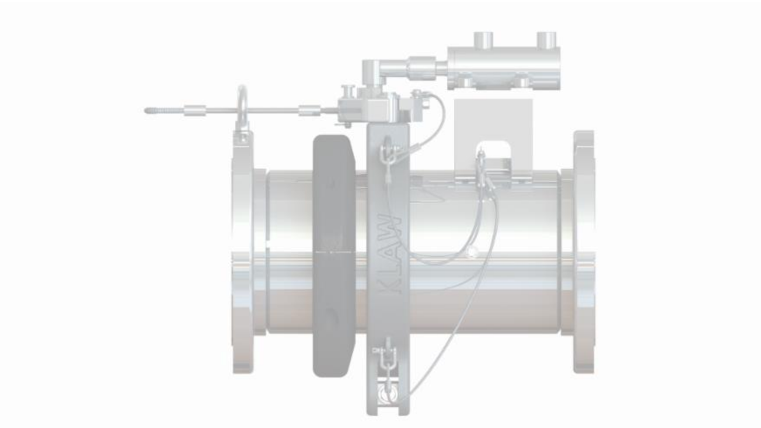
Reducing risk when transferring media at Terminals

The role of Emergency Release Couplings



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Identifying risk at Terminals during product transfer

The transfer of hazardous and potentially pollutant media provides particular risks at certain points within a transfer system. The risk is particularly high where transfer is from one containing or transfer element to another and one or both of the items are designed to be mobile.

The following are examples of mobile and static container elements within a typical transfer system:

Ship (mobile)	Loading Arm (static)	Bulk Storage Facility (static)
- to Truck (mobile) - to Ship (mobile) - to Shore (static)	- to Truck (mobile) - to Railcar (mobile)	- to Railcar (mobile) - to Truck (mobile)

Where one or more of the containing methods are designed to be mobile then there is a risk of inadvertent movement and therefore a demand to separate the connected transfer line in a controlled and safe manner. This demand can be instigated either wrongly by an Operator or by an environmental or external influence not predicted by the Operator.

Movement definitions of transfer elements

Transfer elements that are designed to be mobile will move due one of the three following instigations.

Correct voluntary movement: The Operator has purposely instigated a controlled movement. Examples include: Departing Ship, Truck or Railcar leaving a Terminal as scheduled and in accordance with correct procedures.

Incorrect voluntary movement: The Operator has purposely but incorrectly instigated a controlled movement. Examples include: Departing Ship, Truck or Railcar leaving a Terminal when the transfer system has not been properly disengaged according to procedure.

Involuntary movement: Movement has been provoked by an external factor beyond the immediate awareness and control of the operator. Examples include: vessel drift due to bad weather, swells and collisions; Truck and Railcar displacements due to collisions, earthquakes, floods and wind.

Type of incidents - summary

The following are typical scenarios where a mobile element may provoke an incident.

Ship (mobile): vessel drift - to Truck (mobile): drive-off.
Ship (mobile): vessel drift - Ship (mobile): vessel drift.
Ship (mobile): vessel drift - to Shore (static).

Loading Arm (static) - to Truck (mobile): drive-off.
Loading Arm (static) - to Railcar (mobile): drive-off.

Bulk Storage Facility (static): - to Railcar (mobile): drive-off.
Bulk Storage Facility (static): - to Truck (mobile): drive-off.

Mitigating risk with training, experience and procedures

There have been efforts by Operators to mitigate risk through procedural training and/or concentrating control roles towards experience. Procedures can be detailed and interactive; for example: procedural signing of sheets for each stage of a transfer process.

There is an inherent problem with attempting to tame the human element in any risk reducing system given that it isn't a constant that can be relied upon relative to equipment that is designed and engineered to undertake and complete similar tasks (subject to adequate servicing and management routines).

One problem with the human element is that of the decaying effect caused by familiarity where repeated tasks become automatic. An example is the changing of gears, clutch engaging and steering when driving a car. Experience often evolves mindfulness tasks into subconscious actions. It would be difficult to drive a car without these subconscious actions being executed as this allows for such conscious tasks as road awareness and choosing direction.

A single required action following a series of automated actions is particularly vulnerable. An example is leaving car lights on when arriving at a destination after a journey involving the repeated subconscious actions of driving.

