Good practice guideline

Working at height in the offshore wind industry

G9 Offshore Wind Health & Safety Association

In partnership with

energy institute

GOOD PRACTICE GUIDELINE
WORKING AT HEIGHT IN THE OFFSHORE WIND INDUSTRY

1st edition

November 2014

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

The Energy Institute (EI) is the chartered professional membership body for the energy industry, supporting over 19 000 individuals working in or studying energy and 250 energy companies worldwide. The EI provides learning and networking opportunities to support professional development, as well as professional recognition and technical and scientific knowledge resources on energy in all its forms and applications.

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

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

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

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

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

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

The EI gratefully acknowledges the financial contributions towards the development of this publication from members of the G9 Offshore Wind Health and Safety Association.

Centrica
DONG Energy
E. ON
RWE
Scottish Power
SSE
Statkraft
Statoil
Vattenfall

ISBN 978 0 85293 720 4

Published by the Energy Institute

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

Front cover image courtesy of www.chpv.co.uk

CONTENTS

Contents cont... **Page**

Contents cont... **Page**

LIST OF FIGURES, TABLES AND GRAPHS

Figures

Tables

GRAPHS

FOREWORD

The G9 Offshore Wind Health and Safety Association (G9) comprises nine of the world's largest offshore wind developers, who came together to form a group that places health and safety at the forefront of all offshore wind activity and development. The primary aim of the G9 is to create and deliver world class health and safety performance across all of its activities in the offshore wind industry. The G9 has partnered with the Energy Institute (EI) in order to develop good practice guidelines for the offshore wind industry in order to improve health & safety performance. Through the sharing and analysis of incident data provided by G9 member companies, an evidence based understanding of the risks encountered during the construction and operational phases of a wind farm project has been developed. This information has been used to identify the higher risk activities in the offshore wind industry.

One of the higher risk areas identified through this analysis was working at height. In response to this risk, the G9 commissioned the development of this good practice guideline: *Working at height in the offshore wind industry*. The guideline draws upon existing standards and practices in other industries (including the oil and gas industry) whilst also seeking to take account of and reflect the unique aspects of working in the offshore wind industry. It represents the first step within the G9 to reduce the risk in work at height operations. Following publication of the guideline, the G9 members will work closely with other key stakeholders within the offshore wind industry to implement the key principles and recommendations in this guideline, in order to reduce the number of work at height incidents.

The Technical Department
Energy Institute
61 New Cavendish Street
LONDON, W1G 7AR
e: technical@energyinst.org

ACKNOWLEDGEMENTS

The drafting and development of this guideline was undertaken by SgurrEnergy and heightec. A Working Group comprising G9 member companies, reporting to the G9 Focal Group provided input, oversight and steer to the development of this guideline. At the time of publication the G9 Focal Group comprised representatives from the following companies:

Centrica
DONG Energy
E.ON
RWE Innogy
ScottishPower Renewables
SSE
Statkraft
Statoil
Vattenfall

The EI gratefully acknowledges the input and comments provided by those representatives on the Working Group and in the Focal Group.

An earlier draft of this guideline was made available through a consultation period for review and comment: both the EI and G9 gratefully acknowledge the following companies and organisations who provided comments during the consultation period:

Dutch Wind Energy Association
International Jack up Barge Operators Association
RenewableUK
Repsol Nuevas Energias
Siemens Wind Power

Project coordination and technical editing was undertaken by the EI.

1 INTRODUCTION

Safe working depends on a combination of:

- Plant:
  - the initial design and long-term condition of structures, workplaces and other assets determine the hazards to which workers will be exposed;
- Processes:
  - the way that work is planned and managed will affect the level of risk to the people involved; and
- Place:
  - the characteristics of the working environment, and its hazards.
- People:
  - decisions made by people, at every level, and in every role within a project or facility, can affect their own safety, and the safety of others around them.

These guidelines address aspects of each of these areas, with a focus on work at height; other hazards may be mentioned, but are not addressed in detail.

The guidelines are in four parts, based on the scope of work agreed in discussion with the G9 Work at Height Working Group:

- Lifecycle phase checklists:
  - a checklist for each phase (design, construction, commissioning and operation) to prompt those involved to find ways to reduce the requirement for work at height.
- Topic guidance sheets:
  - these adopt a goal-setting approach to five key aspects of work at height;
    - the topics were selected on the basis of:
      - a review of G9 incident data;
      - workshop discussions with G9 representatives, and
      - surveys to identify areas of concern, conducted through G9 representatives, and of work at height training candidates at heightec.
  - For each of the five topics, the guidance addresses:
    - common hazards;
    - PPE and other relevant standards;
    - training, skills and competence;
    - fitness requirements, and
    - responsibilities of those procuring, supervising and undertaking work.
- Flowcharts to support the preparation and review of procedures.
- Supporting information on:
  - regulatory requirements in the EU and selected nations;
    - these were chosen as the UK, Germany, Denmark, Norway, Netherlands and France;
  - existing guidance on work at height;
  - equipment and technical standards;
  - existing fitness standards in wind, oil and gas and maritime sectors, and
  - analysis of G9 member incident data relating to work at height, and areas of concern from surveys.

1.1 INTERFACE WITH OTHER G9 GUIDELINES

It is recognised that these guidelines interface with other G9 guidelines, in particular on the transfer of personnel between vessels and offshore structures (which is also covered in the good practice guideline *The safe management of small service vessels used in the offshore wind industry*). The exact boundaries between the guidelines are expected to be addressed by the G9 through an implementation process.

1.2 STANDARDS

In parallel with the preparation of these guidelines, a revised draft of EN 50308 *Wind turbines. Protective measures. Requirements for design, operation and maintenance* was undergoing consultation; as the outcome of the consultation was that the draft was voted down, and will not become a revised version of the standard, only the 2004 revision of EN 50308 can be referenced in these guidelines.

2 HIERARCHY OF PROTECTIVE MEASURES FOR WORK AT HEIGHT

All consideration of work at height 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. Where collective protection is correctly installed and maintained, it protects people without requiring them to take any additional actions to ensure safety, and is therefore the preferred approach at each level of the hierarchy; in contrast, personal protection depends on the user making correct and consistent use of the equipment.

1. Work at height should be avoided wherever it is reasonably practicable to do so, by using an existing safe place of work or permanently installed access platform.
2. Where it is not reasonably practicable to avoid working at height, work equipment should be used to prevent falls from occurring:
    a. collective protection, such as providing fixed guardrails, or
    b. personal protection, such as personal fall prevention/work restraint systems;
3. Where it is not reasonably practicable to avoid working at height or to prevent falls from occurring, then work equipment should be used to minimise the distance and consequences of a fall:
    a. collective protection, such as safety nets rigged at high level on a structure, and
    b. personal protection, such as rope access, work positioning, or personal fall arrest system (FAS).
4. Where it is not reasonably practicable to do any of these, then measures should be taken to minimise the consequences of a fall:
    a. collective protection, such as safety nets rigged at low level;
    b. personal protection, such as the use of lifejackets and immersion suits for work over water, and
    c. procedural measures, such as providing suitable incident response, for example having safety vessels standing by when working over water.

Wherever safety depends on the use of work equipment, users must have the necessary competence to use it correctly, and employers should ensure that there is an appropriate level of instruction, supervision, training and other procedural/behavioural controls.

Other forms of work equipment, such as ladders or hop-ups, or the use of signage to guide people away from situations where they could be at risk of a fall from height, do not satisfy the listed criteria. The use of maintained and secured ladders can only be justified where a risk assessment demonstrates that the use of the preferred approaches set out here is not justified because of the low risk and short duration of use, or existing features on site which cannot be altered.

- The level of risk is the most important factor:
    - the probability of falling can be minimised by limiting the activities that are carried out from a ladder, and ensuring that users maintain three points of contact with the ladder;
    - the potential severity of a fall will depend on the height and location of the work.
- The exposure to the risk can be limited by restricting the duration for which such work equipment is used, such as by ensuring that ladders are only used for tasks with a duration of less than 30 minutes.

This guideline seeks to apply these principles in every situation, for example:

– Design decisions can eliminate work at height for some foreseeable future activities, and minimise the risk for those activities where work at height is unavoidable;
– Selection of rescue methods will determine whether the rescuer is in a position from which a fall cannot occur, or if they have to rely on an FAS; and
– The quality of procedures, and the culture in which work is carried out, will affect the effectiveness of procedural controls.

3 LIFECYCLE PHASE CHECKLISTS

These checklists provide prompts to assist those involved in planning or undertaking works in a lifecycle phase, to find ways to:

– reduce the need to work at height, thereby eliminating the hazard; or, where work at height cannot be avoided, to
– make suitable provision and preparations for safe work at height.

The checklists consider three lifecycle phases:

– Design.
– Construction, up to the point where the offshore structure is physically complete;
  – Decommissioning will involve similar hazards relating to work at height.
– Works over the operating lifetime of the offshore structure, including commissioning and operations and maintenance.

The checklists consider the different areas of a Wind Turbine Generator (WTG) or other offshore structure, including:

– access route from vessel to external platform, and activities on this platform;
– towers and other structures;
– nacelle, hub and helihoist platform – but not helicopter hoisting operations, and
– external and internal access to blades.

As a range of different terms is in use for the same types of components of access structures on different sites, the definitions given in Figure 1 are used throughout these guidelines; similar components would be expected on structures such as offshore substations, jackets and meteorological masts.

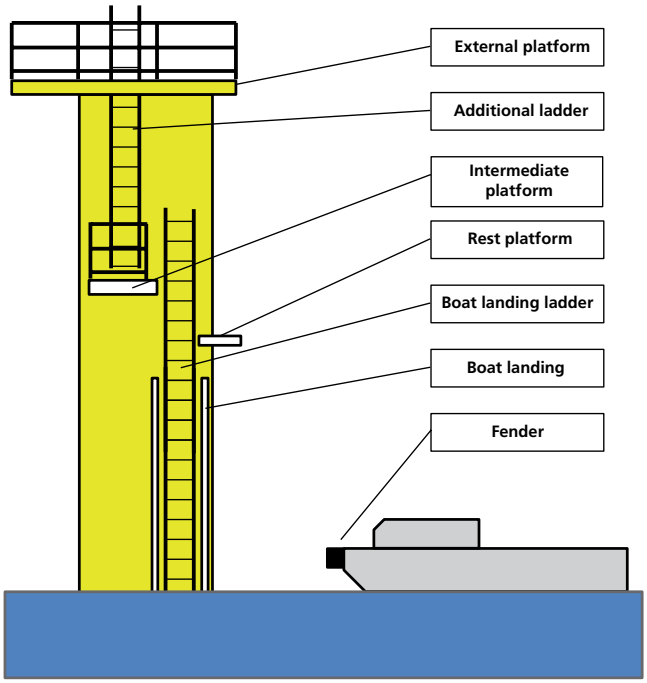


Figure 1: Definitions of access structure components

3.1 DESIGN

The designer should undertake hazard identification and risk reduction, concentrating on significant issues within their area of responsibility, and where it interfaces with other work packages. In order to ensure that such an assessment is effective, and that practical solutions are implemented, it should involve people with direct experience of the activities involved. These solutions should apply the hierarchy of controls to the full lifecycle of the WTG, for example:

– Identifying where the design can enable future operating and maintenance tasks to be undertaken without the need to work at height.
– Ensuring that there is suitable provision for safe work at height for foreseeable activities during construction, commissioning, O&M and decommissioning phases.

This section is focused on functional requirements relating to work at height, and does not set out to address other hazards or design considerations.

3.1.1 Common requirements for access equipment

The requirements outlined in this section are relevant to any part of an offshore structure; specific requirements for particular locations are covered in 3.1.2 to 3.1.11. Within WTG towers, the order of preference for access between levels is:

1. Lift, as this minimises fatigue and eliminates exposure to the risk of falling.
2. Ladder with climb-assist system, which reduces fatigue, and a compatible permanently installed FAS if the climb-assist system does not include the functions of an FAS.
3. Ladder with permanently installed FAS, which, when used correctly, in conjunction with suitable platform design, minimises the risk of falling.
4. Ladder with temporary FAS, installed in such a way as to minimise the number of changeovers between systems; this reduces the risk of falling, but in many cases, temporary systems have poorer ergonomics than permanent systems.
5. Ladder used with scaffold hooks and lanyards; as this increases worker fatigue and has a greater potential for hazardous errors, compared to any of the other systems, it should only be undertaken in exceptional situations, where none of the preferred approaches is available.

3.1.1.1 Ladders

Ladder design is generally based on EN ISO 14122-4 *Safety of machinery. Permanent means of access to machinery. Fixed ladders*; however, there are several differences between ladders in WTGs and in other locations within the scope of the standard, specifically:

– FAS should be used, rather than safety cages, reflecting the findings of research into the fall-arresting effectiveness of ladder safety cages[1,2,3];
  – the FAS must be mounted in a manner that does not overload any components of the ladder;
  – if a fixed FAS is not in use, scaffold hooks and energy-absorbing lanyards will generally be used; on aluminium ladders, as commonly used inside WTG

1 HSE RR258 *Preliminary investigation into the fall-arresting effectiveness of ladder safety hoops*
2 HSE RR657 *Investigation into the fall-arresting effectiveness of ladder safety hoops, when used in conjunction with various fall-arrest systems*
3 HSE CCID 1-2012 - *Safety bulletin - Hooped ladders and the use of personal fall-arrest systems*

towers, the scaffold hooks will have to go around the stiles, in order to provide sufficient strength to arrest a fall:
  - the dimensions of the stiles on aluminium ladders should therefore be suitable for easy connection of scaffold hooks;
  - the mounting of the ladder, and individual sections thereof, needs to have sufficient strength to withstand the load imposed when a fall is arrested, and
  - mounting of other components, such as cable trays, should avoid obstructing access to the ladder stiles.

  While fulfilling these requirements enables scaffold hooks to be used, their use should only be a temporary measure, such as when a permanently-installed FAS is out of service, or if undertaking a rescue.
- The 'diamond' profile of rungs made from square bar, as commonly used on boat landing ladders, is not included in EN ISO 14122-4.
- The standard requires a rest platform to be provided at intervals of no more than 6 m on ladders over 10 m in length; these can either be fixed or movable designs;
  - Due to the challenges of corrosion and fouling, movable rest platforms on external ladders (such as on meteorological masts, and especially on boat landing ladders in the splash zone) are unlikely to be practical.
  - The design and position of fixed rest platforms should not obstruct the fall path, as, in the event of a fall, this would increase the risk of injury to a falling climber, before they had been stopped by the fall arrest system.

The requirements given in the standard should only be deviated from if justified on the basis of risk assessment, which may take account of factors such as:
- ladders in WTGs are equipped with fixed FAS, which mitigates the distance and consequences of a fall;
- ladders in WTGs are only accessible to trained people, equipped with PPE including full body harness and work positioning belts and lanyards, which could be used to enable the climber to rest, if necessary, at any point on the ladder;
- the primary means of access between levels in the tower is the lift, with the ladder being generally being a backup system, and
- on boat landings, rest platforms should not be located in a position where they could present a hazard to crew transfer vessels, or personnel on such vessels, taking account of tidal range, wave motion and foreseeable types of vessel.

Note that national regulations may impose different requirements, which take precedence over standards.

3.1.1.2 Transition between ladders and platforms

Where a ladder terminates at a platform, suitable handholds should be provided (or the ladder should continue) above floor level to enable safe climbing until the climber can step over onto the floor.

Suitable arrangements are needed for the transition from ladder FAS to the platform:
- Disconnection from the ladder FAS should be done from a place of safety – standing on the platform, with the hatch/gate closed; if this is not possible:
  - a designated anchor point should be provided for the attachment of an energy absorbing lanyard, if it is necessary to detach from the ladder FAS while still on the ladder or next to an open hatch. Correct positioning of the anchor point is important:

- the anchor point should be readily accessible to the climber, and be at a height that minimises the fall factor;
- its position should ensure that the lanyard will not pass over any sharp edges, as these could cause failure in the event of a fall, and
- the lanyard should not have to pass through a closed hatch.

3.1.1.3 Hatches and guardrails/gates

Ladder openings can either be protected by hatches or guardrails and gates – or a combination of these in some situations:

- if a hatch is in a location where people are likely to need to walk over it, then it should be flush with the floor when closed; however
- if there is no need to walk over the hatch, and there is a risk of objects on the platform falling through the open hatch, then providing toe plates around the hatch opening can reduce the risk of objects dropping through the hatch.

This is shown in Figure 2.

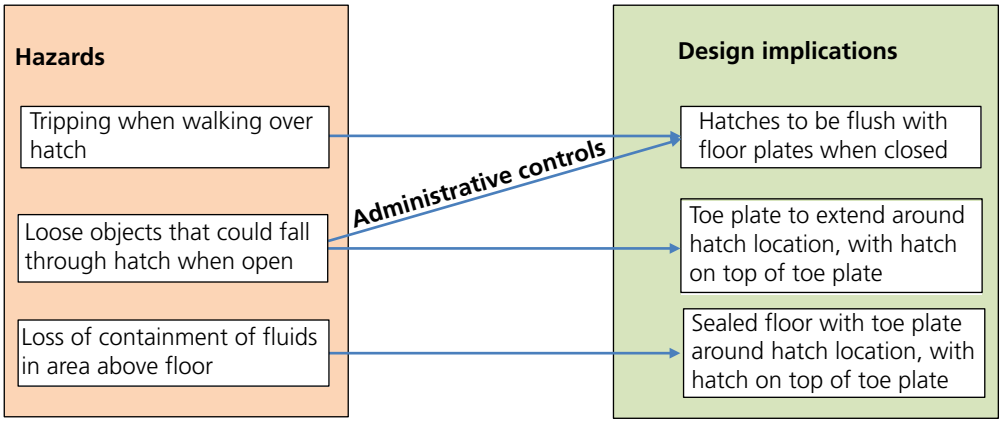


Figure 2: Factors affecting decisions regarding flush or raised hatches

Administrative controls of falling object risk could include improved housekeeping and use of lanyards, both of which reduce the probability of a loose object being present on the floor adjacent to the hatch – see 4.3.1.3.

It is common practice for ladder hatches in WTGs to be of self-closing type; however, this deviates from the requirements in standards:

- EN 50308 states that hatches shall have two stable positions (open and closed).
- EN ISO 14122-4 states that opening hatches shall be manual and easy, the hatch shall allow safe passage of the operator whilst in the open position, and closing following safe passage shall be done without much strain on the operator, for example springs or hydraulic means.

Decisions about the selection of hatches (self-closing or capable of staying open) or guardrails and gates should take account of the activities to be carried out in the vicinity of the hatch:

– If there are situations where people are regularly working between two levels, and/ or passing equipment or components between two levels, then it may be more appropriate to protect the opening with guardrails and a self-closing gate:
  – if the ladder FAS is an SRL, then a closed hatch might interfere with its operation, or
  – if it is intended that a casualty should be lowered down the ladder, then the presence of self-closing hatches could prevent this from being done safely.
  – The decision to specify self-closing hatches should be based on an assessment of the risks that they introduce, as well as those that they mitigate.

Decision criteria to determine whether to use hatches or gates are illustrated in Figure 3.

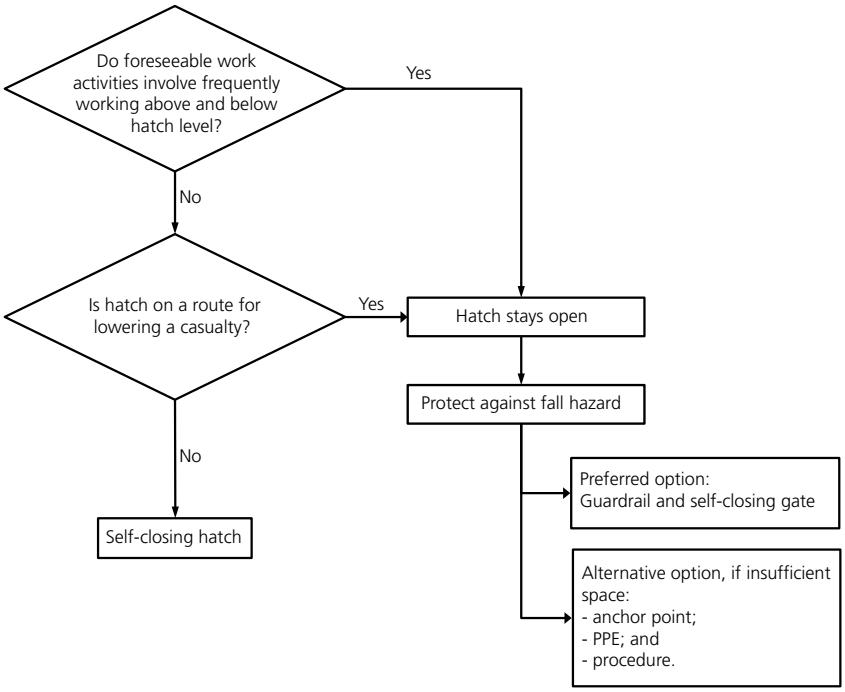


Figure 3: Decision criteria for hatches/gates

Hatches should always be sufficiently strong that they can:
– be safely walked on, and
– withstand other reasonably foreseeable loads that could be placed on them, during expected work activities in their location.

If a hatch is supported by the floor structure along two opposite edges when in the closed position, then the hatch will remain safe, even if a hinge fails.

3.1.1.4 Marking of anchor points

All designated anchor points should be marked in accordance with EN 795 *Personal fall protection equipment. Anchor devices* or PD CEN/TS 16415 *Personal fall protection equipment. Anchor devices. Recommendations for anchor devices for use by more than one person simultaneously*, as appropriate. (Note that PD CEN/TS 16415 is not a harmonised standard, so does not provide presumption of conformity for CE marking under the PPE Directive.)

If neither of these standards applies, then the principles of the marking requirements of EN 365 *Personal protective equipment against falls from a height. General requirements for instructions for use, maintenance, periodic examination, repair, marking and packaging* should be followed; this requires:

- means of identification, e.g. manufacturer's name, supplier's name or trademark;
- manufacturer's production batch or serial number or other means of traceability;
- model and type/identification;
- number and year of the standard to which the equipment conforms, and
- pictogram or other method to indicate the necessity for users to read the instructions for use.

In addition to this:

- EN 795: 2012 has an additional requirement to include marking that the anchor shall be for use of **one** user only, and
- EN 795: 1997 Class C anchors have additional marking requirements for the maximum number of attached workers, the need for energy absorbers and ground clearance requirements.

Clearly, in the case of structural anchor points, not all of this information will be appropriate, but it is still essential that the acceptable uses of the structural anchor are indicated to users, and that the suitability of the anchor for these uses has been assured through appropriate design verification, quality assurance and inspection.

3.1.2 Access from vessel to external platform

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

3.1.2.1 Boat landing structure

The design of a boat landing structure should:

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

These considerations are shown in Figure 4 and Figure 5.

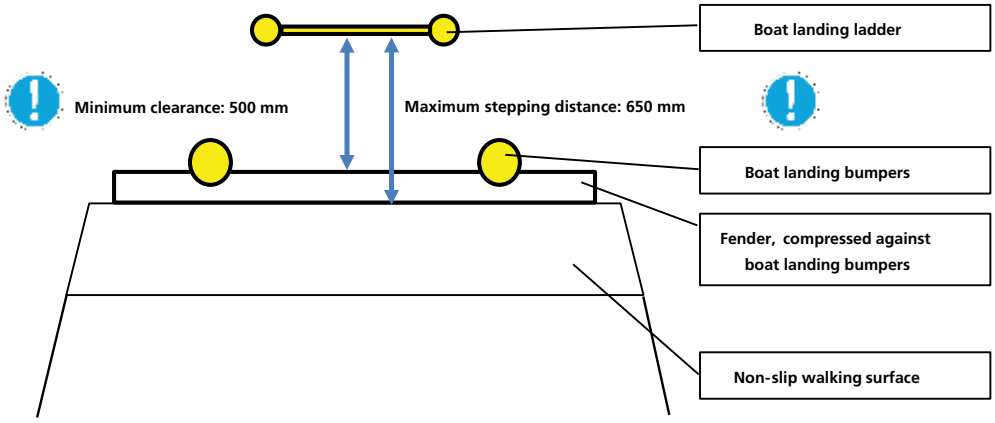


Figure 4: Dimensions of safety clearance and stepping distance

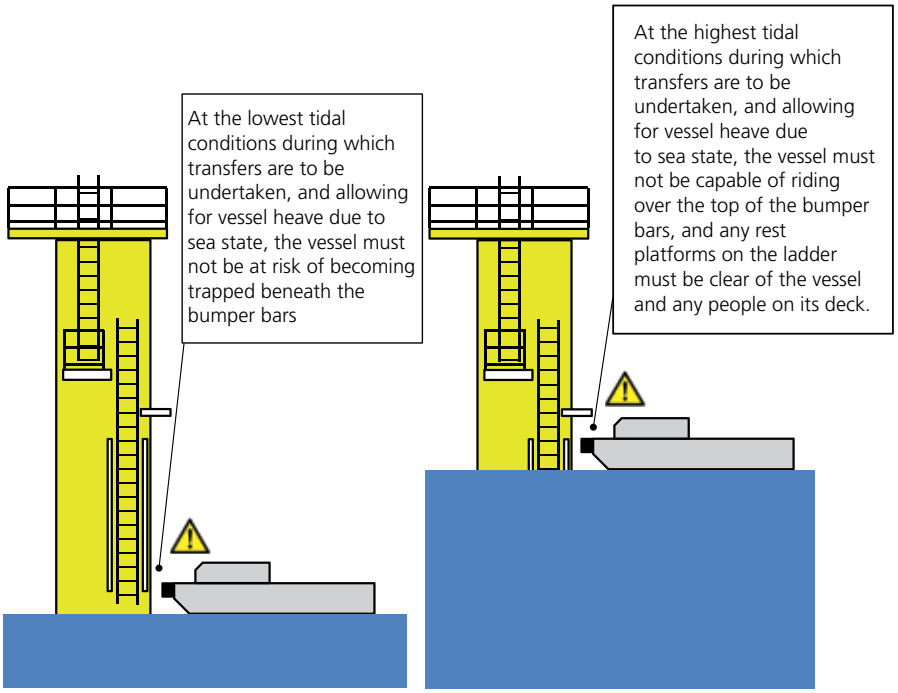


Figure 5: Safety implications of bumper bar height

A suitable FAS, presumed to be an SRL, also known as an 'inertia reel' or 'yo-yo', should be provided on the ladder, to enable attachment before stepping over from vessel; specific requirements include:

- Action of SRL should permit some vessel movement without undesired activation;
  - This may also be affected by details of the procedure used for attachment/ release.
  - When selecting an SRL, data on the lock-on speed should be obtained from the manufacturer, and the corresponding limit on vessel movement determined, in order to ensure that the SRL will not lock on in conditions under which it is intended that transfers should take place.

- Mounting location of SRL should ensure that:
  - if a climber falls, they remain close to the ladder, in the safety zone (specific issue if access ladder is sloping);
  - there is suitable access for installation and maintenance – ideally working from a safe platform, or by providing designated anchor points if work at height is unavoidable, and
  - the SRL will not obstruct climbers, such as by creating a bump hazard, or by impeding ergonomic positioning for climbing and attachment to/from the lifeline.
- A 'tag line' will be needed in order to pull the SRL line down to the climber;
  - The design of the tag line system should both:
    - avoid creating lengths of slack line, which can catch on the structure and impede climbing, and
    - avoid introducing excessive friction, which resists the upward motion of the SRL line while climbing, and can increase the climber's fall factor if tag line friction keeps the connection to the SRL below the climber's harness attachment point when ascending the ladder.
  - The tag line can also be used to ensure that the SRL hook is not allowed to retract in an uncontrolled manner, which can lead to entanglement of the wire, preventing use of the SRL.
- SRLs should not be left extended when not in use, and
- other types of FAS, such as rigid rail systems on ladders, are unlikely to be suitable in the splash zone, due to fouling.

It is important to select a suitable connector for use between the SRL and harness. As connectors with moving parts tend to deteriorate rapidly in the offshore environment, SRLs often have only a plain eye, to which each user attaches by means of a suitable connector.

- Connector between SRL and harness must be secure, but should also be capable of easy and quick release while wearing gloves, which may be wet and slimy from holding the ladder:
  - This minimises the period during which a climber is on the vessel, but connected to the SRL;
    - connectors such as triple-locking karabiners are not quick to disconnect; any delay in detaching from the SRL increases the risk of vessel motion leading to activation of the SRL, and the climber being 'picked up' by the SRL if the vessel moves sharply downwards, and
    - various types of quick connector are available on the market; a suitable connector would meet the requirements of EN 362, be easy to disconnect, but protect against accidental disconnection while under load.

Ladder and bumper bar design should minimise protrusions that could cause injury to a climber falling on the ladder (noting that climbing with energy absorbing lanyards and scaffold hooks will be necessary if the SRL is not in operation, thereby potentially increasing the distance of a fall).

- For example, consider the shape and position of the tops of the boat landing bumper bars: could these be hit by a falling climber, and what would their effect be?

Given the need for occasional use of scaffold hooks on the ladder, the rungs should be rated for fall arrest, and the surface coating specification should seek to minimise the potential for chipping as a consequence of scaffold hook use.

– Scaffold hooks should only be used if the SRL is out of service, and should not be a routine approach.

The potential for ladder/boat landing replacement over the lifetime of the structure should also be considered, such as whether the provision of flanges or plates could enable future bolted connections.

If transfers during the hours of darkness could be undertaken at any point in the life of the structure, then suitable lighting should be provided on crew transfer vessels and/or the structure:
– the positioning of lights should avoid dazzling climbers or vessel crew, and
– lights installed on the structure should minimise maintenance requirements, and be positioned to ensure that safe access is available for maintenance.

3.1.2.2 Intermediate platform

The hierarchy of controls in this situation is:
1. provide self-closing gate on platform;
2. prevent fall, by the use of work restraint, and
3. minimise distance and consequences of fall, using energy absorbing lanyard.

It is an established practice not to have a gate on this platform; while this is consistent with EN ISO 14122-4 requirements for a platform between two adjacent ladders, the preferred solution in the standard is a gated platform, with a horizontal distance of at least 700 mm between ladders. However, there is the potential for gates to be unreliable in this location, as they may be subject to extreme waves, therefore omission of the gate can be justified – particularly as the standard does not assume that climbers will be wearing a harness, and maintaining attachment with lanyards. In the absence of a gate, there should be a designated anchor point or anchorage so that the climber can be in work restraint during changeover between ladder FASs; this can either be achieved by:
– use of a work positioning lanyard, attached (and adjusted if necessary) so as to prevent the user from reaching a position from which they could fall; however, if this is set up incorrectly and a fall does occur, there is no shock absorption, or
– use of an energy absorbing lanyard, attached to a location from which the length of the lanyard prevents the user from reaching a position from which they could fall; even if a fall does occur, the consequences will be reduced through the action of the shock absorber.

As boat landing structures are generally painted yellow, the standard practice of marking anchor points in yellow may not provide the contrast that is needed for ease of identification; a contrasting background, applied to the structure around the anchor, could overcome this concern. Anchor points should be clearly marked with a sign/pictogram to indicate their purpose.

3.1.2.3 Additional ladders

FASs on any additional ladders between the boat landing and the external platform should be capable of reliable operation in an exposed location, although they will not be subject to marine fouling.
– Usage will be simplified if the FAS on all ladders have the same means of attachment to the climber.

- If an SRL is used on additional ladders:
  - a tag line will be needed;
  - the design should avoid the potential for the tag line to catch on the structure (as per the boat landing ladder), and
  - this SRL does not need to tolerate vessel movement, so is not interchangeable with SRL on the boat landing ladder – if physically similar SRLs with different behaviours are in use, then they should be clearly identified to avoid errors in installation/servicing.

