gangway. Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	4	3	12	Safety by design: – Operator must have good visibility of the transfer – Warning lights and alarms (and transferee knowledge of alarm response through training) with suitable tone and volume No ear plugs or ear defenders to be worn by transferees when crossing Gangway transferees will receive formal training in crossing and emergency procedures for each specific gangway, as there are many different designs or gangway operative to provide short briefing on different system Toolbox talk carried out to discuss approach, weather conditions, connection point on installation and transfer process for the specific location Motion compensating gangway The vessel bridge crew and gangway operators will remain in communication at all times and monitor the vessel and gangway movement degrading of the vessel position-keeping equipment or the gangway telescope movement reaches its pre-agreed limit 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 Common practice in W2W gangway design is that there is a short delay before an auto disconnect to allow transferees to make safe FMEA of the gangway before it is installed on the vessel	MOB and EDS drills to be done regularly and FRC team at the ready for retrieval Do not transfer unless wearing SOLAS-approved lifejacket and potential use of PLB PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel If an emergency retraction occurs, investigate why it happened and use the learning to reduce future occurrences Continuous and frequently training of operators and transferees in emergency disconnecting	4	2	8		
H-4.22			Overhead equipment/Dropped objects	Objects Dropped onto personnel from height	Dropped objects from gangway onto personnel on vessel below Lifting of objects above gangway	Major injury or fatality due to Dropped objects	4	2	8	Check for loose objects prior to transfer Request work at height on platform/turbine to be stopped during transfer period to prevent dropped objects causing injury Design of gangway (exclusion zone underneath gangway, nettings etc.) Trolleys to carry goods (no manual handling of goods across gangway) Tether arrangements Gangway design prevents objects larger than 20mm from falling through gaps Carry out a DROPS survey when vessel enters survey and apply drop preventive securing lanyards where needed Quality control of equipment to ensure no loose items	Head protection Personnel avoid working under gangway whilst transfers are taking place SIMOP controls to prevent working under gangways whilst transferees cross and no lifting above gangways whilst transferees cross	4	1	4		
H-4.23			People at height	Gangway strikes/is struck by turbine blade	Movement of turbine blades during transfer	Collapse of gangway, potential major injury or fatality due to fall from height	4	3	12	Procedure to set the WTG to the correct heading and locking the yaw prior to the vessel approach to avoid any risk of collision between the vessel tall structure and the WTG blades SOV Officer and DOP training Standing Orders always requiring two officers on Bridge during mobilisation of W2W prevents human error PTW (lock-out/ tag-out the yaw mechanism)	A blade strike analysis should be done for the specific vessel before entering the wind farm	4	2	8		
H-4.24	Egress	When the transfer of personnel is completed and numbers of POB on both sides confirmed, the gangway operator will check all clear and when instructed by the bridge crew, disconnect the gangway from the structure and stow safely	People at height	Fall from structure	Inability to close gates due to poor design of gates on fixed asset or damage to gates	Person falls from structure into sea Major injury or fatality due to: – Trauma from fall – Hypothermia – Drowning due to cold shock – Drowning due to waves – lost at sea – Heart attack due to cold shock – Personnel in water hit or crushed by vessel or propeller	4	2	8	Safety by design, e.g. gravity gates, spring loaded gates or gates set back 1 m from edge of TP Gate to be closed before gangway is retracted Design of gates to enable opening/closing from a safe location Hook-on points for fall prevention	MOB drills to be done regularly and FRC team at the ready for retrieval Do not transfer unless wearing SOLAS-approved lifejacket and potential use of PLB PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel	4	1	4		
H-4.25			Equipment with moving or rotating parts	Entrapment in/crushed between moving parts	Gangway catches fingers or limbs when being retracted if hands are not placed on top of handrails	Injury and/or possible loss of fingers	3	3	9	Design to avoid creating shear/crush hazards where gangway sections move relative to each other Safe handholds to be provided throughout gangway Correct hand placement on top of handrails Watch foot placement in retraction event and be aware of where the step is located to your proximity When personnel hear the alarm sounding, they shall act in accordance with gangway induction Visual indicator for gangway retraction	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 Follow procedure when if you hear the alarm	3	2	6	This risk may increase when telescoping speeds increase (in worse weather conditions). Recommend applying visual aids to better estimate the relative motion between the two parts of the gangway (fixed part and telescoping part)	

