**Draft Meeting Minutes of the 22nd Meeting of the Informal Working Group on**

**Electrical Vehicle Safety - Global Technical Regulation**

**(EVS-GTR)**

Location: Virtual meeting hosted by the European Commission

Date: October 19-22, 2021

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, USA, OICA, CLEPA, Test houses and laboratories, related industries, standardization bodies -- total about 80 participants.

1. **Welcome**

* Mr. Martin Koubek welcomed the participants and opened the meeting.
* Co-chair, Mr. Aleksander Lazarevic thanked everyone’s cooperation for preparing this meeting. He also clarified that according to the agreement within the EU, The European Commission will represent all MS for this meeting.
* From Contracting Party, Ms. Stefanie Goodwin from NHTSA became a part of the US delegates and Mr. Junichi Tsukada of JASIC Washington represented Japan. From Spain, Mr. Albert Vilaplana, joined for this meeting.

**2. Approvals**

* Agenda (EVS22-A03 [1019]) was approved.
* Draft minutes of 21st meeting (EVS22-A07) were reviewed. The amendments made on the draft minutes and the minutes was approved.
* The secretary introduced the status of the action item list from the last meeting (EVS21-A06).
* Item #1 and #2 (thermal propagation): So far, only Japan provided the input after the last meeting. Other CPs are invited to provide inputs.
* Item #3 (overcurrent): The US discussed with OICA about the possibility of component level test and OICA will present it at this meeting.
* Item #4 (test manual for phase 1) and #6 (water immersion): The inputs from the US were already posted on the website.
* Item #5 (vibration): The progress will be reported with the drafting team report.
* Item #7 (thermal propagation): The outcome has been uploaded.

**3. Reports of UN Activities**

* The Chair briefed that, at the 184th WP29 held in June 2021, a 18-months extension of the mandate of this IWG was endorsed, subject to confirmation by AC3 at its November session.

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

**4.1. Transposition of GTR20 to National Regulation**

* The US (EVS22-D02) – NHTSA plans to release NPRM for public comment for implementing GTR20 in 2022. NHTSA published two research reports related to EVS.
* Japan (EVS22-D03) – The updated UN-R100, 94, 95 and 137 have been adopted as national regulation in June 2021.
* India (EVS22-D04) – Implementation of Indian Automotive Industry Standard AIS-038 revision 2 is still waiting for the final notification by the government and adoption of post-crash regulations corresponding to UNR94, 95 and 137 are under preparation.
* China (EVS22-D05) – 3 mandatory national standards, GB18384, GB38031 and GB38032, have been implemented. China briefed the key difference between GTR20 and these Chinese Standards.
* Korea (EVS22-D06) – Amendment to the Korean motor vehicle safety standard (KMVSS 48) has been implemented for new type of vehicles since July 2021 and will apply for all vehicles as of July 2023.
* Russia (EVS22-D07) – Russia is preparing for the implementation of updated versions of R94, 95 and 100 that will apply in the Eurasian Economic Union from 2025.
* Canada (EVS20-D06)– No update from the report at the last meeting. CMVSS305 is referencing the test procedures of FMVSS305. Once NHTSA issue NPRM to implement GTR20 into FMVSS, Canada will also put priority on this subject. After completion of GTR20 phase 2, FMVSS and UNR100 will be accepted as self-certification standards.
* The European Commission – The EC verbally noted that the updated UN-Rs are not yet mandatory in the EU but are accepted for EU type approval. Once those UNRs are translated and published in EU official Journal, those will become mandatory by updating the list of applicable regulations in GSR.

**4.2. ISO TC22/SC37/WG3 activities (EVS22-D01)**

* Dr. Annika Ahlberg Tidblad, on behalf of ISO TC22/EC37/WG3, presented the progress of the development of ISO 6469-1 Amendment 1, that addresses thermal propagation. The comments to DIS (Draft International Standard) are under discussion and aiming for publication in spring 2022. This document will not include pass-fail criteria and is not aimed to be used for the regulatory purpose. Guidance for the test method selection and the target cell selection will be included. A guideline for developing the safety case documentation is also attached.
* ISO-6469-1 is considered to be industry best practices and outlines reporting requirements that could potentially be used in GTR Phase 1 documentation requirements. Presently the GTR Phase 1 Requirements define egressing the vehicle in 5 minutes and does not contain detailed requirements for the Thermal Runaway documentation required. The US commented on the need to detail the current GTR Phase 1 documentation requirements. The DIS of ISO 6469-1 Amendment 1 is available from ISO web store, or can be obtained from the national bodies for ISO.

