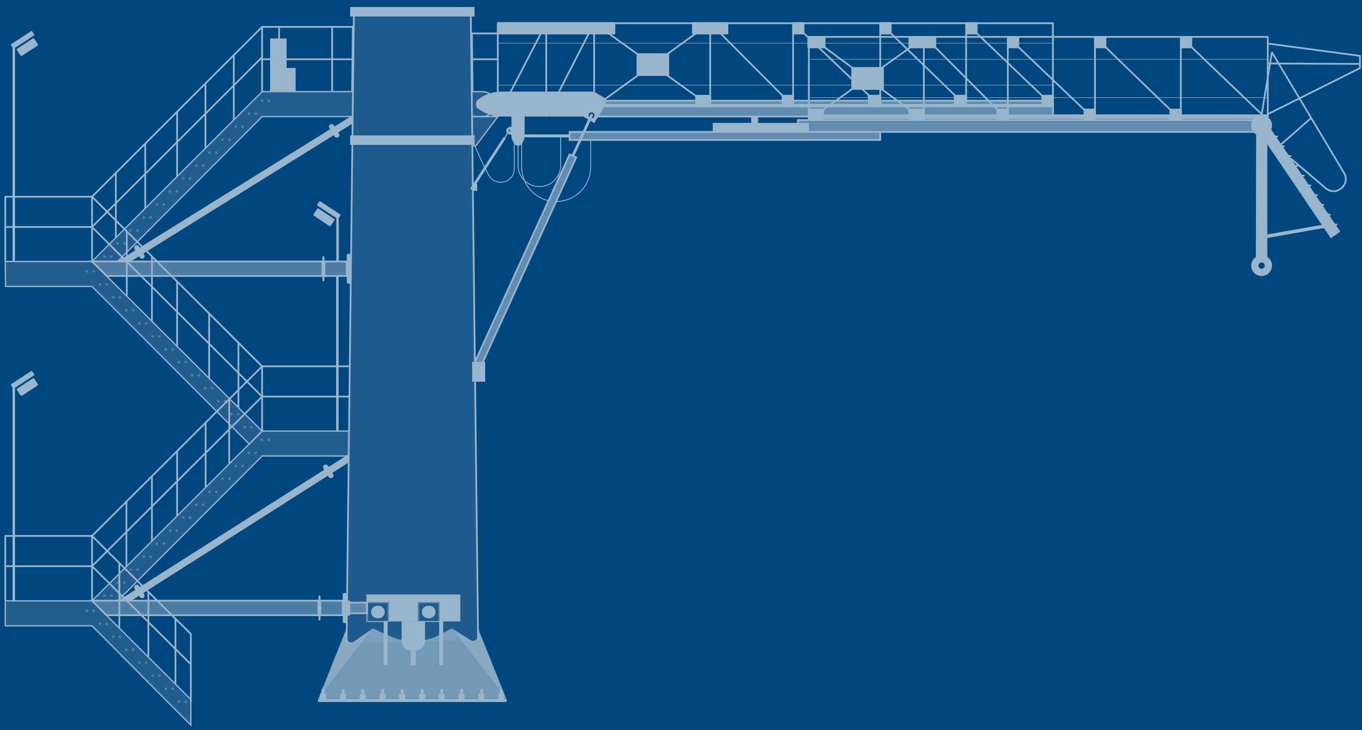

SIGTTO

Society of International Gas Tanker & Terminal Operators Ltd

Guidance on Gas Carrier and Terminal Gangway Interface

First Edition

Guidance on Gas Carrier and Terminal Gangway Interface

SIGTTO

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Introduction and Scope

1. Introduction and Scope

1.1 Introduction

Gangways are the primary means of safe access to a ship that is alongside a jetty. Due to the variety of ship and terminal designs, it is difficult to get a perfect fit in every situation. This document is intended as a step to try to address this issue and to minimise the differences as much as possible. It will discuss different gangway types and configurations, and provide recommendations in an effort to maximise safe access to the ship via the gangway.

This document first provides guidance on shore gangways when used on large gas carriers and then highlights specific challenges for smaller ships. The main focus of the guidance is to provide items to consider when designing a gangway system and during the design of the ship landing area. The guidance also encourages a structured approach to hazard management through the use of risk assessments.

1.2 Scope

The provision of safe access is the joint responsibility of the ship and terminal. The purpose of this document is to provide information to assist equipment manufacturers, ship and terminal designers and operators to meet this goal.

These recommendations are for liquefied gas carriers and land-based terminals. This document does not apply to ship-to-ship transfer operations or to floating terminals.

While it may not be possible to apply all of these recommendations to ships and terminals currently in service, they can be used as a reference when conducting compatibility analyses and risk assessments.

2

Gangway Systems

2. Gangway Systems

2.1 Types of Gangway Systems

Shore-based gangway systems can generally be divided into three main categories, each with their own specific features and benefits. A brief description of each system is provided below.

Column type

The column type gangway system (Figure 1) consists of a tubular support structure (column) resting on a mounting flange, with a control platform at a fixed height above the jetty. As it has a single support column, the foundation of the gangway system requires a relatively small footprint on the jetty.

The elevation of the control platform is typically close to the centre of the vertical envelope. The size of the vertical envelope is determined by considering several factors, such as ship size, ship draught range, tidal range and the expected ship motion during cargo transfer.

The vertical envelope of the column type gangway system is typically up to 20 m. Once positioned on board the ship, the gangway's hydraulic system is put into freewheel mode. This allows the gangway system to move with the ship, within gangway's design range.

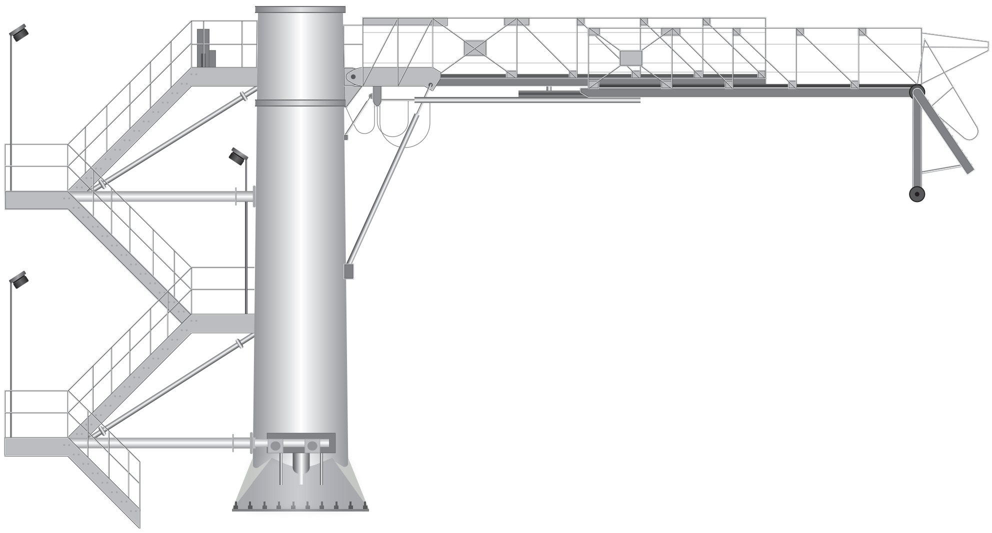


Figure 1: Column type gangway

Tower type

As tower type gangway systems have a lift platform, they may be used when the vertical envelope exceeds 20 m. The lift platform moves vertically along the tower to lift stations that are at fixed heights in the tower. Gangway controls mounted on the lift platform provide a direct line of sight to the landing area.

