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Working Party on the Transport of Dangerous Goods

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Proposals for amendments to annexes A and B of ADR: construction and approval of vehicles

Report of the informal working group on Electrified Vehicles

Transmitted by the Chair of the informal working group

Introduction

1. The mandate of the informal working group is to study the hazards presented by electrified vehicles (battery electric and hydrogen fuel cell) and to advise on amendments needed for the introduction in the ADR.

2. Between the November 2021 and May 2022 session of the WP.15, the working group met 7 times. The working group sessions were well attended with 87 participants on the mailing list representing competent authorities, IGO's, NGO's, vehicle manufacturers, chemical and gas industry, fuel suppliers, inspection bodies, etc. Many participants were active in the sub-groups that would answer specific questions and determine risks these vehicles may present.

Summary

3. There is support in the working group to allow the use of battery electric vehicles for the carriage of substances that require an AT vehicle for ADR 2023. However, for introduction in ADR 2023 there are also reservations that it is too soon and all evaluations are not finalized. For FL, EX/II and EX/III vehicles BEV and hydrogen fuel cell vehicles of all categories it was felt that more consideration is needed to finalize the project. Electric drive on trailers, and batteries for other purposes, will be considered in the future sessions of the working group.

4. Upon request of some participants it was decided to take onboard the use hydrogen as fuel for vehicles with internal combustion engines. Although not in the scope of the mandate it was felt justified as it shared many aspects with hydrogen fuel cell vehicles.

Caveat

5. The following shall be taken into account:

* Considerations of the working group are based on the technology of vehicles foreseen for the coming 5 years and further developments need to be carefully monitored in the coming years.

* There is concern for one-off modifications to electric drive of existing internal combustion engine vehicles as specific designed and serial produced vehicles will have seen a validation process over a longer period ironing out weak point.

6. The annex to this document contains additional requirements and modifications to Annex 1 of document ECE/TRANS/WP.15/2022/5 that became apparent in the time between

the deadline for official documents and the last session of the working group before the WP.15 meeting in May.

Battery Electric Vehicles (BEV)

7. The electric drive system of electrified vehicles shows many advantages over vehicles with internal combustion engines. Not only is the heat developed far less than of traditional trucks with internal combustion engines, also the temperature levels are much lower. The high voltage may be seen as a potential hazard but cables and connections are well protected and when properly laid out present a safety level at least equal to traditional trucks.

8. A point of concern is the battery pack or Rechargeable Electric Energy Storage System (REESS). The REESS contains the assembly of voltaic cells itself, battery management system, heating/cooling and the housing. The issue with Lithium-ion cells that they contain a flammable electrolyte as well as Lithium that burns violently. There are many variations in Li-ion cells and although not confirmed it is believed that LFP¹ type cells will be used that are less sensitive than the earlier NMC² type cells used in passenger cars. A comparison may be made with the significant number of BEV busses in circulation now with limited negative effects.

9. Many safeguards are included in UN Regulation No. 100 that guarantee a long and safe use of batteries in normal conditions of use. However, in abnormal conditions like external fire, ageing or shock (accident) the cells may be internally damaged leading to a thermal runaway. In the latest amendments of UN Regulation No. 100 a requirement is included that a warning will be given at least 5 minutes before a hazardous situation caused by thermal propagation by a short circuit in a single cell. It was felt that this would be essential for the introduction in the ADR. Several ideas were made to mitigate the effect of a thermal runaway, such as detachment of a tractor from the semi-trailer, to build protection to isolate and guard the heat away from the load, possibility to remove the REESS or special access in the housing of the REESS to flood with water by the emergency responders. It was also felt that the requirements in ADR should be purpose orientated.

10. For AT vehicles the requirements for prevention of fire risks by the fuel or engine in 9.2.4 are not applicable. From this point of view it may be found that the above mentioned concerns for the REESS have a more limited effect on AT vehicles. There is a certain urgency to allow the use of electric vehicles, for example supply of bleach for swimming pools in urban zero emission zones, and the availability of these vehicles when ADR 2023 will be in force. This combined with the low hazards for the substances that require AT vehicles the introduction of BEV for the AT category may be justified.

11. For FL vehicles a fire will not only see more effects on the substances loaded but also they have to be safe in areas where an explosive atmosphere may exist. FL vehicles require a switch to break the electrical circuits of the high voltage drive batteries. The electrified vehicles that are designed at this moment also have a low voltage system that needs to circuits to be broken. It is now clear that the high voltage system could be equipped with these switches but the battery management system needs to remain energized for safety reasons and as a result be safe for use in an explosive atmosphere. As explained above the REESS needs particular attention how to mitigate the effects in the case a battery fire evolves. This needs further consideration.

12. EX/II, EX/III and MEMUs are in particular sensitive to heating up of the load. Further consideration is needed for this category.

Hydrogen Fuel Cell Vehicles (HFCV)

13. All that applies to BEV also applies to HFCV and more. The battery will be of a limited size but is still there. In addition to this there will be a hydrogen storage system

¹ Lithium iron phosphate (LiFePO₄).

² Lithium Nickel Manganese Cobalt Oxide (LiNiMnCoO₂).

(pressurized gas or liquefied), piping and a fuel cell assembly. Although much is known already of these vehicles, but they need further considerations. The large scale introduction of HFCV is expected to be a few years later than BEV.

Hydrogen as fuel for vehicles with internal combustion engines

14. At shorter notice hydrogen may be used on vehicles with internal combustion engines in monofuel or dual fuel configurations. Although the properties of hydrogen are different than natural gas it is seen that its behaviour will be similar to CNG or LNG. The containers for hydrogen are included in UN Regulation No. 134 and emissions regulations for vehicles are in place or will be approved shortly. As the basic vehicle configuration is the well-known traditional this would present less an issue for introduction. However, in the working group it was felt not to be problematic if this would be introduced at the same time as HFCV.