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

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

* 1. Canada (EVS22-E1TP-0400)
* CNRC presented the development of TRIM heater for large sized prismatic cells with aluminium casing. It is necessary to assess the internal structure of the cell to ensure effective heat transfer for causing internal shorts. With cell level experiments, it was possible to cause thermal runaway of MNC 60Ah cells. Canada considers that side-wall rupture (SWR) as a result of thermal runaway initiation should be avoided. Element heat contact conditions and cell internal structure will affect the applied heat flux.
* The US commented that SWR will not be a representative situation and should be avoided.
* OICA also commented that SWR should be avoided and it is a good example of the limitation of the test method.
* Transport Canada recalled the round table questions that should be completed by the Contracting Parties. Canada indicated that current GTR rationale specifies that parking mode should be considered.
  1. EC (EVS22-E1TP-0200)
* JRC reported on its study on the thermal runaway criteria. Presented JRC’s experimental data included a number of non-thermal runaway events, which, however, fulfilled the criteria on Tmax and dT/dt as described in the current GTR EVS text. JRC work has shown that GTR EVS criteria for thermal runaway need clarification:

- Criterion (b) (Tmax op & dT/dt) is shown not to be always robust.   
At cell level three non-TR events were identified as TR when criterion (b) was used.

- Condition (i) – specification on voltage drop – needs to be defined.   
At the cell level voltage condition (i) was found to be relatively independent from the voltage drop threshold value.

* - dT/dt condition (iii) was demonstrated to be sensitive to filter parameters (e.g. time averaging window), some specifications should be introduced. Canada commented that continuous temperature increase (i.e. positive second derivative of temperature with time) should also be looked at.
* China questioned why different location of the temperature measurement that is closer to the heater is used. JRC replied that signals from thermocouples installed at other locations have been recorded and their analysis would be presented at the following meetings. For the analysis of robustness of thermal runaway criteria, signals of a thermocouple closest to the heater was considered the worst case scenario for non-TR events.
* The US commented this was a good study and noted that the test criteria in GTR20 Phase 1 are not yet incorporated into the GTR 20 regulatory text.
  1. Japan (EVS21-E1TP-0500, 0501)
* JASIC presented their idea how to proceed with the development of the test procedure. Japan suggested to use tentative draft as a basis of the discussion, that is provided as EVS22-E1TP-0501.
* Japan clarified the intent of the optional method and main method. If the manufacturer would choose the method that can initiate thermal runaway satisfying the defined criteria, such test procedure would be accepted. Otherwise, main method must be used.
* The US commented that repeatability, reproducibility and practicability of the test procedure should be confirmed and to do so, physical testing program should be carried out in addition to the theoretical discussion.
* Canada commented that, although he is supportive to follow the process suggested by Japan, it is important to decide on some fundamental questions before going to the details. It would be necessary to assess the equivalency between the procedures.
* China also supported such process and commented that current Chinese national requirement (GB38031) already adopted similar way as proposed by Japan.
* OICA appreciate that Japan indicated how the regulatory document will be modified.
* The EC noted there might be some difficulty in avoiding different interpretation by the Technical Services in implementing the two-step approach.
* The chair summarized that we may need to agree on some basic issues.
  1. China (EVS22-E1TP-0100)
* China shared their experiences in implementing thermal propagation test in national mandatory standard. In their tests, cooling system works according to the conditions of vehicle application.
* Canada understand that current Chinese standard set the related systems are fully operational but for this GTR discussion, it is necessary to consider these conditions as certain number of events are occurred at parking situation.
* Under the current regulation, the initiation method can be chosen by manufacturer.
* ISO noted that the discussion at ISO and the discussion here are in different perspective, although the outcome of ISO is planned in April next year and a lot of elements can be applied in GTR, it is necessary to take account of the different perspectives.
  1. US (EVS22-E1TP-0600, 601, 700)
* The US introduced NHTSA’s research program being carried out by MGA. There would be several challenges in achieving feasibility, objectivity, practicability. The US introduced their plan of the research tests.
* The US is also conducting the research for early detection with two national labs. The results are expected in the summer next year.
* JRC noted that presented pictures showed that smoke had entered into the cabin in less than 5 min from the TR initiation and asked whether this would be representative for this vehicle model or was it a consequence of vehicle’s modifications. MGA confirmed that this was not related to vehicle’s modifications.
* Japan questioned that the hazardous situation due to smoke is not clear and it is important to define what would be hazardous situation. MGA noted that as a laboratory, it is necessary to measure the data for regulators to make a decision.
* JRC commented that the presence of smoke will be harmful.
* The chair asked about the temperature of the passenger compartment. According to the data obtained by MGA, the temperatures were not so high in 5 minutes after the thermal runaway. Fire occurred much later i.e.20 minutes later.
* A representative of Nikola commented that if the test is conducted with a main switch ON condition, certain warning would be given. NHTSA tested with an OFF condition to understand the phenomena.
* China asked what happened after 300s. The US commented that more data will be provided later.
* Korea asked how the position of the initiation cell was determined. BSI commented that the guidance of the selection of the initiation cell is under discussion at ISO.
  1. OICA (EVS22-E1TP-0300)
* OICA considers that a documentation approach should remain available although an objective test procedure is being developed. OICA proposed to consider developing a guidance material like those prepared for the cyber security or software updates to help practical implementation of the documentation approach for thermal propagation requirements.
* NHTSA’s position is that the documentation approach from Phase 1 needs to be improved and made more robust as a means of ensuring OEMs address this safety hazard without being design-restrictive and simultaneously allows regulatory bodies to continue to regulate as technological innovations evolve rapidly.
* OICA commented that ISO-6469-1 deliverable will help developing more robust documentation requirements.
  1. General discussion
* Canada noted that this group should focus on what would not be addressed by ISO.
* The EC supported the view of Canada and emphasised that pass/fail criteria and associated verification methods are not covered by ISO 6469-1 amendment and will need to be defined for the GTR EVS.
* . The US proposes that the Task-Force should address two focal points: (1) continue development of TR test procedure development, and (2) further detail and develop the GTR 20 Phase 1 documentation requirements. The US is interested in leading the documentation development. JRC commented that even if we set two sub groups, coordination of the two should be maintained.
* The chair suggested that China will lead overall task of thermal propagation with two areas of focus, #1 (Testing approach) support by Canada and Japan and #2 (Documentation) support by the US and EU.

