

**Report of the 30<sup>th</sup> Session of the  
Electric Vehicles and the Environment Informal Working Group (EVE IWG)**

Location: Stockholm, Sweden  
Time / Date: 09h30-17h00 April 8-9, 2019  
Chair: Mr. Michael Olechiw (USA) [Present]  
Vice-Chairs: Mr. Hajime Ishii [Present]  
Ms. Chen Chunmei (China) [Not Present]  
Secretary: Mr. Andrew Giallonardo (Canada) [Present]

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**1. Welcome, introductions, meeting report (Agenda items 1)**

Mr. Mike Olechiw addressed the EVE IWG members and noted the full meeting agenda for the following days. Mr. Olechiw thanked Mr. Per Öhlund, the host, for the 30<sup>th</sup> EVE meeting. He also thanked everyone who supported the meeting in Geneva in the absence of the U.S, and apologized that they could not attend. He was glad the participants were able to carry on and make progress.

Mr. Öhlund welcomed everyone to Stockholm and provided logistics to attendees. Seventeen participants attended the meeting in person and a number of participants connected to the meeting via the available teleconference. Participants in the room included those from Japan, U.S., Canada, OICA, WLTP, JRC, JASIC, NTSEL, CATARC as well as individual stakeholder representatives.

Following the 29<sup>th</sup> EVE IWG meeting in January, this meeting focused on finalizing the views and recommendations for a path forward on in-vehicle battery durability in the status report and on discussions of the validation test program and resulting mandate timelines for completing the GTR on determining the power in electrified vehicles.

## **2. Review of 29<sup>th</sup> EVE Meeting Minutes (Agenda Item 2)**

Ms. Kendelle Anstey prepared the 29<sup>th</sup> EVE IWG meeting report from January. This was distributed before the 30<sup>th</sup> EVE meeting and participants had a chance to review some of the notes beforehand. Overall, the meeting minutes highlighted discussions on in-vehicle battery durability and a need indicated by the EU Commission to conclude the work and move forward with a regulation. Regarding the in-progress GTR, discussions on the validation testing results and overall status of the GTR indicated that the IWG would require an extension of the mandate and would need to look further into the discrepancies between the test procedure results found. On the topic of the method of stating energy consumption, it was indicated that the group of experts on Cleaner Electricity Production (CEP) are interested in taking on the leadership of the work on upstream emissions, however they need time to acquire the right experts on this topic. Members are asked to contact Mr. Francois Cuenot or Ms. Kendelle Anstey if they are interested in joining the CEP group.

## **3. Updates from WLTP (Agenda item 3)**

Mr. Matthias Nägeli provided a verbal update on WLTP SG EV activities. He noted that the SG EV's main objective this year is to update the low temperature test. There is currently a tight timeframe to produce an informal document by January 2020. The EU Commission and Japan, MLIT are pushing for completion of the work by the end of this year.

At the last SG EV meeting on Friday April 5, 2019, there was a request to find a reasonable way forward to focus on pure internal combustion engine vehicles and pure electric vehicles and continue with the work on plug-in hybrids. Several methods are being discussed. The approach to focus on ICE and pure electric vehicles is one that is supported but not the dates. In addition, the information to be provided on customer information, consumption and range remains unclear. There are still discussions being held amongst the SG EV to reflect the procedure and the final targets for a worst case or a representative scenario. The group is also discussing to utilize a family concept. Much time has been spent on the topic and there are still many open points. The discussion will

continue with follow-up meetings to find a concrete procedure which could include the family concept or methods to reduce the testing burden. If it cannot be finalized then the group will have to decide what topics can be moved to the next year and what topics can be finalized.

There is openness concluding the topics as soon as possible. From the manufacturers' viewpoint, the scenarios should incorporate customer information to provide clarity. However, open questions remain in regards to what defines the representative customer. Once this is clarity, then the group can proceed to further discussions. The group needs feedback from a political point of view of what should be reflected at the end. If there is not support for the view at the end, then the group needs to decide on how to move forward.

