Sub-Committee of Experts on the Transport of Dangerous Goods (Eighteenth Session, Geneva, 3-12 July 2000, Agenda Item 2)

WORKING GROUP ON GAS RECEPTACLES AND MULTIPLE ELEMENT GAS CONTAINERS (MEGCs)

UK comments on Proposals contained in UN Document ST/SG/AC.10/C3/32/Add.1 presented to the 17th Session of the UN Sub-Committee of experts (6-17 December 1999), ST/SG/AC.10/C3/34/Add.1: Annex to the Report of the Working Group on Gas Receptacles and Multiple-Element Gas Containers (MEGCs).

Informal document transmitted by the Expert from the United Kingdom

Background

1. The Working Group on Transportable Gas Receptacles met from 6 to 9 December 1999 during the Seventeenth Session of the Sub-Committee of Experts. The report of the Working Group is contained in documents ST/SG/AC.10/C3/32/Add.1 and ST/SG/AC.10/3/34/Add.1.

2. The United Kingdom wishes to submit an Informal Paper commenting on the report contained in the above documents. It is requested that this paper is considered at the Eighteenth Session of the UN Sub-Committee of Experts to be held 3 to 12 July 2000, and specifically within the Gases Working Group of that Sub-Committee, to be held 3 to 7 July 2000.

3. This INF Paper comments on the above Working Group Report, provides information and offers further suggestions where appropriate. The UK also has minor editorial comments to make, which should be discussed in the Gases Working Group.

4. The Paper also provides information on research studies carried out in the UK dealing with the use and reliability of pressure relief devices fitted to gas receptacles containing LPG and Dissolved Acetylene.

Discussion

5. ***Provisions for Multiple Element Gas Containers (MEGCs) and Transportable Gas Receptacles.***

The UK feels that the work on MEGCs and gas receptacles should be concluded at this Session of the Sub-Committee of Experts and certainly no later than the December 2000 meeting of the Committee of Experts. Note is taken of recent correspondence between the USA, Canada and the Gases Working Group Secretariat and the concerns expressed are appreciated. However, it is felt that these concerns should be addressed and concluded at the 18th Session.

It is in the interests of both the Gases Working Group and the UN Committee that the requirements for MEGCs and gas receptacles are agreed and concluded in this biennium. The Working Group have been considering the provisions for MEGCs for 2 biennia and gas receptacles for 1 biennia and find that there are now only a few outstanding issues to be resolved. The UK feels that there is no

reason to further delay the completion of this work and that the Gases Working Group should therefore make every effort to complete the provisions for MEGCs and gas receptacles, including cryogenic receptacles, during this biennium. At the very least, the provisions for MEGCs should be completed at the 18th Session.

6. ***Use of International Standards.***

The UK feels that the referencing of ISO standards need not be the impediment to reaching agreement that it may appear to be as other standards may be referenced which provide acceptable or equivalent safety levels – including the use of national standards. At the 17th Session, the Gases Working Group agreed that references to published ISO standards were preferred. However, other published standards could be referenced although it was clearly stated and recorded by the Secretariat that it was not the intention to include every available standard. It should be remembered that the intention of the UN Model Regulations is to provide basic requirements and recommendations for international transport. These requirements may be supported by **any** appropriate technical standard or specification, relevant to the particular application. In all cases, users should adopt the latest version of the standards.

7. ***Pressure Relief Devices (PRDs).***

The UK notes that this topic has received much debate over the last biennium, and recognises that there are still some differing views expressed between participating members. It is appreciated that this is one of the few remaining issues to be resolved. At the 17th Session, the UK put forward its position on this subject in an Information Paper (UN/SCETDG/17/INF.10). It is also noted that EIGA have prepared a risk assessment paper (UN/STETDG/18/INF.13) considering the use of PRDs on all gas receptacles (other than those used for Liquefied Petroleum Gas (LPG)), with which the UK is generally in alignment. Furthermore, the USA are to review all the available statistical and risk analysis data.

