Item	Rationale proposal	Regulation text proposal	Contracting Party / Agreement / Comment
Sled test proposal revised by Toyota	D. Rationale for scope, definitions and applicability 1. Rationale for paragraph 2 (Scope) 36. This gtr provides requirements for fuel system integrity in vehicle crash conditions, but does not specify vehicle crash conditions. Contracting Parties to the 1998 Agreement are expected to execute crash conditions as specified in their national regulations. Whereas phase 1 of the development of gtr 13 focused on passenger cars (vehicle classes 1-1 and 1-2 with a gross vehicle mass (gvm) of less than 4,536kg), phase 2 aims to include heavy-duty vehicles (classes 1-2 above 4,536kg gvm and 2) into the scope. This reflects the increasing demand for alternative fuel technologies in commercial deployment. The use of compressed gaseous hydrogen systems in commercial buses already has shown the feasibility, benefit as well as the safety of the systems installed in the vehicle class 1-2 with more than 4,536 kg gross vehicle mass. The inclusion of vehicle class 2 will promote the collection of data regarding the applicability for these vehicles. **For development of the requirements and test procedures for heavy duty vehicles, typical natures for such vehicles like; various configuration and use cases, larger mass and dimensions, safety concept (e.g. availability of crash test procedures, speed and other restrictions, etc.), longer service life and use cases should be taken into account.**	4. Applicability of requirements 4.1. The requirements of paragraph 5. (using test conditions and procedures in paragraph 6.) apply to all compressed hydrogen-fuelled vehicles. 4.2. The requirements of paragraph 5.3. apply to all hydrogen-fuelled vehicles using high voltage.	Contracting parties are requested to provide their agreement or rejection. If rejected please specify your concerns or reasons
Sled test proposal revised by Toyota	E. Rationale for paragraph 5. (Performance requirements) 2. Vehicle fuel system requirements and safety needs (b) Post crash requirements **XX. As described in para. 36, existing vehicle crash test procedures shall be used to evaluate post-crash hydrogen leakage but knowing the unavailability of vehicle crash tests for heady-duty vehicles, alternative means of demonstrating that post-crash safety may need to be introduced. In this regards, acceleration tests of gas storage containers and their fixtures have been well established in inter alia UN Regulation No 67 on liquefied petroleum gases (LPG), UN Regulation No 110 on compressed natural gas (CNG) and liquefied natural gas (LNG), as well as European Union Regulation (EC) No 406/2010, implementing Regulation (EC) No 79/2009 on hydrogen safety. ~~In this respect it is thought that its~~**	5. Performance requirements 5.2.2. Post-crash fuel system integrity **Each Contracting Party may maintain its existing national crash tests (frontal, side, rear and rollover) and shall use the limit values of paragraphs 5.2.2.1. to 5.2.2.3.** **In absence of any such vehicle tests or as an alternative to existing tests, at the discretion of each Contracting Party, the acceleration tests of paragraph 6.1.7. may be applied instead of vehicle crash tests. In this case, the performance criterion in paragraph 5.5.2.3. shall apply and additional conditions for the installation in the vehicle may also be applied as appropriate.** 5.2.2.1. Fuel leakage limit	Contracting parties are requested to provide their agreement or rejection. If rejected please specify your concerns or reasons