The WLTP SG EV also discussed the procedure on the conformity of production. There is something already in place for this in Europe and there are discussion at the UN level that began a few months ago. The SG EV is now at the stage of providing feedback on the procedure. They have identified some points which could be drafted in a more robust way. In the January 2019 GRPE meeting, the SG EV identified some points in GTR No. 15 to address this year. Some of these actions include working on definitions to which they hope they can conclude in amendment 6 of GTR No. 15.

Mr. Olechiw asked a few questions to Mr. Nägeli concerning the temperatures that WLTP SG EV is considering in their procedure and considering for pre conditioning and charging. Concerning the pre-conditioning and charging. Mr. Olechiw wanted to know specifically what is reflect of the typical customer such as whether the customers do most of their charging overnight when they come home, or only every day or so. He also asked if there was a data set for the charging profiles that could be used for in-vehicle battery durability. Mr. Nägeli noted that for cold temperatures, -7°C is being considered and that there were no datasets available at this time.

Following these questions, a discussion followed regarding factors that come into play in defining charge profiles. Ms. Elena Paffumi noted that she could see if there are any available datasets to support the discussions. Mr. Nägeli also noted that the SG EV group is working on defining profiles to reflect the realistic infrastructure and changes. Ms.

Paffumi proposed that the group could design a procedure that includes parameters that adopt a typical pattern based on customer information (charging patterns etc.). Mr. Nägeli explained that is the reason he mentioned charging as a condition in contrast to an ageing process. Further discussions on this topic highlighted the factors of range and temperature on capacity and the need to determine the representative conditions of the market. This was one topic noted that should be consistent between WLTP SG EV and the EVE IWG and that they should be reflected in drafting procedures.

#### **4. Power determination items (Agenda 4)**

##### **(i) Updates from teleconference meeting on February 13<sup>th</sup>**

The main objectives of the teleconference meeting on February 13<sup>th</sup> were to discuss the results in details of the validation test program with the U.S. representatives who were unable to make the meeting and discussions held in Geneva.

Document EVE-30-03e as it was presented at the February 13<sup>th</sup> teleconference, highlighted the observations for the discussion on the validation testing. It identified the problem of the differences in test results and identified potential sources causing the discrepancies as expressed by others at the 29<sup>th</sup> EVE meeting. Mr. Safoutin who had presented the document at the teleconference had highlighted the differences in the U.S. results between Test Procedure 1 (TP1) and Test Procedure 2 (TP2). The most significant point, as was the case in other test results from contracting party members was that the results differed. In the U.S. case, the results varied by as much as 10% but were not consistent between the vehicles tested and between test procedure 1 and 2. For tested Chevy volt, TP1 returned a lower power than TP2 and in the Malibu Eco tested, TP1 returned a higher power than TP2. Mr. Safoutin had noted the sensitivity of each test procedure to specific hybrid architectures and the uncertain correction for tire losses and slippage that occur with the use of a dyno roller torque in TP2. To expand on these differences and highlight the problem, Mr. Safoutin had provided background on the measurement tools used for the tests and explained the procedures for TP1 and TP2 in a flowchart. Document EVE-30-09e also shows the flowchart which is discussed in this meeting. It is available separately as document EVE-30-08e. Observations from this presentation highlighted that in theory TP1 and TP2 should deliver the same results and

that for this to be true the respective k factors should be accurate. Incidentally, however, the k factors are rarely accurate for any specific vehicle. Without accurate k factors, both Tp1 and Tp2 would not expect two results to be the same for any specific vehicle which may mean that cherry picking is possible. Possible directions prescribed would be to:

- A) Accept the variation as is;
- B) Tighten up the causes of the variation by either providing specific default k factors or; limit TP2 measurement options;
- C) Eliminate default k factors and require verified k factors from the manufacturer;
- D) Allow default k for only provisional ratings;
- E) Limit the GTR to only TP1 or TP2; or
- F) Delegate the decision to the legislation that references the procedure

Option F would require to acknowledge that the GTR produces different test results, which depend on the variations discussed and it could require specifying options such as taking one test value over the other, or leaving it to the testing authority.