3.1.2.4 External platform

The design of the external platform should:

- Provide safe access around the full 360° of the tower.
- Safeguard the ladder access point with suitable guardrails and an access gate:
  - ensure that the guardrail/gate design provides sufficient protection against objects dropping from the platform, and endangering a climber below, and
  - the risk of user errors can be minimised if all ladder – platform transitions are similar, for example, always stepping sideways between the ladder and platform, rather than sometimes stepping forward between the ladder stiles.
- Ensure that people on the platform can work safely if sections of perimeter guardrail can be opened/removed (such as for crane operation or casualty evacuation), e.g.:
  - design opening so that guardrail swings inwards, and prevents access to opening, so that platform remains a safe working area;
  - provide temporary guard rails to maintain a safe working area while the perimeter guardrail is open, or
  - provide anchor points so that all personnel involved in the lifting operation are in restraint, and cannot reach the open edge.
- Ensure that the design of the platform crane (commonly a davit crane, either powered or manually operated) minimises the need to work at height when rigging, operating, inspecting and maintaining it.
- Ensure that, if the crane jib is to be used to anchor the casualty evacuation system, the:
  - anchor points on crane are of a suitable rating;
    - note that if a lifting system includes a pulley, suspended from a lifting eye, then this will almost double the force on the lifting eye, compared to a hoist attached at the same point;
  - system can be rigged quickly, ideally by one person – or is always in place;
  - system design is simple, in order to minimise the risk of errors in assembly leading to danger;
  - system can be operated by people at platform level;
    - if it is necessary to lift the casualty from the platform floor level, prior to lowering to the vessel (for example, in order to lift the casualty over the guardrail), then there must be safe access to the lifting/lowering system, and
  - system provides sufficient clearance to manoeuvre casualty over/through guardrail.
- Minimise the risk of objects falling from the platform, particularly above boat landing areas, as these are the locations where there will be the most frequent movement of objects on the working platform, together with the highest probability of a person being beneath the guardrail;
  - this could be achieved by solutions such as mesh infill of guardrails above boat landings, and secondary retention of components such as detachable hoists that might be handled while a vessel is present beneath;

    - note, however, that mesh infill can be subject to icing in some locations/ conditions.
- Minimise the risks associated with any equipment items that are to be mounted over the side of the platform guardrail, such as aids to navigation:
    - identify their maintenance requirements, and how these can be minimised, e.g. LED lighting in place of fluorescent lamps;
    - ensure that the mountings of over-side equipment allow for the items to be brought inboard easily for servicing, eliminating the need to work outside the guardrail;
    - avoid mounting equipment on guardrail near crane operating area;
        - this eliminates the risk of a load getting caught on equipment protruding from the platform, in order to avoid the potential for equipment damage, or for an object to be dislodged and drop onto the vessel;
        - if this cannot be avoided entirely, the detail design of brackets, and even the attention to detail in assembly (such as minimising protrusion of bolts) can reduce the risk of loads being fouled;
    - ensure that the design of fastenings minimises the risk of items coming loose, and
        - consider secondary attachment, particularly for any items that are above the boat landing.
- Provide suitable platform lighting, if nighttime use is expected.
- Consider whether any alternative access methods, such as stabilised gangways, may be used over the lifetime of the structure, and identify suitable landing areas to enable safe use of such methods.
- Ensure that material selection, surface coating and corrosion allowance for all external safety-related components and structures, such as ladders, guardrails, anchor points and supporting steelwork, are suitable for offshore use.

3.1.3 Access to basement

In WTGs where the transformer and/or switchgear are located in the basement beneath the entrance area, safe access should be provided to this area. Considerations include:

- Hatches should meet the requirements described in 3.1.1.3;
- The ladder should have an FAS, and suitably-located anchor points should enable safe attachment to/detachment from the FAS.
- The hatch should be positioned so that:
    - it is not on a main access route to/from the tower entrance, as this increases the risk of a person falling into the open hatch;
    - it is not affected by the lowest stopping point of the lift, to avoid a situation where if power is lost, access to the basement is impeded by the lift resting on the access hatch, and
        - if this cannot be achieved by design, then procedural measures will be necessary to ensure that the lift is not left parked over the hatch.

3.1.4 Access to foundation

The section of a monopile foundation between the airtight hatch and the water level will generally be a hazardous confined space, with an oxygen-depleted atmosphere, and the potential for harmful gases to seep out of the seabed (See 4.2.1, penultimate paragraph). Access to this area should be minimised, both through design decisions, and through adoption of techniques such as remote inspection systems, where it is reasonably practicable to do so. If access cannot be avoided, then the confined space hazards must be managed effectively. In relation to work at height, the principal concerns are:

- Condition of ladder, handrails and platforms may be uncertain, due to corrosion and infrequent access; until their load bearing capacity has been verified, climbers should be protected against falling by attachment to a suitable anchor above the sealed hatch level.
- There is no permanent lighting in this area; climbing and other movement in limited light may increase the risk of slips/falls occurring.
- The sealed hatch will generally be much heavier than a standard hatch, so suitable arrangements for lifting and securing it in the open position will be necessary.

Rescues from foundation areas may involve hauling the casualty up, over a distance of 10-20m; suitable equipment needs to be available, together with people who are competent in its use.

3.1.5 WTG tower

3.1.5.1 Lift

Ensure that lift design, and integration with platforms/landings, fulfils the Essential Health and Safety Requirements (EHSRs) of Directive 2006/42/EC (the Machinery Directive), taking account of the state of the art[4]. In particular:

- Protect people from fall hazards:
  - landing gates should be interlocked with the carrier, so that they can only be opened when the carrier is stopped at the landing, and the carrier cannot depart until the gate is locked closed;
    - if the lift runs on the ladder, a safe means of access to the ladder will be necessary – either an override for the interlocked gates, or separate self-closing access gates, and
    - people should not have to climb over guard rails to access the ladder.
  - Provide door locking system on carrier, so that the door cannot be opened between landings in normal circumstances.
- Protect people from mechanical hazards created by the moving lift:
  - fall-prevention barrier can achieve this in most locations;
  - barriers at top and bottom platforms should have mesh infill, to prevent body parts entering travel zone, and
  - the use of trip plates over the full area of the top and bottom of the lift can provide protection to people if there are other circumstances or locations in which people could be in the travel zone of the lift.
- Provide emergency stop controls at carrier control stations:
  - required at bottom, recommended at top, and
  - should be clearly identified as relating to the lift alone.
- Ensure that the design allows for foreseeable emergency situations:
  - interlocks on the landing gates and carrier door should be capable of being overridden in case of emergency, and

4 Annex 1 of the Machinery Directive states that 'The essential health and safety requirements laid down in this Annex are mandatory; However, taking into account the state of the art, it may not be possible to meet the objectives set by them. In that event, the machinery must, as far as possible, be designed and constructed with the purpose of approaching these objectives'. The Guide to Application of the Machinery Directive 2006/42/EC states that 'In order to correspond to the state of the art, the technical solutions adopted to fulfil the EHSRs must employ the most effective technical means that are available at the time for a cost which is reasonable taking account of the total cost of the category of machinery concerned and the risk reduction required.' The state of the art for lifts has been determined by a working group under the Machinery Directive – see European Risk Observatory Report *Occupational safety and health in the wind energy sector*, p29.

  - Safe emergency egress from the lift would also require provision of suitable anchor points, and ensuring that the lift is sufficiently close to the ladder to enable access.
  - Provide a means of controlling the carrier from outside, in the event of incapacity of the person inside.
- Provide a means of lowering the carrier safely, from inside, in the event of breakdown or loss of power or motor failure.
- Provide a safe means of observation between landings, such as a window or removable panel, to enable safe inspection of the suspension ropes.

3.1.5.2 Design for rescue

The WTG design should enable foreseeable rescues to be undertaken safely and swiftly, and can also affect the minimum safe number of people who need to be present on a WTG: if the design can allow a single rescuer to undertake the majority of rescues, then this allows the minimum working party size to be two people, unless specific tasks with more complex rescue requirements are to take place.

Suitable fixed and/or movable anchor points should be in place throughout the structure, to enable rescue equipment to be set up. Depending on the means of evacuation in an emergency, it may be necessary to move a casualty on a stretcher/spine board from any location in the WTG to either a vessel at the boat landing, or onto the helihoist platform, so rescue routes should be defined on this basis. A stretcher should generally be transported so that the casualty remains horizontal, and should only be inclined where necessary to pass through restricted openings on the rescue path. The effect of transporting a casualty at angles other than horizontal will depend on their condition, and the duration of transport in this manner.

At the design stage, specifications should be prepared to define the rescue equipment that should be:
- present within the WTG or other offshore structure;
- carried by personnel at all times, or for specific activities, and
- available nearby, perhaps kept on the access vessel.

Storage areas should be clearly designated, so that equipment is easily located when needed, and any missing equipment is obvious.

It may be possible to use the lift aperture in platforms as an effective rescue path for moving a stretcher-borne casualty between levels in the tower, provided that it is of suitable size for an inclined stretcher to be guided through:
- it avoids the complication of lowering a casualty through self-closing ladder hatches, if fitted, and
- it enables one member of the rescue team to monitor/guide the casualty as they are being lowered.

Suitable anchor points should be provided to enable this route to be used.

Other openings in the structure that may be part of a rescue path, such as between the nacelle, yaw deck and tower, need to be of sufficient size to allow a stretcher-borne casualty to be passed through. Provision of an effective internal rescue route can reduce the need for casualties to be lowered outside the tower.

3.1.5.3 Internal intermediate platforms

Internal intermediate platforms should provide safe access to all tower joint flanges and related cable joints, both for initial assembly and subsequent inspections and maintenance.

Openings for the ladder or lift must be suitably protected; the exact method depends on the location. The transition between the ladder and platform, and the ladder hatches, should meet the requirements described in 3.1.1.2 and 3.1.1.3 respectively. The lift well should be protected by guardrails and an interlocked gate.

In order to minimise the risk of objects falling in the tower:
- Fill in any voids in the structure where tools or equipment could fall;
- Avoid locating components that may require maintenance directly above openings in floors; for example, fluorescent strip lights are often located so that they protrude down through a floor, in order to light above and below the floor, and be accessible for maintenance. Solutions that minimise work at height include:
  - mounting the light fitting so that it can be moved over an area of solid floor, while still on secondary attachment, so that the lamps can be changed without working through an opening of the floor;
  - using LED lighting, which should not need to be replaced during the lifetime of the WTG, and
  - powering emergency lighting from a central UPS, so that individual luminaires will not require periodic battery replacement.

3.1.5.4 Yaw deck

In addition to the design requirements specified for intermediate platforms, the route from the yaw deck to the nacelle should enable safe climbing, with good ergonomics, and suitably-positioned anchor points.
- if the design of the route allows an FAS (such as an SRL) to be installed and used effectively, then this further reduces the risk from falling;
- climbing may be easier if the ladder is inclined from vertical, and
- if a situation could arise in which a person falling from the nacelle access ladder could fall through an opening in the yaw deck, then despite the short length of the nacelle access ladder, continuous attachment becomes essential, due to the potential consequences of a fall.

The transition between the ladder and platform, and the ladder hatches, should meet the requirements described in 3.1.1.2 and 3.1.1.3 respectively.

3.1.6 Nacelle – interior

The internal design of the nacelle should:
- Provide solid flooring, without openings or trip hazards, as far as possible throughout the nacelle.
- Provide safe access between levels within the nacelle:
- Enable safe working above main floor level;
  - preferred option is passive fall protection – guardrails, gates, hatches; if this is not possible, then
  - provide anchor points for fall protection equipment.
- Provide for safe working adjacent to temporary openings that give rise to a risk of falling from height:

  - routine tasks such as hoisting operations with the onboard service crane should not expose people to a risk of falling from the nacelle, and
  - if major component exchanges, such as gearbox replacement, create an opening that could allow a fall to a lower level, then there should be provision for working in restraint.
- Provide guardrails or anchor points if the yaw – nacelle hatch has to be open for transfer of equipment/materials.
- Avoid sharp edges – these are an immediate direct hazard to people, but can also create serious latent hazards if sharp edges damage PPE such as harnesses or lanyards.
- Minimise the risk of loose objects, such as fasteners or hand tools, dropping through gaps in the nacelle flooring, and endangering people below – either inside or outside the tower.
- Enable the rescue of a casualty from any location that they would need to access in order to perform work.

3.1.7 Nacelle – exterior

Equipment should be specified and located to avoid the need to work at height. Where access to the exterior of the nacelle is essential, the design should provide safe access.

- If a helihoist platform is fitted, this can provide safe access to instruments, aviation lights etc:
  - the platform should be designed to be maintenance free, to avoid introducing future work at height requirements, and
  - design requirements with respect to safe helihoist operation are defined by national aviation authorities, and may therefore differ between jurisdictions.
- If the nacelle roof has to be used for access, then the design should:
  - provide good access – walking surfaces should be:
    - clearly defined, and coated with durable non-slip finishes, and
    - sloping at a sufficient angle to shed water, without being steep enough to increase the risk of slipping;
  - If it is not reasonably practicable to provide safe working areas with guardrails to prevent falls, then sufficient anchor points should be provided in suitable locations, depending on whether they are intended to be used for restraint or for fall arrest:
    - the spacing of anchor points will determine the length of lanyard that is needed, to enable continuous attachment while moving between anchor points on the roof;
      - in general, shorter energy absorbing lanyards are preferable, as they reduce the distance of a fall, and
    - anchor points must be of sufficient strength for their intended purpose; on the nacelle roof, this will often be achieved by attaching the anchor points to the underlying structure, rather than the roof itself.

3.1.8 Nacelle evacuation

In the event of a fire that prevents egress down the tower, emergency evacuation generally involves external descent from the nacelle. The combination of the WTG/external platform design and the wind speed limits for working in the nacelle should ensure that it is possible to land on the external platform. However, if this is not achieved, or if the extent of the fire means that vessels cannot approach the boat landing, descent into the sea may occur, in

which case use of PPE to protect from drowning (lifejacket, Personal Locator Beacon (PLB) and possibly an immersion suit) will be necessary; if this situation is foreseeable, then such PPE should be available in the nacelle. Having the PPE available could be achieved by approaches such as:

– providing single-use immersion suits and foam block lifejackets in sealed packs in the nacelle;
– bringing vessel transfer PPE to the nacelle on arrival, or
– a combination of these approaches, particularly for items such as PLBs.

The exact approach to be taken will depend on assessment of risks at a site, including consideration of the ability to land on the external platform, sea temperature and potential time to rescue the person(s) from the water. It should be noted that the time to recover a person or persons from the sea in this situation may be longer than if a person falls overboard from a vessel, as the vessel will be further away, and will not have immediate visual contact with the person(s). Fundamentally, it is not acceptable to have a situation in which people are present in any location from which their escape in the event of a fire will result in landing in the sea, without suitable protection from drowning, or means of being located.

The contents of a rescue/evacuation kit are described in 4.6.1.1; selection of a descender should include:

– Checking the descent energy rating of the descender (see 3.1.8.1).
– Assessing the time to evacuate the expected number of people in the nacelle, to determine whether or not a single descender (which normally allows two people to escape at once) is sufficient when compared to foreseeable fire scenarios.
– Checking the minimum ambient operating temperature of the descender, to ensure that it is suitable for foreseeable conditions under which people would be working at the project location, as performance cannot be guaranteed if used outside design limits.

The descender should be capable of easy and secure attachment to the structure above the emergency evacuation location, without having to use textile slings, as these could be weakened by high temperatures in the event of a fire.

The arrangements for attachment to the harness must be compatible with the lifejacket; in particular, it must be possible to attach to/detach from the escape line while wearing the lifejacket – this can be difficult after a lifejacket has inflated, especially if two people have descended at once.

3.1.8.1 Descent energy

Descenders control the rate of descent by limiting the speed of the rope, and in doing so, are subject to frictional heating. Any given descender has a limit on the descent energy that it can absorb prior to needing servicing; this limit determines its descent energy class. The descent energy is the product of the weight of the people on each descent, the height of descent and the number of descents. EN 341 *Personal fall protection equipment. Descender devices for rescue* defines four descent energy classes, of which Class A is the highest rating, while Class D devices are only suitable for a single descent.

The information supplied by the manufacturer must include the maximum rated load, minimum rated load and maximum descent height of the descender device. It should be noted that these figures may be mutually exclusive, i.e. the maximum rated load may not necessarily be achieved over the maximum descent height.

3.1.9 Hub

The design should provide safe internal access between the nacelle and hub, ideally without involving work at height. The entrance/hatch opening to the hub needs to be large enough to ensure safe access and egress, and have sufficient anchor points on both sides. Both the hatch itself, and adjacent equipment, should provide a path through which an immobile casualty can be rescued on a spine board or stretcher.

Provision for safe working should also consider work involving major components, such as blade installation or pitch bearing exchange; if these tasks cannot be completed from a safe location, from which a person cannot fall, then suitable anchor points should be provided.

Anchor points and any additional equipment that is needed for rescue from the hub should also be provided.

Where hatches have to be opened to gain access to the hub, the hatch and its fastenings should be designed to avoid creating a falling object hazard; hinged external hatches should be capable of being fastened in the open position, so that they do not blow shut in the wind.

3.1.10 Blade access

Provision should be made for future internal and external blade inspection/repair activities. When selecting blade access methods, the hierarchy of protective measures should be applied, including determining whether the task objectives can be achieved without the need for work at height. As a minimum, given the foreseeable need to use rope access techniques, the design should:

– allow rope access teams to attach to the system in a place of safety;
– avoid ropes passing over sharp edges, and
– provide separate anchorages for working and back-up ropes.

Anchor points for internal blade access are generally located in the hub, as this provides a strong supporting structure, and enables periodic inspections of the anchor points to be carried out without entering the blades; anchor points for external blade access are generally either inside or on top of the nacelle. During rope access work, the ropes move slightly in response to the climbers' movement, which can result in localised wear due to fretting, it is therefore extremely important that the route taken by the ropes does not pass over any sharp or rough edges. Further details on rope access work are given in 4.5.2.

Where hatches are used to gain access to the interior of blades, the hatch and its fastenings should be designed to avoid creating a falling object hazard, which could either endanger people beneath, or lead to loose components such as fastenings being left inside the blade.

Internal blade access will generally be carried out with the blade locked in a horizontal orientation, so, provided the integrity of the blade is assured (for example, by carrying out an external inspection), there is no risk of falling. If the integrity of the blade were uncertain, internal access would be a very high risk operation.

3.1.11 Meteorological masts

Meteorological masts are high lattice structures, with instruments installed on the mast structure, and on retractable booms. Design decisions that will influence the safety of work at height include:

- provision of fixed fall arrest on access ladder;
- provision of suitable working platforms at levels where work will be necessary during installation, commissioning and maintenance activities;
- provision of designated anchor points, and
- ensuring that there is safe access to all items of equipment that may need to be maintained or exchanged over the working life of the mast.

As meteorological masts are open structures, any falling objects present a hazard to people on the external platform below; the risk can be reduced by:

- design of reliable fastening arrangements;
- permanent secondary attachment of components that may need to be released or adjusted during maintenance activities;
- provision of suitable lifting or attachment points on components that may need to be removed for maintenance, and
- if it is foreseeable that people may need to be present on the external platform level while others are working on the mast (for example, checking signals from instruments), then the design should provide a safe location on the platform for this work to be carried out.

3.1.12 Work on foundations

Structures such as transition pieces and jackets may require inspection and maintenance work to be carried out between the external platform and the sea surface; this will generally involve the use of rope access. While most of these structures will involve vertical access from the external platform downwards, areas such as the underside of offshore substations may also need to be accessed. In order to enable safe use of rope access over the working life of the structure, consideration should be given during the design phase to:

- where ropes could be anchored;
- the route that ropes will take from the anchor locations to the climbers below;
- whether temporary access platforms may be necessary in some locations, and how they would be installed, and
- how access would be gained from the external platform.

Design decisions will also determine the ease with which foreseeable tasks, such as boat landing structure repair, can be carried out.

Rope access work may also be necessary inside monopile foundations, below the airtight hatch, with the added complexity of working in a confined space.

3.2 CONSTRUCTION

This section considers work at height during construction activities, both offshore and in port. Decommissioning can also be considered as a construction activity, the safety of which depends not only on the extent to which the structure has been designed for decommissioning, but also on how it has been maintained over its working life, so that it is still in a safe condition for work to be carried out.

3.2.1 Contractor selection

The majority of work in the construction phase is generally undertaken by contractors, therefore the selection of competent contractors is vital to controlling the health and safety risk profile of the phase.

Further guidance on contractor selection and subsequent monitoring is given in Annex F.4.2 and F.4.3.

3.2.2 Temporary hazards

The incomplete structure may give rise to temporary hazards, which will not be present on completion, such as openings where cables or equipment are to be inserted. For example:

- After installation of the transition piece, but before tower installation, there could be a risk of falling from the external platform into the inside of the TP:
  - the severity of this is further increased if there are large openings in the first platform within the TP;
  - if such a fall hazard exists, it can be mitigated by:
    - providing temporary guardrails/covers so that people cannot fall to a lower level, and
    - if these guardrails/covers have to be removed prior to tower installation, it will be necessary for any personnel on the platform to be working in restraint, so that they cannot fall into the opening.
- Prior to fitting of the hub to the nacelle, or of blades to the hub, there may be large openings in the nacelle, hub or spinner, through which a person could fall:
  - the risks presented by different erection strategies should be assessed when selecting the approach to be taken;
  - if such openings cannot be avoided:
    - falls can be prevented by working in restraint;
    - the distance and consequences of a fall can be minimised by the use of energy absorbing lanyards if people have to work in a position from which they could fall, and
      - in order for this to be a practical solution, anchor points should be provided in suitable locations, and sharp edges on openings avoided.

The risk of falling objects is high during assembly operations; for example, the insertion of bolts into tower flange joints involves handling heavy bolts, washers and nuts directly above ladder and lift openings, which may either be partially closed by hatches, or completely open. This risk must be controlled, for example:

- provide robust temporary covers over such openings to prevent bolts from falling through, or
- provide temporary protection such as catch netting above areas where people may be working, to stop falling objects putting them at risk, or
- maintain an exclusion zone, so that no one is present in lower levels of the tower when bolts are being inserted.

3.2.3 Provision of equipment for safe work at height

The planning of construction work should aim to:

- minimise work at height, for example by maximising assembly, installation and acceptance inspections of equipment in the factory and onshore, while tower sections are horizontal and nacelles are at ground level;
- ensure that anchor points are inspected before first use – this would ideally be done onshore, working from ground level;
  - this reduces offshore inspection work, and provides safe anchor points for use during construction;
- make equipment such as lifts and permanent ladder FAS available from the earliest possible stage of installation; in any situations where this is not possible:

  - provide temporary FAS on any ladders where the permanent FAS cannot be used until a later stage of installation, and
- ensure that any necessary rescue equipment is always readily available. For example, if people are working in a part-completed tower, they will not have access to any equipment that is stored in the nacelle, which has yet to be installed, so another means of rescue should be available.

In general, the least preferred option is to install and inspect equipment offshore.

3.3 COMMISSIONING AND OPERATIONS AND MAINTENANCE (O&M)

These two phases have been grouped together, as they both take place on a structure that is mechanically complete, so the temporary hazards of work at height on incomplete structures will no longer be present.

3.3.1 Contractor/vessel selection/mobilisation requirements

During the commissioning phase, numerous access vessels are likely to be in use; during the O&M phase, there is more likely to be an established fleet at the site, but with some changeover of vessels and personnel, over time and to support peaks in demand. It is therefore important to have robust processes for vessel selection and mobilisation; key hazards to address, and recommended risk controls, are given in 4.4.6.

The criteria given in Annexes F.4.2 and F.4.3 should be applied to the selection and management of contractors, in proportion to the risk that work packages present.

3.3.2 Planning work

The planning of tasks is an opportunity to minimise the risks from work at height, by applying the hierarchy of protective measures: avoiding work at height, and where it cannot be avoided, ensuring that suitable work equipment is used by competent personnel, and identifying how to minimise the consequences of potential deviations from the planned course of events.

Early planning of foreseeable tasks that could involve work at height can allow strategies to be adopted that reduce the need to work at height, for example:

- Using alternative approaches, such as using an Unmanned Aerial Vehicle for initial inspection tasks, rather than having people working at height.
- Minimising the number of transfers and climbs, for example by:
  - making effective use of diagnostic systems, to increase the probability of faults being rectified at the first attempt, and the right spares being available, and
  - scheduling inspection work so that full use is made of each offshore visit.
- Minimising the number of different people who have to access each location by undertaking multi-skill training.
- Using the contracting strategy to reduce the number of times that work at height has to be initiated; for example, if it is known that there is some blade surface damage, a contract that allows for inspection and repair (within agreed limits) in a single visit can result in fewer set-ups than if inspection and repair are undertaken separately.

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

Potential deviations that need to be considered include:

- Where multiple activities are planned, identifying if one activity creates a falling object risk for others:
  - for example, small components or tools (such as sockets) might drop from the nacelle to a lower area, and
  - the need to make effective use of available weather windows for access should be balanced by the risks associated with working at multiple levels on a structure; where this is necessary, planning should include identifying suitable risk control measures.
- Ensuring that if a person were to be incapacitated, suitable arrangements are in place for a rescue:
  - this includes both having sufficient numbers of competent people, and all necessary equipment available;
  - the proposed rescue method must be capable of being carried out safely in any conditions under which the task would be carried out, and
  - during the O&M phase, work is more likely to be carried out by small, relatively isolated teams, so having the necessary competence in every team is essential.

The detailed planning of tasks is covered in section 5.

3.3.3 Maintenance of equipment for work at height

Directive 2009/104/EC on the use of work equipment (The EU Work Equipment Directive) provides a common baseline requirement; Article 4(2) states:

'In order to ensure that health and safety conditions are maintained and that deterioration liable to result in dangerous situations can be detected and remedied in good time, the employer shall ensure that work equipment exposed to conditions causing such deterioration is subject to:

(a) periodic inspections and, where appropriate, testing by competent persons within the meaning of national laws and/or practices;

(b) special inspections by competent persons within the meaning of national laws and/or practices each time that exceptional circumstances which are liable to jeopardise the safety of the work equipment have occurred, such as modification work, accidents, natural phenomena or prolonged periods of inactivity.'

As the Directive refers to national laws, requirements will vary between member states.

In practical terms, sustaining the safety of work at height over the lifetime of an offshore wind farm depends on certain maintenance actions being carried out:

- Access ladder fouling should be minimised by operating an effective cleaning programme, taking account of the tidal range at a site.
- Structural integrity should be assured by a risk-based inspection programme.
- All PPE, anchor points and fall arrest systems should be subject to pre-use checks (by users) and periodic inspection (by competent persons), in order to ensure that they remain in a safe condition for use.

While regulations specify certain inspection intervals, the objective of an inspection programme should always be to ensure that equipment is safe for use, which may entail more frequent inspections than would be necessary for regulatory compliance alone.

3.3.3.1 Inspection of personal fall protection equipment

Formal inspection procedures should be put in place by employers to ensure that personal fall protection equipment is subject to a detailed inspection at intervals that satisfy national regulations, and take account of the potential rate of deterioration of the equipment, considering its usage and the working environment.[5] In practice, this generally involves several levels of inspection:

- Equipment should be subjected to *detailed inspections* (which would be known as 'thorough examination' for lifting equipment) by a competent person in accordance with a predetermined regime.
- *Interim inspections* might be needed between detailed inspections in situations where the risk assessment has identified a hazard that could cause significant deterioration in the equipment, such as items that are subject to high levels of wear and tear or contamination, including the effects of the marine environment.
- Users should carry out a *pre-use check* before each use, and should have the necessary level of competence to do so.
- In all cases, damaged equipment should be taken out of service immediately.

Records of detailed and interim inspections should be kept, as required under national regulations; while there is no requirement to record the completion of pre-use checks, employers should ensure that that these vital checks are carried out effectively.

3.3.3.2 Competent person

EN 365 specifies that the competent person for periodic examination must:

- Be knowledgeable of manufacturer's current periodic examination requirements, recommendations and instructions for the specific model of component, sub-system or system.
- Be capable of identifying and assessing the significance of defects.
- Initiate the corrective action to be taken for defects and have the necessary skills and resources to do so.

Depending on the degree of complexity or innovation, or whether safety-critical knowledge is needed to conduct the examinations, this knowledge may need to take the form of training from the manufacturer or an authorised representative; such training may need periodic refreshment to take account of modifications and upgrades.

National regulations and guidance may specify requirements for the independence and impartiality of the competent person, and in particular, whether or not they are required to be from an external company. If in-house inspectors fulfil the role of competent person, then they must be sufficiently independent and impartial to allow objective decisions to be made, and have the authority to ensure that examinations are properly carried out and that the necessary recommendations arising from them are made. As a general principle, the competent person for inspection should not be the same as the person who undertakes routine maintenance, in order to ensure that a person is not inspecting their own work.

5 Practical guidance is available in HSE INDG367: *Inspecting fall arrest equipment made from webbing or rope*, although legislative references are specific to the UK.

3.3.3.3 Inspection of rescue kits

Rescue or evacuation equipment is classified as lifting equipment, and should be inspected as other equipment for work at height.[6] The default period for thorough examination (the equivalent of 'detailed inspection' for other work at height equipment) is defined in national regulations. In the UK, the default interval is six months, although – subject to a written scheme of examination drawn up by a competent person – this period might be longer, for example, if the equipment has not been used and has been stored correctly.

Equipment should in any case be inspected at least once a year; for a hermetically sealed rescue kit, the scope of the inspection may be limited to verifying the integrity of the seal, until a defined lifetime has been reached. Rescue kits should also be inspected by a competent person after use for a rescue or evacuation, and repacked in readiness for further use. Specific guidance on the scope or interval of inspections should be obtained from the manufacturer or supplier.

3.3.3.4 Inspection of anchors

Anchors may be structural or personal, single user or multi-user. If used for lifting or lowering loads, all require a thorough examination. In the UK, the default period for thorough examination of equipment and accessories used for lifting and lowering people (e.g. those used for rope access, davits or designed specifically for emergency evacuation) is six months, although – subject to a written scheme of examination drawn up by a competent person – this period might be longer, subject to risk assessment. This should take account of the frequency of usage, loading, condition and the environment; a bi-annual thorough examination is sometimes specified. It should also consider whether proof load testing at periodic intervals is required, in order to assess the integrity of the anchor. The manufacturer of the anchor device should be consulted for advice. In other cases, e.g. anchors for fall-arrest, EN 365 includes a recommendation that the periodic examination frequency for PPE shall not be less than once every 12 months.

6 Practical guidance is available in HSE INDG422 *Thorough examination of lifting equipment: A simple guide for employers*, although legislative references are specific to the UK

4 TOPIC GUIDANCE

4.1 INTRODUCTION

This section gives guidance on five topics, which were selected following analysis of G9 member incident data, priority areas of concern identified in a survey conducted by G9 representatives, and a survey of work at height training candidates undergoing recertification at heightec. Further details of this analysis are given in Annex E. Based on this work, the five topics were chosen as:

- Activity-specific topics:
  - Falling objects (see 4.3).
  - Personnel transfer between crew transfer vessels and offshore structures, by means of boat landing and ladder (see 4.4).
  - Access to working locations (see 4.5).
  - Rescue (see 4.6).
- Safe behaviour for work at height (see 4.7).

While behavioural safety is not exclusively related to work at height, it was an immediate cause of around 60 % of the incidents recorded in the G9 data, so is an essential aspect of safe work at height.

In order to avoid repetition, where training, competence and PPE requirements that are common to all of these topics have been identified, these are covered in 4.2, prior to addressing the topics listed in this section.

For each of the four activity-specific topics, the following aspects are covered:

- prerequisites for the activity;
- training and skills;
- roles and responsibilities of clients, **employers**, contractors, managers, supervisors and individuals for preparation and execution of tasks, and maintaining safety, and
- hazards at particular stages of the activity.

The recommendations given in these sections seek to apply the hierarchy of protective measures, in order to support safe work at height.