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
H-4.26			Weather	Transfer in adverse weather adds additional risk of fall into water	Personnel transfer during adverse weather – see additional causes from other activities High winds, waves and swell causing more vessel movement Lack of understanding of relative safety and risk of transferring to get off turbine outside normal conditions	Fall into sea or from height causing major injury or fatality	4	3	12	Review of metocean data prior to vessel leaving port (three-day forecast), including a safety factor to account for weather forecast uncertainty Delay to operation Allowable weather windows Continuously monitoring of actual weather/conditions Survival kits on turbines in case of stranding (non-emergency), to relieve pressure on teams/crews to conduct operations in unsafe conditions Use of decision support tools to ensure that the vessel heading is optimal for the actual sea state Monitoring of vessel motions to determine whether magnitude of motion is within safe operating limits of gangway	MOB drills to be done regularly and FRC team at the ready for retrieval Do not transfer unless wearing SOLAS-approved lifejacket and potential use of PLB PPE Training (GWO Sea Survival, GWO transfer, induction to site and vessel) Buddy check by individual with support from crew for correctly worn PPE MOB equipment onboard vessel	4	1	4		
H-4.27				Unable to land gangway in adverse weather conditions to recover personnel already on structure	Weather worsens during time personnel are on structure	Unable to recover personnel – personnel left on structures during adverse weather/at night, potentially leading to major injuries	3	1	3	Review of metocean data prior to vessel leaving port (three-day forecast) Transfer will never be initiated in increasing marginal weather conditions (only ever on a decreasing or stable weather pattern) Allowable weather windows Delay to operation if forecast is poor Alternative transfer methods (e.g. helihoist) Monitoring of vessel motions to determine whether magnitude of motion is within safe operating limits of gangway	Emergency supplies and equipment stored on board structure Personnel make safe if problem or fault with gangway is detected	3	1	3		
H-4.28			High temperature	Wearing of PPE in hot weather	Personnel heat up in PPE due to sun and hot weather	Exhaustion, dehydration	2	2	4	Personnel keep fluids on their person to maintain hydration Provide shaded areas to personnel		2	1	2		
H-4.29			Low temperature	Extreme low temperature	Extreme low temperatures can reduce dexterity, e.g. making it more difficult to clip onto safety equipment and PPE, etc.	Safety equipment not worn correctly reducing safety – could reduce efficacy of equipment, leading to minor injuries	2	4	8		Personnel given suitable PPE to ensure that they are protected from weather, e.g. gloves,	2	1	2		
H-4.30			People under water	No credible hazard/ scenario identified												
H-4.31			Objects under tension	No credible hazard/ scenario identified												
H-4.32			Object under compression	No credible hazard/ scenario identified												
H-4.33			Boat collision hazard	No credible hazard/ scenario identified												
H-4.34			Sea state	No credible hazard/ scenario identified												
H-4.35			Fall into water	No credible hazard/ scenario identified												
H-4.36			Exhaust fumes	Temporary installation of a gangway with diesel powerpacks or when gangway is near smokestacks the exhaust fumes	Exhaust stack fumes	Personnel inhale toxic fumes, injury to personnel	3	3	9	Installation of exhaust away from gangway Toolbox talk W2W landing zone assessments considers venting/fumes onto vessel	Respiratory masks for operator if applicable	3	1	3		
H-4.37			Manual handling materials	No credible hazard/ scenario identified												
H-4.38			Noise	Temporary installation of a gangway with diesel powerpacks or when gangway is near engine room	Diesel powerpacks or engine room noise	Injury to hearing to personnel	3	3	9	Consideration in deck layout Radio communication equipment is compatible with hearing protection	PPE (hearing protection)	3	1	3		
H-4.39			High humidity	No credible hazard/ scenario identified												
H-4.40			Vibration	No credible hazard/ scenario identified												
H-4.41			Workstations	No credible hazard/ scenario identified												
H-4.42			Awkward location of work	No credible hazard/ scenario identified												
H-4.43			Mismatch of work to physical capabilities	No credible hazard/ scenario identified												
H-4.44			Mismatch of work to cognitive capabilities	No credible hazard/ scenario identified												
H-4.45			Long and/or irregular working hours/shifts	No credible hazard/ scenario identified												
H-4.46			Marine crew sufficient manning	No credible hazard/ scenario identified												
H-4.47			Work planning issues	No credible hazard/ scenario identified												
H-4.48			Post-traumatic stress	No credible hazard/ scenario identified												
H-4.49			Psychological impact	No credible hazard/ scenario identified												
H-4.50			Fatigue	No credible hazard/ scenario identified												
H-4.51			Shift work	No credible hazard/ scenario identified												
H-4.52			Medical unfitness	No credible hazard/ scenario identified												