Once the gangway is positioned on the ship's deck, the lift platform can move automatically between stations to ensure that the gangway inclination is within its design range.

The minimum jetty foundation footprint for the tower type design is approximately 3.0 × 4.0 m. An example of a tower type gangway is shown in Figure 2.

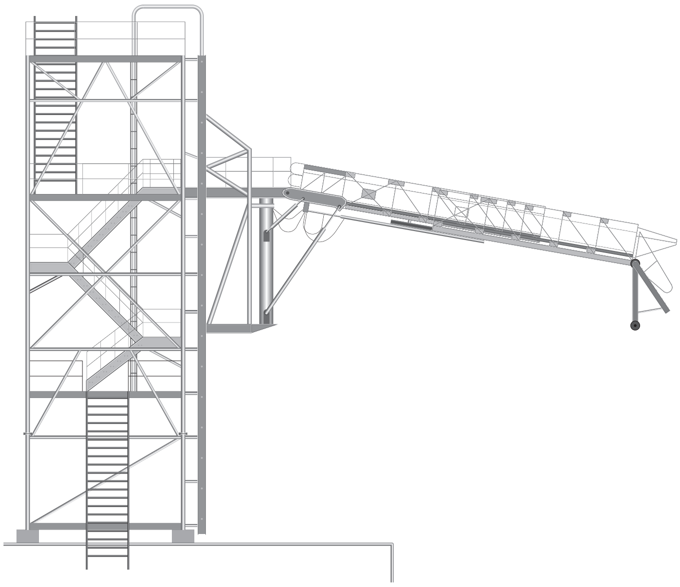


Figure 2: Tower type gangway

Riding type

Riding type gangway system is a term used for a variety of systems that are designed to move parallel or perpendicular to the berthing line. Ship movements are compensated by the articulating movement of the gangway. This contrasts with the telescopic movement commonly found in column type and tower type gangway system designs.

Positioning the gangway onto the deck can either be by means of an integrated hoist or a separate hoisting davit. Depending on the size and weight of the riding equipment, the system may be powered or manually driven.

Riding type gangway systems typically have a relatively larger footprint than tower type and column type systems. Figure 3 is an example of a riding type gangway system.

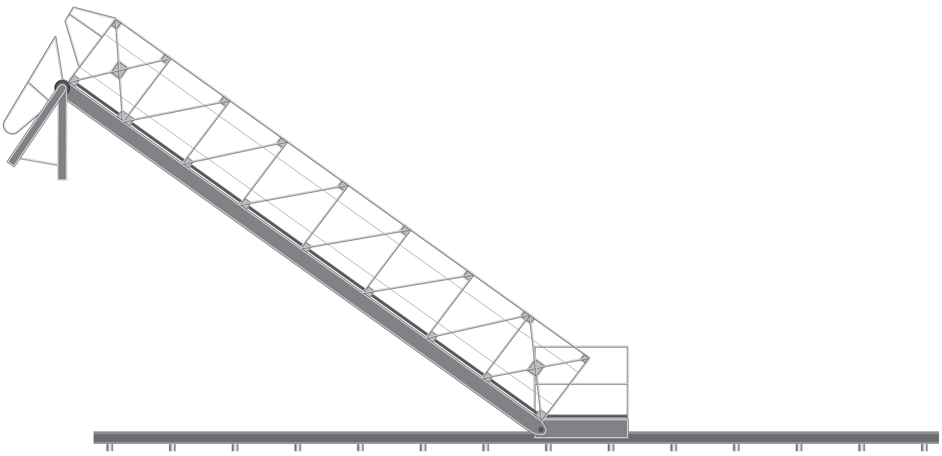


Figure 3: Riding type gangway

2.2 Gangway Safety Features

A brief description of some of the common safety features found in gangway systems is provided below.

Emergency retraction

Powered gangway systems are typically equipped with a separate capability to manually lift the deck ladder clear from the ship's deck in case of a power failure. Hydraulically operated gangway systems typically come with a hand pump as a means to remove the gangway from the ship. Other options include an independently powered backup pump or a hydraulic accumulator.

Mechanical limit protection

The gangway and deck ladder can have a swivelling connection or a weak link connection. A swivelling connection allows the deck ladder to be pulled over the ship's handrail without causing damage to the ship or gangway once the maximum extension has been reached. A weak link connection converts into a swivelling connection once the weak links have failed at the extension limit.

Automated retraction

This is a feature where the gangway retracts automatically on receiving a signal. This feature should be used with caution, as the gangway may be used as a means of escape by personnel in an emergency. Manual initiation should be preferred as this allows for time to assess the situation.

The automated retraction feature is not designed to prevent damage in the event of a sudden unexpected movement of the ship. The swivelling or weak link connection between the gangway and the deck ladder is usually designed for that purpose.

Alarms

Telescopic gangways are fitted with alarms which sound when the gangway approaches its mechanical limit.

2.3 Types of Deck Ladder

Deck ladders are located on the outboard end of the gangway system and are the part that is landed on the ship. The most commonly used types of deck ladder are described below.

Three-wheel and four-wheel

These are usually found where there are no restrictions on the footprint area. The typical footprint is approximately 1.5 m width × 2.2 m length. Note that the width of the ladder is taken in the same orientation as the ladder steps.

These ladders are designed to be balanced and are placed on the ship's deck on three or four wheels. This type of ladder does not need a mechanical system to keep it in the vertical position.

Two-wheel

This type of deck ladder is typically found on LNG berths and has a relatively small footprint. The typical footprint is approximately 1.5 m width × 1.1 m length. Note that the width of the ladder is taken in the same orientation as the ladder steps.

Side step

This is of similar design to the two-wheel type deck ladder, except that the step down ladder is rotated perpendicular to the direction of the gangway. The side step can be designed either at a fixed angle of 90° relative to the gangway, or with the freedom to rotate within a 180° range.

Saddle

This is specifically designed for ships with reinforced box rail sections, as this type of ladder lands directly onto the box rail instead of the deck. The advantage of this design is that it requires a small space on the ship's deck. The disadvantage is that it is limited only to the areas where the reinforced box rail is installed on the ship.