The UK position on the issue of PRDs is that they should be fitted to gas receptacles used for the transport of flammable liquefied gases such as Liquefied Petroleum Gas (LPG). The UK have found that PRDs on LPG receptacles very rarely leak and that the benefits afforded by PRDs in the event of fire engulfment, far outweigh the risks of fire arising from leakage of a PRD. Justification for this was provided in the previous UK Information Paper (/INF.10) and is expanded in the attached **ANNEX 1**.
PRDs may also be fitted to non-flammable, non-toxic gases but are not recommended for compressed or toxic gases.

In addition, further work has indicated that in the case of large hydrogen tube or cylinder type trailers, the overall expected annual probability of failure (in terms of leaks or catastrophic failure) resulting in the release of hydrogen would be expected to increase by approximately 60% if bursting discs were fitted. This is due to the spurious failure of bursting discs under normal conditions. In the case of hydrogen, any uncontrolled release of this gas is undesirable due to the risk of auto-ignition arising from the reverse Joule-Thompson effect.

Also, research conducted on receptacles for Dissolved Acetylene concluded that they should not be fitted with PRDs. A brief summary and the conclusions of this research are given in **ANNEX 2** of this INF Paper.

As a compromise and in the interests of concluding discussion on this issue, the UK proposes a solution and this is shown in paragraph 11 of this INF Paper.

Proposal 1, Proposed texts 1.2.1 Definitions

8. ***Pressure Drums***.

The UK supports the proposal for a limit of 1000litres for pressure drums. The proposed definition aligns with that given in RID/ADR Marginals 221 and 2211 respectively and many national standards also include this limit.

9. ***The definition for 'Authorised Body'***.

This has been the subject of some concern in international documents as a result of differing interpretations by participating members.

In order to clarify the situation, it is proposed to define the term as "*the Testing and Certifying Body (or Bodies) approved by the Competent Authority"*. This coincides with the use of that term throughout the remaining texts.

Proposal 3, Special Packing Provisions

10. Paragraph 4.1.6.1.4. The UK is content to accept the reference to ISO 10297 in (d) and the last paragraph. The square brackets should be removed.

Packing Instructions P200

11. P200 (a). In view of the debate on the use of PRDs, it is proposed that the following phrase is adopted: *"PRDs shall be fitted to pressure receptacles where specified by the Competent Authority for the country of use"*. As the risks to public safety are in the country of use, this should be included. The square brackets should then be removed.

12. P200 (j) (a). Proposal for moisture content. In the UK, the accepted 'dryness' figure for moisture is below -46^0C at 1013mbar. However, it is accepted that other countries adopt different dew point temperatures in order to control corrosion. A measure for 'dryness' of the gas is defined in EN ISO 11114 Part 1, therefore, it is proposed that this definition is adopted in this Packing Instruction. The paragraph should be rewritten to introduce the term 'dryness' of the gas. The second sentence should read; *"— for gases with a subsidiary corrosive risk where the gas is not 'dry', the period is reduced to 3 years. Note: 'dry' is defined as containing no free water under any service conditions including at the highest expected operating pressure and at the lowest expected operating temperature"*. Consideration could also be given to the fitting of residual pressure devices.

13. P220 (l) m. It should be pointed out that the reference to an extended inspection period of 15 years requires certain criteria to be met in accordance with the standard. It should **not** be used as a period to be automatically adopted without full justification.

14. P200 (l) m (b). Reference should only be made to those standards that have been published, therefore, ISO/DIS 10464 should not be referenced until it is published. The appropriate alternative published standard in this case is EN 1440.

15. P200 - Table, pages 9-17. The asterisks in the table need to be annotated and clarified. This was also highlighted and discussed at the last meeting.

16. P202. Due to current proposals to remove airbag inflators, modules and seat belt pretensioners from Division 2.2, (ST/SG/AC.10/C.3/2000/12) it is proposed to delete this Packing Instruction if that proposal is adopted

17. P203. As previously stated, the UK feel that cryogenic receptacles should be included and completed in this biennium.

18. P203 (g). Delete Carbon Dioxide, refrigerated liquid (UN2187) and its mixtures as it is not feasible to contain this gas in an open cryogenic receptacle.

Proposal 4, Requirements for the Construction and Testing of Receptacles.