	~~rigorous implementation has indeed contributed to a high level of safety in the field, supported by the observed absence of relevant failures in the vehicle fleet that has been subject to these particular regional requirements.~~ The absence of relevant failures in the field encourages the assumption that the rigorous implementation of such tests has contributed to a high level of safety. *(i) Rationale for paragraph 5.2.2.1. post-crash test leakage limit* 85. Allowable post-crash leakage in … *(ii)Rationale for paragraph 5.2.2.2. post-crash concentration limit in enclosed spaces* 89. This test requirement has been… *(iii) Rationale for paragraph 5.2.2.3. container displacement.* 90. One of the crash safety regulations for vehicles with compressed gas fuel systems is Canada's Motor Vehicle Safety Standard (CMVSS) 301. Its characteristic provisions include the fuel container installation requirement for prevention of displacement.	The volumetric flow of hydrogen gas leakage shall not exceed an average of 118 NL per minute for the time interval, Δt, as determined in accordance with paragraph 6.1.1.1 or 6.1.1.2 (para. 6.1.1. test procedures). 5.2.2.2. Concentration limit in enclosed spaces Hydrogen gas leakage shall not result in a hydrogen concentration in the air greater than 3 ± 1.0 per cent by volume in the passenger and luggage compartments (para. 6.1.2. test procedures). The requirement is satisfied if it is confirmed that the shut-off valve of the storage system has closed within 5 seconds of the crash and no leakage from the storage system. 5.2.2.3. Container displacement The storage container(s) shall remain attached to the vehicle at a minimum of one attachment point.	
Sled test proposal revised by Toyota	1. Rationale for storage and fuel system integrity tests *(a) Rationale for paragraph 6.1.1. test procedure for post-crash leak test procedure for compressed hydrogen storage systems* 108. The post-crash leak test is … *(b) Rationale for paragraph 6.1.2. (Test procedure for post-crash concentration test in enclosed spaces for vehicles with compressed hydrogen storage systems)* 113. The test may be conducted by…. ***(c) Rationale for paragraph 6.1.7.*** **(Acceleration tests alternative to vehicle crash tests)** **XXX. The acceleration levels have been established in UN Regulation No 67 on liquefied petroleum gases (LPG), UN Regulation No 110 on compressed natural gas (CNG) and liquefied natural gas (LNG) and UN Regulation No. 134 on hydrogen and fuel cell vehicles (HFCV).**	6. Test conditions and procedures 6.1. Compliance tests for fuel system integrity 6.1.1. Post-crash compressed hydrogen storage system leak test The crash tests used to evaluate post-crash hydrogen leakage are those already applied in the jurisdictions of each contracting party. … 6.1.6. Installation verification The system is visually inspected for compliance. **6.1.7. Acceleration tests alternative to vehicle crash tests** **The CHSS and its fixture to the vehicle structures shall be subject to the relevant alternative accelerations specified below in order to verify that the following accelerations can be absorbed without breaking of the fixation or loosening of the container(s). [A calculation method can be used instead of practical testing if its equivalence can be demonstrated.] The accelerations shall be measured at the location where the CHSS is**	Contracting parties are requested to provide their agreement or rejection. If rejected please specify your concerns or reasons

		installed. The CHSS shall be mounted and fixed on the representative part of the vehicle. The mass used shall be representative for a fully equipped and filled CHSS. **(a) Accelerations for LDV:** **(i) 20 g in the direction of travel (forward and rearward direction);** **(ii) 8 g horizontally perpendicular to the direction of travel (to left and right).** **(b) Accelerations for HDV of category 1-2 with a gross vehicle mass (GVM) not exceeding 5,000 kg and category 2 with a gross vehicle mass (GVM) not exceeding 12,000 kg:** **(i) 10 g in the direction of travel (forward and rearward direction);** **(ii) 5 g horizontally perpendicular to the direction of travel (to left and right).** **(c) Accelerations for HDV of category 1-2 with a gross vehicle mass (GVM) exceeding 5,000 kg and category 2 with a gross vehicle mass (GVM) exceeding 12,000 kg** **(i) 6.6 g in the direction of travel (forward and rearward direction);** **(ii) 5 g horizontally perpendicular to the direction of travel (to left and right).**	
Sled test proposal by EU	**3. Rationale for paragraph 4 (Applicability of requirements)** 39. The performance requirements in paragraph 5. address the design qualification for on-road service. 40. It is expected that all Contracting Parties will recognize vehicles that meet the full requirements of this gtr as suitable for on-road service within their jurisdictions. Contracting Parties with type approval systems may require, in addition, compliance with their requirements for conformity of production, material qualification and hydrogen embrittlement. **Contracting Parties may also elect to allow alternative methods to demonstration that requirements are met, for instance on the basis of established equivalence.**	**4. Applicability of requirements** 4.1. The requirements of paragraph 5. (using test conditions and procedures in paragraph 6.) apply to all compressed hydrogen-fuelled vehicles. 4.2. Each contracting party under the UN 1998 Agreement shall maintain its existing national crash tests (frontal, side, rear and rollover) and use the limit values of section paragraph 5.2.2. for compliance. In absence of any such test or as an alternative to existing tests, the acceleration tests of paragraph 6.1.1. may be applied instead, to the discretion of each contracting party. 4.3. The requirements of paragraph 5.3. apply to all hydrogen-fuelled vehicles using high voltage.	Contracting parties are requested to provide their agreement or rejection. If rejected please specify your concerns or reasons
Sled test proposal	**1. Rationale for storage and fuel system integrity tests**	6.1.1. Post-crash compressed hydrogen storage system leak test The crash tests used to evaluate post-crash hydrogen leakage are those already applied in the jurisdictions of each contracting party.	

