Training Package AIGA TP 33/23

Product Vehicle Emergency and Recovery



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Vehicles Recovery Training

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Section 1 Introduction

Introduction

Road vehicle incidents involving gases industry products can be serious. The dangers can worsen during the recovery operation, particularly, if the recovery is not managed in a safe and professional manner by those at the scene.

Due to the unplanned nature of any transport emergency, safety must be given the highest priority.

This Training Package has been developed to provide information about transported products, identification of the products and some of the design features of gases industry road transport equipment.

The Training Package also provides guideline on product handling, vehicle recovery, preparing for transport emergency safety aspects, etc.

Section 2 Scope and purpose

Scope

This Training Package is intended for all persons both within and outside the gases industry who could become involved in a gases industry road vehicle recovery operation. This can include member companies, hauliers and drivers under contract, emergency service personnel, vehicle recovery operators and members of other organizations.

This Training Package provides guidance on road vehicle recovery and also on the following:

- Product safety information
- Incidents where there is product release or potential product release
- Damage to pressure vessels / receptacles (e.g. tankers, cylinders, tubes and bundles) and manifolds
- Prevention of fire
- Fires which may have occurred

Road transport equipment includes road insulated tankers (both vacuum and nonvacuum insulated), ISO tanker/containers, multiple-element gas containers(MEGCs) such as high pressure tube trailers and packages gases cylinder trucks / semi trailers.



Purpose

This purpose of this Training Package is:

- to provide guidance, training material and procedures to be followed in order to minimize the effects of transport emergency event. This will include guidance relating to emergency incident planning, the procedures and actions to be followed during any transport emergency event.
- to provide specific Gases Industry product and vehicle / equipment information to promote maximum co-operation from all those involved in an incident, particularly the emergency services
- to provide guidance on the follow up actions required to ensure that any lessons learned are considered, and incorporated into future emergency planning to avoid repetition of the transport emergency event.

Note: the purpose of this TP is <u>NOT</u> to provide full scale training on all products or vehicles in operation

Section 3 Gas hazards

Gas Hazards

Most gases transported by the gases industry have one, or more, of the following hazards:

NON-FLAMMABLE GAS

FLAMMABLE GAS

OXIDIZER

5.1

- Asphyxiant
- Oxidizing
- Flammable
- Low temperatures (cryogenic gases) up to -269°C.
- Decomposition leads to release of energy and possibly burst of equipment

The warning diamonds shown on the transportation equipment will indicate which of these properties is present.

The product may have different risk according to the combination of labels.

Product UN Numbers, Including Primary and Secondary Hazards

Gas	UN number	Primary Hazard	Secondary Hazard
Nitrogen, Refrigerated Liquid	1977	NONFLAMMABLE GAS	
Oxygen, Refrigerated Liquid	1073	NONFLAMMBLE OSS	OXIDIZER 51
Argon, Refrigerated Liquid	1951	NONFLAMMABLE GAS	
Hydrogen, Compressed	1049	PLAMABLE GAS	
Hydrogen, Refrigerated Liquid	1966	PLAMNABLE GAS	
Carbon Dioxide, Refrigerated Liquid	2187	NON-FLAMMABLE GAS	

Section 4 Vehicles and equipment

Vehicles and Equipment



Vacuum insulated Tankers (Nitrogen, Oxygen, Argon), Bulk H2 & HE









Vehicles and Equipment





Cylinder trucks, ISO containers, rigid tankers





Section 5 Transport Emergency Response Plan

Transport Emergency Response Plan

The transport emergency plan should include as a minimum the following:

- Involved personnel
- Planning and understanding the lines of communication (internal, external, media)
- Equipment preparedness
- Stabilization of the emergency at the scene
- Recovery of the vehicle and equipment
- How to quickly return to normal operation

AIGA 039/16 – Road transport / product delivery emergency preparedness for more detailed information.

Transport Emergency Response Plan Flow Diagram



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Section 6 Transport emergency event equipment

Example of typical transport emergency equipment

- The transport emergency equipment should be readily available for transport to the scene of any incident and may be specific to the vehicle and product.
- It may be held in a "Transport Emergency Trailer" or light goods vehicle can be used to transport the items from rescue terminal to the scene.
- The equipment should be regularly checked and maintained for immediate use.