Combination

This is a combination between the two-wheel type deck ladder and the saddle type deck ladder. It can be used either as a standard type deck ladder or as a saddle type deck ladder on ships equipped with box rails.

2.4 Operational Challenges

There are generally five areas of physical ship and shore compatibility:

- Safe mooring arrangement
- fender contact
- manifold and loading arms arrangement
- emergency shutdown (ESD) system linked connections and communications
- gangway arrangements.

Unlike other interface elements, such as mooring, loading arms and ESD systems, there are no industry guidelines for ship builders, terminal designers or operators to reference for ship and shore gangway interface issues. Publications that provide regulatory guidance regarding gangway design, construction and maintenance include:

- The International Convention for the Safety of Life at Sea (SOLAS) II-1, Part A-1, Reg 3-9 - *Means of embarkation on and disembarkation from ships* (Reference 1)
- IMO MSC.1/Circ.1331 - *Guidelines for Construction, Installation, Maintenance and Inspection/ Survey of Means of Embarkation and Disembarkation* (Reference 2).

The following publications provide general operational guidance regarding safety and access to and from ships, but do not address ship and terminal interface issues:

- *Safe Access on Ships with Exposed or Raised Deck Structures* (OCIMF) (Reference 3)
- *International Safety Guide for Oil Tankers and Terminals* (ISGOTT), Chapter 16.4 - Ship/Shore Access (Reference 4)
- *UK SIP014 - Guidance on Safe Access and Egress in Ports* (Reference 5).

Ships may call at a wide range of terminals throughout their trading lives and experience has shown that the gangway arrangement is often the most difficult issue in determining compatibility between the ship and the terminal.

As a result, situations can arise where gangways are not suitable for the operational envelope of a given ship and terminal arrangement. This can occur through the access being too steep, or the deck area being too congested (due to interferences) or restricted (due to insufficient clear space).

Figures 4 to 9 provide examples of the interface challenges experienced by gas carriers and terminals. In Figure 4, the incline of the gangway is steep and the ladder at the jetty platform end is not sitting properly on the platform.

Figure 4: Gangway not suitable for operational envelope

Figure 5 shows the same installation as Figure 4, with the ship end of the gangway arrangement. The incline of the gangway is steep and the truss section steps are not suitable for climbing (not levelling).

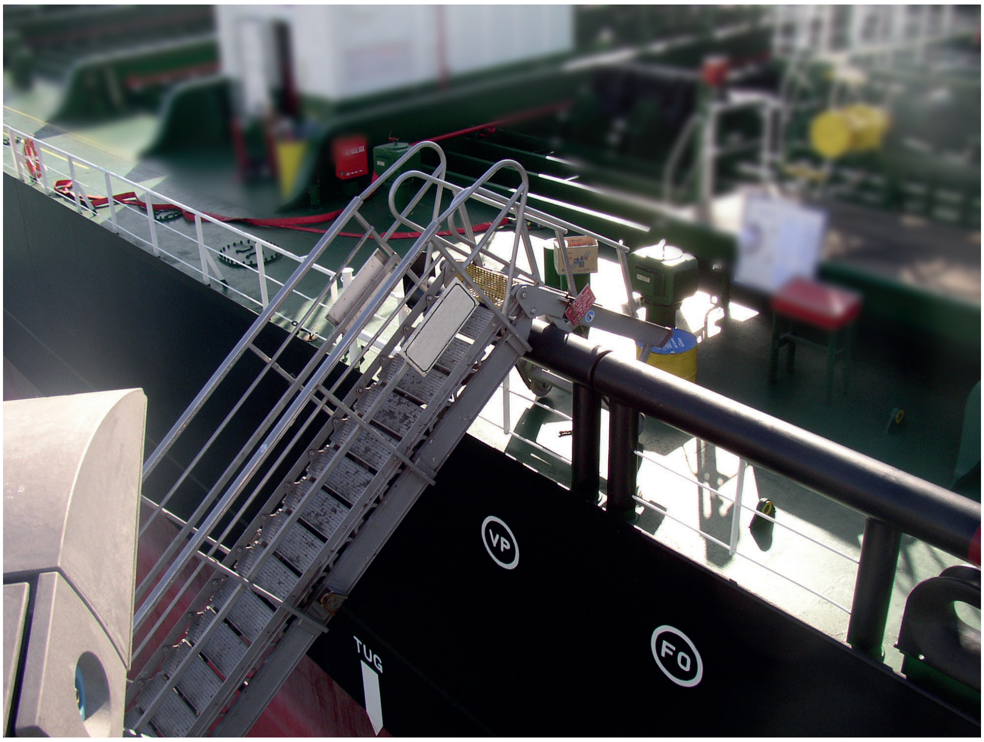


Figure 5: Gangway not suitable for operational envelope

In Figure 6, the foot of the ladder is landed in a restrictive area, as it is in the way of the deck longitudinals. The foot of the ladder is landed on top of the raised bolt access hatch. This may be an issue if there is a high protrusion of the hatch, which could create a significant obstruction for the ladder landing or movement.

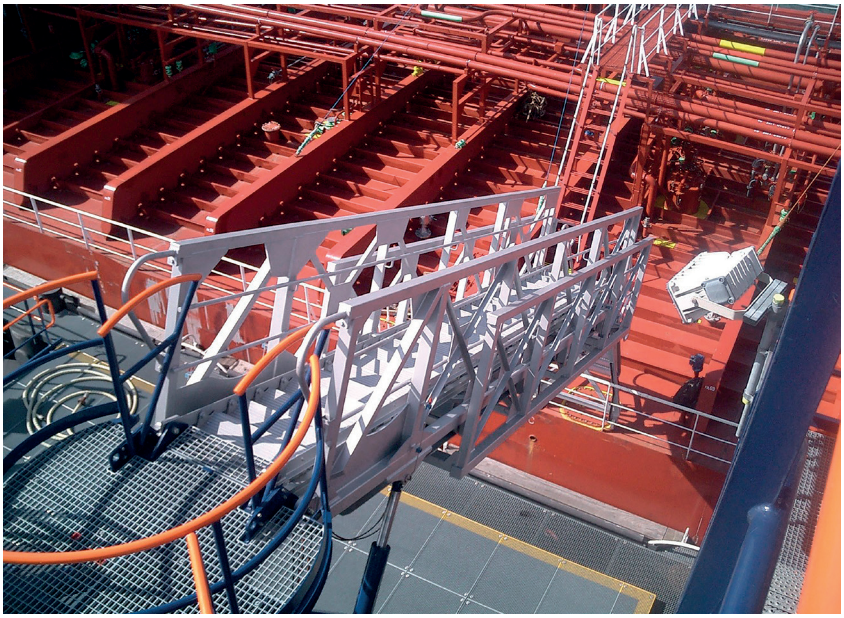


Figure 6: Insufficient landing space on ship deck

Figure 7 shows a temporary portable platform arrangement with the following issues:

- Lack of clear forward and aft access on the ship deck
- need to ensure that any temporary platform has been properly designed and constructed
- inadequate deck space on the platform for the size of the bulwark ladder
- possibility of platform toppling over the side, if dragged by shore gangway
- rope railings may be unsuitable for fall protection or prevention of the gangway falling over the side
- solid railings create a trap hazard for users, especially if the platform is too small.