	(a) Rationale for paragraph 6.1.1. test procedure for post-crash leak test procedure for compressed hydrogen storage systems **000. As a general principle, the crash tests used to evaluate post-crash hydrogen leakage are those already applied by the respective contracting parties.** **000. Contracting parties may permit alternative means of demonstrating that post-crash safety is ensured, notably in absence of a specific crash test for a given orientation. It concerns specifically alternative tests subjecting vehicle fuel systems to specified acceleration levels. This practise has been well established in *inter alia* UN Regulation No 67 on liquefied petroleum gases (LPG), UN Regulation No 110 on compressed natural gas (CNG) and liquefied natural gas (LNG), as well as European Union Regulation (EC) No 406/2010, implementing Regulation (EC) No 79/2009 on hydrogen safety. In this respect it is thought that its rigorous implementation has indeed contributed to a high level of safety in the field, supported by the observed absence of relevant failures in the vehicle fleet that has been subject to these particular regional requirements.** **[000. However, to account for technical progress, the European Commission has carried out an analysis of world-wide crash and crash test data for all respective vehicle categories[1] (acknowledged to be limited in certain cases). It was carried out with a view to review and adjust, where necessary, the specified accelerations in order to align more appropriately with the acceleration levels observed in the available crash and test data attributed to the respective vehicle categories. The relevant updated values are therefore incorporated in the regulatory text encompassed in paragraph 6.1.1.]**	**In case that a crash test as specified above is not applicable, or as an alternative thereto, the vehicle fuel system may, instead, be subject to the relevant alternative accelerations specified below, to the discretion of each contracting party, [so that the following accelerations can be absorbed without breaking of the fixation or loosening of the container(s).] [A calculation method can be used instead of practical testing if its equivalence can be demonstrated.] [The hydrogen storage system shall in such case be installed in a position satisfying the requirements in paragraph XXX]. The accelerations shall be measured at the location where the hydrogen storage system is installed. The vehicle fuel system shall be mounted and fixed on the representative part of the vehicle. The mass used shall be representative for a fully equipped and filled container or container assembly.** **Accelerations for vehicles of categories 1-1, 1-2 and 2 with a gross vehicle mass (GVM) of 3,500 kilograms or less** **(a) [20 or 26] g in the direction of travel (forward and rearward direction);** **(b) [8 or 12] g horizontally perpendicular to the direction of travel (to left and right).** **Accelerations for vehicles of categories 1-1 and 1-2 with a gross vehicle mass (GVM) of at least 3,501 kilograms up to 5,000 kilograms and category 2 with a gross vehicle mass (GVM) of at least 3,501 kilograms up to 12,000 kilograms** **(a) 10 g in the direction of travel (forward and rearward direction);** **(b) [5 or 8] g horizontally perpendicular to the direction of travel (to left and right).** **Accelerations for vehicles of categories Category 1-1 and 1-2 with a gross vehicle mass (GVM) of at least 5,001 kilograms and category 2 with a gross vehicle mass (GVM) of at least 12,001 kilograms** **(a) [6.6 or 8] g in the direction of travel (forward and rearward direction);** **(b) [5 or 8] g horizontally perpendicular to the direction of travel (to left and right).**	

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[1] https://data.europa.eu/doi/10.2873/58935