PEVEKIMAGES

Example of typical transport emergency equipment

Small hand tools / equipment checklist

- Mobile phone
- 1 x hacksaw blade
- 1 x large hammer
- 1 x spanners set for flange nuts
- 1 x large adjustable spanner
- 1 x medium adjustable spanner
- 1 x small adjustable spanner
- 2 x safety torch light
- 1 x roll PTFE tape
- 1 x small pliers

- 1 x large pliers
- 1 x screw drivers set
- 1 x 10 litre plastic water container
- 1 x Digital / disposable camera
- 1 x large wrench
- 1 x foot pump
- 1 x set files
- 1 x copper mallet
- 1 x pair side cutters
- 1 x sharp knife
- Spill kit
- Belt / Web slings

Example of typical transport emergency equipment

Large equipment items checklist

- First aid box
- Shovel & broom
- Earthing Rod
- Plastic bags
- Recovery straps
- Rope
- Large chisel
- Bolt cutters
- Vent stack
- Fire extinguishers





Example of typical transport emergency equipment

Personal Protection Equipment checklist

- Overalls (fire retardant)
- Hard hats
- Cryogenic gloves
- Waterproof overclothes
- Ear plugs
- Waterproof boots
- Warning vests
- Large plastic sheet
- Eye protection / Safety glasses
- Face shield





Example of typical transport emergency equipment

Warning devices checklist

- Warning triangles
- 1 x 500 metres barrier tape
- Warning lights
- Gas warning devices (as applicable), i.e. Portable Atmosphere Monitor









Section 7 Communication flow chart

Communication flow chart

Incident levels and emergency controller

Incidents and emergency situation can be divided into three severity levels:





Communication flow chart

Incident levels and emergency controller



Communication flow chart

Incident levels and emergency controller

Level 3

Serious incidents that could potentially escalate into a national disaster emergency situation, such as a liquid oxygen tanker rollover in a town center with major gas leakage



Section 8 Recovery methods

Product handling in a roll over situation

- There are specific hazards associated with product handling:
 - ✓ Vapour clouds
 - ✓ Toxicity
 - ✓ Fire
 - ✓ Tanker instability
- Product handling considerations:



- Product retention simplest, often safest method of product handling
- Product disposal may be the safest method of product handling, particularly if the tanker involved has been damaged
- Product transfer minimize escape of product to the atmosphere

Product handling in a roll over situation

- 1. In the event product transfer is considered in a roll over, the "Liquid off-take" will be determined by the tanker position.
- 2. Pressure transfer procedure shall be carried out.
- 3. If the tanker is leaking and the leak cannot be contained, consider clearing the area and venting the load to atmosphere after taking all safety and administrative measures.





Product handling - #1 Retention

Advantages

- Speed
- Safety
- Complete recovery of product
- No requirement to handle product in a non-standard manner



Risks

- Instability caused by sudden movement
- Pressure increase
- Unexpected product release
- Product venting through rupture discs or safety valves



- Plan the recovery in stages agreed with recovery team
- During these stages some product may be removed
- Never transfer product whilst lifting / recovery



Product handling - #2 Disposal

Advantages

- Takes less time than product transfer
- No need for waiting for alternative equipment
- Speed will depend on whether gas or liquid is released



Risks

- Pools of cryogenic liquid to atmosphere
- Cryogenic hazards
- Serious lack of visibility due to vapor clouds
- Fire hazard
- Oxygen enriched or deficiency hazard
- High Noise



- Specific designed venting equipment is required for venting flammable gases
- Can this controlled release be safely stopped, or paused, if required?



Product handling - #3 Transfer

Advantages

- Minimum release of product to atmosphere
- Minimize cryogenic hazard
- Minimize O2 enriched or deficiency atmosphere



Risks

- Use of incompatible product receiving tanker (eg. LNG tanker for LOX tanker recovery)
- Possible use of warm receiving tanker for product transfer
- Over Pressure hazard (use of low pressure tanker to recover product from a high pressure tanker.



