Dear all,

Please find attached ISO‘s recommendations and comments for consideration.

As you will see, we feel that there are still a large number of safety concerns that need to be addressed before the draft GTR can move to the next stage of approval, especially on the containers. We have recommended that these safety concerns be addressed in task force meetings. This would increase the efficiency of the work as these matters would be discussed in a small group that could look at all aspects and thoroughly address the safety issues at hand. The results of the TF would then be presented to the SGS for their consideration.

Unfortunately, neither Randy nor myself will be able to attend, but we are looking forward to your feed-back on our recommendations.

Please circulate our papers to the SGS group as soon as possible. Please note that ISO action items TF4 and TF 5 are included in our comments on the container (see Annex A). Regarding ISO action item 21, ISO will provide the ISO/DIS 17268 when it is approved. It is under circulation until 25 June 2010.

Best regards,

Sylvie

ISO's recommendations –

Proposed path forward to overcome the HFCV GTR Challenges

ISO would like to convey to the HFCV SGS group its concerns regarding the development of the HFCV GTR. These concerns are related to the safety aspects of the HFCV GTR as well as the process used for the development of the HFCV GTR.

In terms of safety, we consider that a number of safety related matters have not been addressed by the SGS. Our detailed technical comments are provided in Annexes 1 and 2. Here is a summary of those outstanding safety matters.

- GH_2 Container: The provisions for the GH_2 container use a new performance based approach that has not been properly validated.
  - Open to any type of tanks, even those not on the market
  - Unrealistic assumptions of service conditions for vehicles used in commercial applications (e.g. taxis)
  - Low burst ratio and no consideration of stress ratio
  - Consideration of new test procedures that have not used in any standards/regulations and which have not been properly validated (e.g. pneumatic testing, fire test)
  - No consideration of material (no mandatory material tests, same burst pressure used irrelevant of the type of fibre)
  - Confusion about the allowed permeation rate
  - Elimination of boss torque and penetration tests
  - No mandatory batch and routine tests
- LH_2 Container: The provisions of the LH_2 container use a new approach that has not been validated. The requirements are not harmonized with the International Standard ISO 13985 *Liquid hydrogen — Land vehicle fuel tanks,* which has recently been reconfirmed by the ISO membership. An effort should be made towards harmonization.
- Components: Critical components not addressed properly: TPRD, shut-off valves, fuelling receptacle, etc.
- Leakage: Allowance of up to 4 % hydrogen in passenger compartment

To resolve the technical matters, we recommend that task force meetings targeted on the GH_2 container should be set up to get to common ground between ISO requirements which are very close to the EC and Japanese regulations and the OICA papers. The LH_2 container issues should also be discussed in task force meetings.

Through this exercise, the safety concerns of ISO and some member countries (e.g. Germany, Canada, etc.) should be considered with the view of achieving harmonized positions. This work should be supported by an R&D and testing program to properly validate new testing approaches/procedures that are being considered for integration into the draft GTR. The current provisions on the GH_2 container have not been validated by any testing. The only test that was made available to support the new approach did not include enough samples to prove the concept, but more importantly it was done on an earlier version of the draft GTR text that has been substantially changed since then.

Once agreed by the HFCV SGS, these harmonized positions should be integrated into the draft GTR. In the interest of meeting the intent of the WTO, the goal should be to have harmonized requirements between the HFCV GTR and ISO international standards. In this respect, we would like to re-state that ISO is not necessarily expecting that all our requirements will be transferred into the GTR. We are quite prepared to take a look at any new (compared to existing ISO requirements) requirement in the GTR as long as it is safe and properly substantiated (with results of validation and testing shared with the SGS group). We are willing to submit these new requirements on the container for consideration by the ISO working group as long as they are well supported with documentation and rationale. Right now, we do not have much confidence in the requirements proposed by OICA. They keep changing at every meeting.

Further, the process for the GTR development should be improved; it should no longer be allowed to have new proposals from some parties (e.g. OICA) directly incorporated in the draft GTR text without consultation. Proposed changes to the GTR text should only be integrated in the draft when an agreement is reached. The comments received from all parties should be kept in a compilation of comments in which the decision of the SGS should be recorded. Also, parties that are submitting proposal for changes to the draft GTR text should be asked to mark the changes for easier retrieval. It is unacceptable that participants have to compare each version side by side in an effort to find out what are the proposed changes from the previous version. Due process should also be respected. Documents for the meeting should no longer be distributed only two weeks before the meeting. A six week distribution should be required.

ISO is prepared to work with the HFCV SGS to achieve a safe HFCV GTR. We believe some changes in direction are necessary to achieve this goal. We hope that the SGS will seriously consider these recommendations in an effort to improve the efficiency of work and the resulting consensus-based GTR text.