TPRD Direction	a. Rationale for paragraph 5.2.1.3.1. pressure relief systems 78. The vent line of storage system discharge systems (TPRDs and PRDs) should be protected by a cap to prevent blockage by intrusion of objects such as dirt, stones, and freezing water. **Horizontal discharge, i.e., parallel to the road surface, should be avoided in order to protect first responders**~~**, and**~~ **other road users** and adjoining buildings **from potentially harmful ignited discharge directly. Vertical discharge direction should consider potential releases in tunnel and underground car parking garages. In addition, it is recommended to not direct the TPRD towards any exits of buses to avoid hindering passengers from leaving the vehicle in case of a breakdown or accident.**	5.2.1.3.1. Pressure relief systems (para. 6.1.6. test procedure) (a) Storage system TPRDs. The outlet of the vent line, if present, for hydrogen gas discharge from TPRD(s) of the **CHSS** storage system shall be protected **from ingress of dirt and water (e.g.** by a cap**)**; ~~[(b)~~ ~~**The hydrogen gas discharge from the TPRD(s) of the storage system shall be directed upwards or downwards at the manufacturer's discretion assessing the appropriate angle considering the vehicle design, including at least the following points:]**~~ (**b**) Storage system TPRDs. The hydrogen gas discharge from TPRD(s) of the CHSS storage system shall be directed ~~forward from the vehicle (in the direction of travel of the vehicle) or horizontally (parallel to road) from the back or sides of the vehicle. Furthermore it should be directed~~ such that the hydrogen exhaust does not impinge upon: (i) ~~Into~~ enclosed or semi-enclosed spaces; (ii) ~~Into or towards~~ any vehicle wheel housing; (iii) ~~Towards~~ hydrogen gas containers; **(iv)** ~~**Towards**~~ **the vehicle's REESS.**	NHTSA: - reservations China: - agrees EU: - agrees Korea: - agrees Japan: - agrees
Service life of containers	**2. Rationale for paragraphs 3.9. and 3.48. (Definitions of service life and date of removal from service)** **46**~~37~~. These definitions pertain to qualification of the compressed hydrogen storage system for on-road service. The service life is the maximum time period for which service (usage) is qualified and/or authorized. [This document provides qualification criteria for liquid and compressed hydrogen storage systems having a service life of ~~15~~ **25** years or less (para. 5.1.). The service life is specified by the manufacturer.] **47**~~38~~. The date of removal from service is the calendar date (month and year) specified for removal from service. The date of removal from service may be set by a regulatory authority. It is expected to be the date of release by the manufacturer for initial usage plus the service life.		Contracting parties are requested to provide their agreement or rejection. If rejected please specify your concerns or reasons

Service life of containers	*(ii) Rationale for paragraph 5.1.1.2. baseline initial pressure cycle life* **71**~~54~~. The requirement specifies that three (3) randomly selected new containers are to be hydraulically pressure cycled to 125 per cent NWP without rupture for 22,000 cycles or until leak occurs. Leak may not occur within a specified number of pressure cycles (number of **cycles** ~~Cycles~~). The specification of number of cycles within the range 5,500 – 11,000 is the responsibility of individual Contracting Parties. That is, the number of pressure cycles in which no leakage may occur, number of cycles, cannot be greater than 11,000, and it could be set by the Contracting Party at a lower number but not lower than 5,500 cycles for 15 years' service life. **For service life of over 15 years but up to 25 years, the number of pressure cycles in which no leakage may occur is 11,000.** The rationale for the numerical values used in this specification follows: … b. *Rationale for number of cycles, number of hydraulic pressure cycles in qualification testing: number of cycles greater than or equal to 5,500 and less than or equal to 11,000* **77. In Phase 2, data from various regions (Japan, Germany, United States) supported the proposal to maintain 11,000 hydraulic test pressure cycles and 22,000 "leak before burst" cycles when service life is extended to 25 years for both light-duty and heavy-duty vehicles.** **(a) Japan – A database of Japanese legal inspection records as of July 2019 was analysed. This database contained 6,000 records for light-duty vehicles and 21,000 records for heavy-duty vehicles (all fuel types). For this GTR13 purpose, the focus was on the analysis of the records for commercial vehicles, as these vehicles have a higher usage (consistent with the rationale for Phase 1). The maximum lifetime miles travelled for each vehicle were determined and by applying a range per fuelling of 320 km for light-duty vehicles and 400 km for heavy-duty vehicles. Using the above, the number of pressure cycles were calculated and are shown in Table 1 below.** **Table 1** **Results of Japanese study**	5.1.1.2. Baseline initial pressure cycle life Three (3) new containers randomly selected from the design qualification batch are hydraulically pressure cycled ~~at 20(±5)°C to 125 per cent NWP without rupture for 22,000 cycles or until a leak occurs (para.~~ **in accordance with paragraph** 6.2.2.2. ~~test procedure).~~ **The container attachments, if any, shall also be included in this test, unless the manufacturer can demonstrate that the container attachments do not affect the test results and are not affected by the test procedure.** Leakage shall not occur within a number of **cycles** ~~Cycles~~, where the number of **cycles** ~~Cycles~~ is set individually by each Contracting Party [~~at 5,500, 7,500 or 11,000 cycles for a 15-year service life.~~ **at 5,500 or 7,500 cycles** ~~for a service life of 15 years~~ **or less, or at 11,000 cycles** ~~for a service life or 25 years~~ for a maximum service life of up to 25 years**.]** 6.2.2.2. Pressure cycling test (hydraulic) The test is performed in accordance with the following procedure: (a) The container is filled with a **hydraulic** ~~non-corrosive~~ fluid; (b) The container and fluid are stabilized at **the ambient temperature of 20 ± 15 °C** ~~the specified temperature~~ and relative humidity at the start of testing; the environment, fuelling fluid and **the surface of the test article** ~~container skin~~ are maintained at the specified temperature for the duration of the testing. The container temperature may vary from the environmental temperature during testing; (c) The container is pressure cycled between ≤ **2** ~~2 (±1)~~ MPa and ~~the~~ ≥ **125 per cent NWP** ~~target pressure~~ at a rate not exceeding 10 cycles per minute for ~~the specified number of~~ **[two times the number of** cycles **as specified in para. 5.1.1.2. or until a leak occurs]**; (d) The temperature of the hydraulic fluid within the container is maintained and monitored at **20 ± 15 °C** ~~the specified temperature~~. **(e) The container manufacturer may specify a hydraulic pressure cycle profile that will prevent premature failure of the**	NHTSA: - No service life limit - Prefer a test of minimum performance representing a service life of 25 years - Prefer CP option China: - Range for hybrid HDV could be more than 1,000 km - Cycles could be too high - Would like to consider different power sources Korea: - CP option is ok - Regardless of the service life number of cycles should be 11,000 cycles EU: - CP option is ok Japan: -

