Flammable liquid fuel road tanker emergencies

By Colin Deiner, chief director, disaster management and fire brigade services, Western Cape Government

Overturned tanker explosion and fire on the Interstate 85 in Gwinnett County, US. The tanker contained around 7 500 gallons of petrol and 1 000 gallons of diesel

Tankers transporting various types of liquid fuels are a common sight on our roads. The many diverse locations of fuel stations across the country results in these vehicles traversing a wide variety of roads in order to service them. Fortunately, fuel tanker emergencies are rare; however, they can be diverse and can range from a leaking, overfilled vehicle with no fire to a collision or rollover with or without product ignition.

Tanker truck emergencies are classified as 'low frequency/ high risk' incidents and will almost always make for rather spectacular viewing.

Legislation

The transport of dangerous goods in South Africa is regulated by the National Road Traffic Act (Act 93 of 1996 as amended). This Act requires compliance to a National Standard, namely SANS 1518:2011 Edition 4 - "Transport of dangerous goods - Design, construction, testing, approval and maintenance of road vehicles and portable tanks". SANS 1518 in turn requires compliance to specific sections in the "European Agreement concerning the International Carriage of Dangerous Goods by Road", commonly referred to as the ADR.

A range of other standards also become relevant to this industry depending on the specific operation of the business. These include standards on design, construction, testing, approval and maintenance of road vehicles and portable tank, the identification and classification of dangerous substances and goods, packaging of dangerous goods for road and rail transportation and emergency information systems.

Tanker truck construction

The typical tanker truck configuration consists of the chassis/cab component and the product compartment which is constructed of aluminium and has a ladder providing access to the top of the tanker. The product compartment can be divided up into several sub-compartments that makes it capable of transporting different types of product.

Each product compartment (tank) has a fixed ladder providing access to the top where a series of dome hatches are located. (These are the

locking lids for the opening at the top of each compartment).

Filling and emptying of the tank are enabled by the belly valves which are located at the bottom of each compartment. There is also an emergency shut-off valve that will close all belly valves in the case of an emergency.

From the belly valve, the belly pipe (wet line) extends to the compartment external valve where a flexible hose is attached for off-loading and most times on-loading product. Activation of the emergency shut-off will therefore stop the flow of product into the wet lines. Each belly valve can be individually controlled by a valve control system located remotely. Unless the tanker is empty the belly pipes will generally have product inside them. This is important to remember when responding to a vehicle underride incident where these pipes might have sheared off or suffered some other sort of damage.

The shut-off valve is further augmented by an additional system designed to shut off all belly valves in the event of a fire under the product compartment.

Further safety systems on the vehicle include the following:

- A 'pull-away socket and plug system' (Scully device) that is plugged into the loading terminal to control the fill and prevent overfilling while also dispersing static electricity.
- Pressure relief valves designed to keep the pressure within the tank's design limits. The tanker will be fitted with both a positive-pressure relief and a negative pressure relief. Although a liquid fuel tanker is a non-pressurised vessel, pressures of more than four psi (approximately 0,27 Bar) will activate the positive-pressure relief to prevent any build-up of pressure. Similarly, any negative pressure will activate the negative pressure relief valve and allow air to enter thereby eliminating any chance of buckling of the aluminium tank walls.
- The rollover rail, which is mounted along the top side of the tanker and is designed to protect the components located on the top of the tanker in the event of a rollover.
- The vapour valve, which allows vapour to enter each individual compartment to replace the liquid product that has been offloaded. The tanks are also fitted with vapour recovery systems which are a series of pipes and connections that are used to recover flammable vapours.

Understanding the physical properties of the fuel involved will give a good indication of how they will behave in spill and fire conditions

Each sub-compartment is fitted with a solid separation wall called a bulkhead and within those compartments several walls with holes in them are installed. These 'baffles' are designed to reduce the surge movement of the product when the vehicle is moving.