Members were asked to consider this flow chart and the options before the EVE 30 meeting.

Upon reviewing document EVE-30-08e, members agreed to eliminate the greyed out section of the flowchart as shown. However, the IWG later in the meeting added this option back in to consider, as adding weights in the validation tests as prescribed was not initially completed and could be a potential source of error.

## **(ii) Status and discussion of Options**

Mr. Safoutin led the discussion through document EVE-30-09e on the status and tasks of the system power determination GTR. He indicated issues known before the validation program and issues discovered through testing. Mr. Safoutin highlighted that the IWG needs to reach consensus on fuel flow rate, and resolve the tire slippage concern as a potential reason for the losses. He noted that gear shifting is not monitored closely and that it could be possible to get a higher power if the vehicle shifts at an opportune time even if it is not part of the normal operation by the user. He also noted the concerns of

the modes to define hybrids in, and the factors that could be contributing to the differences in the test procedure results such as inaccurate default values. Slippage on rollers in TP1 were also noted and the uncertainty on whether the provisions are sufficient. There were also concerns whether slippage on the dyno can cause the gearshift to happen at a different time. Repeatability was also raised a concern for some vehicles tested at the EU JRC test lab.

Mr. Safoutin summarized an account of all the test laboratory recommendations and suggestions on the procedure. These were mainly:

- To allow free acceleration which can help identify the speed of maximum power
- To consider that the conditioning cycle may be insufficient for the transmission oil to warm up
- To drop the first test results
- Suggestion to closely monitor the battery temperature
- During SOC regeneration it should be clarified if the vehicle is charging from the grid
- If additional validation testing is done then the testing variables should be weighed
- For chassis roller dyno, for TP2, torque should be validated with wheel torque sensors
- The improved draft procedure should have a manufacturer cooperation to ensure that the k factors represent those provided

The differences between TP1 and TP2 test results were also noted. All three test labs had differences where tests results from TP1 were typically larger than those from TP2.

Mr. Safoutin highlighted the differences between Canada's testing work and the U.S. EPA's testing work that could lead to differences. These differences were related to using CAN data, correcting for tires or slippage, collecting torque data and using torque sensors.

Options for completing the GTR were also discussed. Option A would not significantly modify the draft procedure as it would either disregard the differences between TP1 and TP2. It would inform the reader by highlighting the differences as a caveat of the GTR.

Option B would modify the draft procedure by aiming to reduce the differences between TP1 and TP2 or by eliminating the differences so that the procedure only produces a single value. If the differences between the values is eliminated then the GTR would either be restricted to only TP1 or only TP2 or would require both procedures. Slide 10 of the presentation reflected a flowchart to show the options. Mr. Safoutin also explained a method to verify k factors should the manufacturers be required to provide them. Slide 19 provides a verification explanation of how the k factor could be verified by the data. The k factor could be determined through the relationship between K1 and K2 factors along with the two power data points determined from test procedure 1 and 2. Given one k factor, and the two data points, one can calculate a plausible zone that the other k factor could fall within when graphed.

**(iii) Japan's input on HEV power determination and continued discussion**

Mr. Shinichi Abe presented document EVE-30-05e which provided input on document EVE-30-03e and explained possible resolutions for the concerns in validation test procedure.

Mr. Shinichi indicated Japan's interest in option F which refers to the legislative authority with respect to Mr. Safoutin's presentation, document EVE-30-09e. In Mr. Shinichi's presentation, Japan is opposed to requiring two test procedures of TP1 and TP2 since it can causes an increase in workload. Japan supports TP1 on the premise that all contracting parties have an engine certification method such as those from R85 or from the SAE available. Japan does not want to deny TP2 but they think it is necessary to prepare a gearbox efficiency measuring method. Mr. Shinichi noted that the GTR should include the SAE test procedure when diverting results to R85 is not possible. The presentation lists some possible resolutions in the provided matrix. The direction on TP1 and TP2 was noted to still remain an open issue for Japan.