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

* 1. JRC (EVS22-E2TG-0200)
* JRC reported on their research progress for the detection of liquid electrolyte leakage by using Li ion chemosensors.
* The US wondered where this work would be applied in the GTR. JRC noted that because “no electrolyte leakage” is one of the pass/fail criteria of the GTR, it would be ideal to have the detection method.
* The US asked whether Li ions are targeted because of their toxicity. JRC replied that Li ions themselves are not toxic but their presence in the vicinity of a battery pack would indicate a leak of electrolyte.
* JRC noted that their motivation is the current procedure of visual inspection would not be precise enough and therefore more robust method should be developed.
  1. China (EVS22-E2TG-0100)
* China reported on the progress of their research on the measurement of the venting gas.
* The chair requested JRC and China to be tasked on drafting the requirements in this area.
* OICA recalled that a Swedish research for first responders in the crash event has been published.

**5.3 REESS vibration profile**

* 1. China (EVS22-E3VP-0100, EVS22-E3VP-0200)
* China introduced the content of the updated proposal (EVS22-E3VP-0200).
* NHTSA reiterated that this test does not address a safety need. China also reported on the results of the drafting team meeting held on Sep 29. (EVS22-E3VP-0100). At the meeting several questions were raised and China provided the response to these questions. In the newly provided materials, China introduced the actual cases of battery connector fracture, BUSBAR fracture, battery electrolyte leakage, battery pack tightness failure and other scenarios caused by vibration.
* OICA commented on the key issues introduced at the drafting team meeting (EVS22-E3VP-0101) and which were not yet fully addressed by the drafting team.
* The chair asked if there is any field event associated with vibration. China noted that it will be difficult to identify from the field fire incidents if the cause is due to vibration for the reason that the evidence has been burned in the fire. OICA recalled that the joint submission by US-CA-OICA at the last meeting includes FMEA analysis where the failures caused by the vibration will not lead to an immediate safety hazard. The US recommended a “sanity check” or comparison of recent field events to these tests to determine if the vibration tests are representative and are addressing an actual safety need. Further, the GTR should focus on minimum safety requirements rather than on reliability requirements.
* China believed that their profile has been developed through an actual driving and therefore should be more representative and appropriate.
* JRC commented that eliminating vibration test would make the GTR EVS more lenient and this would be risky given the fact that at the moment the root-cause remains unidentified for about 30 % of battery electric vehicle fires.
* JRC presented their comments and questions on the China’s regulatory text proposal for the vibration test, which were also explained at the drafting team meeting (EVS22-E3VP-0102).
* The US and Canada repeated that the vibration would not be a safety issue and have no intent to adopt it into national requirement. The reason for having vibration included in GTR phase 1 is simply because it was already included in the UN regulation.
* China noted that failure due to vibration is happening, which could lead to safety accidents by causing problems with mechanical or electrical connections.
* OICA also recalled that over-engineering should be avoided and ISO 6469-1 profile has been developed based on the vehicle data from Germany.
* The Chair requested China, JRC and OICA to continue the dialogue on this subject.

