**Draft Meeting Minutes of the 19th Meeting of the Informal Working Group on**

**Electrical Vehicle Safety - Global Technical Regulation**

**(EVS-GTR)**

Location: Berlin, Germany

Date: December 3-5, 2019

Chair: Mr. Martin Koubek (USA)

Co-Chair: Mr. Aleksander Lazarevic (EC)

Co-Chair: Dr. Wang Fang (China) on behalf of Ms. Chen Chunmei

Secretary: Dr. Kenichiroh KOSHIKA (Japan)

Participants: Canada, China, India, Japan, Korea, Russia, the European Commission, OICA, Test houses and laboratories-- total about 60+ participants.

1. **Welcome**

* Mr. Martin Koubek introduced himself as a new chair of this group and opened the meeting.
* Mr. Aleksander Lazarevic of European Commission and Mr. Gerwin Postel of VW welcomed the participants.
* Participants made self-introduction.

**2. Approvals**

* Agenda (EVS19-A03 [1129]) was approved with the cancellation of presentation by China on gas toxicity.
* Draft minutes of 18thmeeting (EVS19-A07) were reviewed. There were several comments and modification from members. The mandate of IWG will be discussed during this meeting. A few amendments were proposed and it will be integrated to the final minutes.
* China reported the results of CN-JP-OICA discussion on the vibration profile (EVS19-HACT0400, EVS19-HACT0410). Background information of OICA proposed profile will be presented by ISO on the 19th IWG meeting.

**3. Reports of UN Activities**

* Co-Chair (European Commission) verbally introduced the related topics of the 179th WP29 held in November 2019.

**4. Update on ongoing and planned research and rulemaking activities**

* 1. Reports from Russia (EVS19-D01)
* Russia introduced their proposal to amend UNR100, requiring the complete sealing of all electric power train according to IP66 (inside passenger/luggage compartment) or IP68 (outside passenger/luggage compartment) and prohibiting open-type traction batteries.
* Nikola recalled that this proposal is significantly different from the GTR and therefore it was advised by GRSP to discuss in this group.
* OICA commented that the aim of this group is not to introduce technology restrictive provisions and the water immersion situation is under discussion in this group.
* EC agreed that the technical topics on EV safety should be discussed in this group before being raised in GRSP.

* 1. ISO (EVS19-D02)
* Dr. Matthias Reichert, the convenor of TC22/SC37/WG3, provided a liaison report of his group. ISO is currently working on the amendment of ISO6469-1 to include the state-of-the-art thermal propagation test procedures. Two approaches; (1) demonstration test and (2) documentation, are considered.
* Different triggering methods are being evaluated. The suitability of the test procedure will depend on cell type and construction. Each procedure has pros and cons. Extent and influence of the DUT modifications are also considered.
* The 1st version of WG has been developed. DIS registration should be made before March 2021, where no new trigger method should be introduced. The next meeting will be in May 2020 in Japan and develop WG#2 where several questions will be addressed.
* Basic triggering methods at cell level have been defined but those for pack or vehicle level were still under development.
* OICA commented that the objectives of ISO work and this IWG are not the same. ISO does not focus on the pass-fail criteria and suitability for regulatory purposes.
* EC appreciated that the outcome of this ISO work will be useful for GTR development but the timeline does not match at the moment.
* VDA commented that the DIS (targeted by March 2021) will be publicly available.
* Chair commented that setting cut-off date for new idea during the standard development would be a good practice that can also be applied for the GTR discussion.
* OICA noted that the test procedure developed by ISO should be validated before the adoption as a GTR test procedure. On the other hand, the ISO work for documentation is to provide a guidance for the requirements of GTR phase 1.
  1. Reports from Contracting Parties
* Canada: Validation of GTR phase 1 test procedures is on going.
* China: No progress since the last meeting. Waiting for the final publication.
* Japan & EC: Working on the transposition to UNR and will be introduced to GRSP next week. Once UNR is adopted it will be introduced into national/regional requirements.
* Korea: New KMVSS harmonized with GTR20 will be released in the next year and likely to apply from July 2021.
* India: AIS038 will be modified to align with GTR/UNR. For L category, separate standard (AIS156) in line with UNR136 is also under development. Implementation of these standards will be decided later on.
* Russia: UNR100 and GTR20 are under study.
* US: BMS functionality tests are under validation and if any improvements of the phase 1 requirements were required, it will be reported to this group.