Japan has made a few statements on what they agree on in terms of the open issues and the possible options and paths forward provided by presentation EVE-30-09e. These are the following:

- That the chassis dynamometer should use a hub dynamometer or have torque sensors attached
- Japan agrees with the statement made on the background on the measurement problem that component rated power cannot be relied on
- On left side of flow chart, for obtaining the ICE power, Japan suggests to conduct ISO 1585:1992 in the conditions specified in ISO 1585:1992, ask the manufacturer for the ICE power or conduct TP2
- Japan agrees with the statements made on the k factors, that the k factors should be accurate and support direction C to eliminate default k factors and require a verified k factor from the manufacturer
- Japan suggests that the GTR needs a description of the measuring methods such as invert motor efficiency and gearbox efficiency
- Japan recommends that the GTR should include the SAE test procedure when diverting results to R85 is not possible
- Japan notes that the definition of gearbox efficiency issue has to be developed

Everyone in the room agreed with the suggestions regarding provisions surrounding the hub dyno and torque meters.

The EVE IWG discussed some of the points, one of which highlighted whether the EVE IWG would want to rely on manufacturer information for numbers and if they should ask the manufacturers how to drive the vehicle for maximum power. The group also discussed concerns with gearshift when there is not a selectable gear and discussed whether certain vehicles will always shift in specific conditions. Mr. Masao Kubodera noted that there is no definition of gearbox efficiency in the GTR and that in TP2 the indirect gearbox efficiency needed for series hybrids is not available. If the TP2 included the indirect gearbox efficiency value then for those vehicles, TP1 and TP2 should have the same result.

The discussions followed back the flowchart reflected in slide 10 of document EVE-30-09e and the paths forward. The EVE IWG group agreed that the pathway of allowing the manufacturer to choose TP1 or TP2 seemed to be the least acceptable solution and that the most preferred option would be to reduce or eliminate the differences, the right hand

options of the flow chart. Mr. Safoutin thought that this might have the best chance to find a solution within the group. The EVE IWG group agreed that it would be best to try to make the procedure as robust as possible and that if there are no solutions then the IWG could resort to the left side of the flow chart. At this stage, members agreed that it would be pre-mature to cut off any branches of the flow chart.

The EVE IWG discussed that if the gearbox efficiency needs modification then TP1 might be more preferred as there is a way to verify the k factors at least. To resolve the issues of gearbox efficiency, the EVE IWG would need see if ISO could consider a procedure on gearbox efficiency or if the EVE IWG can identify experts who can provide input. Clarifying the gearbox efficiency concerns would provide more arguments for the discussion. Discussions also highlighted an open issue with the test procedure that there isn't a tolerance specified for intake manifold pressure for TP1 and that there are no current methods to verify the efficiency of the transmission data provided by the manufacturer.

The EVE IWG agrees that eliminating either pathway of the flowchart for TP1 or TP2 at this stage is pre-mature without a full understanding of the factors causing the differences. In some cases of this, it might mean that one procedure is more accurate over the other. Most EVE IWG members agreed that working to reduce the differences between the test procedures would provide more data and help eliminate options. The goal for the EVEIWG would be to reduce the differences but allow for other options of the table. Given the urgency for the GTR and the time limits to complete the GTR by, then the EVE would look into completing more testing, looking into the factors more and using that information to identify the next steps with all options open.

#### **(iv) Test results performed at Volvo**

Mr. Bengt Noren presented data via teleconference on additional tests completed by Volvo on the company's XC60 T8 plug-in hybrid. Volvo looked more into the tire losses and slippage and found that once taken into account, TP1 and TP2 provided very similar results. It is uncertain whether this was a coincidence. The tire losses were approximately 10 kw. Mr. Noren explained the trends in the graphs and noted the calculations they used

as shown on slide 6. He explained that they used the efficiency of 0.85 for TP1 as specified in the ISO standard, and used the simplified TP2 calculation where the vehicle had varying types of transmissions used and found that both values are what is reported in the vehicle on board system models.

