

SGS-2-10 Rev.1

**2nd Hydrogen Fuel Cell Vehicle (HFCV) – Subgroup on Safety (SGS)
Meeting**

Geneva – United Nations

14-16 January 2008

Brief notes from this meeting are shown below in red.

PROPOSED AGENDA

1. Welcome and Introductions

Co-chairs welcomed attendees, introductions. A list of meeting attendees is attached. A revision of SGS responsibilities was announced. Japan, Germany and the United States continue to be co-sponsors of the HFCV-SGS. Mr. Martin Koubek (U.S.-NHTSA) will now be co-chairman of the SGS along with Mr. Kazuyuki Narusawa of Japan. Mr. Nha Nguyen (U.S.) will serve as the U.S. delegate and secretary to SGS, which includes responsibility for drafting the FCV GTR.

2. Practical Arrangements

2.1 Documents (Detailed list in Appendix)

Documents from the 1st SGS meeting are listed in the appendix to this agenda. The actual documents are available at the SGS website. The URL address for the SGS website is noted in the appendix.

3. Approvals

3.1 Agenda

3.2 Minutes/decisions of the 1st Meeting

The agenda for this 2nd meeting of the SGS was approved with the addition to Section 7.2 to discuss and clarify “hydrogen storage systems”. The draft minutes of the 1st SGS meeting were approved with minor clarifications to organizational references.

4. Reports of UN Activities

4.1 143rd Session of WP.29 (November 2007)

4.2 42nd Session of GRSP (December 2007)

Mr. Albus (Germany) provided a report on the 43rd WP.29 meeting. Mr. Albus provided WP29 with a summary of the 1st SGS meeting that was held in Bonn in September 2007. It was affirmed at WP.29 that the existing Japanese FCV regulation would be a

compendium document for the SGS development of the FCV GTR. Mr. Albus also reported that WP.29 established an informal working group under GRSP to develop proposed amendments to ECE R.100 (high voltage safety) to accommodate all categories of vehicles, including FCVs, that use high-voltage systems. This new electrical safety working group should coordinate closely with SGS for purposes of the electrical safety aspects of the FCV GTR.

Mr. Van Der Straaten (OICA) provided a summary of the 42nd GRSP meeting. A review of the 1st SGS meeting in Bonn was provided to GRSP; however, there was not much further discussion about SGS since the primary focus of the 42nd GRSP was head restraints. There was mention in the 42nd GRSP of the new electrical safety WG. Document GRSP 42-1 is the German proposal to amend ECE R.100, while GRSP 42-26 provides the Japanese requirements for electrical safety. It was agreed at GRSP that the electrical safety WG would have responsibility for developing electrical safety updates to ECE R.100, and that this work could also be the basis for the electrical safety aspects of the FCV GTR.

- 5 Reports of other activities
 - 5.1 National/Regional
 - 5.2 ISO
 - 5.3 Others

Several brief reports were provided by government delegates and others:

- ◆ US reported that NHTSA is working with Transport Canada to perform hydrogen container testing, and that this testing may include an evaluation of SAE J2579 procedures.
- ◆ European Commission said that a draft framework document for the further review in March 2008. In parallel with this, the Commission is continuing to develop the “comitology” document, which will specify the technical details of the FCV regulation.
- ◆ Japan had no new developments to report. ISO asked if there was an English translation of the JAS 002. Co-chairman will check.
- ◆ Canada reiterated the U.S. comment that Canada and U.S. are cooperating on hydrogen container testing, although no specific regulatory work is going on. In addition to possible validation of SAE J2579, Canada is also interested in developing procedures to localize fire, based on its previous experience with CNG, and will likely work with Powertech to develop evaluation procedures. Canada has contracted with Powertech to compare pressure vessel codes and standards. Canada provided a summary of this report in a subsequent agenda item. A copy of the Powertech report will be posted on the SGS website.
- ◆ Korea noted that the Korean Ministry of Transport and Construction had initiated its 5-year research project on FCVs.
- ◆ China said that fuel cell vehicles would be prominently used during the 2008 Summer Olympics in Beijing. China also plans to have technical standards for FCVs completed in about one year.