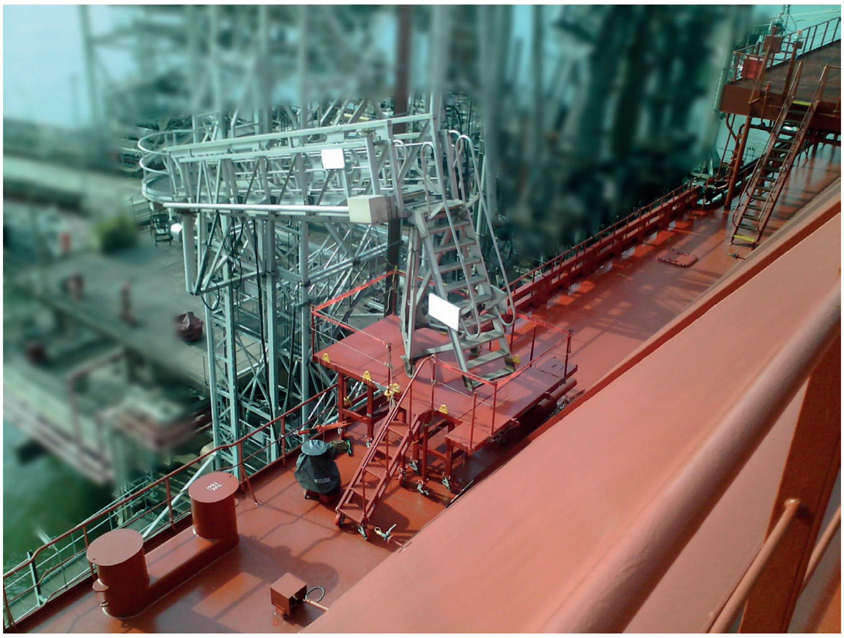


Figure 7: Temporary portable platform over obstructive deck fittings

Figure 8 is an example of the following issues:

- Overly congested space
- possible interference of piping with ladder transit
- lack of clear forward and aft access on the ship deck
- need to ensure that any temporary platform has been properly designed and constructed
- inadequate deck space on the platform for size of the bulwark ladder
- solid railings create a trap hazard for users, especially if the platform is too small
- direction leads personnel directly under the manifold drip tray
- access is from forward, not close to the accommodation
- inadequate slew to allow gangway to land clear of the manifold platform and stairs
- access is located too close to the vapour line center, leading to a high probability of interference with manifold platform.

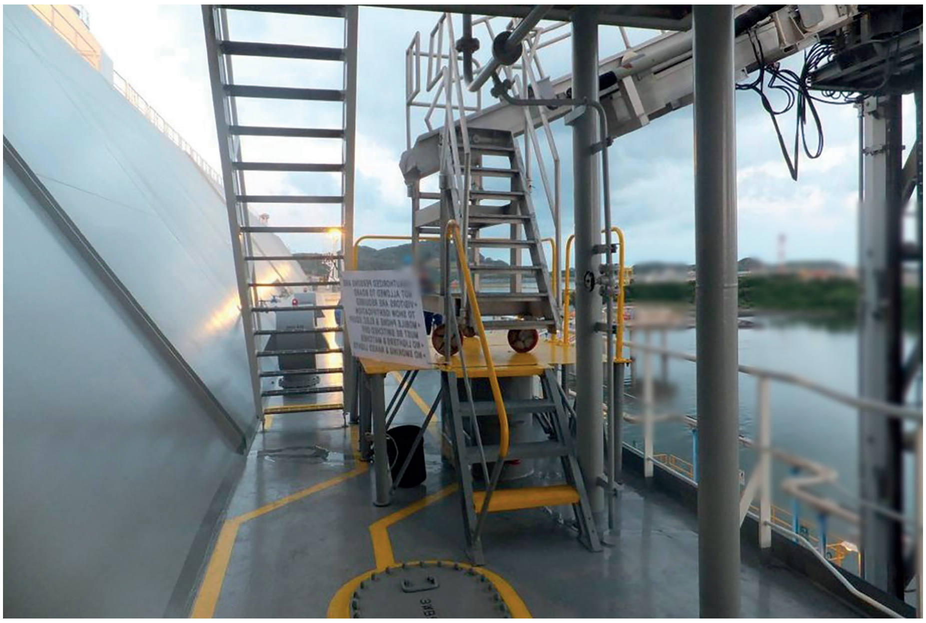


Figure 8: Temporary portable platform over obstructive deck fittings and incorrect placement of gangway

While temporary platforms are used as a mitigation measure at many terminals, the goal of ship and terminal designers should always be the proper engineering of the ship and shore interface, so that use of temporary platforms can be avoided.

The design and implementation of any temporary or permanent construction for gangway landing should follow a risk-based approach. The level of safety for a gangway landing on a temporary construction should be equivalent to the level of safety for a gangway landing on the ship deck or support rail.

In Figure 9 there is a congested area for gangway landing, unless the gangway is positioned well forward.

Figure 9: Example of a main deck with fittings

Figures 10 and 11 are examples of gangways in optimum arrangements. These gangways are located directly on the main deck, aft of the manifold, in an area free of obstructions. The angle of the gangway in the vertical plane is within the recommendations and there is adequate area for safe entry and egress from the deck ladders. There is reduced transverse area required for a forward and aft exit deck ladder.

Figure 10: Transverse exit deck ladder

Figure 11: Forward and aft exit deck ladder

3

Gangway Hazard Management

3. Gangway Hazard Management

3.1 Introduction

This section uses Bowtie terminology when discussing risk management. Refer to Annex 1 for the definition of terms used.

Hazards associated with the transfer of personnel and associated systems should be assessed to identify the potential risk to people, the environment and assets. This assessment is typically carried out as part of a larger risk assessment conducted independently by terminals and ships.

Once the hazards are identified, suitable risk mitigation measures (*barriers*) can be found and implemented in the design phase. These barriers may be design measures, operational measures, maintenance measures or training requirements, etc.

Barriers can protect against a cause (*threat*) and help to reduce the outcome (*consequence*) of an actual incident (*top event*). It is important that barriers are understood by all relevant personnel. It is also important to know what can cause a barrier to fail (*degradation factor*), and to guard against it.

Recognising that humans can make mistakes and considering this factor in gangway system design is important. Human-centred design processes are helpful to ensure that this is addressed. *Human Factors Engineering in Projects* (Reference 6) and *ISO 9241-210 - Human-Centred Design for Interactive Systems* (Reference 7) contain useful information on this topic.