Mr. Noren also noted the following in his summary on slide 9 of the presentation. These concerns and suggestions were not new concerning the discussions of the open issues. They consist of the following points:

- They found no issues with running at high power on the dynamometer.
- Avoiding shifting during testing is a concern
- There is a risk of inconsistent evaluation of peak power since the dynamic behavior of TP1 and TP2 for power behavior is different
- Sustained power of 10 seconds is preferred for robustness and the initial transient may give unpredictable results on peak power
- A method needs to incorporate the estimation of tire losses if testing without torque measurements on wheels or drive shafts
- The ISO standard only has general assumptions on system efficiencies and guidance on more appropriate efficiency measures would be helpful to correlate with current motor measurements

Ms. Annika Ahlberg-Tidblad noted that this time the only item they had not looked at before was the difference in the dynamics between the two test procedures since where the max ends up on the curves it impacts the test results.

Mr. Safoutin noted that it seems that the TP1 in this case based on on-board measurements for engine power and not engine speed or R85 results. Mr. Noren responded that it was but the significant part of the control system look up table was used in combination with aerodynamics. He noted that it is quite similar for a look up table with speed compensation added on top. Mr. Safoutin thought that that was probably an accurate method but also noted the typical method used for the purposes of validation. Mr. Safoutin also inquired into the rolling resistance of the tire losses to which the answer was that it uses an exponent measurement, which is about the same for the fuel

consumption calculation, which is a theoretical value but is based on tire tests for other purposes. Ms. Paffumi noted that in her methods to correct she followed the EPA's method and noticed a different weight distribution and that the method wasn't correct. It provided a correct distribution but gave more range than a specific number. The EVE IWG discussed whether the GTR should include a methodology to establish losses and what such a method would look like. The EVE IWG thought that if it is too complicated to reflect then they could rely more on wheel configuration.

**(v) Discussion of GTR work and validation testing continued**

The rest of the discussions on validation testing focused on reviewing all of the open issues as indicated below.

Outstanding Issue	Possible resolution
(1) Greater variation observed for TP2 than for TP1	(A) Collect multiple observations and report average (B) Eliminate roller measurement option for TP2
(2) Proposed requirement to collect fuel flow rate for TP1 (to verify per R85)	(C) Collect fuel flow rate as additional means of verifying R85 conditions
(3) How to account for tire losses and slippage for TP2 (if measurement is at dyno rolls)	(B)
(4, 9) Allowability/impact of gear shifting on maximum power	(D) Require manufacturer to specify mode, speed, and gear and pedal modulation to elicit maximum power
(5) Should PHEV test be in CD or CS mode, and how to determine	(D)
(6) Applicability to novel or complex powertrains (multi motor, Rex, 4WD)	(D) (E) Extend validation program to additional powertrains not yet tested
(7) TP1 and TP2 results differ significantly	(B) (F) Eliminate default K factors (G) Require manufacturer to provide K factor (H) Provide way to verify the provided K factor via slide 19 or slide 20 methods (I) Specify acceptable tolerance for intake manifold pressure or fuel flow rate necessary to verify that engine is operating at max power re R85
(8) For some vehicles, repeatability of maximum power was a concern	(A) (D)

Conditioning cycle inadequate for transmission oil (affects TP2)	(J) Drop first observation from average
How fast to regenerate SOC?	(K) Specify approximate C rate limit

The EVE IWG group decided that four iterations of the test was enough at the time. The EVE IWG also discussed whether vehicles have a theoretical max power than never occurs due to shifting up or down by the customer. The IWG also identified a problem with the modes and that the GTR could write some language regarding the which mode should be used to represent the customer would normally experience. The discussions also reflected if the modes should be the predominant mode or if they should capture other vehicle modes such as sport mode and moved towards how the GTR covers all vehicle types. The group also discussed limiting the scope of the GTR to only light-duty vehicles now that the GTR is a separate one instead of an annexed version it no longer identifies the scope. There was also discussion on specifying somewhere in the GTR that the validation didn't cover all test procedures. Japan noted the EVE IWG didn't test any pure range extender type vehicles or a true series hybrid vehicle. Mr. Safoutin noted that at some point the EVE IWG should try the test procedure on other powertrains. The concerns with covering all vehicle architectures also relates to the concerns that have some up with certain complex powertrains. The discussion also noted that if not all architecture types can be tested then the results should be presented in a way that indicates that.