The section on behavioural safety considers:

- Fundamentals of behavioural safety: types of error, contributory factors and safety culture.
- Specific behaviours for safe work at height.

4.2 COMMON REQUIREMENTS

This section covers the training and competence requirements that are common to most activities involving offshore work at height. These relate both to those who will be directly involved in undertaking the tasks, and to those who will contract for and manage work at height. Competence is necessary in both the specific technical aspects of work at height, and the broader risk perception, communication and supervisory skills that enable safe working.

4.2.1 Training

The minimum standard for anyone undertaking work at height in the offshore wind industry is generally accepted to be:

– Global Wind Organisation (GWO) *Work at Height Training*, and
– GWO *Sea Survival Training* (SST).

The full GWO *Basic Safety Training* (BST) syllabus also covers First Aid, Manual Handling and Fire Awareness, and employers may require these modules to have been successfully completed. While this provides a common core syllabus, the GWO acknowledges that legal requirements could set higher standards in some countries, so some country-specific training may still be necessary, although this should not be significant in scope.

On sites where helicopters may be used for transfer, helicopter escape training such as the Offshore Petroleum Industry Training Organisation (OPITO) *Helicopter Underwater Escape Training* (HUET) will be required; this is also covered as one part of the OPITO *Basic Offshore Safety Induction and Emergency Training* (BOSIET).

The remit of training standards must be clearly understood, particularly where workers are moving between industries, to ensure that they cover all of the competencies required for proposed activities; some key gaps are:

– Transfer between vessels and ladders on boat landings is only covered in the GWO SST, and is not covered in HUET/BOSIET, although these training standards cover other aspects of marine safety and survival. The OPITO standard *Travel Safely by Boat* also does not cover transfer from a vessel to a ladder.
– HUET and BOSIET do not cover winching from a helicopter, so while they would be valid for transfers in which a helicopter lands on the helideck of a substation or large vessel, further training (Helicopter Hoist Operations Passenger) would be needed for winched transfers; this is generally provided by the helicopter operator.
– If personnel access a WTG by helicopter, then they should also have received the required training for vessel transfer, in case this is required for the return journey;
– Use of standard wind industry fall arrest systems on ladders (including boat landing ladders), and related rescue equipment, is only covered in the GWO WAH standard; it is not covered in BOSIET or rope access training standards such as IRATA.
– GWO WAH does not specifically cover hub access and rescue, nor entry into blades, for which additional training is likely to be needed, taking account of the variety of WTG designs and corresponding rescue methods.
– Structures such as meteorological masts may require different access and rescue techniques to be used, which are not covered in the GWO WAH standard.
– Additional training would be needed for work in confined spaces, and for confined space rescue.

The remits of, and gaps between, these standard qualifications are illustrated in Figure 6.

In addition to the standard competence training, it is essential that suitable site-specific familiarisation is provided in safe systems of work, taking account of site hazards. Having successfully completed a training course does not necessarily mean that a person will be competent in all aspects of the course content, so employers should have systems in place to develop and monitor competence, such as accompanying new personnel during their first few transfers to offshore structures.

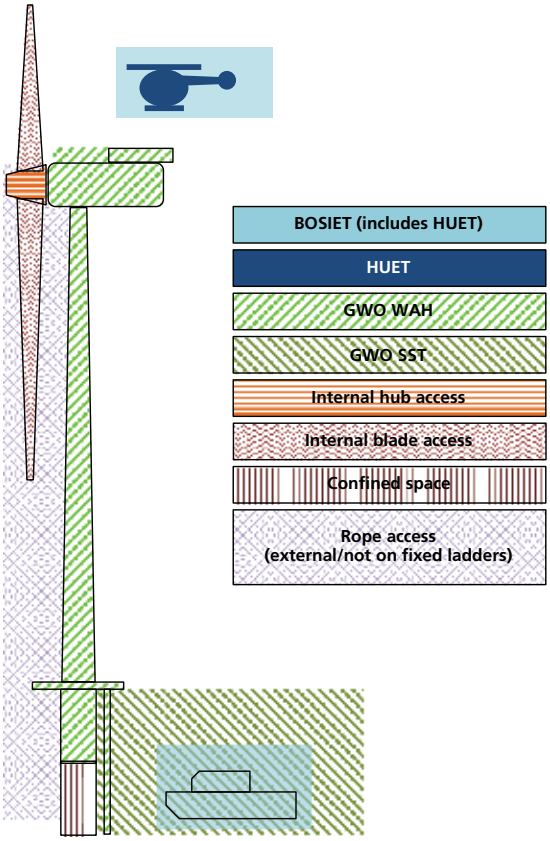


Figure 6: Permitted access zones for different training standards

The designation of the area of the foundations beneath the airtight hatch as a confined space reflects Annex 4, Part A of Directive 92/57/EEC - *Temporary or mobile construction sites*, which states that:

'*Workers must not be exposed to harmful levels of noise or to harmful external influences (e.g. gases, vapours, dust).*

. . . If workers have to enter an area where the atmosphere is liable to contain a toxic or harmful substance or to have an insufficient oxygen level or to be inflammable, the confined atmosphere must be monitored and appropriate steps taken to prevent any hazards.'

On this basis, the area of the foundations below the sealed hatch would always be a confined space, due to oxygen depletion of its atmosphere; other areas of the WTG could be confined spaces, depending on the hazards present, on a permanent or temporary basis. The specific regulations governing work in such locations may differ between EU member states. Other locations in WTGs may have restricted access, but are only considered as confined spaces if the atmosphere can present a hazard to people.

4.2.2 Fitness

All of the activities addressed in these guidelines can involve climbing vertical ladders:

– Transfer from vessels may involve a climb of about 20 m on external ladders, which are subject to marine fouling (which may increase grip strength requirements) and weather.
– If the lift in a WTG is out of service, access to the nacelle will involve an internal climb exceeding 60 – 100 m for each ascent or descent of the ladder.
– Meteorological masts have external ladders, providing no shelter from the weather, with a height of 85 – 100 m.

A good level of fitness is necessary for such activities, particularly given the remote locations involved. Further detail on fitness standards is given in Annex D. Note that even where people have a suitable level of fitness to undertake these climbs without undue difficulty, there may be long-term musculoskeletal effects from regular climbing of vertical ladders, so lifts should be the normal means of access between levels in a tower, with the ladder only being used in exceptional circumstances.

4.2.3 Use of anchors

Whenever personal fall protection equipment is to be used, it is essential that it is attached to suitable anchors. The order of preference for the selection and use of anchors can be summarised as:

1. Design provides suitable anchors, in terms of their strength and location. These could either be dedicated anchor points (to EN 795/CEN TS 16415 etc.) or designated structural anchors.
2. Method statement considers the needs for anchoring, and identifies any other structural anchors that are needed (both for the task being planned and potential rescues); a competent person then verifies the strength of these anchors. This verification may include carrying out calculations, inspection and/or testing as required, taking account of the potential direction of load. Other factors affecting their suitability, such as the presence of edges that could damage lanyards or ropes, should also be assessed.
3. If people are to make judgements about anchor points while carrying out a task, this must be within the limits of their training and competence, and recorded. For example, rope access technicians may have various levels of training in the identification of suitable anchors, including how to set up a system that equalises the load on multiple anchors and provides double protection, but other personnel may not have the necessary competence to make such judgements.

4.2.4 Competence for specific roles

In order for work at height to be undertaken safely, it is important that all parties involved in contracting, organising, planning, managing and supervising the work, have sufficient competence to fulfil their role.[7]

4.2.4.1 Contracting for work at height

Any **Employer** that appoints contractors to undertake work at height will influence the safety of the work. The precise legal duties on the **Employer** depend on which EU member state the work is taking place in, and whether or not the work is being carried out as part of a construction project. However, in order to ensure that the work is done safely, the **Employer** should:

7 The approach outlined in this section is based on the Advisory Committee for Roofsafety *Guidance Note for competence and general fitness requirements to work on roofs,* ACR (CP) 005: 2012, with modification.

- Provide accurate information on the scope of work, the structure and location where it will take place, and any hazards that a competent contractor might not be expected to be aware of.
- Select a competent contractor.
- Ensure that safe systems of work are in operation, within which the work at height will be undertaken; depending on the situation, this may involve:
  - reviewing how contractors propose to manage the work;
  - managing the site where the work will take place;
  - periodic auditing of contractors, to ensure compliance with agreed procedures;
  - monitoring contractors' working practices, by carrying out safety inspections, and
- Ensure that the structure is maintained in a condition that allows safe work at height, for example ensuring the integrity of collective safeguards (such as guardrails) and equipment such as anchor points.

In order to be able to select competent contractors and review proposed methods, the **Employer** needs to have sufficient understanding of how the work should be undertaken. For specialised tasks, such as rope access work, the **Employer** may need to obtain assistance from advisers with recognised competence in such activities.

4.2.4.2 Organising, planning and managing offshore work at height

The key competencies that are needed are:

- Undertaking suitable and sufficient risk assessments, to identify hazards and necessary precautions;
  - the level of risk will inform the choice of control measures from the different levels on the hierarchy of protective measures.
- Selection of suitable techniques and work equipment, both for access and rescue;
  - this selection should apply the hierarchy of fall protection.
- Preparation of method statements and rescue plans, and integration with site Emergency Response Plans.
- Understanding of relevant legislative requirements.
- Understanding of the additional challenges that offshore work imposes, such as increased remoteness, effects of weather and sea conditions, limited access, and restricted space.

Management should also select suitable teams to undertake the work, taking account of the level of risk that the work presents, and different levels of competence. The planning of work should avoid creating situations in which time pressure could affect safe working; therefore, the progress of tasks should be monitored by working parties and their supervisors to ensure that sufficient time is available, with respect to constraints such as weather windows, hours of daylight and availability of crew transfer vessels.

The competence to carry out these activities will only come from having breadth and depth of experience in undertaking the activities being considered in the offshore setting, together with suitable training in safety management, and being up to date with current techniques and regulations.

4.2.4.3 Supervising work at height

While a work package is in progress, supervisors are responsible for:

- ensuring that safety management arrangements are in place for the complete scope of work that is to be undertaken by their teams;
- carrying out pre-work checks to ensure that the correct work equipment is available, including provision of spares/replacements if necessary;
- carrying out effective pre-work briefings and toolbox talks, to provide information, set expectations and check understanding of hazards, risk controls and safe systems of work;
- ensuring that work is undertaken in a safe manner and that site rules are being followed, and
- monitoring conditions in the workplace, so as to ensure that housekeeping is of a good standard.

In the offshore wind industry, most workers operate in small self-managed workgroups, with either remote or occasional direct supervision, especially in the O&M phase. Any such workgroup must therefore have sufficient competence and supervisory skills to allow them to manage their work safely. Teams will need to:

- understand the duties that relevant legislation imposes on their work;
- be competent in their tasks, and have a clear understanding of the agreed methods or procedures;
- have an appropriate level of risk-awareness to be able to identify dangerous situations and working practices in the tasks that they are to undertake, and stop the task or take other steps to re-establish safe working, and
- understand the risk assessment and method statement for the work, and ensure that the precautions are implemented effectively and are sufficient for the actual situation faced.

Carrying out these responsibilities will need good communication skills, both to manage the team undertaking the task, and interfaces with clients and other work parties affected. Employers therefore need to:

- provide training for lead technicians that goes beyond technical and functional knowledge for work at height, and develops the supervisory/leadership competencies listed;
- consider the level of risk that a task presents, and decide if it is within the capability of a particular team, and whether additional safety management support may be needed for specific tasks;
- ensure that an effective process is operated for controlling any changes that occur on site, for example by reviewing risk assessments, updating method statements, and communicating changes to all personnel involved in the works, and
- operate an effective induction process for people who are new to a site, with further care being taken to ensure the safety of people who are new to the industry.

4.2.5 Work at height on vessels

Work at height on vessels is subject to the requirements of the same EU directive[8] as work at height on land or on fixed structures, so similar standards should be maintained, even if the work is being undertaken by the crew of the vessel, under the direction of the Master, in the course of normal ship-board activities.

8 Directive 2009/104/EC*: Minimum health and safety requirements for the use of work equipment by workers at work*, Annex 2, Section 4.

Employers should set clear expectations for the standards of safety that are expected in relation to work at height on vessels, and ensure that all personnel involved have suitable training and competence for the tasks that they are expected to undertake. Unless specific training is provided, and competence demonstrated, vessel crew should not be expected to transfer to offshore structures, participate in rescues on these structures, or become involved in the operation of SRLs or other FASs for transfer. Access arrangements to vessels in ports should also be assessed, to ensure that technicians and crew all have safe means of vessel access and rescue available.

4.2.6 PPE

These guidelines assume that all personnel involved in work at height will have the following PPE available as a minimum, and be competent in its use:

- full body harness (in accordance with EN 361 *Personal protective equipment against falls from a height. Full body harnesses*) with work positioning belt and lanyard (in accordance with EN 358 *Personal protective equipment for work positioning and prevention of falls from a height. Belts for work positioning and restraint and work positioning lanyards*);
- energy absorbing lanyards with energy absorber (in accordance with EN 354 *Personal fall protection equipment. Lanyards* and EN 355 *Personal protective equipment against falls from a height. Energy absorbers*);
- fall arrest slider (EN 353-1 *Personal fall protection equipment. Guided type fall arresters including an anchor line. Guided type fall arresters including a rigid anchor line*) compatible with the fixed rail/wire installed in the tower, and
- safety helmet (see Table 16 in Annex C for details of the different safety helmet standards).

The standards listed above are briefly summarised in Table 15 in Annex C.

Note that energy absorbing lanyards can have either stretchable energy absorbing webbing, or separate energy absorbing element(s); compatibility with the rescue kits on a site should be checked (see 4.6.1.1).

Additional PPE will be needed for specific activities, or to protect from other workplace hazards, not related to work at height. Selection, care and inspection of PPE should take account of the potential for accelerated degradation in the offshore environment.

4.2.6.1 Appropriate use of energy absorbing lanyards

Some types of energy absorbing lanyard can be used to provide work restraint (only if this is specified in the instructions for use); the user should always be aware of the lanyard's extended length, in order to prevent them reaching a position from which they could fall. Energy absorbing lanyards should not be used as a deliberate means of suspension – for example, they should not be used in a situation where a work positioning lanyard should be used to support the user.

Note that EN 363 *Personal fall protection equipment. Personal fall protection systems* defines a restraint system as being a system that restricts the movement of the user, so that they are prevented from reaching areas where a fall from a height could occur; such a system is not intended to arrest a fall from a height, nor is it intended for work in situations where the user needs support from the body holding device (e.g. to prevent them from slipping or falling).

4.3 FALLING OBJECTS

This section covers any activities that may present a risk of an object falling.

The Dropped Objects Prevention Scheme (DROPS)[9] has been active in the oil and gas industry since 1999, and is an industry-wide initiative focused on preventing falling objects; it comprises over 100 operators, contractors, service companies and industry bodies. Their guidance recognises two types of falling object, namely:

- Static – any object that falls from its previous static position under its own weight, such as a light fitting that drops due to fasteners coming loose over time.
- Dynamic – any object that falls from its previous static position due to force applied by a person/equipment/machinery or moving object, such as an object being knocked off a platform, and falling to a level below.

The methods used to manage the risk of falling objects differ depending on whether they are static or dynamic. When preventing static objects from falling, the focus is on engineering controls, such as securing devices or catch nets. The prevention of dynamic falling objects involves the use of work equipment such as tool lanyards, supported by procedures and rules designed to highlight the hazards to the workforce and instruct them how to minimise the potential for objects to fall.

This section covers:

- the principles of effective falling object risk management;
- supervisory/working arrangements, and the responsibilities of the different parties involved;
- interactions of PPE and falling object risk, and
- specific falling object hazards in the course of different activities, and suggested methods of risk reduction.

4.3.1 Falling object risk management

The risk presented by falling objects can be managed by applying a hierarchy of controls, as shown in Figure 7, with the level of protection reducing as the lower levels are reached.

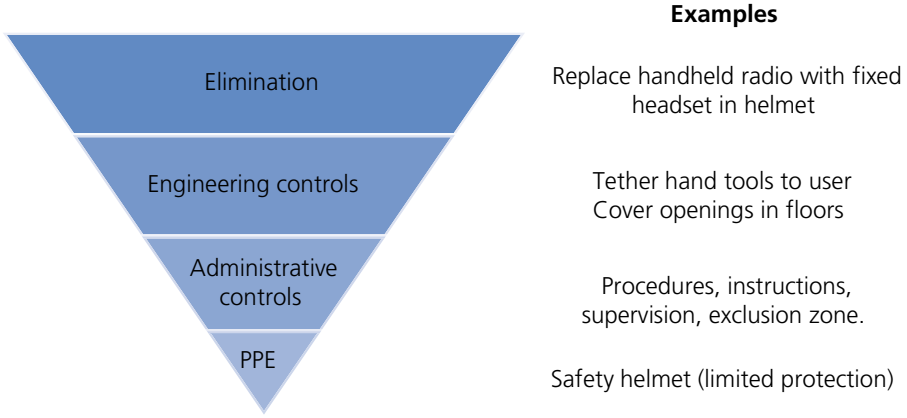


Figure 7: Hierarchy of controls for falling objects

9 See http://www.dropsonline.org for further information and detailed advice on falling object prevention.

4.3.1.1 Elimination

The complete elimination of a hazard should always be the preferred option, and is most effectively achieved during the design phase. Designers should use hazard identification and risk assessment to identify areas where falling object hazards may arise over the lifetime of a structure, and aim to eliminate these hazards where possible; for example, openings where cables or access routes pass through platforms can also provide opportunity for objects to fall through, while the detail design of platforms and hatches can eliminate the risk of objects falling through openings.

4.3.1.2 Engineering controls

If falling object hazards cannot be eliminated, engineering controls are the preferred approach to risk reduction. This method involves the use of equipment to reduce the potential for objects to fall, or to reduce the risk if an object does fall. Examples of engineering controls include:

- tools being transported in securely closed containers, particularly when being lifted between levels;
- lightweight hand tools, communication equipment and PPE being tethered to the user;
- heavier tools and components being tethered to the structure if work has to be done in a location where the component could easily drop, such as on a meteorological mast;
- temporary covers being placed over openings, and
- using safety netting (to EN 1263-1 *Safety nets. Safety requirements, test methods*, and EN 1263-2 *Safety nets. Safety requirements for the positioning limits*, with fine mesh overlay) to catch tools or equipment that cannot be tethered, such as fasteners.

Note that while a range of different types of tool lanyard is available, they are not PPE and there are no applicable performance or testing standards; the combination of these factors means that they cannot be CE marked. Users should therefore assess the forces that may be exerted on a lanyard, taking account of the weight of the object being retained, and the situation in which it is to be used.

4.3.1.3 Administrative controls

Administrative controls, sometimes also referred to as 'procedural controls', involve:

- providing information and warnings to the workforce about hazards that are present;
- providing instruction on how to carry out the work safely;
- providing supervision to ensure that the procedures are being followed, and
- establishing management processes that define how reported observations/incidents are to be investigated, and the lessons learned implemented to prevent recurrence in both the short- and long- term.

Administrative controls to protect against falling objects typically consist of:

- warning signs, to highlight hazards to the workforce;
- planning of activities, to avoid situations where work is simultaneously being carried out at multiple levels on a structure, and
- exclusion zones being established below areas where people are working.

These controls should be used in conjunction with the other controls on the hierarchy.

4.3.1.4 PPE

The focus of a hierarchy of control is always the prevention of the incident occurring in the first place. However, if the control measure fails and an object falls, the last method of protecting the employee is PPE. As outlined in 4.3.3, safety helmets only provide very limited protection, due to the high level of kinetic energy that an object, falling from typical wind industry working heights, will possess.

4.3.2 Supervisory/working arrangements

In addition to the general responsibilities outlined in 4.2.4.2 and 4.2.4.3, other specific risk controls can reduce the risk from falling objects.

4.3.2.1 Employer's responsibilities

When selecting contractors or personnel to undertake work at height, in addition to assessing general health and safety management, the **Employer** should specifically assess how the contractor manages falling object risk. This assessment could consider:

- Contractors' procedures for work at height, to identify the standards that they set for falling object risk management, such as:
  - provision and use of tool lanyards, catch-nets and other work equipment;
  - management of work, to ensure that exclusion zones are set up and enforced as necessary, and
  - training of personnel, to ensure a suitable level of falling object risk awareness.
- Evidence of falling object incidents and hazardous observations being reported:
  - Is the level of reporting plausible, given the hours worked at height?
  - What is the ratio of numbers of hazardous observations to incidents?
  - Have appropriate actions been identified and implemented?

Once work is in progress, the **Employer** should monitor the management of falling object risk when undertaking site safety tours/inspections.

4.3.2.2 Roles of contractors

Contractors should:

- plan work to minimise situations where work is carried out simultaneously at multiple levels on a structure;
- ensure that work is carried out with an appropriate combination of competent staff and effective supervision, and
- ensure that all staff have a suitable level of awareness of the hazard presented by falling objects;

Planning of all work should ensure that suitable work equipment is provided to, and properly used by, all personnel; particular attention should be given to:

- Selection of work equipment to eliminate the potential for objects to fall, for example:
  - provision of communications equipment that avoids the need for handheld radios;
  - provision of lanyards for hand tools and portable power tools;
  - provision of tools to which lanyards can be attached, and suitable bags for safe lifting of tools/components;
  - prevention of small/loose objects, such as fasteners and sockets, from falling;
  - if work clothes have pockets, then these should be capable of being securely closed, including while wearing a harness; items should not be kept in pockets over which load-bearing harness straps pass;

– ensuring that working practices minimise falling object risk, including maintaining a high standard of workplace housekeeping, and operating systems to check that all tools and components have been removed from, or secured in, the work area prior to completion of the task, and
– operating effective processes for reporting, investigating and learning from hazardous observations and incidents involving falling objects, and developing a culture in which reporting is encouraged.

The contractor has the primary responsibility for the safe execution of the works in their scope, so should ensure that there is adequate monitoring of the effectiveness of falling object risk management.

4.3.2.3 Roles of supervisors

With respect to falling objects, supervisors should monitor the workplace to ensure that work equipment is being used properly, housekeeping is of a good standard, and that the overall risk is being managed effectively.

4.3.3 PPE and falling objects

The selection of PPE for working at height must be based on its suitability for the intended task, the characteristics of the user and the working environment.

PPE should minimise risk of an object falling:
– PPE should be designed and used so that it does not introduce a falling object hazard, such as fall arrest sliders dropping down ladders when being disconnected from the rail.
– PPE should help to minimise the risk of other objects being dropped, for example, gloves may have to satisfy several different requirements, such as:
  – providing protection from any identified hazards;
  – being resilient to the working environment, and
  – providing a level of dexterity that is suitable for the use of fall-protection equipment, hand tools and tool tethers.

Note that these requirements may be difficult to meet with one pair of gloves, so it may be necessary to provide the workforce with multiple types of glove, so that workers can change into more suitable hand protection if required.

In the case of falling objects, PPE can only provide very limited protection. The shock absorption test requirements for a safety helmet in accordance with EN 397 *Industrial safety helmets* would be exceeded by a tower flange bolt falling about 2,5 m, which would also result in a force of up to 5 kN being exerted through the helmet onto the wearer. The helmet could also fail due to penetration. Further, a safety helmet only protects the head, so other areas of the body are completely unprotected from falling objects, and serious injuries could easily be suffered.

4.3.4 Hazards during specific activities

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

Table 1: Falling object hazards

Activity	Hazard	Recommended risk control	Basis of recommendations
Transferring from vessel and accessing place of work	Tools/ equipment falling from person climbing ladder	**Prevention:** – All equipment should be lifted onto the structure via crane if available – All PPE must be suitable for working at height e.g. capable of being fastened to the wearer – No loose items of work equipment to be carried by employee when climbing e.g. mobile phones should be carried in a case/bag, attached to the climber by a lanyard, or in a securely closed pocket – If lifting loads with a manual rope/pulley system, use suitable work equipment to ensure that the load will not drop if the operator lets go of the rope	
		Mitigation: – Only one climber to be on each ladder at any time – Helmet to be worn at all times – Exclusion zone to be maintained beneath lifting operations, noting that falling objects may be deflected as they fall, and present a hazard to a wider area than the lift path alone – Slew crane so that the load is only above the vessel for the lowest part of the lift, when it needs to pass below the level of the deck guardrails	
Lifting equipment onto structure	Tools or equipment falling from unsuitable or unsecured containers	**Prevention:** All loose items should be lifted in securely closed containers	
		Mitigation: Maintain exclusion zone below lifting activities, recognising that objects may fall at an angle from vertical	

Table 1: Falling object hazards (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Lifting equipment onto structure continued...	Failure of lifting equipment, or load becoming detached during lift	**Prevention:** – All lifts should be correctly planned and supervised by a competent person; the lifting plan should take account of: – Safe Working Load (SWL) of all lifting equipment, (i.e. Working Load Limit (WLL), adjusted for any de-rating as a consequence of its configuration or conditions of use) – Weight, dimensions and centre of gravity of the load – Requirements for, and provision of, work equipment such as lifting bags – Any obstacles that may be on the load path (which could catch on the load, and either fall or cause parts of the load to fall) – All slinging of loads to be carried out by trained and competent persons; – Use positive attachment (e.g. lifting eyes) rather than running slings under the body of a load – Use tag lines to guide load away from obstructions – All lifting equipment must undergo pre-use check by user, and periodic thorough examinations	
	Unsuitable environmental conditions	**Prevention:** – Restrict lifting operations to suitable wind speeds/sea states – check forecast in advance. Task-specific limits are determined by crane curve and vessel capability.	
Carrying out works at height on/ in offshore structures	Dropping of tools, equipment and components when carrying out work	**Prevention:** – All contractors should undergo a robust competence assessment process prior to selection; the assessment should include examples of good working practices and safe working procedures – The contractor's proposed method of work should be reviewed by a competent person and be accepted or rejected prior to work beginning – Periodic auditing of the contractor should be carried out to ensure that work practices match the submitted method of work – Plans for work should be reviewed in advance, to identify if any task could create a falling object hazard that affects other planned activities – Suitable supervision should be in place in order to identify and stop potentially unsafe work practices – Hand tools should be tethered to the user, at any time that they are not stored in a suitable closed container – Heavy tools should be tethered to the structure	

Table 1: Falling object hazards (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Carrying out works at height on/ in offshore structures continued...	Errors in assembly, or use of incorrect components could lead to failure	**Prevention:** – Quality management should ensure that the correct components and fasteners are used – Accurate procedures and technical information should be provided to technicians undertaking assembly/maintenance tasks	
	Voids in the structure which work equipment or components can fall through	**Prevention:** – Modularity of design, design for maintenance, trays under machinery – Use secondary attachment of components during renewal/maintenance – Use temporary covers/nets to prevent parts dropping through voids – Organise work area and maintain housekeeping standards to ensure that there are no loose items near voids	
		Mitigation: – Establish exclusion zones beneath work if there is a residual risk of falling objects	
	Components becoming loose due to failure of mountings	**Prevention:** – Witness marks should be applied to confirm fasteners have been tightened – Use secondary attachment of components in high-risk areas, such as above boat landings – Monitor condition of component mountings as part of routine maintenance schedule, and repair/replace as necessary	

4.4 TRANSFER BETWEEN VESSELS AND OFFSHORE STRUCTURES

This section covers personnel transfer from the deck of a crew transfer vessel to the external platform on the transition piece (TP) or equivalent position on other types of offshore structure. It is assumed that this transfer involves stepping from the vessel onto a vertical (or near vertical) boat landing ladder, then climbing to the external platform on the offshore structure, with the operation being reversed for transfer back to the vessel. This section is also applicable to transfers by this method between a crew transfer vessel and a jack-up barge or wind farm installation vessel that is supported on its legs, but does not address the additional complexity that should be considered in transfers to or from a floating vessel, such as a hotel ship.

Falling objects during transfer are considered in 4.3.

4.4.1 Task-specific PPE requirements

This section describes the functional requirements for task-specific PPE, which is additional to the common PPE described in 4.2.6; more detail on relevant standards is given in Annex C.

4.4.1.1 Protection against drowning: lifejacket and immersion suit

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, through a combination of preventive measures in boat landing design, vessel selection, operating procedures, training and competence.

As transfer involves moving around on the deck of a vessel, and stepping over water, a lifejacket should be worn, providing at least 275 N of buoyancy – note that 150 N lifejackets do not prevent casualties being submerged in 1,2 m near-breaking waves[10], which are within normal offshore wind transfer conditions. Lifejackets with automatic inflation are generally used; hydrostatic triggering of inflation avoids the potential for unintentional inflation, which can occur due to moisture ingress on lifejackets that are simply triggered by the presence of water. (Note that lifejackets for use in helicopters must not inflate automatically, so this can affect PPE provision on sites that use both vessel and helicopter access.)

Where the preventive measures leave a significant residual risk of a person falling into the sea, immersion suits may be necessary, particularly in cold water and rough sea conditions. This decision should be based on risk assessment, considering:

- Probability of falling into the sea, which is affected by:
  - detail design of vessel bow – suitable guardrails and anchor points;
  - condition of the deck and ladder surfaces;
  - sea state – rougher seas increase the risk of sudden vessel movement, and the direction of the wind and waves can also affect their effect on the vessel;
  - capability of the vessel to maintain its position against the bumper bars in the prevailing sea state, and
  - interface between vessel and boat landing.
- Sea temperature:
  - low sea temperatures reduce the casualty's survival time.
- Sea state: rougher seas will:
  - increase the probability of falling into the sea, if the vessel starts to move relative to the structure;

10 HSE Offshore Technology Report OTO 95 038 – *Review of probable survival times for immersion in the North Sea*, p12.

  - increase the time to recover the casualty, and
  - reduce the casualty's survival time.
- Ability to recover the casualty from the water, which is affected by:
  - vessel(s) and crew performance in prevailing sea conditions, and
  - position of the casualty: if the waves take them between the hulls of a catamaran, or inside the framework of a jacket foundation, then the risk to the casualty is increased, and recovery may be delayed.

A range of types of immersion suit is available, to protect against different hazards; in particular, different levels of thermal insulation are available. If a person falls into the sea during transfer between a vessel and an offshore structure, then it should be the case that:

- a highly-manoeuvrable crew transfer vessel is present;
- the crew and passengers are trained and competent in their roles in Man Overboard (MOB) recovery in the prevailing sea conditions, and
- it is immediately known that a person is overboard; therefore
- the rescue time should be short (significantly less than 30 minutes).

If these conditions are met, then the main risk to people falling into the sea would come from cold shock and water inhalation (which can lead to drowning within minutes of immersion) rather than hypothermia (which has a slower onset). Therefore, if an immersion suit is to be worn for transfer, it would only need to keep the casualty's body and clothing dry, rather than having to provide protection against gradual cooling, which could result in hypothermia during a long period of immersion (such as could occur from a helicopter ditching). An insulated immersion suit would therefore be unnecessary[11],[12]. Further, as the immersion suit is to be used for climbing, the restricted movement or reduced dexterity of an insulated suit could increase the risk of falling.

Decisions about the wearing of immersion suits, and the type to be used, must be based on detailed risk assessment, considering all relevant factors. An illustration of this is given in Table 2, but should not be taken as being exhaustive.

11 The Danish Maritime Authority (DMA) specifies that '*In Danish ships, immersion suits shall be of a type with built-in insulation and buoyancy*' This conflicts with the UK Maritime & Coastguard Agency (MCA) *Workboat Code* (section 13.5.3), which specifically permits non-insulated immersion suits. National regulations must be complied with.

12 IMCA SEL 025 *Guidance on the transfer of personnel to and from offshore vessels and structures* states 'It is not possible to accurately establish at what water temperature cold water shock occurs to a person who unexpectedly enters the water. Some experts state that this can occur at a water temperature of below 10 °C, others say it can happen when the water temperature is below 15 °C. Clearly there is no consensus. As there are a number of physiological factors that can influence cold water shock, it is difficult to define a set temperature. Thus it is recommended that an assessment of the risks associated with the work activity is undertaken, including, for example; sea state, current, weather, height of transfer, vessel type, fitness of person being transferred, estimated time to recover the person from the water, etc. to identify the correct PPE (thermal protection) required, to ensure the safety of the person, should they fall in the water.'

