THIS DRAFT HAS BEEN REVISED BY THE LNG TF 15 MEETING FROM THE ORIGINAL SUBMITTED BY THE RDW-NETHERLANDS FOR CONSIDERATION AS AN AMENDMENT TO ADR REGULATIONS.

Summary

Introduction

In the November 2013 meeting of WP.15 (95th) the Netherlands forwarded INF ~~doc~~ 10, containing an introduction in new fuels and proposals to amend chapter 9.2 of ADR. Additionally to this document presentations were given concerning the use of LNG and the safety features included in the vehicle fuel systems. The presentations can be found as Informal document INF 23 and INF 25 of the 95th WP.15 session.

Since the 95th WP.15 session the amended UN ECE Regulation No. 110 (further R110), containing the safety provisions for LNG fuel systems for heavy duty trucks ~~(check correct name)~~ has been adopted during the 161 ~~xx~~th WP.29 session in November 2013. The entry into force is expected to be in August~~six months later on xxJune~~ 2014.

The approval and entering into force of R110 will see Heavy Goods Vehicles fueled by LNG entering into service in the time ADR 2015 will be applicable (1-7-2015 to 1-7-2017). CNG fueled vehicles are already ~~under~~ within the scope of the existing R110.
The Netherlands is of the opinion that it is very important that a harmonized and well founded position should~~all~~ be taken by all contracting parties to ADR, when it comes to allowing the use of LNG as fuel for the vehicle categories mentioned in Chapter 9.1. The Netherlands is of the opinion that sufficient safety provisions are included in R110 to justify the use of LNG as fuel for heavy goods vehicles carrying Dangerous Goods and proposes to amend the wording in ADR accordingly. In order to reach consensus on the use of LNG for ADR 2015 the Netherlands proposes, for the time being, to limit adoption of alternative fuels to LNG only for AT, FL and OX vehicles, thus ~~with an~~ excluding~~sion of~~ EX vehicles. EX vehicles are only mentioned …. (zie proposal 3)

The proposals for amendment are kept to a minimum. (see proposals).

A ~~recapitalization~~ summary of the safety aspects of LNG fuel systems:

- LNG fuel tanks are double skinned, the space between is filled with “super” insulation (wound foil) and vacuum is applied. The inner and outer skin are made of austenitic stainless steel which is strong, pliable and has a high resistance to fire conditions.
- The fuel tank design is tested by dropping it from 9 meters on the most critical area (except the piping end) and from 3 meters on the piping end of the tank after which the tank shall remain tight. The tanks have a high resistance to accident damage.
- The fuel tank design is tested in fire conditions, the so called bon-fire test. The tank shall be completely engulfed in fire with a temperature of at least 590 C. The tank ~~may~~ shall not burst. Even in the event of a loss of vacuum between the inner and outer skin of the fuel tank ~~a~~

~~level of ???% insulation remains~~ will discharge in a controlled manner through a PRV. A high resistance to fire conditions is proven.

- Two systems of pressure relief are fitted in parallel. A primary pressure relief valve to remain within normal pressure/temperature conditions (boil-off) and a~~n~~ secondary pressure valve in case of accidental situations.
  The normal boil off is a limited volume vented high up behind the vehicle cab at a relative low pressure. Even in the case of a loss of vacuum this pressure relief is expected to cope. The risk (probability and effect) of this release of gas is very low. Future development may see this outflow contained or used otherwise to limit pollution.
  The discharge from the secondary (emergency) pressure release is also of a relatively low pressure. This means that the discharged gas will remain at short distance to the valve, dispersing in the air quickly. ~~Even in a discharge in fire conditions the energy released will be insufficient for instance to ignite a tire.~~
- When the engine stops, deliberately or in accidental situations an automatic closing valve on the tank will ~~disrupt~~ prevent the outflow of gas.
  The evaporator, fuel line and engine injection system have safety barriers to prevent unintended outflow of gas.
- The design of positive ignition systems used for LNG and CNG vehicles is of a different design than in the nineteen-nineties. Coils generating the high voltage will be on top of the sparkplugs or in close vicinity of the spark plugs and will be electronically triggered, ~~this way~~so that risks of sparks by defective leads and electro magnetic pulses are limited in comparison to traditional systems in use when drafting chapter 9.2 of ADR.
- The physical properties of natural gas are such that~~.~~ ~~A~~although gases are flammable at ambient pressure and temperatures n~~N~~atural gas has a high auto ignition temperature. The risk for ignition by a hot vehicle part is low. An overview of the physical properties of current fuels is given in the table below. Because of the specific weight natural gas will be dispersed in the air and the mixture will be~~come~~ below the lower explosion limit ~~vastly~~[DP1] ~~. Kees,dit geldt bij kamertemperatuur, aardgas is pas bij -120 C lichter dan lucht. Dit betekent dat het LNG dat verdampt,afhankelijke van de weersomstandigheden, zich minuten lang langs de grond kan verspreiden, voordat het opstijgt.~~
- ??? Tab~~l~~e~~l~~: physical properties (indicative) fuels

Fuel	Spec Weight Liquid (g/L)	Spec weight Gas (g/L)	Flash Point	LEL/UEL	Auto ignition Temperature
Petrol	700 @ 20 C	-	-43 C	1.2% -7.1%	280 C
Diesel	800 @ 20 C	-	55 C	0.6%-7.5%	210 C
LPG		20.0-20.67 @ 0C - bar	-60 C	1.8%-8.5%	287 C
Ethanol	790 @20C	-	17 C	3.3%-19%	363 C
Natural gas (methane)	422 @ -162C	7.2 @ 0C-1bar[DP2]	-188 C	5%-15%	537 C
Air		12.9 @ 0C-1bar			

Comparison with d~~D~~iesel fuel

Tanks for d~~D~~iesel f~~F~~uel are thin walled and commonly squared off. The design requirements are limited, only for fuel tanks made of plastic materials a bon-fire test is prescribed.

