DNV·GL

W2W JIP

Gangway Access To Offshore Facilities

Walk-to-Work (W2W)

Industry Guidance

Det Norske Veritas Ltd., UK

Report No.: PP097552, Rev. 1
Document No.: 18T2TWB-619
Date: 2015-04-24

Participants of the W2W JIP are those represented above as well as others listed in the Acknowledgements section

Project name:	W2W Guidance JIP	Det Norske Veritas Limited
Report title:	Gangway Access To Offshore Facilities (W2W)	DNV GL Oil & Gas
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Project No.:	PP097552	
Organisation unit:	Aberdeen SHE Risk	
Report No.:	PP097552, Rev. 1	
Document No.:	18T2TWB-619	

Task and objective:

The DNV GL led 'W2W Joint Industry Project (JIP)' has developed a comprehensive industry guidance document (this W2W Guidance) to assist offshore facility operators achieve safe and efficient personnel transfers to/from their facilities via a gangway system on a workboat, ship or semi-submersible unit.

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Keywords:
JIP, W2W, Industry Guidance

Reference to part of this report which may lead to misinterpretation is not permissible.

Rev. No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
0	2015-04-23	Final Internal Draft	HAMISH/WALC	MISI	MISI
1	2015-04-27	Released for use	HAMISH/WALC	MISI	MISI

Foreword

The DNV GL led 'W2W Joint Industry Project (JIP)' has developed this comprehensive industry guidance document (referred to as the *W2W Guidance*) to assist offshore facility operators in achieving safe and efficient personnel transfers to/from their facilities via a gangway system on a workboat, ship or semi-submersible unit.

The term 'Walk to Work' (W2W) is used within this *W2W Guidance* to describe this mode of offshore facility manning. The term 'vessel' is used to refer to a floating facility on which a gangway system is installed (i.e. workboat, ship or semi-submersible unit). Offshore facilities may include, but not be limited to: wind turbines, jacket-supported oil and gas production platforms, and anchor-moored floating production storage and offloading (FPSO) ships.

The information contained within this document aims to provide organisations involved in, or considering, the implementation of a W2W solution, suppliers of vessels, gangway systems, onshore services and offshore facility modification services; with information to help deliver a suitable, cost effective and regulatory compliant system.

This publication has been compiled for guidance only and while every reasonable care has been taken to ensure the accuracy and relevance of its contents, the document author, DNV GL, and the sponsoring and supporting companies listed in the Acknowledgements, cannot be held responsible for any action taken, or not taken, on the basis of this information.

Acknowledgements

DNV GL would like to acknowledge the following participants of the W2W JIP for their support and active contribution in the development of the *W2W Guidance*:

- Ampelmann Operations
- Babcock
- BP
- Damen Shipyards
- Maersk Oil North Sea UK Ltd
- Marine Aluminium
- Nexen
- Perenco
- Shell
- Siem Offshore Contractors
- Statkraft
- Statoil
- UpTime
- Vroon Group
- Wagenborg Offshore

DNV GL would also like to acknowledge the following regulators for their support and contributions:

- UK Health and Safety Executive (HSE)
- UK Maritime and Coastguard Agency (MCA)
- Norwegian Maritime Authority (NMA)

Executive Overview

The manning and transfer of personnel to and from offshore facilities by a marine vessel via a gangway system provides an alternative to other means, such as by helicopter, basket transfer or boat landing.

Otherwise known as Walk to Work (W2W), this approach can offer significant benefits including, improved manning flexibility, reduced lifecycle costs and improved safety. It may also, depending on the capability of the chosen vessel, provide hotel, standby, cargo, crane, helicopter and other facilities.

The W2W vessel, which is the combination of vessel and gangway system, can range from relatively small and fast offshore wind farm workboats that ferry small groups of personnel between land and multiple wind turbines, to very large semi-submersible 'flotels'. The latter being stationed alongside fixed platforms and may remain on location for extended periods having the ability to accommodate many hundreds of personnel.

Within this range, W2W solutions based on Offshore Support/Service Vessels (OSVs), intervention vessels, construction vessels or other offshore multi-role vessels are becoming more common.

Figure 0.1 W2W Vessel Examples

A successful W2W solution requires the careful consideration of a number of components: selection of a vessel and gangway system; location of the gangway system on the vessel; location of gangway access location(s) on the offshore facilities; selection of port(s) and other support services on land; development of appropriate policies and procedures; and the engagement of the workforce and others involved.

Figure 0.2 W2W Components

Purpose built W2W vessels with integral gangway systems are available, where the vessel is designed and out-fitted for W2W operations. The design and construction of such ships indicates that the owners and operators will have endeavoured to optimise their vessels to safely deliver an effective and economic W2W capability.

An alternative to a purpose built W2W vessel is to install a gangway system on to an existing vessel. This approach requires those responsible for the selection of vessel and gangway system, and the installation of the gangway system on the vessel, to understand many important aspects. Aspects, that those responsible for the purpose built W2W vessel will have considered in depth.

Offshore facility operators planning to use a W2W solution need to understand and consider many factors from initial concept development through to live operations. Of key importance are the choice of a suitable vessel, the selection and positioning of an appropriately capable gangway system, if not already installed, and the integration of these with the offshore facilities that are to be serviced.

To develop a W2W solution and predict its likely performance there is a need to understand the interrelationships and dependencies between: environmental conditions at the offshore facility(s); vessel motion response and ability to hold location in these conditions; location of the gangway system on the vessel; capability of the gangway system to compensate for the vessel motions; and location of gangway access points on the facility(s).

This *W2W Guidance* has been written to help those involved in W2W, primarily the offshore facility operator who will have the need for a manning solution, to understand the important aspects requiring consideration during the selection and implementation of a W2W solution. This should encourage and expedite development of safe, cost effective and regulatory compliant, W2W solutions.

All stages of the W2W lifecycle, from the initial requirement definition through concept development into operation are covered in this *W2W Guidance*. It covers the full size range of W2W vessels, but focuses on the mid-range (i.e. mono-hull service type vessels). The *W2W Guidance* does not address personnel transferring using an alternative means to a gangway, such as by jumping or being lifted to/from the offshore facility by crane or robotic arm. It also does not address operations where the gangway is deployed from the offshore facility rather than from the vessel.

This *W2W Guidance* has been developed to provide general guidance that is not country, industry or W2W solution specific. It contains no mandatory sections and is for information only.

The *W2W Guidance* is structured to follow the typical flow of a W2W project, as shown in the following figure.

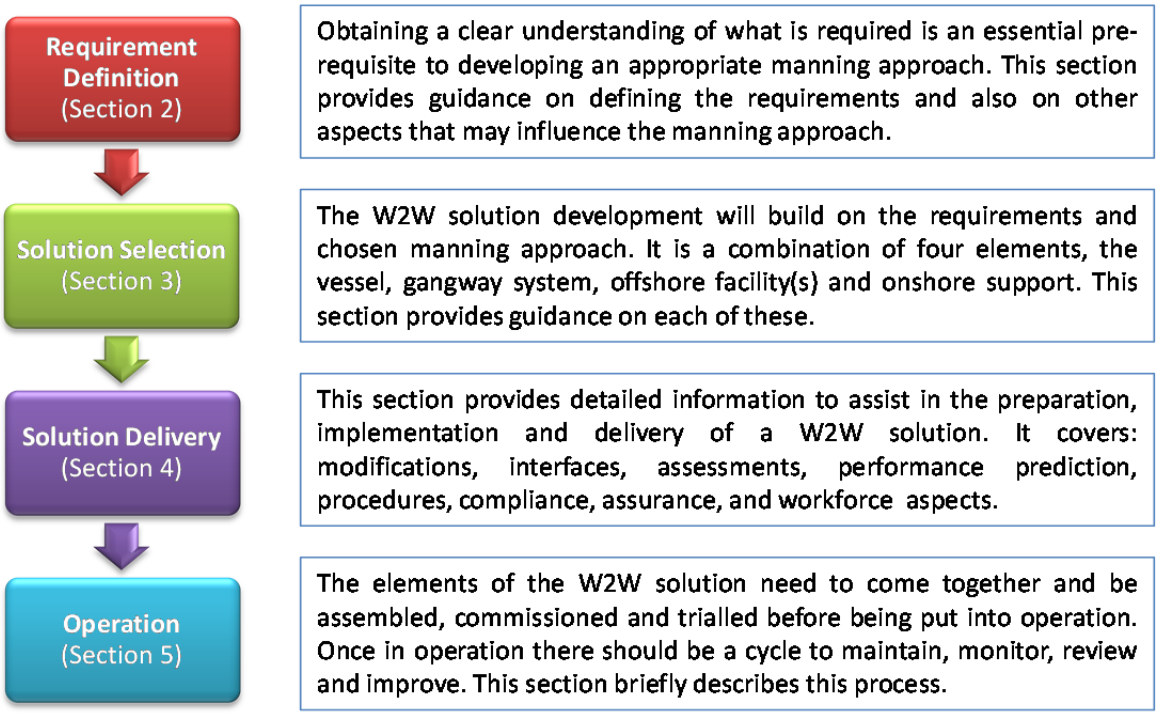

Figure 3 W2W Guidance Structure and Contents

In addition to the main body of the *W2W Guidance* (outlined above) there are four annexes at the end of the *W2W Guidance* that provides additional valuable information.

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ABBREVIATIONS

AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
ARPA	Automatic Radar Plotting Aid
ASOG	Activity Specific Operational Guidance
CAMO	Critical Activity Mode of Operation
CAPEX	Capital Expenditure
CMID	Common Marine Inspection Document
COMOPS	Combined Operations
COSWP	Code of Safe Working Practices for Merchant Seaman
CoG	Centre of Gravity
CTV	Crew Transfer Vessel
DARPS	Differential, Absolute and Relative Positioning System
DGPS	Differential GPS
DP	Dynamic Positioning
EEC	European Economic Community
EMC	Electro Magnetic Compatibility
ER	Emergency Response
ERN	Environmental Regularity Number
ERP	Emergency Response Planning
FME(C)A	Failure Modes Effects (and Criticality) Analysis
FOC	Flag of Convenience
FPSO	Floating Production, Storage and Offloading vessel
FRC	Fast Rescue Craft
FSU	Floating Storage Unit
FTA	Fault Tree Analysis
GA	General Alarm
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
H_2S	Hydrogen Sulphide
HAZID	Hazard Identification
HAZOP	Hazard and Operability

HF	Human Factors
Hs	Significant Wave Height
HSEQ	Health, Safety, Environmental and Quality
HUET	Helicopter Under Water Escape Training
ILO	International Labour Organisation
IMCA	International Marine Contractors Association
IMO	International Maritime Organisation
IR	Individual Risk
ISM	International Safety Management
ISPS	International Ship and Port Facility Security
KPI	Key Performance Indicator
LOLER	Lifting Operations & Lifting Equipment Regulations (UK)
LSA	Life-Saving Appliance
LTW	Light Taut Wire
MARPOL	International Convention for the Prevention of Pollution from Ships
MCA	Maritime and Coastguard Agency
MGO	Marine Gas Oil
MLC	Maritime Labour Convention
MOB	Man Over Board
MOC	Management of Change
MODU	Mobile Offshore Drilling Unit
NDT	Non-Destructive Testing
nm	Nautical Miles
NPAI	Not Permanently Attended Installation
OCIMF	Oil Companies International Maritime Forum
O&G	Oil and Gas
OPITO	Offshore Petroleum Industry Training Organization
ORA	Operational Risk Assessment
OREI	Offshore Renewable Energy Installation
OSV	Offshore Support/Service Vessel
OVID	Offshore Vessel Inspection Database
OVIQ	Offshore Vessel Inspection Questionnaire

OVMSA	Offshore Vessel Management Self-Assessment
PA	Public Address
PFEER	Prevention of Fire, Explosion and Emergency Response Regulations
PLB	Personal Locator Beacon
POB	Persons On Board
PPE	Personal Protective Equipment
PRS	Positioning Reference System
PS	Performance Standard
PSV	Platform Supply Vessel
PTV	Personnel Transfer Vessel
PTW	Permit to Work
PUWER	Provision and Use of Work Equipment Regulations
QRA	Quantitative Risk Assessment
RA	Risk Assessment
RAO	Response Amplitude Operator
REWS	Radar Early Warning System
ROV	Remotely Operated Vehicle
SAR	Search and Rescue
SAT	Site Acceptance Testing
SIL	Safety Integrity Level
SIMOPS	Simultaneous Operations
SMART	Specific, Measurable, Attainable, Realistic and Timely
SMO	Safest Mode of Operation
H&SMS	Health and Safety Management System
SNS	Southern North Sea
SOLAS	International Convention for the Safety of Life at Sea
SPS	Special Purpose Ship
SSA	Ships Security Assessment
SSP	Ship Security Plan
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
TR	Temporary Refuge
UKCS	United Kingdom Continental Shelf
W2W	Walk to Work

GLOSSARY

The following terms are used throughout this *W2W Guidance* and are defined below for clarification:

- **Walk to Work (W2W)** is personnel transfers between a **W2W vessel** and an **offshore facility** via a **gangway system**. The *W2W Guidance* does not address personnel transferring through jumping or being lifted to/from the offshore facility by crane or robotic arm. The gangway system will be deployed from the vessel. The *W2W Guidance* does not address operations where the gangway is deployed from the offshore facility.
- The **W2W vessel** is a floating structure (i.e. a **vessel**) ranging in size from a small workboat to a large semi-submersible offshore facility on which a gangway system is installed by which W2W personnel transfers are undertaken.
- The **vessel** is a floating structure ranging in size from a small workboat to a large semi-submersible offshore facility.
- The **offshore facility** is the facility, which can be fixed or floating, geostationary or underway to which, W2W personnel are transferred to/from via the gangway system.
- A **gangway system** is a walkway that has a fixed end on the W2W vessel and a non-fixed end that makes a connection with the offshore facility. The gangway system can be a **passive system** or an **active system**.
- A gangway system that is a **passive system** is one that does not depend upon a motion compensation system to hold the gangway stable and available during the transfer of personnel.
- A gangway system that is an **active system** is one that depends on an active 'live' motion compensation system to hold the gangway stable and available during the transfer of personnel.
- A **W2W solution** is an integration of a vessel, gangway system, offshore facility(s) and onshore support facilities for the purpose of undertaking W2W.
- **Manning** is the populating of an offshore facility with personnel.
- **Boat landing access** is a transfer whereby a vessel (e.g. a small workboat, Crew Transfer Vessel (CTV) or Personnel Transfer Vessel (PTV)) pushes up against an offshore facility while personnel step across between vessel and facility (sometimes also referred to as "Bump 'n Jump").
- **Access location** is the selected point(s) of connection of the gangway system on the offshore facility.
- **Significant wave height (H_s)** is defined as the mean wave height (trough to crest) of the highest third of the waves.
- **W2W vessel availability** is the proportion of total project time that the W2W vessel is available to perform W2W operations.
- **Unavailability** is the time the W2W vessel is unavailable, for example, due to:
  - (De)Mobilisation, transit, port time
  - Crew change
  - Downtime, due to, for example, bad weather or technical fault of vessel or gangway system
  - Competing Simultaneous Operations (SIMOPS) preventing W2W operations
  - Waiting time due to other reasons (e.g. vessel certification surveys, work planning, issuing permits, etc.)

- **Operability** is the percentage of time during a complete year that a W2W vessel can transfer personnel at offshore facility(s) within operational limits in the prevailing weather conditions. Operability is effected by, not only the capabilities of the gangway system and vessel (to maintain a stable position and heading), but also the influence on vessel heading due to gangway system location and gangway access location(s) on the offshore facility(s).
- **Workability** is the percentage of time (during a defined period) that a gangway system and vessel combined (i.e. W2W vessel) can transfer personnel within their operational limits.
- **Downtime** is the **unavailability** of the W2W solution e.g. weather or the W2W solution is not ready for operation and is out of service for whatever reason.
- **FACILITY OPERATOR** is the industry operator i.e. oil and gas, wind industry operating company that has a need for facility manning.
- **SHIP OPERATOR** is the operating company responsible for the W2W vessel on hire.
- **GANGWAY PROVIDER** is the operating company responsible for the gangway system on hire.
- **TURNKEY PROVIDER** is an offshore service provider that could be contracted by the operator to perform an integrated W2W solution i.e. vessel + gangway system.
- **Special purpose ship (SPS)** is a mechanically self-propelled ship (vessel), which by reason of its function carries on board more than 12 **special personnel**.
- **Special personnel** are all persons who are not **passengers** or **marine crew** and are carried on board in connection with the special purpose of the vessel, or because of special work carried out on board that vessel.
- **Passenger** is, according to International Convention for the Safety of Life at Sea (SOLAS) regulations, every person other than the master and the members of the vessel's crew or other persons employed or engaged in any capacity on board a vessel on the business of the vessel.
- **Marine crew** is the individuals employed or contracted by the SHIP OPERATOR to crew a marine vessel.
- **Workforce personnel** are the individuals employed or contracted by the FACILITY OPERATOR who are not part of the **marine crew** or **gangway personnel**. They may transfer across the gangway system to the facility or may remain on the W2W vessel.
- **Gangway personnel** are the individuals employed or contracted by the GANGWAY PROVIDER or SHIP OPERATOR to operate and maintain the **gangway system**.
- **Safety critical** is whereby failure of a system (hardware, process or procedure) could result in serious injuries or fatalities.

1 INTRODUCTION

In the context of this *W2W Guidance*, the W2W solution is the combination of a gangway system on a floating vessel to transfer personnel to/from an offshore facility which may be floating (e.g. another vessel) or a fixed structure (e.g. an oil production or wind farm related structure).

Of particular importance when developing a W2W solution, is the selection of an appropriate vessel and integration of a gangway system (if not already installed). The geographic location, requirements of the offshore facility(s) and regulatory aspects should heavily influence the selection process.

The operational performance of the integrated W2W solution is heavily dependent on the individual capabilities of the vessel and the gangway system, how they are combined and how they work together to provide a safe and reliable means of personnel transfer, in the foreseeable environmental conditions.

The combined operability and availability for the W2W vessel needs to be ascertained, before a realistic prediction of workability for W2W operations can be assumed for business case development.

1.1 Guidance Structure

The *W2W Guidance* is structured to follow the typical flow of a W2W project. This is represented in Figure 1.1.

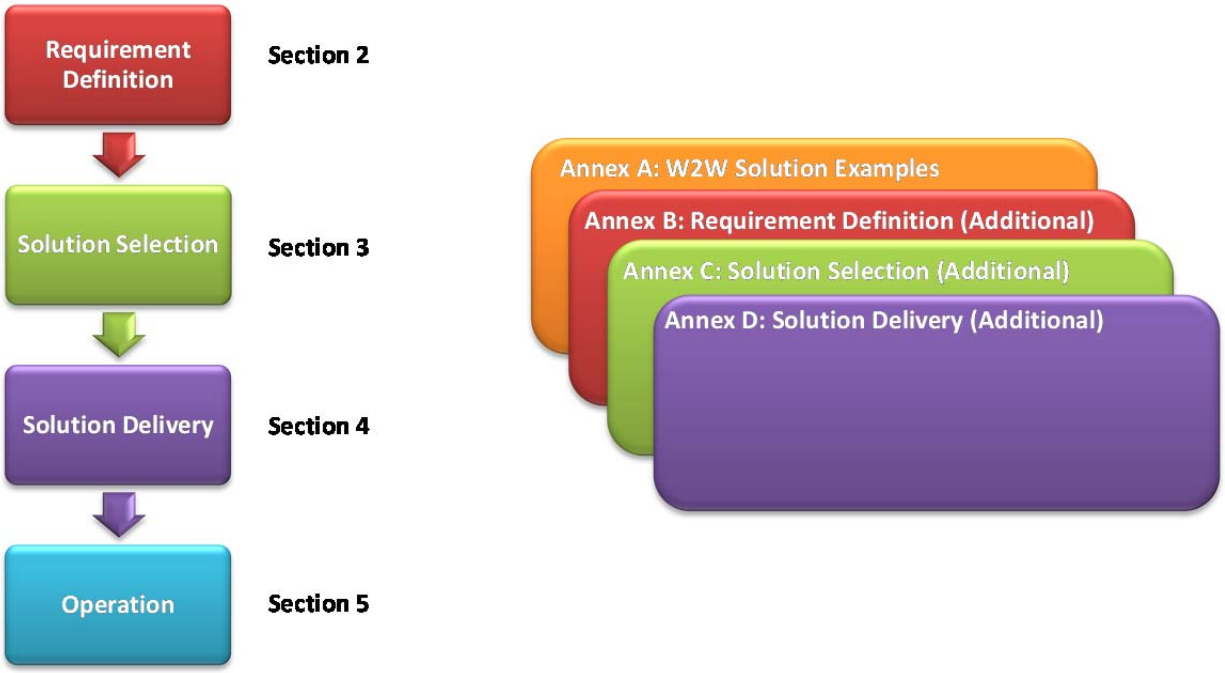

Figure 1.1 *W2W Guidance* Structure

Information boxes (like this one) are used throughout the *W2W Guidance* to emphasise key points and previous experience.

1.2 Opportunity

A W2W solution can be a sole or supplementary method for transferring personnel onto offshore facility(s). It provides an alternative manning approach to methods such as helicopter, swing rope, boat landing access and basket transfer.

Examples of W2W solutions are provided in Annex A for information.

A W2W vessel can range in size and capability from small crew ferry boats operating directly between land and one or more offshore facilities, to very large semi-submersible flotels that accommodate many hundreds of personnel and service a single offshore facility. The range of vessels between these extremities that offer or could offer W2W is great, for example: from offshore support/service vessels (OSVs), passenger ships, construction vessels to purpose built W2W vessels with helideck, accommodation, diving, remotely operated vehicle (ROV), fabrication and crane facilities.

The W2W gangway system can range in complexity from a passive, limited movement gangway, to a computer controlled active system, providing full six degrees of articulation and motion compensation.

The range of offshore facilities to which W2W personnel transfer could be deployed is large. These include the wind turbines, foundations and offshore substations of an offshore wind farm, small normally un-manned platform, or large, permanently manned, multi-function facilities. The offshore facility could have a fixed supporting structure (e.g. steel or concrete jacket foundation), or be floating (e.g. another vessel or an anchor moored, weather-vaning, oil production unit or thruster positioned drilling rig).

The size and capability of a W2W vessel will be determined by many factors, but distance from land, environmental exposure, numbers of personnel to transfer, number of offshore facilities for W2W to service and cost; will be some of the key factors in selecting effective W2W solutions. Figure 1.2 gives an illustration of how these factors may influence W2W vessel selection.

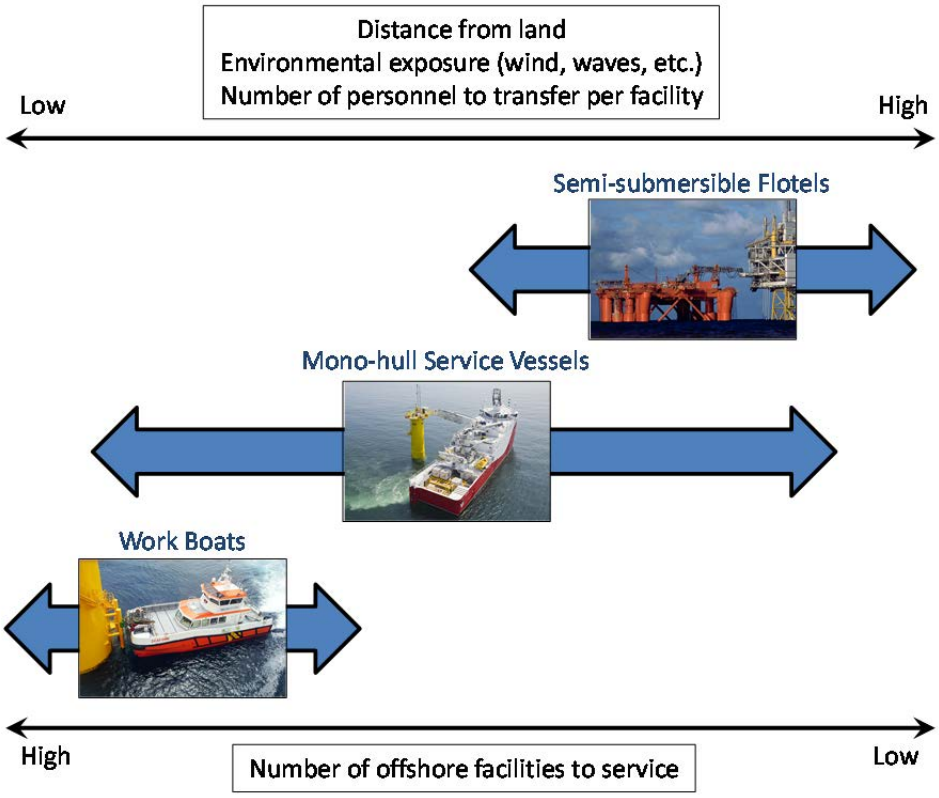

Figure 1.2 Illustration of Possible W2W Vessel Suitability

W2W personnel transfer can offer a safe, cost-effective means to man-up/down offshore facilities on a regular, fixed term, ad-hoc or exceptional circumstance basis. It can be used throughout the lifecycle of an offshore facility, from installation and commissioning, through its operational life, to decommissioning, dismantling and removal. Appropriately selected, optimised and implemented, a W2W solution can offer significant opportunities to an offshore FACILITY OPERATOR including, but not limited to: cost reduction, increased manning levels and/or flexibility of manning and reduced accident risk.

1.3 Objective

The objective of this *W2W Guidance* is to capture current experience and knowledge within the offshore oil, gas, wind, marine and gangway supplier industries and various relevant regulators; to provide guidance aimed at helping in the selection, development and implementation of W2W solutions.

This *W2W Guidance* is not prescriptive; rather it aims to give information and guidance to allow individual organisations to develop a W2W solution to satisfy their own specific operational needs, within their own operating environment.

1.4 Scope

All stages of the W2W lifecycle, from the initial requirement definition through concept development into operation are covered in this *W2W Guidance*. As previously noted, the range of W2W vessels is extensive: from small workboat to large semi-submersible flotel; the *W2W Guidance* covers the full range, but focuses on the mid-range (i.e. mono-hull service type vessels).

There are many variables in the capability of a W2W vessel and how it is operated. For example: the W2W vessel may, or may not have overnight accommodation for the transferring workforce personnel; or it may or may not remain at an offshore facility for a period longer than that required to transfer the workforce personnel. The *W2W Guidance* focuses on the main components of a W2W solution, namely: the vessel, gangway system and offshore facility integration. It also highlights other areas such as overnight accommodation that may be considered whilst developing the solution.

The *W2W Guidance* does not address workforce personnel transferring using an alternative means to a gangway, such as by jumping or being lifted to/from the offshore facility by crane or robotic arm.

The *W2W Guidance* does not address operations where the gangway system is deployed from the offshore facility (rather than from the vessel).

1.5 Application

This *W2W Guidance* contains no mandatory sections and is for information only.

The *W2W Guidance* has been developed to provide general guidance that is not country, industry or W2W solution specific.

An overview of international legislation and standards relevant to W2W implementation is presented in Annex B.

The target audience for the *W2W Guidance* is:

- FACILITY OPERATORs
- W2W SHIP OPERATORs
- GANGWAY PROVIDERs
- W2W TURNKEY PROVIDERs
- W2W consultants and other 3rd parties
- Offshore facility regulators
- Maritime regulators, Flag States and Ship Classification Societies

2 REQUIREMENT DEFINITION

The basis for this section of the *W2W Guidance* is that the decision on manning approach is still to be made from available options (e.g. W2W, helicopter, jack-up barge, boat landing access). The basis for continuing to the next section (i.e. Section 3) is that a W2W approach has been chosen.

2.1 Statement of Requirements

Obtaining a clear understanding of what is required by the FACILITY OPERATOR is an essential pre-requisite to developing an appropriate manning approach. The 'statement of requirements' allows the potential manning options to be: identified, comparison of manning options made, the selected 'best' option developed, and actual operational performance assessed. A W2W solution may or may not be the best outcome to fit the FACILITY OPERATOR's requirements.

Figure 2.1 presents subject areas, which would normally be included in the requirement definition in order to adequately describe what is required.

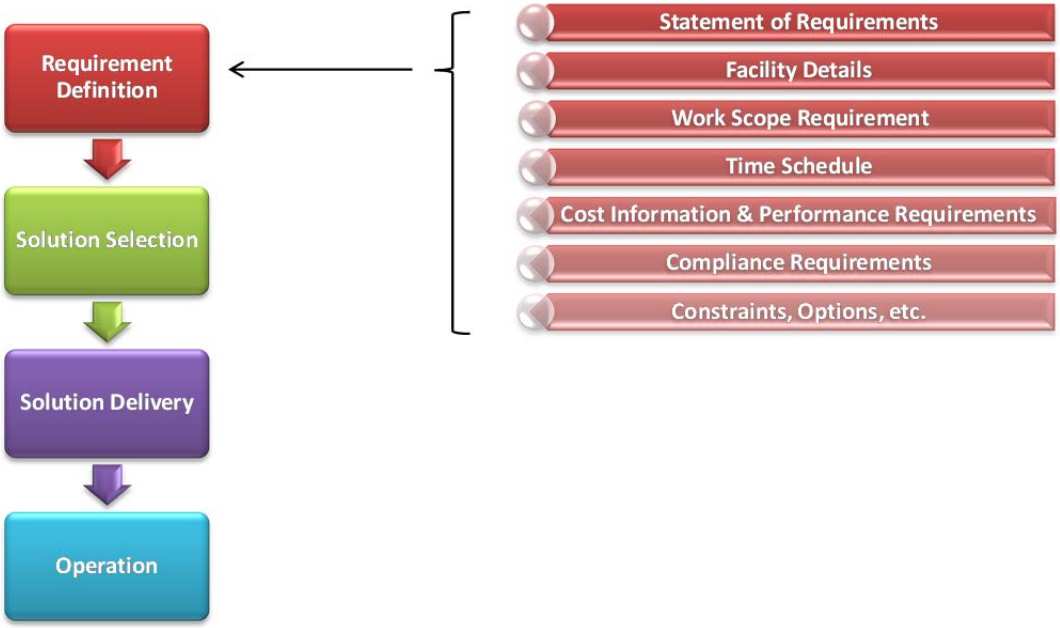

Figure 2.1 Manning Requirement Subject Areas

Once drafted, the statement of requirements should undergo a 'sense check' to help ensure that they are realistic and achievable.

In setting the statement of requirements, management expectations should be communicated to all stakeholders. Checking against these expectations during the selection, development and operation of a W2W solution is important. This helps to ensure the manning solution goals and management expectations are aligned and any gaps can be identified and managed.

In developing the statement of requirements it is recommended that the market is examined to ascertain what options (e.g. helicopters, flotels, vessels, gangway systems, and onshore facilities) are available.

TOC
Abbrev & Gloss
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2. Require
3. Select
4. Deliver
5. Operate
Annex A
Annex B
Annex C
Annex D

2.1.1 Facility Details

The facility(s) to be manned need to be adequately described. This may include, but not be limited to, the following:

- Facility name(s) and location(s) to be manned
- Manning constraints (maximum and minimum manning, competencies, etc.)
- Gangway landing elevation(s) and available location(s)
- Capabilities of on-board facilities (craneage, welfare, emergency response, lifeboats, etc.)
- Material handling constraints (craneage, space, logistics on vessel/facility, etc.)
- Accident hazard risk profile associated with the manning means (e.g. helicopter, jack-up barge, W2W vessel, etc.)
- Operation requirements (environmental envelope, exclusion zones, mooring areas, approach directions, etc.)
- Vulnerabilities of structures, plant and systems (e.g. impact energy constraints)

2.1.2 Work Scope Requirement

Understanding details of what is required of the workforce to be transferred onto offshore facility(s) is essential. This may include, but not be limited to, the following:

- Number and type of persons to be transported, accommodated and transferred
- Manning patterns including shift rotations, crew changes, etc.
- If sequential manning required on a number of facilities, distance between facilities and required time between manning transfers
- Man-hours to be delivered on facility(s)
- FACILITY OPERATOR workforce personnel change requirement
- Workforce personnel handover arrangements
- Additional burden on work planning and permit to work (PTW) system(s)

2.1.3 Time Schedule

The intended project duration (e.g. from 1 week to a long-term 10 year contract) is important, as it may influence the solution that is adopted.

The time of year, over which the manning is required is also an important input, as the environmental factors (waves, swell, current, wind, fog, etc.) can vary through the year depending on geographical location.

Additionally, if the work needs to be performed within a certain window/timeframe (e.g. 4 month period from June to September); this may require 24 hours operations, which will have an impact on the manning solution employed.

If a specific jack-up barge, vessel, gangway type or helicopter type is intended to be selected, then availability of this could also become a factor.

2.1.4 Cost Information and Performance Requirements

The FACILITY OPERATOR should consider:

- The budget available and/or other financial expectations that will influence the manning solution implemented. There will be an expectation to seek out the most cost effective, safe solution.
- Detailing explicit performance requirements to enable manning solutions to be compared and their performances judged.
- Potential for concurrent activity opportunities. The financial viability of using a manning solution can be heavily influenced by joining multiple activities. For example: a W2W vessel executing Remotely Operated Vehicle (ROV) inspection work scopes during periods when not transferring personnel.

2.1.5 Compliance Requirements

Operator standards, policies and procedures, along with international and local regulations will need to be defined.

For example, statements may be required to detail the compliance requirements for:

- Facility (legislative and industry - see Section 4.5)
- Vessel (maritime legislative and Classification Society – see Annex B)
- Gangway system (legislative and industry - see Section 4.5)
- Company standards and procedures (e.g. health, safety, environmental, security, marine, change management, alcohol and drugs policy etc.)

