FIFTEENTH MEETING OF THE GRPE INFORMAL WORKING GROUP ON HEAVY DUTY HYBRIDS (HDH)

San Francisco, 24 to 25 October 2013

MINUTES OF THE MEETING

Venue: Galleria Park Hotel, 191 Sutter Street, San Francisco
Chairman: Petter Åsman (Sweden)

1.- WELCOME AND INTRODUCTION

The Chairman welcomed the participants and thanked the ICCT for hosting the meeting.

2.- ADOPTION OF THE DRAFT AGENDA
(Working paper HDH-15-02e)

The draft agenda was adopted.

3.- DRAFT MINUTES OF THE FOURTEENTH MEETING
(Working paper HDH-14-07e)

The draft minutes of the 14th meeting were approved.

4.- CONTRIBUTIONS FROM STAKEHOLDERS

4.1 Hybrid and GHG activities

None.

4.2 Assessment of powertrain testing

The Group finally agreed that powertrain testing be included both for validation of the HILS method and for testing a hybrid powertrain as an alternative to the HILS method.

4.3 Assessment of chassis dyno testing

There being no further input, it was agreed to take the final decision at the 16th HDH meeting. This decision would be presented to GRPE at the 68th session. It was also agreed that both HILS and powertrain testing would fit very well into the context of gtr n° 4, which is not the case for chassis dyno testing. This conclusion needs a detailed explanation in the final report.

5.- HDH VALIDATION TEST PROGRAMS

5.1 Report of the institutes on validation test program 1
(Working paper HDH-15-04e)

Mr. Silberholz gave a brief summary of the work achieved during validation test program 1 (pages 3 to 10 of HDH-15-04). He reported that extensive changes on models and model structure have been made. The new structure is component library based and enabled implementation of a flexible signal data bus, which allows adding more signals on the data bus. There was positive feedback from and good cooperation with the OEMs. The next model release is planned for the end of October, and would need to be tested again by the OEMs.

It was agreed that the additional testing of the models should not be a show-stopper for the drafting work. Mr. Silberholz confirmed that the models are described well enough for the drafting process, and could be inserted in their current stage.

5.2 Status of validation test program 2
(Working paper HDH-15-04e)
(Working paper HDH-15-09e)

Dr. Perujo presented working paper HDH-15-09 as a short introduction of the validation test program 2 (VTP2). The goal of VTP2 is to provide a methodology for verifying the HILS model in the gtr and to elaborate a new verification procedure for the gtr, if necessary. The measurement procedure is explained on pages 4 to 6. The three vehicles were tested at JRC between May and September 2013 with the Volvo bus being tested twice. As regards the accuracy of the chassis dyno, torque measurement was within ± 10 % of a wheel hub torque meter. Higher deviations were observed on the WHVC compared to constant vehicle speed operation. Data processing and comparison between experimentally measured parameters and parameters obtained by the HILS model is underway. Further investigations are necessary for resolving some of the problems encountered during the test program.

Mr. Six presented a detailed analysis of the HDH drive cycle (WHVC with road gradients) on pages 11 to 33 of HDH-15-04. Parts of the investigations were done in conjunction with the chassis dyno tests at JRC. He concluded that the minicycle approach very well aligns WHVC and WHTC. This is considered a solid basis for the new test cycle. The approach considers added and removed payloads for positive and negative work, thereby matching of positive WHTC work independent of test weight (i.e. slopes will adjust work). A great benefit is that negative work is independent of test weight, so that adequate recuperation energy is always available. This better reflects real world operation for different payloads. A summary of the methods analyzed (minicycle, 30 sec average, individual slope, fixed slope) is shown on page 32. The final test cycle proposal of the institutes is a minicycle approach with positive and negative WHTC work, which is a clear improvement over the flat WHVC approach.

The detailed test results are shown on pages 36 to 48 for the Volvo bus and on pages 50 to 59 for the MAN bus. An analysis of the Iveco results is not available, since HILS modelling is still under construction. Additional chassis dyno tests are planned for early 2014.