1. **Technical information from Contracting Parties and Industry (OICA) about the (10) items for phase 2**

**5.1 Thermal propagation and methods of initiation in battery system**

* 1. European Commission (EVS19-E1TP-0500)
* JRC reported the progress of their research. The short-stack/module tests (with 40Ah pouch cells) are on going.
* Different severity levels of initiation were tested. Criterion for stopping the initiation needs to be evaluated further.
* OICA asked how statistically meaningful results can be obtained. JRC admitted that it will be difficult to conduct a large number of tests by 1 laboratory. The level of confidence we need for regulatory testing should be discussed.
  1. Japan (EVS19-E1TP-0600, EVS19-E1TP-0601, EVS19-E1TP-0602)
* Japan held a view that nail penetration method could be an effective initiation method for certain configurations of the cell/battery system.　Questions from Canada (EVS19-E1TP-0601) were also answered.
* OICA commented that a nail penetration method will introduce external energy through mechanical means which will influence the outcome of the thermal runaway test. OICA also noted that the direction of nail application might affect the reaction.
* OICA questioned whether a release of gases, during the test, would be evaluated and considered as performance criterion in the GTR requirement. Japan commented that as the vehicle level test was not conducted yet it could not be assessed so far.
  1. China (EVS19-E1TP-0100, EVS19-E1TP-0200)
* China reported the progress of their study on the heating power and heating area. Heating power should be sufficiently high to minimize the induced energy. Smaller heating area would result in the lower induced energy.
* OICA asked if China has some idea about the appropriate limit of the induced energy, like 5% as suggested by Canada. China is still investigating it.
* NHTSA asked that for more stable cells, higher temperature will be required for causing thermal runaway. So, these tests would penalize REESS designs with stable chemistries by testing at more severe conditions than REESS designs with less stable chemistries. It will be necessary to consider this discrepancy while developing a uniform test procedure for all types of REESSs.
* China also reported on the update on the self-triggering method.
* NHTSA asked how multiple cells that are connected in parallel would be treated. China will provide some test results for the future meeting. NHTSA commented that faulting multiple parallel cells simultaneously is unrealistic and does not represent a spontaneous thermal runaway event that could possibly occur in the field.
  1. Canada (EVS19-E1TP-0700)
* Canada introduced the review of their thermal propagation principles. Thermally stable chemistries could be managed by adding additional stop conditions or limit of induced energy.
* OICA had doubts since this test is based on the single cell characterization and wondered how it can be applied to the compliance test of self-certification system. Considering a variety of solutions, a combination of different approaches might be needed to account for differences among certifications systems.
  1. Korea (EVS19-E1TP-0400)
* Korea presented their experiments (at cell, module and pack levels) using a small heater to initiate thermal runaway in a single cell.
* JRC asked bout the applicability of this test method since the tests were done with a pouch cell and the thermal runaway might occur at lower temperature. Korea said it plans to assess other types of cells using their test method.
* JRC also asked about the selection of a target module and about the criteria whether the occurrence of propagation could be allowed or not, as long as the safety of occupants is assured.
* OICA asked if the software modification is needed due to the system modification. Korea responded that the software and electrical connections of the original system were not modified.
* Korea considers that the test procedure to be practicable and can be conducted by the technical service independently from manufacturers.
* Nikola noted that this test procedure is not representable.
* OICA followed with a comment that other regulatory groups are requiring higher energy density for the future, which may cause more severe thermal runaway phenomena once it occurs. Other measures to mitigate the thermal runaway will be expected.
* EC commented that the safety of the occupant should be considered. Smoke intruding into the vehicle cabin creates a safety risk to occupants; therefore, smoke and other emissions from the battery pack should be considered.
* Canada noted that they are conducting the test with vehicle level to assess the influence to the occupants. Time for detection of the event will also be the factor to be considered for the pass-fail decision. NRC asked if there was any electrical failure of heating elements before thermal runaway occurs. Korea admitted that there was such a failure and countermeasures are being considered.
* OICA commented that higher energy density cells will require the system design measure to deal with the characteristics of such cells.
* OICA sees the benefit to conduct the test on the vehicle level while UNR100 allows the REESS system level approval without vehicle integration. It is necessary to consider the way to allow the system level certification.
* NHTSA commented that it is also focusing on vehicle level testing for BMS functionality requirements and urged groups doing research on thermal runaway propagation to also focus on vehicle level testing for regulatory applications.
  1. OICA (EVS19-E1TP-0300, EVS19-E1TP-0301)
* OICA updated on the progress of their study on the internal short detection and thermal runaway prevention.
* China questioned whether the detection method of an early stage of the internal short are still in the research stage and not yet implemented. OICA responded that such technologies are being implemented, but proprietary for each manufacturer.
* OICA commented that it is necessary to maintain documentation approach for the future in order to allow detection and mitigation measures.
* China noted that technology development should not affect the criteria for safety. Regulations should focus on safety requirements and test methods to help OEMs reduce safety risk and protect personnel. OICA responded that we should maintain the safety target, but not necessarily through pass/fail criteria.
* OICA aims to conclude this concept by the end of 2020.
  1. Summary
* Chair commented that this topic contains too many details and there might be a need for splitting the work into subgroups.
* Co-Chair (EC) opposed this idea.
* Nikola recalled the history of thermal propagation discussion. Since the finalization of phase 1, a white paper was discussed over the last 3 meetings. It will help for keeping us on the same page.
* Chair noted that the timelines of the majority of research activities on this topic are not matching the mandate of this group.
* Japan commented that with a growing market of electric vehicles, certain incidents might happen and therefore we need to discuss a further improvement of regulatory requirements to prevent it.
* US commented that the industry’s early detection method is not compatible with proposed initiation methods. By moving forward with these tests, we might be steering the industry into changing their systems by focusing more on reinforcing physical safeguards instead of improving early detection.