The EVE IWG also noted that it would be helpful for validation testing if accurate k factors could be obtained for the vehicles tested. For TP1 the K1 value can be verified independently and for TP2 the k2 value is not always understood but it would be possible to run TP1 and TP2 to set test boundaries. Adjusting the GTR to be more specific than referring to the ISO was also noted as an item to consider for drafting.

Gearbox efficiency was also discussed and members expressed the need to make the procedure robust to compare the values. Some of these considerations include capturing the same operating conditions to measure TP1 on the dyno as mentioned by ISO. Mr. Mike Olechiw noted that as an action item the EVE leadership could contact VDA or the

ISO group to consider creating a standard test procedure for this. It was also noted that the timeline to do this could be too long for the GTR.

Following discussions on obtaining k factors, there were also discussions surrounding how accurate the engine map method is when considering the intake manifold and fuel flow rate measurement.

Another topic mentioned was on repeatability. The U.S. EPA and Canadian test labs didn't have issues with repeatability. It was suggested that perhaps vehicle architectures are playing a role. The EVE IWG also noted that some language regarding regeneration should be added to the GTR draft. The group also briefly discussed the sufficiency of the moving averages for peak power as in some cases it is stable but in others it is not.

The discussions on power determination looked at how ambitious further study would need to be. Mr. Safoutin noted that it would be good to go back to the familiar vehicles tested and get a good set of values for the vehicles with the draft changes incorporated. He noted the two major changes would need two inputs, one being accurate k factors and the other to complete the tests on a hub dynamometer or with torque meters.

Lastly, the IWG discussed determining what kind of timeline they would want to commit to. An action item was identified for the testing labs to see what they could look into for further testing given the needs identified. Since there wasn't a document that summarizes all the vehicle architecture types and those tested by the labs, Mr. Safoutin agreed to prepare such a document. Regarding the timeline, the next opportunities for the group to propose a draft would be January 2020 and June 2020. Given some of the urgencies to not delay the regulation more than a year, the EVE IWG thought a delay until January 2020 would be tight if further testing issues arose or could not be resolved by then, but that it would be possible to commit to this timeline.

The IWG also discussed the status report. Mr. Olechiw proposed to split the power determination section of the report since the work will be extended.

## **5. Battery Durability Items (Agenda item 8)**

### **(i) Update on JRC's modelling**

Ms. Elena Paffumi presented document EVE-30-12 which presented the current status of JRC's TEMA model. Since April 2019, comparisons were made between the model predictions and Nissan data. The data was collected by users in New Zealand from 201 Nissan leafs with 24 kWh charging and 82 Nissan leafs with 30 kWh charging. Most of the samples were used for domestic travel while others were part of company fleets. Since the last update in January, 2019, JRC also explored generalizing the model and extending the battery architecture selections in the model.

From the update in January 2019, JRC last did comparisons between the model and battery durability predictions with Tesla data. They found that on average the batteries have 91% remaining capacity after 270,000km.

Ms. Paffumi provided some background information on model assumptions such as specifying which duty cycles and temperature conditions are used.

The Graphs shown in EVE-30-12e correlate data with model predictions. The red dots are estimates from JRC's model. The estimates are found to be a bit higher on the kilometers but the model does a good job at catching the trends.

JRC looked into generalizing the model. They are also trying to implement performance of the model by working on the architectures. They have a pie shape and a flat shape and new technologies that are on the market now incorporated. They are currently still running BEV 4 results and the next steps are to work with Canada's results.

