Transmitted by the HDH Secretary

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agenda item 4(b))

STATUS OF THE GRPE INFORMAL GROUP ON HEAVY DUTY HYBRIDS (HDH)

The Informal Group on Heavy Duty Hybrids (HDH) held two meetings since the 62nd GRPE session. The 7th meeting took place from 12 to 14 October 2011 in Vienna and focused on first presentations from the research institutes and an in-depth discussion of potential hybrid emission testing methods. The 8th meeting took place on 17 January 2012 in Geneva and was dedicated to the final presentation from TU Vienna and the intermediate presentations from TU Graz and Chalmers University.

EPA presented the status of the US GHG (Greenhouse Gas) rule. The HD National Program was developed by EPA with support from industry, the State of California, and environmental stakeholders, and is a key component of EPA's response to a Presidential Memorandum issued in May 2010. The final rule was published at the beginning of August 2011 and becomes effective in 2014 followed by a second step in 2017. A second phase of regulations is planned for model years beyond 2018.

TU Vienna presented the final conclusions on task 1 and task 2. An important part of the modelling concept is the interface model. It is manufacturer specific and remains confidential, but must be disclosed to the approval authority. The Japanese simulation model is realized with Simulink, a well established programming language, which is based on physical models and lookup tables. The most important model is the powertrain model. In Japan, five different powertrain models exist, but for a worldwide regulation more powertrain models would likely have to be developed. In order to solve this problem, TU Vienna is proposing a component library. For the gtr, general guidelines of model construction on the basis of the component library would need to be developed. With this approach, verification of the models becomes more important.

TU Vienna concluded that the Japanese HILS certification method is a viable concept and provides a good basis for the certification of heavy duty hybrids. However, interface and powertrain model would have to be modified in case of additional necessary signals. Also, if simulation results are not accurate enough, model depth would have to be enhanced. The Japanese component testing provisions could basically be used for a global regulation. But finally, component testing strongly depends on the modeling depth and on the desired accuracy.

TU Graz presented intermediate results on task 4 and task 5. The WHVC was modelled for a large variety of conventional HD vehicle categories. WHVC leads to similar engine loads as WHTC for all tested vehicles. Deviations against WHTC are rather low for criteria pollutants (NO_x ± 6 %, PM ± 25 %) and fuel consumption (± 2.5 %). Influence of vehicle mass and air drag, simulated within a range of ± 15 %, on NO_x and fuel consumption was < 2.5 %.

TU Graz is proposing a “WHTC-corresponding” power cycle at the wheel hub (WHDHC) as an alternative to the vehicle cycle WHVC. This allows a vehicle independent approach and an

agreement of powerpack load between HILS and conventional engine tests. The WHVC weighting factors are calculated with the PHEM model of TU Graz for different vehicle categories so that weighting factors for WHVC sub-cycles result in similar cycle parameters as the representative real world cycles. Basis are the HDV-CO_2 test cycles of the EU research study, but any other representative cycles may also be used. PTO loads are not suggested for criteria pollutants, but may be included for CO_2.

Chalmers University of Technology presented an overview of energy storage principles followed by an overview of hybrid topologies. The most promising solutions are considered to be the hydraulic pump/motor and accumulator, the pneumatic pump/motor and accumulator, the CVT and flywheel, and the motor/generator and flywheel. As a first result, non-electric hybrid powertrain topologies fit well into the same categories as for electric hybrid powertrains, and the mathematical models for flywheel, accumulator and pump/motor have similar model structures as in the Japanese regulation.

While TU Vienna has finished their program, the other work programs are about 2 months behind schedule due to problems with the contracts getting signed, but w/o jeopardizing the anticipated WP.29 adoption. The updated road map is shown on page 4 of informal document n° GRPE-63-19.

The group agreed to rely the further assessment of powerpack testing and chassis dyno testing on inputs from ongoing hybrid testing programs at the Contracting Parties.

Major issues for next meetings are:

- Simulation of a real heavy duty hybrid vehicle by using the Japanese open source model
- Determination of break even point between minimal simulation effort and maximum model quality
- Investigations into possible alternatives, such as extended HILS-testing method or powerpack testing
- Acceptance of wheel power cycle (WHDHC) and establishment of a method to define and to normalize the full load curve for hybrid power packs
- Determination of vehicle category for PTO simulation
- System modelling for non-electric hybrids
- Determination of validation scheme
- Finding laboratories for validation studies

Environment Canada extended an oral invitation to the group to meet in Canada in fall 2012.

The next meetings are scheduled as follows:

- 9th meeting: 21, 22, 23 March 2012, Tokyo
- 10th meeting: 05 June 2012, Geneva (to be confirmed)
- 11th meeting: October 2012, Canada (date and place to be confirmed)

GRPE is asked to reserve a half day for the 10th HDH meeting during the 64th GRPE session.

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