2.1.6 Constraints, Options and Other Requirements

Prior to starting to identify manning solution options it is important that a full understanding of any constraints; essential, necessary and 'nice-to-have' options; and other factors that could influence decision making is developed.

Additional requirements that may constrain, limit or extend the scope of a manning solution need to be set as soon as possible to avoid project escalation and therefore failure to deliver expectations.

Constraints, options and other requirements may include for example:

- No available helideck on facility(s)
- Offshore facilities to remain live with minimal disruption during all manning operations
- Offshore facility structural loading restrictions at the physical interface with manning solution
- Personnel transfer policy
- Limitations on the amount of time the manning solution can be connected or present
- Specific manning solution or part solution or component type to be used
- Simultaneous operations with other activities
- Manning operations to be provided intermittently during 24 hour period
- Manning solution to service other installations

- For a W2W solution, a W2W vessel may be required to have:
  - Specific station keeping and vessel manoeuvrability capabilities
  - A certified helideck for defined helicopter type and operations
  - Defined accommodation facilities for specified number of persons
  - Man overboard or full standby vessel capability with 2 x FRCs with Personal Locator Beacon (PLB) tracking
  - Specified deck cargo capability
  - Hot-work fabrication workshop
  - Craneage capability to defined specification
  - Pipeline and jacket inspection ROV
  - Inspection test and maintenance strategies that do not impact W2W operations
  - Motion monitoring & recording systems
  - Radar Early Warning System (REWS) installed
- Work and rest limitations (e.g. working hours)
- Personnel minimum requirements such as training certificates

Minimum requirements to enable personnel to be transported by an alternative manning means (e.g. if helicopter is a credible scenario then requirements for underwater escape training (HUET), shoulder size dimensions, etc.)The above list is not exhaustive and additional project requirements may apply. Other requirements may define management success criteria for the manning solution such as key performance metrics that have been assigned.

To provide the W2W solution developer greater freedom to develop the 'best fit' solution, the number of requirements should be kept to a minimum.

If a W2W solution looks likely to be the selected manning means, communicate as early as possible with the relevant regulators and other authorities to gain an understanding of their requirements, opinions and time constraints.

2.2 Manning Strategy

Different offshore industries will typically have different manning requirements and constraints. Table 2-1 highlights potential differences between the current main offshore industries: namely, oil and gas, and wind.

Table 2-1: Differences between offshore Oil and Gas and offshore Wind facilities

Topic	Oil and Gas (O&G) sector	Wind sector
Infrastructure	Range from: small, normally un-manned platforms, potentially clustered together, to large, permanently manned isolated platforms or anchor-moored floating production vessels.	Multiple wind turbine structures with a low number of small, normally un-manned, electricity substation platforms.

Topic	Oil and Gas (O&G) sector	Wind sector
Accident hazard risk	Perceived to be high with process hydrocarbon, H_2S, ship collision, helicopter travel typically dominating.	Mainly: electrocution, working at height, confined space working and lone working. Shares some common hazards with O&G, notably ship collision, and environment.
Distance between offshore facilities	Within an operating field, O&G facilities range from a few kilometres to tens of kilometres apart.	Within a wind farm, the wind turbine facilities are typically 500m to 1km apart.
Distance from shore	Various: O&G fields range from close to shore i.e. within 10 to 60km to several 100kms operating in remote regions.	Various: more wind farms close to shore i.e. within 10 to 60km, with new projects operating further afield and in remote regions.
Workforce personnel number	5 – 500 Typically 5-10 person teams for manning normally un-manned platforms; 12-20 person project teams and 30 to 100+ workforce personnel changing.	2 – 50 Typically 2-4 technician service teams on individual turbines; 5-10 on generator platforms; 20-50 for project teams.
Manning approach	Helicopters, flotels, marine basket transfers and W2W.	Marine access via boat landing, helicopters and W2W. Helicopters are mainly for unplanned maintenance and repairs.
Access requirements	Typically, higher number of personnel on smaller number of facilities. Ad-hoc maintenance visits to <3 facilities; daily / weekly / monthly manning of un-manned facilities; regular crew-changing every 2-3 weeks; maintenance campaign visits; project support manning (e.g. for decommissioning).	Typically, smaller number of personnel across a high number of facilities. Planned visits according to scheduled maintenance, to several turbines. Access during construction (repeatedly) to several facilities daily. Ad hoc visits (e.g. maintenance, emergency repairs) several facilities daily / weekly / monthly.
W2W modification potential	Facilities are fewer in number resulting in low multiplier of modification cost. Less economic drive to reduce modification costs on offshore facilities compared to wind.	Large number of facilities resulting in high multiplier of modification cost. Therefore, strong economic drive to reduce modification costs on offshore facilities.
Emergency response (ER)	Facilities may have: lifeboats, liferafts, safe refuges, etc., and have a standby vessel in attendance. Traditionally reliant on helicopter	Electricity substation platforms are similarly equipped to small O&G platforms, e.g. with liferafts, but wind turbines have very little ER facilities.

Topic	Oil and Gas (O&G) sector	Wind sector
	Search and Rescue (SAR).	More reliant on infield marine vessels. Traditionally reliant on helicopter SAR.

The manning solution is part of the operations and maintenance strategy selection for an offshore facility, and hence an important aspect.

The specific requirements of the FACILITY OPERATOR will help determine the manning solution to employ. The requirement definition should provide information to allow a manning strategy to be developed.

The manning strategy may include, but not be limited to, the following:

- Workforce number to be transferred, to where, how often, when and to do what?
- Methods of access to and egress from the facility
- Weather condition limits allowing approach of, transfer to/from and departure from the facility including wave height, tides, wind speed, visibility and daylight
- Monitoring of the weather situation before and while the facility is attended
- Means of communication
- Contingency situations such as inability to retrieve personnel from a facility
- Emergency overnight provision and accommodation
- Evacuation and escape facilities on the facility
- Emergency response provision

The minimum and maximum number of people allowed to be on the facility at any time should be defined, as these will affect the number of persons and skillsets required within the transfer parties. A minimum number may be determined on the requirement to have a defined number of emergency response roles and a maximum number determined by the provision of accommodation, welfare facilities, lifeboats or a regulatory compliance limit.

Twenty four hour, multi-shift operations could be adopted to increase productive time, if the total number of facility persons on board (POB) is a limiting factor. Alternatively or in addition, personnel who spend their off-shift on a facility could be moved to a W2W vessel to increase on-shift personnel numbers within the maximum POB limit. Prior to deciding to move off-shift personnel to a W2W vessel the emergency response (ER) competencies remaining on the facility should be reviewed to ensure that all ER duties can be fulfilled without the transferring off-shift personnel.

Offshore wind electricity substation platforms or wind turbines do not usually have accommodation and hence all personnel would need to stay at an off-facility location, such as: on a W2W vessel, an alongside accommodation unit (e.g. a jack-up unit), or on shore.

Other areas to be considered during the development of a manning strategy are presented in the following sub-sections.

2.2.1 Locality Aspects

Knowing the geographical position of the facility(s) allows the environmental (e.g. metocean) data for the location to be obtained. This will allow an initial high level performance assessment to be undertaken

(Section 4.3). The outcome of which, may impact on the final manning solution proposed (e.g. the size, motion characteristics and position keeping capability of a W2W vessel).

2.2.2 Distance from Land

The proximity of an offshore facility to a suitable land base will influence the need for workforce accommodation on the vessel or other offshore location. If the transit time between land and the offshore location is short, accommodating the workforce offshore may not be necessary. The impact of wind, sea conditions and weather will need to be fully considered when determining all aspects of the manning solution, including the impact it has on transit speed (and if required, heliport or ship port access). Any ship port restrictions, such as access restrictions due to the tide or sea conditions need to be taken into account.

The distance from land will also influence the emergency response solutions and requirements; means for evacuation of personnel from the facilities, and from the facility(s) vicinity to shore. This needs to be assessed when planning the emergency response. This is particularly important for a wind farm located far from shore, where a vessel (e.g. the W2W vessel) will most likely provide the main emergency response provision.

2.2.3 Work Scope

Defining the work scope aspect may help determine, or more clearly define, the type of manning solution to be employed. For example: the requirement for a large defined competent workforce that does not require to crew change often, may point towards a W2W or jack-up barge solution; whereas: the requirement for a small workforce with a competence mix that changes on a daily basis, may indicate a land-based fast crew boat or helicopter solution.

2.2.4 Material Handling

Material handling and the planning of such i.e. how to get tools, spare parts, etc., on/off offshore facility(s), needs to be considered as it may influence the manning solution selection. Personnel may not be able to transfer with their tools and equipment (e.g. on a helicopter or over a W2W gangway) and therefore, the means to transfer these without incurring delay is important to determine before a manning solution is fixed.

Material handling between a vessel and facility may require suitable craneage on the facility or on the vessel. It should be noted that a vessel deployed material handling system (e.g. crane) would likely need to be motion compensated and thought also needs to be given to the ability of the system operator to see the landing location on the facility, which may be considerably higher than the operator's location on the vessel.

2.2.5 Man-hours

The man-hours to be executed and the timeframe for delivery (in most instances) will have a direct impact on the size of the workforce and therefore the number of seats and/or bedding requirement and facilities that will need to be provided. This information will help determine the size and capability of the manning solution from small workforce numbers (utilising a small workboat), through to large workforce numbers (utilising a large semi-submersible offshore facility).

2.2.6 Personnel Movement

Requirements relating to the movement of personnel between on and off-shift periods, or between work areas and rest areas, or any other movement that may impose a time penalty when predicting attainable workforce performance should be defined.

Avoiding the need for workers to return to the W2W vessel during their working shift (e.g. for meals, breaks, toilet visits, etc.) will increase achievable 'productive working time' significantly.

2.2.7 Performance Requirements

At an early stage it is important to establish performance requirements for the project (e.g. manhours delivered and manning solution availability) as they allow manning options to be compared and optimised. They may be explicitly specified within the statement of requirements definition (Section 2.1); but if not, performance requirements should be developed and agreed with the FACILITY OPERATOR.

Where a W2W solution is being considered as a manning approach, an initial assessment should be undertaken to predict a realistic performance that should be achievable for a W2W solution.

During the solution delivery process, conducting a detailed performance prediction (Section 4.3) will enable the likely performance of potential solutions to be predicted and compared.

3 SOLUTION SELECTION

From this point on in the document the *W2W Guidance* now makes the assumption that the FACILITY OPERATOR has decided to employ a W2W solution to expedite their manning requirements.

The W2W solution development will build on the statement of requirements discussed in Section 2.

3.1 Developing the W2W Solution

The W2W solution is seen as the combination of four elements: the vessel, gangway system, offshore facility(s) and onshore support.

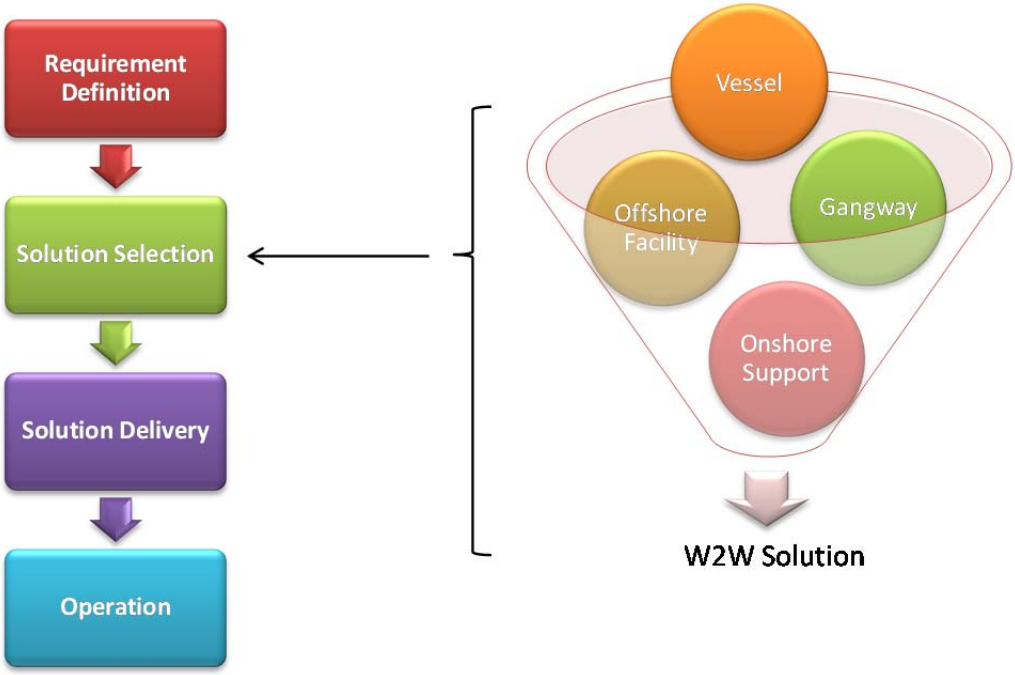


Figure 3.1 W2W Solution Development

Building up W2W solution options will require communication with the offshore facility operator and suppliers to ascertain details of vessels, gangway systems and offshore facilities. Continuing the communication process with suppliers and stakeholders should help achieve the best W2W solution to deliver the project requirements.

It is essential when considering a W2W solution to consider the vessel, gangway, offshore facility and onshore facility together with aspects of one potentially having a significant influence on the performance of the other(s).

The following sections go into more detail for vessel, gangway, offshore facility access locations and onshore facility selection. It is intended that this will help in the assessment of the viable options available, such that the best 'combination' to maximise performance can be selected.

3.2 Vessel Selection

The key considerations for the selection of the vessel are discussed in this section, with further specific detail, available in the Annexes and a comprehensive checklist contained in Annex C.1.

3.2.1 Suitability

All vessels are required to comply with relevant marine legislation, codes and standards. This is a complicated area and needs to be fully understood early in the development of a W2W solution. Whilst some legislation, codes and standards are international, others are dependent on the vessel's Flag State, Classification Society, and/or the Port State in which the vessel will perform W2W operations. Annex B provides an overview of the main marine legislation, codes and standards that apply to vessels.

Of particular note are codes that relate to the number of personnel on board the vessel who are not the vessel's marine crew i.e. the number of persons on board who are associated with the gangway operation and work on the offshore facility. If the number is greater than 12 the vessel requires to be classed as a passenger ship or, depending on acceptance of the Flag State authority, a special purpose ship (SPS); both Classes require greater internal subdivision to give more stability and other measures to give enhanced safety.

Vessels chosen to undertake W2W operations may require to be Classed as a passenger ship or be SPS code compliant with the non-marine crew designated as Special Personnel. The application of the SPS code by the Flag State authority should be sought to clarify the situation for the location of W2W operation.

3.2.2 Motion Characteristics / Gangway System Location

The way a vessel responds to a combination of environmental forces (e.g. wind, wave, current, etc.) will impact the operational availability of the vessel; the personal comfort of those on board; and the ability to conduct activities on or from the vessel. Understanding the vessel motion response in all six degrees of articulation (Figure 3.2) to representative sea state conditions at the area of operation and during transit is essential when deciding the suitability of a vessel for W2W. A vessel that responds slowly or one that responds rapidly i.e. a 'stiff' or 'lively' vessel; can have a significant negative impact on the W2W solution availability, decrease workforce personnel comfort and increase fatigue and wear on W2W system components and structural attachment. Wave slam (detailed later in this section) is another factor that needs to be considered as it can also have a negative effect on personnel comfort and operations.

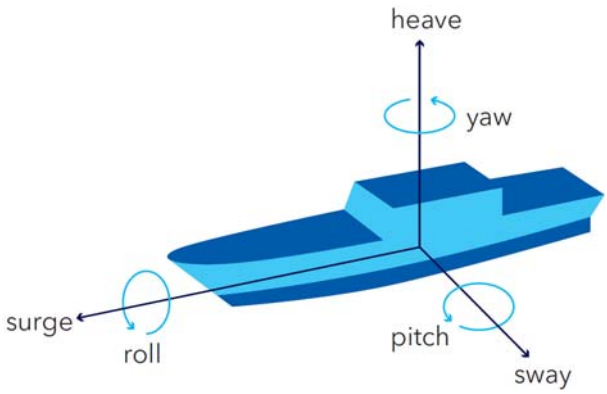


Figure 3.2 Vessel Six Degrees of Motion

Vessel motion response characteristics in the operational sea area, the location of the gangway system on the vessel, as well as the gangway system's ability to compensate for motions imposed on it by the vessel; all need to be taken into account when determining the predicted availability of the W2W solution.

For any vessel the position of least motion is the centre of gravity (CoG) of the vessel. The further the gangway system is moved away from this point the greater will be the motions that the gangway system experiences.

3.2.2.1 Positioning the Gangway System- Fore / Aft

A gangway system needs to compensate for more vertical motion (heave) when positioned towards the stern or bow of a vessel. This is due to the pitching motion of the vessel on the waves and is called pitch-induced heave.

In addition, the further the gangway system is positioned towards the stern or bow the greater will be its yaw-induced transverse motion. For example: a gangway system located at the stern of an 80m vessel, which has its CoG half way along its length would be exposed to nearly 1.5m of transverse motion with ±1° in heading control (yaw). This would be in addition to the transverse motions due to surge and sway.

The gangway system will need to use more of its compensating capacity for compensating heave, than when placed midships (Figure 3.3).

Examples of W2W solutions can be seen in Annex A.

The consequence of positioning the gangway system towards the stern could be that the workability is decreased significantly. The benefit could be that there is a greater variation in vessel heading possibilities. The gross increase or decrease in workability due to a greater available heading (Figure 3.3) versus greater movement will need to be assessed and then compared with the workability of placing the gangway system midships.

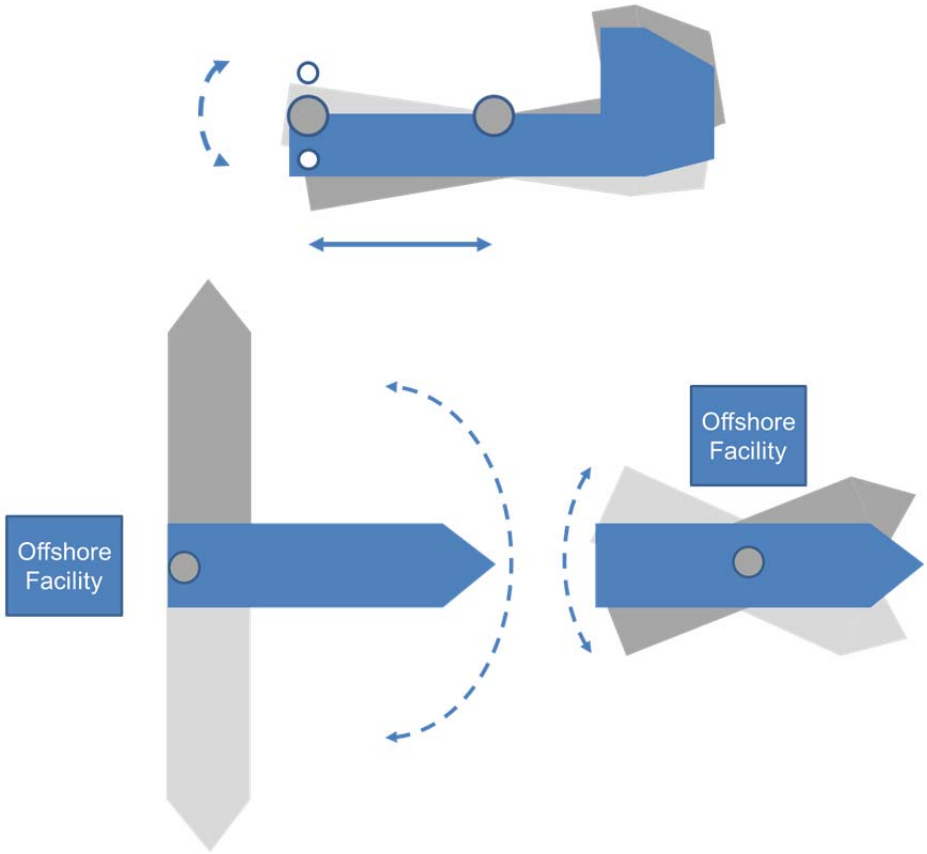
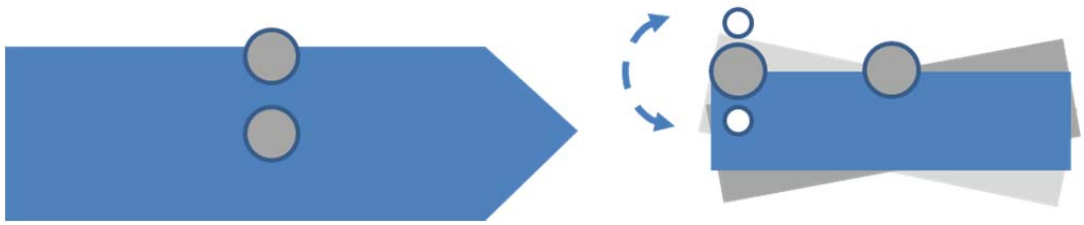


Figure 3.3 Gangway System Position: Midships vs Stern Locations

3.2.2.2 Positioning the Gangway System - Port / Starboard

If a gangway system is placed towards the side of the vessel, this will result in a greater separation distance of the vessel to the offshore facility (Figure 3.4).

The gangway system must compensate for additional roll motions when not positioned near the CoG.



Top view *"Cross-section" of the vessel (bow on)*

Figure 3.4 Gangway System Position: Centre Line vs Port / Starboard Locations

Moving the gangway away from the centreline of the vessel limits the ability to have a bi-directional approach (port or starboard) to the offshore facility. A gangway positioned mid-ships may give the vessel a greater flexibility regarding approach to the offshore facility than having the gangway positioned at the side. It provides port / starboard flexibility with increased potential operability due to reduced accelerations of the gangway. However, may reduce the number of headings which can be maintained to access the offshore facility.

3.2.2.3 Positioning the Gangway System - Elevation

Should a gangway system be positioned at a higher elevation on the vessel, the greater will be the motions that must be compensated (Figure 3.5).

Elevated gangway systems could result in less workability or more use of the telescoping capacity (if present). In some cases it is necessary to elevate a system to reach the desired elevation of the landing zone; in some cases the landing zone can be low and require downwards inclination of the gangway.

Positioning the system higher on the vessel *"Cross-section" of the vessel (bow on)*

Figure 3.5 Gangway System Position: High / Low Elevation

3.2.2.4 Positioning the Gangway System - General

The actual location of the gangway system on a vessel will be determined by consideration of many factors not least: deck space and strength of the vessel, motion of the vessel relative to the sea conditions and headings, the ability of a gangway system to compensate for all or some vessel motions, and accessibility on the offshore facility for gangway landing.

Understanding the motions of a vessel relative to the seas that it is likely to be exposed to is of high importance when developing a W2W solution. Having determined the likely movements of the vessel relative to the potential sea state(s), the approximate movements of the gangway system foundation (i.e. base) may be predicted. From this, the ability of the gangway system to compensate for the applied motions can be assessed and the probable workability of the W2W solution estimated.

In terms of ship design, a response amplitude operator (RAO) is a term or set of terms used to define the likely behaviour of a ship when operating at sea. RAOs are usually obtained from model testing, application of specialized computer programs or sea trials (often all three). RAOs are usually calculated for all ship motions and for all wave headings.

To assess the probable workability of a W2W solution, appropriate dynamic modelling should be conducted using the vessel's RAOs as an input. Through such modelling the potential location(s) of a gangway system can be assessed to determine the suitability of the location(s) taking into account the gangway system motion compensation capability.

The deployed gangway elevation angle will be dependent on the height of the gangway system on the vessel and the offshore facility access location height. Unless the gangway system is already permanently installed on a vessel, it will require to be attached by 'sea fastenings' to suitable structural members on the vessel. Such sea fastenings may raise the height of the gangway system, thereby changing the reach and angle of the gangway. If required, grillage platforms (a framework of steel beams used to spread the gangway system loads to structural members of the vessel) can be fabricated and installed between the gangway system and vessel deck to raise the height of the gangway system, such that its operation is within its working range. If further height is required a support structure could be engineered. An alternative to raising the gangway system on the vessel is to lower the landing

location on the facility. To achieve this, a structure could be engineered for the facility that locates the landing location at a lower elevation. This structure would need to provide a means (e.g. stairs or ladders) for transferring personnel to move between the gangway landing area and existing facility decks.

It should be noted that placing the same gangway system on a larger vessel hull form could provide improved operating parameters for the chosen gangway system and thus greater facility connection time. Additionally, there may be significant benefits to selecting a ship with passive and/or active stability systems that act to reduce the vessel response to sea conditions.

The dynamic forces that the vessel could exert on the gangway system or conversely, the gangway system on the vessel should be examined; not only to ensure the forces are within engineering limits, but also to assess any impact they may have on vessel stability and motions.

Another aspect that should be considered when deciding on a vessel is the potential for wave 'slam'. Some vessel hull forms are susceptible to slamming induced vibrations through the vessel structure when impacted by waves of a certain relative direction and characteristic. For example: a vessel may be suitable for W2W operations with respect to wave induced motions, but may prove unsuitable due to wave slam from lesser waves from the stern.

Photos showing gangway system siting locations on W2W vessels can be seen in Annex A.

This section has referred to the optimisation of the gangway system location on the W2W vessel itself (e.g. to minimise motions) but does not consider the gangway system location with regards to the facility to which it will connect. This is noteworthy, since there may be conflicting requirements and is covered in Section 3.4.

3.2.3 Positioning Keeping

W2W vessels may be required to hold station alongside a facility within a defined footprint and heading to maintain the gangway system within its operational limits during personnel transfers. How this is achieved will vary with vessel type and may include the vessel making contact with physical guides on the facility, being positioned by the vessel's propulsion system or being moored. As a failure to maintain the defined footprint or heading could lead to an accident hazard event occurring; the position keeping approach used should be deemed 'safety critical' and attract an appropriate level of scrutiny during design and operation. The performance of the position keeping approach adopted should be assessed for all reasonably foreseeable operational conditions and failure modes, and in all environmental conditions in which the vessel may conduct personnel transfers.

For those vessels that do not use physical contact or moorings to hold station, it is likely that they will use thruster assisted position keeping or dynamic positioning (DP) controlled propulsion to provide, or support their position keeping capability. When considering the capability of vessel position keeping in representative sea states, it is not only the horizontal footprint (surge and sway) of the vessel that needs to be examined, but the yaw also needs to be considered if the gangway system is located aft or forward on the vessel (see Section 3.2.2.1).

The International Maritime Organisation (IMO) and international DP associations have issued guidance for dynamic positioned ships and more guidance on this can be found in Annex C.2.

For position keeping systems that require position reference systems, the number and type of position references required will depend on the nature and the type of the work being done and the environment in which they are operating. Care needs to be taken when deciding whether redundancy is comprehensively provided by duplication of sensors. Ideally, sensors should be stand-alone and completely independent of each other. For DP operations there are clear criteria, which state that there

needs to be at least two independent reference systems of different types on line. The gangway system may, infrequently, provide a position reference system for a vessel's DP control.

Dependent on the vessel's DP system, the time required to 'set up DP' could vary significantly and should be taken into account when assessing a W2W solution.

If a visit to multiple offshore facilities is a project requirement, then the time taken to set-up vessel position keeping systems (e.g. DP system) may be an an important factor in vessel selection.

Further information and guidance can be obtained from International Marine Contractors Association (IMCA) (reference IMCA M182 International guidelines for the safe operation of dynamically positioned offshore supply vessels). The most common position reference systems are described in Annex C.2.

3.2.4 Welfare

A W2W vessel should be able to accept the required project workforce in accordance with a defined manning strategy. The size of the project workforce that is required to be carried and accommodated (if a live-aboard option is being considered) may dictate the size, accommodation and comfort aspects of the W2W vessel required.

For vessels contracted for W2W through ad-hoc spot hire, consideration should be given to the normal function of the vessel and the potential impact this normal function would have on the W2W operation, e.g.:

- Passenger comfort - the necessary provision for accommodation and welfare facilities for the workforce personnel and/or passengers.
- Motion Sickness - a motion sickness incidence index may be used to assess the level of motion sickness that may be expected on a vessel.

For example, most Platform Supply Vessels (PSVs) are equipped with extra beds to carry non-marine crew personnel on a short term basis (e.g. weeks) and may not cater for longer term (e.g. months) welfare aspects. Larger construction vessels, however, typically cater for long term non-marine personnel to be on board and are suitably equipped with better welfare facilities and provisions.

Purpose built W2W vessels have been designed (to varying levels) for a 'live-aboard' workforce and the workflow and requirements of marine transfer operations. An example of a vessel that has been designed specifically for W2W operations is shown in Figure 3.6.

Figure 3.6 Purpose Designed W2W Vessel Example

Some vessels may have a Classification Society 'Comfort Class' designation which would ensure adequate welfare provisions with noise and vibration in the living areas designed to be low.

Comfort Class considers vessel noise and vibration. It does not consider vessel motions and accelerations, which could result in an unpleasant environment for personnel on board.

Personnel welfare issues can arise with W2W operations, particularly when exposing individuals not used to life on board a marine vessel. Typical areas of concern are listed here (and further detailed in Annex C.3):

- Personnel welfare facilities and features (and improvement opportunities), e.g.:
  - Sound and vibration levels in transit and position keeping (24hr manning)
  - Vessel motion characteristics (both in transit and position keeping)
  - Cabin size, occupancy and WC/shower facilities
  - Cabin security
  - Catering, cleaning and laundry capacities
  - Standard and quality of food
  - Rest and relaxations areas
  - Recreation facilities (e.g. gym, cinema, internet/Wi-Fi availability, TV, quiet room, smoking room, etc.)
  - Medical facilities
- Work related facilities, e.g.:
  - Office space and meeting rooms,
  - Locker space, drink stations, WCs, sinks, showers and changing rooms.
  - Adequate and reliable communication systems (e.g. telephone, internet, video conference facilities)
  - Workshop for repairs and overhauls of equipment

When considering welfare and vessel accommodation provisions for living-on W2W vessels, all reasonably foreseeable manning situations should be examined.

When assessing the accommodation and welfare facilities on a vessel, consideration should be given to non-routine situations, such as when there is a full workforce on board for extended periods (e.g. due to poor weather, gangway system fault, etc.).

3.3 Gangway System Selection

The key considerations for the selection of the gangway system are discussed in this section, with a comprehensive checklist of aspects contained in Annex C.4.

If a purpose built W2W vessel with an incorporated gangway system has not been selected, then a gangway system will need to be designed/selected and mobilised onto the chosen vessel. The following sections aim to help choose the correct gangway system for the specific project requirements.

This *W2W Guidance* only considers gangway systems with a fixed end on the W2W vessel and a non-fixed end that makes a connection with the offshore facility(s). There are two categories of gangway system available:

- A passive system: a gangway system that is a passive system is one that does not depend upon a motion compensation system to hold the gangway stable and available during the transfer of personnel.
- An active system: a gangway system that is an active system is one that depends on an active 'live' motion compensation system to hold the gangway stable and available during the transfer of personnel.

The gangway system will have to be able to facilitate the transfer of the required project workforce in accordance with the manning strategy. The type of operation, number of offshore facility visits and personnel transfers required (as well as the weather operability) will influence the type of gangway system to be selected.

3.3.1 Capabilities

The gangway system selected when mounted on-board a vessel should be able to safely reach the desired elevations (low and high) on the intended offshore facility(s) to be visited. This will be a combination of gangway system operating reach and motion compensation ability (to accommodate the vessel motions).

Whilst the W2W vessel maintains position (footprint and heading) alongside the offshore facility the gangway system needs to have sufficient capacity for normal operating mode up to a defined limit. In addition, it also needs sufficient reserve capacity past the defined limit to allow controlled disconnect (should conditions or circumstances require this). This reserve capacity should provide sufficient time for personnel using the gangway system to move off the gangway or to adopt a safe position whilst the gangway system disconnects.

The operational limits of the gangway system need to be realised so that the vessel motions induced onto the gangway system can be compensated for, in the majority of expected sea-states in the intended geographic location of operation. A gangway system's operating limits is typically quoted in x, y, z directional distances or sea-state significant wave height (Hs). The operational limits of the final integrated W2W solution will also heavily depend on the vessel capability.

The gangway system needs to have the capacity to carry the worst case loading condition. This may be a non-routine case, such as during an emergency response situation where a loaded stretcher could be carried by 2 or 4 persons wearing relatively heavy Personal Protective Equipment (PPE) will cross the gangway.

If material handling is planned to occur over or using the gangway, this needs to be considered within its capabilities to ensure it always operates within its design envelope.

The time to set-up and transfer the required number of personnel may be an important factor dependant on manning strategy adopted for by the FACILITY OPERATOR.

3.3.2 Safety / Performance Record

The FACILITY OPERATOR should review the performance of the selected gangway systems in similar conditions of operation to gain confidence that they will fulfil the required workability.

A gangway system should have a documented test inspection and maintenance regime in place delivered by competent personnel. In addition, due to the safety critical nature of the gangway system there should be robust assurance and independent verification processes in place.

A full set of proving and acceptance trials (derived from the output from a Failure Mode, Effects (and Criticality) Analysis (FME(C)A) should be undertaken to demonstrate initial suitability. These trials should preferably be witnessed by an independent competent person.

The inspection, test and maintenance regime should be suitable to provide assurance of residual capability for gangway systems deployed (i.e. longer than the period required for transfers, for example, a flotel where the gangway system provides an evacuation route).