In multi-load tankers designed to carry more than one type of fuel, you will find that the compartments are fitted with double bulkheads that are meant to prevent any cross contamination of products should a single bulkhead suffer damage. Ventilation holes are fitted between the two bulkheads and are visible at the bottom of the tank.

A distinctive feature of a liquid fuel tanker truck is the elliptical shape of the tank compartment. When viewed from the back of the truck a series of two black dots will be visible (in the three and six o'clock positions). These are where the baffle holes are located that allows liquid to flow to both sides of the baffle when the tanker is lying on its side.

The final feature I would like to mention would be the 'Dangerous Goods' placards that shall by law be affixed to each cargo containment area of a rigid vehicle, semi-trailer and trailer, one at the rear and one on either side of the vehicle, so as to be clearly visible from the roadside. This will be dealt with in greater detail later on. The tankers the specification plate is generally mounted on the side. The specification plate will provide information on the material from which the tank is manufactured (AL=aluminium).

In accordance with South African law, vehicles involved in the transportation of hazardous goods such as chemicals or high-pressure flammable material must carry the following documents:

- Transport emergency card for each Dangerous Goods item
- One or more Dangerous Goods Declarations to cover all the goods that comprise the load
- Confirmation of Classified Waste, if applicable
- Container packing certificate, if applicable
- A nominally empty packing certificate (see SANS 10406) if applicable

It is very important for first responders to have a clear understanding of the construction ▸

of a liquid tanker truck and how it's various components and safety systems work in order to effectively deal with an incident involving one. The impact of a potentially major incident can be massively diminished by the utilisation of the vehicle safety systems as part of the fire fighting or rescue operation.

Emergency response

If we think about all the places that fuel stations can be found, we can appreciate that fuel tanker fires could be caused by several factors and occur in many diverse locations. To a large extent, the location will be the most crucial factor in determining the strategy and tactics to be employed in dealing with a fire of this nature. Fuel tanker emergencies are, of course, not limited to fires but could also include tankers not on fire but leaking or that have been overfilled, overfilling of storage tanks, overturned tankers or tankers involved in motor vehicle accidents with or without fires.

Fuel tanker truck emergencies generally create quite a spectacular scene but, depending on its location, should not create any extraordinary risk to the fire fighting teams if handled systematically a with clear direction. A good working knowledge of the construction and safety features of the vehicle will contribute greatly to a calm and measured fire fighting operation and early control of the incident. The amount of smoke and flame generated by a tanker fire will draw significant attention, which could add the additional burden of larger groups of onlookers and media. Onlooker control will have to be an early command consideration in such an emergency.

While the location of the incident will play a big part in the strategies to be employed, the second most important factor would be if the spill is contained or not. Consider the following few scenarios and the varying levels of difficulty attached to them:

1. Tanker on fire on a bridge with a flaming fuel spill into a water stream flowing below it carrying burning fuel downstream to an area with dwellings located on either side.
2. Tanker accident without ignition on an overpass in a busy city during rush hour with hundreds of sources of ignition (other vehicles and people) in proximity.
3. Tanker on fire on a freeway with the fire contained within the aluminium tanks and no large spillage.

While the first two incidents will severely test you department's response capacity and command decision making and may even exceed you resource capacity, the second incident could be quite easily handled by your first in units, provided you have a well-planned standard operating procedure (SOP) for these types of incidents.

The risk to human lives will always be the first consideration for the incident commander. This will include any victims of the incident, responder, and the public in the immediate vicinity. While evaluating the location and magnitude of the incident, the incident commander should also consider the potential environmental damage, any possible exposures and the disruption to the transportation system around where the incident has taken place.