The "empty" tank which is to receive the product and the transfer equipment must be in the same product service



Typical Trailer General Arrangement Drawing



Н				
S/No	Description	S/No	Description	
А	Blow off plate	F	Rear cabinet & pipework	
В	Top fill sparge pipe	G	Rear fixed supports	
С	Dished baffle	Η	Pressure building coil	
D	Vacuum interspace / insulation	J	Outer jacket vacuum rings	
E	Vapour traps	Κ	Front sliding supports	

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Typical P&ID for a Cryogenic Road Tanker



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P&ID Legends

- V1 main vapour vent
- V2 primary isolation valve
- V3 pressure build up return
- V6 Trycock
- V7 Trycock
- V8 Trycock
- V9 pressure build up liquid feed
- V10 pump discharge drain
- V12 isolator for L.L.1
- V13 fill/pressure discharge
- V14 fill/pressure discharge drain
- V15 pump supply
- V18/26 pump discharge
- V20 pump recycle
- V23 equaliser for L.L.1
- V24 isolator for L.L.1
- DC3 fill pressure discharge connection
- DC4 pump discharge connection
- DC5 vapour recovery connection
- S1 pressure sensing connection

- V25 vapour recovery
- V27 Vapour recovery drain
- V29 pump feed vaporiser valve
- V30 top fill
- PU1 pump
- V31 liquid sample
- V32 Main liquid line drain
- RV1 pressure vessel relief valve
- RV3 pump delivery line relief valve
- RV4 pressure delivery line relief valve
- RV5 pump section relief valve
- RV6A vessel primary relief valve
- RV6B vessel primary relief valve
- RV7 pressure relief build up valve
- RV8 liquid sample relief valve
- RV9 Main liquid line relief valve
- LL1 liquid level gauge
- P2 tank pressure gauge
- P3 pump discharge pressure gauge
- S2 liquid sample valve



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Filling Circuit (Product Collection)



Pressure Raising Circuit



Main Pressure Vent Circuit



Main Pressure Relief Circuit



FULL LADEN TANKER (Normal Condition)





- Filling Circuit NORMAL
- Pressure Venting Circuit NORMAL
- Pressure Relief Circuit NORMAL
- Tanker Level Gauge NORMAL
- Tanker Pressure Gauge NORMAL

FULL LADEN TANKER ON ITS SIDE







- Filling Circuit CAUTION
- Pressure Venting Circuit CAUTION
- Pressure Relief Circuit CAUTION
- Tanker Level Gauge CAUTION
- Tanker Pressure Gauge CAUTION

Product Transfer Consideration FULL TANKER UPSIDE DOWN







- Filling Circuit CAUTION
- Pressure Venting Circuit CAUTION
- Pressure Relief Circuit CAUTION
- Tanker Level Gauge CAUTION
- Tanker Pressure Gauge CAUTION

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PARTIAL FULL TANKER ON ITS SIDE



- Filling Circuit CAUTION
- Pressure Venting Circuit Functional
- Pressure Relief Circuit Functional
- Tanker Level Gauge CAUTION
- Tanker Pressure Gauge CAUTION

HALF FULL TANKER ON ITS SIDE



- Filling Circuit **CAUTION**
- Pressure Venting Circuit CAUTION
- Pressure Relief Circuit CAUTION
- Tanker Level Gauge CAUTION
- Tanker Pressure Gauge CAUTION

THREE QUARTERS FULL TANKER ON ITS SIDE



- Filling Circuit **CAUTION**
- Pressure Venting Circuit CAUTION
- Pressure Relief Circuit CAUTION
- Tanker Level Gauge CAUTION
- Tanker Pressure Gauge CAUTION

PARTIAL FULL TANKER UPSIDE DOWN



- Filling Circuit **CAUTION**
- Pressure Venting Circuit CAUTION
- Pressure Relief Circuit CAUTION
- Tanker Level Gauge CAUTION
- Tanker Pressure Gauge CAUTION



