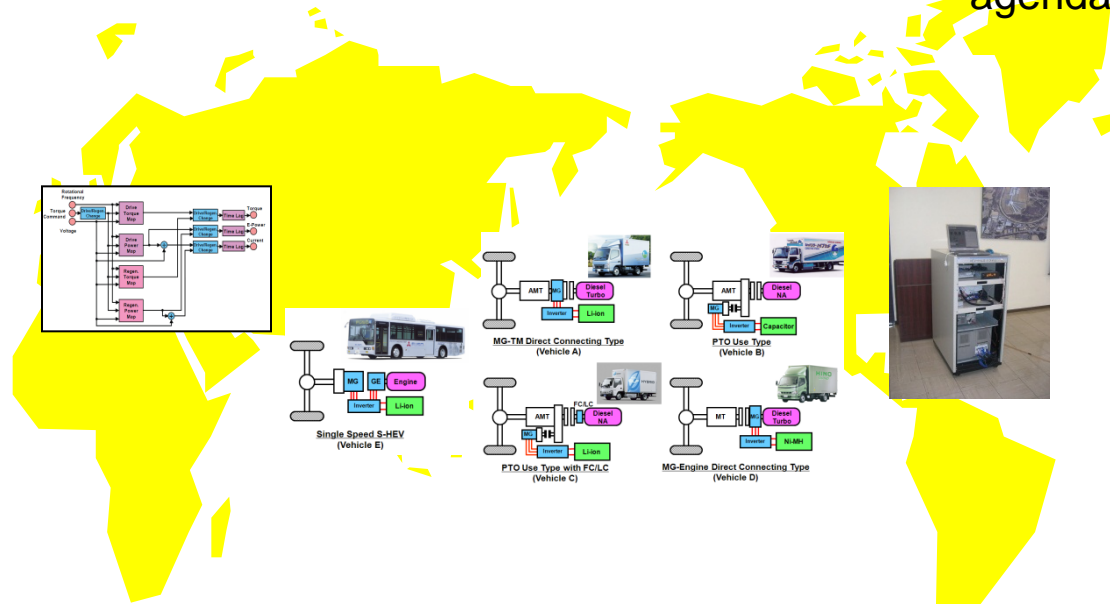




UNITED NATIONS

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GRPE Informal Working Group on Heavy Duty Hybrids

Report to GRPE 69

Geneva, 05 June 2014



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Summary of 17th HDH Meeting

The results of the 17th meeting in Madrid on 08/09 April 2014 are summarized, as follows:

- HILS library version 1.0 was released and agreed
- WHVC slopes based on mini cycle approach with polynomial correction were agreed; TUs will validate slopes with original WHTC gearbox model
- System work as basis for emissions calculation was agreed; equation proposed by the TUs was agreed in principal, but slight modification still needed
- Rated power proposal by TUs was agreed; some additional data needed for final solution
- Hybrid system family was agreed on the basis of the flowchart provided by Japan
- Validation criteria were met for parallel hybrids, but not for series hybrid bus
- General agreement that HILS method was very well developed
- Gear shifting is one of the major problems for model validation
- ± 2 km/h deviation can be relaxed for chassis dyno validation, but must be retained for HILS emissions test.
- Less stringent R2 values for chassis dyno validation are not recommended
- Japanese validation criteria were agreed for both parallel and series hybrids, but further work is needed in a potential second step
- CPs may decide to make HDH mandatory
- Japanese cold start evaluation proposal was agreed
- Micro hybrids will be excluded from HDH approach, but clear provisions are to be developed by the drafting group
- Energy management ECU was agreed as key hybrid functionality for hardware tests; drafting group is asked to provide details
- The test procedure developed by HDH IWG was agreed to be submitted to GRPE for approval as amendment 3 to gtr n° 4
- HDH IWG will consider to propose a second step based on input being available at the 18th HDH meeting



Summary of 18th HDH Meeting

The results of the 18th meeting in Geneva on 03 June 2014 are summarized, as follows:

- Final HILS library version 1.02 was released and agreed
- Open issues list from 17th HDH meeting was solved and presented
- HILS validation was partly successful when applying the Japanese criteria
- Rated power proposal by TUs was presented and finally agreed
- Hybrid system family was presented and finally agreed
- Informal document GRPE-69-10 complementing formal document ECE-TRANS-W.P29-GRPE-2014-11 was agreed
- The technical report (informal document GRPE-69-11) was agreed
- Japan supported adoption of the amendment and could accept minor amendments to the gtr with respect to the validation criteria, at a later stage
- The USA raised some concerns with the HILS method and suggested 3 options for adoption that would be acceptable to the USA
- Canada supported the position of the USA
- The EU supported adoption of the amendment, but will internally discuss on how to deal with the validation problems in view of gtr transposition
- OICA emphasized the complexity of the HILS method and the need for further improvements, which should be introduced at a later stage
- Chairman and secretary thanked the universities and the technical secretary for their excellent work in providing the amendment to gtr n° 4 and the members of the IWG for their active contribution
- Documents ECE-TRANS-WP.29-GRPE-2014-11 and GRPE-69-10 will be submitted to GRPE for approval as amendment 3 to gtr n° 4
- Based on current input, HDH IWG will not propose a second step, at this time



Status Open Issues

The following open issues were reported to GRPE 68; their status is as follows:

- **Validation test program 2: finished, Japanese criteria were not met in all cases**
- **WHVC road gradients: agreed and included**
- **HILS verification criteria: Japanese criteria agreed and included**
- **Approval procedure for OEM specific models: solved**
- **System work: agreed and included**
- **Definition of hardware hybrid control functions: agreed and included**
- **Hybrid system family concept: agreed and included**



Drafting Group

➤ Meetings in 2014

- 3 web meetings (n° 8, 9, 11) were held between January and March 2014
- The 10th meeting was held on 18/19 February 2014 in Tokyo
- The 12th meeting was held on 10/11 April 2014 in Madrid
- 3 web meetings (n° 13, 14, 15) were held in April and May 2014

➤ Result

- The formal document of the gtr was submitted to GRPE on 10 March 2014
- Extensive drafting was done between March and May 2014 to complete the HDH test procedures
- WP.29 approved partial alignment between gtrs n° 4 and n° 11 resulting in additional amendments, which are not related to the HDH work
- The complete set of changes in relation to formal document ECE-TRANS-WP.29-GRPE-2014-11e was submitted as informal document GRPE-69-10



Timeline of gtr Submission

- **GRPE 68 approved the following timeline:**
 - **Submission of formal document**
 - ❖ Document number: ECE-TRANS-WP.29-GRPE-2014-11e
 - ❖ includes drafting and work progress by 01/03/2014
 - **Submission of an informal document to GRPE 69 (GRPE 69-10), which will**
 - ❖ include drafting and work progress after March 2014
 - ❖ include alignment with gtr n° 4
 - ❖ complement formal document ECE-TRANS-WP.29-GRPE-2014-11e
- **The HDH IWG was able to meet this timeline**
- **After adoption of both documents by GRPE 69, a consolidated document will be provided to WP.29 for approval**
- **The technical report was submitted as informal document GRPE-69-11, since the work program was not completed in March 2014**
- **With the submission of the three documents, the HDH mandate has been successfully completed**



Conclusions

- **The Japanese validation criteria were not completely met by all three vehicles; to be on the safe side, HDH IWG proposes to adopt the Japanese criteria**
 - **Further work on HILS validation might be necessary with respect to testing of additional vehicles and /or looking into alternative validation methods**
- **A potential HDH step 2 (like with WLTP) was suggested at the 17th HDH meeting to deal with issues not yet fully resolved**
 - **Step 2 would require commitment from all stakeholders to continue**
 - **Essentially, co-sponsors (EU, Japan) must support continuation**
 - **Step 2 would require budget, vehicles, test cell capacity and ToR**
- **None of the above prerequisites is currently fulfilled**
- **Consequently, the HDH IWG does not propose to GRPE an extension of the mandate**
- **Amendments to the current procedure might be proposed at a later stage based on input from Contracting Parties**



Final Remarks

- **HILS simulation is a novel approach in emissions regulations; such an approach cannot be absolutely flawless at the first attempt**
- **The approach is very challenging for the certification and type approval authorities and requires new ways of thinking and handling of certification/approval dossiers**
- **Contracting parties are asked to carefully study the result of the HDH work program, especially the more complex Annex 9 (HILS)**
- **Taking these aspects into account, the HDH IWG is asking GRPE to adopt the proposed amendment 3 to gtr n° 4 in its current form**
- **Chairman and secretary would like to thank the following persons for their valuable contributions to this project:**
 - **Christoph Six (TU Vienna), Gérard Silberholz (TU Graz), Jonas Fredriksson (Chalmers University) for developing the HILS method**
 - **James Sanchez (EPA) for his support in developing the powertrain method**
 - **Erik van den Tillaart (TNO) for drafting Annexes 9 and 10**