**5.2 Flammability, toxicity and corrosiveness of vented gas**

* 1. EC (EVS19-E2TG-0200)
* EC (JRC) presented the status of their research on this topic. JRC introduced a new equipment for gas analysis and is still continuing the research on this topic.
* OICA asked in which matrix the data could be analysed. In reality, the gas would be a mixture of several components. The experimental work will start with known substances.
* OICA also asked if the timeline will match with the current plan of phase 2. JRC admitted it will be rather difficult. OICA requested each CP to clarify the timeline with respect to the plan of phase 2. NHTSA also considers this will not be a topic for phase 2 since it will still require a lot of research.

**5.3 REESS vibration profile**

* 1. China (EVS19-E3VP-0100)
* China explained that the vibration profile has been revised following the last meeting. The presentation focused on the process to determine a more representable vibration profile. The most of the contents was already presented to this group in previous sessions.
* NHTSA questioned how this vibration profile is correlates to any safety concerns and stated that there is no field data to justify such a test. China commented that during phase 1, vibration was considered a safety requirement and in Phase 2 wishes to improve the profile to be more realistic.
* SGS-TÜV noted that the failure mode from such a test profile will not cause any safety issues in the field.
* Nikola explained that the usual practise of NHTSA is to test a brand-new vehicle and judge the compliance. Field problems of used vehicles are treated under the recall program.
* OICA recalled that its basic position is to drop the vibration test as there are no field issues due to vibration.
* EC commented that the discussion in Phase 2 aims at addressing durability issues while for GTR phase 1, the profile of UNR100 was simply copied.
* China commented UN38.3 includes vibration as a safety requirement indicating it is a part of safety issues. OICA commented that vibration profile of UN38.3 is used as a basis of current UNR and GTR phase 1.
* Japan commented that we are repeating the same discussion and the group should aim for more constructive discussions.
* OICA claimed that China confirmed that the Chinese profile is developed for durability. China responded that China’s profile is to verify the safety of the battery pack and detailed content has been already introduced in previous meetings.
* SGS-TÜV commented that there were some cases where design failures had been identified during the vibration test. Minimum level of vibration requirement will be necessary.
  1. ISO (EVS19-E3VP-0200, EVS19-E3VP-0201)
* Dr. Michael Herz, convenor of ISO/TC22/SC37, presented the background of the vibration requirements of ISO6469-1 edition 3.
* China commented that ISO profile is to have the equivalent level of intensity as R100 profile, which was derived from UN transport test.
* OICA noted that if contracting parties still wish to adopt vibration requirement, ISO profile should be considered.
* For developing the ISO profile, the test track information was not shared and harmonized because these are OEM proprietary.
* Japan reminded the open questions from the CN-JP-OICA meeting.
* OICA responded that
  + Rough road conditions: different road conditions and driving conditions were applied as explained by ISO
  + Recommend Japan to check with the national standardization committee to obtain the information from ISO profile development
  + For the question of upper frequency, manufacturer’s specific profile might be used.
  + Calculation method of LIV is described in the appendix of the ISO6469-1 and if there is any question, it may be addressed to ISO.
  1. Summary
* Chair advised that CP should consider whether vibration should be a safety requirement or not.
* Chair requested OICA to summarize their proposal and the rationale.