Gangway system critical spares and maintenance provision should be included within the gangway system package on board the W2W vessel, such that unplanned downtime and return to shore trips for maintenance and sparing is not required / minimised. This is usually catered for in the form of a spares container incorporated within the W2W spread and the provision of competent gangway personnel. The FME(C)A mentioned above should be used to influence the sparing philosophy.

All historical operation, maintenance, verification information should be retained for a reasonable period.

3.3.3 Interactions with Vessel and Offshore facility(s)

When selecting gangway system(s), the potential interactions with the intended vessel(s) onto which it could be mounted and the intended offshore facility(s) it needs to service should also be considered. For example, large gangway systems may not be compatible / safe for use with smaller type vessels and offshore facilities due to the structural loads exerted. The various 'interfaces' between the components that form the W2W solution are considered in detail in the Section 4.1.

3.3.4 Gangway Personnel

Gangway personnel may be provided either by the SHIP OPERATOR or the GANGWAY PROVIDER. These personnel need to be suitably experienced and skilled operators and/or maintainers, subject to training and certification usually by the GANGWAY PROVIDER (backed up by qualifications, exams or certification).

Where twenty-four hour operations are intended, additional gangway personnel will usually be required to work on each corresponding shift team.

3.4 Offshore Facility Selection

The key considerations for the selection of the offshore facilities suitable for W2W operations are discussed in this section, with a comprehensive checklist contained in Annex C.5.

The following key aspects need to be reviewed and understood by the FACILITY OPERATOR when considering W2W operations at offshore facility(s):

- Practicality and safety of W2W connection and personnel transfer at the proposed offshore facility(s)

- Extent of any modifications required to the offshore facility(s) and interfaces
- Impact on current operational arrangements in place e.g. logistics, emergency response provision

Section 3.4.1 below details access location selection for the W2W connection with offshore facility(s). Offshore facility modifications and interfaces are covered in detail in section 4.1 and operational arrangements are addressed throughout section 4.

3.4.1 Offshore Facility Access Location Selection

The key considerations for the selection of the access location(s) on the offshore facility(s) are discussed in this section, with a comprehensive checklist contained in Annex C.6.

While it is not always possible retrospectively to add an appropriate landing location, consideration needs to be given to the positioning of landing location(s) on the offshore facility. The location(s) should be chosen to:

- Increase the ability of the vessel to be orientated to optimise the prevailing environmental conditions, and
- Give the highest W2W access availability, whilst also meeting the location requirements of the facility (i.e. not in a hazardous area, vessel not operating near an unprotected riser, well conductors etc.).

The capability and location of the gangway system on the vessel, as well as the vessel's station keeping capability may also influence the positioning of access location(s). For example: if the gangway system cannot reach the existing deck elevation on an offshore facility, a lower (or higher) access point on the offshore facility may be needed; potentially adding significant construction and certification costs and delay to a W2W project.

Conversely, the positioning of the access location(s) on the offshore facility may influence the placing of the gangway system on the vessel. For example, if there is only one potential landing position on an offshore facility, the gangway system may need to be situated on the stern of a vessel in order to increase the heading range of the vessel to increase W2W availability.

During selection of the access location(s) on an offshore facility, maximising the opportunity for the W2W vessel to be orientated head-on to the environmental forces during transfer operations should be a priority. On rectangular facilities, siting access locations on a corner or preferable diagonal corners(s) will likely result in significantly increased W2W availability as it will increase the range of vessel headings thereby increasing the likelihood the vessel can sit head-on to the environmental forces. Involving a vessel master (or another suitable mariner) at this stage in marine aspects (e.g. to work out vessel approach and setup details) would be valuable.

3.4.1.1 Identifying Optimum Access Locations on Offshore Facility(s)

Identification of suitable access locations on offshore facility(s) for W2W access and their assessment for both risk and workability needs to be considered, taking into account the following aspects:

Workability:

- Environmental conditions (sea state, prevailing wind and current strength and directions) of the specific geographical location. Prevailing current is particularly important for shallow water locations, such as near-shore wind farms.
- Working envelope of the gangway

- Heading range of vessel with deployed gangway (determined by gangway system envelope, gangway system location on vessel and position of access location on the offshore facility(s))
- Motion response of vessel for best heading within range available for all sea / weather conditions

Risk (hazards):

- Marine collision (including gangway system collision):
  - Riser, wellhead, pipeline, umbilical, turbine, cable proximity
  - Impact by the W2W vessel and/or its protrusions (gangway system, bridge or helideck etc.)
- Offshore facility major hazard loss of containment type events
- Potential impact on emergency response arrangements (e.g. means of evacuation, lifesaving apparatus positions, etc.)
- Vent and drain locations (e.g. overside discharges from offshore facility drains)
- Access location preparation requirements:
  - Structural capacity of access locations
  - Associated installation and maintenance hazards
- Access route to final destination (climbing ladders, stairs; walking through hazardous areas)
- Dropped objects onto transferring personnel
- Helicopter operations

Other:

- Supply vessel operating areas
- Blockage of line of sight (e.g. vision from vessel bridge, communications infrastructure)
- Maintainability
- Personnel/gangway control location
- Changing and meeting room facilities for the W2W personnel
- Muster locations for W2W personnel
- Proximity to fog horns
- Installation impact on W2W vessel (e.g. engine exhausts, discharge caissons, etc.)

In the offshore wind industry, traditionally there are one or two access locations on a turbine i.e. boat landing access with ladder to sea (originally designed for CTVs or PTVs). In the oil and gas industry there may be more options on platforms for access locations.

The more access locations on the offshore facility the greater the flexibility for vessel positioning, increasing the operating window and thereby the W2W operability during the year.

3.5 Onshore Facilities Selection

The key considerations for the selection of onshore facility(s) are discussed in this section, with a comprehensive checklist contained in Annex C.7.

Onshore facilities are needed to support any W2W programme. The onshore facilities provide a safety, security and logistical support and need to be set up and preferably tested prior to operation.

Onshore facilities would normally be expected to provide:

- A reception facility
- A facility to provide inductions (important to provide gangway system inductions prior to W2W transfer)
- A facility for checking for correct personnel documentation, either directly or through use of a computer system
- A facility to allow for establishing the identity of the persons seeking to gain access through the W2W solution
- A facility for necessary security checks
- Baggage handling including searches and unaccompanied baggage management
- Alcohol and drug testing support

In all cases the management of persons entering the system should be in accordance with a written procedure to include actions to be taken when certain issues are identified, e.g. suspected excess alcohol consumption or unaccompanied baggage.

4 SOLUTION DELIVERY

In this section further detailed information is provided to assist in the preparation, implementation and delivery of a W2W solution. The aspects have been grouped into topic areas, as presented in the Figure 4.1 below.

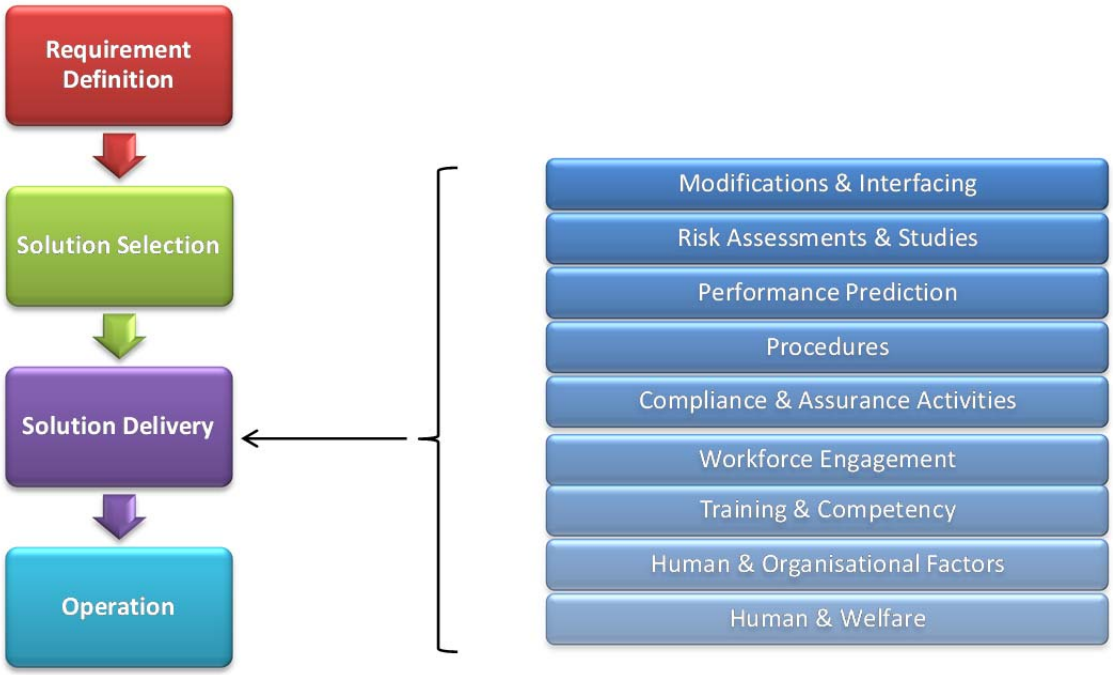


Figure 4.1 Solution Delivery Phase

This *W2W Guidance* assumes that the vessel and gangway system will be separate components in a W2W solution and that they will need to be 'integrated'. Purpose built W2W vessels are available which provide an already integrated W2W solution and the developers of such W2W vessels should have considered the aspects described below.

4.1 Modifications and Interfaces

It may be necessary to modify the components (e.g. vessel, gangway system, offshore facility(s) and onshore support) that formulate the integrated W2W solution. There will be interfaces between the components, such that when combined the operation and maintenance should be managed safely and effectively.

4.1.1 Vessel Modifications

Dependant on the project statement of requirements there may be a need to make modifications to the vessel. Examples of vessel modifications that have been undertaken on W2W projects are:

- Structural strengthening, addition of support frames and grillage
- Modules added for accommodation, workshops, workforce changing, etc.
- Additional FRC
- Upgrades to position keeping systems
- Upgrades to communications
- Possibility to power up black platforms/turbines from vessel (black start capability)

Marine design experience should be taken fully into account when modifying vessels for temporary W2W use (e.g. installing additional deck accommodation, provision of additional catering facilities, added crew requirements); since conventional non-marine approaches, which may be appropriate for fixed offshore facilities, may be inappropriate for marine applications.

The vessel's Classification Society should be consulted prior to vessel modifications to determine whether Class Approval is required. Class Approval activities may require a significant lead time and early communication with the Classification Society is recommended to gain an understanding of their requirements.

FACILITY and SHIP OPERATORs should consider the daily routine of their W2W personnel whilst on board the vessel. Aspects pertinent to the layout design of a W2W vessel are listed in Annex D.1.

4.1.2 Vessel - Gangway System Interfacing

The gangway system interface requirements with the vessel will vary dependent on the vessel and gangway system selected. Table 4-1 lists typical interface aspects for the integration of vessel and gangway system:

Table 4-1: Gangway System / Vessel Interface Requirements

Interface	What it involves
*Vessel structural	Deck structural analysis to be performed at the gangway system location.
*Foundation e.g. grillage, pedestal, tower	A grillage may be required to spread the load of the gangway system across the structural members of the vessel. A pedestal or tower may be required to elevate the gangway system on the vessel's deck; such a structure may avoid the need for separate grillage, if this design function is incorporated into the design.
*Sea fastening	The sea fastening attachment will be required to withstand the accelerations and transit loads created by vessel motions, as well as the static and dynamic loads from the mass and motion of the gangway system. The sea fastening should be considered the final element to fail in any tear-down analysis. In failing, consideration should be given to potential impact on water tight integrity. Where practical to do so, the gangway system should not be directly attached to deckheads forming part of a water tight compartment.

Interface	What it involves
Utilities	*Power - where a gangway system ties-in to the vessel's electrical power distribution system(s); the interfaces will require detailed examination, for example: • System redundancy • Impact on discrimination • Impact on short circuit protection Where possible, gangway systems should be connected to dedicated and segregated deck service electrical distribution systems via isolation transformers. The gangway system should be attached to the vessel's electrical distribution system at its most advantageous point. Earthing - the gangway system may be required to be earthed to the vessel. Fuel (diesel) - where a gangway system has standalone power generators and fuel is required (typically from the vessel's fuel storage). Bunding, transfer and fire-fighting arrangements must be considered. Hydraulics - either from the vessel's systems or standalone, supply and connection arrangements need to be considered. Cooling water - for gangway systems requiring cooling water supplies, careful consideration should be given to how this is routed to limit impact or potential impact on the integrity of existing spaces or systems. It should not be considered acceptable to utilise offtake from fire main, however small the cooling water demand is. Air - a gangway system sometimes demand additional services, such as an air supply. The potential impact of increased air flow through restricted pipework on line air pressure should be considered, especially where momentary high demand may cause sufficient pressure drop to compromise safety systems. Lighting - within the vicinity of the gangway system there will be a requirement for lighting of areas and walkways to sufficient lux levels.
Communications (also refer to Section 4.4.3)	Vessel bridge / gangway system communications: ▪ Voice (radio/public address (PA)) ▪ Alarms ▪ System status e.g. DP / gangway system ▪ CCTV Network connection (WiFi internet)
Bridging document (also refer to Section 4.4.5)	A bridging document should be in place and detail (as a minimum) the following: ▪ Safety management systems ▪ Roles and responsibilities ▪ Emergency response ▪ Vessel fire and safety plan ▪ Access, egress, escape routes ▪ Muster points ▪ Communication means
W2W Operational procedure(s) (also refer to Section 4.4)	Procedures should be in place and detail (as a minimum) the following: ▪ Vessel standing orders ▪ Gangway system operating procedure ▪ Inductions ▪ PTW systems ▪ SIMOPS ▪ Hazard Identification (HAZID)

Interface	What it involves
Access/egress routing	Access and egress routes on board the W2W vessel should provide effective routes for persons during normal operations and reasonably foreseeable situations and events. For vessels not originally designed to carry a full W2W personnel complement, walkways, access/egress doors, stairs, escape routes, other facilities, etc.; may not be fully suitable for the incidents that may occur with the number of people present.
Optional / further possibilities / opportunities requiring interfaces	▪ Gangway system control system and vessel control system (if gangway system is used as a DP reference system) ▪ Impact protection ▪ Cradle ▪ Project specific facility support systems (cable and hoses for power, deluge, mud, grout, fuel etc.)

Note *: These items may require appropriate design, engineering and subsequent approval from the vessel's Classification Society.

Design details should (where possible) be submitted in advance to the Classification Society for approval prior to starting work. Local regulatory requirements may also require other independent competent persons to be involved in the design assurance processes. On mobilisation, a Class surveyor will witness the gangway system installation onto the vessel to ensure it is in accordance to the Class approved design. Refer to Section 4.5.5.

The GANGWAY PROVIDER should ideally have a mobilisation and hook-up procedure to manage and control the above vessel / gangway system interface activities.

Section 4.5 covers vessel, gangway system and combined W2W vessel assurance.

4.1.3 Offshore Facility Modifications

It is preferable to have thought about W2W operations during the design of an offshore facility and include suitable access locations within the design. For existing offshore facilities, there may be requirements to make modifications to the facility to facilitate W2W operations. Examples of modifications to offshore facilities that have been undertaken on W2W projects include:

- Structure to provide support for the gangway system loads on the access locations
- Structure to lower the gangway landing platform to an elevation suitable for the gangway system on the W2W vessel to reach. Structure would require ladder/stairs, handrails, walkways, etc.
- Structural modifications to allow gangway access, clear areas access locations or improve clearances for gangway operations
- Changes to facility walkways, signage, deck markings, alarm coverage and lighting (e.g. for illumination of the gangway landing area, walkways to/from landing area and on sea surface where persons may fall)
- Impact protection to protect vulnerable parts of the facility from gangway system impacts and/or vessel impacts
- Welfare, contingency and emergency response facilities (as appropriate) to reflect any changes in manning numbers or situations (e.g. forced overnight stays, etc.)

- Evacuation and escape provision, as appropriate (e.g. if W2W vessel will be located where liferafts are currently deployed, liferafts will likely require to be relocated)

Some of the above items may need certification and verification by the FACILTY OPERATOR. Local regulatory requirements may also need to be complied with (e.g. in United Kingdom Continental Shelf (UKCS) a Safety Case update may be required).

In order to select W2W as the manning solution for an entire wind farm during operations phase; the wind turbines and substation should be designed to facilitate W2W solutions from the beginning, otherwise the cost of modifying all turbines in an entire wind farm will most likely be high.

Not all offshore facilities require significant modification to allow W2W access. Some W2W solutions can connect to access locations without requiring modification.

4.1.4 Offshore Facility - Gangway System Interfacing

The gangway system interface requirements with the offshore facility will largely be dependent on the gangway system, but may also be influenced by the offshore facility to which it is connecting. Ship to ship transfers, where the offshore facility is another floating structure (e.g. semi-submersible, FPSO or PSV) may require different/additional measures. Table 4-2 lists typical interface aspects for the offshore facility and the vessel.

Table 4-2: Gangway system / Offshore Facility Interface Requirements

Interface	What it involves
Access location (further detail in Annex D.2)	Gangway landing or connection point, as specified by the GANGWAY PROVIDER and installed by the FACILITY OPERATOR. This may include: ▪ "V", cone or pin docking structure that the gangway pushes onto, rests on or locks onto, as per the requirements of the particular gangway system being used ▪ A structural beam onto which gangway system pushes ▪ Gangway restraint provision to prevent vessel motions and/or environmental loads from displacing a deployed gangway (e.g. on a semi-submersible gangway which is deployed for extended periods, potentially through high wind conditions) ▪ Facility handrail modifications (such as removable panel) to allow safe gangway docking and movement of personnel, but without creating a hazard to facility personnel when gangway is not present ▪ Space around gangway access location to allow safe movement of people during both normal and contingency situations (e.g. to allow stretcher passage to/from the W2W vessel) ▪ Space around gangway access location for any auto-retract requirements of the gangway system.
Communications (also refer to Section 4.4.3)	Gangway personnel / offshore facility personnel (gatekeeper) communications: ▪ Radio ▪ Hand signals.
Personnel tracking	Provision of a personnel tracking system to enable personnel movement to/from the offshore facility to be recorded e.g. T-card or swipe card systems.
Procedures	Gangway system operating procedure
Bridging document	Refer to Section 4.4.5.
Optional / further possibilities / opportunities requiring interfaces	Project specific facility support systems (e.g. cargo transfers, cable and hoses for power, mud, grout, fuel).

Some of the above items may need certification and verification by the FACILTY OPERATOR. Local regulatory requirements may also need to be complied with (e.g. in UKCS a Safety Case update may be required).

4.1.5 Offshore Facility - Vessel Interfacing

The interfacing requirements with an offshore facility (small to very large) on implementing W2W operations as a means of access and egress need to be considered. This includes the emergency response capabilities and material handling.

When retrofitting W2W access to an existing offshore facility; the options available may be limited due to constraints posed by the original design and layout, current operations, hazard sources, emergency routes and maintenance, etc. For example: the number and location of gangway system access locations may be limited and sub-optimal which may have a negative impact on W2W performance.

On a new build offshore facility, if W2W manning is specified within the initial scope of design, the W2W requirements can be incorporated in the overall design process. This should result in an optimised, best practical and lowest risk design solution being adopted consistent with any additional Class requirements.

The vessel interface requirements with the offshore facility will vary from project to project. Table 4-3 lists typical interface aspects for the offshore facility and the vessel.

Table 4-3: Vessel / Offshore Facility Interface Requirements

Interface	**What it involves**
Fenders / bumpers	Providing protection for the offshore facility and/or vessel for instances when the vessel comes into direct contact with the offshore facility either intentionally (e.g. boat landing docking poles (for small workboats)) or by accident (e.g. crash barriers around vulnerable process systems near the gangway landing access location to protect from unplanned gangway movement).
Personnel tracking (also refer to Section 4.4.3)	Personnel movement control systems, preferably in both electronic and paper form, should be provided to track personnel on and off the W2W vessel, be it at port or offshore facility. The systems should be sufficiently robust to provide up to date information during normal operations and reasonably foreseeable situations and events.
Communications (also refer to Section 4.4.3)	Vessel / offshore facility communications: ▪ Telephone ▪ Radio ▪ Alarms ▪ Alerts (wave-off lights) ▪ PA systems
Vessel clearance	Ensuring there is adequate separation between the W2W vessel at all locations (e.g. superstructure, radar, aerials, gangway system, cranes, etc.) and the offshore facility (e.g. support structure, decks, vulnerable cables and/or pipes, etc.). This should take into account vessel motions in operating and disconnect sea-states. Note should be taken that the gangway system, if protruding from the side/stern of the vessel during vessel approach to an offshore facility, could be the cause of the first impact and/or could reach further into an offshore facility than other parts of the vessel.
Labelling / signage	Where labelling and warning notices found on the W2W vessel are different to those found on the offshore facility(s), they should be reviewed and if practicable, made consistent. If this is not practical then simple guides should be made readily available to the W2W workforce to help them understand the differences.
DP position reference (also refer to Section 3.2.3)	There may be a requirement to add DP position reference systems (e.g. prisms, transponders / responders) to the offshore facility.

Interface	What it involves
Marine procedures	Procedures should consider: ▪ Vessel pre-approach system checks ▪ Vessel approach and departure routes and directions ▪ Offshore facility restricted areas and exclusion zones ▪ Vessel set-up for W2W operations ▪ Vessel station keeping during W2W operations ▪ Marine crew manning levels ▪ Normal and contingency situations ▪ Communications during all stages of a W2W operation ▪ Any simultaneous operations (SIMOPS), combined operations (COMOPS) or other multirole activities
Bridging document	Refer to Section 4.4.5.

4.1.6 Interfaces with Onshore Facilities / Support

Interface between vessel and port(s) is likely to remain unchanged and existing marine and port(s) procedures should be followed.

The FACILITY OPERATOR should create a bridging document to interface the various Health and Safety Management Systems (H&SMSs) to ensure clarity with regard to policies to be followed (refer to Section 4.4).

The FACILITY OPERATOR should review existing procedures to see how a W2W solution could impact them e.g. marine and aviation procedures, adverse weather policy, emergency response etc. and update accordingly. Any additional procedural requirement should be incorporated into a new over-arching W2W procedure where required e.g. W2W personnel processing, mobilisation and logistics activities (refer to Section 4.7).

All procedures should be practiced as a table top exercise with all relevant parties involved early on in a W2W solution development and then repeated during the development, with the results being fed back into the development team.

All interfaces should be subject to risk assessment (refer to Section 4.2).

4.1.7 Onshore Facilities

Onshore support development commences at the identification of a potential need for a W2W solution. Adequate resources are required to administer the varying elements that build up to a successful W2W solution as detailed above.

A management process should be put in place to effectively manage the onshore facilities change process.

W2W projects will only be successful with sufficient onshore support, in terms of logistics of personnel and equipment, project management and engineering support.

Operators of W2W projects have previously used their existing heliport facilities or port facilities to process their personnel, baggage and equipment. Once processed secure road transport may take the people, baggage and equipment to the port where they can board the W2W vessel.

It is also common that the W2W vessel stays infield (offshore) and the offshore facility workforce is transferred using helicopters.

4.1.7.1 Safety and Security

The security of the W2W vessel and offshore facility is of highest importance. For W2W manning, the offshore facility workforce personnel may be transported by a vessel and there may be an increased opportunity for prohibited items (e.g. matches, drugs, alcohol, etc.) to be passed to a member of the workforce personnel before they transfer onto the offshore facility.

The W2W programme must recognise any security vulnerabilities that may be present with a W2W solution. Controls should be put in place to confirm a person's identity (IMO forms), and ensure prohibited items are not carried offshore either on the person or within luggage/tools. This may require additional screening of marine crew, security searches of the vessel, or screening of the workforce personnel as they move from the vessel to the offshore facility. Screening of the workforce as they move from the offshore facility to the vessel may also be required for vessel security.

As a minimum the following controls should be provided for workforce personnel travelling to offshore facilities via a W2W solution:

- Confirmation they are medically fit to travel (e.g. hold valid offshore medical certificate)
- Confirmation they have the required offshore, sea survival and W2W training (refer to Section 4.7)
- Confirmation that workforce personnel are not under the influence of alcohol or drugs and are not taking on board any prohibited items (as determined by the SHIP OPERATOR and FACILITY OPERATOR)

Medication will usually be allowed, but should be declared. Prohibited items are likely to be similar to those used for air travel to offshore facilities (consider weapons, ammunition, explosives, prohibited substances, alcohol, lighters and matches, control of electronic goods). Clear guidance on prohibited items should be provided by the operators and shared with all parties providing personnel to the vessel.

Port security measures are well established in the marine and offshore industries, IMCA provide guidance on the correct application and administration of the measures.

For vessels compliant with the IMO requirements (e.g. International Ship and Port Facility Security Code - ISPS Code) undertaking W2W operations, the Ships Security Assessment (SSA) and where considered necessary subsequently, the Ships Security Plan (SSP) should be reviewed and amended to reflect any perceived enhanced risks or additional security requirements specified by the FACILTY OPERATOR.

A trial run through of the intended personnel check-in process should be conducted to allow for any significant issues to be identified and be resolved prior to commencing with W2W operations.

4.1.7.2 Logistics

The W2W vessel may be specified to take on additional roles to support the work scopes. One such role can be supply boat services, typically if the offshore facility is normally unmanned. As a minimum the W2W vessel is likely to be required to support the workforce based on it. This will include handling of personnel's luggage and tool bags. How this will be undertaken will need to be considered, since it may place additional requirements for the vessel, gangway system or offshore facility.

To maintain location it may be necessary to conduct infield replenishment of the W2W vessel (e.g. food, water, fuel and lube oil supplies, as well as other materials and spares). Impact of this on the W2W vessel and personnel will need to be assessed from a safety and health perspective, especially as the vessel may not be experienced in undertaking infield replenishment.

An unscheduled port visit may be required for a number of reasons (e.g. adverse weather, equipment breakdown (gangway system / vessel), and medical emergency) and this will always need to be carefully managed.

The logistics support process may identify a need for a W2W Coordinator role on the vessel to ensure the smooth running of activities and reduce waiting and general non-productive time.

4.2 Risk Assessments and Studies

The role of risk assessments throughout the W2W lifecycle are important to maintain safe and efficacious operations and control accident hazards that may have been identified at the 'concept development' stage.

FACILITY OPERATORs should satisfy themselves that sufficient risk assessment has been undertaken and safeguard measures are in place to mitigate the risks associated with W2W activities in connection with their facilities. There may be, depending on local regulations (e.g. UKCS Safety Case material change submission), a legal requirement to demonstrate the safety of the W2W solution to be put in place.

The whole personnel transfer system and activity, therefore requires rigorous review and assessment; with available risk reduction options examined through a defined process. FACILITY OPERATORs may use their risk acceptance criteria / matrix to make an assessment of an events likelihood and consequence i.e. risk impact on safety, environment and business aspects.

Areas to consider when conducting W2W risk assessments are contained in Annex D.3.

Typical safety studies (with a brief explanation) that have been utilised in W2W projects are listed below, with further details of the main risk management processes in Annex D.3:

- Management of Change: a defined process to control a change to a system (Annex D.3.1).
- Hazard Identification (HAZID): the objective of a HAZID is to identify all accident hazard events associated with W2W; record them and any measures that can be taken to ensure barriers are in place to prevent, detect, mitigate and hence reduce risks to levels which are As Low As Reasonably Practicable (ALARP) (Annex D.3.2).
- Simultaneous Operations (SIMOPS): a review for concurrent activities and development of a SIMOPS matrix for their control / manage safely (Annex D.3.3).
- Qualitative and if necessary Quantitative Risk Analysis (QRA) to assess the risks to people, vessel, offshore facility, environment and any other risk area required (Annex D.3.4).
- Failure Modes Effects (and Criticality) Analysis (FME(C)A) and Fault Tree Analysis (FTA): vessel DP systems and gangway system control systems may have undergone FME(C)A and FTA for fault recognition and achieved reliability demonstration purposes. Assurance processes should include a review of these reports by a suitably competent person for completeness (Annex D.3.5).

The risk comparison between W2W versus helicopter can be a valuable input, whether or not to adopt a W2W manning solution; as well as a comparison of risk of boat landing access with CTV/PTV versus W2W platform access.

4.3 Performance Prediction

An assessment of the likely achievable workability and availability of the possible W2W solutions is required for comparison against the performance criterion in the statement of requirements - i.e. an

understanding of the environmental effects versus system availability (combination of vessel and gangway system).

The vessel capabilities are determined by comparing such criteria as the DP capability plots and RAO data against local historical wind and wave rose data.

An understanding of the separate operability of the vessel and the gangway system to be employed needs to be gained, as well as the combined operability. Estimation of potential unavailability of either the vessel and/or the gangway system should be understood to allow an overall availability of the W2W vessel (combined vessel/gangway system) to be calculated.

Vessel motion response characteristics in all vessel headings and sea directions, the location of the gangway system on the vessel, and the gangway's ability to compensate for motions imposed on it; all need to be taken into account when determining the predicted performance of the W2W solution.

The following types of assessment are for example only, some companies may use different terminology and/or differing definitions:

Workability assessment

A study that determines workability based on the following:

- Environmental conditions (sea state) of a specific geographical location
- The intended time of year of the project
- A specific vessel
- A specific gangway system
- A specified location of the gangway system on the vessel
- Specific offshore facility gangway access location(s)

Evaluation of availability

The following categories can be used to evaluate the availability of a W2W operation:

- Mobilisation
- Available for operations
- Demobilisation
- Transit/port time
- Weather downtime
- Technical downtime

During W2W solution development an assessment to predict the likely time breakdown in each of the above listed categories should be completed. Follow-up evaluations using actual recorded time should be completed during W2W operations to help understand performance and look for improvements. Figure 4.2 presents an example of a time breakdown for a W2W operation.

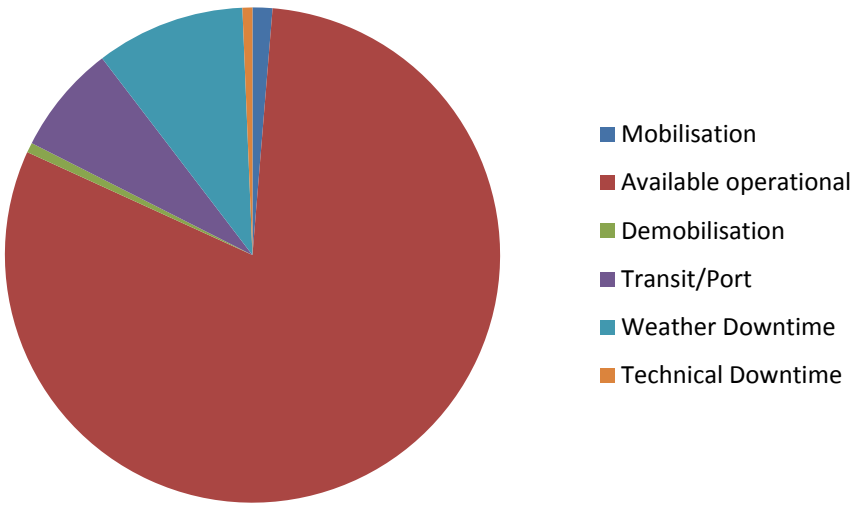


Figure 4.2 Solution Delivery Phase

4.3.1 Prevailing Sea and Weather Condition Assessment

The geographical position of the offshore facility needs to be assessed for prevailing sea and weather conditions. In addition to wave height, aspects such as current, wave period, steepness and directionality; as well as non-collinearity of wind, swell and wind induced waves need to be considered. The sea and weather conditions must be considered for the operating period under consideration.

Historical data for sea and weather conditions can be obtained for an offshore facility's location, which provide field data throughout the calendar year. It should, however, be noted this information is 'historical' and weather patterns and the frequency of severe weather systems are changing (and this must be borne in mind); particularly when considering the vessel size on which to place the gangway systems.

4.3.2 Operational Limits

Operational limits for W2W operations should be set to ensure that personnel transfers can be performed safely. These limits should ensure that as far as is reasonable the motions that the gangway systems is required to compensate for are within its operational design envelope. As detailed in section 3.2, the motions that a gangway system will be exposed to, will be from the motion response of the vessel to seas and weather; coupled to where the gangway system is located on the vessel relative to the vessel's CoG.

The term significant wave height (H_s) may be quoted as a unit of measurement for W2W operational limits. It is a value that is calculated from a number of recorded wave heights and is therefore, not a value that can easily be used during an actual W2W operation to provide input to a go/stop decision. If an operational limit is to be based on sea conditions, this should be influenced by the workability modelling discussed in Section 4.3.1. The modelling should provide information on the seas and weather conditions that could result in the gangway system reaching its operational limits.

Other factors that should be considered when defining operational limits include:

- Limits for dependent operations (e.g. crane operational limits, if W2W is dependent on use of the crane to take a day container up/down for workforce baggage, tools, food, etc.)
- Limits for response operations (e.g. fast rescue boat operational limits)

The actual maximum sea and weather conditions that the W2W solution will operate is dependent upon the capability of the gangway system and vessel motion response characteristics and location of the gangway system on the vessel. Assessment of individual components alone is of little value.

Connections to access locations on the (prevailing) windward side of offshore facility(s); although not preferable, may be possible as long as they are fully risk assessed and appropriately controlled (e.g. in accordance with IMCA guidelines) to reduce the risks of a 'drift on' impact.

The preferable location of a W2W vessel would be such, that should it suffer a position keeping failure (e.g. an electrical blackout) it will drift away from, or past the offshore facility. In situations where the offshore facility has the potential to release a hazardous vapour cloud (e.g. H_2S); this needs to be risk assessed with regard to the location of the W2W vessel, as being downwind of the facility may be hazardous.