**5.4 Water immersion test**

* 1. Drafting team report (EVS22-E4WI-0100) and China (EVS22^E4WI-0200)
* China briefed the outcome of the drafting team meeting.
* The chair requested to involve everyone who is interested for such a TF meeting for the future.
* China showed a video putting a battery pack with damaged sealing was submerged into fresh water for 30 minutes and taken out, then after about 6 hours a fire occurred.
* OICA commented that this is abused condition rather than a normal condition which will not be tested for conventional vehicles. China responded that it is not intended to provide a standardized test condition but to simulate a catastrophic condition.
* The US commented that the catastrophic conditions at which the batteries were subjected to should not be required in minimum standards such as the GTR No. 20. The EC noted that the existing requirements in GTR Phase 1 is sufficient and so far, there is no evidence given if this needs to be changed.
* Canada was confused that the video shown was not corresponding to the proposal in the material where 2 hours observation period is prescribed.
* Russia commented that the sealing damages have been observed in the market.
* Korea noted that the water tightness or an equivalent requirement are necessary.
* The US and OICA noted that in the recent flood situation no EV fires have been reported.
* China noted that China is willing to continue research on the water immersion test with South Korea and Russia and they want to provide more supporting materials in the following meetings.
  1. US (EVS22-E4WI-0300)
* The US introduced their research on battery immersion. Based off research completed to date, a battery immersion test in water if lower salinity (<0.1% NaCl) for a shorter immersion duration would be more stringent than a test with longer immersion duration in sea water. Their reports were available on the IWG website.
  1. Idiada (EVS22-E4WI-0400)
* The dimension of the nozzle in current GTR20/UNR100 was based on IEC60034-5:2000 but the drawing of the updated standard, IEC60034-5:2020 was modified to a slightly different dimension and the suppliers are offering the products based on the latest IEC standard.
* GTR was established before the amendment of IEC and therefore old drawing was used.
* The US advised that we should at first contact IEC why the dimension has been modified.

**5.5 Overcurrent test**

* 1. OICA (EVS22-E5OC-0100)
* OICA indicated the practical issues to implement the overcurrent test for heavy vehicles at vehicle level and therefore proposed to allow a component based test as an alternative.
* NHTSA stated a component-level test proposal is acceptable; however, compliance/enforcement testing is always completed at the vehicle level in the US. This component-level test proposal is geared towards type-approval systems.
* The group indicated general support on this proposal and any questions or concern on this proposal should be sent to OICA for preparation of the detailed draft for the next meeting.

**6. CLEPA issue on R100-03**

* No discussion. The topic was officially cancelled by CLEPA.

**7. Confirmation of the IWG meeting rules for a smooth operation in phase 2**

* The chair explained the background of the copyright disclaimer. According to the UN secretariat there was an incident with a breach of a copyright in the UN Headquarters and in avoidance of any further infringements the UNECE requires all delegates to sign the disclaimer in case they are intending to submit working materials for the publication on the UN website . The chair will consult with the GRSP secretary for the latest update.

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

**8.1 Action Items**

ACTION ITEMS (EVS22-A10)

**22nd Meeting of EVS-GTR Informal Working Group (Virtual)**

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|  | **Action Items** | **Responsibility** | **Due** | **Status** |
|  | Each CP to provide feedback about EVS21-E1TP-0200 with excel file (with CC to secretary) | CPs | End of November | JP, OICA, EC submitted, but can be modified. |
|  | CA to compile the feedback from CPs, then to submit the summary to Secretary. | CA |  |  |
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**8.2 Future meetings**

* Next TF meeting on thermal propagation issues via Web with a secretarial role by Canada on January 19 -20, 2022 8PM-10PM (JST).
* Co-sponsor+ meeting will be scheduled on January 26th.
* Next IWG will be scheduled between March 22 through April 1 for 3 hours x 4 days. The timing and the format (virtual or hybrid) will be confirmed by the end of January.

**8.3 Closing**

* The Chair and co-chair thanked all for their contribution and the Secretary for all the support for the meeting.