Table 2: Factors influencing decisions about wearing of immersion suits for transfer

Note: this table is not a risk assessment, and the values (particularly for sea temperature) are not absolute. Clear decision-making criteria should be established, taking account of these and other relevant factors. It is the combination of different factors, rather than any one factor in isolation, that determines the risk to people, and selection of PPE.

Risk factor	**Condition**		
Sea temperature	Benign e.g. >15 °C	Cold (e.g. <15 °C)	Cold (e.g. <15 °C)
Sea state	Calm/smooth	Moderate – approaching limits for transfer	Moderate – approaching limits for transfer
Light	Daylight	Daylight	Poor/dark
Visibility	Good	Good	Limited
Current/wind	Minimal, will not cause casualty to drift	Some effect – casualty may drift slowly	May cause casualty to drift significantly
Vessel capability	Highly manoeuvrable	Highly manoeuvrable	Limited vessel manoeuvrability
Other vessels	Present nearby, could assist	In area, could come to assist	May take some time to respond
Expected casualty recovery time	Very quick – a few minutes	Quick – definitely within 30 minutes	Potential for delay
Likely outcome:	**Immersion suit may not be required**	**Lightweight immersion suit required**	**Insulated immersion suit required**

Suitable clothing and PPE for transfer should include:

- If an immersion suit is to be worn, then it should be lightweight and flexible;
  - it is extremely important that the harness can still be properly adjusted – slack leg loops can cause injury in the event of a fall, and
  - the collar of the suit should not prevent the climber from looking up, when wearing a helmet.
- Gloves should provide good grip on wet/slippery ladder, protect hands, maintain dexterity for attaching to/detaching from FAS, and not be degraded by salt water;
  - the integrated gloves on some immersion suits are unsuitable for ladder climbing and use of FAS.
- Footwear should be well-fitted, with good grip:
  - bulky integrated boots may impede climbing;
  - thick integrated waterproof socks, worn inside normal safety boots, 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 boots.
- Clothes worn under the immersion suit should provide sufficient insulation for prevailing weather conditions, given that the immersion suit itself is not insulated.

The combination of immersion suit and lifejacket must be compatible with each other:

- The buoyancy of an immersion suit will tend to raise the wearer's legs, giving a horizontal position in the water, thereby reducing the clearance of the casualty's face above the water, and increasing the risk of drowning by water inhalation.
- The supplier of the immersion suit/lifejacket should certify their compatibility against a recognised test protocol.[13]

The immersion suit and lifejacket should also be compatible with the harness, such as ensuring that the attachment point is still accessible.

4.4.1.2 Protection against drowning: casualty location

A Personal Locator Beacon (PLB) and light should be attached to the lifejacket, so that they are accessible and visible if a casualty is in the water:

- The mounting of the PLB must not impede the inflation of the lifejacket.
- The mounting position should ensure that the full signal range from the PLB antenna is achieved.
- Mounting the PLB on the lifejacket, rather than the immersion suit, ensures that:
  - the PLB is always in the same position on the casualty, irrespective of whether an immersion suit is being used, and
  - the inflated lifejacket does not obstruct the casualty's access to the PLB in order to activate it manually.

PLBs emit a homing signal on 121,5 MHz to guide rescuers to the casualty's location, and may also transmit ID and location information on 406MHz to the COPSAS – SARSAT satellite network, which will alert emergency services, who will broadcast emergency information to vessels and activate emergency response resources such as Search and Rescue (SAR).

An alternative to PLBs is the use of Personal Automatic Identification System (AIS) beacons: these transmit the casualty's location and identity number, which will be displayed as a Search and Rescue Transponder (SART) icon on AIS-enabled chart plotters, on any vessel within a range of about four miles. These do not alert SAR authorities.

Both types are effective, but depend upon compatible equipment being present on the vessel, emergency signals being monitored, and all units being properly maintained. The standard should be established at a project (or higher) level, so that all vessels and people on a site have compatible equipment. Tests should be carried out to verify the range that is achieved by a particular combination of PLB and receiver on vessels, also allowing for the effect of different sea states.

4.4.2 Fitness requirements

Transfer may involve climbing heights of around 20 m on vertical ladders, possibly under some heat stress when wearing an immersion suit on a warm or sunny day (but when the sea temperature is still low); the effects of motion sickness may increase the challenge of this activity.

13 HSE Offshore Technology Report 2002/021: *Compatibility test protocol for lifejackets and immersion suits on offshore installations*

4.4.3 Protection against falling: SRL on boat landing ladder

Table 3 considers how to protect people against falling during transfers between vessels and boat landing ladders. Attachment to an SRL before stepping from the vessel to the ladder, and remaining attached while stepping from the ladder to the vessel, can ensure that people do not fall into the sea. However, there are concerns about how SRLs interact with heaving vessels, as this can lead to people being 'picked up' if the vessel suddenly moves down. Continuous attachment during transfer is only appropriate if the following conditions are satisfied:

- Transfer is taking place in suitable conditions, defined as:
  - vessel is holding steady position against boat landing;
  - speed and distance of any movement should be much less than SRL lock-on limits;
    - when selecting an SRL, the specifier should identify the range and speed of vessel movement that will be within acceptable limits for transfer procedure, and ensure that the SRL will not lock on within these limits; this may involve obtaining information on lock-on characteristics from the SRL manufacturer, and
    - data on the speed and range of bow movement can be captured using accelerometers, in order to quantify the demands on the SRL.
- Vessel and ladder/boat landing must be compatible, i.e. sufficient safety zone to prevent crushing (See Figure 4 in section 3).
- Design and operation of SRL should allow for limited vessel movement without activation;
  - if an operating procedure is proposed that involves manually introducing slack into the system, then this should be checked with the SRL manufacturer, to ensure that it does not create a fall factor beyond the energy absorption capacity of the SRL.
- Connector between SRL and harness should enable easy connection/removal, while wearing gloves;
  - this minimises the time during which a person is connected to the SRL, while still on the vessel.

If it is proposed to undertake transfers in conditions that are not suitable (on the basis of the definition given), then the decision should be based on risk assessment, noting that the sea conditions that are impeding use of the SRL will also:

- increase the probability of falling into the sea;
- increase the recovery time of the casualty, and
- reduce the survival time of the casualty.

4.4.4 Supervisory/working arrangements

4.4.4.1 Responsibilities of clients and vessel charterers

The **Client** will generally be responsible for the design/specification of boat landing structures. As the boat landing interfaces with the vessel, relevant information on its design needs to be communicated to any party who will be selecting and chartering crew transfer vessels, to ensure compatibility in terms of factors such as bow profile, bow height, and imposed loadings on bumper bars (both in planned operation and foreseeable potential impacts).

At a site level, suitable systems need to be in place for personnel tracking and marine coordination; the responsibility for this will be determined by the contractual arrangements at the relevant stage of project development.

4.4.4.2 Roles of supervisors, vessel master, deckhand and passengers

In addition to their general responsibilities for the safety of their teams, when transfer operations are taking place, supervisors should specifically ensure that PPE 'buddy checks' are carried out.

The vessel Master has overall responsibility for safety of the vessel and all personnel aboard; specific duties generally include:

- ensuring that vessel safety briefings are carried out;
- safe navigation of the vessel;
- carrying out communications check with the platform party before or immediately after transfer to structure;
- establishing safe positioning of the vessel against the boat landing;
- authorising transfer, based on stable positioning of vessel, and
- maintaining weather watch, and notifying the marine coordinator/working parties of how this can affect offshore work.

The Deckhand has a key role on crew transfer vessels, with responsibilities generally including:

- Ensuring the safety of passengers on board the vessel and during transfers, including carrying out induction/briefings and managing the movement of passengers between areas of the vessel.
- When a climber is descending ladder to vessel, the Deckhand counts down the remaining rungs and tells the climber when to step back onto the vessel.
- Assisting the climber back onto the vessel.
- Should the site procedure assign any other responsibilities to the Deckhand, then training and competence assessment in these tasks will be necessary, and the responsibility interfaces will have to be agreed between the different employers involved. Typical activities at this interface include:
  - confirming that climbers' PPE is correctly fitted for transfer;
  - carrying out pre-use checks on the ladder SRL;
  - pulling down the SRL and attaching it to climbers;
  - assisting with disconnection from the SRL, and
  - 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.

As can be seen from the above list, the Deckhand may have many important and simultaneous responsibilities; these must be realistic, to avoid creating overload. The responsibilities of the Master and Deckhand must be clear and appropriate, particularly as:

- The Master is in a position to see the coming waves, and predict how the vessel *is about to move*, whereas the Deckhand is more likely only to be seeing *how the vessel is moving*, which may be too late for giving correct instructions to climbers.
- The Master has access to the vessel PA system, so may be able to communicate to the climber more effectively than the Deckhand, even though the Deckhand is closer.

Passengers also have specific responsibilities, including:

- compliance with vessel safety policies and instructions;
- wearing correct PPE, ensuring that it is properly fitted, within its inspection date and in good condition;

- carrying out 'buddy checks' prior to transfer;
- confirming correct operation of ladder FAS;
- deciding if transfer is within personal capabilities, at the time of transfer, and communicating this decision, and
- transferring without delay onto ladder, once attached to FAS.

4.4.4.3 Procedural arrangements

Clear decision criteria must be in place for conditions under which transfer can take place. This is not as simple as setting a wave height limit; other important variables are:

- the wave direction (relative to the vessel);
- vessel performance – different vessels may have different levels of movement in similar conditions, and
- the condition of the ladder, especially the level of contamination or presence of ice, which can affect the ease of climbing.

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

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

When reviewing decisions about whether conditions were suitable for transfer, or investigating incidents that occurred 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.

4.4.5 Training and skills

4.4.5.1 Standard qualifications

The common basic qualifications/training standards for work on offshore wind farms are summarised in 4.2.1.

As can be seen from the responsibilities outlined in 4.4.4.2, the Master and Deckhand have key roles in enabling safe transfer. While there are recognised qualifications for Masters and Deckhands/crew, and some of the qualifications are specific to workboat personnel and typical workboat operations, there are no recognised assessment criteria relating to transfer of personnel onto offshore structures. In the absence of such qualifications, **Employers** will have to conduct their own assessment of competence.

4.4.5.2 Site-specific requirements

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

- Training in detailed transfer procedure – take account of vessel/ladder/FAS interfaces.
- Training for Deckhand and Master: roles in procedure, use of FAS and roles in ladder rescue situation.

- Man Over Board (MOB) training for Master, Deckhand and WTG personnel (if vessel crew is just Master and Deckhand, then the WTG personnel may need to assist in any rescue of the Deckhand):
  - Regular practice should be carried out – including:
    - practice in darkness if transfers are ever carried out in the dark;
    - practice in realistic sea conditions, at the limit allowed for transfer;
    - utilising MOB tracking systems as well as visual contact, and
- Training in site emergency arrangements.

4.4.6 Hazards during specific activities

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

Table 3: Hazards during transfers

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

* IMO *Guidance on wearing immersion suits in totally enclosed lifeboats* (Annex A in MCA MGN 396 (M+F) *Compatibility of Life-Saving Equipment)*

Table 3: Hazards during transfers (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Transfer from vessel to boat landing ladder continued...	Fall into sea, between vessel and boat landing ladder continued...	**Prevention:** – Attach to SRL before stepping off vessel	Recommendation to attach to SRL before stepping off vessel is based on: – Transfer taking place in suitable conditions – vessel holding steady position against boat landing – speed and distance of any movement should be much less than SRL lock-on limits; – Vessel and ladder/boat landing are compatible, i.e. sufficient safety zone to prevent crushing; – Design and operation of SRL allows for limited vessel movement without activation; – Connector between SRL and harness allowing easy connection/removal, while wearing gloves.
		Prevention: – Do not climb ladder if iced/severely fouled – Ensure ladder is regularly cleaned at low tide – Use suitable footwear and gloves to provide good grip; – Maintain continuous attachment during climbing (ladder SRL, or scaffold hooks/lanyards if SRL not available)	
		Mitigation: – Do not attach any bags to harness or body – can affect position when floating – Ensure harness (and all other PPE such as lifejacket, immersion suit) is correctly fitted – carry out buddy check before going on deck	Bags can result in: – Added weight (casualty floats lower in water, increasing risk of drowning due to water inhalation), or – Added buoyancy in wrong position relative to casualty's centre of mass (casualty may not self-right to bring face out of water, increasing risk of drowning)

Table 3: Hazards during transfers (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Transfer from vessel to boat landing ladder continued...	Fall into sea, between vessel and boat landing ladder continued...	**Mitigation:** – PLB and light to be worn on lifejacket	Locating PLB on lifejacket ensures that it is always in the same location on the person, irrespective of whether an immersion suit is worn, and ensures that the inflated lifejacket does not obstruct access to a PLB worn on the immersion suit. However, the PLB mounting arrangement must be compatible with the inflated lifejacket – manufacturer approval may be needed.
		Mitigation: – Where the potential for falling into the sea remains, and where the sea temperature and state (wind/waves) gives a high risk of rapid drowning due to cold shock, immersion suit should be worn – Ensure selected immersion suit does not impede safe climbing – Clothing worn under immersion suit to provide sufficient insulation for prevailing conditions	
	Fall between vessel and boat landing ladder, remaining attached to either, resulting in impact with, or crushing between, vessel and boat landing ladder/ bumper bars	**Prevention:** – Only attempt transfers in suitable conditions	
		Mitigation: – Eliminate risk of crushing between vessel bow and boat landing ladder by ensuring vessel and boat landing structure are compatible – after arresting a fall, the FAS should suspend the climber in the safety zone, formed by the bumper bars – include in vessel specifications and surveys (See Figure 4 in section 3) – Step over from vessel to ladder as soon as attached to SRL/ detach immediately after stepover from ladder to vessel – Use FAS so that if a fall occurs, casualty remains in safety zone between ladder and vessel – If Deckhand is attached to vessel, they should be in restraint, so that they cannot be suspended over bow fender – this may require the provision of an anchor point above waist height – Vessel Master to monitor transfers, and manoeuvre vessel to safe position in the event of a failed transfer	

Table 3: Hazards during transfers (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Climbing boat landing ladder	Slip/loss of grip on ladder, leading to fall, resulting in injury of climber and/or Deckhand	**Mitigation:** – Climber to be attached to SRL while climbing	
Transfer from boat landing ladder to additional ladder(s) of TP/jacket	Fall from height during transfer between FAS	**Mitigation**: – Attach to designated anchor point while transferring between FAS	
Climbing additional ladder(s) of TP/jacket	Slip/loss of grip on ladder, leading to fall	**Mitigation:** – Attached to FAS while climbing	
Work on external platform	Fall from height	**Prevention:** – Do not leave any unprotected edges on completion of any tasks that require opening of hatches or guardrails – Work in restraint, to prevent falls if hatches or guardrails have to be opened (e.g. open section of guardrail for lifting loads to/from external platform)	
Transfer from boat landing ladder back to vessel	Fall from ladder (other hazards and risk controls are the same as for transfer from vessel to boat landing ladder)	**Prevention:** – Clarity of Deckhand and Master's roles – Count climber down last few steps, and then instruct when to step back – Having a standard communication protocol can help to avoid misunderstanding e.g. '4-3-2-1-Yes' (avoid words that could be mis-heard, such as 'step/stop', 'go/no'.) – Vessel PA can help with audibility – Deckhand to be ready to assist climber in establishing stable position on vessel, and detaching from SRL	

4.5 ACCESS TO WORKING LOCATIONS

This section covers access from the external platform on the TP (or equivalent location on jacket/offshore substation) to locations where work is to be carried out, such as the WTG tower, basement, nacelle, hub or roof, as well as working areas on substations or meteorological masts. The specific hazards and recommended risk controls relating to access to these locations are given in 4.5.1, while the use of rope access techniques is outlined in 4.5.2.

As a fundamental principle, prior to any location being accessed, a suitable rescue plan must be in place; rescues are covered in more detail in 4.6, while the common requirements that apply to all activities are covered in 4.2.

4.5.1 Hazards during specific activities

Table 4 identifies some of the principal hazards relating to work at height that may be present in the course of obtaining access to a working location, and recommends measures that can be taken to reduce the associated risks. In cases where the basis for the recommendations may not be obvious, this is outlined in the relevant column. This table could be used as an input to a hazard identification and risk assessment process, but is not a comprehensive risk assessment on its own.

Table 4: Hazards in accessing working locations

Activity	Hazard	Recommended risk control	Basis of recommendations
All areas	Slippery surfaces /contamination of footwear due to leakage of oils, bird fouling etc, leading to slip/fall	**Prevention:** – Design: ensure full containment of any potential spillages – Housekeeping: thorough cleaning of affected surfaces after any spillages/contamination	
Changeover from access/climbing PPE to working PPE	Potential for slip/ fall (on same level) if changing in unsuitable location	**Prevention:** – Ensure suitable space is available and clear of other materials/stores, etc.	
	Error in refitting PPE	**Mitigation:** – Carry out 'buddy check' after refitting harness, prior to resuming work at height	
	Damage to PPE (e.g. immersion suit seals) leading to latent defect	**Prevention:** – Take care when removing PPE – Provide designated storage location/receptacle	
		Mitigation: – Carry out effective pre-use checks on PPE	
	PPE not available in the event of emergency escape being necessary	**Prevention:** – Ensure that necessary PPE (harness, immersion suit, lifejacket, PLB) is kept in vicinity of worker at all times, so that it is available without delay when needed	

Table 4: Hazards in accessing working locations (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Access inside WTG tower – climbing ladder	Use of ladder – immediate hazard of fall from height	**Prevention:** – Minimise use of ladder by ensuring lift is available – Commission lift at earliest opportunity after erection – Ensure periodic inspections and certification of lift are carried out as required to keep lift available for use	
		Mitigation: – Anchor points and FAS to be inspected prior to WTG offshore assembly (to the extent possible), and any remaining items inspected immediately after assembly in order to enable safe use – Periodic inspection should take place thereafter	
	Use of ladder – exhaustion from multiple climbs, possible longer-term musculoskeletal disorders (MSDs)	**Prevention:** – Consider setting limit on daily/weekly climbing height – Ensure technicians have suitable fitness and BMI to minimise risk – Avoid combination of ladder climbing and other tasks that can increase risk of MSDs (e.g. prolonged kneeling)	Precautionary approach, as there are insufficient data in the industry to quantify the problem.
	Fall from height while climbing	**Prevention:** – Correct use of ladder FAS and compatible harness	
	Starting to climb section of ladder and forgetting to attach to ladder FAS	**Prevention:** – Use lift whenever available – All personnel should stay alert and observe each other's actions – Provide appropriate safety signage – Training and competence of personnel	
	Fall from height when stepping onto ladder	**Prevention:** – Design: Consistent orientation of ladder to landing area (i.e. all ladders project through floor and have side access to platform – no 'forwards' access/egress between guardrails) – Guard ladder access with self-closing gates	
		Mitigation: – Attach energy absorbing lanyard to anchor point before transferring onto/off ladder – Ensure anchor points are provided in suitable positions	

Table 4: Hazards in accessing working locations (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Access inside WTG tower – climbing ladder continued...	Slip while climbing ladder	**Mitigation:** – Keep ladder and walkways clean of oil spillages, bird fouling etc. (Contaminated footwear increases risk of slipping, even when walking on a clean surface)	
Transfer between ladder and intermediate platforms of tower	Fall from height when detached from ladder FAS	Design of transition should either: 1. Allow the climber to pass through hatch, and close it, before detaching from FAS (**Prevention** - preferred option), or 2. Provide an anchor point for an energy absorbing lanyard to reduce the distance and consequences of a fall after detaching from ladder FAS (**Mitigation**) – Anchor point should be above climber, but still accessible from ladder – Lanyard should be as short as possible, to minimise fall factor – Lanyard should not pass over sharp edges between anchor point and climber	Hierarchy of controls: closed hatch provides a safe working location (prevention), which is preferable to using energy absorbing lanyard (mitigation).
	Falling object	**Prevention:** – All removable parts of FAS should remain securely attached to harness throughout transition to platform. – Hatches to be self-closing, or separated from platform by a self-closing gate and toe plates;	
	Fall through open hatch	**Prevention:** – Hatches to be self-closing, or separated from platform by a self-closing gate; – Communicate with others present before opening hatch.	
Climbing through hatch	Injury due to action of hatch	**Prevention:** – Ensure that hatches are as light as possible, consistent with strength requirements; – Avoid sharp edges on hatches; – Avoid creating trapping/crush points in locations where climbers may be expected to have their hands/fingers.	

Table 4: Hazards in accessing working locations (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Standing on hatch	Fall from height due to failure of hatch/hinges	**Prevention:** – Hatches should be designed so that failure of a hinge does not allow the hatch to drop through the opening – Hinges should be subject to periodic inspection	
Transfer from yaw deck to nacelle	Fall from height (nacelle ladder to yaw deck)	**Prevention:** – Design ladder for good ergonomic access to minimise risk of slip/fall; provide FAS	
		Mitigation: – Attach to FAS/anchor points when climbing between yaw deck and nacelle	
Access inside WTG tower – using lift (normal operation)	Fall from lift landing area	**Prevention:** – Lift access to be protected by gates, interlocked so that they can only be opened when lift is at landing – If the lift runs on the ladder, access should be provided through an alternative, self-closing gate, or through interlocked gate by means of an override – it should not be necessary to climb over guardrails	
	Lift stops and will not restart	**Prevention:** Lift design to enable controlled lowering without the need for power	
		Mitigation: Lift design and integration into tower must provide safe means of escape to ladder in event of mechanical blockage of lift. Key requirements are: – Anchor point in suitable location in lift – Lift location to be sufficiently close to ladder to enable safe step-over, while maintaining continuous attachment – Energy absorbing lanyard length must be sufficient to enable escape from lift to ladder	
	Injury to personnel on a platform due to contact with moving lift	**Prevention:** – Guard landings to prevent contact between persons on landing, and the lift. However, this may not be practical (due to need for access to lift area for evacuation/escape/climbing ladder), in which case the full area of the base and top of the lift should be interlocked to stop it if it makes contact with any obstruction	Essential Health and Safety Requirements of the Machinery Directive.

Table 4: Hazards in accessing working locations (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Access inside WTG tower – using lift (normal operation) continued...	Lift falls due to suspension wire failure	**Prevention:** – Design to include back-up system (e.g. second wire) – Effective inspections required – lift design should enable thorough visual inspection of suspension wires to be done safely from inside the lift, and also enable physical access for measurement of wear – Manufacturer to specify inspection criteria, and design life of critical components	
Working in nacelle	Fall from height through openings created by work being carried out (e.g. during major component exchange, or use of service crane)	**Prevention:** Task risk assessment should consider if openings are created; if so, either: – Establish exclusion zone in area with unprotected edge; or – Provide temporary edge protection; or – Work in restraint when in area with unprotected edge	
	Damage to PPE, versus not wearing PPE when needed	Decisions about whether harnesses should be worn in nacelle should be based on an assessment of: – Nacelle design: are people at risk of a fall from height? If so, then harness should be worn and continuous attachment should be maintained – Task being undertaken: would wearing a harness impede work, or could the work lead to harness damage? If so, consider removing harness, provided that removal will not impede rescue – If the person were to be incapacitated, would rescue be impeded if they were not wearing a harness? Is a rescue harness ('nappy') available in the rescue kit? Provided that rescue will not be impeded, harness can be removed When undertaking work for which a harness does not have to be worn, it should be kept immediately available, in case it is needed for emergency evacuation	

Table 4: Hazards in accessing working locations (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Access to hub/ spinner	Fall from height when using external access route	**Prevention:** – Design: new WTGs to have access route that provides safe internal access to hub	
		Mitigation: – Procedure: On existing WTGs where external access is required: follow procedure: use restraint/fall arrest PPE if accessing exterior of hub	
Working in hub/ spinner (normal maintenance tasks)	Fall from height within hub (e.g. into blade)	**Prevention:** – Design of working locations should not expose people to risk of falling to a lower level	
		Mitigation: – Attach to anchor points if a fall hazard exists – Ensure blade hatches are securely closed	
Working in hub/ spinner (during blade installation or exchange)	Fall from height through hole that blade normally fills	**Prevention:** – Hub/spinner design should enable personnel access for blade insertion/ fastening without being at risk of falling from hub/spinner	
		Mitigation: – Attach to anchor points where a fall hazard exists – High level of supervision required for high risk task	

Table 4: Hazards in accessing working locations (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Work on top of nacelle	Fall from height over edge of nacelle	**Prevention:** Identify how work on top of nacelle can be avoided – specify high-reliability equipment, consider mounting arrangements – can access be provided from inside nacelle? Design of component mounting: – Minimise work near edges of nacelle – Provide high anchor points at any locations where people have to stand – Helihoist platform can eliminate the need to work on unprotected roof area Design of anchor points/rails to minimise the need to transfer between isolated anchor points; – Condition of surfaces to be accessed: non-slip finish free from ice – Ensure that footwear is in good condition and free from oil/grease contamination – Work within weather limits – e.g. wind speed, absence of lightning – Work in restraint	
		Mitigation: Provision for rescue – method must be compatible with PPE e.g. rescue kit must be capable of engaging with the type(s) of energy absorbing lanyard in use on the site	
Access beneath sealed hatch to foundations	Hazardous confined space – potential for oxygen depletion or other hazardous atmosphere	**Prevention:** Restrict access e.g. lock hatch and provide clear 'Access prohibited' signs	
		Mitigation: Confined space procedures to be implemented for any access	

Table 4: Hazards in accessing working locations (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Access beneath sealed hatch to foundations continued...	Fall from platform inside TP	**Prevention:** Ensure that platform design includes provision of suitable guardrails	
	Fall due to condition of access ladder/ platform/ guardrails – potential for high corrosion rates if in contact with salt water	**Prevention:** Remain attached to designated anchor point above foundation area until condition of structures is verified (also likely to be required as part of safe working in confined space)	
	Complex rescue	**Mitigation:** Detailed rescue plan, considering the height through which a casualty may have to be raised, confined space hazards, work equipment requirements, competence requirements and number of people required to undertake a rescue	
Work on meteorological mast	Initial access is by climbing external ladder; some tasks may require work positioning or rope access techniques	**Mitigation:** Design: – Provide FAS on ladder – Provide suitable platforms at levels where work is to be carried out – Provide designated anchor points where necessary (e.g. in locations where structural members are either too large for the use of scaffold hooks, or too slender to have sufficient strength to arrest a fall without damage) Training: – Additional or alternative training (compared to standard WTG work at height training) may be necessary, to take account of different rescue methods, and any additional hazards such as radio frequency (RF) radiation Rescue: – Ensure that a suitable rescue plan is implemented, and that the necessary personnel and equipment are present	

Table 4: Hazards in accessing working locations (continued)

Activity	Hazard	Recommended risk control	Basis of recommendations
Rope access work	Fall from height	**Prevention:** – Rope access work to be planned, supervised and undertaken by competent specialists – Apply principle of 'double protection' to eliminate risk from single point failures	
Work inside blades	Fall from height	**Prevention:** – Ensure blade is locked in horizontal position for internal access – Ensure blade integrity is sufficient for safe access	
Work between underside of external platform, and surface of sea	Fall from height into sea	**Prevention:** – Design to provide for needs of future rope access work – Rope access work to be planned, supervised and undertaken by competent specialists – Apply principle of 'double protection' to eliminate risk from single point failures	
		Mitigation: – Wear PPE to protect against drowning (lifejacket, immersion suit, PLB etc.) – Vessel to be on standby to retrieve any personnel who fall into sea	
Work at height on transition piece platform prior to installation of tower	Fall from TP external platform into open top of TP – additional hazard if top internal platform of TP has openings	**Prevention:** Design to consider relative heights of internal and external TP platforms Procedure: – Eliminate fall hazard by keeping openings covered – only remove covers immediately before WTG tower is lifted into position – Work in restraint if covers are removed and a fall hazard exists	

4.5.2 Use of rope access

Rope access is a work positioning technique, used for gaining access to difficult locations at height. It is defined by the Industrial Rope Access Trade Association as a

'method of using ropes, in combination with other devices, by which a user descends or ascends a working line to get to or from the workplace, and for work positioning, while further protected by a safety line, such that both lines are connected to the user's harness and separately secured to a reliable anchorage in such a way that a fall is prevented or arrested'[14].

The industry has an excellent safety record, and clear standards set by its trade associations, including:

- Industrial Rope Access Trade Association (IRATA International);
- Society of Professional Rope Access Technicians (SPRAT), based in the USA; and
- Samarbeidsorganet For Tilkomstteknikk (SOFT), based in Norway.

Each of these associations sets competence standards for technicians (of various different levels) and supervisors. In addition to the standards, it is important that technicians and supervisors appreciate the differences that offshore work brings, compared to more conventional situations.

While many tasks undertaken by WTG technicians involve work at height in order to gain access to the place of work, in rope access, the work is undertaken while working at height, supported by the rope access system. Undertaking the rope access work will therefore be a core competence of rope access technicians, in addition to their competence in the task that they will be undertaking, such as inspection and/or repair of blades and structures.

The fundamental principles of safe rope access are described in ISO 22846-1 *Personal equipment for protection against falls. Rope access systems. Fundamental principles for a system of work* and the IRATA *International Code of Practice* (ICOP). The fundamental principle is that whenever a technician is suspended, he will always be attached to at least two, independently anchored, ropes, one of which is taking the technician's weight (the working rope), and the other is a back-up (the 'safety-rope'), that will prevent a hazardous fall if the working rope fails.

Other general principles of rope access can be summarised as:

- Planning and management of work:
  - work should be planned and managed by a person whose competence has been demonstrated through obtaining a rope access qualification of the appropriate level, such as an IRATA Supervisor;
  - the risks involved in a work package must be assessed, and
  - all practicable measures should be taken to avoid injury due to impact with structures; this may include routing the suspension ropes away from edges that could cause damage.
- Undertaking and supervising work:
  - employers should ensure that technicians have suitable physical capability and health to undertake the work;

14 Latest version of IRATA ICOP can be obtained from the IRATA website.

  - technicians must have appropriate training and competence for the task and any potential rescues; the different grades of technicians' qualifications determine the levels of complexity of tasks and rescues for which they are competent;
  - work should be carried out under appropriate supervision, taking account of the place of work and level of risk; supervisors should therefore be competent in rope access techniques, and
  - supervisors should be competent in organising and/or carrying out rescues.
- Provision and use of equipment:
  - back-up devices should always be used, and be capable of safely arresting a fall, without catastrophic damage to the device or the safety rope; this is achieved through a combination of the design and operation of the back-up device – keeping it as high as possible on the safety rope, to minimise the fall factor;
  - descender devices should fail to safe, i.e. they lock onto the rope if the user either lets go, or squeezes too hard;
  - equipment should be subject to pre-use inspection and periodic thorough examination;
  - technicians should be competent to determine when equipment should be withdrawn from use;
  - equipment should be procured with full traceability to the manufacturer, and properly stored and maintained, and
  - other PPE should be used, as appropriate to the location and task:
    - if working in the splash zone, then immersion suits and lifejackets will generally be required.
- Methods of work:
  - technicians should connect to the rope access systems in a location where there is no risk of a fall from height, or use other means of protection;
  - technicians should always be connected, through their harness, to both the working and safety ropes, even if using a work seat;
  - the ropes should be set up to avoid inadvertent descent off the bottom of the rope, such as by tying a stopper knot in each rope;
  - the minimum size of a rope access team is two technicians, one of whom should be a competent supervisor, and
  - an effective communication system must be in place; if necessary, equipment such as radios may be used (and should, of course, be prevented from being dropped).
- Emergencies:
  - a rescue plan, specific to the intended work, should always be in place. Rescues should be practised periodically, based on an assessment of the risks that work presents;
  - while technicians are trained in how to recover themselves, in some situations they may have to rescue each other, or be assisted by an on-site rescue team. planning for rescues should be assessed prior to contract award;
  - as rescues generally involve descent, if working over water, the rescue may involve retrieval from the sea;
    - planning should ensure that a vessel is standing by if required for a rescue, and that technicians have suitable PPE.
- Protection of others:
  - suitable exclusion zones should be established, and
  - in some locations, it may be necessary to have a look-out to protect against ropes being damaged.

