



# ISC Safety Lore

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## Key lessons from road transportation incidents

### Introduction

Road transportation of hazardous materials, activities associated with loading/unloading of hazardous materials or truck tankers being involved in road accidents occur quite frequently. These events need to be investigated to better understand the overall effects of such events and further improve emergency preparedness.

#### Case 1 – Ammonia release using wrong hose

On July 15, 2009 a cargo transfer hose ruptured shortly after transfer of anhydrous ammonia began from a cargo tank truck to a storage tank. A white cloud of anhydrous ammonia moved from the parking lot of the facility across the highway to a largely wooded area, where it dispersed. At the same time, a car driver travelling on the highway drove into the ammonia cloud, attempting to get away from it, got out of her car and died. Seven people got slightly affected by the toxic material.

On the morning of the accident the cargo tank truck arrived at the facility and the driver and his trainee checked in at the office. They were told to park their truck next to the piping manifold near a designated storage tank. After parking the truck, the driver picked up the vapor hose assembly that was lying on the ground next to the manifold and connected it to the vent line on the cargo tank. They then removed the cargo transfer hose assembly from the storage tube on the trailer, checked the pressure valves on the tank, and connected the assembly to the liquid discharge fitting on the tank. A plant employee fastened the other end of the transfer hose assembly to the facility piping manifold. The driver then engaged the power take-off unit, turned on the pump, and checked the tank volume gauge to make sure product was flowing. Then he instructed the trainee to oversee the unloading while he completed paperwork in the truck. Approximately eight minutes after the unloading had begun, the trainee heard a pop sound followed by a loud rush of gas. He looked underneath the truck and saw a rupture in the transfer hose assembly directly in front of him. He pushed the emergency shutdown button and evacuated. The driver also heard the sound and after turning off the engine to stop the trailer pump put on his half-face respirator and escaped through the gas cloud.

#### Key learning points

The investigation found that the ruptured hose was designed for LPG transfer only. It was constructed of several different layers of material; internal fibers made of PET, which was chemically incompatible with anhydrous ammonia. However, it was used to transfer anhydrous ammonia 2-12 times before it failed. The degradation and final failure were the direct result of chemical incompatibility. The hose for LPG transfer was originally assigned to another trailer and it was imprinted with text "LPG transfer only". The text was not visible on the full length of the hose, only partially. The hose was not inspected and tested before the accident because it was not considered in service. There was no procedure in place to define what "in service" means. The transfer hose for ammonia was carried on the LPG trailer instead of the ammonia trailer. When making deliveries, truck drivers occasionally used facility-owned hoses instead of the hose on the cargo tank vehicle.

#### Case 2 – LNG truck rollover

On October 20th in 2011, a tanker having loaded 20 tonnes of LNG had a road accident. Another truck driving on the highway carrying precast concrete panels broke down and stopped on the hard shoulder of the road, partially blocking the lane. Twenty minutes later, the LNG tanker collided with the rear of the parked vehicle. Due to the collision, the driver lost control over the truck; it surpassed the parked truck and slammed into the ditch against the 10 m height bank of soil. The tanker suddenly ignited just after its full stop. The truck driver died in the accident. When firefighters arrived, they noted that almost all the insulation of the tank had been destroyed by the accident and as a precautionary action they evacuated a 600 m radius area. Flames appeared on the top of the tank, indicating that the safety relief valves opened, discharging LNG as a jet fire. Within half an hour, the firefighters heard whistles and cracking sound and decided to withdraw to 200 m. Immediately after this, the tank exploded, creating a huge fireball. The thermal radiation reached minimum 170 m and the blast effect reached approximately 125 m.

#### Key learning points

Even though the tank was insulated with polyurethane, the accident demonstrated that both the road accident impact and the fire can destroy the insulating layer. An important factor is the possibility of flames impinging on the tank wall. If it takes place above the liquid level, the wall temperature will raise and, even if safety valves are correctly operating, it is possible that the vessel cannot stand the pressure and explosion can occur at any moment. The impact of such event can be very serious both in terms of the blast effect and the thermal radiation. That should be considered when intervention starts by fire fighters.



The ISC believes that leadership across six key functional elements is vital to achieve good process safety outcomes. These elements are:

- systems & procedures
- engineering & design
- assurance
- knowledge & competence
- human factors
- culture

In the *What can I do* section below you can see how each of these elements plays a part.