A detailed known example of a critical action failure was a truck drive-off by an experienced driver who had completed the same task for over 20 years without incident. On this day, the driver was pre-occupied with an illness in the family. He inadvertently drove off with the Truck still attached to the Loading Arm. No emergency close and detach system was installed and the spill and damage to the Loading Arm was extensive.

In contrast, a risk reducing piece of equipment is engineered for an unchanging and limited number of functions. Any other functions are not relevant. The equipment is therefore unintelligent as regards any function not relevant to its existence but is supreme as regards the functions it is designed for. In other words, the human is designed for many things. A small part is arriving at work and fulfilling duties. The human is not a dedicated component within a transfer system.

The human element still has an irreplaceable role within a transfer system. Realistically, the physical aspects of transfer must still be undertaken and managed by humans and the human must retain the overriding decision making process so that situations can still be managed. The human also oversees the management and confirmed effectiveness of safety critical equipment.

The two levels of controlling risk

In the sections above, it has been demonstrated that staff training, experience and procedures can only have a degree of influence on the overall risk of an incident eventually occurring.

The law of eventuality determines that the risk of a detrimental incident occurring for a given action increases with increased frequency of that action and longer time periods of assessment. This means all things within the context of the assessment will eventually happen given enough frequency and time.

Incidents such as drive-offs and vessel drift therefore do and will continue to occur.

Staff training, experience and procedures may evolve and respond in relation to the experience curve of the Terminal Operator and Owner but this can only lessen risk to a degree and will still be compromised by the decay of familiarity as discussed above in the section Mitigating risk with training, experience and procedures.

Commercial pressures or unforeseen distractions during transfer may also abruptly disrupt attention or procedures.

Mitigating the consequences of an incident

A sudden and unpredicted event means the Terminal Operator loses control both of the variables within an incident and the extent of the consequences for each of these variables.

An event may lead to other events such as in a chain reaction and the circumstances occurring may have not been tested or planned for.

Predicting the extent of damage and injury can therefore be difficult due to the number of variables in terms of people in the vicinity, type and volume of media being transferred, other Terminal equipment and media becoming vulnerable; and environmental considerations such as weather and nearby liabilities such a rivers and involuntary risk receptors such as non-Terminal property and the general public.

Below is a summary of currently known core consequences of a Terminal incident caused by incorrect voluntary movement or involuntary movement of transfer elements as defined earlier.

People
Voluntary risk receptors - Terminal personnel injury or death.
Involuntary risk receptors - non-workforce injury or death.

Assets
Damage to transfer equipment Terminal assets.
Damage to non-transfer equipment Terminal assets.
Damage to non-Terminal assets.

Operation costs
Clean up cost and time.
Transfer downtime.
Terminal disruption and downtime.

Litigation
Fines.
Litigation contractual.
Litigation tort (civil actions: workforce personnel, non-workforce involuntary risk receptors).
Litigation authorities (trade, government).

Future costs
Insurance premiums.
Compromised reputations (commercial and financial consequences).
Compromised investment sources.
Compromised contracts.
Distracted management time in dealing with direct and indirect consequences.

Dual Risk Reduction Policy

It has now been shown that near complete prevention of an incident is impossible. However, installing safety critical equipment within the transfer process that is dedicated to minimising the risks associated with the consequences of an incident will provide two levels of risk management.

1. Controlling the risk of an incident occurring.
2. Mitigating risk regarding consequence following an incident.

Mitigating risk regarding consequence following an incident is where the Terminal Operator and Owner have the greatest if not complete control.

Dual level risk management

A competent Terminal Operator will therefore operate a Dual Risk Reduction Policy.

1. An active management plan designed to reduce the risk of an incident occurring.
2. Equipment fitted within the transfer system designed to mitigate the consequences of a product spill incident.

Mitigating the consequences of an incident

Demonstrating due-diligence

Ensuring adequate precautions have been taken to reduce risk, particularly minimising the consequences of an incident, will likely prove useful in the event of any potential litigation arising from an incident.

A Terminal that has not installed Emergency Release Couplings (ERCs) might find it difficult to demonstrate reasonable care had been taken to reduce the consequential risks of an incident.

This is particularly true where known risk is commonly known and experienced within the industry.

Litigation might focus on two aspects of an incident where the Terminal had not installed ERCs.

1. The actual fact that ERCs were not installed into the transfer system.
2. The fact that ERCs were not fitted indicates potential other failings as to required procedures.
3. The fact that ERCs were not fitted suggests misdirected priorities and potentially flawed decision making.