Understanding the physical properties of the fuel involved will give a good indication of how they will behave in spill and fire conditions. Due to the specific gravity of petroleum products, they will be able to flow on top of water and could be carried for quite a distance before finding an ignition source. Should it flow into storm water drains, uncovered

Oil tanker explodes after crashing into pylon in Chiang Mai, Thailand

manholes or any other confined spaces, the vapour density of the product could cause a build up of flammable gasses, which could then lead to a confined vapour cloud explosion and any resulting, secondary ignitions. Ignited product floating on top of a rapidly moving stream will be a major challenge as it presents a moving target for resources generally focused on static operations. Knowing where the spilled fuel is flowing to, will also be critical in determining the most effective response. Consider the infrastructure around the incident. If the fuel is running towards a recessed parking garage or a storm water system, this will guide your placement of fire fighting resources and evacuation procedures.

The type of fuel involved will also determine the choice of foam application. Fuels such as ethanol are polar solvents that will require the application of alcohol-resistant aqueous film-forming foam (AFFF) or fluoroprotein, film-forming fluoroprotein (FFFP) foam.

As with any hazmat call, the first action in your SOP should be to approach the incident from upwind and uphill or upstream. Staging a safe distance away will allow you to determine the type of tanker involved, the product involved and what it is doing (spillage without ignition, fire or any other mechanical damage ie a road accident).

The situation may be of such a nature that responders can't learn all they need to know about the vehicle from their vantage point. This may be for a variety of reasons such as the tanker is on fire or partially obscured by be a ditch or another vehicle.

The Dangerous Goods placard, as legally required, will indicate the four-digit UN number of the dangerous goods being transported and when waste is transported, the word "WASTE" will be added above the UN number. In the case of a mixed load, the words "MIXED LOAD" will appear in the goods identification zone, with the two words "MIXED" and "LOAD" one above the other. The operator's telephone number as well as a number for specialist advice will also be on the placard.

Petrol tanker caught fire on N3 highway in Ekurhuleni, South Africa

Finally, it will also display the hazard class diamond appropriate to the hazard associated with the goods in terms of SANS 10228 and where subsidiary risks are identified in terms of SANS 10228, the subsidiary risk diamonds will be attached to the sides of the hazard class warning diamond.

Attempting to locate the driver/operator will also be invaluable. This might not always be possible if he/she has been injured or departed the scene. It is from the driver/operator that you will be able to get additional information such as the mechanism of the accident and the volume of product on board. Should the driver not be available, the emergency number could even be helpful in providing the information needed. Modern operators have a remote tracking ability that registers each time product is off-loaded and should be able to easily provide this to the responders.

One of the most common incidents involving road tankers that fire departments will respond to, will be when a fire starts under a tanker. This may be caused by a vapour release from an underground tank during a filling operation, an overfill of an underground tank, a smaller vehicle underride leading to ignition or a brake or tyre fire. A large measure of control can be achieved on such incidents by activating the emergency valves thereby isolating the tanks; the fire can then be attacked with foam lines or Class B fire extinguishers. An aluminium tank will not be breached below the level of the product in it although the aluminium above the liquid (the vapour space) may burn through and allow the vapour on top of the product to burn. This is still ultimately a manageable operation that does not require huge resources. A well contained foam attack while protecting any exposures will allow quick control and extinguishment.

Should the fire breach an aluminium wall of an empty tank, the vapours still inside the tank will be likely to flash and cause secondary ignition.

In the event of a tanker truck being involved in a rollover without a major spillage or fire, it will be necessary to transfer the product to another tanker before it can be uprighted. This is mainly due to the mass of the product and comparative weakness of the aluminium tank. This is a highly complex task that involves drill into the aluminium tank and transferring the product into an empty tanker and is usually carried out by private contractors or specialised hazmat team. It would, however, be required of the fire department to provide support in terms of isolating the scene and firefighting capability. Good ▸

