Minutes

Joint KPT - ITA COSUF Webinar

Impact of New Energy Carriers on Road Tunnels

Date	14 December 2022
Time	12.00-13.30 CET
Participants	79

Opening and introduction KPT

Ben van den Horn, coordinator KPT, opens the webinar and welcomes the speakers and participants. Ben then gives the floor to ITA COSUF colleague Eric Premat (acted as ITA COSUF Chairman) for a brief introduction of ITA COSUF, an appreciated partner in organizing events related to operational safety of underground facilities. Co moderator Tom van Tintelen (KPT) who will assist in Q&A introduces himself.

Reason to organize this webinar is that the energy transition has been making big leaps. More and more vehicles with sustainable alternatives for fossil fuels are on the market and using our road tunnels. A new research topic in the Netherlands is how the availability of Dutch tunnels is impacted by the vehicle transition. A lot of research has been done and is still needed to assess impacts on tunnel safety. What are the challenges for road tunnel managers in adaptation of maintenance strategies to the vehicle transition? What lingering questions are still unanswered in order to ensure availability and safety of our road tunnels?

The following presentations were given:

- Chris Vriens (Innocy): Availability of tunnels for new energy carriers
- Jonathan Gehandler (RISE): The risk of methane or hydrogen pressure vessel explosion in the event of fire

Questions and answers following the presentation of Chris Vriens:

- How much water is being produced by a 'standard' FCEV if you see this as a risk?
  Water cellars and their respective pump systems have been designed for rainfall and water production of gasoline vehicles. To verify whether pump cellar capacity and pump dimensions are future proof I checked if more water is produced by FCEV's than by ICEV. An approximation shows that 0.14kg of water per mile is produced by ICEV and 0.15 kg of water per mile is produced by FCEV. This marginal increase will not impact necessary pump dimensions.

- Do you see an increase in the probability of structural damage due to the higher probability of a higher kinetic impact incident? I.e. a lot more heavier vehicles than now?
  No, I do not think that the probability of structural damage will increase. Firstly, most tunnels in the Netherlands are in a straight line, meaning that the current momentum of the vehicle will drive the vehicle forward should a collision between the barrier and vehicle occur. In most cases the kinetic energy will thus be distributed over the road surface and the barrier. Head-on collisions are highly unlikely, but will theoretically increase damage to the structure of the tunnel. I don't think designers of tunnels need to strengthen the structure itself, should practice show that measures are necessary. Less costly measures can be taken, like strengthening the barriers.

- Do you have experience about influence to the rescue forces?
  I do not have personal experience, however, studies show that electric vehicles and hybrid vehicles are much more difficult to extinguish since the extinguishing medium has a hard time reaching the internal cells of the battery. Firefighters have tested several new methods of extinguishing and some are very promising. An example is an extinguishing lance that can penetrate battery packs and apply the extinguishing medium directly inside the battery. This lance is reportedly quite unwieldy and not the ideal solution, but advances are being made to reduce effort required to extinguish vehicles with new energy carriers. Another risk for rescue forces is reignition of the battery packs due to thermal runaway. Towing the vehicle outside of the tunnel before extinguishing is one option to reduce the time before the tunnel can be opened again, however safety risks and procedures for recuing forces will need to be reevaluated.

- How about the cleaning after a tunnel incident with an EV? I mean in terms of contaminants.
  Different contaminants are released during an EV fire. New contaminants consist mostly of toxic metal oxides. The process of removing contaminants will remain mostly identical to the way contaminants are currently removed. After extinguishing the vehicle, the contents of the pump cellar will need to be contained within a pump vehicle, and the cellar will have to be cleaned. Based on the severity of the fire, the tunnel walls and asphalt may have to be cleaned. The airborne contaminants will be dispersed by the ventilation system.

- Fires will be more complicated and will take more time. Is it time for active fire extinguisher system?
  My expertise is in reliability and availability of tunnel systems. Based on these two I would argue that an active fire extinguisher system is not necessary. Most process steps required to safely release a tunnel (tube) will have to be conducted both in the case with an active suppression system and without. The time for emergency services to arrive at the tunnel and extinguishing time will be impacted. The average calculated un-availability caused by vehicle fire is smaller than 30 minutes per year, so the impact will be marginal. The costs of such a system are high, don't forget that maintenance is also required for such a system. Other arguments can be made for active fire extinguisher systems based on safety considerations, however I have not researched the topic from that point of view. I personally doubt the added value of such a system given the extremely low probability of fire in a tunnel, moreover I think the emergency services are capable of fighting the fires, and the money might be better spent on more training and specialized tools for emergency services.

Questions and answers following the presentation of Jonathan Gehandler

- What type of Thermal Pressure Relieve Device (TPRD) did you use? A plug or a glass filled with a liquid?
  We bought tanks that are used on gas vehicles. I assume it was metal plug.

- You clearly showed the effects of a pressure vessel explosion. What does that mean for transportation and future plans for energy transition?
  In the long term standards need to be updated to lower this possibility more. In the short term it will be a great challenge for de rescue service if a vehicle is on fire in a road tunnel You would have to be very fast and act before the tanks are treat them or you need to take a very defensive tragedy.

- Do you share your knowledge or are you in discussion with rescue people about these results?
  We've been trying to share this knowledge in Sweden with the rescue service., who also did a lot of work. They produced some guidelines, but more can be done, for instance sprinklers, a strategy for such cases.

- Can you show again and comment on the difference in effect distance between CNG and H2 tank explosion?
  When it comes to CNG the numbers come from simulations. There are many assumptions about the tunnel cross sections and to estimate the pressure level. With quite a high certainty it will be worse for H2 tank explosion, because its much more reactive and you get these secondary explosions witch you probably wouldn't get for CNG.

- When TPRD are activated, what danger rescue forces are confronted with?
  I think the main danger is the direct explosion of the jet flame. We measured the heat, from a distance it's not very problematic at all. Large jet flames only exist for a very short time. The smaller ones we will probably see more of in the future, is more similar from a pool fire from a ordinary vehicle.

- What is the chance that this kind of events will happen during/after a collision?
  If the tank has been damaged, there is a fair chance. Although the tanks are placed in a safe place of course, it's more delicate to deal with damaged tanks during a collision for the rescue services.

- In the Netherlands we have 40 years experience with LPG in cars, is there a great difference?
  Major difference is the tank pressure. CNG pressure starts at 200 bar up to 700, LPG pressure around 10 bar. But for LPG-vehicles you can have a BLEVE more easily, than for LNG etc. So maybe the risks are comparable.

- Is it important to instal the tanks on the roof of the vehicles for sprinklers to be effective?
  There are also problems with putting them on the roof. Some of you have seen the incident in Stockholm. Roof tanks can be exposed to barriers for height detection. Sprinklers maybe only cool the cover on top. So it is uncertain that the sprinklers reach the tank.

- Do you know if the tanks that have exploded in real life had been properly maintained and were undamaged before the incident?
  In Sweden all explosions that have occurred before 2017. These tanks were not inspected. Since 2019/2002 they are being inspected. So it's possible the thanks were damaged.

Closure

The speakers and participants are thanked for their contribution and the webinar and before closing the webinar a mentimeter survey was launched, with the purpose to identify the most relevant areas of interest in the audience. The result is shown below.

Mentimeter