As a conclusion, the Japanese verification (R^2 criteria) failed until now. Identification of the causes is ongoing, with respect to the HILS model, the chassis dyno measurements and a combination of both. Regression analysis is principally considered as a good basis, but further investigation regarding time sensitivity and alternatives is needed. Mr. Six concluded that it is premature to agree on HILS certification procedure on a solid technical basis.

5.3 WHVC road gradients
(Working paper HDH-15-05e)

Mr. Osaki presented working paper HDH-15-05. A new analysis was made after it was reported at the 14th HDH meeting that the Japanese approach deviated significantly from the target work. This re-analysis showed a good correlation between the minicycle and the 30 sec moving average approaches. Mr. Osaki informed that contrary to the minicycle approach presented by Mr. Six, the JASIC proposal does not include negative slopes. A summary of the different methods is shown on pages 17 and 22. It was concluded that the 30 sec moving average with fixed slope was the best approach for certification purposes.

The IWG agreed that a fixed slope approach was superior to an individual slope approach with regard to certification. However, Dr. Kawai supported in principle the institutes' proposal to include negative slopes. The institutes and JASIC were asked to develop a compromise solution for the fixed slope method including negative slopes.

5.4 Discussion

Mr. Sanchez asked why only R^2 is used for the HILS verification. He suggested that slope and intercept of the regression might need to be added.

JASIC indicated that the verification results of the Volvo bus looked very good for a first shot. The driver model might need to be adjusted after the first full verification to get better results with the second shot. It was also reported that the Japanese procedure has different R^2 values for parallel and serial hybrids.

6.- TOPICS FOR DISCUSSION

6.1 General comments on HDH work program
(Working paper HDH-15-08-rev1e)

Mr. Kurokawa presented an analysis by JARI on the influence of the different methods under discussion within the HDH work program on the NOx emission. Basis for the comparison was the NOx emission on the WHTC. The 30 sec moving average method came closest to the WHTC emission level (90 %). If a second-by-second slope is used the ratio is 77% mainly caused by a shift in the engine map towards lower loads. In conclusion, the 30 sec moving average slope, which shows a load frequency second closest to WHTC after the second by second slope, is preferable.

Mr. Sanchez suggested that additional emission testing should be done.

As regards the HILS models, it was agreed that it is not acceptable to only allow for Matlab to be used but it should at least in principle be allowed to use other software packages. As a consequence, the models have to be described in detail in the gtr.

6.2 Certification plug-in hybrids
(Working paper HDH-15-03e)

Mr. Danczyk presented the OICA proposal for plug-in hybrids, as announced at the 14th HDH meeting. The principle proposed is derived from the approach chosen for passenger cars within the WLTP work program. The group concluded that unlike for passenger cars it would be very difficult to develop the UFs for heavy duty vehicles. This is not considered feasible within the current HDH mandate. Mr. Dekker noted that the approach presented is used for

passenger cars only with respect to CO_2, not for criteria pollutants. This was also confirmed by Mr. Öhlund. Japan made clear that for emission the "worst" case should apply as the driver can choose to drive different modes but emission limits should apply anyhow. The chairman suggested to not handle plug-in hybrids now even though it is in the mandate of the HDH IWG.

It was agreed to not consider a special procedure for plug-in hybrids.

6.3 Vehicle categorization

(Working paper HDH-15-06e)

Mr. Danczyk presented the OICA proposal for vehicle parameters for the HILS modelling. Background for the proposal are the different vehicle categories in the regional legislation of the Contracting Parties. The vehicle parameters under consideration are summarized on page 4. For the driving resistance parameters (test vehicle weight, curb weight, rolling resistance, air resistance), calculation formulae based on engine power are being proposed. Ratio related parameters, losses and inertia moments would be based on OEM specific values.

The proposal was agreed by the Group. The institutes were asked to integrate the equations into the models.

6.4 WHVC weighting factors

(Working paper HDH-15-07e)

Mr. Silberholz presented the TU Graz analysis on the WHVC weighting factors, which is an open task remaining from the initial research program. The method was introduced in working paper HDH-08-04. In conclusion, the use of weighting factors is not recommended.

The Group agreed that weighting factors will not be used for hybrid emissions testing.