Good design should be supported by clear operational procedures, maintenance procedures and equipment-specific training for personnel. When these measures are adopted as part of a robust safety management system, the level of risk can be reduced.

3.2 Generic Example

The following is a generic example that shows a few issues that could be considered during a review of gangway systems. This is not an exhaustive list of items and a full site and equipment-specific risk assessment should be carried out for each installation.

The bowtie figures in this example are highly simplified and are only provided to illustrate the concept.

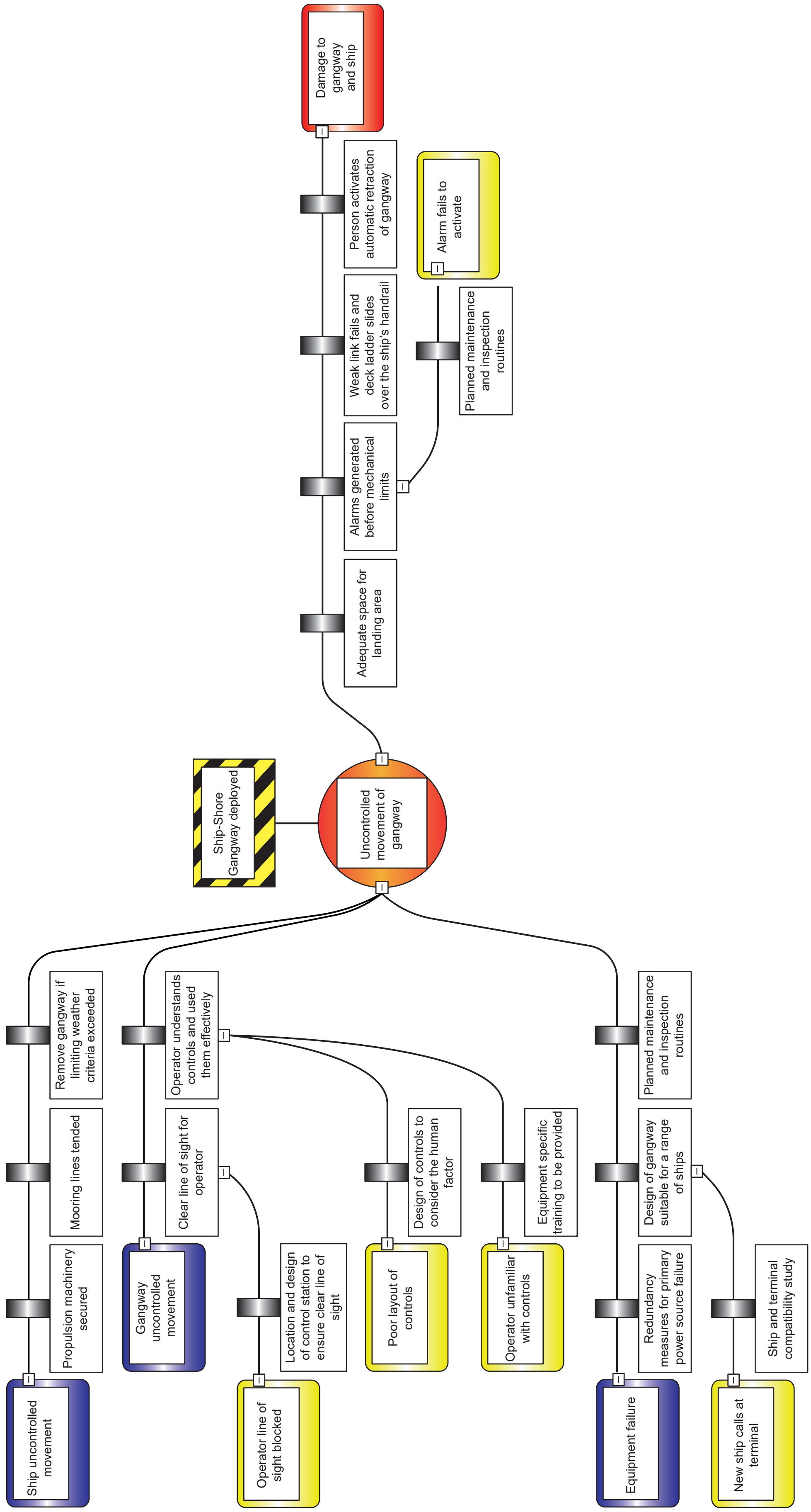


Figure 12: Simplified example of ship to shore gangway deployed

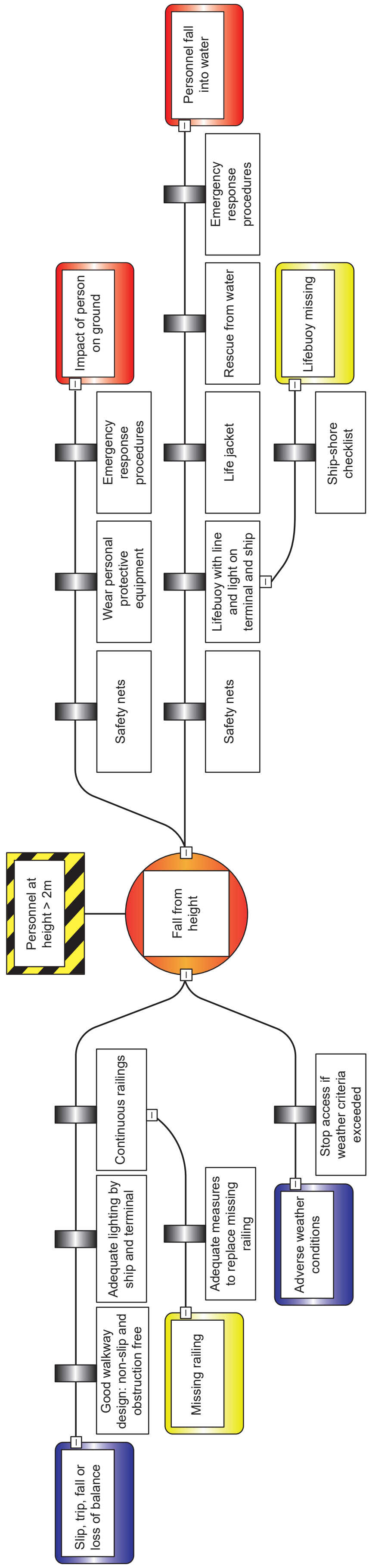


Figure 13: Simplified example of personnel at height greater than 2 m

Hazards

Hazard identification of personnel transfer activity relates to the type of activity and the equipment used. There are several hazards that could arise and a few typical examples are:

- Ship-shore gangway deployed
- personnel at height greater than 2 m
- hydraulic oil under pressure
- electrical equipment.

Threats

Threats are initiating events that could lead to a *top event,* such as uncontrolled movement of the gangway or a fall from height. Some examples are:

- Ship uncontrolled movement
- gangway uncontrolled movement
- gangway equipment failure
- adverse weather conditions.