For a turret moored FPSO the risk of the unit changing heading in varying environmental conditions needs to be considered and consideration given to providing heading control for the FPSO (e.g. use of FPSO thrusters or tug) to minimise the potential for the FPSO moving into the W2W vessel.

4.3.3 Gangway System Availability

The operator should estimate a gangway system availability figure based on GANGWAY PROVIDER's performance data and taking into account the unknown factors coming from unique elements in the design or usage of the system.

Any deficiencies found in the W2W gangway system should be rectified prior to deployment and attachment to offshore facility.

The availability of the gangway system is completely independent of the weather conditions and is captured under operability.

There will be a requirement for maintenance of the gangway system. Any downtime for routine maintenance should also be accounted for in the availability /operability assessment calculation, as it will have a direct impact of up-manning availability. Gangway system maintenance should (where possible) be planned for periods when the gangway is not required for personnel transfer.

4.3.4 Overall Availability

The overall availability is estimated by product of the weather and gangway system availability and other potential delays, and taking this from the ideal project availability of 100%.

The calculated overall availability should be considered an estimation and be subject (especially for longer period projects) to periodic review.

To assess the probable availability of a W2W solution, suitable dynamic modelling should be conducted.

The greater the number of access locations, the higher the degree of operability and availability of the W2W solution; through introducing flexibility in set up, taking into account varying factors such as waves, current, weather and any ongoing SIMOPS. The provision of access locations on different corners (if rectangular) or orientations (if circular) of the offshore facility(s) will increase the availability window.

For example: by having the vessel heading into the prevailing weather (i.e. bow-on) the hull form is such, that the power required to maintain station is reduced; or alternatively stated, the vessel's operating envelope is maintained with less power consumption. However, if the vessel is orientated stern-on to the

prevailing weather the power required to maintain station will increase and the operating envelope is reduced; though in the context of the operating envelope of the gangway system, this will likely be considered marginal. If the vessel has to take up a cross-seas orientation the power requirement to hold location will increase significantly with a corresponding decrease in operating envelope. For DP vessels this will be reflected in the DP operation footprint diagrams.

Overall operability percentage times can be calculated considering waves from all directions. It should be noted the operability figures calculated will be a coarse estimate of actual operational performance.

4.4 Procedures

This section details the requirement for procedures and procedure integration, implementation and optimisation. The W2W operations rely on good marine coordination, formalised through procedures and offshore facility representation. It should be noted that the W2W vessel master has overriding authority and responsibility for the safety of the vessel and the personnel on board (including those involved in transfers). The master cannot be forced to conduct a W2W operation, but the transfer operation can be vetoed or halted by the offshore facility manager or others with operational authority.

4.4.1 W2W Procedure(s)

The FACILITY and SHIP OPERATORs should have procedures in place to govern the operations and activities required for the transfer of personnel to and from the W2W vessel to an offshore facility via the gangway system.

The key aspects that should be covered in the W2W procedure(s) are described in this section with further specific detail available in Annex D.4 (with a comprehensive procedural control checklist in Annex D.4.1 and a 'planning a visit' checklist in 4.4.2).

4.4.2 Adverse Weather Criteria

The FACILTY OPERATOR should specify clear weather limitations that are not to be exceeded for W2W transfers when manning and/or de-manning an offshore facility i.e. if triggered, W2W transfer does not go ahead.The FACILTY OPERATOR should also have procedures to ensure there is adequate weather forecasting to enable future bad weather is predicted so that appropriate measures can be taken.

Alert levels for operating limitations should be developed. For DP vessels, IMCA documents M103 and M182 describe a system for managing degraded DP operation. The situations that should trigger these alert levels should be based on safe operating parameters, reflecting the capability of the vessel, gangway system and offshore facility to operate within safe working limits. These limits must consider the capabilities / weather limitations of the primary and secondary evacuation means, as well as the capabilities / weather limitations of the emergency response provision.

Vessels should be set up for the safest mode of operation for the W2W activities planned and operational guidance should be provided to the marine crew. Further detail on Adverse Weather Policy is contained in Annex D.4.3.

4.4.3 Communications

Recognised channels of communication should be established between the SHIP OPERATOR, GANGWAY PROVIDER and the FACILITY OPERATOR and be detailed in the W2W procedures and bridging document. Further detail on communications is contained in Annex D.4.4.

Effective communications will be required to be established and tested between:

- Vessel bridge and gangway personnel on vessel

- Vessel and offshore facility to any supporting standby vessel
- Vessel and offshore facility control centre
- Vessel and offshore field co-ordinator, or similar that is controlling the marine traffic to and from the offshore facility

Further detail on communications is contained in Annex D.4.4.

4.4.4 Personnel Tracking

A continuous tally of personnel location should be maintained throughout the project for all foreseeable circumstances (e.g. on/off vessel in port, over gangway system, ad-hoc helicopter transfers, etc.).

Where possible the personnel tracking system adopted on the W2W vessel should be compatible with existing personnel tracking system at the offshore facility(s).

Limitations on numbers transferred to an offshore facility may apply due to restricted LSA capability. As such, it is necessary to have in place a sufficiently robust method at the gangway system to prevent too many persons transferring.

4.4.5 Bridging Documents

Bridging documents should be prepared between the FACILITY OPERATOR and the SHIP OPERATOR for the W2W activities (and any other agreed parties such as GANGWAY PROVIDER). These should interface the H&SMS of the respective parties; including, but not limited to details of the offshore facility, the vessel and the gangway system. Provide a clear W2W organisation structure and define roles and responsibilities.

A comprehensive bridging document checklist is provided in Annex D.4.5.

4.4.6 Emergency Response Provision

A review of the SHIP OPERATOR and FACILITY OPERATOR emergency response provision should be undertaken to determine how W2W operations may impact the current provisions. Many FACILITY OPERATORs have been able to incorporate the W2W vessel into their existing field emergency response provisions, removing the necessity for an additional vessel to provide emergency response, standby duty cover.

Where the W2W vessel takes on emergency response duties then an assessment should be made. Any additional risks involved (in particular including any that could affect its emergency response function) and measures to mitigate the risk put in place. Where undertaking other duties (that do not conflict with the standby role) they should also take worst-case loading conditions into account when calculating the stability conditions for emergency response (e.g. launch and recovery of FRCs, with survivors on board, etc.) and consider the effect of any deck and bulk cargo, (if applicable) on stability.

Further detail on emergency response provision is provided in Annex D.4.6.

4.4.6.1 Evacuation and Escape Provision

Emergency response plans (ERP) should be reviewed and amended as necessary. All options for combining and/or aligning the gangway system with the evacuation and escape provision should be considered, with a view to improving (and where practicable simplifying) what is provided on the offshore facility(s).

For wind farms, the possibility and solutions for evacuation from turbines and offshore substations must be assessed. Currently, the most common primary means of evacuation is the use of the CTVs or PTVs,

with helicopter being the secondary means. For a W2W solution, the gangway system will most likely be the primary means of evacuation.

Detail on how the W2W solution can be incorporated into an offshore facilities evacuation and escape provision is provided in Annex D.4.6.1.

4.4.7 Transfer Management

During workforce personnel crew transfers it is important that the offshore facility or any facility POB limitations are not exceeded. Additionally, the offshore facility core workforce personnel competencies (i.e. emergency response cover) must be maintained on the offshore facility at all times it is manned. It is essential that sufficient time is given to allow for proper handover between workforce shifts (e.g. as in accordance to the ISM Code).

At each visit, a workforce personnel day container may be required to be transferred from the W2W vessel onto the offshore facility. Such a container might be needed to ensure personnel bags, tools, etc., follow their owner's movements. W2W experience has seen projects use the offshore facility crane, or the W2W vessel motion compensating crane (where fitted). Some gangway systems have the possibility to transfer goods, this can reduce the need for crane activities and shortens the time the W2W vessel needs to be alongside the offshore facility.

4.4.8 Personal Protective Equipment (PPE)

Whilst on the vessel, all personnel must wear appropriate PPE in accordance with SHIP OPERATOR's procedures. Whilst working on the offshore facility, the workforce personnel should wear PPE in accordance with the FACILTY OPERATORs procedures.

Whilst transferring to/from the offshore facility, the workforce personnel should wear PPE in accordance with the W2W procedures, as agreed by the SHIP OPERATOR and FACILITY OPERATOR.

Although the minimum standard of PPE for personnel transfer will vary between W2W operations, it may include:

- Hard hat
- Fire retardant coveralls (note reflective strips on coveralls may impair a DP Cyscan position reference system)
- Safety glasses
- Safety boots
- Gloves
- Hearing protection as determined by ambient noise level
- Automatic lifejacket

Consideration should be given to the use of PLBs, which may be an integral part of the lifejacket; especially for operations in the hours of darkness.

If there is a possibility for W2W personnel to arrive or leave by helicopter, this needs to be fully considered. The provision of helicopter survival suits and lifejackets will need to be effectively managed and a pre-flight heliport safety briefing (video) may need to be available for induction purposes on the W2W vessel.

4.4.9 Welfare Procedures

The SHIP OPERATOR should have procedures in place for managing workforce personnel welfare, which should include, but not be restricted to:

- Minimum standards, reflecting those contained with International Labour Organisation (ILO) Maritime Labour Convention (MLC)
- Food safety management
- Legionella prevention
- Potable water system management
- Pest control
- Daily inspection requirements
- Stewarding
- Medical facilities and personnel

4.5 Compliance and Assurance Activities

4.5.1 Legislative Compliance

A review of the legislation and standards applicable to the intended region of the W2W operations should be performed (e.g. in the UKCS safety case requirements or other operational risk assessment demands). This review should include both offshore and maritime legislation and guidance. An overview of international legislation and standards is provided in Annex B.

Obtaining legislative compliance approval can be the project critical path e.g. for example, satisfying safety case requirements in the UKCS.

4.5.2 Suitability Survey and Vessel Assurance

The FACILITY OPERATOR should undertake initial vessel suitability surveys and then review for robustness, the SHIP OPERATOR's assurance processes for the selected vessel (and gangway system if part of the ship's equipment). Such assurance, should build on established assurance guidance as appears in IMCA Common Marine Inspection Document (CMID) and OCIMF Offshore Vessel Inspection Database (OVID). It should also consider: regulatory compliance, access / egress routes to the walkway (especially when transferring injured personnel), LSA, ISPS and SPS compliance requirements.

Ideally, gangway systems affixed to, or otherwise part of the vessel should be considered to be part of the vessel; and as such should be managed using the vessel's H&SMS and resources. The design and continued condition of equipment, systems and structures on marine vessels where they have a safety or integrity impact, are primarily controlled and verified through Flag State or Classification Society rules and in-service surveys.

Section 4.5.5 covers in detail the sea fastening requirement for W2W gangway systems.

4.5.3 Gangway System Assurance

If the W2W gangway system is part of the ship's equipment it will fall within a vessel's Classification Societies' verification scheme. Hired gangway systems are considered 'add-on' deck equipment and will be required to be certified to an appropriate standard. This would be to help ensure that the safety and integrity management of the gangway system and dependent equipment are critically examined, and

processes put in place to ensure personnel risks associated with using the system are maintained at an acceptable level.

> Only gangway systems that are part of the ship's equipment currently fall within Class. To close this potential safety assurance gap a W2W project should consider specifying a requirement that the gangway system needs to be certified to an appropriate standard and a robust assurance process is developed and implemented.

The W2W gangway system should be considered safety critical; failure of which, could lead to loss of life. Therefore, it is important that GANGWAY PROVIDERs are able to demonstrate that their gangway system is of inherently safe design, follows a controlled manufacturing process and reasonable assurances are in place. The creation of an Health, Safety, Environmental and Quality (HSEQ) demonstration document by the GANGWAY PROVIDER will help convey the suitability of their system for a W2W solution. This HSEQ demonstration would need to be supported by appropriate assessments including: Hazard Identification (HAZID) and Hazard and Operability (HAZOP) studies, Failure Mode Effects (and Criticality) Analysis (FME(C)A), Fault Tree Analysis (FTA), Safety Integrity Level (SIL) analysis, etc.

The information from the GANGWAY PROVIDER for the purposes of HSEQ demonstration should include, but not limited to:

- Equipment and system description down to component level, providing appropriate detail of the gangway system units, their primary functions, safety systems etc.
- Inherent safety features:
  - Equipment redundancy and failure modes
  - Software and firmware control aspects
- A description of the H&SMS in place at GANGWAY PROVIDER operating company demonstrating compliance to an international standard e.g. ISO 9001, IEC 61508
- Product certification to a recognised standard e.g. Offshore equipment technical standards, IEC 61508
- Detail of the accident hazard events that have been identified for the gangway system with a demonstration that risks are acceptable
- An explanation of the operation statement providing a justification and assurance to the hiring operator and regulatory bodies to allow the gangway system to be used in the offshore environment for personnel transfer operations.

4.5.4 Combined / Integrated W2W Solution Assurance

Whilst sections 4.5.2 and 4.5.3 refer to vessel and gangway system identification of failure modes separately; the W2W system as a whole should be subjected to a thorough failure mode review (including FME(C)A, where appropriate) of the combined gangway system and shipboard (including DP) systems.

4.5.5 Acceptance Criteria for the Installation of W2W Gangway Systems

From the Classification Society structural perspective, unless the gangway system is permanently installed on a vessel, the W2W system and any associated equipment (e.g. power packs, spares containers, etc.) are not Class equipment. However, such a gangway system may fall within local regulatory requirements (e.g. Lifting Operations and Lifting Equipment Regulations (LOLER) in the UK).

Figure 4.3 illustrates the arrangement of a temporarily installed gangway system on the deck of a vessel. The figure shows five components, but this may be reduced to only three (i.e. 1, 4 and 5), if a support structure is not required.

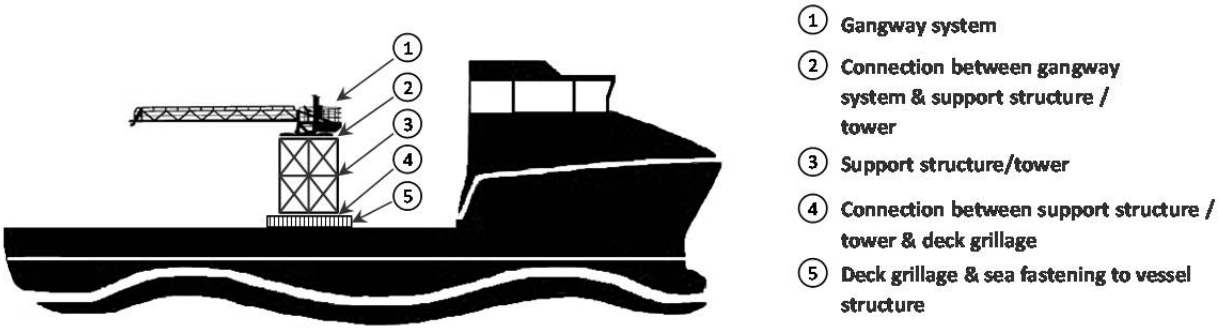


Figure 4.3 Gangway System Arrangement on a Vessel

An example of a W2W gangway installation on a vessel is shown in Figure 4.4.

Figure 4.4 Example of a Gangway System Arrangement on a Vessel

The design of the grillage and sea fastening on board of Classed vessels should be undertaken in accordance with the requirements of the Classification Societies Rules for Ship Construction applicable for heavy equipment of the vessel.

Care must be taken to ensure that the grillage, sea fastenings and other structural components have been designed and installed to accept all loading conditions (including allowable overloads). The GANGWAY PROVIDERs documentation should state that the footprint loads cover all the relevant loads and load combinations. The loads reacted in the gangway system structure by the placement of the sea fastening must be acceptable to the GANGWAY PROVIDER. The approval letters should include clear information regarding the source of the loads, including the limitation of Class involvement in the estimation of the loads.

The sea fastening of the gangway system to the vessel should be pre-engineered with the drawings and calculations approved by the Classification Society prior to the mobilisation stage to avoid delays.

Following installation, the efficiency of the sea fastening should be assessed by visual inspection and non-destructive testing (NDT). Load testing could provide an additional positive assessment of the integrity of the attachment and other structural components, and should be performed in accordance to a testing protocol supplied by the GANGWAY PROVIDER.

The gangway system will carry human life, as such the Class structural scope (review and survey) should include all intermediate structural elements between the ship's structure and the gangway system (e.g. grillage, support structure, pedestals and towers); and the connections between these elements and the ship's structure and the gangway system. Not all Classification Societies will include these intermediate structural elements. SHIP OPERATOR should ensure their Classification Society includes the intermediate structural elements in their scope, so as to ensure all safety critical structural components associated with the gangway system are appropriately examined.

Any additional steelwork added to the ship's structure as part of the connection solution of the gangway system will be considered covered by the gangway system certification. Similarly, the strength of the gangway system for the loads induced into the gangway system by any sea fastening solution, should be discussed and agreed with GANGWAY PROVIDER and part of the gangway system certification.

The SHIP OPERATOR should ensure there is no impact on escape routes, muster stations, fire plan drawings (especially when manned containers are fitted, as these need to be included on fire plan and inspected in accordance with Class rules) and field of vision.

Although this section focuses on the arrangement for the gangway system, the requirements should also be considered and applied to any ancillary equipment i.e. power packs, spares containers.

4.5.6 Safety Critical Systems and Performance Management

Any part of the W2W gangway system affixed to, or otherwise part of, the offshore facility (e.g. landing platform, stairs/ladders, normal and emergency lighting, etc.) will fall (as applicable) within the offshore facility's H&SMS.

Use of a gangway system is considered to be safety critical and therefore, systems and performance management measures / standards need to be put in place. This is because failure of the gangway system or access location could lead to a person or people falling from height, onto a deck/into the sea, and potentially resulting in fatality(s).

It is recommended that a review of the offshore facility's safety critical systems and performance management is undertaken to see if W2W operations have been adequately addressed and the risks controlled. Specific areas to consider are:

- Access location / platforms
- Gangway system
- Gangway system supporting structures and sea fastening
- W2W vessel
- Normal and emergency lighting provision

- Normal and emergency communications, and
- Emergency response (evacuation, escape) provision.

The operator should establish minimum assurance requirements for the vessel and gangway system. Such assurance should take into account access / egress routes to the walkway including when transferring injured personnel.

4.5.7 Justification to Commence W2W Operation

A demonstration should be made to the various operating organisations (e.g. SHIP OPERATOR and FACILITY OPERATOR; and potentially their regulators) that the W2W solution that they are planning to implement has been assessed and any risks can be demonstrated to be acceptable.

The gangway system is safety critical and it is important to demonstrate the W2W solution is inherently safe and reasonable assurances are in place prior to operation. This safety demonstration will be a combination of:

- The risk assessment processes
- The vessel supplier's HSEQ demonstration
- The gangway system supplier's HSEQ demonstration
- The procedural development
- The workforce selection, training and competence
- Human factor analysis
- Verification activities
- Justification for operation statement
- Tertiary escape and LSA

4.6 Workforce Engagement

Workforce involvement can often be overlooked and is a significant factor in determining the success of a W2W project. Early workforce involvement and engagement should be planned for, and include both the regular offshore personnel and any third party personnel that will utilise the W2W system.

The FACILITY OPERATOR should consider conducting vendor engagement sessions and provide workforce engagement packs to detail the additional requirements or considerations for those expected to use the W2W solution.

4.7 Training and Competency

4.7.1 Inductions

There will be a requirement for multiple inductions covering various topics in order to familiarise personnel with 'new surroundings/environments' that W2W will expose them to. Many offshore workers may not be familiar with sea ports and travelling on/or staying aboard a marine vessel and transferring across a W2W gangway system. Conversely, some personnel may be required to cross on to an offshore facility, or to a facility that they have not visited before.

Hence, the following three areas are likely to be needed in the workforce induction process:

1. W2W vessel induction
2. Gangway system induction
3. Offshore facility induction.

4.7.2 Marine Crew

Having a marine crew that has prior experience with W2W operations is beneficial in the implementation and operation of a W2W solution. If this cannot be achieved, additional time should be allocated for familiarisation and training across the full range of W2W operations and situations. This may need to include sea trials, where trial connections and disconnections take place (without any additional personnel on the vessel). It is important that an effective, integrated working team is created between the marine crew, gangway personnel and offshore facility workforce personnel (if present).

Marine crew supporting the function, such as FRC crew, should have the correct training and certification and be regularly drilled to demonstrate expected capabilities.

The abilities of a ship to reliably remain on station is directly related to the competency and training of marine crew members with responsibilities for this. These include both the bridge and maintenance teams. Inappropriate actions by either, may result in introduction of faults, at least as significant as the worst case fault identified in the FME(C)A.

Such assurance must include an appropriate method allowing these marine crew members to take the correct course of action in an emergency. Typically this takes the form of drills, simulator training, and company guidance in the form of ASOG's, CAMO's and safety mode of operations (SMO).

4.7.3 Gangway Personnel

The GANGWAY PROVIDER or the SHIP OPERATOR (depending on contractual arrangements) will be responsible for the training and competency of the gangway personnel. The gangway system assurance may not fall under the vessel assurance process, in which case this aspect should not be overlooked.

It is important to conduct company audit and gangway personnel competency checks at the tendering stage, prior to operations, and during operations.

Drills should be periodically undertaken based on varying realistic failure modes allowing the gangway personnel to take the necessary correct action to mitigate any risk.

4.7.4 W2W Workforce Personnel

The offshore workforce personnel that are going to use the W2W solution may consist of personnel with varying levels of experience and competency for the intended project work scope. It may be formed from a number of companies and may include ad-hoc agency personnel. Campaign teams may have been assembled from existing campaign teams that are familiar with the offshore facility, but not with marine vessels or gangway systems. Conversely, new team members from contractor resources could be hired in for the project and may have W2W experience, but be unfamiliar with the offshore facility. Potentially, some resources may be unfamiliar with all aspects of the project.

It is good practice to create a training needs matrix for the W2W workforce personnel to identify the needs of specific individuals, their roles and refresh (as and when required). Ultimately, these persons are under the 'management control' of the FACILITY OPERATOR, which has a 'duty of care' to those using the W2W solution. The training matrix should confirm the individuals:

- Have the required offshore facility training, including any training requirements for any reasonably foreseeable situations that could occur (e.g. Helicopter Under Water Escape Training (HUET) where helicopter transfer is foreseeable in the event of W2W unavailability).
- Have specific training for joining and living (if applicable) on-board the W2W vessel. Normally accepted offshore training for offshore facilities may not adequately cover the basic needs for workforce personnel while on the vessel.

4.7.5 Emergency Response Training and Exercises

Emergency response training and exercises should be conducted with the inclusion of W2W specific scenarios (e.g. W2W vessel collision with offshore facility, gangway system failure, ladder rescue, man overboard, etc.). It is recommended that emergency response plans are developed, reviewed and periodically updated; and training exercises / drills are conducted to refresh and reinforce the information.

It is good practise to run desktop / role play exercises to test the emergency response arrangements, systems and procedures in place. Initially, these should take place early on in a W2W project, once the solution has been agreed upon and then periodically repeated, before project implementation so that lessons learnt can be fed back into the project. These may involve offshore personnel implementing installation specific emergency response plans; through to mobilising the onshore incident management, emergency response teams, standby vessel support and relevant authorities. Note that multiple incident management and emergency response teams may be involved with FACILITY OPERATOR, SHIP OPERATOR, GANGWAY PROVIDER and contractor team's communication channels being tested.

4.8 Human and Organisational Factors

A review of the proposed W2W solution should be performed to identify and evaluate any human and organizational factor issues.

Human factors (HF) may be considered to apply to three discrete groups of persons:

Offshore facility workforce personnel - these are the persons who must transit back and forth using the W2W solution. These are likely not to be marine personnel or personnel with extensive knowledge of ships and shipping activities. They may consider the free movement of the vessel in heavy seas to be disturbing and may not be resilient to the medical effects this may have (including nausea and fatigue).

Vessel marine crew - having a W2W solution may bring traditional marine crew in close proximity to non-marine crew, in a way that, initially may appear unusual. It may be that a period of familiarisation is required and allowance given for interruptions to the normal routines of the marine crew.

Gangway personnel - these may be ship marine crew or non-marine crew, but who are familiar with ships and shipping activities and such, find integration into the ship simpler than the workforce personnel.

The FACILITY OPERATOR should ensure that adequate arrangements are in place by the employers of each of these groups to manage the HF element in the W2W solution.

Experience gained during W2W operations highlight the importance of effective coordination of W2W activities and operations (e.g. to plan worker movements and work tasks, interface with marine operations, manage local logistics, etc.). A dedicated W2W coordinator may improve overall work delivery efficiency.

More information on HF is provided is Annex D.4.7.

4.9 Health and Welfare

The health and welfare of the personnel living on a vessel is the responsibility of the vessel master. The W2W vessel accommodation and welfare provision for the workforce personnel and gangway personnel, should be at least equivalent to that provided for the resident marine crew. Compliance to the requirements of ILO MLC 2006 should be applied to both permanent and temporary installed accommodation on the W2W vessel.

Limits for noise exposure for workforce personnel should be at least equivalent to that applicable to marine crew. Before commencement of hire, a complete (and relevant) noise survey should be in place on any W2W vessel, upon which the workforce personnel will be resident.

Workforce personnel used to living and working in a stable and fixed environment may be susceptible to sea sicknesses (i.e. motion sickness) when on board the W2W vessel. Anyone prone to getting motion sickness, should be advised to consider taking sea sickness medication prior to arriving at the vessel, as prescribed by the medication supplier. Avoiding or reducing the potential for sea sickness within the W2W campaign is important and will improve the working environment for the workforce.

More information on health and welfare is provided is Annex D.5.

5 OPERATION

This section looks at the coming together of the various W2W components: vessel, gangway system, offshore, onshore facilities and the workforce; and the necessary verification and assurance activities that need to take place prior to a trial phase.

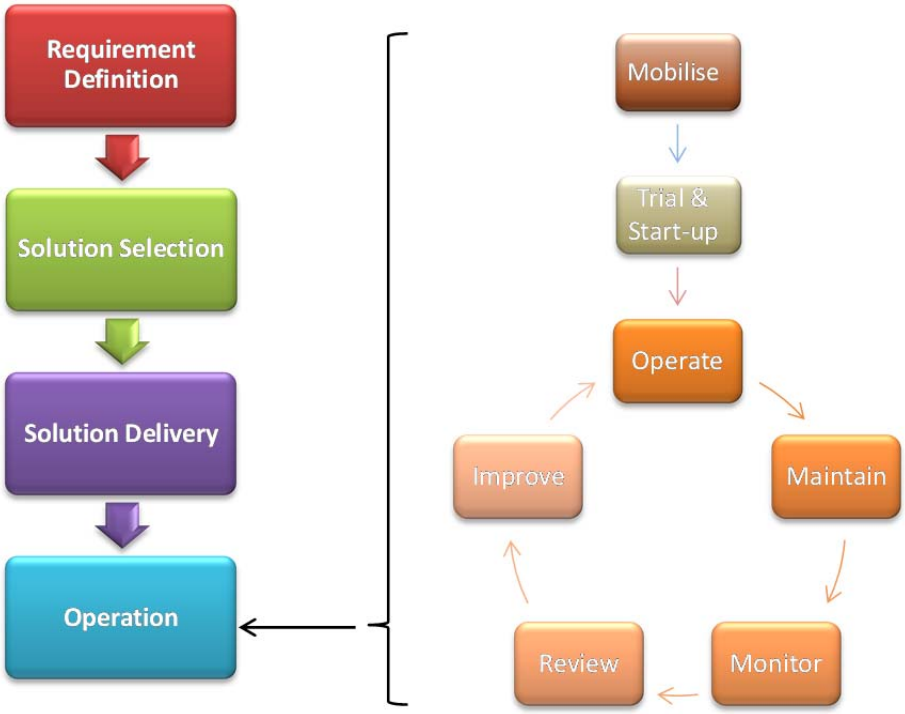


Figure 5.1 Mobilise and Commission Phase

5.1 Mobilise

The 'mobilisation phase' is the mobilisation of the selected gangway system onto the deck of the chosen vessel. If possible, the intended onshore process facility location should be adopted and involve the workforce in the integration process.

If an integrated solution or bespoke W2W vessel has been hired this mobilisation phase has already taken place.

5.1.1 Installation of Gangway System to Vessel, Gangway System Hook-up and Interfaces

The gangway system will require lifting (mobile, quayside or possibly vessel crane) onto the vessel in the predetermined position (e.g. midships, aft, mezzanine deck etc.). The foundation requirements (e.g. grillage, pedestal) have been covered in section 4.1.2 and the sea-fastening design in section 4.5.5.

The number of other interfaces, which will be required to be connected up between the gangway system and the ship will vary and be specific to the gangway system employed. These have also been covered in section 4.1.2.

Depending on the project work scopes to be conducted the W2W vessel specification may require installation of further equipment at quayside i.e. additional FRCs, PRSs, cabins etc.

All equipment will require correct installation, testing and verification by Class or other competent authority prior to sailing.

5.1.2 Hazardous Areas

It is not likely that a gangway system would be installed on a ship having significant hazardous areas on deck. It may be that the proximity of vents or where goods are transported for use (such as Marine Gas Oil (MGO) storage tanks), that such hazardous areas or zones affect gangway installation and operations. It is important, that any part of the gangway system that encroaches or has the potential to encroach, into these areas is of suitable design and correctly certified for the gas type/exposure potential.

Where doubt exists the SHIP OPERATOR should obtain response from the vessel Classification Society regarding any specific requirements. A gangway system design should not cause the need to establish a hazardous zone or make change to dangerous goods plans.

5.1.2.1 Exceptional Circumstances

In exceptional circumstances, it may be necessary to consider exposure of the gangway system (or parts of it) to explosive atmospheres. These exceptional circumstances may be created on the vessel due to spillage or resultant from the offshore facility (for example due to a process safety event).

Where it may not be practicable for a gangway system (or parts of it) to be certified for use in explosive atmospheres, an 'isolation control' approach may be considered appropriate to minimise the potential for the gangway system to ignite an explosive atmosphere. This would typically be in the form of an ability to shut down the system safely through action taken remotely. One method is isolation of electrical power supplies at a remote switchboard. In doing this, consideration has to be given to controlling access to the gangway system during this period.

It is recommended that, where potential exists for these exceptional circumstances, a properly described procedure with actions to take is in place and that drills and exercises are periodically performed.

5.1.2.2 Internal Combustion Engines

Internal combustion engines demonstrate a clear risk in terms of fire and harm to persons and should be carefully positioned. Where these are installed in enclosed areas, care should be taken to recognise any potential for considering this space 'category A machinery space' under SOLAS.

5.1.3 Commissioning

Systems associated with the gangway system are to be commissioned as part of the hook up process. Where necessary, this involves a flushing regime for pipework (e.g. utilities); a setup of control and alerting parameters; as well as function test of all discrete components, including the integrity of any protection arrangements (e.g. environmental, explosive gas, dust, security etc.).

Commissioning should be in accordance to a written plan provided by the GANGWAY PROVIDER and will form part of the site acceptance test (SAT). Once installed the gangway system and all interfaces should be subject to the SAT to verify they are working as intended. This should initially be done at quayside and then as part of sea trials, to prove the integration between the ship and gangway system.

The final part of the marine assurance process should be conducted by a suitably independent competent person at the quayside, prior to the vessel going on hire. Vessel inspections, audit and review of marine crew training and competencies should be undertaken (at an early stage to allow rectification of any identified deficiencies) in accordance with the FACILITY OPERATORs marine assurance process.

5.2 Trial and Start-up

Once the mobilisation phase is complete, an initial soft start programme should be performed to confirm the combined operation of the vessel and gangway system. The phases of the soft start operation consist of:

1. Initial trials onshore quayside
2. Offshore, in open sea
3. Offshore at fixed installation.

The initial trials at onshore quayside act as the commissioning phase of the gangway system and operator familiarisation. Testing can be carried out on a test landing, for example: connection point mounted on top of a container.

In open sea conditions the vessel DP capability and gangway system deployment (with motion compensation enabled) can be tested, monitored and if required, adjusted.

Offshore trials at an offshore facility can then take place. Trials could consist of repeated approaches and connections of the gangway system, with no personnel crossing the gangway. After completion of the initial connection trials, personnel may cross the gangway system and confirm the interface with the landing platform.

It should not be expected to undertake trials at every offshore location, as this is unlikely to be needed and would reduce the W2W solution economics.

Proving of the W2W vessel and gangway system will be an on-going process and should be monitored and documented to build up an operational history. Opportunities for improvement should be looked for on a continuous basis.

5.3 Operate

Once the W2W system is commissioned and project action items closed out (specifically those which are safety critical and constituent safeguards against accident hazards), the commencement of normal W2W operations can start. Where project items cannot be immediately addressed before the commencement of normal W2W operations, then these should be covered by suitable Operational Risk Assessments (ORAs), or equivalent.

Following implementation, onshore support should maintain regular communication with the various contractors providing components making up the W2W solution. Such contact should include meetings, whereby the results of performance against deliverables and Key Performance Indicators (KPIs) are discussed. Incidents recognised as arising from the use of the W2W solution need to be properly investigated.

Daily meetings between key personnel on the W2W vessel and the offshore facility(s) are important for 'look-ahead' planning and logistics.

5.4 Maintain

The FACILITY OPERATOR is responsible for managing the maintenance and inspection of the offshore facility including the W2W access locations.

For gangway systems that have a longer connection time (e.g. large semi-submersibles), it may be required to monitor for galvanic action (corrosion) on the W2W components between the vessel and the facility.