Diesel Fuel tanks offer limited protection against mechanical impact. When they rupture several hundreds of liters of dDiesel fFuel may run out, forming a pool around the vehicle. Although the flashpoint is above 55 C, the auto ignition point of dDiesel fuel is low at 210 C. Touching hot vehicle parts may lead to ignition. When the diesel fuel ignites there will be sufficient fuel around to fuel exothermic reactions which set the vehicle (and its tires) into a blaze.

LNG tanks will stand up to mechanical impact and no release of fuel is expected from impact. The fuel valve is closed automatically if the engine stops. No significant volume of fuel is available to sustain a fire. Even in a fire condition the release of gas is limited, making that it is unlikely to, will for instance, not be sufficient to ignite a truck tire.

Proposals

To make the use of CNG or LNG possible the following amendments are proposed.

Proposal 1. Amend Subsection 9.2.4.3 (a) (new text in italic, replaced text stricken through) to read:

(a) In the event of any leakage *in the normal operating conditions of the vehicle*, the fuel shall *not come* drain to the ground without coming into contact with hot parts *[above the auto ignition temperature of the fuel]* of the vehicle or *with*[DP3] the load.

Justification proposal 1:

Subsection 9.2.4.3 (a) requires that leaking fuel "shall drain to the ground". This is not possible for fuels in gaseous form that are lighter than air. In this interpretation this requirement prevents the use of gaseous fuels .

It cannot be prevented that leaking fuel will contact hot vehicle parts or the load in any position, (e.g when on its side or completely overturned, nose-up/nose-down). For this the wording "normal operating conditions" in plural are included. It means the vehicle shall be on its wheels, either with the engine running or not, level or sideways banked/uphill/downhill etc.

However However, the basic performance requirement that leaking fuel shall not come into contact with hot parts of the engine, exhaust or load could be a problem applicable to all fuels (, the vehicle could be on its side or overturned, nose-up/nose-down) . Additional the auto ignition point of the particular fuel may be taken into consideration. (Kees, is dit laatste niet extra verwarrend?) OK deleted!

Proposal 2. Amend Subsection 9.2.4.3 by adding a new paragraph (c) to read:

(c) Fuel containers (CNG) or fuel tanks (LNG) shall comply with the provisions of ECE Regulation No. 110. Additionally tThe discharge of the (emergency) pressure relief device device- or valve shall be so directed to avoid any danger to the load through heating or ignition.

Justification proposal 2:

New subsection 9.2.4.3 (c) gives the basis requirement for CNG fuel containers or CNG fuel containers or LNG tanks to comply with. The wording fuel container and fuel tank are the terminology used in the relevant regulations. For new vehicles the reference to the Regulations may be superfluous but it may be useful for retrofitteding existing vehicles.

The second sentence contains a basic provision, not part of Regulation No. 110, that the discharge of gas by the safety valve should not endanger the load by heating or ignition. LNG systems have two pressure relief valves, one for the boil down off and another for emergencies. A possible option would be to reroute the discharge piping of the primary pressure relieve valve to meet the special requirements of the ADR. bring a discharge pipe of the pressure relief valve to the top of the drivers cabin away from the tank or other superstructure, other satisfactory solutions should be possible. En CNG?

Proposal 3. Amend Subsection 9.2.4.4 (new text in *italic*) to read:

The engine propelling the vehicle shall be so equipped and situated to avoid any danger to the load through heating or ignition. In the case of EX/II and EX/III vehicles the engine shall be of compression-ignition construction *using only fuels with a flashpoint above 55 ^{0}C.*

Justification proposal 3:

An amendment is proposed to remain in keeping with the original intention of this subsection. ~~Dual-~~Dual-fuel systems on the market today, combining diesel and a gas with a compression ignition engine may otherwise be used. The gas is only added under certain engine running conditions. The flashpoint of LPG or natural gas is significantly lower than the flashpoint of diesel.

Combustion heaters

Combustion heaters shall comply with ECE Regulation No. 122. In this regulation LPG and CNG are included as gaseous fuels. However where additional safety regulations are included for LPG (annex 8) no specific regulations are included for CNG and also not for~~.~~ LNG. ~~?~~
The conclusion can be drawn that safety regulations for CNG/LNG combustion heaters should be added to ECE Regulation No.122 with the adoption and amendment of ECE Regulation No. 110. This should be brought to the attention of GRSG and WP.29 .

Because of the lack of specific safety requirements for CNG and LNG the use of combustion heaters ~~on~~with these fuels shall not be allowed. ~~it can be considered not to allow for this.~~

~~The use of gaseous fuels for combustion heaters in 9.2.4.7.6 in connection with 9.2.1.1 is at present prohibited for EX/II and EX/III vehicles only. EX vehicles are , and excluded from the scope of gaseous fuels in this document anyway. (Kees, is dat wat je wilt zeggen?)~~
~~The conclusion can be drawn that safety regulations for CNG/LNG combustion heaters should be added to ECE Regulation No.122 with the adoption and amendment of ECE Regulation No. 110. This however is not an activity of WP.15.~~

Justification

Safety … see the above

Feasibility …. See the above

Enforcibility …. No specific problems are foreseen