Barriers

Barriers that prevent a *threat* from developing into a *top event* are *proactive barriers* and those that can mitigate the *consequences* of a *top event* are called *reactive barriers.*

Examples of proactive barriers are:

- Continuous railings
- stop access if weather criteria is exceeded
- propulsion machinery secured
- planned maintenance and inspection routines.

Examples of reactive barriers are:

- Weak link fails and deck ladder slides over the ship's handrail
- lifebuoy with light and line
- safety nets
- emergency response procedures.

Degradation factors

These can defeat or degrade a barrier and should also be identified in the risk assessment. Some examples are:

- Operator unfamiliar with controls
- alarm fails to activate
- lifebuoy missing
- missing railing.

Degradation controls

These are measures which help prevent the degradation factor from impairing the barrier. Some examples are:

- Equipment-specific training to be provided
- location and design of control station to ensure clear line of sight
- ship-shore checklist
- maintenance.

4

Design and Operation

4. Design and Operation

Gangway design should be carefully considered to ensure the highest possible level of safety and operational compatibility. To ensure safe gangway operations, ship and terminal cooperation is essential. It is important that the relevant organisations work together to achieve this goal.

This section provides some considerations to improve gangway design and operations.

4.1 Terminal Design Considerations

As a minimum, the following safety aspects should be amongst those considered during the gangway design stage:

- The walkway should be obstruction-free and non-slip
- there should be continuous handrails on both sides
- the gangway should be electrically insulated to prevent electrical continuity between the ship and shore
- the gangway should be capable of being locked in the stored position
- the gangway can be operated in free wheel mode after positioning on the ship
- there should be operation redundancy in the event of primary power source failure
- consider the human factor to minimise risk of human error in operations
- consider the human factor to minimise the risk of injury and error during maintenance
- clear information about the operational limits, including limiting weather criteria, should be provided
- automatic retraction of the gangway should not be initiated by automation
- manual activation of automatic retraction should have sufficient delay for personnel to escape
- the gangway bridge should have sufficient width for a stretcher to be carried across
- fit position monitoring systems that generate alarms before operational limits are reached
- as far as possible, position the gangway between the manifold area and accommodation ladder
- terminals that allow port and starboard berthing may need to consider two gangway towers
- the terminal control room should be able to monitor the gangway and deck ladder visually or by CCTV
- gangway location should be considered early in the design stage and gangway designers should be consulted and kept informed during the various project phases
- adequate lighting should be provided for the gangway.

Gangways should be designed to ensure maximum compatibility with a wide range of ships. The following compatibility aspects should be amongst those considered during the design stage:

- As far as possible, the gangway design should avoid the need for special fittings on a ship
- the landing footprint should be as small as possible
- there should be the ability to slew a minimum 2.5 m forward and aft of the landing position centre
- the slewing range should be greater than the terminal surge and sway allowance
- the operational envelope should consider deck elevations and drift values of the ships expected to call at the terminal
- the longitudinal position of the gangway landing area should be clear of the manifold area, accommodation ladder fittings, ship-to-ship transfer fittings and any other deck fittings that would possibly impede the safe operation of the gangway in expected operational conditions.

4.2 Ship Design Considerations

Suitable spaces should be identified and specially designed for landing gangways. The following aspects should be considered in the ship's design:

- Ship design should try to provide the maximum clear area for landing a shore gangway
- there can be more than one location on each side of the ship, and, where possible, landing areas aft of the manifold area are to be preferred
- obstructions in the gangway landing areas should be minimised, and those that cannot be avoided should be moved as far inboard as possible
- ship drift during operations should be considered
- where possible, the gangway landing area should be a minimum of 2.5 m wide. Note that this refers to the ship's perspective and refers to athwartship measurement
- where possible, limit the height of deck fittings that are in line with ship side railings to the height of the railings
- try to provide the longest possible box rail with a safe working load of 4.2 MT (vertical) and 1.7 MT (horizontal)
- clear information should be provided to the ship owner regarding the strength of relevant deck areas and supports
- the ship and shore interface plan should include information on the gangway landing area, including any obstructions, detail of manhole covers and handrails and supports.

4.3 Gangway Compatibility

The terminal will determine what documentation and information is required from the ship to assure ship and gangway compatibility. Any limitations or restrictions should be clearly stated in the terminal information booklet.

Figure 14 shows a typical gangway operational envelope.

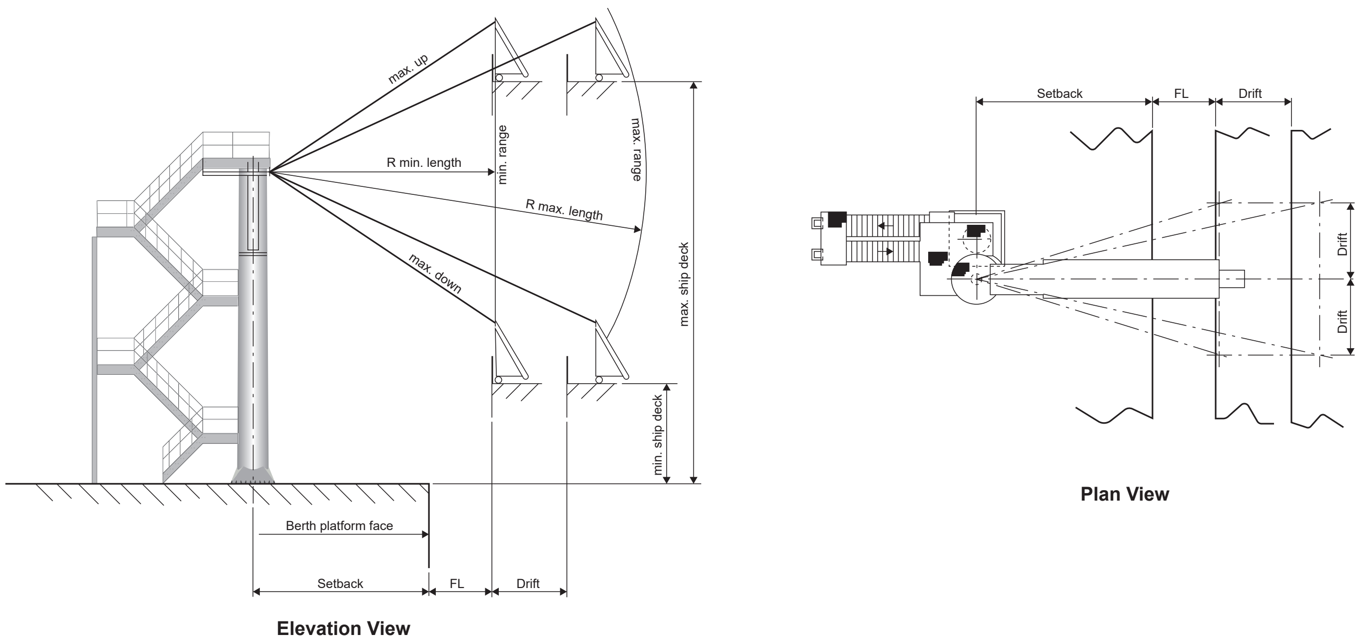


Figure 14: Typical gangway operational envelope

At a minimum, the terminal should provide drawings and information to the ship operator that show:

- The location of the gangway centerline from the spotting line
- the gangway operational envelope
- the deck ladder footprint
- any required minimum spacing around the deck ladder
- the maximum allowed height of handrails
- in the case of the gangway landing on reinforced box rails, the required dimensions and structural strength.