The SHIP OPERATOR is responsible for managing the maintenance and inspection of the vessel and all equipment permanently residing on the vessel, except the gangway system (unless designated part of the ship's equipment).

Under the ISM Code the SHIP OPERATOR is ultimately responsible for managing the maintenance and inspection of the gangway system and all associated equipment. In reality, gangway system maintenance and inspection activities may be conducted by the GANGWAY PROVIDER and/or SHIP OPERATOR.

The port contractor is responsible for managing the maintenance of the portside facilities.

5.5 Monitor and Audit

During the W2W operating period, ongoing monitoring of all aspects of system performance, should be in place to enable review and improve work processes.

Auditing and review of the FACILTY OPERATOR and SHIP OPERATOR H&SMSs may be conducted by either the FACILTY OPERATOR or SHIP OPERATOR according to their own procedures and in consultation with each other. An audit of the GANGWAY PROVIDER inspection and testing regime, once the W2W operation has commenced should be conducted to ensure the safety systems in place for the gangway system are being followed. The results and actions of any audit must be communicated to all stakeholders.

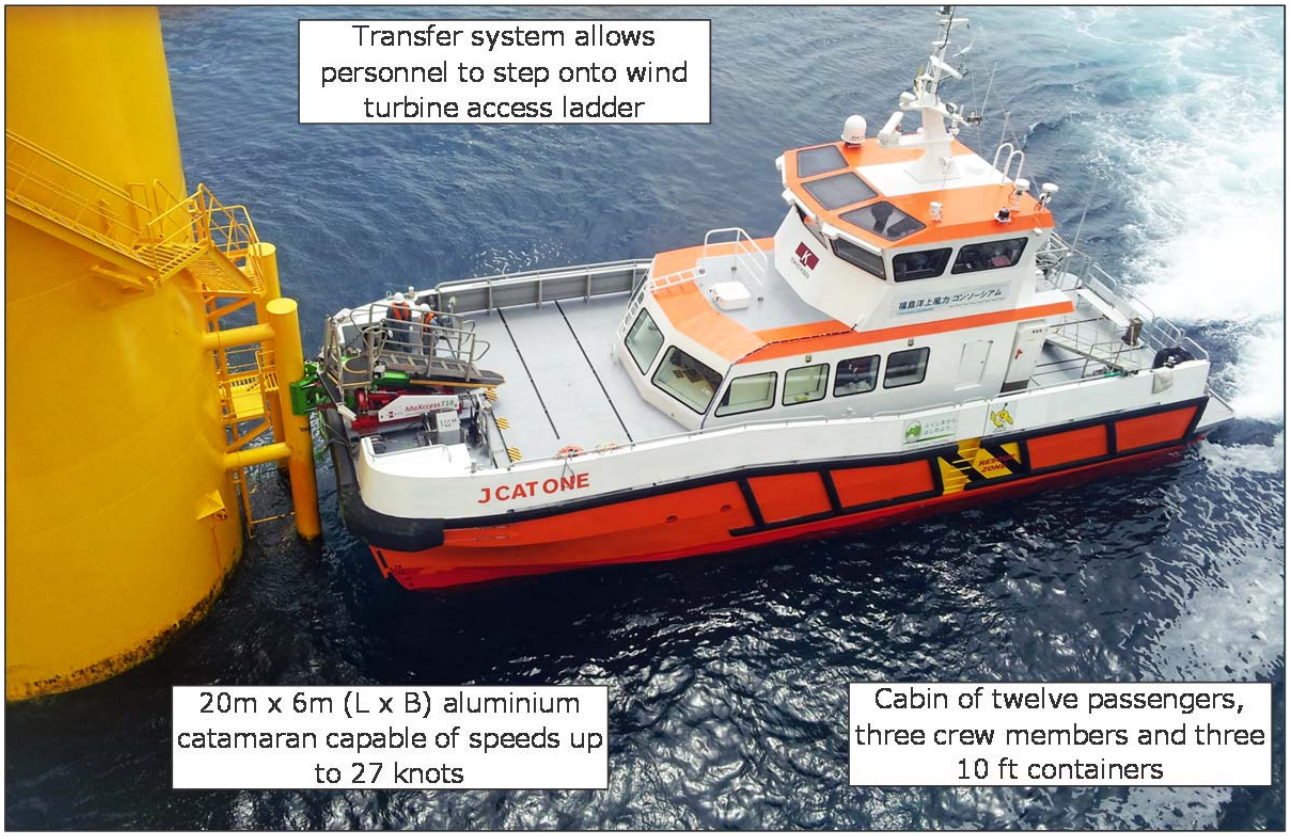
Both the FACILTY OPERATOR and the SHIP OPERATOR should establish an audit programme for the contracted service (including subcontractors). The OPERATORS should also conduct periodic audits of the GANGWAY PROVIDER contractor, any sub-contractors and the W2W operation as a whole. Both parties are responsible for communicating and tracking lessons learned to their teams, and more widely across the operator and third-party organisations.

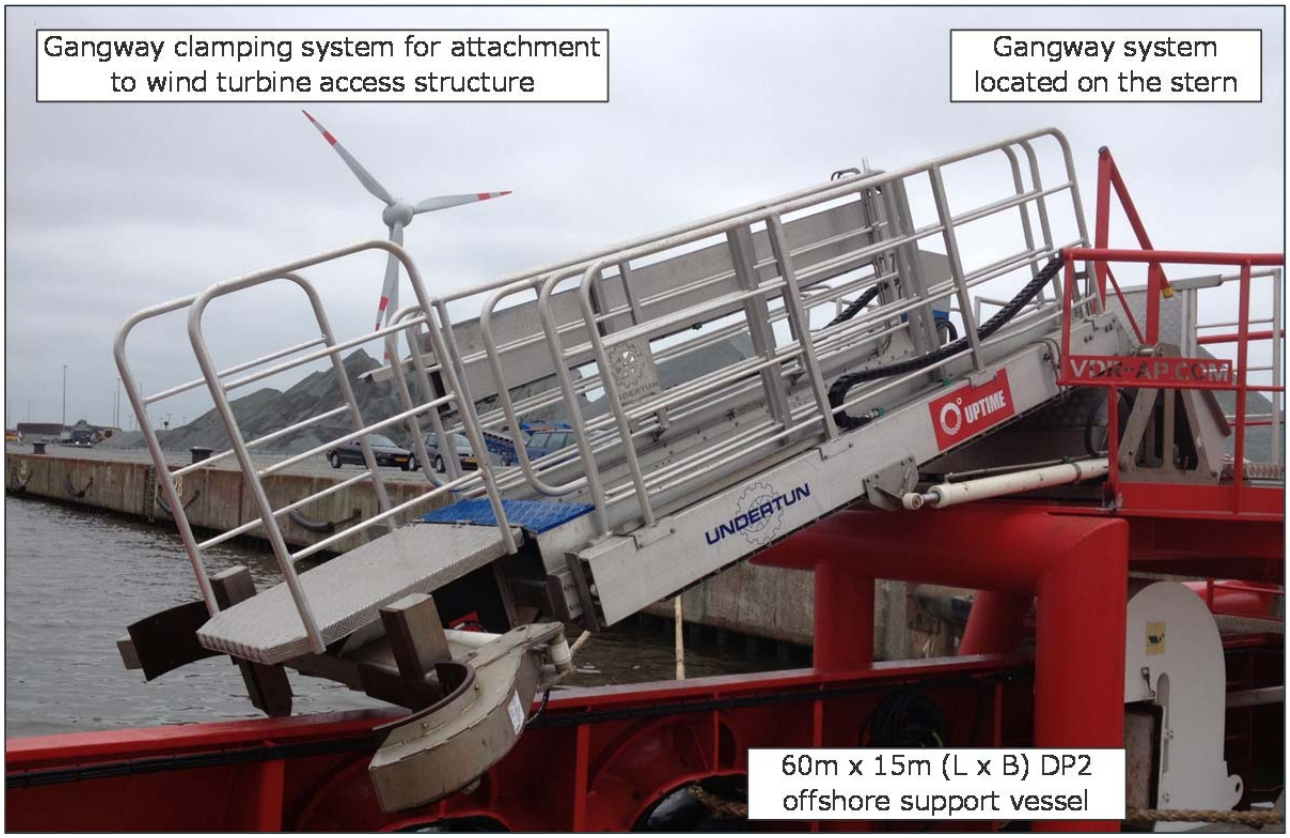
5.6 Review and Improve

Opportunities during the operational period of a W2W solution should be planned to review past performance and identify potential improvements.

Any changes to a W2W solution; whether associated with hardware, procedures, or people aspects should be captured and controlled within the Management Of Change (MOC) procedure. It may also trigger a regulatory requirement (e.g. safety case material change within the United Kingdom Continental Shelf (UKCS)).

ANNEX A W2W SOLUTION EXAMPLES





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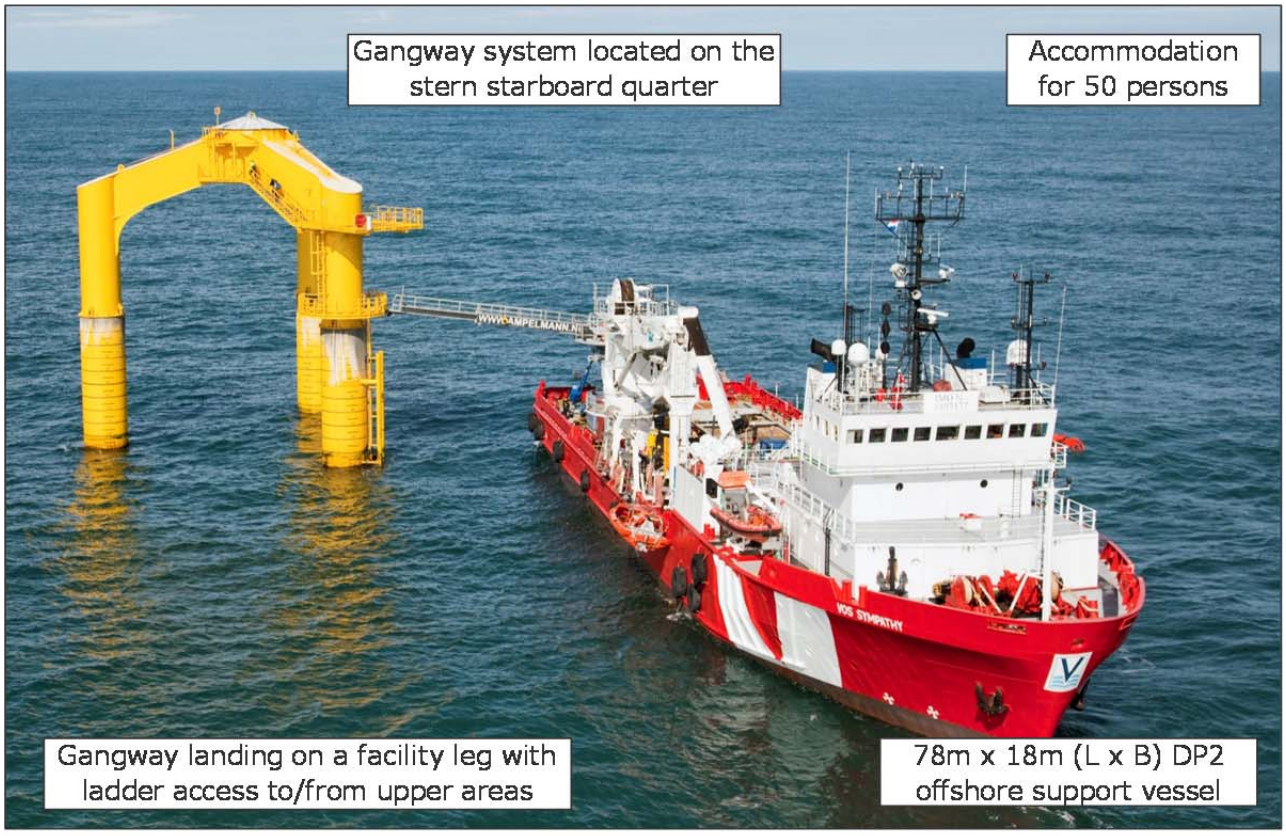

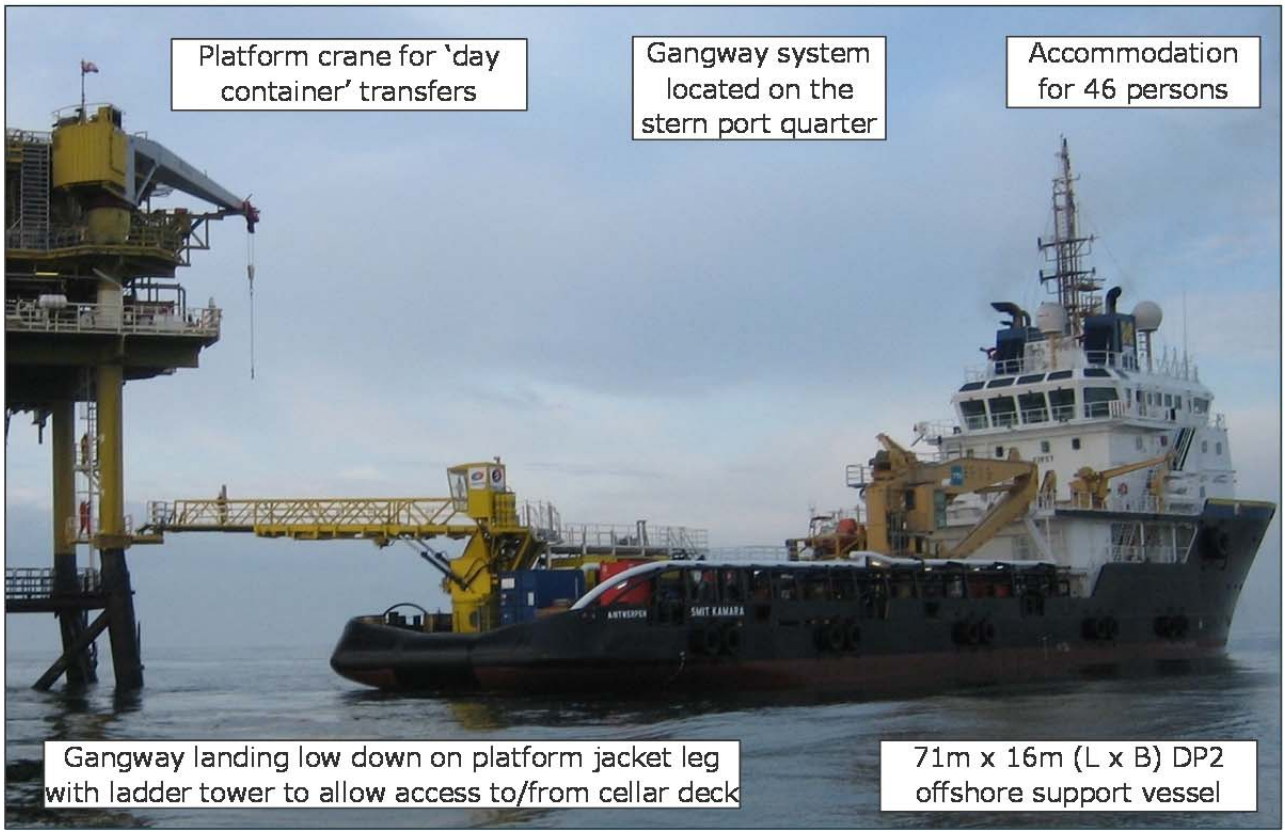

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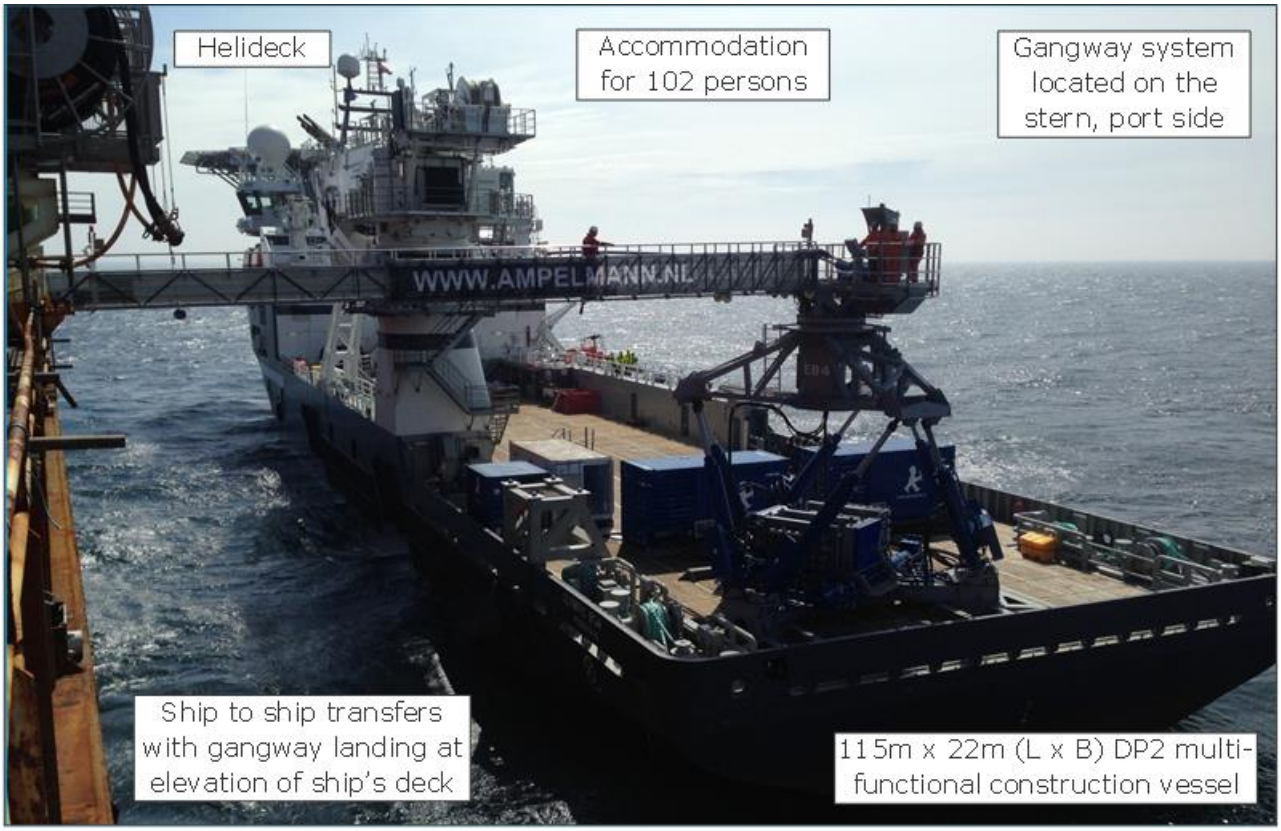

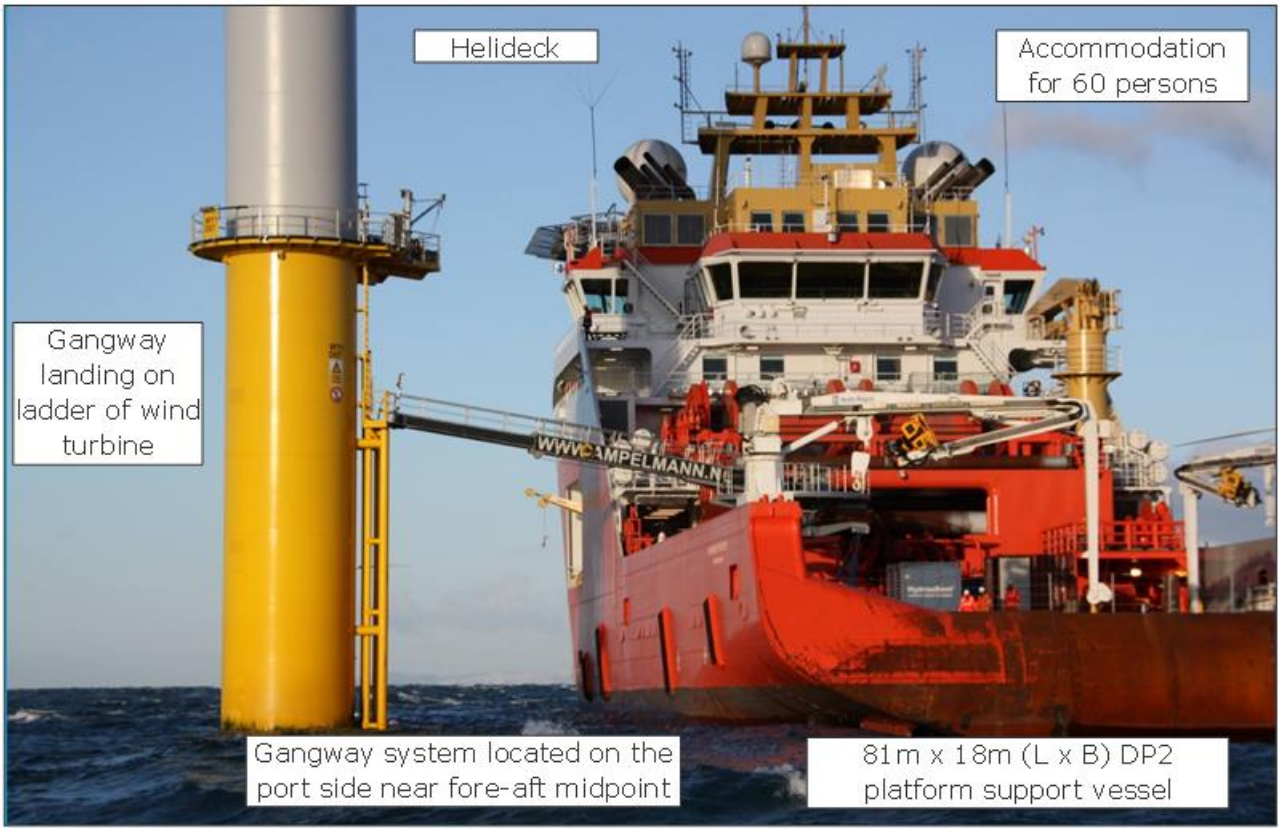

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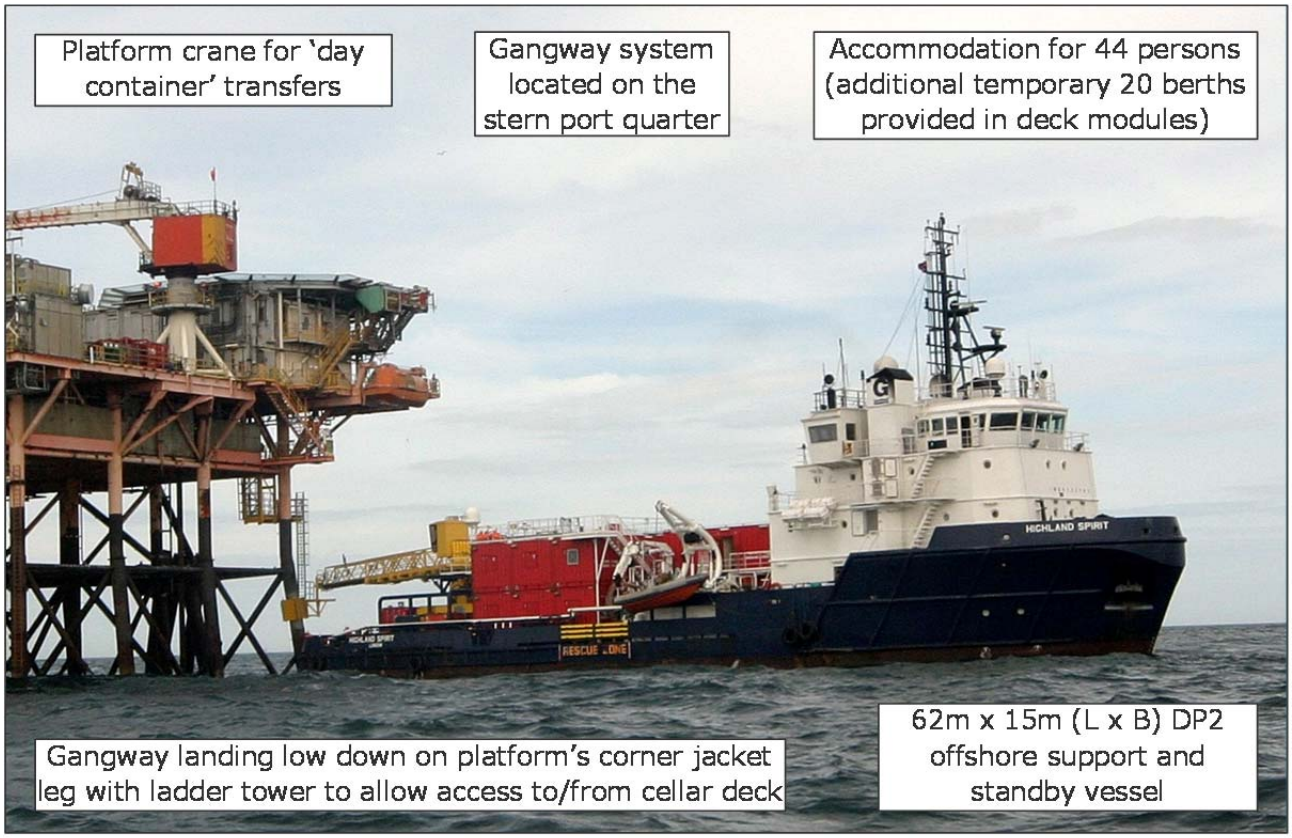

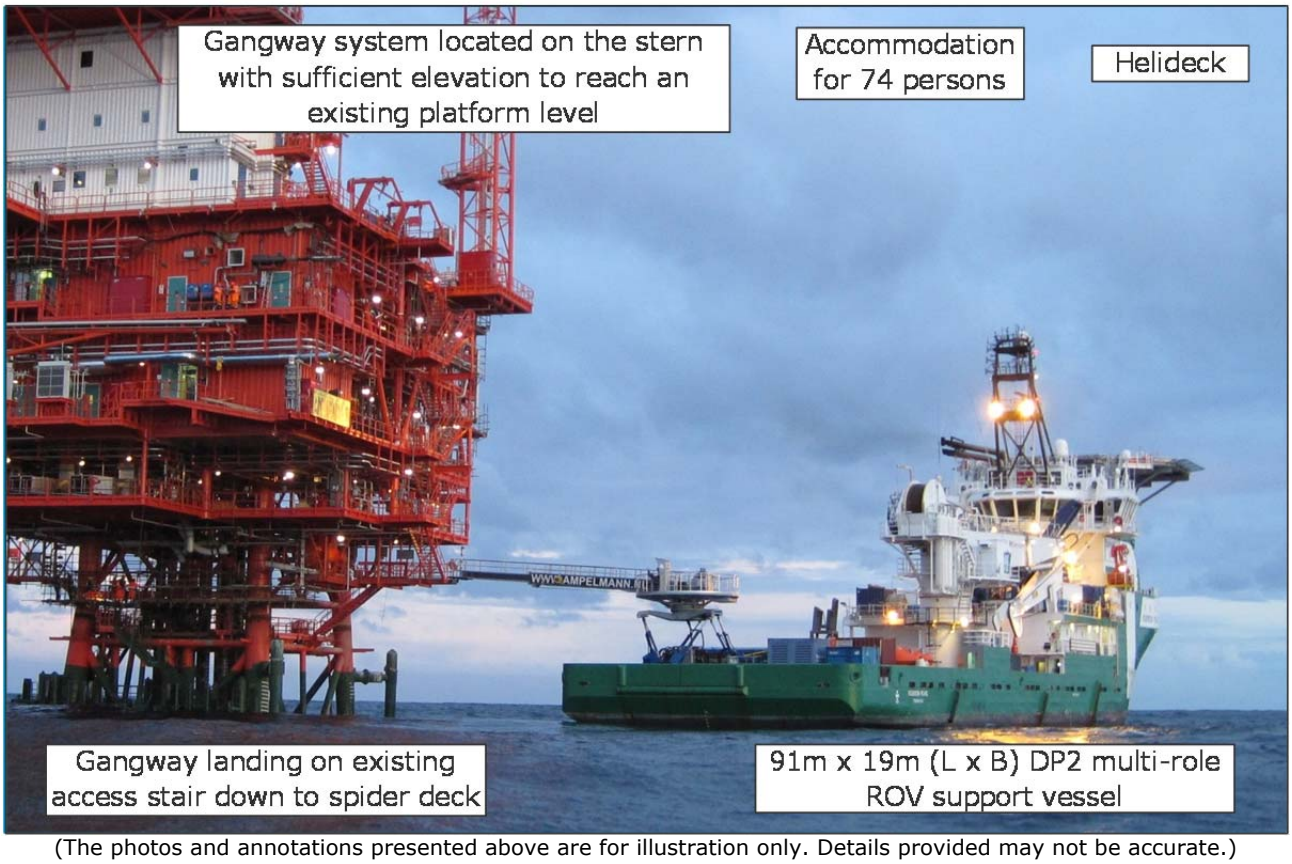

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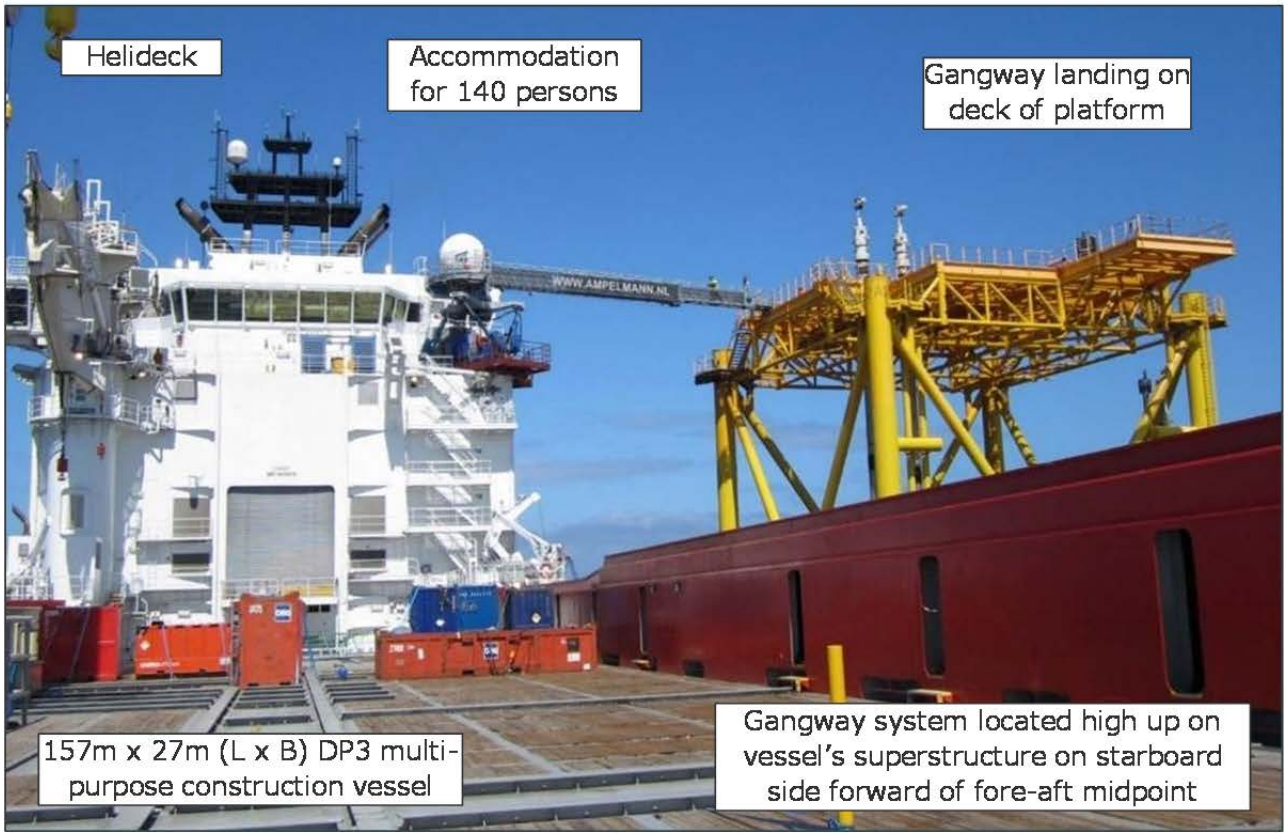