Mr. Giallonardo asked if the model would require continual updates to the chemistry performance for the latest model. Ms. Paffumi noted the difficulty in finding open source data. Ms. Ahlberg-Tidblad also made the observation that it simplifications are made that this type of data would need to be provided in the model and that it is interesting the environmental max and min temperature every month of the year would vary significantly depending where the vehicles are. The question that comes of mind is if a vehicle has different ratings and results depending on where it is sold and used.

Ms. Paffumi responded that they are looking at the temperatures of all the countries and trying to identify the ranges. She noted that temperature has a big impact on the battery management system if it isn't active.

Mr. Giallonardo thought that it would be good to follow up on the political or policy decisions that could offer an idea of what to expect. It could be based on the existing EU proposal what the real world driving emissions informal working group (RDE IWG) is doing. There is the question of what are reasonable temperature parameters and the extended set of conditions if it is considered as a policy tool. There would have to be some negotiation and agreement for durability and the temperature ranges to assess which are unlikely to be an extreme temperature range.

Ms. Ahlberg-Tidblad noted that it would be interesting if there could be collaboration with manufacturers to compare their estimates with the model to see if the results are the same. Ms. Paffumi noted that JRC is trying to propose something similar to that to verify information privately to see where they are.

Ms. Paffumi also provided an update from the EU commission on in-vehicle battery durability after meeting held a few weeks before this meeting. Regarding eco design, the EU commission was explicit that battery use in transport will be excluded. The EU commission's position under discussion is to not implicate the designs in the automotive industry. They think that if the modeling work is progressing very well then they prefer to move in the direction of a GTR. The EU Commission will have another discussion to decide whether to channel all of their activities on eco design. The EU has indicated a strong request for in-vehicle battery durability by the end of the year. Ms. Paffumi highlighted options in the EVE IWG's efforts, such as warranty option which could be supported by Norway, or through separating the battery application through design. She also noted the possibility to approach the model with a generation factor and that JRC will proceed in parallel to assess the best options and to have something concrete going forward. Ms. Paffumi also noted that the EU commission will be at the next EVE meeting in May.

**(ii) Japan presentation on battery durability positions and status report discussions and review**

Mr. Hajime Ishii provided Japan's latest positions on in-vehicle battery durability in document EVE-30-06e. At the last GRPE meeting, Japan supported the position that the progress of battery technology is too rapid and that it causes difficulty to develop a standardized test method. As a new reflection, Japan considers that the consideration/evaluation of the environmental impact caused by battery deterioration in the vehicles should be conducted under the GRPE umbrella, including continuous research, clarification of the GTR purpose and the GTR development.

Mr. Ishii reminded contracting parties of the common demands for durability on OVC-HEVs and NOVC-HEVS in the situation of degraded batteries. Japan's inputs related to this include the possibility to use deterioration factors for pollutant emissions from OVC-HEVs and NOVC-HEVS under the situation where the batteries are degraded. He added that explanations should be provided that the treatment systems for pollutants can be manageable with the degraded batteries. Japan would like to add input descriptions to require the manufacturers to provide clear explanations in the report. Japan's position is reflected in the EVE-29-03-Rev2e version of the report and in the current version of the status report.

As an interim approach Japan recommends that it is possible to use deterioration factors (DF) for pollutants. EVE IWG members also thought that if CO<sub>2</sub> is a concern then range should be a requirement as DF for pollutants would not correlate with the climate change concern.

The group spent some time going through the status report and making suggestions on wording or edits. Japan proposed to adjust the table of views in the status report as per EVE-30-04-Rev1e.

**(iii) Canada presentation on status of in-vehicle battery durability**

As the group proceeded to the recommendation section, Mr. Giallonardo presented on the feasible options of in-vehicle battery durability requirements for a GTR. These options included those that were informally discussed in IWG meetings, such as on warranty and

labelling. The presentation highlighted some key noticeable differences between combustion engine vehicles and electrified vehicles to highlight concerns on some aspects of the durability requirements. On these differences, specifically available range of the vehicle types was compared and battery warranty vs realistic vehicle lifetimes differences. The presentation also showed reference material on the available research findings.