At a minimum, the following information should be provided to the terminal:

- A shipyard scaled drawing that shows the proposed landing area with distances from the vapour line
- a photograph showing the proposed landing area with the landing area outlined with chalk or tape, or marked up on an image of the landing area
- ship arrival and departure drafts
- in the case of the gangway landing on reinforced box rails, the dimensions and structural strength of the box rails.

Note that ship drawings may not show the present configuration of the main deck equipment due to the possibility of inaccuracies or post-delivery modifications.

More recent LNG ship designs are constrained by their parallel body profile, tug push points and need for rigging floating fenders as part of ship-to-ship (STS) capability. This narrows down the area of deck space where necessary deck fittings such as fairleads, bitts and pedestal winches may have to be located, creating obstructions for gangways to land. Terminal and ship operators are encouraged to work together to implement mitigations for gangway compatibility issues that are risk-assessed and offer a similar level of safe access between ship and shore as is detailed in the terminal information booklet.

4.4 Gangway Operations – Terminal

The ship and terminal should share the responsibility of ensuring safe access between the ship and terminal. The following points are useful to help ensure safe operations:

- The gangway should be installed and operated according to the manufacturer's instructions
- planned maintenance routines and inspections should be carried out
- a lifebuoy with light and line should be provided on the jetty near the gangway
- terminal procedures should clearly indicate the weather limiting criteria for safe operations
- clear instructions should be available on what to do if the maximum values are exceeded
- initial and refreshment training should be provided to personnel involved in operations and maintenance
- appropriate area access restrictions should be in place
- gangway compatibility should be checked with every ship calling at the terminal
- shore gangway systems are strongly preferred over portable gangways, but if portable gangways are unavoidable, then safety nets should be used
- deck ladders should be placed directly on the ship's deck and temporary platforms should be avoided as far as possible
- straight shore gangways should not be landed on ship's handrails unless they are specifically designed for that purpose
- the weight or force exerted by the gangway on the ship's deck or gangway support should be provided to the ship.

4.5 Gangway Operations – Ships

The ship and terminal should share the responsibility of ensuring safe access between the ship and terminal. The following points are useful to help ensure safe operations:

- Adequate lighting should be available in the landing area
- appropriate areas on the ship's deck should be treated with anti-skid measures
- where handrails are removed to allow for the shore gangway, adequate safety measures should be put in place
- a lifebuoy with light and line should be provided near the landing area
- safety nets should be provided where appropriate.

5

Small-scale Gas Carrier Considerations

5. Small-scale Gas Carrier Considerations

The small-size gas carrier fleet has a relatively large number of different ship layouts and serves a wide range of terminal designs. The trading pattern of these ships can also vary widely. This causes additional challenges to ensure that safe access is provided by gangways.

Depending on the cargo tank type, the ship could have a flat deck or a sloped trunk deck. In addition, these ship types typically have cargo tanks on deck. There is a wide range in ship sizes. For example, the cargo capacity of LPG carriers ranges from around 1000 to 85000 m^3. For most ship sizes it is difficult to find clear space on deck for shore gangways.

The largest LPG carriers (VLGCs), and the terminals built to accommodate them, may be able to use standard gangway designs. This may also be true for ethane carriers that have been constructed for dedicated trade between a few terminals. But for most other types it is a difficult task and designers should consider the following, over and above the recommendations of the previous sections.

5.1 Terminal Design – Additional Considerations

Terminals should endeavour to provide shore gangways for all gas carriers calling at their facility as this is typically a safer option. Gangway designs should aim for the smallest footprint possible as this will accommodate the largest range of ships.

The shore gangway deck ladder may be placed inboard of the ship's accommodation ladder. This usually means that the gangway has to cross over the accommodation ladder in the stowed position. In some cases, accommodation ladder fittings could be more than two metres high. The gangway design should consider this aspect for maximum compatibility.

Where a suitable shore gangway is not available, and the ship cannot use its accommodation ladder, jetty design should provide an area to land the ship's portable gangways. This landing area should be clear of the cargo manifold area and should be suitable for the expected operating range of the ship's portable gangway.

5.2 Ship Design – Additional Considerations

Optimising the design of accommodation ladder support fittings could help with landing a shore gangway. The height and transverse width of accommodation ladder fittings should be as small as possible. The longitudinal space between gangway support fittings should be as large as possible. These design considerations will provide the best possible chance of landing a shore gangway safely.

For new ship designs, information gathered from visits to terminals should be considered and fed back to the ship designers to improve the design.

In addition to a full-size portable gangway, providing the ship with a small portable gangway should be considered. This will provide more options for the ship personnel to work with.

Consideration should be given to strengthening various areas that could be used to land shore gangways, such as suitable railings and platforms. In areas where shore gangways can be landed, protrusions from the deck should be minimised. Manhole cover design that is flush with the deck is an example of a useful feature.

For smaller gas carriers on dedicated trades, compatibility studies between the ship and terminal should also check gangway placement options. These terminals typically have shore gangways and ship designs should try to accommodate these where possible.

Annexes

Annex 1 – Glossary of Terms and Abbreviations

Barrier A control measure or grouping of control elements that on its own can prevent a threat developing into a top event (*proactive barrier*) or can mitigate the consequences of a top event once it has occurred (*reactive barrier*). A barrier must be effective, independent and auditable

Bowtie A risk diagram showing how various threats can lead to loss of control of a hazard and allow this unsafe condition to develop into a number of undesired consequences. The diagram can show all the barriers and degradation controls deployed. Figure A1 is an example of a generic bowtie