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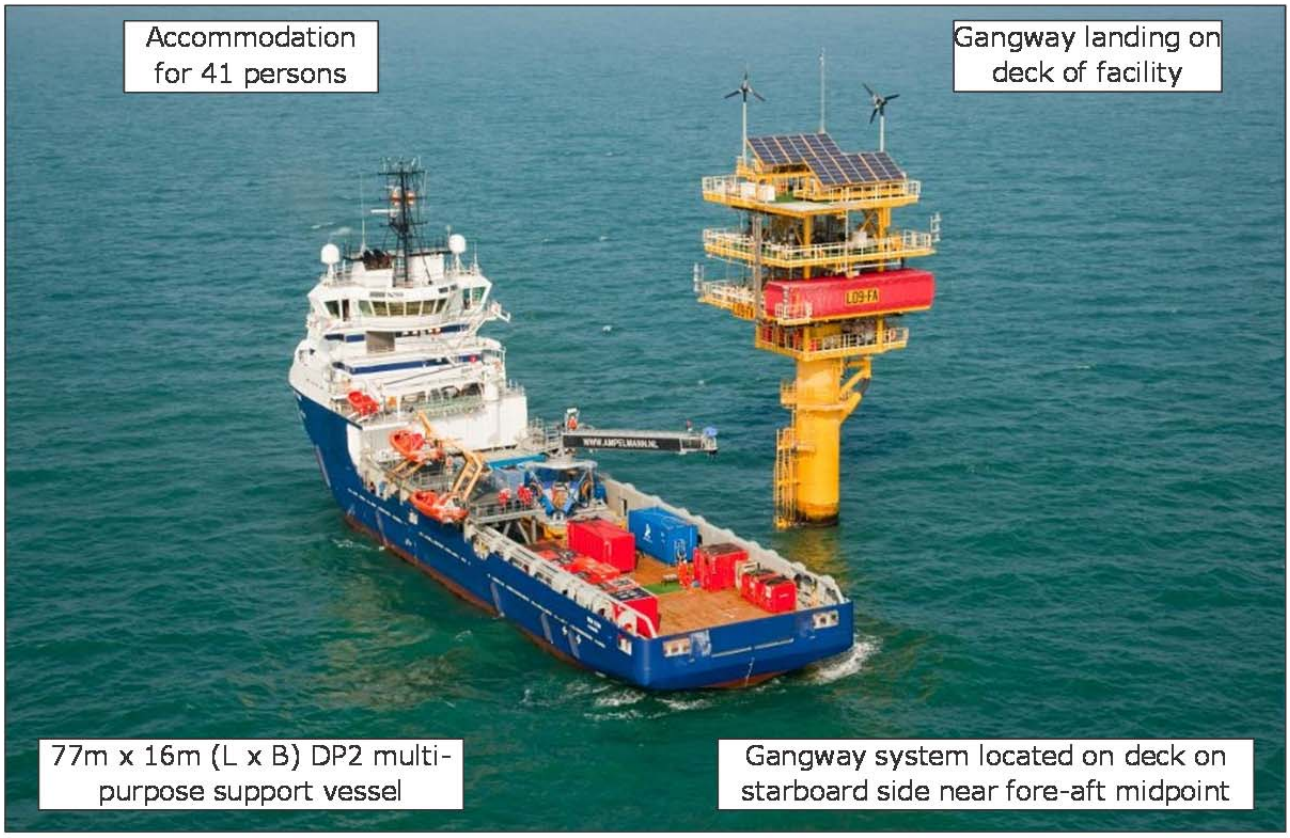

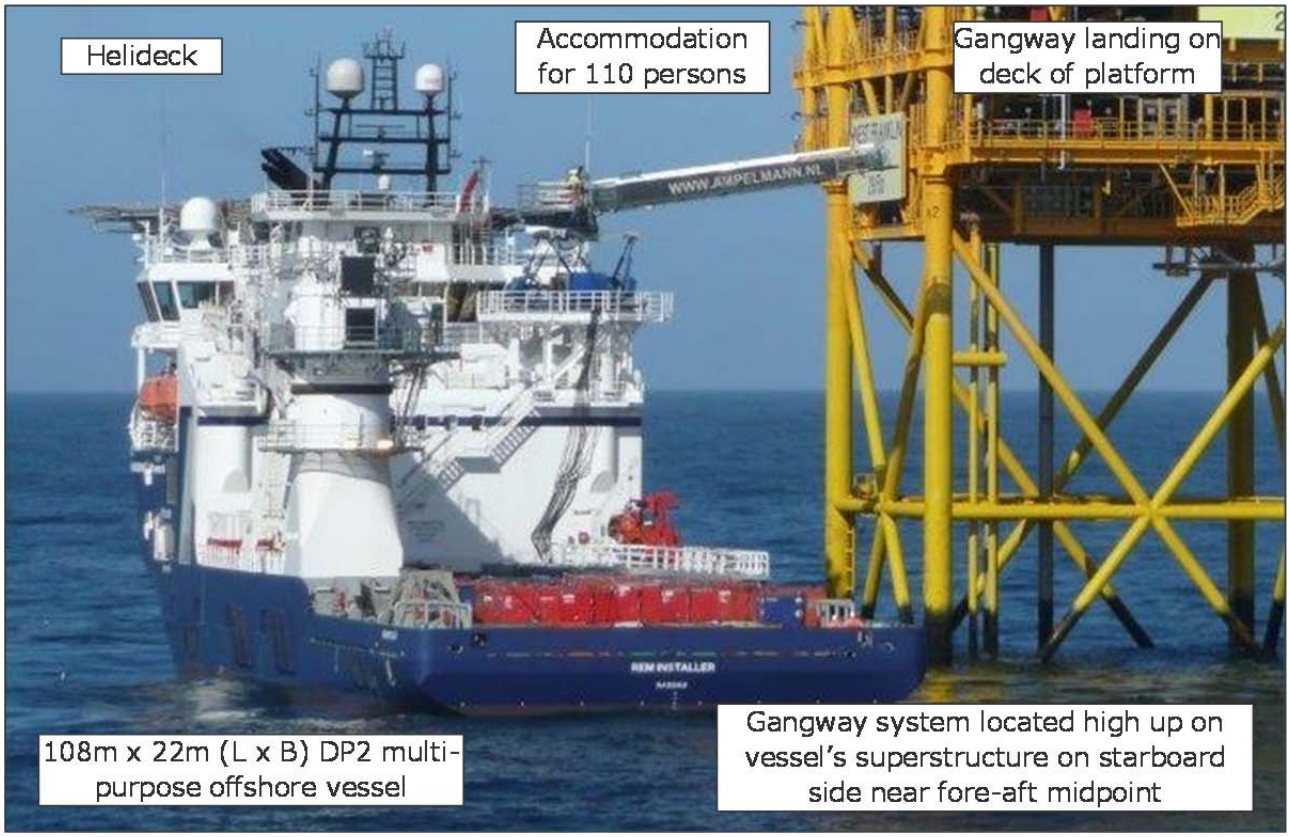

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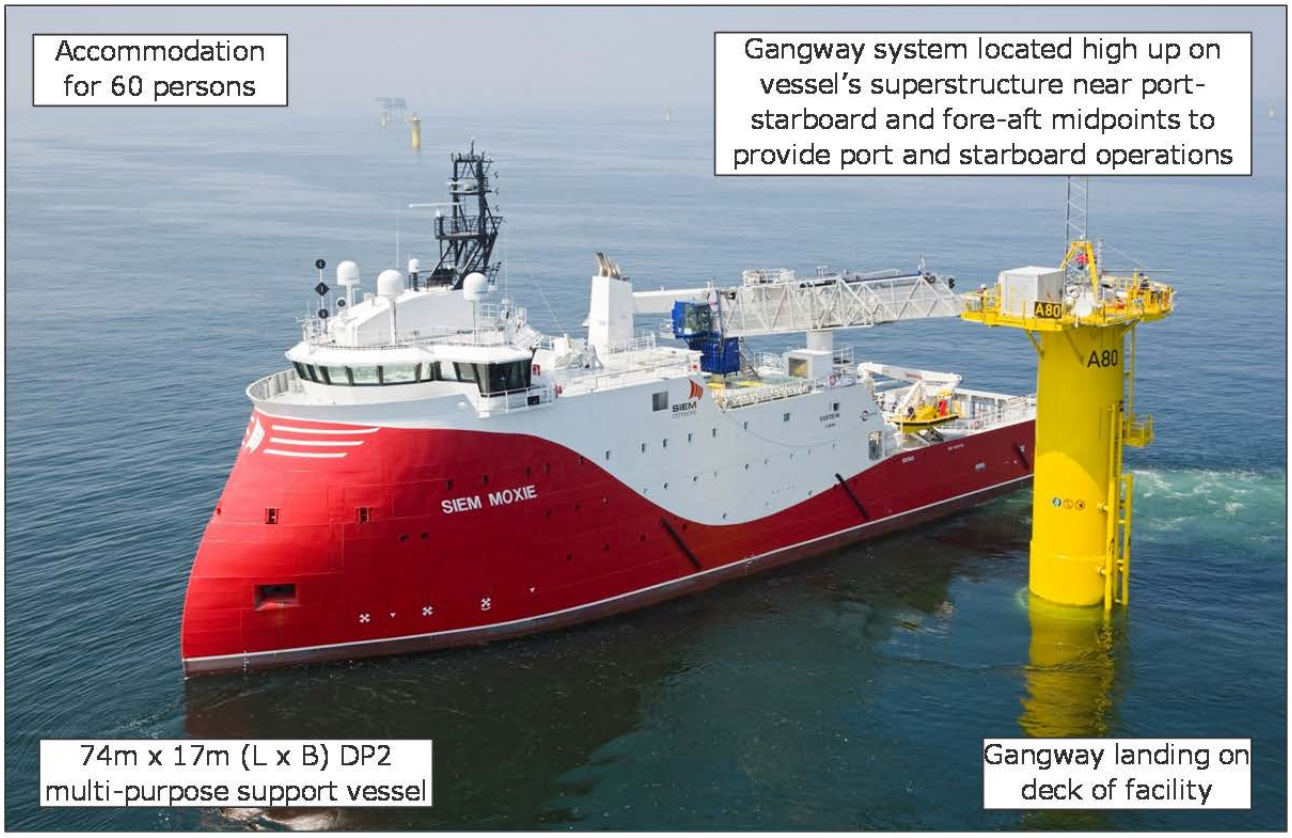

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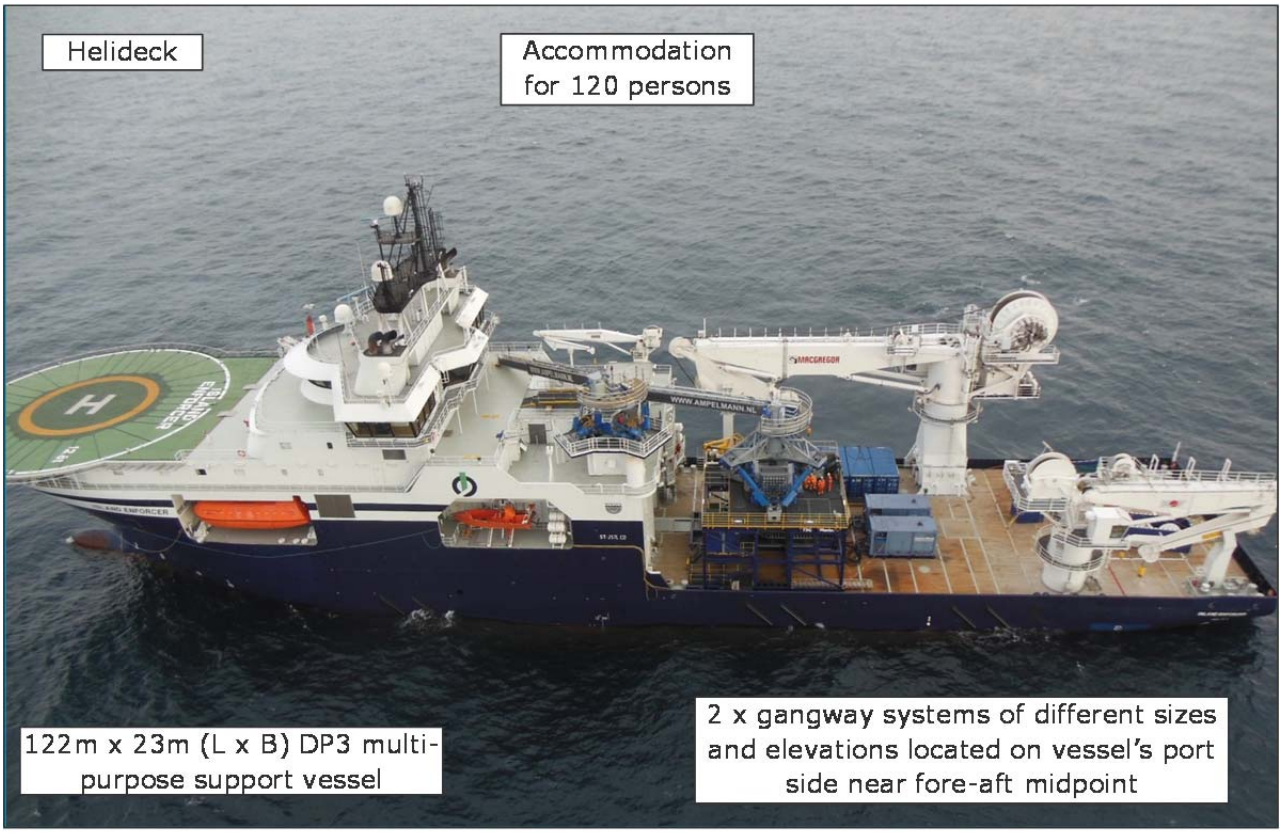

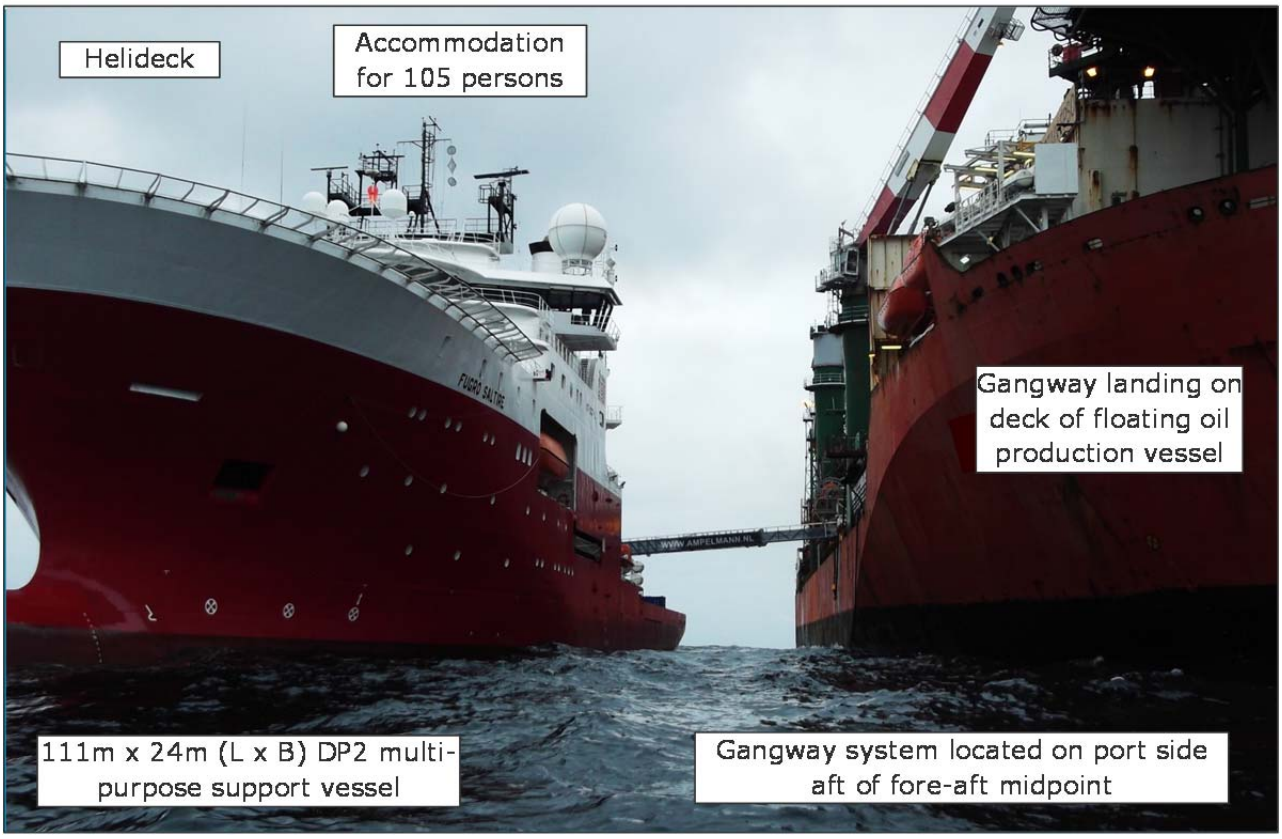

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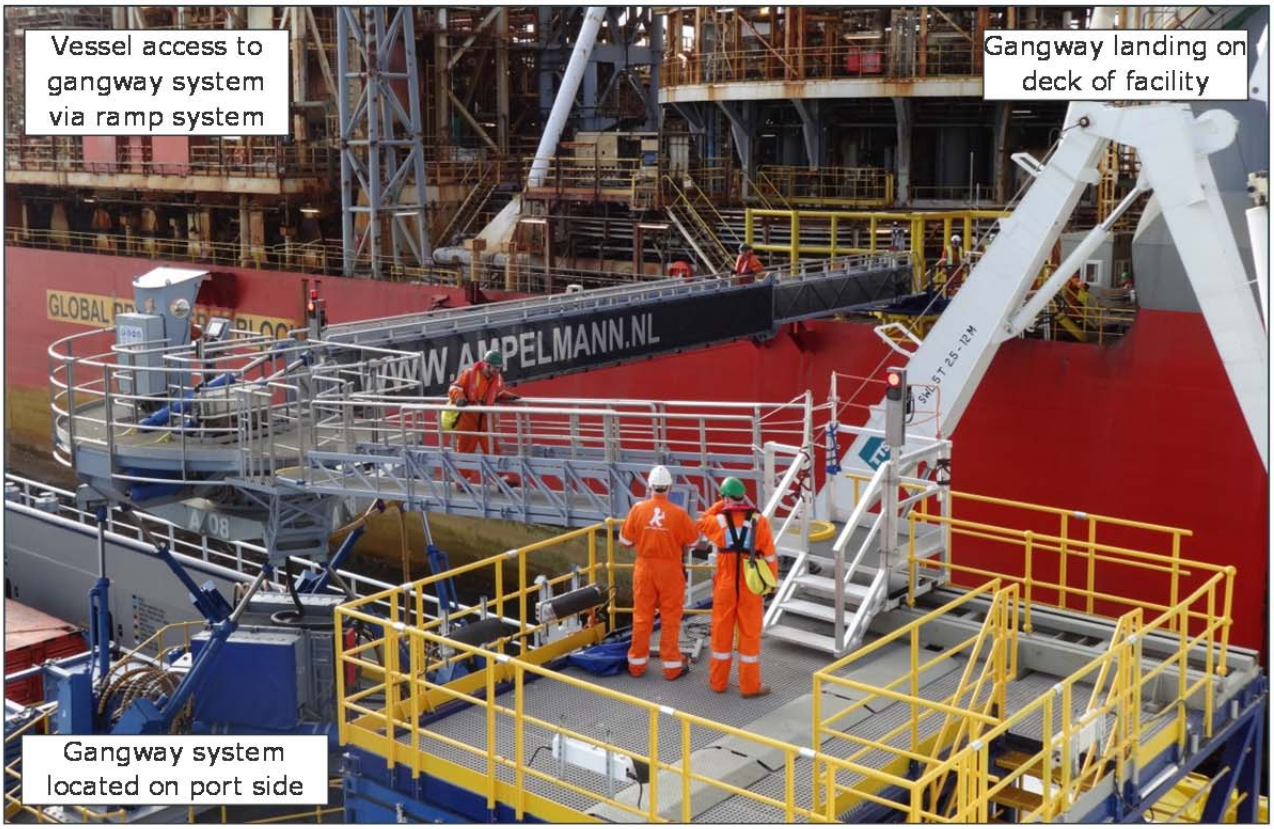

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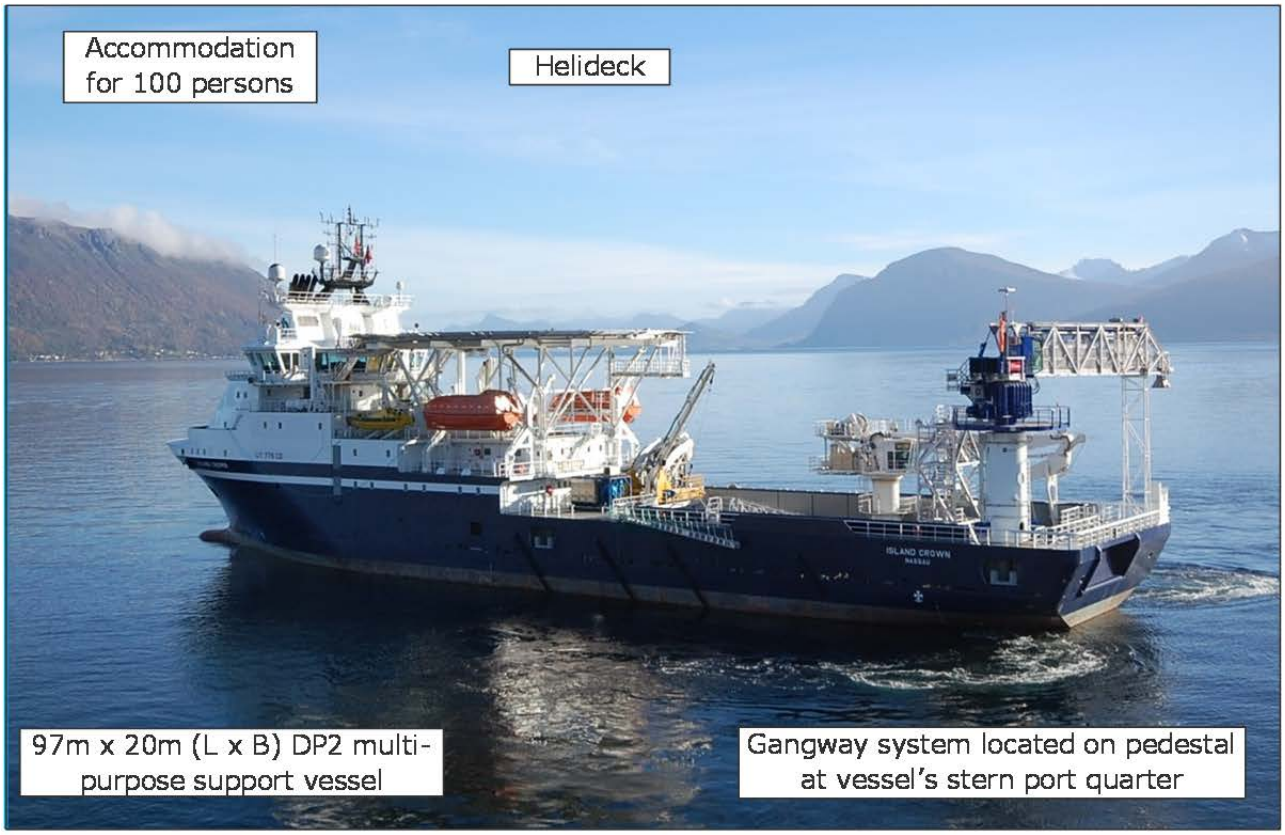

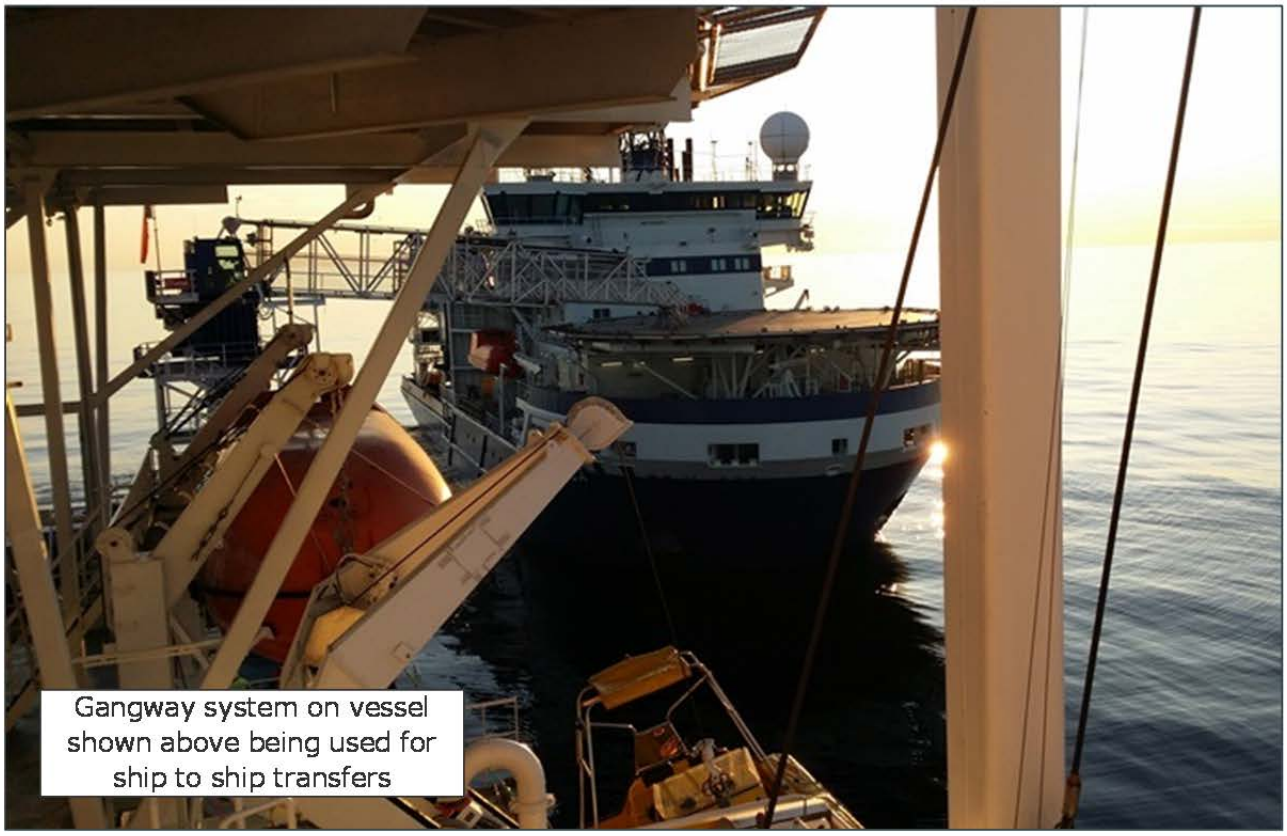

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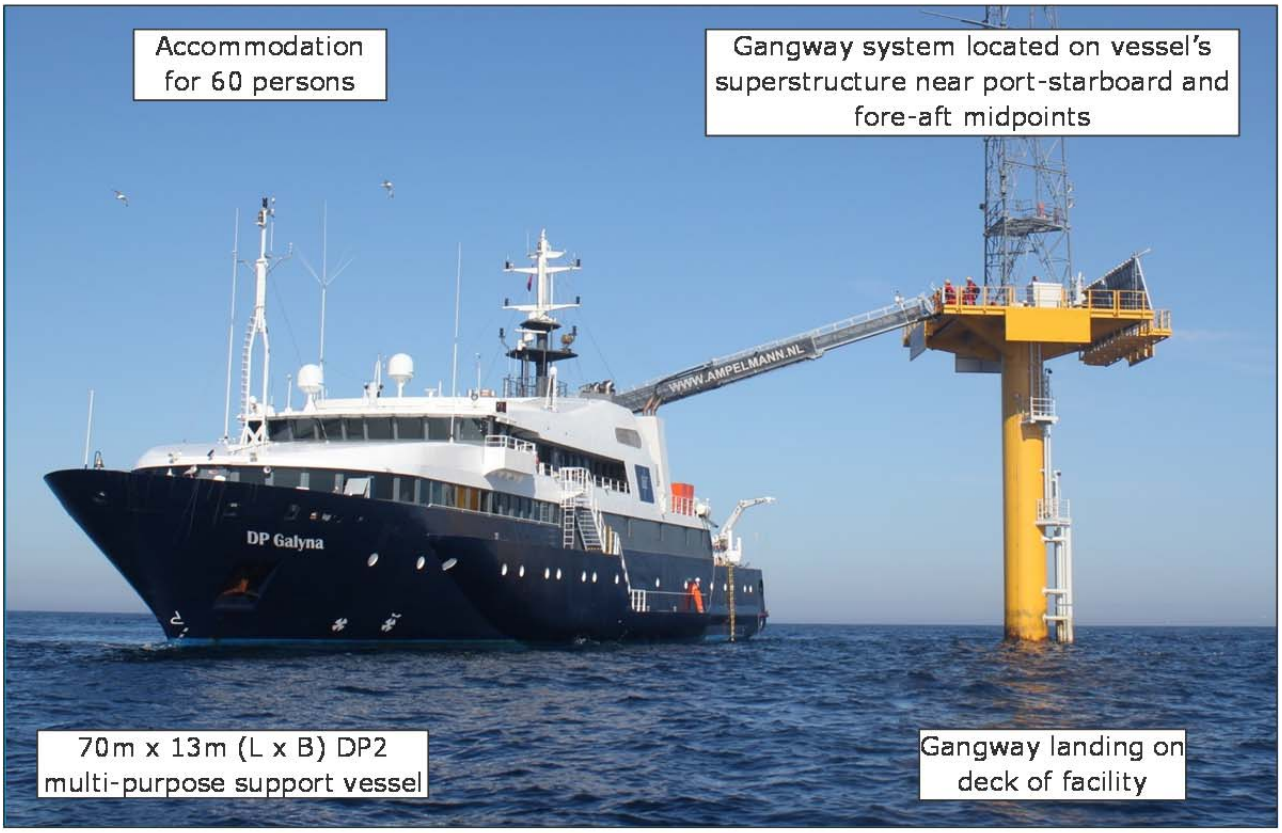

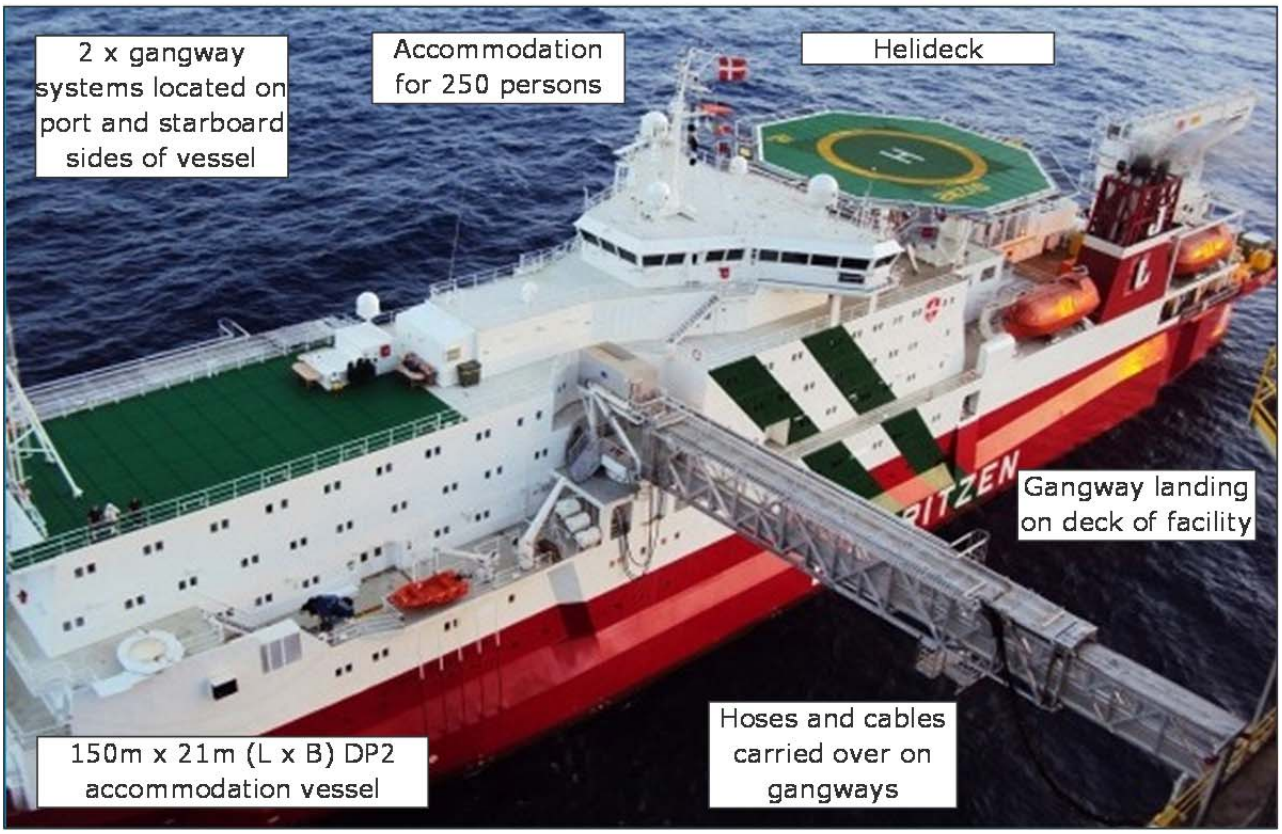

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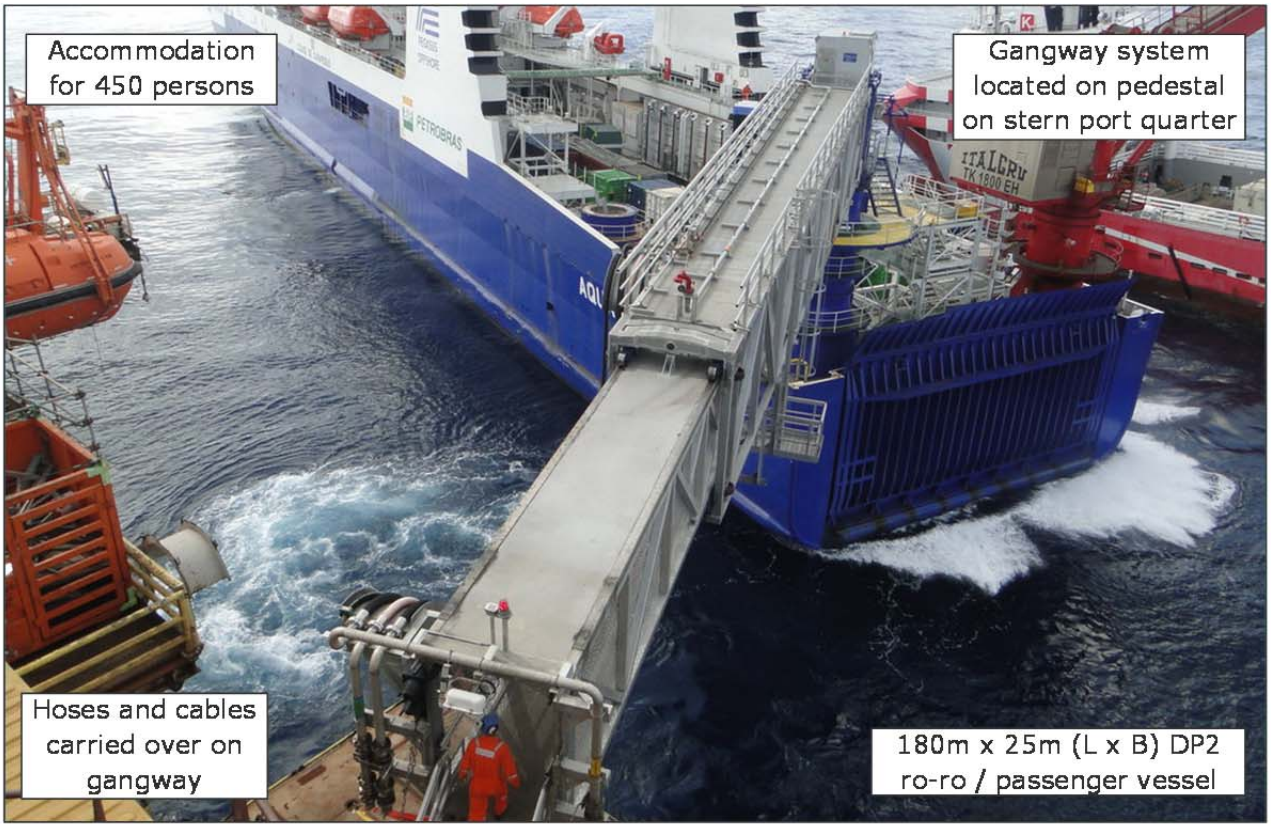