Vehicle Type	*Max svc. life*	*Max lifetime miles travelled*	*Lifetime No. of fills ("pressure test cycles")*	*Ref: GTR13 Phase 2 Proposal*
HD Commercial	**15 yrs**	**--**	**--**	**11,000**
	20 yrs	**3,500,000 km**	**8,500**	**11,000**
	25 yrs	**4,000,000 km**	**9,800**	**11,000**
LD Commercial	**15 yrs**	**--**	**--**	**5,500, 7,500 or 11,000**
	20 yrs	**2,100,000 km**	**6,600**	**11,000**
	25 yrs	**2,400,000 km**	**7,400**	**11,000**

While the details of this analysis can be found in the document "GTR13-11-12b TF1 210927 Estimation of VMT TF1-JAMA.pdf" (https://wiki.unece.org/download/attachments/140706658/GTR13-11-12b%20TF1%20%20210927%20Estimation%20of%20VMT%20TF1-JAMA.pdf?api=v2), a brief summary of the methodology is as follows:

(i) Records from periodic legal inspections were collected from about 400,000 on-road vehicles. Heavy-duty vehicles were defined according to Japanese categorization as those with greater than 10 number of seats and a loading capacity of greater than 1,250 kg (assuming the vehicle weight is greater than 3,500 kg).

(ii) The annual VMT (km/year) of each vehicle was calculated by the taking the difference between the records of the current inspection less the previous inspection. An average vehicle mile travelled (VMT) per year (VMT_{year}) was calculated for the vehicles of a certain age. A maximum VMT for each year for each vehicle age was also calculated by adding three times the standard deviation of the VMT_{year} to the average.

$$\text{maxVMT}_{\text{year}} = \text{aveVMT}_{\text{year}} + 3\text{sigma}*\text{VMT}_{\text{year}}$$

(iii) Finally, a maximum lifetime miles traveled (VMT_{life}) was calculated by summing $\text{maxVMT}_{\text{year}}$ over the years.

$$\text{VMT}_{\text{life}}\ (\text{km}) = \Sigma\, \text{max}VMT_{year}$$

container due to test conditions outside of the container design envelope.

	Data for commercial vehicles were then separated and analysed since commercial vehicles have higher mileage than personal vehicles. (iv) The number of lifetime refuellings were calculated by dividing VMT_{life} by the fuelling interval. In Phase 1 of the GTR13, the filling range of 320 km (200 mi.) was assumed for light-duty vehicles. While production HFCVS have a much longer range now, the same value was applied to LDV as to stay consistent with the earlier methodology. For HDVs, a range of 400 km (250 mi.) was determined to be reasonable, as HDVs typically have a larger fuel capacity and therefore range. While it is difficult to get a single data-based fuelling interval value for hydrogen fuel cell HDVs, an assumption of 400 km (250 mi.) can be a sufficiently conservative value. (v) Finally, a data filtration process was performed to ensure the data set overcame limitations of the vehicle odometer (limited to 5 or 6 digits) and those records deemed as extreme outliers. In this study, the threshold of maximum effective VMT_{year} was defined to the maximum value of the sum of averaged VMT_{year} and 6 times standard deviation within the first 5 years of the vehicle ages. The data shows that the VMT_{year} of a vehicle’s early years in service are higher than later years so those that exceeded the maximum effective VMT_{year} were removed. While these maximum effective VMT_{year} can seem a near impossibility in the Japanese market (1,000 km/day and 365,000 km/year), these maximum values were maintained since only a few vehicles were close to this maximum limit and thus their effects negligible. (b) Germany – The most recent available mileage data from heavy duty semi-trailer trucks were collected from the German Federal Motor Transport Authority (KBA). The data examined are from inspection records from 2014 to 2018 of new semi-trailer trucks after one year of service. The data shows that the average VMT over 20 or 25 years is lower than the average of the first 3 years, which is consistent with industry practice for trucks to be driven the most in the first few years of use. After examining the results from the data, the		