	ISO Comments on the container		
No.	**Paragraph/figure/table**	**Recommendation**	**Comment/Justification**
1	A.5.1.1.8 b) (6) P.23	Remove this item from the draft GTR. This is a misleading statement. Further considering that the current version of the GTR includes a test in B.5.1.3 that is substantially less stringent than the test done by Powertech, this means that the test program currently included in the GTR has not been validated.	The Powertech report does not provide any evidence in support of the statement that tanks that have passed the ISO TS (NGV2) tests have failed the tests proposed by OICA. Further the Powertech report was intended to validate the SAEJ2579 test program. The verification test for expected on-road performance specified in B.5.1.3 of the current version of the draft GTR is substantially less stringent than the test done by Powertech (5 % of cycles done at -40 C and 50 C as opposed to 25 % of cycles in the Powertech testing and static hold at 55 C as opposed to 85 C in the Powertech testing).
2	A.5.1.2.3 Material test requirements P. 27	Material properties are essential requirements for the safety of containers. They should be included in Part B of the GTR. The proposed material requirements were provided by ISO in SGS-6-11 (see Clause 5.1.6). These material requirements are performance-based and are not design restrictive.	The overall based performance-based qualification does not address the suitability for use of the materials. Specific performance based material tests are needed.

3	A.5.1.2.7 Verification tests for Conformity of Production with Design Qualification P.33-34	The need for the container manufacturer to perform and keep record for the batch and routine production test should be included in Part B of the GTR. The proposed batch and routine tests were provided by ISO in SGS-6-11 (see Clauses 5.1.8 and 5.1.9)	Batch and routine production test are essential to guarantee the safety of the containers that are produced in series. The manufacturing of container is a special process (i.e. the quality of the container cannot be fully assessed by non destructive testing at the end of the manufacturing process). It is therefore essential that the manufacturing process is kept under control and it is the purpose of the batch and routine test to demonstrate that the tanks that are produced on a daily basis have not deviated from the tanks that were initially qualified. Further, the approach by OICA is also based on the fact that there is a need to limit the variability due to manufacturing, which is assured by the batch tests.
4	B.5.1 Types of tanks P. 46	It is recommended that the GTR recognizes that there are currently 4 types of tanks used for the storage of gaseous hydrogen (Type 1 – Metal containers; Type 2 – Hoop wrapped composite containers with a metal liner; Type 3 – Fully wrapped composite containers with a metal liner; Type 4 – Fully wrapped composite containers with no metal liner.)	It is virtually impossible to safely cover any new design of tanks without reassessing the testing program. A new technology may have failure mode that have not been planned in the testing. A re-evaluation of the test program should be done before allowing new types of tanks. Also, by keeping the types of tanks, the testing program can be adjusted based on the known failure mode. Some tanks could be exempted from some tests.

5	B.5.1.1.1 Baseline Initial Burst Pressure p.47-48	The initial burst pressure test should retain the commonly used burst ratio that are based on the type of fiber as follows: • Metal: 2,25 X working pressure (WP) • Glass: 2,4 WP for type 2, 3,4 WP for type 3 and 3,5 WP for type 4 • Aramid: 2,25 WP for type 2, 3,0 WP for type 3 and 3,0 WP for type 4 • Carbon: 2,25 WP for WP greater than 35 MPa • Carbon: 2,0 x WP for WP of 35 MPa and higher • Also stress ratio should be considered (see SGS-6-11 clause 5.1.5).	These burst and stress ratios have a long history and should not be discarded just for the sake of using a more performance-based approach that use the same burst pressure ratio for all types of tanks. The Powertech validation testing program does not provide the confidence that the new testing approach will detect all tanks that would fail in service. The number of samples that were tested to prove this concept was limited to one tank. Further, according to the report, this tank has had numerous failures in vehicle service and routine testing and would have probably failed any test. This subject should be further discussed in a task force meeting.
6	B.5.1.1.2 Baseline Initial Pressure Cycle Life P. 48	The LBB test is not clear. The acceptance criteria is unknown. What is the pass/fail criteria for this test?	This subject should be further discussed in a task force meeting.
7	B.5.1.2 Verification test for Performance Durability P. 48	The SGS still need to determine if the number of cycles specified in B.5.1.1 (5500 cycles) is adequate. Vehicles used for taxis as an example could be subjected to more fillings than expected. In ISO, the number of filling cycles for commercial use is 11250 cycles.	This subject should be further discussed in a task force meeting.