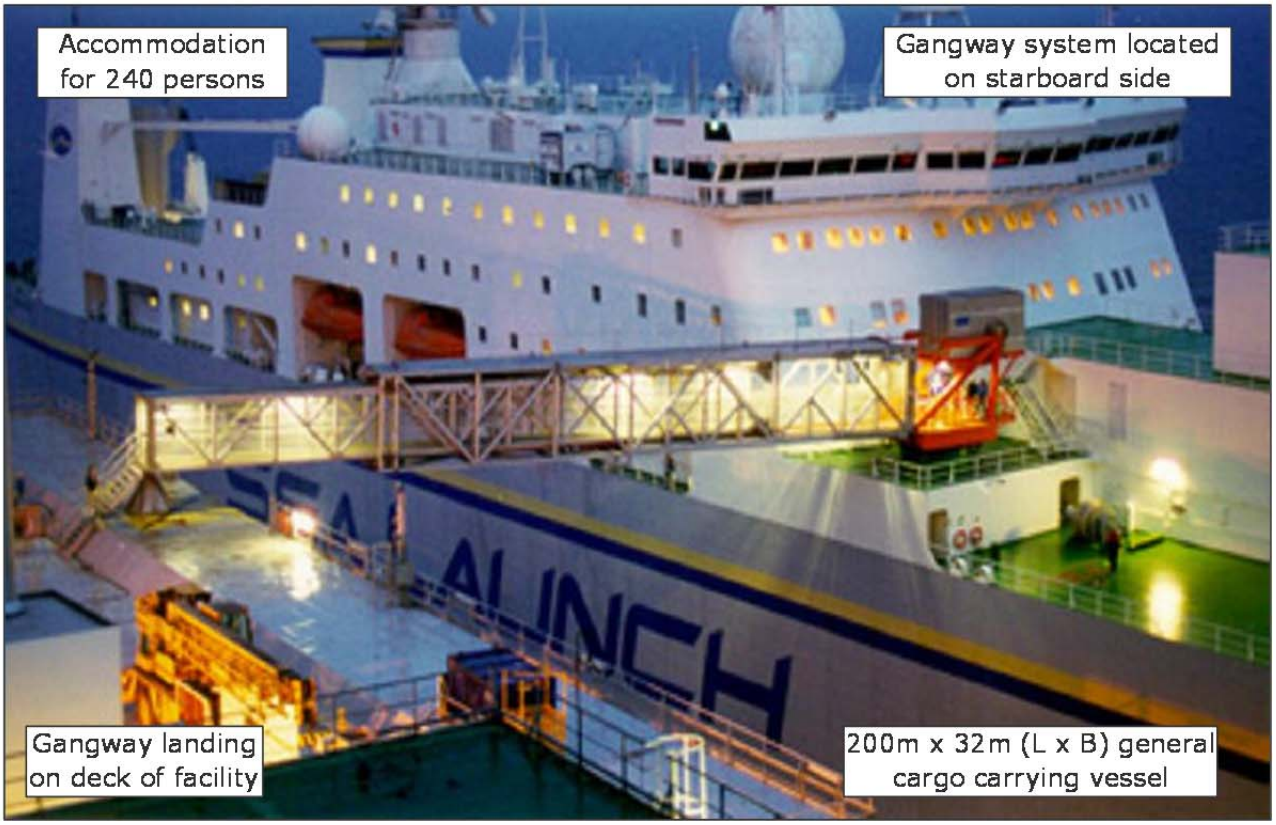

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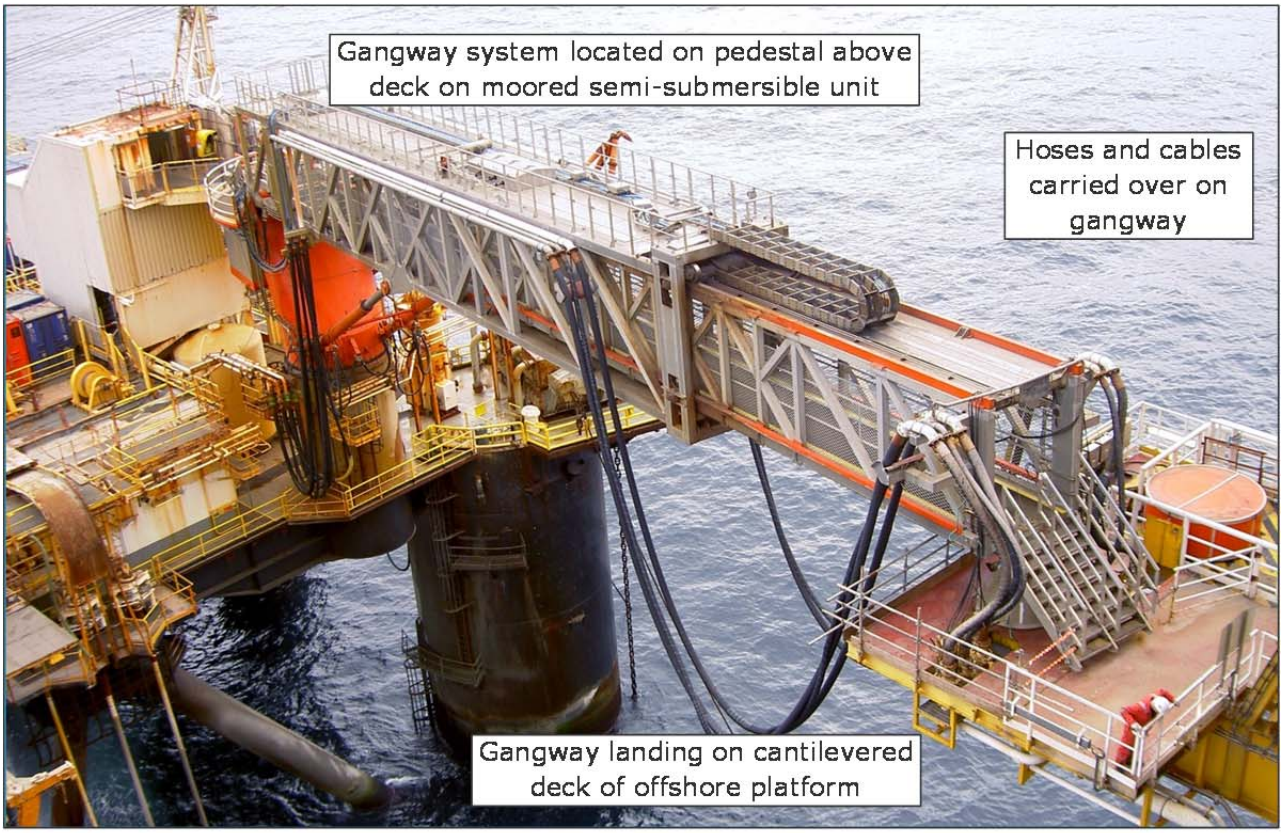

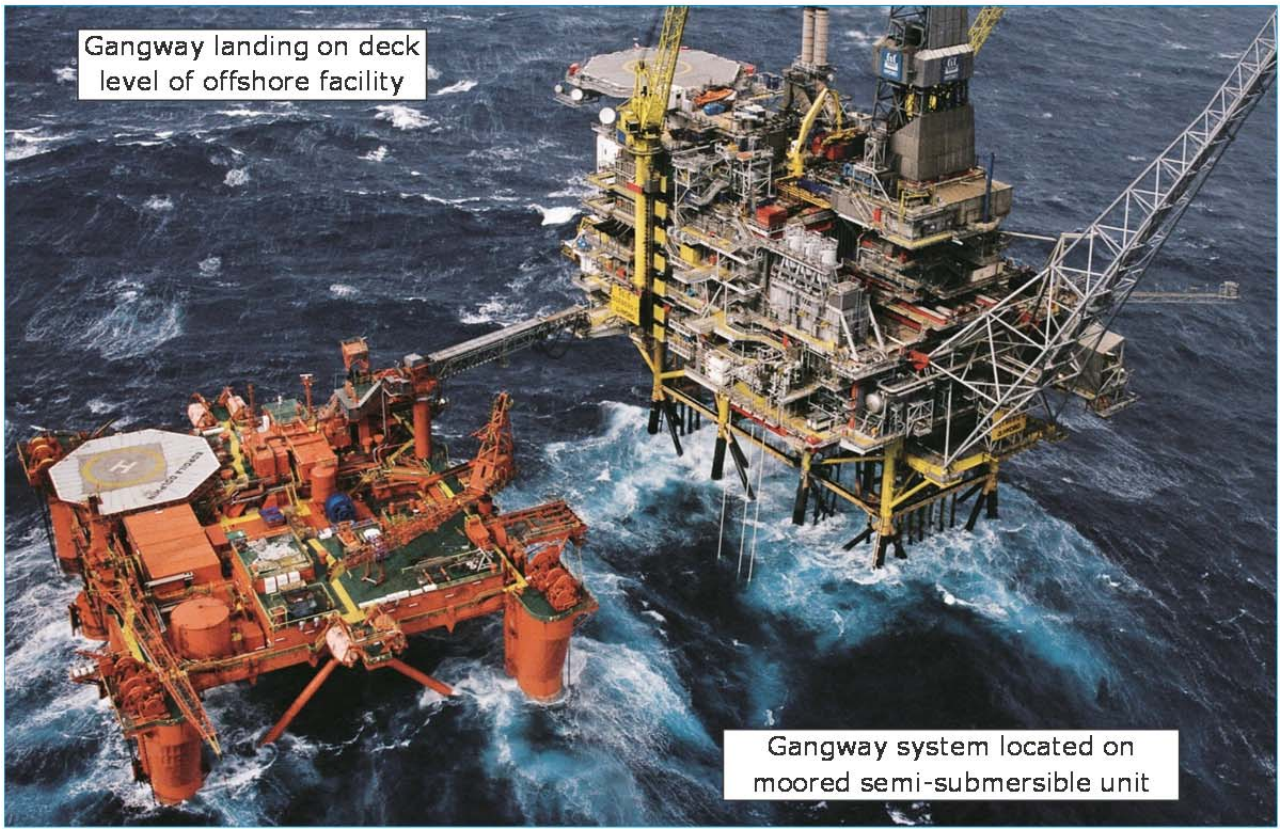

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ANNEX B REQUIREMENT DEFINITION (ADDITIONAL)

B.1 Statement of Requirement Checklist

The following checklist can be used when selecting a manning approach and then updated during the project. It needs to be recognised that, it is not extensive and there may be other issues that the FACILITY OPERATOR needs to consider; its primary purpose though is to aid the thought process whilst enabling information to be captured in a systematic manner:

Facility Details	
Facility name(s) and location(s) to be manned	
Manning constraints (maximum and minimum manning, competencies, etc.)	
Gangway landing elevation(s) and available location(s)	
Capabilities of on-board facilities (craneage, welfare, emergency response, lifeboats, etc.)	
Accident hazard risk profile to/from attendant W2W vessel	
Marine operation requirements (environmental, exclusion zones, mooring areas, approach direction, etc.)	
Vessel or gangway impact on vulnerable structures (impact energy constraints) and systems	
Work Scope Requirement	
Number and type of persons to be transported, accommodated and transferred	
Manning patterns including shift rotations, crew changes, etc.	
If sequential manning required on a number of facilities, distance between facilities and required time between manning transfers	
Man-hours to be delivered on facility(s)	
FACILITY OPERATOR workforce personnel change requirement	
Workforce personnel POB management and handover arrangements	
Additional demand on work planning and permit to work (PTW) system(s)	
Time Schedule	
Intended project duration	
Time of year over which the manning is required	
12 hour or 24 hour operation	

Cost Information and Performance Requirements	
Budget available and/or other financial expectations that will influence the manning solution implemented	
Explicit performance requirements for the proposed manning solution e.g. percentage availability	
Concurrent activity opportunities	
Compliance Requirements	
Facility (legislative and industry - see Section 4.5)	
Vessel (maritime legislative and Classification Society – see Annex 2)	
Gangway system (legislative and industry - see Section 4.5)	
Company standards and procedures (e.g. health, safety, environmental, security, marine, change management, alcohol and drugs policy etc.)	
Constraints, Options and Other Requirements	
Constraints, options and other requirements may include for example:	
• No available helideck on facility(s)	
• Offshore facilities to remain live with minimal disruption during all W2W operations	
• Offshore facility loading restrictions at the physical interface with W2W solution	
• Gangway transfer policy	
• Limitations on the amount of time the W2W solution can be connected	
• Specific vessels and/or gangway type to be used	
• Simultaneous operations with other activities	
• W2W operations to be provided intermittently during 24 hour period	
• W2W vessel to service other installations	
• W2W vessel to have: ○ A certified helideck for defined helicopter type and operations ○ Defined accommodation facilities for specified number of persons ○ Man overboard or full standby vessel capability with 2 x	

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Fast rescue crafts (FRCs) with personal locator beacon (PLB) tracking ○ Specified deck cargo capability ○ Hot-work fabrication workshop ○ Craneage capability to defined specification ○ Pipeline and jacket inspection remotely operated vehicle (ROV) ○ Inspection test and maintenance strategies that do not impact W2W operations ○ Motion monitoring & recording systems ○ Radar early warning system (REWS) installed	
• Work and rest limitations (e.g. working hours)	
• Personnel minimum requirements such as training certificates	
• Minimum requirements to enable personnel to be transported by helicopter (if this is a credible scenario) such as training, shoulder size dimensions, etc.	
• Vessel maneuverability capabilities	

B.2 International Legislation and Standards

	Description	W2W Watch points
International Maritime Organisation		
The International Convention for the Safety of Life at Sea, 1974 (SOLAS)	The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the Convention as proof that this has been done. Although many of its regulations are only directly applicable to vessels on international voyages, they are often applied by States for domestic voyages, which include those to and from offshore facilities.	Ships will have a Ships Security Assessment (SSA) and Ships Security Plan (SSP) approved by their Flag State Authority. Early in the project planning it may be necessary to repeat the SSA to establish any additional security threats and so determine additional control measures. These measures will need to be described in the SSP which will be subject to re-approval by the Flag State.
Global Maritime Distress and	GMDSS is an integrated communications system that sends and receives safety &	All aspects of SOLAS do not always apply. It may become

	Description	W2W Watch points
Safety System (GMDSS)	distress information. Under the GMDSS, all passenger ships and all cargo ships over 300 gross tonnage on international voyages have to carry specified equipment in order to meet the SOLAS requirements.	applicable for a W2W vessel, but there are a number of factors. Whether the equipment is required, depends on flag state, area of operation, size of vessel, etc. It is therefore, important to check its applicability on a case by case basis.
The International Safety Management Code (ISM)	The Code requires that the entity that has assumed responsibility for operating the ship ('the SHIP OPERATOR') establishes safety-management objectives, enacts a Health and Safety Management System (H&SMS) for the vessel and implements a policy for achieving the objectives. The procedures required by the Code should be documented and compiled in a Safety Management Manual, a copy of which should be kept on board.	The Ship's H&SMS is one of three safety management systems (Ship, gangway system, offshore facility) that will need to be integrated via the bridging document. From the SHIP OPERATORs perspective their H&SMS will take precedence when it comes to the Ship. A gap analysis must be undertaken and any issues resolved during the development of the bridging document.
The International Ship and Port Facility Security (ISPS) Code	The ISPS Code is a set of measures designed to enhance the security of ships and port facilities, developed in response to the perceived security threats to ships and port facilities. This is achieved through a risk based approach that determines what security measures are appropriate for the Security Threat Level set by the Flag State and Local Authority. The Code assists in this process by providing a standardized, consistent framework for managing risk and permitting the meaningful exchange and evaluation of information between contracting governments, companies, port facilities, and ships.	Engagement with both the port security officer and the security officer for the SHIP OPERATOR early on in the project will assist in developing a security plan for the W2W project. As this may also include an element of flying, even as a contingency, then there may also be a need to liaise with the aviation security officer early on too, so as the right security package is put in place for the project as a whole. If this includes changes to the SSP then this will need to be re-approved by Flag State.
International Convention for	MARPOL is the main international convention covering prevention of pollution of the marine	Consideration needs to be given to any potential, for

	Description	W2W Watch points
the Prevention of Pollution from Ships (MARPOL)	environment by ships from operational or accidental causes. MARPOL covers pollution by oil, chemicals, ozone depleting substances, emissions, harmful substances in packaged form, sewage and garbage.	operational or accidental, discharges to sea that could occur from the W2W operations. Ships may be required to have a Ships Energy Efficiency Management Plan, Any impact of the W2W operation on the key assumptions of this plan should lead to re-assessment.
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)	The IMO's International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) is an internationally-agreed Convention to address the issue of minimum standards of competence for seafarers. It clarifies the standards of competence required and provides effective mechanisms for enforcement of its provisions.	W2W personnel may require a STCW 95 medical certificate to enable them to be carried as "other persons" aboard the ship. This should be checked with the SHIP OPERATOR early on in the project.
Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs)	The COLREGs set out, among other things, the 'rules of the road' or navigation rules to be followed by ships and other vessels at sea to prevent collisions between two or more vessels.	The master of the W2W vessel will deal with this and the only time consideration may need to be given to it, is if the W2W vessel is operating in a high traffic or traffic segregation area.
International Life-Saving Appliance (LSA) Code (2010 edition)	Amongst other things the LSA code covers the definitions and general requirements for life-saving appliances. In the 2010 consolidated addition the Revised Recommendation on Testing of Life-Saving Appliances and the Code of Practice for Evaluation, Testing and Acceptance of Prototype Novel Life-Saving Appliances are also included.	For W2W the requirements and testing recommendations for the following may require consideration: 1. Lifebuoys and life-jackets 2. Immersion suits, anti-exposure suits and thermal protective aids 3. General requirements for lifeboats 4. General requirements for life-rafts 5. General requirements for rescue boats 6. Launching and embarkation appliances

	Description	W2W Watch points
		7. Marine evacuation systems 8. General emergency alarm system 9. Public address system 10. IMO symbols and safety signs
Code of safety for Special Purpose Ships (SPS) (2008 edition)	SOLAS allows a cargo vessel to carry up to 12 passengers in addition to the crew. A ship carrying more than 12 passengers by definition must be a passenger ship. The SPS code recognises that there are ships carrying more than 12 persons that are of such a design, which operate in services and under conditions, that make strict compliance with passenger ship requirements inappropriate. The SPS Code provides an appropriate level of safety for those ships and the persons carried, as well as the valuable and beneficial operational flexibility needed to address those scenarios. Moreover, SPS code alternatives for the training and certification of personnel on board may be more effective for operations on such ships, than would by strict compliance with the SOLAS and STCW regulations for cargo or passenger ships.	The SPS code introduces the concept of 'special personnel', which may include the following: • Diving, remotely operated vehicle (ROV) and other technicians in the hydrocarbon extraction or other offshore industries. • Technicians that work on wind and tidal turbines, or other emerging energy technologies. This therefore allows the SPS code to potentially be applied to W2W vessels. Guidance on this aspect should always be sought from the local marine regulator as early on in the project as possible.
International Code on Intact Stability, 2008	The purpose of the code is to present mandatory and recommendatory stability criteria and other measures for ensuring the safe operation of ships, to minimize the risk to such ships, to the personnel on board and to the environment.	Consideration should be given early on in the project to the impact on the stability of the W2W vessel by the addition of the gangway system, in both stowed and operational mode, particularly if it is going to be raised up on a grillage to add extra height.
Code for the construction and equipment of Mobile Offshore Drilling Units, 2009 (2009 MODU code)	The MODU code was developed to provide an international standard for MODUs to facilitate their international movement and operation, and to ensure a level of safety for such units, and for the personnel on board, equivalent to that required by SOLAS.	The MODU code is typically applicable to the larger semi-submersible flotel units, particularly if converted from drilling units that were constructed under the code. Typically, it is only when

	Description	W2W Watch points
		major modifications are made to the unit that the code will need to be considered.
International Labour Organisation		
Maritime Labour Convention 2006	MLC ensures globally applicable, easily understandable and uniformly enforced regulations that recognise and ensure seafarer's rights to decent living and working conditions. MLC certificates are required for all ships of 500 gross tonnage or over, engaged in international voyages or flying the flag of an IMO member country. Ships below 500 gross tonnage flying the flag of an IMO member country simply require inspection.	The MLC code is specific to seafarers and a number of countries have opted out of it for offshore service vessels. As such, its application will need to be checked, and if applicable, an assessment undertaken of how the W2W project could impact on it. This assessment can be undertaken when consideration is being given to how the W2W vessel will operate and the impact of it on transfer personnel.
IMO Guidelines		
Guidelines for the Design and Construction of Offshore Support/Service Vessels (OSV) 2006 (2007 edition)	The guidelines are only applicable to OSVs (sometimes also referred to as platform supply vessels) where the vessel is 'primarily engaged in the transport of stores, materials and equipment to offshore installations' and for the carriage of not more than 12 'industrial personnel' or special personnel.	If the W2W vessel being considered has been built to the OSV Guidelines then early engagement with the marine regulator is essential to see whether the vessel will be suitable, as it may need to be assessed to see whether it will meet the SPS code for instance.
Guidelines for Construction, Installation, Maintenance and Inspection / Survey of means of Embarkation and Disembarkation (MSC.1/Circ.1331)	The guidelines include information on the following areas, amongst others: • Design requirements and the need to be designed and built in accordance to a recognised standard • Location • Lifesaving appliances • Lighting • Minimum load carrying capabilities for steps • Minimum inspection and testing criteria	A regulator or Flag State may require that a gap assessment be undertaken to show, whether there is an equivalent level of safety with a W2W system in relation to these guidelines. It is suggested, that if a novel solution is being adopted, then the SHIP OPERATOR may wish to undertake such an assessment themselves as part of their case for safety.
Guidelines for Vessels with	The guidelines were developed to provide an international standard for dynamic	If the W2W vessel has Class DP notation then the

	Description	W2W Watch points
Dynamic Positioning Systems (MSC/Circ.645)	positioning (DP) systems on all types of new vessels.	requirements of these guidelines can be seen to be met. If the vessel does not have Class DP notation then the OPERATORS should review the vessel against these guidelines or the equivalent IMCA publication listed below, in order to show that the vessel has a suitable level of DP assurance. The onus should always be on the OPERATORS to 'prove' that the vessel is safe to use for the intended operations.
International Marine Contractors Association (IMCA)		
The International Marine Contractors Association, commonly referred to as IMCA, produce a large range of publications in the form of guidelines, frameworks and other forms. Below is a list of potentially, the most useful of these for providing guidance for W2W projects.		
Guidance on the Transfer of Personnel to and from Offshore Vessels and Structures (IMCA M 202 Rev. 1)		
Guidelines for the Design and Operation of Dynamically Positioned Vessels (IMCA M 103 Rev. 1)		
DP Position Loss Risks in Shallow Water (121 DPVOA)		
Common Marine Inspection Document (IMCA M 149 Issue 8)		
Guidance on Failure Modes and Effects Analyses (FMEAs) (IMCA M 166)		
International Guidelines for the Safe Operation of Dynamically Positioned Offshore Supply Vessels (IMCA M 182 Rev. 1)		
Considerations about the use of hold-back Vessels during DP diving operations (IMCA M 185 Rev. 1) (*Note: Maybe applicable for W2W operations at turret moored FPSOs/FSUs*)		
Marine Inspection for Small Workboats (Common Marine Inspection Document for Small Workboats) (IMCA M 189 Rev. 2)		
Guidance for Developing and Conducting annual DP trials programmes for DP vessels (IMCA M 190)		
Guidance on Simultaneous Operations (SIMOPS) (IMCA M 203)		
Vessel Assurance (IMCA M 204)		
Guidance on Operational Activity Planning (IMCA M 220)		

	Description	W2W Watch points
The Training and Experience of Key DP Personnel (IMCA M 117 Rev. 1)		
Safety Interface Document for a DP Vessel working near an Offshore Platform (IMCA M 125)		
Specification for DP capability plots (IMCA M 140 Rev. 1)		
Flag State		
Individual Flag States will have their own interpretations of the IMO Conventions, Codes and Guidelines	For instance the MCA publishes the UK code of Safe Working Practices for Merchant Seaman (COSWP), which requires the following areas to be considered for vessel access: • Requirements to perform a risk assessment on any boarding arrangement • Limitations on angles of inclination • Local LSA • Minimum lighting • Freedom from obstructions and trip hazards • Use of safety nets • Maintenance, corrosion management and diminution criteria, inspection • Requirement for compliance to BS MA 78;BS MA 89 depending on exact designation • Design constraints	Early engagement with Flag State for the intended W2W vessel will enable their requirements and interpretations to be incorporated into the project from the start.
Regulators		
Individual countries have differing regulatory frameworks for W2W projects, and the applicable setup and boundaries between varying regulators need to be understood at the start of each project. Hence, OPERATORS are advised to engage with all regulatory stakeholders early on in the project to understand their requirements and aspirations.		
Classification		
Classification Societies have been established to develop design, construction and material standards and to oversee the construction of ships. Ship Classification Societies undertake a broad range of activities under strict quality standards and in accordance with the purpose, framework and structure, based on all existing requirements and recommendations of IMO instruments, regarding recognized organizations. It is normally a requirement of a marine insurance policy for a vessel that it is Classed, hence any modifications that are made to is that may affect its Classification need to be assessed and approved by Class or the vessel may not be insured. Therefore, as with regulators, early involvement with Class, for at least the vessel, is recommended. Particularly as Class involvement can provide the project with other assurance services that can form part of the case for safety for the W2W project as a whole.		

ANNEX C SOLUTION SELECTION (ADDITIONAL)

C.1 Vessel Specification Checklist

The following checklist can be used when selecting a vessel and then updated during the project. It needs to be recognised that, it is not extensive and there may be other issues that the FACILITY OPERATOR needs to consider; its primary purpose though is to aid the thought process whilst enabling information to be captured in a systematic manner:

Suitability	
Vessel compliant with Special Purpose Ship (SPS) Code	
Persons on board (POB) limit as stated on the SPS documentation and / or lifesaving appliance (LSA) capacity	
Number of beds and / or public spaces / POB limit	
LSA (Record of Equipment for Cargo Ship Safety) / POB limit	
Comfort Class notation	
Endurance of vessel (e.g. provisions storage, potable water supply, fuel supply, waste etc.)	
Motion characteristics	
Vessel hull form	
Response amplitude operators (RAO) / Nordforsk criteria data	
Active and passive stability systems	
Motion monitoring systems	
Position keeping	
DP Class	
DP references	
Footprint and heading control	
Time taken to set up DP	
Max transit speed on DP	
Environmental regularity number (ERN) DP criteria	
W2W	
Additional requirements capability e.g. inter-field cargo transport, remotely operated vehicle (ROV) support, emergency response provision / standby cover, fabrication, heliport, etc.	
Utilities capability e.g. power, fuel, hydraulics, cooling water, air, lighting	

Deck space size / locations available (e.g. gangway system spread, laydown, warehousing, workshop)	
Layout of vessel for flow of workforce on and off the vessel during transfers	
Gangway system impact: clash with existing facilities e.g. crane, ROV, line of sight, power, man overboard (MOB) recovery	
Welfare	
Noise and vibration levels (including during DP operations, if relevant)	
Cabin size, occupancy and WC / shower facilities	
Catering, cleaning and laundry capacities	
Food quality and mess room capability	
Recreation facilities including: • Telephone availability • Internet (access availability and bandwidth) • TV provision and availability of channels with workforce language content • Gymnasium • Cinema • Quiet room(s) • Smoking room(s) • Bond provision	
Medic and medical facilities	
Security	
Ships Security Assessment	
Ship Security Plan	
Marine assurance	
Safety performance	
Experience and competency of vessel crew	
Relevant experience (both at-sea & on-leave crews)	
General condition	
Vessel status	
Asset requirements	
Vessel displacement (for impact energy)	
Collision avoidance management e.g. ARPA and AIS	

C.2 Dynamic Positioning

Based on International Maritime Organisation (IMO) publication 645 the Classification Societies have issued rules for dynamic positioned (DP) ships described as Class 1, Class 2 and Class 3:

- Class 1 has no redundancy. Loss of position may occur in the event of a single fault.
- Class 2 has redundancy, so that no single fault in an active system will cause the system to fail. Loss of position should not occur from a single fault of an active component or system, such as: generators, thruster, switchboards, remote controlled valves etc., but may occur after failure of any normally static component (e.g. cables, pipes, manual valves, etc.), which is not properly documented with respect to protection and reliability.
- Class 3, which also has to withstand fire or flood in any one compartment without the system failing. Loss of position should not occur from any single failure, including a complete loss of all components contained in any one water tight compartment or fire sub-division through fire or flood, respectively.

A DP system relies on position referencing systems (PRSs) to function, the most common PRSs are detailed below:

- Differential Global Positioning System (DGPS) - the position obtained by GPS is not accurate enough for use by DP. The position is improved by use of a fixed ground based reference station (differential station) that compares the GPS position to the known position of the station. The advantage of DGPS is that it is almost always available. Disadvantages are degrading of the signal because of sunspots or atmospheric disturbances, blockage of satellites by cranes or structures and deterioration of the signal at high latitudes.
- Acoustics - this system consists of one or more transponders placed on the seabed and a transducer placed in the ship's hull. The transducer sends an acoustic signal (by means of piezoelectric elements) to the transponder, which is triggered to reply. As the velocity of sound through water is known (preferably a sound profile is taken regularly), the distance is known. There are many elements on the transducer, the direction of the signal from the transponder can be determined. Disadvantages are the vulnerability to noise by thrusters or other acoustic systems. Furthermore, the use is limited in shallow waters because of ray bending that occurs when sound travels through water horizontally.
- Light Taut Wire (LTW) - the oldest position reference system used for DP is still very accurate in relative shallow water (typically up to 80m). A clump weight is lowered to the seabed. By measuring the amount of wire paid out and the angle of the wire by a gimbal head, the relative position can be calculated. Care should be taken not to let the wire angle become too large to avoid dragging. For deeper water the system is less favourable, as current will curve the wire. There are, however, systems that counteract this with a gimbal head on the clump weight. Horizontal LTW's are also used when operating close to a structure. Objects falling or drifting onto the wire may cause significant transient positional errors.
- Fanbeam and CyScan - these are laser based PRSs. They are very straightforward systems, as only a small prism needs to be installed on a nearby structure or ship. Risks are the system locking on other reflecting objects and blocking of the signal. Range depends on the weather, but is typically more than 500 meters.
- Artemis - a radar based system. A unit is placed on a nearby structure and aimed at the unit on board the ship. The range is several kilometres.
- Differential, Absolute and Relative Positioning System (DARPS) - commonly used on shuttle tankers while loading from a floating production storage offloading (FPSO) vessel. Both will have a GPS receiver. As the errors are the same for the both of them, the signal does not need to be corrected. The position from the FPSO is transmitted to the shuttle tanker, so a range and bearing can be calculated and fed into the DP system.

- RADius and RadaSca - these are radar based system, but have no moving parts as Artemis. Another advantage is that the transponders are much smaller than the Artemis unit. The range is typically 500 - 1000 meters.