highest annual VMT from new truck data was used for this calculation as a very conservative value, rather than the average over the actual service life. The assumptions are as follows:

- **Trucks are driven the same number of miles each year over its service life (115,017 km annually), representing an extreme usage case.**
- **The average European truck driver works 9 hours per day.**
- **The maximum speed on German highways for trucks is 80 km/h.**
- **A fully-fuelled hydrogen truck has a conservative range of 500 km.**

Using the above assumptions, a total range of 720 km per work day is calculated, resulting in approximately 1.5 fuelling cycles a day. Since GTR 13 Phase 1 did not consider partial fuelling so this number was rounded to 2. With the VMT rate expanded over 20 and 25 years, the number of fuelling cycles were estimated as follows:

Vehicle Type	***Max svc. life***	***Max lifetime miles travelled***	***Lifetime No/ of fills ("pressure test cycles")***	***Ref: GTR13 Phase 2 Proposal***
HD Commercial	**20 yrs**	**2,300,340 km**	**6,390**	**11,000**
Semi-trailer truck	**25 yrs**	**2,875,425 km**	**7,987**	**11,000**

Table 2
Results of German study

(c) United States – The National Renewable Energy Laboratory (NREL) published a study in 2021 which examined the end-of-life conditions of compressed natural gas vehicle fuel tanks. The focus was to investigate the structural integrity of CNG fuel tanks under nominal operating conditions at the end of their service life to help manufacturers to "better identify, understand, and mitigate safety risks and address barriers and opportunities related to CNG storage

onboard vehicles." A total of 60 Type II and Type IV CNG fuel tanks from transit buses used for 15 years were obtained from the Los Angeles County Metropolitan Transportation Authority.

These tank designs had been qualified under ANSI CSA NGV2 but the exact service history of each tank could not be obtained. Still, each tank was estimated to have been cycled from 1,000 to 4,400 pounds per square inch gauge (psig), 6 times per week for 15 years, resulting in an estimated total of 4,680 fatigue cycles over its useful life.

Non-destructive evaluation (via modal acoustic emission, MAE) and physical testing (per ANSI CSA NGV2) were performed on these tanks. Twenty of the 60 tanks were burst-tested without being subjected to any additional damage to establish a baseline understanding of the tank's structural integrity at EOL.

An additional 20 tanks were subjected to artificial notch and impact damage followed by fatigue cycling and burst pressure testing to understand structural durability. Another 20 tanks were subjected to hydraulic fatigue cycling followed by a burst test to simulate continued use of the tanks beyond their defined EOL.

The results of the structural integrity testing of the Type III and Type IV CNG fuel tanks at the end of their defined useful life of 15 years suggests the "potential opportunity of continued use of tanks", as all 60 tanks were beyond their defined useful life of 15 years but seemed to be structurally sound based on the results of the initial visual inspection and MAE examination. The tanks maintained the required strength for burst pressurization at the time of manufacture and did not experience any significant strength degradation during their use in service as determined by the burst pressurization test.

Even after additional hydraulic fatigue cycling, the tank integrity based on the burst test "suggest the potential of additional service life for CNG tanks beyond their defined end of life."

78. The current GTR13 requirement of 11,000 initial baseline cycles is already very conservative for a tank with a service life of 15 years. Data from Japanese and German trucks in service show that a 25-year VMT, and consequently the number of refuelling cycles, are much lower than

	what is already in the GTR 13. Furthermore, the end-of-life testing of CNG tanks designed to similar requirements at the GTR13 showed an acceptable structural integrity even after further damage and cycling. For these reasons, the Phase 2 group agreed that the current GTR13 requirements of 11,000 initial baseline cycles and 22,000 "leak without burst" cycles could be applied to an extended service life of 25 years.		