8	5.1.2 Verification test for Performance Durability P. 48	A boss torque test should be included for composite tanks with non load sharing liners.	The boss torque test has historically been used for composite tanks both used for the transport of gases (ISO 11119) and onboard applications. Further since the OEMs rely on the integrity of the tank especially when the vehicle is parked (no warning in case of leakage), the need for this test should be reconsidered and discussed in a task force meeting.
9	B.5.1.2.6 Extreme temperature pressure cycling P. 50	We suggest the following changes to the test: The storage system will be pressure cycled from less than 2 MPa to NWP at -40C for 1000 cycles and from less than 2 MPa to 125 % NWP at 85C and 95 % relative humidity for 1000 cycles in accordance with test procedure B.6.2.2.2).	These changes are requested to bring the document in line with ISO/TS 15869, which are more representative of service conditions. The number of cycles should be discussed in a task force meeting.
10	B.5.1.3 Verification test for expected on-road performance P. 50-52	Further discussion would be required on this test. OICA has not provided a justification for the change in procedure as requested in Geneva (action item 14). The current version of the GTR is less stringent than the earlier version proposed by OICA. • 5 % of cycles done at -40 C and 50 C as opposed to 25 % of cycles • Static hold at 55 C as opposed to 85 C Further there should be a discussion on the need to examine the plastic liner and the liner/end boss interface for evidence of deterioration or damage at the end of the test as it is requested in ISO/TS 15869.	This new test procedure has not been validated. The Powertech report was intended to validate the SAEJ2579 test program. The verification test for expected on-road performance specified in B.5.1.3 of the current version of the draft GTR is substantially less stringent than the test done by Powertech: • 5 % of cycles done at -40 C and 50 C as opposed to 25 % of cycles in the Powertech testing • Static hold at 55 C as opposed to 85 C in the Powertech testing This subject should be further discussed in a task force meeting.

11	B.5.1.3.3 Leak/permeation test P. 52	It is still unclear what should be the allowable permeation rate. The latest document provided by HySafe is unclear and we have a Japanese proposal that should be examined.	Before a permeation rate is specified, the SGS should thoroughly examine this question. This subject should be further discussed in a task force meeting.
12	B.5.1.4 Verification test for service terminating conditions P. 52	The penetration test should be included as part of these tests.	The penetration test has historically been used for composite tanks both used for the transport of gases (ISO 11119) and onboard applications. This subject should be further discussed in a task force meeting.
13	B.5.1.4.1 Fire test P.52	The fire test procedure needs to be defined.	This subject should be further discussed in a task force meeting.
14	B.5.2 Liquefied Hydrogen Storage System P.53-56	We suggest that the requirements for the liquid hydrogen storage system be harmonized with the requirements of the international standard ISO 13985 *Liquid hydrogen — Land vehicle fuel tanks,* which has recently been reconfirmed by the ISO membership.	This exercise should be addressed in a task force meeting.

	ISO Comments on other items than the container		
No.	**Paragraph/figure/table**	**Recommendation**	**Comment/Justification**
15	A.5.1.2.4 Qualification test for hydrogen-flow closures P.27	The qualification tests of critical components such as the TPRD, shut-off valve and check valve are not defined. These qualification requirements should be defined and included in Part B of the GTR.	The verification test for expected on-road performance described in B.5.1.3 and the fire test of B.5.1.4.1 are not sufficient to address the safety of critical components such as the TPRD, shut-off valve and check valve. Specific qualification test are needed to ensure the safety of these components. We suggest that the requirements included in the EC Directive be used as the basis for the HFCV GTR.
16	A.5.3.1.1 TUV proposal P. 36-37	These requirements should be moved to Part B.	All these requirements are general requirements that should be considered as mandatory. They shall be moved to B.5.1 along with the requirement that the check valve, shut-off valve and TPRD shall be mounted directly on or within each container. All these requirements can easily be verified by a visual inspection.
17	B. 5.3.1.1 Gas fuelling port P.57	Gas fuelling port: The gas fuelling port shall comply with ISO 17268.	The fuelling receptacle is an important component of the system from a compatibility and safety point of view. Simply specifying that the profile of fueling receptacles shall prevent fuelling of containers with pressures for which they are not designed, for example a 35MPa container with 70MPa fuelling pressure, does not ensure safe refuelling. It is also a requirement that cannot be verified.

18	B. 5.3.1.3.2 and B.5.3.1.3.3 Protection against flammable conditions P. 58	The SGS should reconsider the maximum volume fraction of hydrogen in air. 4 % is the lower flammability limit. It should be lowered to 1 %.	Most of the standards where hydrogen is being used limit the volume fraction to 0,25 % LFL (1 % of hydrogen in air) before triggering a remedy action. Similarly, any leakage in the enclosed or semi-enclosed space of the vehicle that results in a volume fraction of hydrogen in air above 1 % should trigger a remedy action. As the enclosed and semi-enclosed spaces within a vehicle are small, further precautions should be taken to avoid a rise in the concentration above LFL. The 1 % limit will provide the system with time to react before the situation becomes catastrophic.
19	B.5.3.1.4 Tell-tale warning to driver p. 58	The tell-tale should be prescribed. For safety reasons, the same warning should be provided when the conditions of 5.3.1.3.4 are met.	Considering the importance of this warning, it is important that drivers are familiar with the sign. It should be consistent from one car to the other.