The durability requirements reviewed included, the useful life of air pollutants and CO<sub>2</sub>/energy consumption, range durability requirements with X% at a Y lifetime, base range requirements with a threshold, labeling requirements, manufacturer statements, DFs, and a warranty option. Document EVE-30-15e reflects comments and concerns on each of the options. These comments and concerns stem from the available research tools and methods that can be used to establish a robust GTR.

Mr. Giallonardo highlighted that the EVE IWG shares views to require some kind of durability requirement that focuses on deterioration, whether it be on pollution, range or other options discussed. Deterioration factors (DFs) for pollutants are already available, but there have also been discussions on whether range should be a necessary component of a GTR. Some contracting parties expressed to limit substandard products and set minimum expectations such as default DF's. The EVE IWG also considered if DF's for battery or electrically related components were necessary and whether it should be done through modelling or through in-service conformity.

EVE IWG is of the view that research is not at the level where a robust durability requirement that maintains a certain level of battery range capacity by a certain number of years is feasible. Options moving forward might require answers to more political questions such as range, or making decisions regarding battery state of charge swings.

Mr. Giallonardo noted that it would be good to hear from parties should this GTR have provisions for data collection to inform future regulations. The technologies are continuously expanding and continuing research would allow the EVE IWG to stay up to date. Given the lack of information available and the maturity of the market, Mr. Olechiw pointed out that it would be good if part of the data collection includes generic data from

vehicles to inform how they are deteriorating and how the batteries would change over time. Mr. Olechiw noted that the California Air Resources Board has implemented some on-board diagnostic data that could be useful to the EVE IWG to read from the controller.

The EVE IWG discussed the specifics of such options such as those with warranties and labelling. The group also discussed considerations for a GTR such as energy storage and additionally how detailed a GTR would have to be for HEVs, PHEVs or PEVs given specific limitations due to the nature of the vehicle. At this stage, a GTR is possible to focus on deterioration factors on pollutants and possible deterioration factors on range, but a GTR that approaches that have a physical test may not be possible. A GTR that uses DF's already available could use conformity checks that are more similar to the test procedures proposed by the Real World Driving Emissions Informal Working Group or those in place by the WLTP IWG.

#### **6. Discussion of final timelines and mandate (Agenda item 9)**

Regarding in-vehicle battery durability, the EVE IWG thought that a formal document for May for consideration by WP. 29 in November may not be possible, however the informal document in May could lead to a draft formal prepared by January 2020 for consideration by WP. 29 in March of 2020.

#### **7. Method of Stating Energy Consumption (Agenda Item 10)**

The EVE IWG has completed the task of finding leadership to take on the method of stating energy consumption work. Mr. Francois Cuenot indicated at the January 2019 GRPE meeting, that Group of Experts on Cleaner Electricity Production (CEP) are interested in taking over the leadership of the group, but that they need time to acquire the right expertise. EVE IWG members who know of others who might be interested in joining the CEP group are asked to indicate so to Mr. Francois Cuenot or the EVE secretary to forward the message.

## **8. Determination of next EVE meeting location (Agenda Item 11)**

The next EVE IWG meeting was proposed to be in Korea since rotation of the meetings is expected to take place somewhere in Asia. Mr. Olechiw thought that perhaps Hyundai could host the meeting. Mr. Norbert Klein indicated that he would check back with his contacts to see if it was possible to host. The EVE IWG thought that hosting it around the same time as the RDE meeting and the WLTP meeting which to be in Korea would be helpful.

## **9. Summary, Action Items, conclusions (Agenda Item 12)**

Mr. Andrew Giallonardo indicated that his further participation in the EVE IWG will be limited due to a promotion and that his new role that require him to cover more WP. 29 participation.

Mr. Masao Kubodera also indicated that this is his last time with the EVE IWG since he will be more involved more on the topic of vehicle air pollutants. However, he remains available in topics that may cross paths with the EVE IWG and air pollutants.

To cover updates on the validation test program before the May EVE meeting and GRPE, the group is to have a teleconference meeting during the week of May 10.

Action items from the day were recorded and can be found in document EVE-30-13e.