A case study of an incident is summarised below.

Case Study JetA1

A leading international Oil and Gas operator was operating a Ship Terminal with two Marine Loading Arms (MLAs). The Terminal was importing Jet A1 with no Emergency Release Couplings installed in the transfer system. During an unloading operation the vessel lost its moorings and the Operators were unable to recover the vessel.

The resulting movement caused the loading arm to be significantly damaged and had to be removed from service. Additionally, a release of Jet A1 occurred within the dockside loading area and in the water.

This operator has since installed ERCs at this Terminal.

Simple illustration of typical drive-off incident

Simple incident risk reduction example: using KLAW Emergency Release Couplings

Types of critical safety equipment designed to mitigate the consequences of an incident

Emergency Release Couplings and transfer systems are available for both ambient and cryogenic liquids and gases. These systems have long since been proven to be reliable in the field in both Passive and Active states.

Emergency Release Couplings (ERC) must deliver two levels of performance.

Reliability and efficiency - Passive State

An ERC is passive when it is performing as part of a transfer system. Performance relates to minimum headloss or maximum product flow and not activating when the variables required to activate are not present. This delivers a reliable and efficient safety component within the transfer system.

The ERC by its design, specification and application therefore determines the difference between normal operating conditions and extraordinary circumstances that require instant action.

Reliability – Active State

An ERC may be Passive for years (subject to service interval requirements) then be required to instantly enter and complete an Active State procedure.

In Active State the ERC will close the two internal Flip-Flap valves and separate. This means both the upstream a downstream flows are contained and spill is minimised. The separated coupling therefore allows the mobile elements to continue without damaging assets.

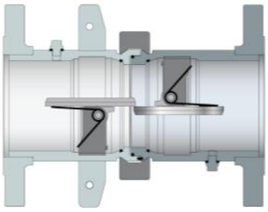
Management of a safety critical system within a transfer operation

Installing critical safety equipment such a ERCs into a Terminal transfer operation is one of two parts of a competent incident risk reduction strategy. The second part is the management of the system.

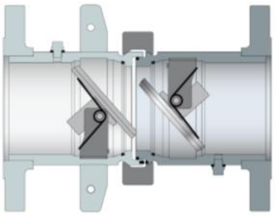
Proper maintenance and servicing of the equipment determines if the system retains its Passive and potential Active Status. A neglected maintenance regime, as with any other transfer procedure, will compromise the risk reduction policy and increase risk.

<u>Explanation of the internal Valve activation of the ERC</u>

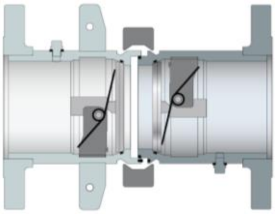
The Flip-Flap Valve mechanism is in open flow status and therefore the ERC is in Passive State and part of the transfer system.



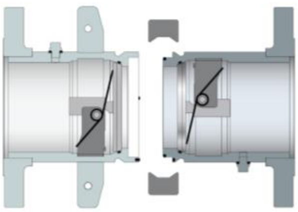
The Collar Release is activated and the ERC commences Active State in response to incident variables.



The body seal retains media until the valves close. The media is then contained in both the upstream and downstream sections of the transfer system. The separation sequence continues.

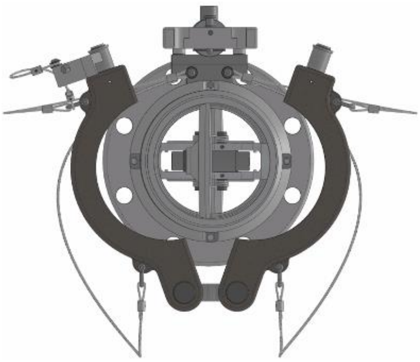


ERC separates allowing the mobile elements of the transfer system to continue in movement without damaging previously connected assets.



Activation methods of the ERC

The ERC Collar release mechanism can be activated using various release mechanisms according to the specification required by the Terminal.



Release mechanism options are Cable Release, Hydraulic Release or Dual Release.

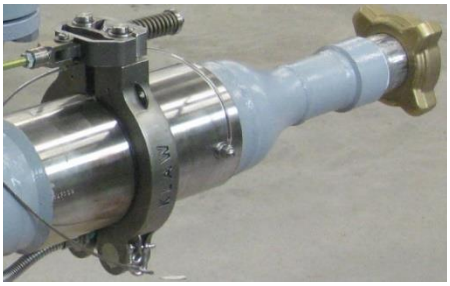
Shown is a Dual release ERC incorporating both a Cable and Hydraulic Release.