4.5.2.1 Application

Rope access is typically used if work has to be carried out in locations where it is not practical to use permanent or temporary fixed access solutions, such as:
- external inspection and maintenance of blades or tower sections;
- external work on foundation structures, below the level of the external platform, or
- repair/replacement of ladder sections.

4.6 RESCUE FROM WORKING LOCATIONS TO VESSEL OR HELIHOIST PLATFORM

This section covers the rescue of a casualty, who may be conscious or unconscious, from any working location on an offshore structure, to the vessel or helihoist deck.

It is essential that, should a person become injured or incapacitated in any location on an offshore structure, they can be rescued to a place of safety without undue delay; no persons should ever be in a location from which this cannot be achieved.

Within this document the terms rescue and evacuation are defined as:
- Rescue: The recovery of a casualty by another person, either remotely or directly, in some cases with multiple phases:
  - the initial stage of rescue brings the casualty from being in immediate danger (such as being suspended after a fall) to a safe location where their condition can be stabilised, followed by
  - rescue to a means of transport (vessel or helicopter) and thereafter to a safe location where all necessary treatment can be given.
- Evacuation: Carried out by a stranded user to escape a remote/hazardous situation.
- Evacuation point: A location on the structure where a casualty can be effectively evacuated e.g. the helihoist platform of a WTG, or a rescue vessel.

The Working at Height Safety Association (WAHSA) recognises four options and lists them in order of preference for rescuing a casualty, these are:
1. lowering a remote casualty;
2. raising a remote casualty;
3. self-evacuation by descent, and
4. rescue of another by descent.

The last of these approaches is the least-preferred option, as it requires the rescuer to leave a safe location and descend with the casualty.

4.6.1 Preparation for rescues

Effective preparation for rescue involves ensuring that structures are designed, work is planned, and suitable equipment and training are provided, with consideration of potential rescue scenarios.

4.6.1.1 Selection of a suitable rescue system

Rescue equipment must be suitable for the structure being worked on. Rescue kits typically consist of:
- a suitable length of rope for the location;
- a method of attaching the rope to the structure and the casualty, such as a range of connectors and slings, and

- a device for controlled raising/lowering of the casualty, known as a descender;
  - if there is a requirement to lift the casualty (e.g. over a handrail or other obstructions) to allow them to be lowered, then it will be essential that the descender can also be used to raise a casualty.

Rescue equipment tends to be supplied as complete kits that are either permanently located in the work area, or taken to site by the work team. These kits are stored in a sealed bag or other container. It is important to ensure that the kits that are permanently located on site are capable of accommodating the types of rescue that may be carried out. Additional rescue equipment may be needed when carrying out specific tasks, or working in certain locations within a structure.

Rescue equipment should always be in a location that allows it to be used promptly, to minimise harm to a casualty. For example, it is important that a suspended casualty can be rescued as quickly as possible to an initial place of safety (such as the next platform beneath them), even if additional equipment will then be needed for subsequent stages of rescue to a vessel or the helihoist platform.

In all normal work at height situations, back-up systems are used, for example, work positioning requires the use of a back-up system – a work positioning lanyard would be backed up with an energy absorbing lanyard. Rescues are the only time that a person will deliberately be supported by a single rope with no back-up, so it is vital that the equipment is in good condition, correctly assembled and operated. During training, however, it is essential that the casualty (and, on occasion, the rescuer) has a back-up system.

4.6.1.2 Compatibility

When defining rescue kit requirements, an assessment of the workforce's PPE, and the structure being worked on, must be carried out in order to determine the necessary equipment, for example:

- The height of the structure determines the length of rope that will be needed, although sufficient allowance must be made for deviations, use of pulley systems etc, which can increase the length that is needed;
  - however, excessive length can increase the time taken between descents, if it becomes necessary to pull excess length through, and/or tie knots in the rope to provide loops for attachment.
- The rescue kit must be able to connect with the anchor points on the structure and the attachment points on the casualty's harness:
  - This involves detailed consideration of the PPE that is in use, for example:
    - the sewn fabric attachment points on some types of harness tend to flatten when under load, making it impossible to insert a second karabiner to rescue a suspended casualty;
    - if the rescue kit relies on attaching to the casualty, and then cutting their lanyard/rope, this would not work if the casualty were suspended on an all-metal system;
    - if the rescue plan is based on the expectation that the rescue system will be attached to a dorsal D-ring attachment point on the casualty's harness, then any personnel on site whose harnesses did not have this attachment point, could not be rescued in the expected manner, and
    - the rescue kit must be compatible with working procedures; in particular, if there are any locations in which technicians are permitted not to wear harnesses, then the rescue kit will require a rescue harness that can

be fitted to an incapacitated casualty. (See Table 4 in 4.5.1 for further discussion of this issue).

- The potential anchor points on the structure should also be assessed. While designated anchor points are suitable for connection of standard karabiners, other potential anchorages such as structural beams and cast lifting eyes on major components such as gearboxes may require the use of slings in order to attach the rescue system.

– The rescue method should be capable of being set up and used in the work location without putting the operator at risk, for example by avoiding the need to lean over handrails to operate a descender device.

4.6.1.3 Maintenance and inspection of a rescue system

The requirements for periodic thorough examination of rescue equipment are outlined in 3.3.3.3. In addition to the periodic thorough examination, a rescue kit should be checked:

– On delivery to/installation on the site: the contents should be verified as being correct; in the case of a sealed kit, this may be limited to checking the documentation/ contents list.

– Prior to starting work: the location of the kit should be checked, to ensure that it is present and sealed; if not sealed, a visual and tactile pre-use inspection should be carried out to ensure that the equipment is in good condition – in an emergency, there might not be time to do this.

During the pre-use check, should a piece of rescue equipment be found to be damaged or malfunctioning, it should be replaced before allowing the work to continue; having spare kits available in-field can ensure that work can proceed safely. An operational restriction should be put in place if the kit has to be removed from its normal location.

4.6.1.4 Additional training

Training must be provided for employees who will carry out a rescue if needed. Given the different variations of rescue kits that are available, employee training should take account of the potential rescue situations that may arise, and the equipment that will be used on site. This training must also be carried out by a competent person.

Formal refresher training should also be undertaken to ensure that the employee's knowledge of the rescue equipment and techniques remains current. Further, where possible, there should also be a level of local refresher training; for example, during bad weather days, drills using the equipment could be carried out by the workforce.

4.6.1.5 First aid

Personnel should possess a level of first aid training that is appropriate for the task being carried out, and the location of the workplace. The number of employees on site who will be trained in first aid, and their level of training, should be based on an assessment of the work area, the tasks being undertaken, and the potential injuries that may be sustained. Given the isolated nature of offshore WTGs, and the need to ensure that first aid can be provided, without delay, to any injured person, this will generally mean that every work party should include at least two first aiders.

Basic emergency first aid covers the initial care of a casualty who may be:
- unconscious and/or in seizure;
- suffering from internal or external bleeding;
- in shock;
- choking, or
- have sustained a fracture or spinal injury.

For work at height, additional training may be required for a first aider to:
- fit a neck collar, and
- move the casualty onto a spinal board and stretcher, and package for the next stage of the rescue.

Decisions about the number of first aiders, their level of training, additional medical support and provision of first aid/medical facilities and equipment should be based on a thorough assessment of first aid requirements, and integrated with the site emergency response arrangements, which will determine how long it may take for further help to arrive. The GWO BST First Aid module provides a common baseline level of training, but further training may be needed, depending on the outcome of the assessment.

4.6.1.6 Planning

A rescue plan must be in place prior to any work at height being carried out. The plan must be applicable to the works and included in the safe system of work for each location. Typical components of a rescue plan include:
- details and the location of the rescue equipment that is in place;
- limitations of the rescue system, such as:
  - configuration of the system;
  - maximum weight;
  - weather restrictions such as high winds;
  - requirements for additional resources, such as extra personnel or equipment, to be brought to the structure;
- locations of suitable anchor points on the structure;
- rescue paths on/in the structure, and
- communications arrangements, within the site and with external support.

A rescue plan also needs to take account of the casualty's injury and condition. A casualty in an offshore WTG may either have to be lowered to the external platform, and from there to a vessel, or raised to the helihoist deck for evacuation by helicopter. Rescue routes may either be inside or outside the tower:
- external rescue routes should be as close as possible to the tower, to minimise the effect of wind, which could otherwise cause a stretcher-borne casualty to spin, and
- internal rescue routes allow greater monitoring of the casualty's condition, although no real opportunity for intervention between platform levels;

Internal lowering is only a viable option if the design of tower platforms allows an inclined stretcher to be lowered through the openings in intermediate platforms.

Alternatively, if the casualty is to be evacuated by helicopter, then a suitable route and lifting equipment will be necessary in order to bring the casualty to the helihoist platform, for winching and evacuation by a suitable helicopter.

Offshore meteorological masts have different rescue requirements to WTGs; for example, platforms within the mast may prevent internal lowering, and helicopters cannot access met mast platforms, due to the obstructions presented by the booms of the mast. For these reasons, working parties on met masts must be competent in the specific rescue techniques that may be required.

New rescue plans should be tested, to ensure that the arrangements work as expected, and full briefing on the plans should be provided to all who may be involved. The weather limits for external rescue methods should be established, as these will determine the working limits for the relevant locations on a structure. Periodic drills should be carried out, to maintain familiarity with the methods and support reviews of the plans.

4.6.2 Supervisory/working arrangements

4.6.2.1 Employers' responsibilities

Employers need to ensure they have sufficient competence within their organisation to:

- Assess the competence of all contractors being used;
  - This assessment should be based on a review of the contractors' competence training, safety performance and culture; and
- Review safety documentation to ensure that all work at height is properly planned and that these plans include suitable preparation for emergency situations and rescues.

If an **Employer** recognises that it does not have the necessary competence to fulfil these responsibilities, then external competent advisers should be consulted, particularly for specialised areas of work at height, such as the planning of rescues.

4.6.2.2 Roles of contractors

- ensure the supervisor on site has the competence to carry out their duties;
- assess the risks related to work at height, in order to minimise the requirement for rescue;
- provide suitable rescue equipment for the workforce;
- include rescue in the planning of all works;
- include rescue equipment in the project's equipment maintenance schedule, and
- ensure that the workforce has been trained in the rescue systems that are in place.

4.6.2.3 Roles of supervisors

- ensure that the correct rescue kits are in place, taking account of the tasks that are to be carried out, and their locations, and
- coordinate any rescue on site if required, including liaison with additional support from other parts of the site, or external resources.

4.6.3 Hazards during specific activities

Table 5 identifies some of the principal hazards relating to work at height that may be present in the course of typical rescue activities, and recommends measures that can be taken to reduce the associated risks. In cases where the basis for the recommendations may not be obvious, this is outlined in the relevant column. This table could be used as an input to a hazard identification and risk assessment process, but is not a comprehensive risk assessment on its own.

Table 5: Hazards in rescue activities

Stage	Hazard	Recommended risk control	Basis of Recommendations
Identify that a rescue is required to be carried out on site.	Delay in recognition that a rescue is needed, leading to casualty's condition deteriorating	**Prevention:** – Ensure that personnel working at height are within sight of each other – teams should avoid getting too spread out	
Initiating rescue	Inadequate assessment of situation and hazards, or unfamiliarity with rescue plan, leading to: – Delays in rescuing the casualty – Additional injury being sustained by casualty; or – Rescue team being endangered during rescue – Delays in receiving additional help	**Prevention:** – Maintain familiarity with rescue plans – both technicians and support functions must be ready to respond correctly – Ensure effective communications systems are always available – Train and coach personnel in rescue techniques and wider hazard identification skills	
	Rescue equipment not available/not suitable/not functional, leading to delay in rescue	**Prevention:** – Ensure that rescue equipment is regularly inspected; – Check rescue equipment is available at start of work – Carry out periodic drills using actual rescue kit and PPE as used on site – check for any compatibility problems	

Table 5: Hazards in rescue activities (continued)

Stage	Hazard	Recommended risk control	Basis of Recommendations
Carrying out rescue	Errors made in operation of rescue kit, leading to harm to the casualty or rescue team	**Prevention:** – Ensure that all personnel have thorough training, suitable site equipment familiarisation and regular refresher training/drills – Ensure that training is appropriate to the locations where people are working – meteorological masts may require different techniques to WTGs, hubs may need different techniques to nacelles	
	Unsuitable weather conditions for rescue, leading to harm to the casualty or rescue team	**Prevention:** – Ensure that work only takes place in conditions under which a rescue could be carried out safely – Assess the weather-tolerance of rescue techniques by carrying out practices (using weighted dummy – not real people) in realistic conditions and from actual working heights	
After initial stage of rescue	Miscommunication delaying evacuation	**Prevention:** – Rescue plan should include emergency contact information	
	Incorrect treatment of casualty (e.g. failure to recognise and treat suspension intolerance)	**Prevention:** – First aid training of personnel must be sufficient to identify and treat foreseeable injuries that could be sustained on site – First aiders may also benefit from being able to access medical advice by radio	

4.7 SAFE BEHAVIOUR FOR WORK AT HEIGHT

4.7.1 Definition

Behavioural safety covers all non-technical aspects of safety, and determines how work will actually be undertaken, which may differ from how it might be expected to be undertaken according to the safety management system.

4.7.2 Introduction: importance and approach

Analysis of G9 incident data showed that behavioural failures were an immediate cause of over 60 % of the recorded incidents during work at height, rather than equipment or design issues. This is a common situation: the UK HSE note that 'up to 80 % of accidents may be attributed, at least in part, to the actions or omissions of people'[15]. However, this does not mean that the accidents are entirely caused by the individual involved; the same guidance goes on to state 'Many accidents are blamed on the actions or omissions of an individual who was directly involved in operational or maintenance work. This typical but short-sighted response ignores the fundamental failures which led to the accident. These are usually rooted deeper in the organisation's design, management and decision-making functions.'

This section provides an overview of the factors that contribute to different types of behavioural error, including how design and safety culture can influence behaviour, then considers the responsibilities of the different parties involved in a workplace, and provides further detail on specific behaviours for safe work at height.

4.7.3 Contributory factors

The risk from behavioural errors is affected by the combination of three major groups of factors:

– the job or task, and its physical and mental match with the person carrying it out;
– the individual: their competence, attitude, skills, habits, risk perception and personality, and
– the organisation, which influences group and individual behaviour, through its culture, leadership, resources, work patterns, communications and contractual arrangements.

It is not realistic to expect an individual technician or vessel crew member to change the culture of an organisation, whether that be their direct employer, or an **Employer**, but rather, the organisation is likely to affect the behaviour of individuals.

The **Employer** has a key role, as they:

– Set the objectives, in terms of design standards, safety, cost and schedule;
– Appoint the main contractor(s); and
– Have a role in monitoring how the work is carried out.

The exact legal duties will depend on the nature of the work, and which regulations apply. The different responsibilities of **Employers**, contractors/employers and individuals are described in more detail in Annexes F.4 to F.6.

15 HSE HSG48 *Reducing error and influencing behaviour*

4.7.3.1 Design considerations

Decisions made during the design phase will determine how effectively the highest levels of the hierarchy of protection are applied, and the residual risks that will rely on safe behaviour for mitigation. The design also affects the level of effort that is needed in order to work safely, for example:

- if a competent worker has to undertake a task at height, and suitable anchor points are available, they are very likely to use them; however
- if no suitable anchor points are available, then the worker has to stop the job, which many workers will hesitate to do, unless there is a strong safety culture on the site:
  - this introduces the temptation for a worker to improvise or take a shortcut, potentially putting themselves or others at risk.

4.7.3.2 Lifecycle phase effects

During the construction phase, the duration of a typical work package will often be too short for major changes in safety culture and behaviour to be achieved; however, there are various ways in which **Employers** can influence the safety culture on a project, such as:

- establishing a strong project safety culture, and then selecting contractors whose own safety culture is compatible, or
- entering into long-term partnering arrangements with selected contractors, so that a safety culture can be developed and brought to a number of different projects over time.

Employment practices can also affect the development of a safety culture; if a high proportion of the workforce is on short-term contracts, or there is a high turnover of personnel, the potential for development of a shared culture will be reduced.

In the O&M phase, there are likely to be long-term relationships between **Employers** and contractors, and a higher proportion of the workforce will be permanent (either employed by a contractor, or by the owner/operator), giving greater opportunity for safety culture development. Given that the O&M phase has the greatest reliance on small self-managed workgroups, the reliance on safe behaviour is at its greatest, but so is the potential for development of a strong safety culture. Further details on safety culture and improvement tools are given in Annex F.7.

4.7.4 Specific behaviours for safe work at height

All those involved with work at height, in any capacity, should seek to apply the hierarchy of protective measures, the first of which is to avoid work at height.

These principles should be applied to the design of equipment and workplaces, and the planning and execution of work. In order to ensure that these are effective, all personnel involved in organising, planning, supervising and undertaking work at height must be competent for their role, including both competence in the task and potential rescues, and the ability to identify, communicate and mitigate hazards.

In situations where it is necessary to work at height, the specific safety-related duties and behaviours of employers and employees are set out in Table 6 – note that, in this context, the term 'employer' refers to anyone who employs people, rather than the defined term **Employer** in a contractual context.

Table 6: Employer and employee's duties in relation to safe work at height

Stage	Employer's duties	Employee's duties
Planning the work	– Hazard identification and risk assessment – Select fall protection system according to hierarchy of protective measures – Ensure that the work involved in installation, use and dismantling of an FAS does not expose people to greater risks than would be the case if it were not used – Ensure that work is properly planned and supervised, so that risks are minimised – Ensure that the plan is communicated effectively, e.g. through clear and accurate procedures and effective briefing/toolbox talks – Plan the response to potential emergencies and rescue, and ensure that arrangements are put in place for these situations – Selection of rescue methods should minimise risk to both the rescuer and the casualty – Establish effective communication systems within the team that is undertaking the task, and with other workgroups as necessary – Ensure that work is only carried out in suitable weather conditions – Ensure that work is assigned to people with suitable training and competence to carry it out safely – Consult with employees and/or their representatives	– Read and understand method statements; – Participate in briefings/toolbox talks, and understand and apply their content; – Be familiar with appropriate rescue and emergency procedures for the work being undertaken.

Table 6: Employer and employee's duties in relation to safe work at height (continued)

Stage	Employer's duties	Employee's duties

Equipment selection	– Ensure that equipment is procured from reputable sources, with a verifiable supply chain back to the equipment manufacturer, in order to avoid counterfeit products
	– Ensure that any equipment designed, supplied or installed by others is fit for the purpose for which it will be used in the intended work, for example:
	  – Equipment has been installed in accordance with the manufacturer's instructions
	  – The strength of supporting structures has been shown to be sufficient
	  – Equipment conforms to relevant standards
	  – All components in a fall protection system have adequate static and dynamic strength and appropriate factors of safety
	  – The combination of components in a system is compatible
	– Select access and egress methods that are appropriate to the distance, duration and frequency of access
	– Ensure that work equipment (such as tools) can be used without risk of being dropped
		– Use equipment in accordance with manufacturer's instructions;
		– Ensure that markings on equipment are legible, so that items can be identified correctly.

Training	– Ensure that all personnel have the necessary competence for their roles, based on recognised industry standards (where available) or internal assessment where necessary
	  – Provide suitable refresher training to avoid 'skill fade' in infrequent tasks such as rescues
	– Provide relevant site-specific inductions and training
	  – Ensure that trainers are competent
		– Work in accordance with training and additional information provided;
		– Understand and work within personal limits of competence and the remit of the training received.

Table 6: Employer and employee's duties in relation to safe work at height (continued)

Stage	Employer's duties	Employee's duties
Use of equipment	– Provide instructions and training for correct use of equipment – Ensure that anchor points are unquestionably reliable (in terms of strength and stability, when initially installed, and by periodic inspection after installation) – Where anchorages other than designated anchor points are to be used, they should be assessed by a competent person as being unquestionably reliable – Ensure that anchor locations minimise the distance and consequence of falls, including the potential for a swinging fall – Ensure that exclusion zones are established or other protection provided against falling objects as necessary	– PPE should be worn and used correctly, according to the work situation and conditions; – Connect to fall protection systems while in a safe location, where there is no risk of a fall from height; – Ensure that tools, work equipment and activities do not endanger safety of work at height: – e.g. beware of cutting tools, sparks from grinding, or chemicals, damaging PPE for work at height; – Ensure that personal fall protection systems are not exposed to rough or sharp edges, as these can damage ropes and lanyards; – Ensure that work equipment is secured at all times to prevent it from falling; – Establish and comply with exclusion zones; – Check that there is sufficient clearance to enable a fall to be arrested before contact is made with obstructions; – Remain alert to unexpected hazards or deviations from the intended plan;

Table 6: Employer and employee's duties in relation to safe work at height (continued)

Stage	Employer's duties	Employee's duties

Inspection and maintenance	– Ensure that equipment is subject to pre-use checks and periodic inspections by a competent person
	  – Ensure that defective equipment is withdrawn
	  – Keep appropriate records of inspection, and ensure that they are available
	– Operate an effective quarantine system for defective or suspect equipment
	– Ensure that equipment is stored properly
	– Ensure that equipment is maintained in a safe state
	– Comply with manufacturer's advice on obsolescence
		– Carry out pre-use checks, and put suspect equipment into quarantine – do not attempt to repair.

Supervision and reporting	– Ensure that safety is given the highest priority when work is being undertaken: encourage employees to stop if they have any doubts about the safety of a situation or action, and support the review of their concerns
	– Ensure that there is effective supervision
	  – Additional supervision may be necessary for inexperienced workers, or when high risk tasks are taking place
	  – Do not condone unsafe acts or behaviour – always intervene when such situations are observed
	– Encourage the reporting of hazardous observations, near hits etc.
	  – Ensure that lessons are learned and implemented effectively
	– Ensure that incidents and accidents are investigated thoroughly
	  – Ensure that both immediate and underlying causes are identified and addressed
		– Stop if unsure about the safety of an action or situation, and review before proceeding further;
		– Report hazardous observations, incidents, accidents etc;
		– Do not ignore unsafe acts or behaviour – always intervene when such situations are observed.

5 FLOWCHARTS: PREPARATION/REVIEW OF OPERATIONAL PROCEDURES

This section outlines a process that can be used to support the development of 'operational procedures' or 'work instructions' for offshore tasks involving work at height. These documents define both the technical and safety management steps to take in the execution of a task, and would form part of a safe system of work, supported by the risk assessment and method statement for the programme of works as a whole.

Four stages are outlined:
- preparation: defining the task, determining if a procedure is appropriate, and how it should be prepared;
- writing the procedure;
- implementing the procedure, and
- reviewing the procedure.

5.1 PREPARATORY STEPS

This stage considers the purpose of the procedure, initial risk assessment, and deciding how the procedure should be prepared, including deciding who should be involved in its preparation.

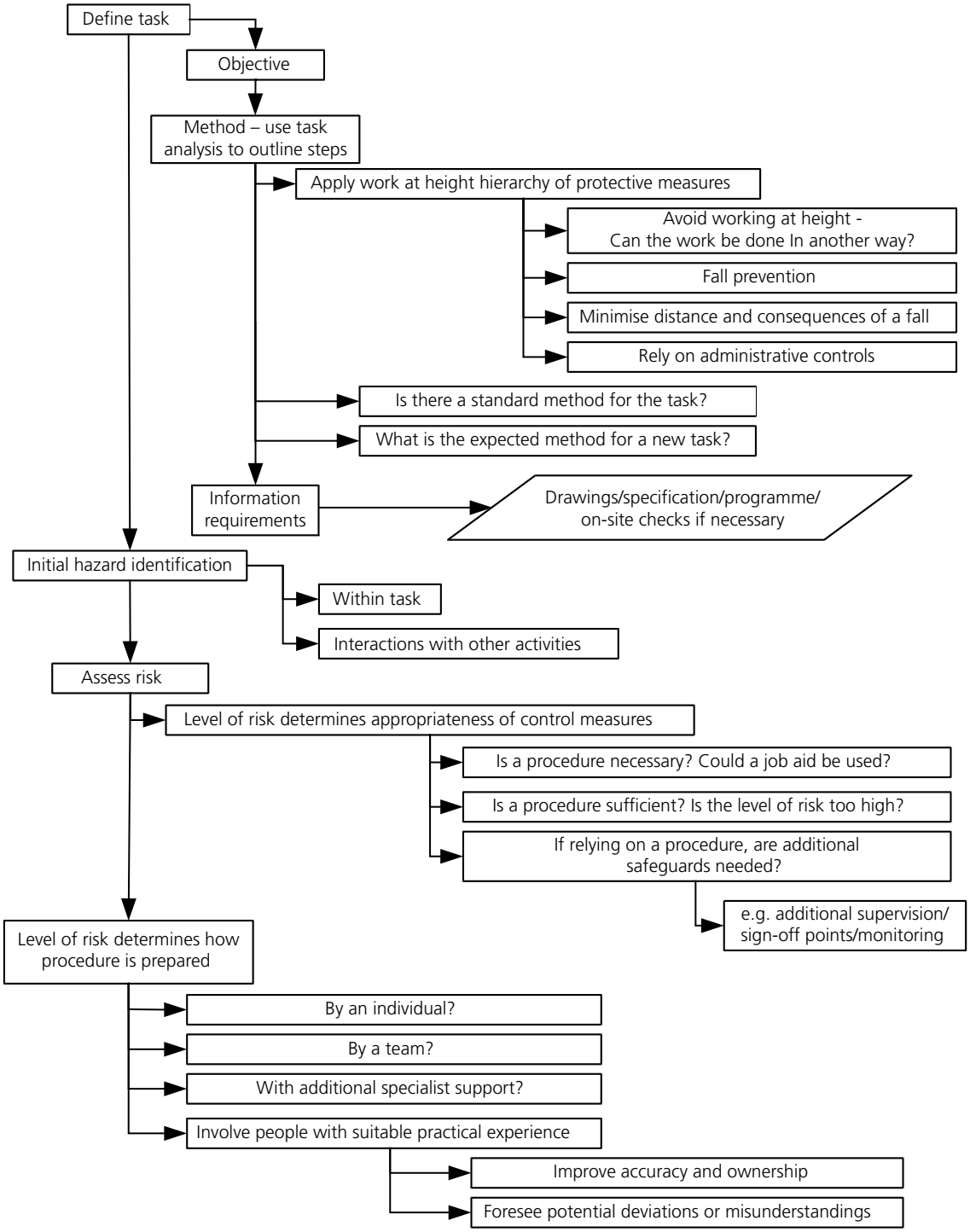


Figure 8: Flowchart for preparation before writing procedures for work at height

5.2 WRITING THE PROCEDURE

The aim of this stage is to produce a procedure that is readily understood, accurate, and provides the users with sufficient information about the task, the hazards involved, and how the hazards will be managed.

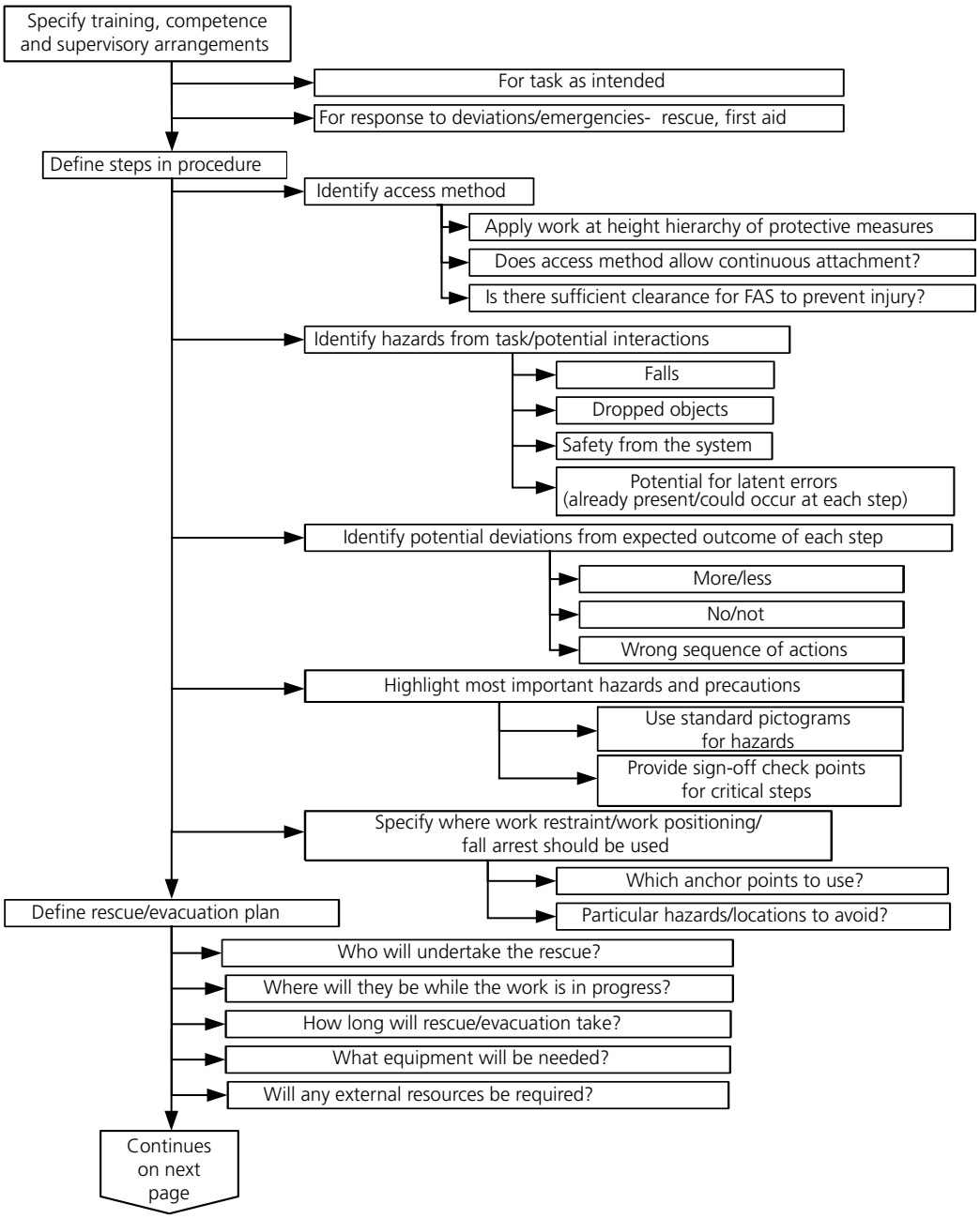


Figure 9: Flowchart for writing procedures for work at height

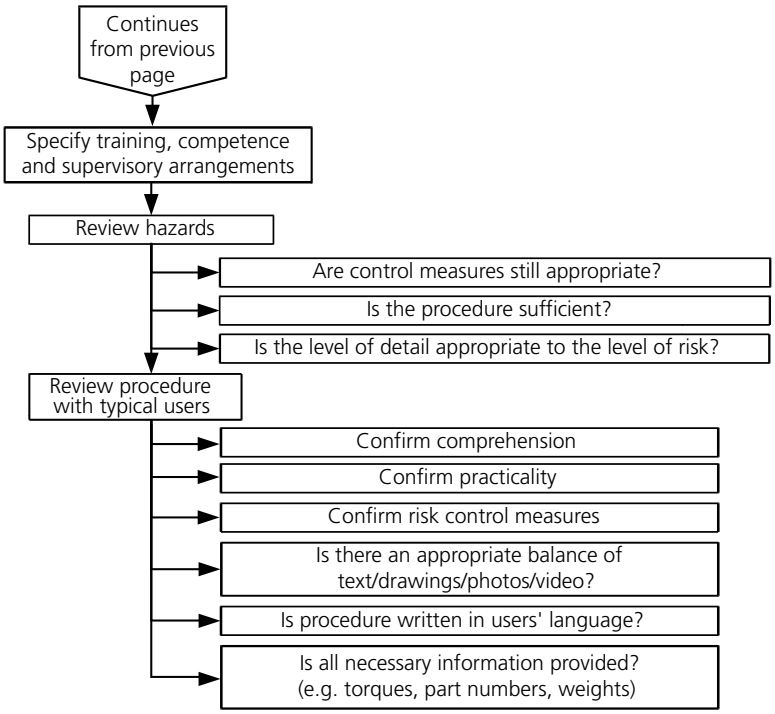


Figure 9: Continued

5.3 IMPLEMENTATION OF THE PROCEDURE

Effective implementation of procedures is essential, in order to ensure that tasks are performed consistently and correctly, risk assessments are valid, and risk control measures are effective.