- ◆ European Commission provided an overview of the International Partnership for a Hydrogen Economy (IPHE). The scope of this organization is to raise awareness and motivate harmonized codes and standards to facilitate successful transition to a worldwide hydrogen economy. One activity currently underway in IPHE is an analysis of needed research, awareness, policy information, education, and first responder guides. A second activity of IPHE is establishment of a website for the compilation transportation related hydrogen regulations. Next meeting of IPHE is February 2008 in Germany.
- ◆ Messrs. Rothe and Horton (on behalf of SAE) provided copies of the recently published SAE J2579 Technical Information Report for hydrogen storage systems. As at the 1st SGS meeting, SGS delegates were encouraged to consider SAE J2579 for the hydrogen storage aspects of the FCV GTR. SGS delegates were generally receptive to this suggestion pending validation of the J2579 test protocols and relevant test protocols of other entities, including ISO.
- ◆ ISO shared a listing of various ISO documents involving FCVs, including the gas receptacle, liquid tank and accessories, gas tank and pressure relief device, protection against shock, fuel cell module, energy consumption measurement, fuel quality, fueling stations, liquid hydrogen fueling system interface, and hydrogen storage. ISO commented that the ISO hydrogen storage document (15869) had recently been amended to move it closer to a performance-based standard. He estimated that ISO 15869 might be published in approximately five months.

6 General Discussion on GTR re:

6.1 Structure¹

6.2 Scope and Application²

6.3

Several topics discussed in previous meetings were again reviewed during this 2nd SGS meeting, as described below. (NOTE: Highlights of the following discussions were recorded by co-chair Koubek in a matrix that was initiated at the 1st SGS meeting in Bonn. This updated matrix will be posted on the SGS website.)

- ◆ Co-chairs emphasized the importance of cooperation in order to achieve the timetable of submitting an FCV GTR to GRSP and WP.29 in 2010. OICA responded that SGS should work to achieve the 2010 target date; but also noted that a good GTR that misses the target date is preferable to a poor GTR that meets the date.
- ◆ There was a brief discussion of the appropriate structure of the GTR; i.e., one GTR that covers multiple FCV safety topics versus multiple GTRs that each addresses a single topic. Previous agreements by WP.29 and AC.3 to have a single GTR covering all FCV safety topics were reviewed. Co-chair Narusawa stated that this issue should be decided by the co-sponsors in consultation with WP.29, and that the SGS should focus only on technical content of the GTR.

¹ How should we deal with the structure of the GTR? What is the most appropriate body to address this issue?

² What vehicles should be included in/covered by the GTR? Can begin the discussion of technical aspects in early stage?

- ◆ Mr. Albus (Germany) noted that the scope of the GTR should be limited to hydrogen-fueled vehicles.
- ◆ Regarding the application of the GTR, SGS wanted to clarify the position with respect to 2-wheel and 3-wheel vehicles. During the 1st meeting of the SGS, India stated that inclusion of these two types of vehicle in GTR was very important. Co-sponsors of SGS stated that they would contact representatives of the Indian government and industry regarding the possible inclusion of 2- and 3-wheeled vehicles in the FCV GTR. General sentiment of those attending 2nd SGS is that the GTR should focus on 4-wheeled motor vehicles, at least initially.
- ◆ There was discussion regarding which categories of motor vehicles should be included in the scope of the FCV GTR. The tentative outcome of this discussion is that Category 1-1 vehicles as defined in Special Resolution 1 should be the focus of the FCV GTR, at least initially.
- ◆ There was discussion of whether or not auxiliary power units (APUs) should be included in the scope of the FCV GTR. The general sentiment was that it would only be necessary to include APUs if they were fueled by hydrogen, which is usually not the case.
- ◆ There was discussion of whether the GTR should cover only compressed hydrogen gas versus both compressed and liquid hydrogen. Mr. Gissibl (OICA-BMW) pointed out that BMW offers an internal combustion engine (ICE) vehicle that is fueled by liquid hydrogen, and recommended inclusion of liquid hydrogen in the GTR. In support of this, it was noted that the roadmap document calls for the GTR to cover both compressed and liquid hydrogen, and also to cover both ICE and fuel cell vehicles. Mr. Gissibl was asked to bring a proposal for liquid hydrogen to the next SGS meeting.