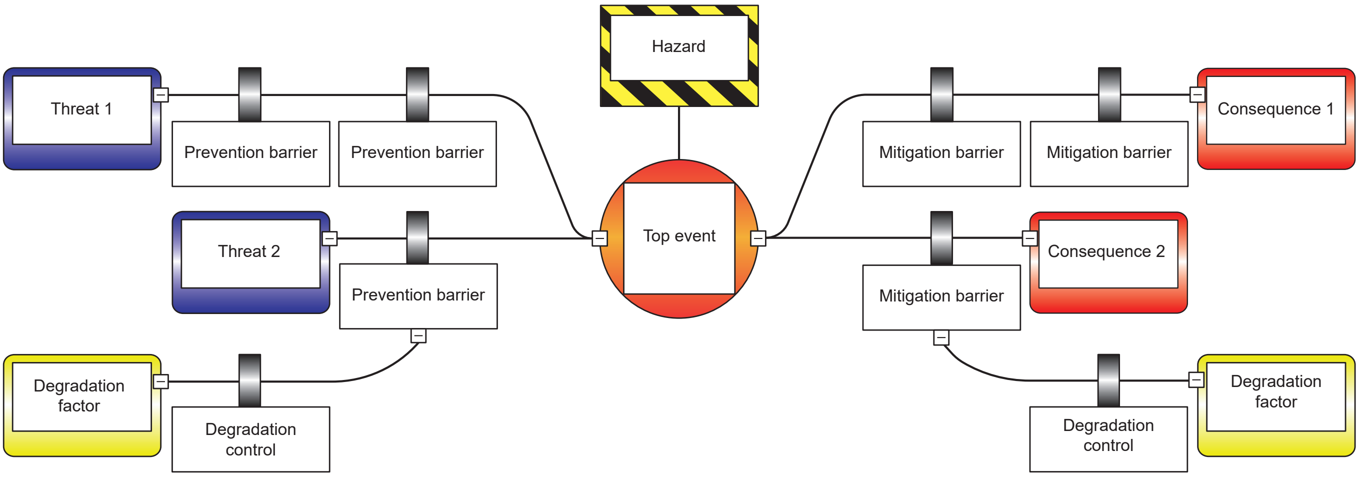


Figure A1: Example of a generic bowtie

Box Rail A hand rail comprised of a box (tube) girder of suitable strength to support the weight of the gangway structure

Consequence The undesirable result of a loss event, usually measured in health and safety effects, environmental impacts, loss of property and business interruption costs

Degradation Control Measures which help prevent the degradation factor impairing the barrier

Degradation Factor A situation, condition, defect or error that compromises the function of the main pathway barrier, through either defeating it or reducing its effectiveness. If a barrier degrades then the risks from the pathway on which it lies increase or escalate

ESD Emergency Shutdown

Hazard An operation, activity or material with the potential to cause harm to people, the environment, property or business

IAPH International Association of Ports and Harbors

IMO International Maritime Organization

IOGP International Association of Oil and Gas Producers

ISO International Organization for Standardization

LNG Liquefied Natural Gas

LPG Liquefied Petroleum Gas

OCIMF Oil Companies International Marine Forum

Safety Net A net that is rigged between the ship and shore

Ship's Accommodation Ladder Access device, consisting of a straight lightweight structure fitted with side stanchions and handrails, resting against the ship's side and primarily intended for access to boats from the main deck

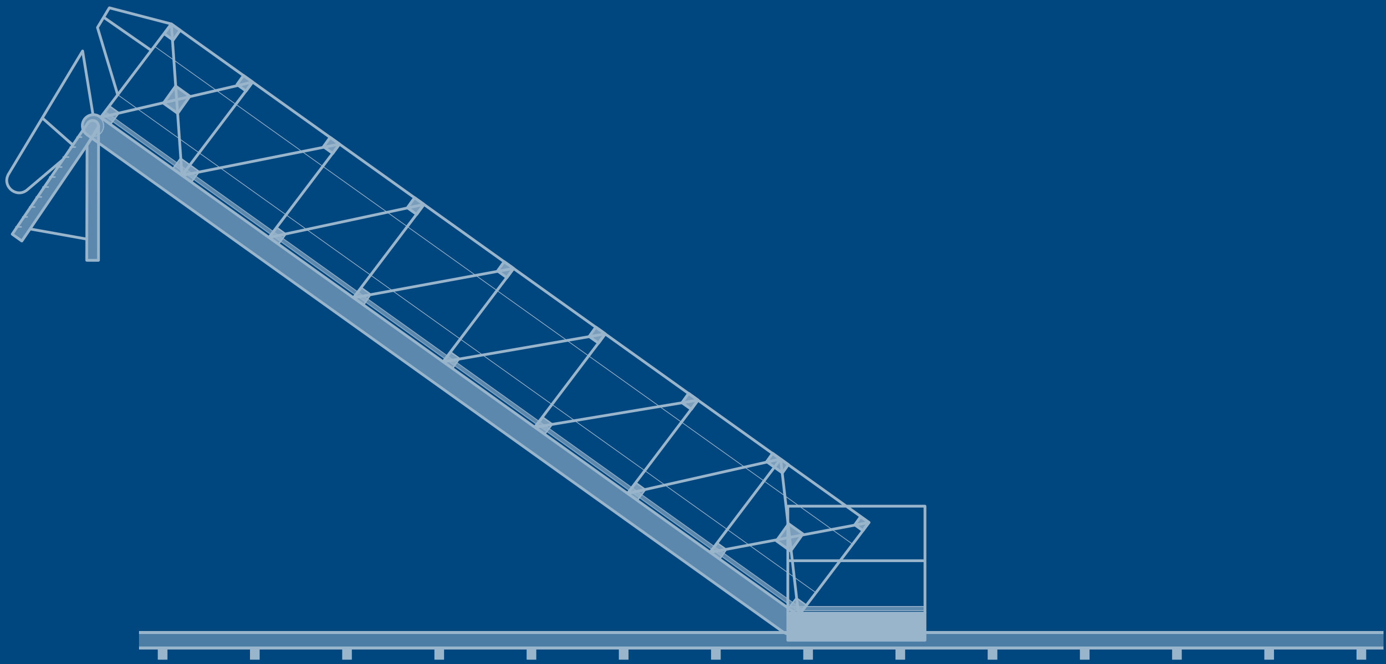
Threat A possible initiating event that can result in a loss of control or containment of a hazard

Top Event In bow tie risk analysis, a central event lying between a threat and a consequence corresponding to the moment when there is a loss of control or a loss of containment of the hazard

VLGC Very Large Gas Carrier. Fully-refrigerated gas carriers of 70,000 to 85,000 m^3 capacity.

Annex 2 – Reference List

1. The International Convention for the Safety of Life at Sea (SOLAS) II-1, Part A-1, Reg 3-9 – Means of embarkation on and disembarkation from ships
2. IMO – MSC.1/Circ.1331 Guidelines for Construction, Installation, Maintenance and Inspection/ Survey of Means of Embarkation and Disembarkation
3. OCIMF – Safe Access on Ships with Exposed or Raised Deck Structures
4. IAPH/ICS/OCIMF – International Safety Guide for Oil Tankers and Terminals (ISGOTT)
5. UK Health and Safety Executive/Health and Safety in Ports – UK SIP014 Guidance on Safe Access and Egress in Ports
6. IOGP – Human Factors Engineering in Projects
7. ISO 9241-210 – Human-Centred Design for Interactive Systems



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