Electric heaters

15. As presented at a previous session of the WP.15 the discussion on electric heaters has not yet been finalized. Combustion heaters draw in air (and possible flammable components), combust fuel and air, and expel warm/hot gases on the exhaust that may ignite a flammable atmosphere. Electric heaters will just heat air for example inside the cabin or heat the liquid of the general cooling/heating system of an electric vehicle. It needs to be decided by WP.15 if the amendment of combustion heaters to combustion heaters and electric heaters should be followed or not. This then would apply as well to vehicles with internal combustion engines as to electrified vehicles.

Annex

Proposals of Annex 1 of UNECE/TRANS/WP.15/2022/5 for the introduction of Battery Electric Vehicles as category AT in 9.2 of ADR (Amended wording in bold underlined text)

1. In the table of 9.2.1.1 introduce a new 9.2.4.6 and renumber the current 9.2.4.6 and 9.2.4.7 and 9.2.4.7.1 to 9.2.4.7.6 as 9.2.4.7 and 9.2.4.8 and 9.2.4.8.1 to 9.2.4.8.6 respectively:

9.2.4.6	<u>Electric power train system</u>			X	
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2. In the table of 9.2.1.1 amend the heading of the new 9.2.4.8 to read:

9.2.4.8	<u>Combustion and electrical heaters</u>				
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3. Amend the second paragraph of 9.2.2.1 to read (new wording underlined):

“The electrical installation ~~as a whole~~, with the exception of the electric power train high voltage drive system in compliance with the technical provisions of UN Regulation No. 100 (Supplement 1 to the 03 series of amendments), shall meet the provisions of 9.2.2.2 to 9.2.2.9 in accordance with the table of 9.2.1.”

4. Amend 9.2.3.1.1 to read (new wording underlined):

“Motor vehicles and trailers intended for use as transport units for dangerous goods shall fulfil all relevant technical requirements of UN Regulation No.13⁴, as amended, in accordance with the dates of application specified therein. Vehicles equipped with an electric regenerative braking system Battery Electric Vehicles shall fulfil all relevant technical requirements of ~~Revision 11 or higher of the~~ UN Regulation No. 13 at least up to and including Supplement 18 of the 11 series of amendments as applicable.”

5. Introduce a note after the heading of 9.2.4.3 to read:

“**NOTE:** 9.2.4.3 likewise applies to fuel tanks and cylinders used for hybrid vehicles which include an electric power train drive system in the mechanical driveline of the internal combustion engine or use an internal combustion engine to driving a generator to energize the electric drive system.”

6. Introduce a note after the heading of 9.2.4.4 to read:

“**NOTE:** 9.2.4.4 likewise applies to hybrid vehicles which include an electric power train drive system in the mechanical driveline of the internal combustion engine or use an internal combustion engine to driving a generator to energize the electric drive system.”

7. Introduce a new subsection 9.2.4.6 to read:

9.2.4.6 Electric power train drive system

NOTE: 9.2.4.6 likewise applies to hybrid vehicles that include an electric power train drive system in the mechanical driveline of an internal combustion engine. Electric power train drive systems shall not be used for EX and FL vehicles. [Electric power train drive shall only be used on tractors for semi-trailers.]

The electric power train drive system shall meet the requirements of UN Regulation No. 100 at least 03 series of amendments⁸. Measures shall be taken to prevent any danger to the load by heating or ignition.”

Footnote 8 reads:

⁸ UN Regulation No. 100 (Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric power train).”

In Chapter 9.2, renumber subsequent footnotes accordingly.

8. Renumber the existing 9.2.4.6 and 9.2.4.7 as 9.2.4.7 and 9.2.4.8 respectively. Under 9.2.4.7, renumber the paragraphs and cross-references accordingly. In 9.3.2.2, replace “9.2.4.7.1, 9.2.4.7.2, 9.2.4.7.5 and 9.2.4.7.6” by “9.2.4.8.1, 9.2.4.8.2, 9.2.4.8.5 and 9.2.4.8.6”. In 9.7.7.1, in the first sentence, replace “9.2.4.7.1, 9.2.4.7.2, 9.2.4.7.5” by “9.2.4.8.1, 9.2.4.8.2, 9.2.4.8.5”. In 9.7.7.1, in the last sentence, replace “9.2.4.7.3 and 9.2.4.7.4” by “9.2.4.8.3 and 9.2.4.8.4”. In 9.8.6.1, replace “9.2.4.7.1, 9.2.4.7.2, 9.2.4.7.5, 9.2.4.7.6” by “9.2.4.8.1, 9.2.4.8.2, 9.2.4.8.5, 9.2.4.8.6”.

9. Amend the heading of the renumbered 9.2.4.8 to read (deleted wording stricken through):

“Combustion and electrical heaters”

10. Amend the renumbered 9.2.4.8.1 to read as follows (new wording underlined). Footnote 8 is renumbered as 9.

“9.2.4.8.1 Combustion and electrical heaters shall comply with the relevant technical requirements of UN Regulation No. 122⁹, as amended, in accordance with the dates of application specified therein and the provisions of 9.2.4.8.2 to 9.2.4.8.6 applicable according to the table in 9.2.1.”

11. Amend the renumbered 9.2.4.8.5 to read (new wording underlined):

“9.2.4.8.5 ~~1~~ The combustion heater, or electrical heater [for the drivers cab,] shall be switched on manually. Programming devices shall be prohibited.”