Multi-generational leadership in the fire service

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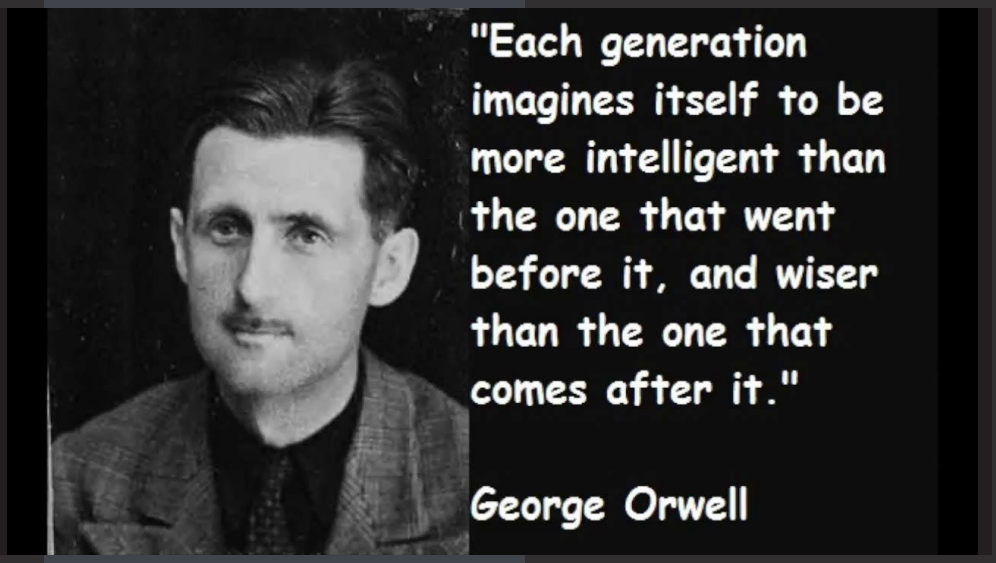

"Each generation imagines itself to be more intelligent than the one that went before it, and wiser than the one that comes after it." ~ George Orwell.

In Fire and Rescue International Volume 6 number 1, I wrote about the "importance of developing leadership and standards within the fire and emergency services. Specific reference was made to the "Gordon-Howell report in which four criteria for defining a profession are suggested". For this article, I am going to focus on the first of four suggestions, namely, "A profession should rest on a systematic body of knowledge of substantial intellectual content and on the development of personal skill in the application of this knowledge to specific cases."

The next generation of fire service leaders are already in the making. Every generation has its own values and viewpoints. It is those differences that define each generation but often also lead to disillusion among younger team members and has the potential to cause friction among different generations.

Any leader expecting to be successful in the contemporary workplace,will have to be very skilled at building and sustaining a culture that not only appeals to people from multiple generations but that deliberately pursue and stimulates collaboration between them.

When I first joined the fire service in 1986, I thought I had a good understanding of leadership. As many young South African men of that era, I completed my compulsory National Service in the military. I therefore immediately related to the hierarchical leadership within the fire service. As in the military, there were people in command and there were the rank and file like me who performed the work. There were no grey areas; everybody knew exactly what was expected from them. We worked in a system under clear supervision of a leading fire fighter, which was in turn managed by a station officer. There was a clear

- coordination and communication must be ongoing between the contractors/hazmat team and the fire service incident commander.

In closing

Flammable fuel road tanker emergencies can present a myriad of challenges to emergency responders. As I stressed earlier, the fact that they are mobile means that incidents involving large volumes of flammable liquids can happen almost anywhere. Add to this the fact that responders could be faced with two probable scenarios: (1) a major incident (incident with ignition) or, (2) a potentially major incident (incident with no ignition). Both scenarios will require you as incident commander to make many decisions, which might not always be part of your playbook. What if you had a tanker on fire right next to a multi-storey residential with smoke pouring into open windows all along its frontage? What if you had a trailer on fire and you had the option of dropping the trailer's landing gear and saving the truck by driving it away from the burning trailer?

Think these things through. They are the types of choices you may have to make.

Finally, what does you foam system look like in your department? Are you able to deploy the resources you need to rapidly contain the types on incidents described above and prevent them from getting so large that your bad preparation made you the idiot on the evening news?