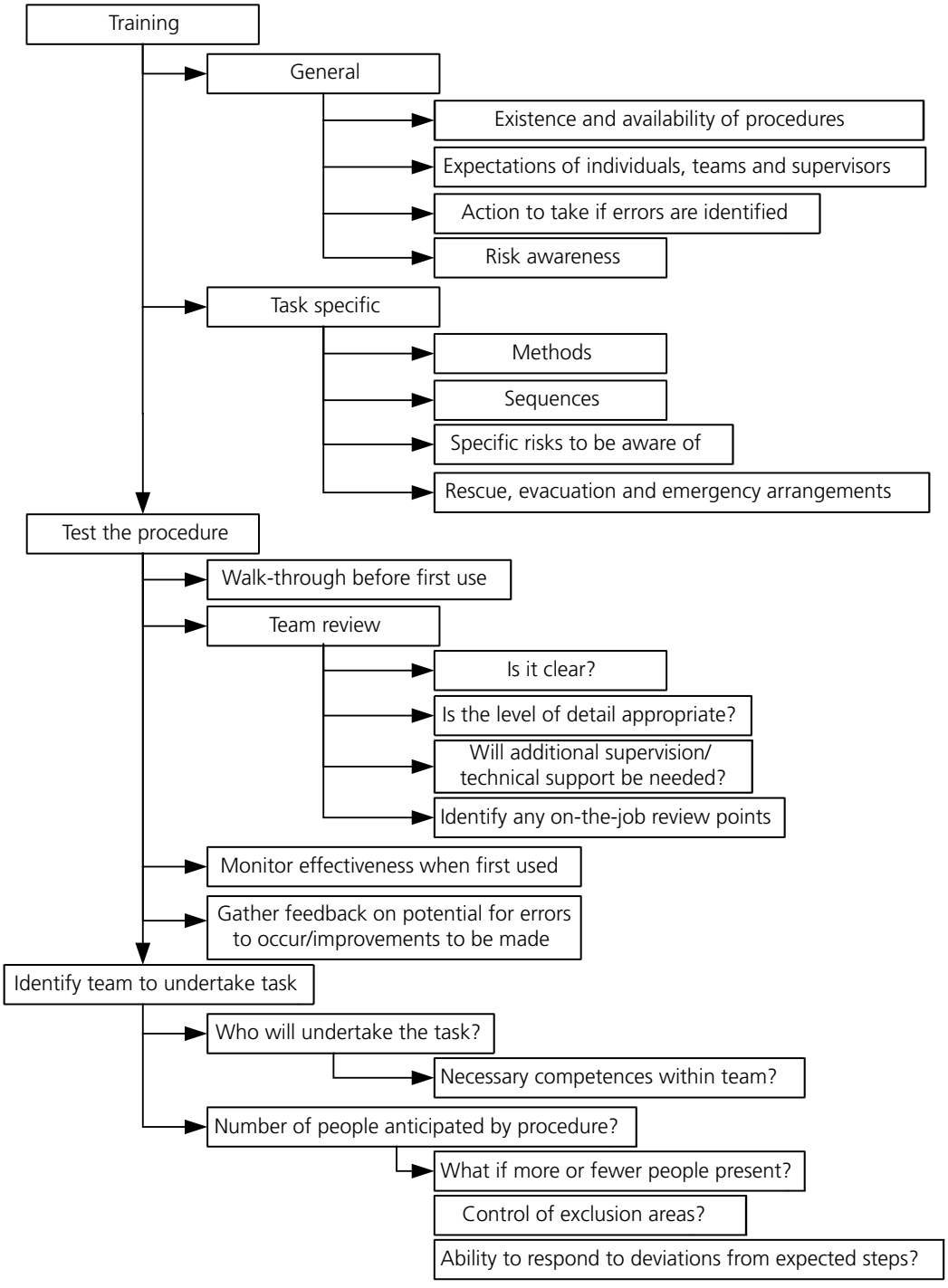


Figure 10: Flowchart for implementation of procedures for work at height

5.4 REVIEW OF PROCEDURES

Compliance with procedures is most readily achieved if procedures are accurate, efficient and practical. Operation of an effective review system allows for procedures to be improved, based on the learning from identified errors, incidents or hazardous observations, and the availability of improved methods or tools.

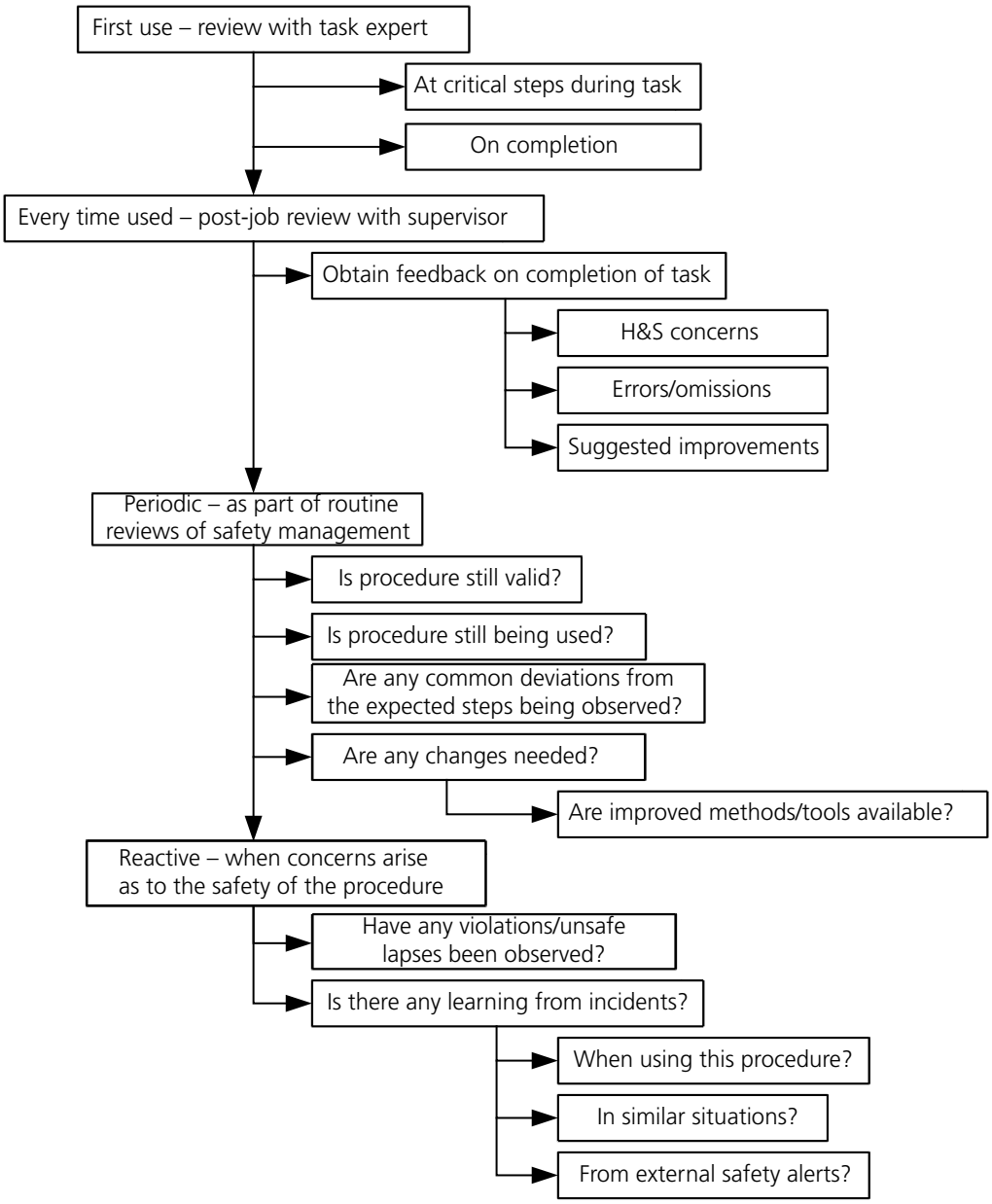


Figure 11: Flowchart for review of procedures for work at height

ANNEX A
EU DIRECTIVE AND NATIONAL REGULATIONS

The regulatory content of these guidelines is based on the regulatory regime within the EU; however, the broader content of the guidelines, such as hazards and good practices, could apply in any regulatory regime.

This section provides an overview of the EU directive relating to work at height, and the national regulations of six countries. It should be noted that the powers and responsibilities for health and safety regulation and enforcement lie with national governments, who will regulate on the basis of their national regulations, therefore compliance with local requirements is essential.

A.1 THE DIRECTIVE

EU legislation on work at height is contained in Directive 2009/104/EC 'concerning the minimum safety and health requirements for the use of work equipment by workers at work', otherwise known as the Work Equipment Directive, which is the second individual directive made under the Framework Directive. There is no directive relating exclusively to work at height.

As the directive defines the minimum requirements, governments are free to apply higher standards in their national regulations; in particular, the directive does not define work at height; this is contained in (or omitted from) regulations. The resulting differences in national regulations can be a source of confusion and conflict in a multi-national workplace.

A.2 RELEVANT CONTENT OF THE DIRECTIVE

Key parts of the directive are summarised in Table 7; direct quotations are in italics, and key points are emphasised in bold. It should be noted that where the directive mentions ladders, the provisions generally relate to portable, rather than fixed, ladders.

Table 7: EU Directive requirements for work at height

Section	Summary of provision
Article 3	Employer to **ensure that work equipment is suitable for the work**, and safe to use. If risks cannot be eliminated, they shall be minimised.
Article 4	Employer to ensure that work equipment complies with the requirements of Annex 1, and that it is **properly maintained**.
Article 5	Employer to **ensure that necessary inspections are carried out** in order to maintain health and safety conditions.
Article 8	Employer to **provide adequate information/instructions to enable safe use** of work equipment.
Article 9	Employer to **ensure that workers have the necessary training.**
Annex 1	Specifies minimum requirements in relation to a range of different risks. Specific requirements apply to certain groups of equipment; in particular Section 3.2.4 *gives the requirements for* ***work equipment for lifting or moving workers***, which includes both permanently-installed lifts and temporary equipment such as man-baskets.
Annex 2	Section 4 of the annex contains the specific requirements for 'work equipment provided for temporary work at height', including: **If . . . temporary work at a height cannot be carried out safely and under appropriate ergonomic conditions from a suitable surface, the work equipment most suitable to ensure and maintain safe working conditions must be selected. Collective protection measures must be given priority over personal protection measures.** The most **appropriate means of access** to temporary workplaces at a height must be selected according to the frequency of passage, the height to be negotiated and the duration of use. The choice made must permit evacuation in the event of imminent danger. Passage in either direction between a means of access and platforms, decks or gangways must not give rise to any additional risks of falling. **Ladders** may be used as work stations for work at a height only under circumstances in which, . . ., the use of other, safer work equipment is not justified because of the low level of risk and by reason of either the short duration of use or existing features on site that the employer cannot alter. **Rope access and positioning techniques** may be used only under circumstances where the risk assessment indicates that the work can be performed safely and where the use of other, safer work equipment is not justified. Depending on the type of work equipment selected on the basis of the foregoing, the appropriate measures for minimising the risks to workers inherent in that type of equipment must be determined. If necessary, provision must be made for the installation of **safeguards to prevent falls**. These must be of suitable configuration and sufficient strength to prevent or arrest falls from a height and, as far as possible, to preclude injury to workers. Collective safeguards to prevent falls may be interrupted only at points of ladder or stairway access. When the performance of a particular task requires the **temporary removal of a collective safeguard designed to prevent falls, effective compensatory safety measures must be taken.**

Table 7 (Continued)

Section	Summary of provision
Annex 2 (continued)	The task may not be performed until such measures have been taken. Once the particular task has been finished, either definitively or temporarily, the collective safeguards to prevent falls must be reinstalled. Temporary work at a height may be carried out only when the **weather conditions** do not jeopardise the safety and health of workers. Section 4.2 covers the use of **(portable) ladders**, and Section 4.3 covers the use of **scaffolding**. Section 4.4: Specific provisions regarding the use of **rope access and positioning techniques:** The use of rope access and positioning techniques must comply with the following conditions: (a) **the system must comprise at least two separately anchored ropes, one as a means of access, descent and support (work rope) and the other as backup** (security rope); (b) workers must be provided with and use an appropriate harness and must be connected by it to the security rope; (c) the work rope must be equipped with safe means of ascent and descent and have a self-locking system to prevent the user falling should he lose control of his movements. The security rope must be equipped with a mobile fall prevention system which follows the movements of the worker; (d) **the tools and other accessories to be used by a worker must be secured to the worker's harness or seat** or by some other appropriate means; (e) the **work must be properly planned and supervised**, so that a worker can be rescued immediately in an emergency; (f) in accordance with Article 9, the **workers concerned must receive adequate training specific to the operations envisaged, in particular rescue procedures.** In exceptional circumstances where, in view of the assessment of risks, the use of a second rope would make the work more dangerous, the use of a single rope may be permitted, provided that appropriate measures have been taken to ensure safety in accordance with national legislation and/or practice.

The European Commission has published non-binding guidance to good practice for the application of the directive in *How to choose the most appropriate work equipment for performing temporary work at height*.

A.3 REVIEW OF SELECTED NATIONAL WORK AT HEIGHT REGULATIONS

The regulations pertaining to work at height were reviewed for six countries: Great Britain and Northern Ireland, Denmark, Germany, Norway, the Netherlands and France. Key guidance documents were also identified, although the lists given in the following sections are not exhaustive. The guidance documents are listed for information, but have not been reviewed in detail.

A.3.1 GREAT BRITAIN AND NORTHERN IRELAND

- Legal framework:
  - Health & Safety at Work etc. Act 1974 (HSWA)/Health and Safety at Work (Northern Ireland) Order 1978.
  - Work at Height Regulations 2005 (WAHR)/Work at Height Regulations (Northern Ireland) 2005.
  - Apply to work throughout the GB EEZ[16].
- Definition of work at height:
  - 'work in any place, including a place at or below ground level' and 'obtaining access to or egress from such place while at work, except by a staircase in a permanent workplace, where' . . . 'a person could fall a distance liable to cause personal injury'.
- Regulators:
  - Health & Safety Executive.
  - Health & Safety Executive of Northern Ireland.
- Guidance:
  - Extensive range of guidance published by HSE and trade associations – see References.

A.3.2 DENMARK

- Legal framework: Working Environment Act
  - Matches directive - no height specified.
  - EU Directives are applied to Danish ships, and foreign ships carrying out construction work in Danish waters for a period of 14 days or more[17].
- Regulator:
  - Working Environment Authority (*Arbejdstilsynet*);
    - Enforcement guidance refers to 2 m; implies that action should only be taken if there are particular hazards, or height >2 m.
- Key points:
  - Extensive guidance on roof and ladder work.
  - Use of fall protection is limited to tasks of duration less than four man-hours.
  - Lifting equipment to be used for lifting people has to be registered with Labour Inspectorate.
  - Guidance for roof work allows work to be carried out on flat roofs up to 3,5 m high with no edge protection.

16 HSWA and specific regulations are extended offshore through the Application Outside Great Britain Order 2013.
17 See Chapter VI, Annex 3 of the Executive Order 1246 of 11/12/2009

Table 8: Danish regulations and guidance

Title	Translation/content
Bilag til bekendtgørelse nr. 1109 af 15. december 1992 om anvendelse af tekniske hjælpemidler	Order on the use of work equipment - Annex to Executive Order No. 1109 of 15 December 1992 concerning the use of work equipment (Section 6 of annex covers work equipment provided for temporary work at height)
Transportable personløftere med arbejdsstandplads (At-meddelelse nr. 2.04.3)	MEWPs
Bekendtgørelse om brug af personlige værnemidler Arbejdstilsynets bekendtgørelse nr. 1706 af 15. december 2010	Regulations on the use of PPE
Ulykker ved fald til lavere niveau	Guidance on prevention of injuries from falls to a lower level

A.3.3 GERMANY

- Legal framework:
  - Occupational Safety and Health Act (*Arbeitsschutzgesetz - ArbSchG*), Industrial Safety Ordinance (*Betriebssicherheitsverordnung - BetrSichV*);
  - ArbSchG applies throughout German EEZ[18], although BetrSichV only applies to German ships;
  - Matches Directive, no height specified, and
  - Statutory 'G41' medical examination required for work at height.
- Regulators:
  - German Social Accident Insurance (Deutsche Gesetzliche Unfallversicherung (DGUV)) is the umbrella association of the accident insurance institutions for the industrial (BG) and public sectors
  - Professional Associations (BG) for different sectors:
    - construction, BG Bau, and
    - power generation is covered by BG-ETEM,
  - publish guidance which sets out how to comply with the duties under regulations;
  - provide statutory health insurance and occupational health services;
  - Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA)) carries out research, development and knowledge transfer and provides policy advice, and
    - publishes Technical Rules for Occupational Safety (Technische Regeln für Betriebssicherheit (TRBS)).
- Extensive and detailed guidance:
  - workplace guidelines;
  - technical rules for occupational safety, and
  - BG rules, regulations, information.

18 ArbSchG Article 1(1), BetrSichV Article 1(4).

– Rope access trade association FISAT – Fach- und Interessenverband für seilunterstützte Arbeitstechniken has its own Level 1 – 3 certifications for rope access technicians and supervisors.

Table 9: German regulations and guidance

Title	Translation
Arbeitsschutzgesetz - ArbSchG	Occupational Safety and Health Act
Betriebssicherheitsverordnung - BetrSichV	Industrial Safety Ordinance
Technische Regel für Betriebssicherheit 2121 Gefährdung von Personen durch Absturz - Allgemeine Anforderungen	Technical Rule for Occupational Safety 2121 Risk to people from falling: General requirements
Technische Regel für Betriebssicherheit 2121 Teil 1 Gefährdungen von Personen durch Absturz - Bereitstellung und Benutzung von Gerüsten	Technical Rule for Occupational Safety 2121 Part 1 Risk to people from falling: Provision and use of scaffolding
Technische Regel für Betriebssicherheit 2121 Teil 3 Gefährdungen von Personen durch Absturz - Bereitstellung und Benutzung von Zugangs- und Positionierungsverfahren unter Zuhilfenahme von Seilen	Technical Rule for Occupational Safety 2121 Part 3 Risk to people from falling: Provision and use of rope access and positioning techniques
Technische Regel für Betriebssicherheit 2121 Teil 4 Gefährdungen von Personen durch Absturz - Heben von Personen mit hierfür nicht vorgesehenen Arbeitsmitteln	Technical Rule for Occupational Safety 2121 Part 4 Risk to people from falling: lifting of people using work equipment not designed for lifting people
DGUV Information 201-018 (BGI 772) Handbetriebene Arbeitssitze	Rope access
DGUV Information 250-449 (BGI/GUV-I 504-41) Handlungsanleitung für die arbeitsmedizinische Vorsorge nach dem Berufsgenossenschaftlichen Grundsatz G 41 'Arbeiten mit Absturzgefahr'	Guide to the G41 medical for work at height
DGUV Grundsatz 312-906 BGG 906 Auswahl, Ausbildung und Befähigungsnachweis von Sachkundigen für persönliche Schutzausrüstungen gegen Absturz	Selection, training and certification of competent persons for (inspection of) personal fall protection equipment.
DGUV Regel 112-198 BGR/GUV-R 198 Benutzung von persönlichen Schutzausrüstungen gegen Absturz	Use of personal fall protection equipment
DGUV Regel 112-199 BGR/GUV-R 199 Retten aus Höhen und Tiefen mit persönlichen Absturzschutzausrüstungen	Rescue from height and depth using personal fall protection equipment

Table 9: German regulations and guidance continued

Title	Translation
DGUV Information 212-870 BGI 870 Haltegurte und Verbindungsmittel für Haltegurte	Work positioning belts and connectors
DGUV Information 208-019 BGI 720 Sicherer Umgang mit fahrbaren Hubarbeitsbühnen	Safe use of MEWPs
DGUV Regel 101-005 BGR 159 Hochziehbare Personenaufnahmemittel	Suspended access equipment
DGUV Information 203-007 BGI 657 Windenergieanlagen	Wind turbines
FISAT – Fach- und Interessenverband für seilunterstützte Arbeitstechniken	German Association for Rope Access – Level 1,2,3 certifications

A.3.4 NORWAY

Note that Norway is not an EU member, but has adopted the requirements of many EU directives and European standards.

- Legal framework:
  - Working Environment Act;
    - applies to oil and gas activities in Norwegian Territorial Sea and continental shelf – not explicitly applied to other activities, and does not apply to shipping;
  - work at height is regulated in the 'Regulations for the execution of work', chapter 17.
  - similar to Directive, although some differences in relation to ladders – sets limits of 4 m, 6 m depending on type.
- Regulator:
  - Norwegian Labour Inspectorate;
  - Industrial Safety Organisation is the supervisory authority for industrial safety.
- Guidance:
  - Very limited guidance from regulators;
  - Employers are responsible for working out how to fulfil duties:
    - detailed guidance published by major firms, or groups of firms such as the oil and gas initiative 'Working together for Safety' (SfS).
- Norwegian Standards match EN.
- Rope access trade association: SOFT - Samarbeidsorganet for tilkomstteknikk, which has two certification levels: Class A (Advanced, within which are levels 1 – 3 and Safety Supervisor) and Class B (Basic), defined in standard NS 9600.

Table 10: Norwegian regulations and guidance

Title	Translation/content
Lov om arbeidsmiljø, arbeidstid og stillingsvern mv. (arbeidsmiljøloven)	Working Environment Act
Forskrift om utførelse av arbeid, bruk av arbeidsutstyr og tilhørende tekniske krav. Kapittel 17. Arbeid i høyden	Regulations for the execution of work, the use of work equipment and associated technical requirements Chapter 17 – work at height

A.3.5 THE NETHERLANDS

- Legal framework:
  - Working Conditions Act, Decree, Regulations, Annexes;
    - applies to activities within the EEZ;
  - Amendment to Working Conditions Decree matches the Directive; however, Article 3.16 of Decree refers to 2,5 m as the height above which protective measures are needed;
- Regulator:
  - Inspectorate SZW;
- Guidance:
  - 'Work Catalogues' document how employers and unions in a sector have agreed to implement regulations:
    - e.g. 'Energy production and supply', 'Energy network companies', 'Building and infrastructure' all have provisions on work at height;
  - work catalogues contain advice on measures to be taken by organisations and employees to control specific risks.

Table 11: Dutch regulations and guidance

Title	Translation/content
Arbeidsomstandighedenwet (Arbowet)	Working Conditions Act (translation)
Besluit tot Wijziging van het Arbeidsomstandighedenbesluit) Staatsblad, 2004-06-29, No. 279, pp. 1-5	Decree Amending the Working Conditions Decree, adding provisions regulating the use of work equipment for temporary work at height.
Arbocatalogus - Risico: Vallen van hoogte	Work catalogue: Risk: falling from height.
Arbocatalogus - Risico: Letsel door vallende voorwerpen	Work catalogue: Risk: injury from falling objects
PBM: persoonlijke valbeveiliging	Personal fall protection advice
Algemene informatie over het risico valgevaar	General information on the risk of falls
Arbouw-advies Veilig werken op hoogte	Advice on safe work at height

A.3.6 FRANCE

- Legal framework:
  - Code of Work, not explicitly extended throughout EEZ, and
  - relevant articles match Directive, height not defined;
- Regulator:
  - Ministry of Labour;
- Guidance:
  - Key publication bodies are:
    - INRS (l'Institut National de Recherche et de Sécurité - National Institute for Safety Research);
    - CNAMTS (Caisse nationale de l'assurance maladie des travailleurs salariés) – National Fund for Employees' Health Insurance.

Table 12: French regulations and guidance

Title	Translation/content
Code du travail, Articles R4323-58 – R44323-90	Transposes directive into French law
INRS - La prévention des chutes de hauteur	Prevention of falls from height (brochure)
INRS - Prévention des risques de chutes de hauteur	Prevention of risk of falling from height
INRS - Plates-formes élévatrices mobiles de personnel	MEWPs
INRS - Principales vérifications périodiques	Principles of periodic inspection (not limited to PPE)
INRS - Repérer les situations de travail en hauteur, prévenir les risques	Guidance on risk prevention in work at height (website)
CNAMTS - Utilisation des systems d'arrêt de chutes	Recommendations on use of fall arrest systems
CNAMTS - Utilisation de plates-formes élévatrices mobiles de personnes (PEMP)	Recommendations on use of MEWPs
CNAMTS - Dispositifs d'ancrage pour les équipements de protection individuelle contre les chutes de hauteur	Recommendation on anchor devices for use with personal fall protection equipment
SYNAMAP Guide d'installation des dispositifs d'ancrage permanent selon la norme EN 795 pour les EPI contre les chutes de hauteur	SYNAMAP (PPE manufacturers' and distributors' association) guidance on installation of EN 795 anchor points

ANNEX B
REVIEW OF EXISTING WORK AT HEIGHT GUIDANCE

Table 13: Review of existing work at height guidance

Document	Scope and industry relevance	Comments
Work At Height Safety Association (WAHSA) Technical Guidance Note (TGN) TGN01 – *Consideration for the use of personal fall protection equipment*	Document provides brief guidance on considerations when selecting work at height equipment including: – Suitability – Condition – Traceability – Compatibility – Security – Anchorages – Fit – Age of equipment – Clearance – Selection	Document is very basic, providing headings and a brief overview on considerations. Document could not be used on its own, as it does not go into detail and offers no specific information on manufacturing standards.
WAHSA TGN02 – *Guidance on the selection, use, maintenance and inspection of retractable type fall arresters*	Document provides detailed information on: – The function of a fall arrester – Applicable standards – When a fall arrester should be used – Safety concerns when using fall arrester – Checks to be made if intending to use a fall arrester – Pre-use checks to be carried out on the fall arrester – Inspection and servicing frequencies of a fall arrester – Cleaning, storage and maintenance of a fall arrester – Training and rescue when using a fall arrester	The document makes reference to suitable clearance distance but does not provide any information on how to determine this clearance or where to find this information.

Table 13: Review of existing work at height guidance (continued)

Document	Scope and industry relevance	Comments
WAHSA TGN03 – *Guidance on inspecting personal fall protection equipment*	Provides guidance on the interpretation of regulation 12 of the Work at Height Regulations 2005. Areas covered include: – The UK legal requirements for inspection – Practical reasons for inspection – Details on inspection frequencies and regimes – Competence requirements of inspectors – Record keeping – Withdrawing equipment from use Document also references relevant British Standards, UK regulations and HSE guidance	Document is fairly high level and does not offer detail on actual inspection criteria.
WAHSA TGN04 – *Guidance on the use of single and twin energy absorbing lanyards*	Provides information on the use of energy absorbing lanyards. Areas covered in the guidance include: – The function of energy absorbing lanyards – Correct and incorrect methods of attaching an energy absorbing lanyard – Differences between a single lanyard, double lanyards and twin lanyards – Information on acceptable lanyard life – Information on acceptable user weight – Training recommendations The guidance also references other documents in the WAHSA guidance note series, standards, codes of practice, UK regulations and HSE guidance	

Table 13: Review of existing work at height guidance (continued)

Document	Scope and industry relevance	Comments
WAHSA TGN05 – *Guidance on rescue during work at height*	Provides guidance on emergency planning and the provision of rescue resources for work at height: – The legislative requirements for emergency planning – Considerations for rescue – Types of casualty rescue – Procedures for casualty recovery – Medical implications of suspension – Overview of rescue equipment and its inspection including relevant standards – First aid	
WAHSA TGN06 – *Guidance on inspecting eyebolts used for personal fall protection purposes*	Document provides guidance on carrying out examination on class A1 anchor devices as per BS 7883:2005 (requires updating to latest version of standard). Areas covered in the guidance include: – Background to the guidance – Definition of class A1 anchor devices – Periodic examination requirements – Competence for inspection – Examination reports – Labelling – Marking of eyebolts – Test equipment	
WAHSA TGN07 – *Reference information for work at height*	Document identifies further sources of work at height information and guidance, including industry-specific information for the following industries: – Roofing – Construction – Rope access – Utilities and telecommunications – Scaffolding Document also covers sources for: – Mobile Access Towers (MAT) – Mobile Elevated Working Platforms (MEWP) – Ladders	Some of the references are now out of date

Table 13: Review of existing work at height guidance (continued)

Document	Scope and industry relevance	Comments
RenewableUK *Onshore and offshore windfarms,* Health and safety in the wind industry sector 2010	Document provides health and safety information for the wind industry, and was updated based on lessons learned in the industry from 2008 – 2010. Document identifies work at height as a hazard and also details: – Employer's duties under Work at Height Regulations 2005 – The need for specific work at height training for workers – Specific head protection requirements when working at height	Document essentially presents the Work at Height Regulations 2005 as guidance, so some parts are not specific to the wind industry. Document does not make any reference to work at height offshore. RenewableUK *Offshore Wind and Marine Energy Health and Safety Guidelines* partially superseded this document in 2013, and the onshore document is to be revised in 2014.
RenewableUK *Offshore Wind and Marine Energy Health and Safety Guidelines 2014*	Document provides health and safety guidance based on existing UK health and safety legislation and emerging good practice, and consists of three parts covering: A – Health and Safety Management B – The Offshore Project Lifecycle C – Offshore Hazards and Activities Section C-24 presents a detailed examination of work at height offshore, including: – Direct work at height health and safety risks – Commercial and operational risks relating to work at height – Relevance of work at height to the key lifecycle phases of an offshore project – The regulatory requirements of work at height offshore – Identifying opportunities to effectively manage offshore work at height risks – Considerations when carrying out reviews or managing changes	The Work at Height section does not go into any technical detail, only comprising one section of the wide-ranging overall guidance.

Table 13: Review of existing work at height guidance (continued)

Document	Scope and industry relevance	Comments
RenewableUK *Lifts in wind turbines 2011*	Health and safety briefing based on the implementation of Machinery Directive 2006/2/EC; provides a basic overview of the current knowledge and legislation regarding the selection, installation and use of lifts in wind turbines. Document provides information on: – The risks associated with the installation and use of lifts – The applicable legislation to review when installing and using lifts	The document recognises the challenges of achieving full compliance with the directive, and provides information, recognising the dynamic state of the technology.
RenewableUK *Approved Training Standard – Working at Height & Rescue – Wind Turbines*	Specifies the requirements for basic two-day work at height course, equivalent to GWO Basic Safety Training WAH module	Does not address in detail the specific training and knowledge requirements for: – Hub rescue or rescue within blades; or – Safe working at height and rescue associated with lifts in turbines; or – Safe working at height and rescue associated with climb assist and associated technologies; – Safe working at height and rescue for turbines where primary access to the nacelle is external to the tower; or – Any other situation with the potential for work at height or rescue in a wind turbine which involves more complex or extreme hazards or operational circumstances. (e.g. extreme weather; chemical exposures etc.)
IRATA – *Application of rope access methods in the construction, inspection, repair and maintenance of wind turbines*	Guidance document for work in and on wind turbines located both onshore and offshore. Document is designed to supplement the IRATA ICoP, and provides an overview of: – Planning and management of rope access work on turbines – Potential hazards when working offshore – Overview of competence and training requirements – Care and maintenance of equipment – Emergency procedures	Applicable to rope access works only.