7. Key Items for HFCV GTR

7.1 Hydrogen Containers³

7.1.1 Compressed Gaseous

7.1.2 Liquefied

Mr. Coons (Canada) delivered a presentation which summarized a report prepared by Powertech for Transport Canada in March 2007 entitled "Study of High Pressure Vessel

³ Can we fully harmonize the container requirements? What are the major discrepancies among Japanese regulations, ISO standards, SAE standards, and others? What is the current status in the debate on containers for liquefied hydrogen? Chairman also sincerely seeks input from all SGS members in order to find best solutions to the following ideas:

-Gtr contains full spec of fuel container requirements with regard to agreed items. Gtr includes items list for tests and its test procedures.

-Gtr only contains the item list of container requirements with regard to agreed items. Contracting Parties can decide the test procedure.

-Gtr specifies the container standards in the text such as "Contracting Parties may use ISO standards or SAE standards or any other technical specifications."

-Gtr mentions container requirements such as "Contracting Parties may decide the container requirements in its own national legislation."

-Gtr never mentions container.

Cylinders – Cylinder Standards Evaluation”. The body of the report provides a chronology of the development of high pressure vessel standards. The majority of Mr. Coons’ presentation focused on four tables included in the report that compare key aspects of various pressure vessel codes. Table 1 summarizes pressure definitions contained in the various codes; table 2 compares pressure cycling requirements; table 3 compares hydrostatic burst strength requirements; and table 4 evaluates suitability of each code for possible adoption as Canadian regulation. The specific codes included in these four comparison tables are CSA B51 Part 2, ANSI HGV2, draft ISO 15869.2, EIHP, FMVSS 304, and SAE J2579.

There was a follow up discussion to Mr. Coons’ presentation regarding the basis for existing hydrogen container regulations and draft regulations. The current Japanese hydrogen storage regulation was developed based on previous Japanese CNG regulations. The German MOT specifies EIHP for type approval of hydrogen containers. The draft European Commission regulation is also based on EIHP.

An important discussion followed regarding the extent to which hydrogen storage requirements should be included in the FCV GTR. Five varying degrees of inclusion were listed, from comprehensive coverage of hydrogen storage requirements and test procedures (option #1) to no mention of hydrogen storage in the GTR (option #5). (The five alternatives are shown in footnote 3 of this agenda.)

Co-chair Narusawa stated that Japan would have significant difficulty accepting hydrogen storage requirements in the GTR. Mr. Yuntang (China) stated that China might also have difficulty including hydrogen storage in the GTR. The problem for Japan and China is that different ministries are responsible for pressure vessel regulations, such that the inclusion of hydrogen storage requirements in the FCV GTR would be outside the regulatory scope of the motor vehicle regulatory authorities in those countries.

Other contracting parties (U.S., Canada, Korea) stated that hydrogen storage requirements and test procedures should be included in the FCV GTR, and indeed that this was probably the most important reason for having the GTR. Several representatives from OICA also expressed strong support for inclusion of hydrogen storage in the GTR, emphasizing that there is virtually no value in continuing to work on the GTR if storage is omitted.

U.S. suggested that a resolution would be to include hydrogen storage provisions in the GTR, and then contracting parties would have the option to adopt only portions of the GTR into their national requirements. Mr. Van Der Straaten (OICA) supported this U.S. suggestion.

At the conclusion of this agenda item, it was agreed that there are four primary reference documents for hydrogen storage requirements: the existing Japanese regulation, the draft European Commission regulation (based on EIHP), the SAE J2579 TIR, and draft ISO 15869. Representatives from each of these organizations were asked to provide a 1-page summary of their respective hydrogen storage requirements to Mr. Coons to supplement

the comparison tables that he reviewed, and also asked to provide a presentation at the next SGS meeting summarizing the hydrogen storage provisions of the respective regulations and standards.