6.5 Master ECU

Mr. Sanchez emphasized that the master ECU must capture the main energy flows of the system. The chairman added that the key functionalities should be in the hardware. It was agreed that definition of the master ECU needs further consideration, and discussion will be resumed at the 16th HDH meeting.

7.- DEVELOPMENT OF THE GTR

7.1 Report from the drafting group

The secretary reported that the technical secretary, Mr. van den Tillaart from TNO, was finally nominated in September 2013. The drafting group held its 4th meeting, the first one with the technical secretary, the 2 days before the 15th HDH meeting.

7.2 Re-structuring of gtr n°4

The technical description of the HILS test procedure will be incorporated into a new annex 8 to gtr n°4, the powertrain test procedure into a new annex 9. On the HDH website, specific folders "HDH DG … session" have been created. The draft versions prepared by the drafting group will be uploaded to the drafting group folders, as appropriate, for review by the IWG

member. Any editorial comments should be submitted to the technical secretary, any other comments to the IWG for discussion.

7.3 General contents
(Working paper HDH-15-04e)

Mr. Silberholz presented open issues for the drafting on pages 61 to 75 of HDH-15-04. Those issues were discussed in detail and will be taken into account during the further drafting process. The most prominent ones are listed below:

- Handling of gearboxes and shift algorithms; the Japanese regulation allows both generic and OEM specific model for automatic transmission.
- Definition of the rated power of a hybrid system; institutes were asked to check the US EPA approach and to make a proposal.
- How to deal with vehicles which by design cannot reach the maximum WHVC speed; it was suggested to scale power down, but EPA raised some concerns; Japanese approach should be checked.
- Work (engine or system) to be used for the emissions calculation. Mr. Dekker made clear that NL have concerns about the systems approach. The chairman concluded that there seems to be some diverging views within the group and that this will be an important topic to be discussed at 16th HDH meeting.
- Equivalency between post-transmission powertrain test, HILS with verification on chassis dyno and HILS with verification on system bench (pre-transmission powertrain test).

8.- ROAD MAP AND PROJECT PLANNING
(Working paper HDH-15-10e)

The secretary presented working paper HDH-15-10. The roadmap agreed at the 12th HDH meeting remains unchanged, for the time being. The HDH IWG intends to submit the informal document of the gtr at the 68th GRPE in January 2014. The official document will be submitted in March 2014 for adoption at the 69th GRPE in June 2014 together with an informal document with changes made between March and May 2014. Details see page 6. WP.29 adoption is still foreseen in November 2014. The major problem for the timing is currently finalization of validation test program 2. The road map is shown on page 7 of working paper HDH-15-10.

9.- NEXT MEETINGS

The next HDH meetings will take place, as follows
- 16th HDH meeting: 07 January 2014, Geneva
- 17th HDH meeting: 08 and 09 April 2014, Madrid
- 18th HDH meeting: 03 June 2014, Geneva

The next meetings of the drafting group will take place, as follows
- 5th HDH-DG meeting: 12 November 2013 (web meeting)
- 6th HDH-DG meeting: 27 November 2013 (web meeting)
- 7th HDH-DG meeting: 12 December 2013 (web meeting)
- 8th HDH-DG meeting: 18 November 2013

10.- SUMMARY AND CONCLUSIONS

Chairman and secretary summarized the meeting as follows:

- The results of validation test program 1 with the new model structure were presented by the institutes; the new model structure includes a comprehensive component model library, a new signal naming convention and restructured vehicle models
- The next model release will be on 31/10/2013
- The final decision on chassis dyno testing will be taken at the 16th HDH meeting
- Validation test program 2 at JRC has started in May; so far, the validation criteria of the Japanese regulation could not be met; further work is needed.
- Institutes and JASIC will jointly develop a proposal for fixed slopes
- A specific procedure for plug-in hybrids will not be included
- The OICA proposal on vehicle parameters was agreed
- Weighting factors will not be included
- Discussion on master ECU will continue
- Discussion on work (engine or system) for the emissions calculation will continue at the 16th meeting
- The technical secretary of HDH drafting group has been nominated
- The drafting group will work hard to have the informal document ready for the 68th GRPE

11.- OTHER BUSINESS

The participants thanked the ICCT for the excellent arrangements made for the meeting and Mission Motors for the interesting company tour.