Ref	Access/ Egress	Stage	Hazard/ Guideword	Scenario	Source/cause	Consequence	Inherent Risk			Recommended safeguards		Residual Risk			Recommendations	Notes
							Severity	Likelihood	Risk	Prevention	Mitigation	Severity	Likelihood	Risk		
Miscellaneous hazards																
H-4.53	Access/ Egress	All stages	Poor organisation and job design	Slip, trip or fall from vessel or height (into sea or onto vessel), or missing steps in process due to rushing to 'get the job done'	Poor safety culture	Occupational injury, major injury, or fatality				Implementation of a no-blame and good safety culture. Competence management Competent personnel who understand their limitations and their roles and responsibilities All parties agree to ASOG and specific site owner rules on operational limits (speeds, thrust %, approach procedures etc.) to avoid conflict in decision making						
H-4.54				Shortcuts taken, task steps not safely carried out	Unclear procedures	Occupational injury, major injury, or fatality				Work as done is reflected in procedures, so shortcuts are less likely to be taken, permit to work would enable you to understand the procedure, PPE requirements, means of access, etc Sufficient training for personnel on new equipment and systems						
H-4.55				Lack of competency in safety critical roles and no analysis of training needs for vessel crew and/or transferees	Poor understanding of training needs and lack of provision	Occupational injury, major injury, or fatality				Training needs analysis for vessel crew and/or transferees conducted for job roles to fully understand what training/qualifications are required for them, including refresher training to account for skill fade						
H-4.56			Communication	Language difference between crews	Transfer personnel and vessel crews may speak different languages and have difficulty conversing in non-native tongue	Personnel mis-directed when transferring, potentially leading to serious accident				Crew members and transferee to be competent, informed and trained in the process of transfer to recognised standards Verify vessel crew, work crew and gangway operators all meet minimum acceptable language proficiency in the agreed lingua franca						
H-4.57				Lack of commonality used between transferees and vessel crews	Difference in training requirements	Personnel mis-directed when transferring, potentially leading to serious accident				Having a standard communication protocol can help to avoid misunderstanding						
H-4.58				Uncertainty on roles and command structure	Difference in roles/commands between vessels/organisations	Ineffective teamwork and leadership, leading to potential increased risk of other scenarios or delayed response in emergency situation				Clear definition of roles and commands communicated for all crew/transferees involved in transfer Toolbox talk prior to transfer						

ANNEX C
GLOSSARY AND REFERENCES

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Acceptable
ALARP	As Low As Reasonably Practicable
AIS	automatic identification system
ASOG	activity specific operating guidelines
CCTV	closed circuit television
CTV	crew transfer vessel
DP	dynamic positioning
DSC	distress selective calling
EU	European Union
FAS	fall arrest system
FAT	factory acceptance test
FMEA	failure mode and effects analysis
GPS	global positioning system
HAZID	Hazard Identification
HSE	Health and Safety Executive
ID	identification
IP	injured person
MAH	major accident hazard
MOB	man overboard
OSP	offshore substation platform
PA	public address
PFD	personal floatation device (generally a lifejacket)
PLB	personal locator beacon
PPE	personal protective equipment
PTC	personnel transfer capsule
RAC	risk acceptance criteria
RAMS	risk assessment method statement
SAR	search and rescue
SART	search and rescue transponder
SAT	site acceptance test

SFAIRP	So Far As Is Reasonably Practicable
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
UPS	uninterrupted power supply
VHF	very high frequency
W2W	walk to work
WAH	work at height
WTG	wind turbine generator

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, https://assets.publishing.service.gov.uk/media/5f2140d3e90e071a603d33b3/MGN_610_2020.pdf

Convention on International Civil Aviation, Annex 12, https://www.pilot18.com/wp-content/uploads/2017/10/Pilot18.com-ICAO-Annex-12-Search-and-Rescue.pdf

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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