7.2 Hydrogen Leakage⁴

7.2.1 In-use

7.2.2 Post-crash

7.2.3 Other

Mr. Shigeyuki Kawatsu (JASIC) began this agenda item with a review of two papers: (1) Answers to questions from the 1st SGS meeting regarding hydrogen sensor reliability, handling of false-positive hydrogen readings, etc., and (2) a paper describing natural gas odorization. These two papers will be posted on the SGS website.

Prolonged discussions of various aspects of hydrogen leakage then ensued. These discussions involved in-use requirements versus post-crash requirements, design specifications (e.g., sensor and sensor locations) versus performance-based requirements, hydrogen leaks from high-pressure components only versus leakage from high, low and medium-pressure components, existing approaches to leakage in various codes and standards, etc. Concern was expressed regarding the difference between Europe's focus on in-use hydrogen leakage requirements versus North America's focus on post-crash requirements. It is recognized the different regions having The two widely varying approaches to crash test procedures are recognized but it is beyond the scope of SGS to harmonize worldwide crash test procedures. U.S. proposed the solution of including post-crash hydrogen leakage requirements in the FCV GTR, while clarifying within the GTR that these post-crash leakage requirements apply only with respect to the crash test procedures that already exist within each contracting country.

Following an off-line discussion among industry members, Mr. Van Der Straaten on behalf of OICA offered to bring a proposal to the next SGS meeting for hydrogen leakage. Based on the views expressed by the delegates, the OICA proposal may include most or all of the following aspects:

- ◆ Allowable permeation in a fully functional system;
- ◆ Allowable hydrogen concentration in the occupant compartment in case of a single-point hydrogen leakage failure;
- ◆ Allowable hydrogen leakage post-crash;
- ◆ Allowable hydrogen concentration in the vehicle exhaust system; and possibly
- ◆ Specifications for allowable directions of hydrogen release through PRDs.

The national delegates accepted OICA's offer to bring forth a proposal on these aspects of hydrogen leakage. OICA was asked to include test procedures along with suggested requirements to the extent possible. U.S. also asked OICA to provide any available test

⁴ Should we add tests for low and medium pressure component and set limit values for leakage? Is it necessary to have on-board sensors? Do we need limit values for leakage during purge or post crash? Do we need to specify the direction of PRD discharge?

data, research, etc. that would help support the proposed requirements. U.S. specifically asked for test data from SAE/Ballard concerning the ability to initiate and sustain fire at various hydrogen concentration levels.

8. Electric Safety⁵

Messrs. Kellermann (Germany) and Rothe (OICA-GM) provided a summary of a meeting of the GRSP electrical safety WG that was held on the afternoon of January 14, 2008. Mr. Rothe substituted as chair of the WG in place of Mr. Thomas Sasse (TUV), who was unable to attend. Many SGS participants attended the electrical safety WG meeting since SGS was recessed at that time.

The primary focus of the electrical safety WG was to clarify its scope of responsibility. It is clear that the WG has a mandate to develop recommendations to amend existing ECE R100 to accommodate FCVs. It was also contemplated by WP.29 when it chartered the electrical safety WG that its work output should be adopted within the FCV GTR. However, there are significant issues relating to this dual WG responsibility to amend ECE R.100 and provide electrical safety content for the FCV GTR.

One issue is the significantly different timetables for accomplishing these two tasks. There is an urgent need to amend ECE R100 to facilitate Type Approval of vehicles that use higher voltage. It is expected that these revisions that involve only signatories to the 1958 Agreement can be accomplished quickly. In contrast, the FCV GTR is on a longer timetable and involves a different set of signatories to the 1998 Agreement. It may be very difficult to reach agreement on the full text of electrical safety provisions for inclusion in the FCV GTR within the compressed timeframe for updating ECE R.100.