C.3 Welfare on Vessel

Personnel welfare issues can arise with W2W operations, particularly when exposing individuals, not used to life on board a marine vessel. The following list is drawn from W2W experience:

- Personnel welfare facilities and features (and improvement opportunities):
  - Sound and vibration levels could wake the sleeping workforce or disrupt workstation environments. An understanding of the sound and vibration levels throughout the ship during the various ship operations is required and if there will be any detrimental impact on the well-being and comfort of the workforce. For example: noise levels caused by generators, thrusters and other ship systems within the accommodation and workspaces during DP operations, normal sailing, standby/on station activities. Noise and vibration levels need to be considered within limits, such that they do not have a detrimental impact on those who are sleeping - potentially, both at night time and day time (if 24hr operations are being employed). In DP conditions, propulsion thrusters may impact on certain areas of the vessel. However, countermeasures could potentially be taken to improve sound levels. Classification Societies have Comfort Class which may be used to ensure vessel noise and vibration levels are within pre-defined criteria for personnel comfort. Comfort Class has three designations with '1' offering the most comfort (e.g. for passenger ships) and '3' the least comfort. Bespoke W2W may be designed to achieve a 2 or 3 rating, with a 1 rating likely to be unjustified. PSVs may be able to obtain a 3 rating or no rating at all.
  - Vessel motion characteristics (both in transit and position keeping). Ship accelerations and motions can bring on sea sickness or lead to sleep deprivation, increased slips, trips and falls, difficulty performing activities, etc. (especially for non-mariners).
  - Cabin size, occupancy and WC/shower facilities. Check for build quality and soundproofing. Cabin lockers should be large enough to accommodate Personal Protective Equipment (PPE) (e.g. lifejackets, survival suits, etc.) and personal effects and equipment for the duration of the trip.
  - Cabin Security. Workforce may have high value personnel effects and a suitable method should be in place to allow these to be secured when cabins are not occupied.
  - Catering, cleaning and laundry capacities. W2W vessel dry goods / cold store capacity will need to meet demands of the workforce for the campaign duration. Manned laundry facility, providing 24hr turn round of both coveralls and personal items.
  - Food offering. Ensure food is provided of a similar style / standard to the liking of the workforce e.g. a British trained chef for a British workforce!
  - Rest & relaxations areas to improve the 'life at sea' experience for the facility workforce. This in turn, will greatly increase the personnel's readiness for work the next day. If possible, the creation of spaces with natural light and access to the outside, gym, satellite TV and the internet would be beneficial.
  - Recreation facilities (e.g. gym, cinema, good reliable internet/Wi-Fi, TV, quiet room, smoking room, etc.) should be sufficient to accommodate the entire workforce
    - This is especially important if 24 hour working, so not to disturb the resting shift in their cabins. If these are not available on the vessel, they can be retrofit as modular containers on deck
    - Sufficient gym provision to cope with multiple users. Vessel motions need to be considered when selecting and laying out a gym

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    - Adequate availability of telephones with connection to outside lines in all sea states / ship headings
    - Reliable TV service provided to a similar style / standard to the liking of the workforce under all sea states and all vessel headings
  - Medical facilities. For example, hospital and fully trained medic could be a specific legislative or project requirement
- Work related facilities, e.g.:
  - Office space and meeting rooms, W2W vessel meeting room(s) must be sufficient for the workforce requirements. If these are not available on the vessel, they could be retrofited as modular containers on deck
  - Locker space, drink stations, WCs, sinks, showers and changing rooms
  - Good, reliable telephone, internet, video conference, etc. Telephones and/or connection to outside lines, can typically be limited and internet/wifi connection signals weak. Substantial IT connection required to ensure good coverage, high bandwidth and continuity of signal in all sea states / ship headings

C.4 Gangway System Checklist

The following checklist can be used when selecting a gangway system and then updated during the project. It needs to be recognised that, it is not extensive and there may be other issues that the FACILITY OPERATOR needs to consider; its primary purpose though is to aid the thought process whilst enabling information to be captured in a systematic manner:

Capabilities	
Gangway Reach:	
• Operating length (min/max)	
• Extreme length (min/max)	
• Neutral operating height on vessel (min/max)	
• Neutral operating height on asset (min/max)	
• Motion compensation (roll, pitch, heave, yaw)	
• Resultant closest point of approach between vessel and offshore facility in three dimensions	
Transfer Time:	
• Time to set up to transfer	
• Transfer rate	
• Time between transfers (if applicable)	
• Time to stow	
Operational Limits:	
• Expected sea-state limits	

Capabilities	
• Wind speed limits	
• Personnel weight limits (incl. baggage)	
• Number of personnel of gangway	
• Cargo handling limits	
• Ability to transfer injured persons in stretcher	
• Manual handling aids on gangway (if applicable)	
Safety / Performance Record	
Demonstration of safety (e.g. relevant certification, risk assessment, HAZID, Failure Modes Effects (& Criticality) Analysis (FME(C)A), safety case for system, etc.)	
Operational limits identified for the units based on design and testing	
Safety systems installed	
Ex-rating requirements for equipment	
Earthing requirements	
Lightning Protection	
Lighting requirements around gangway	
Exposure of gangway personnel to the weather during complete transfer cycle	
Exposure of transfer personnel to the weather during complete transfer cycle	
Exposure of gangway personnel to other hazards from either vessel or offshore facility	
Interactions with	
Vessel:	
• Footprint on deck (length/breadth)	
• Deck loading	
• Is grillage required for loading or height?	
• Class involvement required	
• Ship structure modifications required	
• Services required from vessel (air, water etc)	
• Power supply protection (if applicable)	
• Repeat of gangway status on bridge?	

Capabilities	
• Repeat of DP status at gangway personnel station? (if applicable)	
• Gangway status repeated in at transfer personnel congregating point?	
Offshore facility:	
• Landing footprint	
• Landing loading (initial/operational/extreme)	
• Structural additions required at landing location	
Manning Requirements	
Manning requirements for operations	
Manning requirements for maintenance	
Competency assurance arrangements	
Certification of personnel for working on a vessel	
Maintenance	
Written maintenance scheme	
Time required and schedule	
Critical sparing philosophy	
FME(C)A in place for the system (including controls and software)	
Written scheme of examination and testing	
3rd Party verification	
Fatigue and corrosion monitoring & measurement	
Gangway System Mobilisation	
Mobilisation location	
Transportability	
Craneage required to install	
Sea fastening requirements	
Protection structure around gangway modules	
3rd Party approval of design packs for additional structure	
Post-installation tests	

C.5 Offshore Facility Checklist

The following checklist can be used when considering an offshore facility for W2W operations and then updated during the project. It needs to be recognised that, it is not extensive and there may be other issues that the FACILITY OPERATOR needs to consider; its primary purpose though is to aid the thought process whilst enabling information to be captured in a systematic manner:

W2W Interface	
Height of lowest normally manned deck above LAT suitable for use as an access location	
Potential access locations for W2W connection	
Restrictions to vessel access e.g. platform overhangs, risers, subsea infrastructure	
Access location requirements (e.g. elevation to be reached on the offshore facility, docking design and standardisation, gangway system loading, structural & environmental loads, safe access to existing deck walkways, lighting, signage, alerting functions etc.).	
Minimum core competencies of visiting teams	
Vessel to offshore facility communication and vice versa (e.g. UHF, VHF, NavAids)	
Offshore Facility specific	
Proposed W2W manning profile vs current manning profile and POB maximum (day/night) / constraints on POB	
Offshore facility crane requirements, e.g. (day container, supplier, engineering) vs offshore facility crane capability (reach, loading)	
Offshore facility available cargo deck space	
Day-light only operations or 24 hour access requirements (suitability of offshore facility for 24 hour operations) e.g. lighting	
Contingencies and additional facilities to cover instances where W2W personnel cannot return to the vessel	
Maintenance	
Maintenance and performance management of the access location(s)	
Emergency Response	
Emergency response provision / standby capacity and capability	

C.6 W2W Access Location Selection Checklist

The following checklist can be used when selecting suitable access location for the W2W connection at the offshore facility(s) and then updated during the project. It needs to be recognised that, it is not extensive and there may be other issues that the FACILITY OPERATOR needs to consider; its primary purpose though is to aid the thought process whilst enabling information and references to be captured in a systematic manner:

Availability	
Prevailing weather direction e.g. wind, current, tidal conditions	
Risk (hazards)	
Marine collision (including gangway collision), for example if the W2W vessel's dynamic positioning system were to fail with potential for drift/drive onto the offshore facility • Riser, wellhead, pipeline, umbilical, turbine, cable proximity • Impact by the W2W vessel and/or its protrusions (gangway, bridge or helideck etc.) could result in structural failure, hydrocarbon release from risers or the topsides equipment. • Collision of the W2W vessel with the offshore facility, may still require the offshore facility to be shut down for structural surveys, even if there was no hydrocarbon release.	
Access route to final destination (climbing ladders, stairs; walking through hazardous areas)*:* • Access locations in process areas will potentially require personnel to walk through zone 1 and 2 hazardous areas in full PPE to reach the TR & muster point. Jacket POB restrictions may also need to be taken into consideration.	
Offshore facility vent and drain locations: • Dispersion modelling and control of venting / discharge • Overside discharges from offshore facility drains onto W2W vessel / transferring workforce	
Access location preparation requirements: • Structural capacity of areas access locations to withstand pushing / pulling forces of docking connection • Offshore facility and maintenance hazards associated with access gate(s) and /or landing platform(s)	
Emergency escape (possible interaction and impairment of the evacuation and escape provision by the vessel, gangway system, access platform etc.): • The bridge of the W2W vessel could possibly get stuck under any deck overhangs. A stuck W2W vessel could impede the ability to launch evacuation and escape provisions. • Avoid locating roll-over liferafts or descent stations above the W2W	

access location.	
Dropped objects: • Onto subsea pipelines and cabling • If the W2W access location is to a low elevation where it would be vulnerable to dropped objects from activities occurring on decks above	
Helicopter approach	
Supply vessel operating areas	
Blockage of line of sight communications on the offshore facility	
Maintainability	
Where it is expected to repeat the use of W2W systems, consideration must be given to potential degradation between uses, given the limitation in fabric maintenance support which may exist on the offshore facility(s). The placement of an access location platform within the winter splash zone may lead it being unserviceable in relatively short period of time.	

C.7 Onshore Facilities Checklist

The following checklist can be used when selecting onshore facilities for the W2W project and then updated during the project. It needs to be recognised that, it is not extensive and there may be other issues that the FACILITY OPERATOR needs to consider; its primary purpose though is to aid the thought process whilst enabling information to be captured in a systematic manner:

Location	
Identification of potential port facility(s) close to location of the offshore facility(s) e.g. existing heliport / port facility(s) or suitable FACILITY OPERATOR offshore facility(s)	
Distance / travel time from potential port(s) to the offshore facility(s)	
Security	
Method of transfer for security to vessel e.g. secure vehicle-transfer (from security to vessel)	
Method of boarding the vessel at port	
Expected level of identification and security to be defined as per IMO ISPS code, legal requirements etc.	
Personnel Processing	
Number of personnel to be processed (per hour, and frequency, days of the week, notice period)	
Number and types of bags and equipment to be processed at the security facility	
Vessel Requirements	
Bunkering requirements e.g. marine berthing, bunkering & supply facilities	

required	
Any access restrictions (e.g. no 24hr operations) at the port(s)	
Facilities	
Secure car-parking requirement (for personnel going offshore)	
Land side and marine side waiting room facilities e.g. seating and toilet requirements, refreshments	
TV lounge, safety briefing room/tool box talk area	
Contingency Arrangements	
Non-routine visits requirement, e.g. inclement weather return to port or vessel breakdown	
Arrangements to transfer personnel, luggage, tools, PPE to vessel in port	
Contingency planning - availability of alternative manning transfer options e.g. helicopter where W2W is not available due to breakdown or inclement weather	

ANNEX D SOLUTION DELIVERY (ADDITIONAL)

D.1 W2W Workflow on Vessel

When designing the layout of the W2W vessel the following aspect should be considered:

- Logical movement of W2W personnel to create best possible workflow e.g.:
  - Location of gangway system on the vessel with safe non-slip walkways to/from can be achieved by fixing of grating to the deck, with a wooden chamfered edging to prevent turning of ankles
  - Accommodation shelter close to the gangway system for the crew to shelter while DP checks, close manoeuvring and gangway connection takes place
  - clean/dirty room reception should be near gangway system to avoid spreading of dirt through vessel
- Timings e.g. wake up 6am, vessel DP starts, gangway system checks, 500m checklist, toolbox talk, deployment at first offshore facility move onto next etc.
- Personnel transfer process will require strict procedural control to reduce workforce agglomeration in areas where dispersal in contingency is difficult; waiting time and time exposed to accident hazard risk and possibly inclement weather
- Area and limits of deck space for W2W and other activities
- Provide clear instruction in the form of visual and audible aids
- Adequate lighting
- Visual and audible contingency alerting

D.2 Design of Offshore Facility Access Locations

The interfacing requirements with an offshore facility (small to very large) on implementing W2W operations as a means of access need to be considered.

When retrofitting W2W access to an existing offshore facility, the options available may be limited, due to constraints posed by the original design and layout, current operations, hazard sources, etc. For example: the number and location of gangway system access locations may be limited and sub-optimal, which may have a negative impact on W2W performance.

On a new build offshore facility, if W2W manning is specified within the initial scope of design, the W2W requirements can be incorporated in the overall design process. This should result in an optimised, best practical and lowest risk design solution being adopted.

The following considerations may need to be taken into account when designing and implementing the access locations on the offshore facility:

- Offshore facility access locations e.g. boat landing access, leg access platform, ladders & stairs and access gates; it should be possible to open the gates on an unmanned offshore facility from the tip of the gangway (i.e. no climbing over handrails)
- Special consideration needs to be given to FPSO's as access location may need to consider the implications of oil storage tanks, bulwarks, web frames, the proximity of the turret, Class requirements etc.
- Interfaces - positioning reference systems (e.g. prisms and reflectors will have to be fitted to the offshore facility and tested)
- Permanent or temporary fixture (only during W2W operations)

The means of getting from the vessel to a deck of the offshore facility should be selected, designed, installed and maintained based on risk management processes and in keeping with normal offshore facility best practices. For each access location the following requirements should be considered:

- Safe design - to prevent fall of personnel (e.g. into the sea) when in use and also when not in use. Many FACILITY OPERATORs have fitted with a customised gate, providing secure access to and from the offshore facility. When not in use, the gate will form part of the offshore facility perimeter handrail
- Robust - sufficient structural strength to support the maximum predicted loads imposed by the gangway system when loaded with personnel/cargo in all operating conditions. Where necessary the effects of ice accretions should be considered
- Space - sufficient room around the gangway access location for personnel movements (including casualty rescue) and any additional safety equipment storage requirements
- Bag transfer - hand tools, food, etc. between the vessel and offshore facility. Personnel crossing the gangway may be allowed to carry a back pack, but this is not always the case and therefore a cargo lifting means will be required. If ladders form part of the access route (especially with caged ladders) carrying a back pack would probably not be permitted
- Electrical continuity / earthing - ensuring galvanic balance between gangway system and offshore facility
- Reliability, availability and contingency arrangements if the gangway system becomes unavailable
- Power, lighting and other utilities required
- Offshore facility maintenance and inspection requirements
- Safety risks
- Costs

It may be likely that the elevation where personnel will arrive on the offshore facility from the vessel (e.g. leg access platform) could be significantly below that of the offshore facility's cellar or lowest deck and therefore, a safe means of changing elevation is required. Options such as: elevating platforms, stairs, ladders, lifts, and other recognised ways of safe means to change height should be assessed within the design process. The following should also be considered in the assessment:

- Need for additional structure for support
- Environmental impact on additional structures (e.g. immediate and long term impact of adverse weather on usability and maintainability)
- Need to inspect after significant storm or a period of non-use before re-use
- Physical fitness and ability of personnel as they will be expected potentially to physically climb the elevation change

Once an access means has been selected, then additional risk reduction measures should be sought to reach an acceptable risk level solution (e.g. non-slip coating on stair treads, fall arrest system on ladders, etc.).

D.3 Risk Management Processes

A W2W project should consider the following aspects when conducting risk assessments (if applicable to their operation):

- Generic marine and slips, trips and falls hazards
- Offshore facility-based hazards that could impact or influence W2W operations
- W2W vessel hazards that could impact the offshore facility

- W2W vessel, gangway system, offshore facility, company and responsible person interfaces
- Restrictions that may be required on asset operations during W2W operations
- Escape and evacuation possibilities and restrictions
- Impact of increased POB on the offshore facility including emergency, evacuation and escape arrangements including Life-Saving Appliance (LSA)
- Management of POB numbers on vessel and offshore facility to stay within limits
- Reasonably expected environmental impacts
- Collision assessment and avoidance management

A risk assessment should be conducted for all fendering, gangway system and docking operations to demonstrate that the following have been considered for transfers:

- Structural capacity of offshore facility (to absorb attendant vessel collision impacts)
- Location and vulnerability of J-tubes, umbilicals, cables, risers and other such facilities hazards
- Expected wind, swell, wave and tide speeds, heights and directions
- Hazardous areas through which personnel may be expected to transfer to get to muster areas, accommodation or the regular place of work
- Expected vessel and offshore facility protrusions
- Crane access
- Emergency evacuation/escape
- Potential of dropped objects including from craneage
- Proximity to fog horns and other such warning and communication devices
- Risk of collision from other vessels
- High voltage systems and cables
- Hydrocarbon containment and release dispersal
- Location of hazardous zones
- Location of any temporary hydrocarbon system repairs
- H_2S or other hazardous substances
- Proximity of flare stacks, vents or drains
- Proximity to load noise sources (e.g. fog horns)
- Helicopter approach

D.3.1 Management of Change (MOC)

Material changes due to implementation of a W2W solution should be formally managed by the FACILITY OPERATOR's Management of Change (MOC) process. Any changes to an on-going W2W programme, such as change of vessel or gangway system being used should also trigger the MOC process.

Management of any changes to the offshore facility, including the access platforms, should be conducted according to the FACILITY OPERATOR's MOC process. Management of any physical, procedural or organisational changes (temporary or permanent) on the vessel (except the gangway system itself) should be conducted according to SHIP OPERATOR's MOC process. Changes to the gangway system should be managed by the GANGWAY PROVIDER. All stakeholders (including safety representatives) should be consulted and represented throughout any material or organisational change on the vessel or gangway system. Any changes should be risk assessed and formally approved (as required) and should be evaluated and managed to ensure HSE risks arising from such changes remain at an acceptable level.

It may be necessary to alter a procedure due to unforeseen operational constraints and/or the addition of further tasks to a work scope during the operational phase of a contract. Should this situation arise the vessel's MOC procedure should be used and strictly adhered to. Such in-field changes must be authorised by the vessel master, offshore facility manager and any on-board FACILITY OPERATOR representative prior to implementation.

D.3.2 Hazard Identification and Analysis

At an early stage in the project, it is good practice to familiarise the participants with the W2W concept, the gangway system and identify all reasonably foreseeable hazardous events and conditions; that could arise as a result of using a gangway system for personnel transfer alongside an offshore facility.

The objective of hazard identification and analysis is to ensure that all accident hazards associated with W2W, which are thought to have the capacity to result in safety, environmental, or business impacts are identified, recorded and measures taken to ensure that risks are reduced to levels which are acceptable.

The risk assessment and hazard analysis for a W2W operation, should include representation from the SHIP OPERATOR, GANGWAY PROVIDER, FACILTY OPERATOR marine representative, offshore facility and project personnel. The following detailed aspects should be covered:

- The vessel's position, orientation and how close it could be to the surface structure or structures and hydrocarbon containing equipment such as risers and well conductors (where relevant)
- The vessel's station keeping capability and environmental limitations. These should be evaluated against the proposed activity and safe working limits shall be developed for any sensitive stages of the operation
- The competence and operational experience of the marine crew and gangway personnel in similar work scopes
- The planned approach and departure, considering adjacent hazards, propulsion arrangements and escape routes
- The procedures in place to deal with all possible failure modes, for example: with the vessel, or because of external forces (such as weather)
- Whether or not a marine representative should be present during the operation
- Any simultaneous operations (SIMOPS) and whether restrictions need to be placed on other vessels or activities
- Whether or not the position reference systems (PRSs) are required and are suitable for the operation and if any other PRSs are required
- Hydrocarbon containment arrangements
- Emergency response / standby cover
- Helicopter operations
- Logistic (supply vessel) support
- Collision risk

Extra mitigations should be considered for larger vessels: as their physical size, mass and inertial forces may restrict their manoeuvrability, their ability to respond to changing situations rapidly, or to manoeuvre to a safe area.

D.3.3 Simultaneous Operations (SIMOPS)

Dependant of the nature of the project and the intended work scopes to be carried out, there may be a requirement to perform necessary actions, to manage safely any SIMOPS. Any potential for SIMOPS must be reviewed and risk assessed on a case-by-case basis with involvement from the offshore facility representative and vessel master.

D.3.4 Quantitative Risk Analysis (QRA)

It is good practice is to conduct a 'risk comparison' of individual risk (IR), that personnel working on the offshore facility are exposure to under the current manning model, with the risk they will be exposed to using a vessel-based W2W model.

Calculating the new individual risk for a W2W manning model should require the FACILITY OPERATOR to create a campaign / annual manning model for the proposed W2W activities. This may vary from other manning models in the following areas.

Journey times may increase or decrease depending on the concept undertaken:

- Offshore crew changing using a W2W vessel as a 'fast ferry' will probably substantially increase the journey time, if compared with the use of helicopters.
- 'Live-aboard' campaign maintenance with a W2W vessel already in the field should result in a reduced transfer time, if compared to helicopter check-in process and flight time. There may also be an increase in productive working time for the offshore workforce (i.e. increasing their exposure to on-facility risk).
- Where the offshore workforce have swapped their bed on a manned offshore facility for a bed on the W2W vessel, they will have effectively traded their 'facility' risk for a 'marine' (time on vessel/at sea) risk.

The implementation of a W2W solution will increase the number of infield vessel visits, approaching an offshore facility. There is potential for impact between the vessel and the offshore facility, whenever the vessel is brought alongside. The collision risk needs to be assessed, and measures taken (if justified) to reduce risks to an acceptable level.

On the offshore facility, measures may include: strengthening of the jacket; buffers with or without energy absorbing devices; ensuring there are no vulnerable risers or umbilical; painting visual reference markings on the jacket, etc. For new designs, risers and electrical umbilicals could be installed inside the structure of the offshore facility to help protect them from impacts. The potential for vessel protrusions (e.g. telescopic gangway system, davits, etc.) to impact vulnerable structures or pipework within an offshore facility should be considered within the collision assessment (ref. Mumbai High attendant vessel major fire event was caused by an impact between a helideck on a vessel and a hydrocarbon riser relatively high up on the offshore facility).

D.3.5 Failure Mode Analysis (FME(C)A, FTA)

The need for failure mode analysis should be identified from the HAZID or risk assessment studies. This *W2W Guidance* is aimed at a spectrum of operations, some of which will not need a detailed level of analysis.

When failure mode analysis is considered necessary, the FACILITY OPERATOR should look to ascertain failure rate data for the identified critical systems employed on the W2W vessel. The manufacturers of the vessel's DP system and the gangway system should have undertaken some form of failure mode analysis demonstration for their respective systems. These failure mode reports could be reviewed for completeness by a competent person. Any additional systems or interface connections between the component items that make up the overall W2W solution (e.g. gangway tie-in to ship's power, communication system) that are deemed safety critical should also be considered for failure mode analysis.

D.4 Procedures

D.4.1 W2W Procedures

The following checklist can be used when preparing W2W procedures and then updated during the project. It needs to be recognised that, it is not extensive and there may be other procedural issues that the FACILITY OPERATOR needs to consider; its primary purpose is to aid the thought process whilst enabling information to be captured in a systematic manner:

Vessel	
Adverse weather criteria	
Communications • Vessel bridge to gangway system • Vessel to offshore facility • Emergency	
Offshore facility approach	
Bridging of Health and Safety Management System (H&SMS) (refer to separate checklist 4.4.5)	
Adherence to the marine coordination or procedures of the offshore project or offshore facility	
Welfare procedures	
Marine activities of the vessel	
Collision avoidance management	
Actions in the event of degradation of critical equipment	
Transfer management	
Emergency response provision	
Gangway	
Gangway deployment	
Gangway transfer policy	
Gangway emergency	
Personnel protective equipment (PPE)	

Offshore Facility	
Transfer of personnel between the vessel and the offshore facility • Up-manning • Down-manning • Shift handovers • Core-crew competencies	
Personnel tracking • Onshore facility to vessel • Vessel to offshore facility • Offshore facility to onshore facility • Helicopter survival suits	
Bridging of Health and Safety Management System (H&SMS) (refer to separate checklist 4.4.5)	
Emergency response provision	
Project	
Reporting policy	
Audit policy	

D.4.2 Planning a Visit Checklist

As part of a planned offshore facility visit, the following aspects should also be considered by the W2W vessel master, offshore facility representative and gangway personnel:

Outside safety zone	
Combined vessel motions/interaction	
Weather forecast should be assessed taking into account the anticipated time and duration of the visit. Notably: • Wind speed above a predefined limit • Poor visibility, such that the requirements in the Emergency response provision may not be met	
Adverse weather-induced fatigue and previous hours worked	
Alongside offshore facility	
Continuous monitoring of the following aspects • Spinning reserve, the remaining thruster load capability, should not fall below 60% as determined by use of the DP system consequence analysis • Vessel motion starts to affect station keeping • Gangway system approaching operational limits	
Leeside working only	
Offshore facility overboard discharges in relation to the gangway system location and vessel set-up position	

The vessel may only be connected to the offshore facility for transfer of personnel during daylight or where artificial lighting allows sufficient illumination for recovery of man overboard	

D.4.3 Adverse Weather Policy

The weather conditions where W2W operations will be suspended should be defined.

On arrival at the offshore facility, if the conditions are unfavourable, the personnel transfer activities should be delayed, until they fall within limits and the short term forecast is favourable. In extreme circumstances, where the offshore forecast indicates a prolonged period of unfavourable conditions, the W2W vessel master may decide to abort/postpone transfer operations. This may require overnighting on the vessel or offshore facility and consideration for this should be completed. The W2W vessel master, in consultation with the on board offshore facility representative may consider departing the field to seek sheltered waters.

D.4.4 Communications

All key stakeholder parties should be allocated communication means (usually hand held radios) and call signs to provide clear communications. The stakeholders are likely to be the vessel master and bridge crew, offshore facility manager and gangway personnel.

There should be sufficient alarms (visual and/or audible) installed to inform the gangway personnel and personnel crossing the gangway, of the current status of the gangway system and to warn of imminent action, such as disconnection. Gangway system alarms may be relayed back to a centralised and permanently manned control station, for example the vessel's bridge. It is important that the source and cause of alarm and alerts are known, to help ensure appropriate action is taken.

Having offshore facility alarms repeated on the vessel (e.g. fire and gas alarms) may be considered beneficial. This system may be used to warn the vessel operations of offshore facility events in order that appropriate actions can be taken on the vessel (e.g. stop transfer of personnel from vessel to offshore facility).

A secondary means of communicating serious contingencies must be agreed for example by use of the ships public address (PA) or general alarm (GA) systems to instruct the gangway personnel of potential hazardous situations.

All alarm and alerts should have procedures detailing the appropriate actions to be taken. These procedures should have a training and exercise programme to ensure alarm/alert response is effective.

D.4.5 Bridging Document Checklist

The following checklist can be used when preparing W2W bridging documents and then updated during the project. It needs to be recognised that, it is not extensive and there may be other procedural issues that the FACILITY OPERATOR needs to consider; its primary purpose is to aid the thought process whilst enabling information to be captured in a systematic manner:

Organisation and Responsibilities	
• Organisation	
• Roles & responsibilities	
Communications	
• Onshore communications	

• Offshore communications	
• Emergency communications	
Emergency Response Provision	
• Emergencies and incident response primacy i. Inside safety zone ii. Outside safety zone • Medical evacuation • Management of evacuated personnel • Accident & incident reporting • Personnel tracking & security	
Operations and Risk Assessment	
• Training and inductions i. Vessel ii. Gangway system iii. Offshore facility	
• Health & safety i. Drugs, alcohol and substance abuse ii. Personnel protective equipment (PPE) iii. Incident reporting	
• Adverse weather	
• Lifting and crane operations i. Vessel to vessel ii. Offshore facility to offshore facility iii. Lifting between offshore facility and vessel	
• Collision avoidance	
Management Systems, Audit & Review	
• Management of change (MOC)	
• Document control	
• Auditing of systems	

D.4.6 Emergency Response Provision

SHIP OPERATOR, FACILITY OPERATOR and GANGWAY PROVIDER's response to an emergency should be formally written in emergency response and incident management procedures and referenced in the bridging document.

They should define which company has response primacy (depending on the event location) and detail how the relevant emergency response procedures of each company should interact. Specific areas for consideration are:

- Emergencies and incident response primacy
- Medical evacuation
- Management of evacuated personnel
- Gangway system response
- Accident & incident reporting
- Personnel tracking and security

Controlled copies of the emergency response and incident management procedures should be held by stakeholders.

D.4.6.1 Evacuation and Escape Provision

The role of the W2W vessel under any abnormal operations should be clearly defined, documented and understood by all parties prior to first manning. In circumstances where the W2W vessel may not be available, alternative evacuation arrangements will need to be place.

Options that may be considered for evacuation from an offshore facility include:

- W2W vessel
- Helicopter
- Daughter craft / FRC
- Basket transfer (man riding crane on either offshore facility or W2W vessel)
- Second W2W gangway system
- Boat landing access using the daughter craft or FRC

W2W may be suitable for down manning, where the vessel remains infield, as it will be nearby and capable of attending in this scenario. For large offshore facilities, the offshore facility POB may exceed the normal operational capacity of the vessel. Consideration should be given to the maximum POB the vessel could be expected to take in abnormal scenarios, as this may be above the vessel's POB threshold. It is possible that, not all personnel on an offshore facility would be familiar with and trained in W2W transfer procedures.

The primary means of evacuation from an offshore facility is usually the method, by which personnel arrived on the offshore facility. Whereby, the W2W vessel remains infield, or has the potential to be the first responder, it could be considered as an evacuation option. Direct involvement in evacuation would be dependent on the W2W vessel being able to safely approach the offshore facility in a timely manner, under a potentially developing scenario (and ultimately the decision of the vessel master). The vessel master's primary concern will be the safety of the persons already on the vessel and to the safety of the vessel itself. Should the W2W vessel not be able to approach the offshore facility, it may still be capable of performing a support role to any evacuation (or escape) process. As such, primary and alternative evacuation systems may still be required to be put in place for the offshore facility.

Some W2W solutions could form part of the facilities escape strategy. (e.g. form part of the escape to sea provision).

D.4.7 Human Factors (HF)

The assessment and management of human factors (HF) is considered to impact in three areas:

On individuals - each person will have similar, but differing attitudes to W2W and the impact it has on their day to day lives. The W2W project should recognise how, why and to what extent persons are

TOC
Abbrev & Gloss
1. Intro
2. Require
3. Select
4. Deliver
5. Operate
Annex A
Annex B
Annex C
Annex D

impacted; this is fundamental to the influence of HF on safety and project delivery. It is not likely that the FACILITY OPERATOR will be best placed to provide the necessary support and mitigation measures. Instead the FACILITY OPERATOR should engage with the various third party employees to ensure that they have in place collaborative suitable resolutions.

On the organisation of the W2W solution – resolutions found for managing the HF of the individuals engaged in the W2W project, should be properly described within each company's applied management system. The bridging documents should ensure a consistent, efficacious approach and mitigation measure at the worksite. In providing for this, it would be hoped that the attitudes and group behaviour is influence by the build-up of a positive culture. Each part of the W2W solution: marine crew, gangway personnel, workforce personnel; must integrate and work together for the success of the project.

Job - when developing the various project plans and work instructions the requirements of the management system must be taken into account, but also consideration given to any potential effect of the contents of the bridging document. In doing so, conflict caused by introducing activities, not consistent with the demands elsewhere may be limited. For example: the demands of the marine crew to have 'noisy periods', which must be allied with the hours of rest requirements for resident workforce personnel.

D.5 Health & Welfare

D.5.1 Working Environment

Personnel living on a vessel need to take care, particularly when moving about, due to vessel movement. They also have to take care, when passing through some doorways, which may have both a high up-stand and low door-head. Special care should be taken when passing through self-closing water tight doors, especially where these can be remotely controlled. The use of such doorways shall be described in the vessel induction.

The stairs on marine vessels can be very steep, but to allow safe passage they are usually narrow with handrails on both sides. People using them can maintain a minimum of three points of contact, rather than the two available on conventional non-marine stairs. Having handrails both sides, also allows people to pass each other without need to take their hand off a rail.

Corridors in vessel living quarters, also may be narrow with hand rails, again to provide safe passage during all vessel motions. Stairways are segregated from corridors by a fire door, which must remain closed at all times (except for transit). The exception being fire doors, which have automated release mechanisms activated by a fire or general alarm.

D.5.2 Cultures

The W2W vessel's marine crew, gangway personnel and offshore facility workforce personnel will live in close proximity on the vessel. The cultural differences between the different groups should be recognised and measures taken to mitigate any negative impact.

Aspects such as: spoken language, TV channels, personal hygiene, tidiness, food and behaviour will require consideration.

D.5.3 Noise

All off-duty personnel should be provided with accommodation, with acceptably low noise and vibration levels. Accommodation areas, where noise limits are exceeded when the vessel is at location (especially cabins for sleeping) should not be used. A vessel's propulsion system (e.g. engines, thrusters, etc.) can

be a source of considerable noise and vibration, and the impact of this on the working and off-duty environment should be assessed. Temporarily exceeding limits may be acceptable, although the potential impact on rest period should be taken in account.

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