Table 13: Review of existing work at height guidance (continued)

Document	Scope and industry relevance	Comments
IRATA – *International Code of Practice (ICoP)*	International voluntary code of practice gives definitions, recommendations and guidance on the use of IRATA international rope access methods. Document consists of five parts that provide detailed information on: Part 1: Document scope, terms and definitions, principles and controls. Part 2: Detailed guidance on: – Planning and Management – Objective – Planning – Pre-work analysis – Risk Assessment – Safety Method Statement – Procedures and personnel in place before work begins – Competence – Training – Managers and supervisors – Selection of equipment – Inspection and care of equipment – Primary rope access systems Part 3: Informative annexes Part 4: Legislation Part 5: Bibliography and further reading	Covers areas applicable to rope access operations only and does not cover certain line rescue techniques. Note that rope access does not include fall arrest.

Table 13: Review of existing work at height guidance (continued)

Document	Scope and industry relevance	Comments
HSE information sheet 4: *Selecting, using and maintaining personal fall protection equipment*	Part of the HSE's 'height aware' campaign. Information document designed to assist anyone working at height. Document provides information on: – The types of fall arrest equipment available – Considerations when selecting equipment, including standards – Training requirements for using the equipment – Maintenance of equipment – Additional sources of information	Document provides general information aimed at users of fall arrest equipment but does not refer to any industries, and only provides an overview of the individual considerations. Document was withdrawn by HSE while these guidelines were being prepared, and replaced by the 'WAIT Toolkit', which addresses common work at height situations – it does not set out to cover the complex situations that may arise during offshore wind work at height.
HSE work at height solutions – register at: http://webcommunities.hse.gov.uk	Website providing public questions and answers covering various topics including falls from height, including: – Selection and use of equipment – Industries with prominent work at height risks – Industry-specific tasks and how to manage work at height risks.	Although information offered can be used in the offshore wind industry, very little wind industry-specific questions are available.
Step Change in Safety – *Best practice guide to manriding safety 2002 and Manriding Checklist*	Guidance document covering best practice information for manriding operations in the oil and gas industry. Areas covered include: – Top 10 alternatives to manriding – Training and competence – Manriding hand signals – Manriding competence task list – Pre-manriding checklist – Manriding register – Participating companies	Comprehensive document covering a high risk activity; however, document is now 11 years old and may not include other technologies that have since been developed.

ANNEX C
GUIDANCE ON TECHNICAL AND EQUIPMENT STANDARDS

The principal standards relating to equipment for work at height are listed in Table 15, together with comments that provide information on their current status, any current areas of concern about their content, or common areas of confusion. Further detail on helmet standards is given in Table 16.

Additional introductory information is given on CE marking and environmental effects on equipment performance, as this is only partially addressed in the standards.

C.1 CE MARKING

The CE mark is only permitted to be applied to products that fulfil the 'basic' or 'essential' health and safety requirements of an EU directive or regulation on the supply of new products. In order for a product to bear the CE mark, it must either:

– Fulfil the requirements of a harmonised EN standard, i.e. a standard that carries the presumption of conformity to the appropriate directive, or
– Be assessed (on the basis of its technical file and type testing) against the requirements of the appropriate directive or regulation.

The definitive list of harmonised standards is published in the Official Journal of the EU; information is also available on the European Commission Enterprise and Industry website.

For typical equipment used in offshore wind, relevant directives include the:

– PPE Directive, 89/686/EEC, and
– Machinery Directive 2006/42/EC (this includes WTGs, lifts in WTGs, and lifting accessories).

It should be noted that the General Product Safety Directive 2001/95/EC covers products intended for, or likely to be used by, consumers, so is not applicable to products for professional use, while EU regulation 305/2011 on Construction Products is mainly concerned with basic requirements of normal construction products (such as their structural and thermal performance), rather than the characteristics of specialised components such as anchor points.

Health and safety directives, such as the Work Equipment Directive, which impose duties on employers in relation to the provision and use of work equipment, do not contain any provisions relating to CE marking.

There are several different situations in which an item of equipment cannot bear a CE mark; depending on the reason for the absence of a CE mark, these situations may or may not be safe. Examples of these situations are given in Table 14. It should be noted that there is no single recognised marking that indicates that an equipment item conforms to a non-harmonised standard.

Table 14: Safety implications of products without the CE mark

Reason for absence of CE Mark	Probable safety implications	Example
The equipment conforms to applicable EN or national standards, but is of a class of equipment that is not subject to a directive	Safe, based on the standard	Rescue lifting device to EN 1496:2006
There is no applicable standard	Safety depends on design, testing and product quality	Lifting bag*
The equipment conforms to a standard that does not satisfy the health and safety requirements of a relevant directive	Unsafe	Fall arrester to EN 353-1: 2002, without having passed the additional testing requirements
The equipment does not conform to applicable standards	Unsafe	Connectors that have not been sourced through an appropriate supply chain, and are of unknown origin and performance

C.2 ENVIRONMENTAL EFFECTS ON EQUIPMENT PERFORMANCE

Testing requirements in the standards may include carrying out performance tests in a range of ambient temperatures, and in both wet and dry conditions.

Certain standards listed in Table 15 include corrosion testing, such as by undertaking a neutral salt spray test in accordance with EN ISO 9227 *Corrosion tests in artificial atmospheres. Salt spray tests*; however, this does not necessarily imply suitability for use in a marine environment – particularly in challenging locations such as the splash zone. Information on suitability for such use, and any additional requirements for care and inspection, should be obtained from the manufacturer.

* Lifting accessories are subject to the Machinery Directive, but lifting bags are not classified as lifting accessories (in contrast to items such as textile slings). See Machinery Working Group publication *Classification of equipment used for lifting loads with lifting machinery* for details of equipment classification.

Table 15: Technical and equipment standards

Key:

PPE?: indicates whether or not the standard relates to PPE.

PoC?: indicates whether conformity to the requirements of the standard provides Presumption of Conformity to the basic requirements of the PPE Directive.

Standard	PPE?	PoC?	Title/subject	Comments
BS 7883	N/A	N/A	Code of practice for the design, selection, installation, use and maintenance of anchor devices conforming to EN 795	Current, but revision work is in progress to take account of the revision of EN 795 and publication of PD CEN/TS 16415.
BS 7985	N/A	N/A	Code of practice for the use of rope access methods for industrial purposes	Provides recommendations and guidance which supplement ISO 22846.
BS 8411	N/A	N/A	Code of practice for safety nets on construction sites and other works	Provides guidance on the use, selection and specification of personnel safety nets.
BS 8437	N/A	N/A	Code of practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace	Detailed guidance on a wide range of aspects of personal fall protection, including: – Basic principles; – Selection of systems, including restraint, work positioning and fall arrest; – Rescues, including planning and equipment requirements; – Equipment, including correct and incorrect usage; – Advantages and disadvantages of different design details, for example, different closing and locking mechanisms on connectors, or different attachment points on harnesses; – Inspection, care and maintenance of equipment, including information on modes of deterioration; – Safe methods of work, including method statements, working practices, clothing and protective equipment, and hazards to beware of;

Table 15: Technical and equipment standards (continued)

Standard	PPE?	PoC?	Title/subject	Comments
BS 8437 continued				– Anchoring, including designated anchor points, anchoring to structures, anchoring more than one person; and the different requirements for anchors used for restraint and for fall arrest; – Testing of harness comfort and adjustability; – Suggested inspection checklists for a range of different types of equipment; – Calculation of free space requirements for different types of FAS; – Properties of artificial fibres used in fall-protection PPE; – Effect of wind speed on working times. While legislative references are UK-specific, and some are out of date, the principles contained in the guidance could be applied anywhere.
BS 8454	N/A	N/A	Code of practice for the delivery of training and education for work at height and rescue	The standard gives recommendations and guidance on the delivery of formal training and education for work at height, whether that training is provided internally or externally, at a training centre or in the workplace. It covers roles, facilities, management system, personnel, equipment, first aid provision, courses and assessment, delivery of training, and certification of trainees. It includes the requirement that, if any person is to be suspended on a single line, for example when using equipment for personal evacuation or rescue after a fall, an additional safety system should be used. This ensures that persons being trained are not put at unnecessary risk. It does not specify course content.

Table 15: Technical and equipment standards (continued)

Standard	PPE?	PoC?	Title/subject	Comments
EN 341	TBC*	No	Personal fall protection equipment. Descender devices for rescue	Includes both automatic (Type 1) and manually operated (Type 2) descender devices: Type 1 devices (such as constant rate descenders) do not require any intervention by the user to control their speed, once their descent has started; Type 2 devices have a braking system that requires user intervention, and therefore travel with the user down a fixed rope. The standard includes four classes of descender, according to whether they are for multiple descents (Classes A – C) or one descent only (Class D). Each of classes A – C has a different descent energy rating, which determines the limit on the product of weight, height of descent and number of descents that the device can control. (See 3.1.8.1 for further details)
EN 353-1: 2002	Yes	No	Personal protective equipment against falls from a height. Guided type fall arresters including a rigid anchor line	Presumption of conformity was withdrawn due to safety concerns – this is outlined in the National Annex of the BS version of this standard. In the absence of a harmonised standard, users (i.e. employers) need to: – Find out which additional tests (beyond EN 353-1 requirements) have been carried out to arrest backwards and sideways falls; – Check with manufacturer/supplier to find out if there are any restrictions on the types of harness that are compatible with the FAS, and – Ensure that there are suitable end stops on the line (where applicable). Additional tests are contained in a Recommendation for Use sheet**. Users should also ensure that the device is being used within its design limits, such as limits on deviation from vertical.

* Clarification on this point is being sought at the time of publishing of this draft.

** Recommendation for Use sheet CNB/P/11.073 published by Vertical Group 11 *Protection against falls from a height* of the European Coordination of Notified Bodies in the field of PPE.

Table 15: Technical and equipment standards (continued)

Standard	PPE?	PoC?	Title/subject	Comments
EN 353-1: 2014	Yes	Yes	Revised standard expected in Q3/4 2014 Personal fall protection equipment – Guided type fall arresters including an anchor line	The revised standard is intended to address the shortcomings in the 2002 edition, and regain the presumption of conformity, thereby eliminating the need to undertake additional tests beyond those contained in the standard. The scope and the requirements are based on the philosophy that a guided type fall arrester including a rigid anchor line is rated to sustain the maximum dynamic load generated in a fall from a height by the mass of one person, including any equipment carried. The standard provides requirements and test methods for such fall arresters, used in personal fall protection systems in accordance with EN 363. Annex B provides details of significant technical changes between this document and the previous edition EN 353-1:2002.
EN 353-2	Yes	Yes	Personal protective equipment against falls from a height. Guided type fall arresters including a flexible anchor line	Flexible anchor line is a synthetic fibre or wire rope, attached only at an upper anchor point – most commonly used on a temporary basis, prior to installation/commissioning of a permanent FAS. The condition/age of the rope can affect the effectiveness of the 'rope grab' element of this type of FAS; testing is always done on new rope (including under conditions of heat, cold and wet, and optionally with dust or oil contamination).
EN 354	Yes	Yes	Personal fall protection equipment. Lanyards	This standard relates to restraint lanyards – by definition, must not be able to get to the fall hazard, as these lanyards do not provide any shock absorption. – Standard does not include requirements or testing for resistance to UV and abrasion, but does include testing in wet/cold conditions, and for slippage of the adjusting mechanism; – Do not 'choke' the lanyard unless the manufacturer permits this (and it has been tested accordingly).

Table 15: Technical and equipment standards (continued)

Standard	PPE?	PoC?	Title/subject	Comments
EN 355	Yes	Yes	Personal protective equipment against falls from a height. Energy absorbers	In order to minimise the distance and consequences of a fall: – Attach lanyard as high as possible (consistent with the tasks to be carried out); – Use the shortest possible lanyard that can reach the available anchor points (maximum available is 2 m, shorter is preferable); – Ensure that there is sufficient clearance for the lanyard to arrest potential falls; – Always attach above body's centre of gravity, and centrally – never use a side attachment point for fall arrest; – Beware of pendulum falls – user may swing into obstruction; also risk of lanyard being damaged/cut if it slides along a sharp/rough edge while user is swinging; – Do not extend the fall height, for example by adding additional slings or karabiners to the system; – Stow carefully when not in use – long lanyards are a tripping hazard; Standard covers different types: – Single leg, for attachment to a fixed or mobile anchor point; – Twin-tailed ('y-shaped') lanyard with single energy absorber – enables continuous attachment while moving around – but don't clip spare leg back to harness, as energy absorber will be bypassed; – Two single-legged energy absorbers – don't clip both legs to the same anchor (except momentarily whilst traversing) – the forces to extend each of the lanyards add together, risking injury; Standard test is with 100 kg mass; check min/max user weights in instructions. Energy absorbers start to deploy at 2 kN, so users should avoid exerting a shock load. Note that lanyards need to be compatible with the rescue kit: if the rescue kit includes a rope grab, it must be capable of engagement with the lanyards – webbing-type lanyards are incompatible with most rope grabs.

Table 15: Technical and equipment standards (continued)

Standard	PPE?	PoC?	Title/subject	Comments
EN 358	Yes	Yes	Personal protective equipment for work positioning and prevention of falls from a height. Belts for work positioning and restraint and work positioning lanyards	– Standard covers both the belt and the lanyard. – Assess back support ('comfort') as per BS 8437.

EN 360	Yes	Yes	Personal protective equipment against falls from a height. Retractable type fall arresters	– Should not use over edges;
				– Avoid pendulum falls – risk of swinging into obstruction, or rope being damaged/cut as it runs along edge;
				– Use in the correct plane, i.e. an overhead anchor point is generally required,– there is no test to prove the 'cone of influence';
				– Don't leave anchor line extended – use a tag line;
				– Is path of cable direct, i.e. not impeded?
				– Consider whether the following features are required:
				  – Swivel hook;
				  – Fall arrest indicator;
				  – Short webbing attachment strop;
				  – Retraction brake;
				  – Integral means of rescue (larger blocks);
				  – Tolerance of some movement before starting to engage, to allow use from vessel at boat landing on offshore structure – but note that there is no standard test/ specification for this feature;
				  – Assess use in wet, dusty, cold and icy conditions;
				  – If using with horizontal anchor lines, check if 'ratchet bounce' is an issue;
				  – Need to be able to achieve the 'lock on' speed – ensure that obstructions in fall path will not prevent this.
				– Standard is currently being revised (August 2014).

Table 15: Technical and equipment standards (continued)

Standard	PPE?	PoC?	Title/subject	Comments
EN 361	Yes	Yes	Personal protective equipment against falls from a height. Full body harnesses	– Assess 'comfort' e.g. leg loops for climbing; – Good fit is important, e.g. adjustability; – Care with choice of connector(s) for front attachment point: webbing loops can close up during rescue (versus a D-ring) and cross-gate loading should be considered; – Instructions for use will specify how attachment points are to be used, and how to ensure compatibility; – The standard allows for attachment to fall arrest systems at the front (sternal) or back (dorsal) positions, however, note that if fall arrest lanyards are attached to the dorsal attachment point, they will have to be longer than if they were attached at the front, thereby increasing the distance of any fall; – When working in work positioning/restraint, always attach to both sides of work positioning belt, otherwise the load will not transfer to the sub-pelvic straps of the harness, risking injury to internal organs.
EN 362	Yes	Yes	Personal protective equipment against falls from a height. Connectors	Standard covers: – Screwlink connectors, for locations that are used infrequently; – Basic connectors (such as karabiners); – Termination connectors (such as scaffold hooks); with – Self-closing, manual locking and self-locking types of gate. Usage: – Consider the alignment of any connectors; – Consider 'roll out'; – Keep loading to 'spine' – use of wide strops can distribute the load further away from the spine, increasing the stress on the connector; – Consider whether a 'captive' connection is required?
EN 363	N/A	N/A	Personal fall protection equipment Personal fall protection systems	– Describes fall protection systems, built up from the components in product standards (e.g. anchor point + lanyard + harness).

Table 15: Technical and equipment standards (continued)

Standard	PPE?	PoC?	Title/subject	Comments
EN 364	N/A	N/A	Personal protective equipment against falls from a height. Test methods	– Contains information on test facilities and equipment, as well as methodology (Note: As new standards are produced, the latter are being replaced). More applicable to manufacturers and notified bodies.
EN 365	N/A	N/A	Personal protective equipment against falls from a height. General requirements for instructions for use, maintenance, periodic examination, repair, marking and packaging	– Primarily (not exclusively) aimed at manufacturers.
EN 397	Yes	Yes	Industrial safety helmets	– See Table 16 for detailed comparison of helmet standards.
EN 795	Some	No	Personal fall protection equipment. Anchor devices	– The French Government has lodged an objection, claiming that Types A, C and D are not PPE; if this objection is upheld, standard will no longer be harmonised, so will not permit use of CE mark – this was the case for the previous version of the standard. – EN 795 anchor points are only for single users – for multi-user anchor points see PD CEN/TS 16415 – For exclusions see Scope, e.g. the standard does not cover 'structural anchors'. – EN 795 and TS16415 do not cover anchor systems that are not intended to be removed from the structure, and therefore may not strictly apply to most anchor systems in WTGs; however, the test methodology is still a valid approach; – Type C: 'Horizontal' is defined as +/- 15 degrees – must ensure that attachment to the system is done in a point of safety; – Check anchor loads resulting from 'vector' forces; – Note that recent draft of EN 50308 specifies anchor points with a 'two-person' rating of 20 kN – this approach may be incompatible with EN 795.

Table 15: Technical and equipment standards (continued)

Standard	PPE?	PoC?	Title/subject	Comments
EN 813	Yes	Yes	Personal fall protection equipment. Sit harnesses	– Consider adequacy of back support and comfort of leg loops;
EN 1263	No	No	Safety nets: 1 – Safety requirements, test methods; 2 – Safety requirements for the positioning limits	– Specifications for the manufacture, testing and installation/positioning of safety nets for fall arrest. (Revision expected in 2014)
EN 1496	No	No	Personal fall protection equipment. Rescue lifting devices	– No CE mark.
EN 1497	TBC	Yes	Personal fall protection equipment. Rescue harnesses	
EN 1498	No	No	Personal fall protection equipment. Rescue loops	– May not be as appropriate (comfort) as a 'nappy' rescue harness, but useful in restricted access areas.
EN 1868	N/A	N/A	Personal protective equipment against falls from a height. List of equivalent terms	
EN 1891	Yes	Yes	Personal protective equipment for the prevention of falls from a height. Low stretch kernmantel ropes	– Standard rope is Type A – low stretch ('semi-static').
EN 12492	Yes	Yes	Mountaineering equipment. Helmets for mountaineers. Safety requirements and test methods	– Commonly used in wind industry, but are generally incompatible with PPE such as ear defenders, face visors etc. – See Table 16 for detailed comparison of helmet standards.
EN 12841	Yes	Yes	Personal fall protection equipment. Rope access systems. Rope adjustment devices	– Back-up devices (Type B): Opinion has been expressed that part of the standard is flawed.

Table 15: Technical and equipment standards (continued)

Standard	PPE?	PoC?	Title/subject	Comments
EN 14052	Yes	Yes	High performance industrial helmets	– New standard - fulfils site safety helmet requirement but also meets climbing requirements, close fitting, no peak, undergo impact testing across top and sides of helmet, two-point chin strap retention strap system, able to mount head torch and other PPE (depending on design). – See Table 16 for detailed comparison of helmet standards.
EN 50308	No	No	Wind turbines — Protective measures — Requirements for design, operation and maintenance	– Refers to EN ISO 14122 for walkways, climbing facilities such as ladders. – Specifies anchor points in detail, 20 kN for safety lines/10 kN per person (min 20 kN) for emergency descent points. – Specifies ladders to be 'safeguarded by an anti-fall device comprising an anchorage line and fall-protection mechanism or a climbing cage (shaped structure) if the vertical height exceeds 3,0 m, although allows for omission of cage if ladder is within 0,8 m of WTG wall, and climber has back to wall. – Shortcomings of the standard are widely recognised; a revised draft was released in 2013, but was not adopted, and future plans for this standard are not known at present.
EN ISO 14122	No	Yes	Safety of machinery – Permanent means of access to machinery (Note: this standard is a harmonised standard, giving Presumption of Conformity in relation to certain Essential Health and Safety Requirements of the Machinery Directive)	Standard is in four parts: – Part 1: Choice of a fixed means of access between two levels; – Part 2: Working platforms and walkways; – Part 3: Stairways, stepladders and guard-rails; – Part 4: Fixed ladders. While the standard provides detailed and useful design requirements, some of its provisions conflict with current understanding of safe design (for example, the standard prefers the use of hoop ladders to fall arrest systems).

Table 15: Technical and equipment standards (continued)

Standard	PPE?	PoC?	Title/subject	Comments
ISO 22846-1	N/A	N/A	Personal equipment for protection against falls. Rope access systems. Fundamental principles for a system of work	– Provides the fundamental principles for a safe system of work in industrial rope access; – The IRATA ICOP adopts these.
ISO 22846-2	N/A	N/A	Personal equipment for protection against falls. Rope access systems. Code of practice	– Does not cover the 'quality' aspects provided by trade association, e.g. IRATA; – The IRATA ICOP provides far more detail. However, it is lacking on management/supervision; – IRATA is currently preparing supporting information on hazards specific to work on wind turbines.
PD CEN/TS 16415	No	No	Personal fall protection equipment. Anchor devices. Recommendations for anchor devices for use by more than one person simultaneously	– EN 795 and PD CEN TS16415 do not cover anchor systems that are not intended to be removed from the structure, and therefore may not strictly apply to most anchor systems in WTGs; however, the test methodology is still a valid approach.

Table 16: Comparison of safety helmet standards

Standard	EN 397	EN 12492	EN 14052
Title of standard	Industrial safety helmets	Mountaineering equipment. Helmets for mountaineers	High performance industrial helmets
Purpose	Protect the wearer against **falling objects** and consequential brain injury and skull fracture	Protect the upper part of a wearer's head against **hazards which might occur during activities carried out by mountaineers**	**Greater protection from falling objects,** protection from off-crown impacts and protection from penetration by a flat blade striker It also includes a **retention system** that meets mandatory requirements for system **release force** and system **effectiveness**
Mandatory requirements	**Shock absorption (vertical)**, resistance to penetration, flame resistance, **chin strap strength and release** and label	**Shock absorption, (vertical, front, side, and rear)**, resistance to penetration, **retention system strength and effectiveness** (roll off) and label	**Shock absorption at the crown and a range of angles**, resistance to penetration, **retention system strength, release and effectiveness**, flame resistance and label
Optional requirements	Very low temperature (-20 °C or -30 °C), very high temperature (+150 °C), electrical properties (up to 440 V a.c.), lateral deformation and molten metal splash		Performance at lower temperatures, performance at higher temperature, resistance to radiant heat, electrical properties and molten metal splash
Shock absorption	A **5 kg** striker (with a hemispherical surface) is dropped onto the helmet from a height of **1 m** The maximum transmitted force cannot exceed **5 kN**	**5 kg hemispherical striker** is dropped from a height of **2 m**, at **top**. A **5 kg flat striker** is dropped from a height of **500 mm, at the front, rear and sides** The transmitted force cannot exceed **10 kN**	**Crown impact**: **100 J (5 kg dropped 2,04 m)**. **Off-crown impacts: 50 J (5 kg dropped 1,02m**) with the headform inclined at **angles of 15°, 30°, 45° and 60°.** The force transmitted shall not exceed **5 kN** for an impact to the crown and the deceleration of the striker shall not exceed 300 *g* for off-crown impacts

Standard	EN 397	EN 12492	EN 14052
Penetration	A **3 kg pointed cone striker** is dropped from a height of **1 m**, onto an area **at the crown** of the helmet. The striker must not contact with the headform underneath the helmet	A **3 kg pointed cone striker** is dropped from a height of **1 m**. The striker must not contact with the headform underneath the helmet Tests can be carried out on **any point around the shell** of the helmet	A **1 kg flat blade striker** is dropped **2,5m** (**crown** impacts) and **2 m** (**off-crown** impacts), with no contact between the striker and headform allowed
Chin strap/ retention system	Chin strap is optional. If fitted, it must have a minimum width of 10 mm, when un-tensioned The standard requires that the **anchorage shall withstand no less than 150 N, but break at no more than 250 N**	Chin strap can **withstand a sustained load of 500 N** for two minutes, with <25 mm of movement of the helmet. There is **no specified breaking force for the strap**. **Basic testing of retention system effectiveness**	Chin strap is optional, but manufacturer may specify it as an essential part of retention system. **Must release at a force of no less than 150 N and no more than 250 N. Additional testing of retention system effectiveness**, using test headform and people carrying out specified exercises
Warnings in text of standard		Mountaineers' helmets are fitted with a retention system to retain the helmet on the head. However, there may be a foreseeable risk that helmets could become trapped and thereby cause a **risk of strangulation**	No requirements concerning **mechanical rigidity**, as no valid test method was recognised by the technical committee

Nothing in EN 397 would prevent a manufacturer from offering a helmet with a shell that also passed all or some of the additional testing requirements in EN 12492, combined with a chin strap that released as required under EN 397; such a helmet could only be certified to EN 397, but could be accompanied by information stating the additional type testing of the shell that had been undertaken. Users should ensure that they read the instructions for PPE, and use it as intended, taking account of any warnings or limitations.

ANNEX D
REVIEW OF FITNESS STANDARDS

A detailed review was carried out of the following:

- Energy Institute (EI) *A recommended fitness standard for the oil & gas industry*;
- Maritime and Coastguard Agency (MCA) ENG1 *Certification process*;
- Oil & Gas UK (OGUK) – *Medical aspects of fitness for work offshore*;
  - *Guidelines for examining physicians*;
- RenewableUK RUK *Medical fitness to work – Wind turbines*;
  - Guidelines for near offshore and land based projects.

The review is summarised in Table 17, and assessed the approach and criteria that are set out in each of these standards. It should be noted that only the RenewableUK standard has been specifically created for the wind industry; however, this standard does not set out to cover far-offshore wind farms or other situations where people are offshore for more than 24h at a time.

Of these four publications, the EI publication is entirely focused on fitness assessment; the other three approaches consider a wide range of underlying health issues, as summarised in Table 18.

In addition to the referenced standards, certain countries have statutory medical examination requirements for personnel undertaking work at height; these include:

- Germany:
  - Statutory 'G41' medical for people undertaking work at height:
    - Considers fitness and underlying medical conditions;
    - Duration of validity of certificate depends on age of person;
    - Medical examination may also be required prior to return to work after illness etc.
- Sweden:
  - AFS 2005:6 Art 41-45 defines medical examination requirements for a wide range of areas of work, with specific requirements for work at height:
    - Examination takes place annually, or following a relevant illness or accident;
    - Includes history of diseases or illnesses that can cause sudden loss of consciousness, or other sudden weakness;
    - Includes routine physical status with determination of blood pressure and the propensity for orthostatic reaction, assessment of cardiac and pulmonary status, and stress test with ECG monitoring. Frequency of ECG depends on age of candidate:
      - Once every five years for persons under 40 years old;
      - Biannual for persons between 40 and 50;
      - Annual for persons over 50.

Table 17: Summary of medical fitness assessments

Body	Purpose/target group	Approach/focus
EI	Clearly-defined fitness tests and their application to typical offshore oil and gas roles.	Fitness in relation to typical demands of offshore roles. Underlying health conditions not in scope of publication.
MCA	Unrestricted medical certificate allows work anywhere in world, in any role on any type of vessel.	Risk assessment, which may lead to an unrestricted certificate, or various levels of restriction (of duration and role). Strong emphasis on underlying health conditions. Carried out by doctors appointed by MCA, who should have an understanding of maritime operations.
OGUK	Personnel working on installations up to 200 miles from shore, with a crew of 20 – 250 persons; typical factors in this work include: Helicopter transfer, two – three week offshore tour of duty; Offshore survival and breathing apparatus training required; Offshore medic on installation; Evacuation to shore may take four – five h and could be delayed for two – three days at a time due to weather.	Risk assessment in relation to role, which may be specific (or restricted by the outcome of the medical) to a single installation. Strong emphasis on underlying health conditions that could present increased risk offshore.
RUK	Personnel working onshore and offshore, returning to shore within 24 h.	Health and fitness in relation to typical WTG tasks.

Note that the MCA Chief Medical Adviser is quoted in the RUK medical fitness guidelines as stating in March 2011 that 'The MCA standards should not be used except for the crews of vessels. Employment decisions for wind farm technicians based on these standards will not be valid, may not be safe and could leave the employer open to a legal challenge if a person is denied employment'.

Table 18: Summary of aspects of health considered in medical assessments

Shaded cells indicate that the standard considers the listed aspect of health; the actual health standard for each aspect may vary depending on the role for which the candidate is being assessed, and the combination of health issues that an individual presents.

Aspect of health	RUK	OGUK	MCA
Vision	■	■	■
Hearing	■	■	■
Cardiovascular system	■	■	■
Respiratory health	■	■	■
Locomotor system	■		
Nervous system	■	■	■
Diabetes	■	■	■
Mental state	■	■	■
Drugs and alcohol	■	■	■
Skin conditions	■	■	
Peripheral circulation	■	■	
Obesity	■	■	■
Physical fitness to climb	■		■
VO_2max: defined minimum value	■		
Gastrointestinal system		■	
Musculoskeletal disorders		■	
Genitourinary disorders		■	■
Diseases of blood-forming organs		■	
Organ transplants		■	
Malignant neoplasms		■	■
Infectious diseases		■	■
Dental health		■	■
Allergies and anaphylaxis		■	■
Medications being taken	■	■	■
Pregnancy		■	
Specific requirements for emergency response teams		■	
Specific requirements for crane operators		■	

D.1 KEY FINDINGS

None of the standards in Table 18has been created specifically to address the combination of risks that are present in offshore wind. Both the OGUK and ENG1 standards are based on a risk assessment approach, which relies on the medical practitioner having sufficient understanding of:

– The demands of a role, and how a person may:

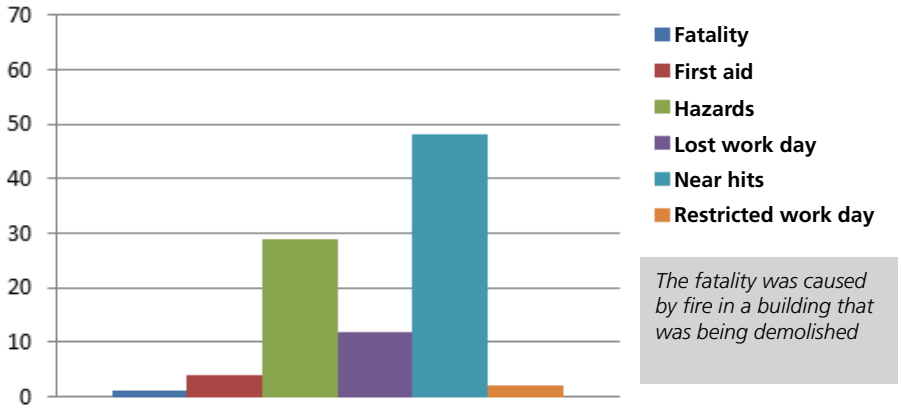
  - be fit to fulfil these demands, or
  - have health issues that may be adversely affected by the demands.
- The consequences of any health problem occurring when a person is at their place of work, including:
  - the level of medical care (if any) that is immediately available, and
  - the potential duration and challenges of evacuating the casualty to the level of medical care that their condition may demand.