The Hydraulic Release provides the option to control the ERC via an HPU (Hydraulic Power Unit) or simple Hand Pump.

The HPU or Hand Pump provide alternative control options where required by the Terminal Operator during system specification.

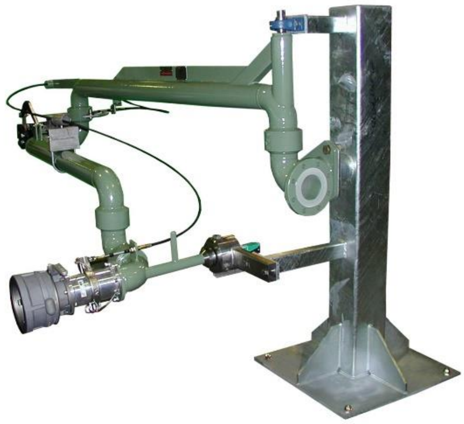
The cable on a Dual Release unit provides a backup for activation in the event the hydraulics cannot function.

Cable Release ERC



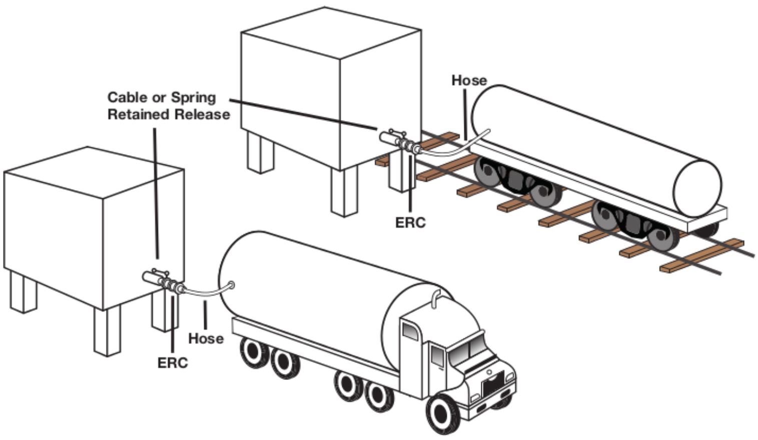
Shown are Cable Release ERCs.

Application of a Cable Release ERC on a loading arm.



The ERC Release Cable is shorter than a fully extended Loading Arm. This means the ERC will activate and separate before the Loading Arm is fully extended and damaged.

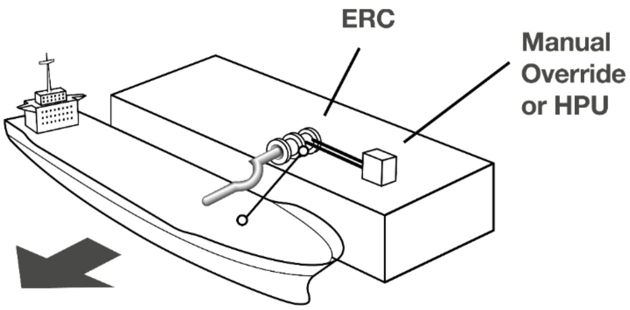
Typical Truck and Railcar transfer systems with ERC fitted



Shown are conceptual illustrations of typical systems for truck and railcar.

Typical Ship Terminal with Dual Release ERC fitted

The ERC can either activate automatically due to ship drift as indicated by the direction of the arrow below or due to a manual override instigated by a human to another reason.



Shown is a conceptual illustration of a typical ship-to-shore system.

Shown is an actual ship-to-shore safety transfer system.

Conclusions

1. There is a substantive risk of spill, injury and damage to assets where one or both elements within a transfer system are mobile.

2. Risk of a procedural breach that leads to an incident can be reduced but not eliminated with the use of training and procedures; but the risk of incident still remains.

3. A Dual Risk Reduction Policy demonstrates reasonable care within the context of Terminal product transfer management.

4. A Dual Risk Reduction Policy may be compromised by neglected procedures or maintenance regime.

5. The consequences of an incident are not easily predictable or within the control of the Terminal Operator.

6. Consequential risk following an incident is minimised with the installation of a suitable ERC or Breakaway Coupling.

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The role of Emergency Release Couplings

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