Figure 1: The ISC Framework

<b>What can I do?</b>	
<b>Management</b>	
<span style="color: blue;">●</span> <span style="color: grey;">●</span>	<ul style="list-style-type: none"> <li>• Make sure that risk assessment is carried out for loading/unloading activities within the facility.</li> </ul>
<span style="color: blue;">●</span> <span style="color: green;">●</span> <span style="color: red;">●</span>	<ul style="list-style-type: none"> <li>• When design a new loading/unloading station, bottom loading is preferred to prevent falls from height during tanker loading. It also often provides quicker and safer escape routes than top loading.</li> </ul>
<span style="color: green;">●</span> <span style="color: blue;">●</span>	<ul style="list-style-type: none"> <li>• Make sure that operating procedures and regular training are provided to tank truck drivers.</li> </ul>
<span style="color: green;">●</span> <span style="color: red;">●</span>	<ul style="list-style-type: none"> <li>• Loading bays should be equipped with alternative escape routes with emergency stop buttons. For toxic materials automatic emergency shutdown should be in place.</li> </ul>
<b>Process Engineer/Supervisor</b>	
<span style="color: red;">●</span> <span style="color: yellow-green;">●</span>	<ul style="list-style-type: none"> <li>• Make sure that the operator is conversant with the task, understanding the hazards, the risks and the consequences of 'getting it wrong'.</li> </ul>
<span style="color: blue;">●</span> <span style="color: red;">●</span>	<ul style="list-style-type: none"> <li>• Make sure that loading stations are equipped with dry decoupling protection or physical barrier to prevent "drive aways".</li> </ul>
<span style="color: red;">●</span>	<ul style="list-style-type: none"> <li>• Make sure that the wrong hoses are not available to use, via selective couplings or dedicated loading areas.</li> </ul>
<span style="color: purple;">●</span> <span style="color: grey;">●</span>	<ul style="list-style-type: none"> <li>• Make sure that personnel working within the transfer zone or near the tank during filling wear individual protective gear appropriate for the type of hazardous material being delivered.</li> </ul>
<span style="color: green;">●</span> <span style="color: blue;">●</span>	<ul style="list-style-type: none"> <li>• Ensure that the system is checked / functionally tested before use for hose integrity.</li> </ul>
<span style="color: blue;">●</span>	<ul style="list-style-type: none"> <li>• Check if a suitable spill kit available for emergency use and that operators trained in its use.</li> </ul>
<span style="color: blue;">●</span> <span style="color: yellow-green;">●</span>	<ul style="list-style-type: none"> <li>• Ensure that hose assembly is subject to the maintenance regime; suitable maintenance is completed and when and that integrity checks are done.</li> </ul>
<b>Operator/Driver</b>	
<span style="color: blue;">●</span> <span style="color: grey;">●</span>	<ul style="list-style-type: none"> <li>• Make sure you follow operating procedures when preparing and conducting loading/unloading operations.</li> </ul>
<span style="color: blue;">●</span>	<ul style="list-style-type: none"> <li>• Make sure that the transfer hose assembly is the correct one to connect to the tanker/storage tank to avoid chemical incompatibilities and potential release due to inappropriate coupling; check if flexible hoses are the correct ones (colour coded, selective or clearly identified, e.g. for correct materials of construction and correct end connections to suit tanker and plant).</li> </ul>
<span style="color: blue;">●</span>	<ul style="list-style-type: none"> <li>• Check if the hoses are in good condition (not kinked, twisted, elongated or damaged).</li> </ul>
<span style="color: blue;">●</span> <span style="color: purple;">●</span>	<ul style="list-style-type: none"> <li>• Moving a vehicle while it is loading product or driving away with the hose still connected can have serious consequences.</li> </ul>
<span style="color: blue;">●</span>	<ul style="list-style-type: none"> <li>• Make sure you communicate clearly when a loading/unloading operation is ongoing to prevent truck moving from the bay prior to the end of filling.</li> </ul>
<span style="color: green;">●</span>	<ul style="list-style-type: none"> <li>• Earth/ground and bond tanker/road truck, equipment and containers to prevent static charge build-up.</li> </ul>
<span style="color: blue;">●</span> <span style="color: green;">●</span>	<ul style="list-style-type: none"> <li>• Drivers, deliverers should make sure that they are familiar with the emergency shutdown system in place, emergency warning and access to emergency exits.</li> </ul>
<span style="color: blue;">●</span> <span style="color: purple;">●</span>	<ul style="list-style-type: none"> <li>• In case of a road accident, make sure to set up appropriate safety distances and evacuate people from the vicinity of the release of hazardous materials from the tanker.</li> </ul>
<span style="color: blue;">●</span> <span style="color: purple;">●</span>	<ul style="list-style-type: none"> <li>• Carrying a loaded truck is a very dangerous activity and as such, be aware that you take all precautionary measures to follow the highway code to prevent road accidents.</li> </ul>
<span style="color: blue;">●</span> <span style="color: green;">●</span>	<ul style="list-style-type: none"> <li>• Make sure you receive trainings on risks related to the transferred product, safety procedures and what to do in case of an emergency.</li> </ul>
<span style="color: blue;">●</span>	<ul style="list-style-type: none"> <li>• Ensure the vehicle maintenance log is up-to-date and inspect the vehicle before driving it.</li> </ul>
<span style="color: purple;">●</span>	<ul style="list-style-type: none"> <li>• Drive at a suitable speed for the task, ground or weather conditions, and at a slow enough speed to stop safely.</li> </ul>