Medical practitioners can only be expected to make valid assessments if they are given sufficient information on the role, and context of the role, for which the person is being assessed. The RenewableUK guideline could be used to provide such information, although with modifications to reflect the differences in far-offshore and long-duration deployments.

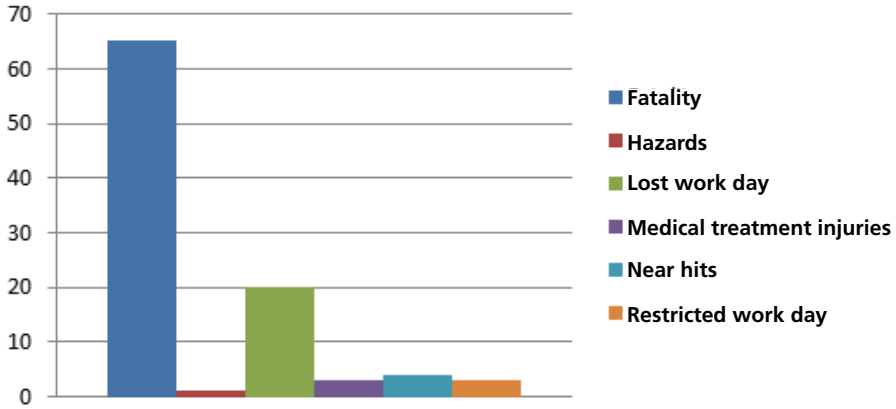
ANNEX E
INCIDENT DATA AND RISK PERCEPTIONS

E.1 ANALYSIS OF G9 MEMBER INCIDENT DATA

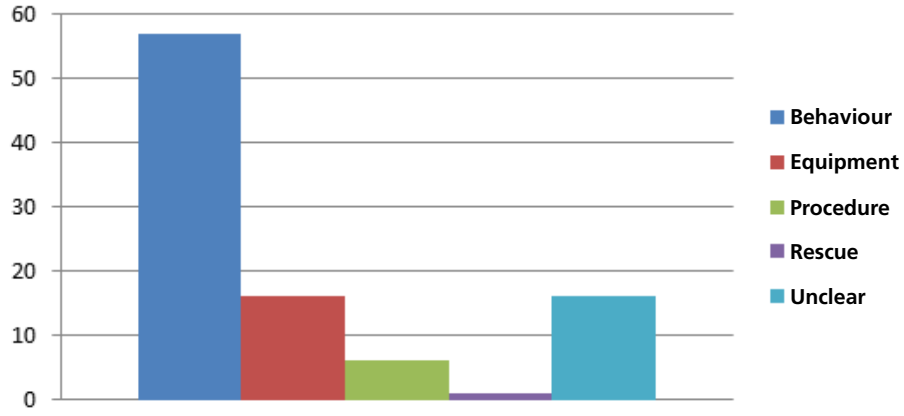
Incident data from January 2011 to June 2012 were provided for analysis. Within this period of 18 months, the nine companies reported a total of 95 incidents.



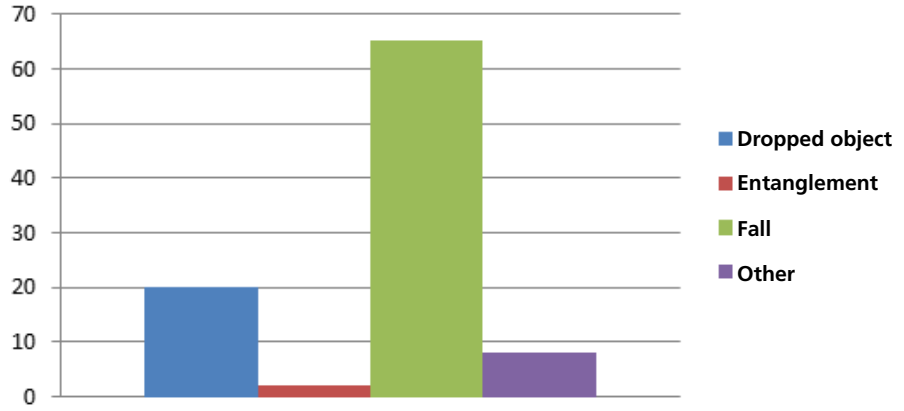
Graph 1: Actual severity of the incidents



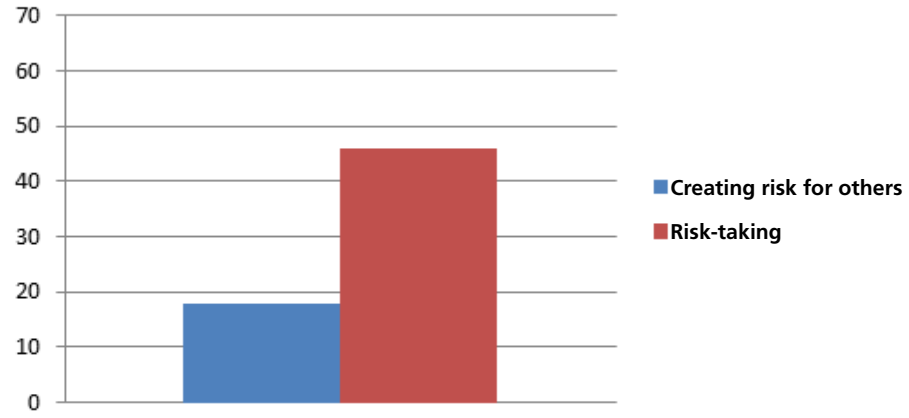
Graph 2: Potential severity of the incidents



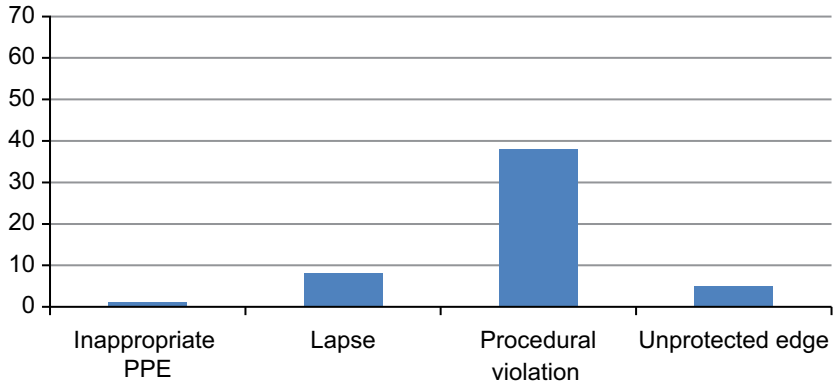
Graph 3: Immediate cause of the incidents



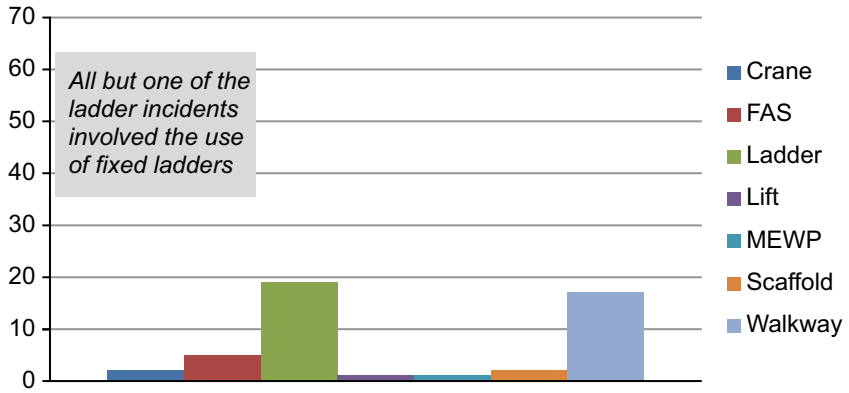
Graph 4: Identified hazard in the incidents



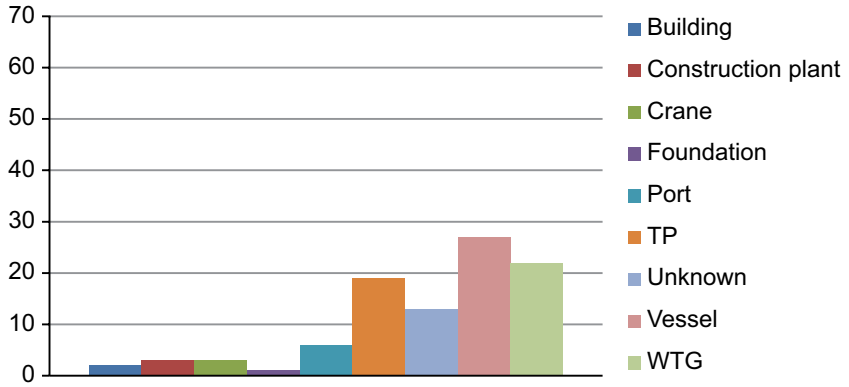
Graph 5: Who was immediately at risk in the incidents?



Graph 6: Types of behavioural failure in the incidents where behavioural failures were an immediate cause



Graph 7: Types of access equipment being used in the incidents



Graph 8: Locations of the incidents

E.2 SURVEYS TO IDENTIFY AREAS OF CONCERN

Following a project workshop with G9 representatives, it was agreed that an informal survey should be undertaken to identify areas of concern relating to work at height. Participants in the survey were asked 'What are your top 10 health and safety concerns relating to work at height?' The survey was carried out by:

- G9 representatives asking colleagues/contractors, and
- a questionnaire being offered to candidates at heightec, undertaking work at height revalidation courses for wind turbine climbing; 29 completed questionnaires were received in time for inclusion in this analysis.

This approach allowed the opinions of a wide range of technicians, managers and safety professionals to be taken into account.

The responses were collated, taking account of the rank that participants assigned to their different concerns; the results are given in Table 19. While there was broad agreement in the areas of concern, there are some noteworthy differences in perception:

- The heightec survey was mainly completed by technicians, who expressed higher levels of concern about procedures and rescue provision than the G9 results.
- Conversely, the G9 results had much higher levels of concern about falling objects and behaviour, which may reflect the 'management' perspective of this survey group.

This difference in perception is important, as it will affect the behaviours and priorities of the two groups in seeking to achieve safe work at height. All of the priority areas identified by both groups are addressed within sections 3 to 5 of these guidelines.

Table 19: Ranking of areas of concern from survey data

Topic group	G9 rank	heightec rank
Design	1	2
Falling object	2	6
Vessel transfer	3	3
Procedure	4	1
Behaviour	5	9
PPE	6	8
Maintenance	7	11
Organisation	8	10
Training	9	7
Rescue	10	5
Other		4

ANNEX F
BEHAVIOURAL SAFETY: BACKGROUND INFORMATION

F.1 SAFETY CULTURE

Safety culture is defined in HSE guidance as:

'the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's health and safety management.
Organisations with a positive safety culture are characterised by communications founded on mutual trust, by shared perceptions of the importance of safety and by confidence in the efficacy of preventive measures.'[19]

Each organisation on a project will have its own distinct safety culture – in some cases, different workgroups from the same parent company may also have different safety cultures. Safety cultures can be formally assessed using tools such as the Safety Culture Maturity Model[20], which can be used both internally (as a measurement tool to support improvement), and also as a means of recognising differences in approach between different organisations that will be working together. Where organisations with different safety cultures have to work together, significantly different approaches to safety are likely to appear, and will have to be resolved. For example, an organisation with a well-developed safety culture is likely to generate a high number of hazardous observations, whereas an organisation with a weaker safety culture might see this as an indication of problems.

The leadership of an organisation or project will have a major influence, either positive or negative, on its safety culture.

F.2 TYPES OF UNSAFE BEHAVIOUR

There are several different types of unsafe behaviour, with different contributory factors, and requiring different approaches in order to achieve improvements; these are summarised in Table 20.

19 HSE Human Factors Common Topic 4: *Safety culture*.
20 Step Change in Safety – 'Changing minds guide'

Table 20: Behavioural faults and contributory factors

Type of error/behavioural fault	Typical contributory factors
Deliberate deviation from procedure – routine	– Procedures are incorrect or impractical (in the opinion of the worker, who has to use them) – Short cuts make it easier to accomplish task, and resulting increased risk is not recognised – Low expectation of getting caught
Deliberate deviation from procedure – situational	– Attempting to meet conflicting or unrealistic demands – Trying to get the job done despite not having all of the necessary/correct resources available
Deliberate deviation from procedure – exceptional	– Abnormal circumstances that cause someone to take actions that deviate from the procedures with which they normally comply
Errors of action - lapses or omission – forgetting to do a routine action; or slips – doing routine action incorrectly	– High levels of distractions/interruptions/ fatigue – Confusing sequences of tasks – Level of competence of worker
Errors of thinking – following incorrect procedure for the prevailing circumstances e.g. using methods/equipment on one type of WTG that are intended for another type	– Limited understanding of procedures and their application
Errors of thinking – unfamiliar situation leads to wrong course of action being taken e.g. accident occurs, team focuses on immediate rescue/first aid, and fails to initiate wider emergency response plan	– Lack of realistic practice (drills) in handling unfamiliar situations
Latent errors – ineffective training and communication	– Weak processes for briefing teams and for handovers when tasks span more than one shift/period of work – particularly critical where tasks are interrupted by unplanned events such as weather, and the ability to conduct an orderly handover is challenged – Communication challenges increase with multinational workforce, especially when different contractors work together on a project, using systems established by another contractor – Understand scope and remit of training
Latent errors – errors/omissions/lack of clarity in design or procedures	– Insufficient attention being given to preparation of procedures – Personnel operating beyond their competence

F.3 RESPONSIBILITIES FOR BEHAVIOURAL SAFETY

The guidance in Annexes F.4 to F.6 considers the roles and responsibilities of **Employers**, contractors/employers and individuals separately, as each group has a different contribution to make. The exact roles may vary depending on contracting arrangements:

- On a construction project being managed by the **Client**, with a multi-contractor approach, the **Client** will have far more extensive responsibilities for the coordination of health and safety than on a project where this responsibility is fulfilled by a contractor.
  - The EU Temporary or Mobile Construction Sites Directive, as incorporated into national regulations such as the Construction (Design and Management) Regulations (CDM), defines specific appointments, and their responsibilities for construction projects.
- For work other than construction work, such as the majority of activities during the operations and maintenance phase, the **Employer** is free to adopt a range of organisational models, with different aspects of work and safety management being undertaken by themselves or contractors.

F.4 EMPLOYER'S RESPONSIBILITIES

When an **Employer** initiates any package of work, they:

- set the expectations (safety, price and schedule);
- appoint the main contractor(s), and
- have a role in monitoring how the work is carried out.

The exact legal duties will depend on the nature of the work, and which regulations apply. However, certain principles apply to most situations, and are outlined in the following sections.

F.4.1 Setting expectations

The **Employer** has to set clear and consistent expectations for contractors. If safety is the priority, then contractor selection should reflect this; if contractor selection is too strongly weighted towards the price, or the project schedule is unrealistic (either in terms of activity durations, or lead time for mobilisation), then this may lead to:

- lower-priced (and potentially less capable) vessels or sub-contractors being employed;
- people being over-stretched – rushing tasks, trying to do too many tasks at once, working when fatigued, or attempting tasks that are beyond their competence;
- work starting with inadequate preparation, so necessary resources and safety management arrangements may be missing;
- work continuing in unsuitable conditions;
- inadequate monitoring and review of how work is carried out;
- inadequate readiness and resources to respond effectively to incidents;
- a culture being created where shortcuts are tolerated (as they appear to save time and money), and
- pressure being put on people not to stop work on safety grounds, although this will seldom be stated explicitly.

Any of these factors could encourage unsafe behaviour.

The same expectations should be set for all contractors; for example, vessel crew working at height on the vessel should take similar precautions to those that a wind turbine technician would be expected to take on a similar task. If contractors have a background that does not include wind industry approaches to safe work at height, then additional effort may be necessary to set the expectations and ensure that personnel have appropriate training. Setting these expectations at the start of contractor selection can help to ensure that they are clearly defined as being at the core of the **Employer's** requirements, rather than potentially being seen as an afterthought, or an extra cost for which the contractor had not budgeted.

F.4.2 Selection of contractors

The **Employer** should assess the safety management capability of contractors, with the exact scope of the assessment reflecting the contractor's role.

- Where a contractor will be carrying out work directly on behalf of the **Employer**, key areas of assessment are:
  - how the contractor manages packages of work, such as how they define the scope of work, assess risks, prepare method statements, monitor execution of work, manage handovers between shifts and other teams, manage deviations from the expected method and review tasks on completion:
    - this should include the competence of people involved in preparing, supervising and executing work, and
    - competence assessment should consider both the technical ability to complete the task, and safety-related areas such as risk awareness.
  - the arrangements which the company has made for putting its policy into effect and for discharging its duties, and
  - leading and lagging indicators of safety, including evidence of hazardous observations being recorded and addressed, and jobs stopped if circumstances deviate from those envisaged in the procedure or method statement.
- Where a **Client** is appointing a main contractor (who may also fulfil the functions of a 'project supervisor' and/or 'coordinator for safety and health matters at the project execution stage', as defined in EU Temporary or Mobile Construction Sites directive), the safety performance of the project will be highly dependent on how this contractor manages safety and selects contractors. In these cases, a thorough assessment should be made of this contractor's processes for:
  - selection of contractors and personnel for key safety-related roles:
    - these processes need to ensure that a consistent level of competence is maintained at every level of subcontracting, particularly as the people who will actually be working at height may be employed by an entity that is several levels down the contracting chain;
  - preparation and review of risk assessments/method statements and procedures;
  - preparation of realistic schedules for work;
  - communication with contractors;
  - monitoring safe execution of work, and
  - managing deviations from expected situations, including response to incidents and emergencies.

While formal assessment of safety culture may be unrealistic, the **Employer** should have an understanding of their own safety culture maturity, and that of their contractors, in order to ensure that they are broadly compatible, and to identify areas where significant differences exist, or improvements are needed.

F.4.3 Ongoing monitoring

Once contractors have been appointed, the **Employer** still has a responsibility to ensure that the safety management arrangements are in place throughout the project. The means of doing this will depend on whether the **Employer** is managing the work directly, or if a main contractor is managing the work; typical methods include:

- Health and safety inspections and audits can be used to monitor whether work is being carried out safely, in accordance with the safety management system and approved procedures:
  - the follow-up to observations will depend on who is responsible for safety management.
- **Employer's** representatives must put forward a consistent message on health and safety, ensuring that cost and schedule considerations do not start to take precedence over safety.
- **Employer's** personnel on site must model the behaviours that the **Employer** is seeking from the contractors, including:
  - Respecting the safety management arrangements on a site, whether these have been implemented by the **Employer** or a contractor, and not seeking to be exempt from compliance with site rules, and
  - Taking appropriate action if they observe a hazardous situation or behaviour.

F.5 EMPLOYER'S RESPONSIBILITIES

This section outlines the responsibilities of contractors or other employers of people. For clarity, the term 'employer' is used throughout, but this should not be confused with the defined term '**Employer**' in a contract between companies.

Employers are directly involved in the management of work, and the selection and deployment of people, so have a high level of influence on the behaviour of people undertaking their scope of work.

At the earliest stage of their involvement in a project, employers need to ensure that schedules and budgets are realistic, to enable safe preparation and execution of the work. This is supported by the **Client's** duty to apply the general principles of prevention when estimating the period for completing work[21]. In the UK CDM regulations, this duty is explicitly stated as 'the allocation of sufficient time and other resources . . . to ensure that . . . the construction work can be carried out so far as is reasonably practicable without risk to the health and safety of any person'[22]. This duty should balance the **Client's** likely desire for the work to be done at the lowest cost and in the shortest timescale.

The employer's key responsibilities are to:

- identify hazards and assess risks;
- provide a safe system of work;
- ensure that the safe system of work is being operated effectively;
- provide the necessary information, instruction, training and supervision, and
- provide suitable and safe equipment, and ensure that it is used correctly.

21 Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile constructions sites, Article 4

22 Construction (Design and Management) Regulations 2007, Regulation 9 (1) (a)

Employers need to ensure that workers are competent to:
- undertake the intended task;
- identify, and react appropriately to, previously unforeseen hazards, and
- respond appropriately to incidents and emergencies affecting their work.

This level of competence goes beyond initial basic training and technical skills, and is about the qualities of being a safe worker:
- placing competent people into teams requires effective selection processes, together with training and development to build the necessary competence, however
- if the contracting environment results in a high proportion of personnel being on short-term contracts, the potential for developing competence will be reduced.

As incidents and emergencies should not be frequent occurrences, the responses should be practised regularly, so that people are ready to respond correctly to real incidents; this should include both the immediate rescue techniques, and site procedures for emergency response.

Deviations from approved procedures/methods will be minimised if:
- Employers ensure that procedures are accurate and practical:
  - this will only be possible if the procedures are prepared by competent people, with sufficient time;
  - in some cases, new procedures may have to be tested in carefully-controlled trial runs, before rolling out procedures to the whole organisation;
  - if situations change, or apparent errors are found in procedures, employers need to ensure that:
    - workers do not ignore procedures that they consider to be wrong or not applicable, but are clearly empowered to stop the job in such situations;
    - having stopped the job, workers and site supervisors have effective processes for reviewing procedures, together with clearly-understood boundaries within which they can make changes, and suitable support if further guidance is needed;
  - if workers can see potential improvements to procedures, particularly where these can reduce time and cost, then the operation of an effective suggestion scheme/engagement programme will allow potential improvements to be implemented in a controlled manner, with their risks properly assessed, rather than workers being tempted to take short cuts;
    - this also ensures that improvements are implemented across all relevant workgroups, and on future projects;
- employers ensure that work is carried out under a suitable level of supervision, taking account of the level of risk that a task involves, and the competence of the people involved, and
- employers establish a 'just' safety culture, in which honest reporting of genuine mistakes is encouraged, but deliberate violations of safety rules are not tolerated.

F.6 INDIVIDUAL RESPONSIBILITIES

While the **Employer** and other employers create the working environment, and hence influence behaviour, the final decisions about safe behaviour are taken by individuals.

The key responsibilities of individuals are to:
- know and work within personal limits of competence;
- understand and comply with site safety rules and procedures for tasks;

  - this also requires a clear understanding of the application of procedures;
- stop the task if it cannot be undertaken in accordance with the approved procedure, or if there is a change in circumstances or intent, and inform management;
- participate in reviews of procedures;
- suggest where procedures can be improved;
- report deviations from procedures (including formal reporting of deviations as 'Hazardous observations', if the deviations increase risk);
- highlight if the schedule for a task is unrealistic, or resources are inadequate;
- concentrate on the task, and enable others to do so, to minimise the risk of errors;
- support safe working by co-workers, by looking out for others who are putting themselves at risk through errors or deviations, and intervening in an appropriate manner, and
- participate in incident response drills, and review personal understanding of what to do in a given set of circumstances.

Fulfilling these responsibilities will be easiest in a culture where safety is truly given the highest priority, and there is a high level of trust. In a weak safety culture, a worker who stops a job on safety grounds may be seen as a troublemaker, to the detriment of their employment prospects.

Given that many wind industry tasks are undertaken by small, self-managed workgroups, with remote or occasional direct supervision, the reliance on individual behaviour is higher than in many other industries. Providing training that develops a high level of risk-perception, and the skills to have a 'safety conversation' can help to ensure that individuals can contribute effectively to creating a safe workplace.

F.7 IMPROVEMENT TOOLS

F.7.1 Safety culture maturity model

Research carried out for the UK HSE has identified five levels of safety culture maturity[23]; these are summarised in Table 21. It is important to understand the safety culture maturity of an organisation, as this will indicate where the most effective improvements can be made, and which tools to improve behaviour will be most appropriate.

23 HSE OTO 00049 *Safety culture maturity model*
See also Energy Institute *Human factors briefing notes*

Table 21: Five levels of safety culture maturity

Level	Title	Characteristics
1	Emerging	Technical and procedural solutions to ensure regulatory compliance Accidents seen as inevitable Low level of interest in safety – not seen as a key business risk – safety department carries primary responsibility for safety
2	Managing	Safety seen as a key business risk, and broad-based management effort is invested in accident prevention Focus on compliance with rules, procedures and engineering controls Management perception that majority of accidents are caused by unsafe behaviour of front-line staff Performance measurement based on lagging indicators, and management involvement is reactive
3	Involving	Relatively low accident rate, but not improving Recognition that accidents are caused by a wide range of factors, and root causes often include management decisions Increasing involvement of front-line staff
4	Cooperating	Health and safety is seen as important, on economic and moral grounds Recognition that accidents are caused by a wide range of factors, and root causes often include management decisions; front-line staff take personal responsibility for their own safety, and others around Significant effort invested in proactive measures to prevent accidents, and non-work accidents are also monitored
5	Continually improving	Prevention of harm is a core value, and all employees see health and safety as being a critical part of their work Excellent safety record, but not complacent Wide range of indicators used to monitor performance, and maintain high level of confidence in safety management processes Constantly striving to improve risk management

A range of different tools is available to assess the safety culture maturity of an organisation.

F.7.2 SAFETY LEADERSHIP DEVELOPMENT AND BEHAVIOURAL INTERVENTIONS

Moving to a higher level of safety culture maturity involves changes being made throughout an organisation; a high level of trust between and within different levels of the organisation, together with clear management commitment and effective two-way communication are necessary in order to create a suitable environment for behavioural change.

Guidance produced by Step Change in Safety[24] summarises a range of safety leadership and behavioural intervention tools, experiences of applying them, and critical success factors that have been identified in the offshore oil and gas industries. The guidance notes that it takes time for individuals and organisations to change their behaviour, and suggests that it may take at least 18 months to reach the next level of maturity. This has implications for offshore wind projects: successful safety culture change involves using a suitable tool (in relation to the current and desired future safety cultures), and sustaining a long-term commitment to the change programme.

24 Step Change in Safety – Changing Minds – A practical guide for behavioural change in the oil and gas industry.

REFERENCES

The documents listed in these References have been summarised in Annex B, or are referenced in the main text. Additional laws and guidance documents for specific nations are listed in Annex A.3 and BS/EN/ISO standards referenced in the main text are listed in Annex C, Table 15.

Advisory Committee for Roofsafety (http://www.roofworkadvice.info)

Guidance note for competence and general fitness requirements to work on roofs, ACR (CP) 005: 2012

Arbetsmiljö Verket (http://www.av.se/)

AFS 2005:6 Medicinska Kontroller I Arbetslivet, Articles 41-44 define Swedish medical surveillance requirements for work at height

Danish Maritime Authority (http://www.dma.dk)

Danish Maritime Authority Technical regulation on the construction and equipment, etc. of passenger ships on domestic voyages – Chapter III – Life-saving appliances.

Dropped Objects Prevention Scheme (http://www.dropsonline.org/)

Dropped Objects Prevention Scheme Global Resource Centre

Energy Institute (http://www.energyinst.org)

A recommended fitness standard for the oil and gas industry

Human factors briefing notes

European Union (http://europa.eu/index_en.htm)

Classification of equipment used for lifting loads with lifting machinery

Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile constructions sites

Directive 2009/104/EC of the European Parliament and of the Council concerning the minimum safety and health requirements for the use of work equipment by workers at work

European Risk Observatory Report - Occupational safety and health in the wind energy sector

Recommendation for Use sheet CNB/P/11.073 published by Vertical Group 11 *Protection against falls from a height* of the European Coordination of Notified Bodies in the field of PPE

Global Wind Organisation (http://www.windpower.org/en/global_wind_organisation/about_gwo.html)

Global Wind Organisation Basic Safety Training

Health and Safety Executive (http://www.hse.gov.uk)

Approved code of practice – *Managing health and safety in construction - Construction (Design and Management) Regulations 2007*

HSG150 *Health and safety in construction*

HSG48 *Reducing error and influencing behaviour*

Human factors common topic 4: Safety culture

INDG367 *Inspecting fall arrest equipment made from webbing or rope*

INDG401 *Working at height – A brief guide*
INDG422 *Thorough examination of lifting equipment: A simple guide for employers*
L101 *Safe work in confined spaces*, Confined spaces regulations 1997 Approved code of practice, regulations and guidance (2009 edition)
Offshore Technology Report 2002/021: *Compatibility test protocol for lifejackets and immersion suits on offshore installations*
Offshore Technology Report OTO 00049 *Safety culture maturity model*
Offshore Technology Report OTO 95 038 *Review of probable survival times for immersion in the North Sea*
Work at height solutions

International Maritime Organization (http://www.imo.org/)
Guidance on wearing immersion suits in totally enclosed lifeboats

International Rope Access Trade Association
Application of rope access methods in the construction, inspection, repair and maintenance of wind turbines
International Code of Practice (ICOP)

Maritime & Coastguard Agency (http://www.gov.uk/government/organisations/maritime-and-coastguard-agency)
ENG1 *Certification process*
The safety of small workboats and pilot boats – a Code of Practice applicable to small workboats operating in commercial use to sea and all pilot boats (the Workboat Code)

Oil & Gas UK (http://www.oilandgasuk.co.uk/)
Medical aspects of fitness for work offshore: Guidelines for examining physicians

RenewableUK (http://www.renewableuk.com)
First aid needs assessment
Lifts in wind turbines 2011
Medical fitness to work – wind turbines
Offshore wind and marine energy health and safety guidelines, 2014
Onshore and offshore wind farms, Health and safety in the wind industry sector, 2010

Step Change in Safety (http://www.stepchangeinsafety.net)
Changing minds guide
Best practice guide to manriding safety 2002 and manriding checklist
Changing minds – A practical guide for behavioural change in the oil and gas industry

Work At Height Safety Association (http://www.wahsa.org.uk)
TGN01 – *Consideration for the use of personal fall protection equipment*
TGN02 – *Guidance on the selection, use, maintenance and inspection of retractable type fall arresters*
TGN03 – *Guidance on inspecting personal fall protection equipment*
TGN04 – *Guidance on the use of single and twin energy absorbing lanyards*
TGN05 – *Guidance on rescue during work at height*
TGN06 – *Guidance on inspecting eyebolts used for personal fall protection purposes*
TGN07 – *Reference information for work at height*

ABBREVIATIONS AND DEFINED TERMS

AIS	automatic identification system
BOSIET	basic offshore safety induction and emergency training
CDM	Construction (design and management) regulations (implementing the *Temporary or mobile construction sites directive*, 92/57/EEC)
Client	The client, in the context of work subject to the *Temporary or mobile construction sites directive*, 92/57/EEC
Client	The client or customer of a service provider, in any context other than that of a **Client**
Contractor	A party that carries out work on behalf of an **Employer**
Employer	The party that engages contractors or suppliers to provide services or goods
Employer	The party that has line management and health and safety responsibilities for the people whom they employ
EEZ	exclusive economic zone
EI	Energy Institute
FAS	fall arrest system
g	acceleration due to gravity
GWO	Global Wind Organisation
HSE	Health and Safety Executive
HUET	helicopter underwater escape training
ICOP	International Code of Practice (IRATA publication)
IMCA	International Marine Contractors Association
IRATA	International Rope Access Trade Association
MAT	mobile access tower
MCA	Maritime and Coastguard Agency
MEWP	mobile elevating work platform
MOB	man overboard
MSD	musculoskeletal disorder
OGUK	Oil and Gas UK
OPITO	Offshore Petroleum Industry Training Organisation
PLB	personal locator beacon
PPE	personal protective equipment
RUK	RenewableUK
SAR	search and rescue
SART	search and rescue transponder
SRL	Self-Retracting Lifeline
SST	sea survival training
SWL	safe working load (The maximum load (as determined by a competent person) which an item of lifting equipment may raise, lower or suspend under particular service conditions.)
TP	transition piece
WAH	work at height
WAHSA	Work At Height Safety Association
WLL	working load limit (The maximum load, determined by the manufacturer, that an item of lifting equipment is designed to raise, lower or suspend.)
WTG	wind turbine generator

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

t: +44 (0) 20 7467 7100
f: +44 (0) 20 7255 1472
e: pubs@energyinst.org
www.energyinst.org

ISBN 978 0 85293 720 4
Registered Charity Number: 1097899