**5.4 Water immersion test**

* 1. China (EVS19-E4WI-0100)
* China summarized the information gathered with the white paper.
* OICA stated that the summary analysis made by China does not properly capture the views expressed by each answer and recommend to delete all statements written as summary. China admitted that the statements mentioned as “summary” are a Chinese position.
* OICA questioned what additional benefit can be provided by a component level test since there are certain requirements on vehicle level water immersion.
* China noted that vehicle and REESS level tests are corresponding to different application scenarios.
* US noted that complete submersion of a REESS for a long period of time occurs in floods that are considered catastrophic events. Since conventional fuel vehicles are not subject to tests representing such a catastrophic event, neither should EVs unless there is evidence of a safety need in the field. US reported insurance data from Hurricane Harvey where 101 EV submersion related claims of which 72 were total losses.  There was no evidence of fire or electric shock with these 101 vehicle submersions. Comprehensive field data should be considered before such a test is introduced into the GTR (data can be obtained from HEVs and PEVs).
  1. Korea (EVS19-E4WI-0300)
* Korea explained its intention to introduce REESS immersion test.
* In Korean analysis, clearance and creepage distance might influence the safety performance of the REESS when immersed. Therefore, Korea recommended adopting such requirements as adopted in ISO6469-1:2019.
* Korea also recommended applying a REESS immersion test of ISO6469-1:2019. OICA cautioned that there is an important note on this requirement of the ISO standard.
* OICA commented that the requirements included in the industry standard may not necessarily be relevant for regulatory tests. Chair supported this view, while it is necessary to look at what is described in the standards.
  1. Japan (EVS19-E4WI-0200)
* Japan introduced its guidance for owners of flooded or submerged vehicles.
* India questioned whether??? the US are also giving similar advice to the owners.
  1. Summary
* Canada commented that requiring a sealed battery pack is not appropriate as it is design restrictive. The relevant ISO work can be referred in the rationale section. OICA commented that the OEM requirement of IP degree for battery pack is not necessarily for water immersion but it is for durability and reliability.
* China noted that a waterproof feature or extra design is required to guarantee the safety of a battery pack.
* EC commented that, with respect to the mandate, if there is a need, we can refer to GRSP to extend our mandate.

**5.5 Other issues - High voltage safety**

* 1. OICA (EVS19-E5OI-0200, EVS19-E5OI-0201)
* OICA explained that this topic is still under discussion by the industry. With the trend of increasing battery capacity and system voltage, the HV safety measures are being discussed within the standardization bodies. Setting energy limit of Y-capacitance without having other alternatives will bring design restrictions.
* China will consult with their experts.
* NHTSA commented that, after the review of the response received from Japan, NHTSA concluded that they can support the alternative method for isolation resistance measurement using two voltmeters.
* JASIC introduced its question and comments, and those should be further considered.
* This topic will be further discussed.

**5.6 Protection during AC and DC charging and feeding process** (EVS19-E6AC-0100)

* OICA prepared a draft rationale for winding-up the discussion of this topics for GTR phase 2.
* EC Co-Chair appreciated the initiative of OICA and invited the members to review the proposal of the rationale.
* NHTSA noted that their report on charging safety has been distributed for the group. (EVS19-K01) The test procedures provided in this report involves features in both the charger and the vehicle. NHTSA does not have authority to regulate the charger and requirements for the charger are outside the scope of the GTR. Therefore, NHTSA is providing this report as guidance for industry standards to evaluate safety during charging.