Recovery Method #1 - with airbags and recovery vehicles



Require

- Portable air compressor and manifold system
- 4 to 6 Airbags
- 2 x recovery crane (to Pull and to Restrain)



Recovery Method #2 with 2 x recovery cranes



Most common recovery method adopted in the industry. Uses 2 x recovery cranes



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Recovery Method #2 with 2 x recovery cranes

TANKER RECOVERY USING TWO CRANES

Both cranes



This height to be kept to the minimum







Recovery Method

Roadway recovery of roll over vehicle shall be carried out by competent and trained personnel. This include:

- Site risk assessment on recovery method
- Set up of mobile cranes where acceptable ground conditions are confirmed.
- Outriggers must be fully extended and have proper mat metal plates
- Validate recovery vehicle load weight
- Validate crane capacity and lifting equipment
- Validate of lifting plan by certified lifting supervisor
- Validate crane operators and riggers cert
- Use of communication eqpt between crane operator & lifting supervisor
- PPE including high visibility reflective vest

Section 9 Dynamic risk assessment

- Transport emergency events are unplanned
- Outside the scope of normal vehicle / equipment operation
- Potentially hazardous operations
- Regular risk assessments should be conducted as the recovery progresses
- Where practical, written notes should document the ongoing risk assessments throughout the recovery.





Dynamic Risk Assessment

- These risk assessments must be frequently repeated
- They must be updated every time the circumstances change

Coverage on dynamic risk assessment include the following:

- Appropriate personal protective equipment
- Potential damage to surrounding areas by product spillage (metal embrittlement or permafrost damage)
- Potential damage to underground or overhead services by recovery equipment deployed
- Potential damage to roadways or buildings / structures
- Possible sudden unexpected movement of vehicle recovered caused by product shift



Coverage on dynamic risk assessment also includes the following:

- Slippage of recovery equipment during recovery
- Damage to equipment due to cryogenic temperatures
- Potential failure of safety relief devices
- Potential escape of product through safety relief devices
- Method of transporting the damaged vehicles
- Suitable location where vehicle can be inspected, emptied, purged risk free, and Repaired or disposed of.





SPECIAL CONSIDERATIONS

The most important of these are:-

- Vapour clouds
- Cryogenic burns
- Gas hazards
 - Flammable gases
 - Asphyxiant gases
- Fire
 - Tyre fires
 - Hydrogen gas fires
 - Oxygen enrichment fires





Asia Industrial Gases Association No 2 Venture Drive, #22-28 Vision Exchange, Singapore 608526 Tel: +65 67055642 Fax: +65 68633307

Internet: http://www.asiaiga.org LinkedIn Profile: https://www.linkedin.com/company/asiaigaorg

Summary

- Conduct a risk assessment on arrival at the scene of the transport emergency event
- Repeat the risk assessment whenever anything changes
- Make notes of these Risk Assessments as soon as practical
- Always ask: "Has anything changed since I last considered the situation?"
- Expect the unexpected!

Section 10 Post transport emergency event actions

Post Transport Emergency Event Action

Post transport emergency event checks may be required by:



- Police
- Local government transport agency
- Other local authority (e.g. National Environmental Agency)
- The gases company which operated or owns the vehicle
- Any contractor involved
- Manufacturer of the vehicles / tankers
- Insurance companies with a vested interest.

Post Transport Emergency Event Action

Post incident event action include:

- Return of vehicle to base and quarantine the vehicle.
- The driver and other available witnesses should be interviewed as soon as possible to determine the cause. Driver' alcohol / drugs test may be done if necessary





 On Board Computer / cameras / GPS and other fleet technology video footage shall be downloaded as soon as practicable, preserved and for use by investigation team.



Post Transport Emergency Event Action

- Review the RCA objectively and without bias.
- Review the whole emergency response regarding this events for lessons learned
- Implement changes necessary to address the root cause finding
 - Technology & equipment used
 - Driver operating procedures
 - Driver working (on-duty and driving) hours
 - Working conditions of the driver
 - Driver behavior (driver risk profile) during his working activity
 - Driver competency (Training and Qualification)
 - Any other elements which may have contributed to the accident







Stay Safe & Thank You

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