Compounding this timing disparity is the fact that ECE R.100 is focused on in-use electrical safety, whereas North America at least will want the FCV GTR to include post-crash electrical safety provisions similar to the approach taken in FMVSS 305. This need for different regions to evaluate and accept in-use versus post-crash provisions that they are not already familiar with is likely to considerably delay completion of the electrical safety portions of the FCV GTR compared to the urgent need to update ECE R.100.

Attendees at the electrical safety WG expressed willingness to support both the update to ECE R.100 and to develop content for the FCV GTR, but requested clarification of their mandate given the difficulties associated with this dual responsibility. Mr. Rothe will share these discussions with the chair of the electrical safety WG (Mr. Sasse). In addition, Mr. Albus (Germany) will seek clarification from WP.29 and AC.3 regarding the scope and priority of responsibilities for the electrical safety WG.

9. Time-Plan Review⁶

⁵ What collaboration is needed – Germany will lead the discussion in the Electric Safety Group.

⁶ When considering the time-plan, how do we set goals we want to achieve by each meeting?

There was no significant discussion of this topic beyond the previously stated goal of completing the FCV GTR by 2010.

10. Miscellaneous Administrative Items

10.1 Approval of the Decisions of the 2nd Meeting

10.2 Next Meeting⁷

10.3 Other

Co-chair Koubek reviewed a complete list of action items from this 2nd SGS meeting, segregated by responsible organization. The complete list of action items will be posted on the SGS website. A few of the key items are summarized as follows:

- ◆ OICA will develop a proposal for hydrogen leakage for the next SGS meeting. This significant assignment will require at least two or three OICA meetings prior to the next SGS meeting. The first of these OICA meetings is planned for February 6 and 7, 2008 in Paris.
- ◆ Japan, European Commission, SAE and ISO will each provide two items regarding their respective hydrogen storage regulations/standards: (1) a 1-page summary to be provided to Mr. Coons, and (2) a presentation to be given at the next SGS meeting.
- ◆ SAE and ISO will furnish relevant FCV definitions (especially hydrogen storage and pressure definitions) from their respective standards.
- ◆ SAE will furnish available data regarding the ability to ignite and sustain a flame at varying hydrogen concentration levels.
- ◆ Electrical safety WG will obtain clarification of its mandate, and will consider scheduling future meetings adjacent to SGS given the linked interests of these two groups. Japan and U.S. will provide information regarding their existing electrical safety regulations.

The next (3rd) meeting of SGS is planned for the week of May 12, 2008 in the United States. The specific venue will be either Washington, D.C. or Detroit. U.S. delegates will inform full SGS of specific location once it is determined.

The 4th meeting of SGS is planned for the week of September 22, 2008 in Japan.

Co-chairs thanked participants for their contributions and adjourned the 2nd meeting of SGS.

⁷ The 3rd SGS meeting scheduled in April or June 2008 in Washington DC?

APPENDIX

List of Documents for the 2nd Meeting of the HFCV GTR

The following documents concerning the September 2007 1st HFCV-SGS Bonn meeting have been made available before the 2nd meeting on the UN website:

http://www.unece.org/trans/main/wp29/wp29wgs/wp29grsp/sgs_1.html

Doc. n°	Label of the document	Remarks
BONN		
01_01	Development of an EU Regulation for the type-approval of the hydrogen vehicles	European Commission
01_02	National Highway Traffic Safety Administration - Research & Development Studies	USA
01_03	Research Plans for HFCV Rule-making in Korea	Rep. of Korea
01_04	Establishment of Safety Regulation for Fuel Cell Vehicles in Japan- Hydrogen Safety	Japan
01_05	Japan guidance	Japan
01_06 bis	ECE/TRANS/WP.29/2007/41 - Proposal to develop a global technical regulation concerning hydrogen / fuel cell vehicles	
01_06	Status of SAE FCV Safety Working Group Activities	SAE
01_07	Agenda of the first meeting	
01_08	Meeting minutes of the first meeting	