**5.7 Long-term fire resistance test** (EVS19-E7FR-0100)

* OICA prepared a draft rationale for winding-up the discussion of this topics for GTR phase 2.
* Canada supported the intent of the rationale.
* EC Co-Chair invited the members to review the proposal of the rationale.

**5.8 REESS rotation tests** (EVS19-E8RT-0100)

* OICA prepared a draft rationale for winding-up the discussion of this topics for GTR phase 2.
* Canada commented that, for the post-crash vehicle assessment of lead-acid batteries, current requirements of F(C)MVSS305 will continue.
* China noted that for new GB on battery safety, the rotation test has been removed.
* EC Co-Chair invited the members to review the proposal of the rationale.

**5.9 Overcurrent requirements + tests** (EVS19-E9OC-0100)

* OICA commented that this test should be reconsidered and the transposition to national regulation should be suspended. OICA stated that the safety hazard stemming from these abnormal conditions is already addressed by other tests. OICA also commented that the test setup is too challenging for Heavy vehicles.
* NHTSA mentioned that their research on BMS functionality testing reveals that the test setup is not an issue. NHTSA also added that having a hazard addressed in one test does not rule out the need of another since they can stem from different sources/catalysts.
* EC and Japan commented that, at the moment, there is no sufficient evidence to drop this test from UNR. Korea and India will neither suspend this test for the moment.
* This topic will be further considered in this group.

**5.10 Post-crash REESS safety assessment and stabilization procedures**

* This topic was not discussed as no material was provided for this meeting.

**5.11 Light electric vehicles (e.g. categories L6 and L7, low speed vehicles)**

* This topic will be reconsidered at the future meetings.

**6. Confirmation of the IWG meeting rules for a smooth operation in phase 2** (EVS19-A12)

* Secretary encouraged the participants to keep to the deadline for submitting the materials.

**7. Wrap up of the meeting Actions items and future meetings**

**7.1 Action Items**

* Chair reminded that the mandate of this group is to submit the proposal at the GRSP meeting in December 2021.

ACTION ITEMS (EVS19-A10)

**19th Meeting of EVS-GTR Informal Working Group (Berlin)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Action Items** | **Responsibility** | **Due** | **Status** |
|  | All CPs to share their views and information on developing more defined test methods on the approach to the TP, via, e.g., validation tests by CPs: CND, EC/JRC, China, Korea, and others.  Each CP to confirm whether using a rapid localized external heating method is the most appropriate  -CPs conducting research and/or validation testing to exchange information  -Fill out the ‘suitability table’ (will be provided by CND) to establish suitable method(s)  -CND to develop concrete proposal for rapid localized external heating test procedures (at vehicle level) | CPs | (pending approval, CND can provide as early as 02/20, in which case CPs are urged to provide feedback by end of 3/20)  At the latest 4 weeks before the MTG) |  |
|  | CPs asked to consider the need for the vibration profile ??? requirement given the differences in opinions among the stakeholders whether or not it is a safety or durability issue.  Feedback from CPs on the profile  Follow-up needed to the CN- OICA discussion on Vibration Profile  Interested stakeholders (CPs and industry) to prepare explanation on why vibration requirement(s) would not be necessary in the Regulatory part of the GTR.  CPs asked to provide feedback on OICA’s proposal (based on ISO?) made available at 19th IWG | OICA  CPs  CN | 4 weeks before the MTG)  3/31 |  |
|  | EC will follow-up to contact LV experts to complete the task. Feedback from all stakeholders will also be needed. | EC  India | Two months before the MTG | NB: Light vehicle experts in India were contacted |
|  | Canada to provide results of its analysis on non-crash EV-related incidents; other CPs and stakeholders also encouraged to share information on such incidents | All | On-going |  |
|  | In regard to water immersion, all CPs are asked to review the White Paper on WI submitted at the 18th IWG meeting and provide feedback, as well as share any pertinent information, such as evidence and test methods and test data, if available and as appropriate. | All CP | DDL? |  |

**7.2 Future meetings**

* Next meeting will be in Tokyo, Japan on May 26-28, 2020.
* The meeting after the next meeting will be in November 2020.

**7.3 Closing**

* IWG acknowledged and appreciated the support of VW.
* Chair thanked to the Secretary for all the support during the meeting as well as to all the participants for their active participation and closed the meeting.