19. Paragraph 6.2.1.1.4. The final sentence would be more suitably repositioned at the end of paragraph 6.2.1.1.3.

20. Paragraph 6.2.1.1.5. Propose to delete the word 'entirely'.

21. Paragraph 6.2.1.1.7. There is some concern over the test pressure for cryogenic receptacles. A number of different figures are used for the test pressure before insulating and jacketing in international standards. The US DOT 4L (Canadian TC 4L and UK DOT 4L(HSE)) uses 2 times the working pressure, whilst the European Standard EN1251 Part 2 uses 1.3 times the MAWP. Some National Standards use 1.5 times the working pressure. Therefore the present wording is supported as this allows higher national requirements.

22. Paragraph 6.2.1.3.4. The UK agrees in principle to the use of the words *'When fitted'* at the beginning of the first sentence.

23. Paragraph 6.2.1.3.5. As stated above, cryogenic receptacles should be considered during this biennium.

24. Paragraph 6.2.1.6.2 and 6.2.1.6.3. As stated above, reference should only be made to published standards and specifications. Therefore references to ISO/DIS should not be made unless they are published.

25. Paragraph 6.2.1.8. **Approval of pressure receptacles**.
The definition of an Authorised Body has been covered under item 9 of this INF Paper. However, it is proposed that these bodies are approved by the Competent Authority of the country of *'approval'*, rather than the country of *'origin'*.

26. Paragraphs 6.2.1.9.1 and 6.2.1.10.1. The inspection of internal neck threads should be included in the requirements for both initial and periodic inspection, with the exception of open cryogenic receptacles. The following wording is proposed for a new paragraph (d); *'Checking of the internal condition of the screw threads in the pressure receptacle'*.

Proposal 7, Requirements for MEGCs

27. Paragraph 6.7.5.3.6. Propose to delete the second sentence as that standard has not yet been published.

28. Paragraphs 6.7.5.7 and 6.7.5.8. Although it was suggested that this be reviewed by the US CGA, the UK supports the current text.

29. Paragraph 6.7.5.13.2. Propose to close the square brackets at the end.

ANNEX 1

THE USE OF PRESSURE RELIEF DEVICES (PRDs) ON TRANSPORTABLE GAS RECEPTACLES CONTAINING LIQUEFIED PETROLEUM GAS (LPG)

1. For over 25 years the UK have supported the policy of fitting PRDs to gas receptacles containing LPG due to the significant reduction in explosion risk in the event of ignition of the gas.

2. During 1974 and 1975, the UK Home Office conducted many trials in order to provide guidelines on the use of PRDs on LPG gas receptacles. Whilst the aim is always to store and use LPG cylinders outside, rather than within buildings, concern was raised over receptacles involved in fires arising from ignition in typical house dwellings and other buildings. The trials involved receptacles fitted both with and without PRDs and the conclusions were that receptacles fitted with PRDs in typical house fires (as simulated), dramatically reduced the risk of rupture.

3. The ignition sources (as simulated) were from beyond the boundary of the receptacle and therefore not related to any perceived leakage from the PRD itself. The risk of PRD leakage was not verified during those trials.

4. A risk assessment conducted by the UK Health and Safety Executive also indicated that in the event of fire, missile projection distances were far greater for LPG receptacles not fitted with PRDs than those fitted with PRDs. Although LPG Receptacles without PRDs will take longer to heat up and ignite, it is arguable that this additional time will allow personnel to evacuate. However, the resulting explosion and fragmentation from such receptacles creates projection distances in excess of 100metres, therefore affecting a wider population more distant from the scene of an incident. Under equivalent circumstances, LPG receptacles fitted with PRDs are less likely to violently rupture and fragment, resulting in missile projection distances of typically less than 20metres.

5. When PRDs relieve during a fire, it is possible for them to affect adjacent receptacles, therefore consequently causing them to ignite and/or relieve. However, this scenario is less likely to cause an uncontrollable hazard than one which results in a major explosion. Although the fire services treat every event as unpredictable imminent failure, a fire is considered easier to control than an explosion. The results of a probability assessment of missile projections arising from fires involving LPG receptacles is shown in **TABLE 1.**

6. There are very few recorded incidents involving the rupture of LPG receptacles in the UK. For example, in 1994, an incident occurred where hundreds of receptacles on a trailer were affected by fire. Approximately half of these receptacles were fitted with PRDs. Those with PRDs either resisted explosion or travelled substantially shorter distances, rupturing into fewer fragments, than those receptacles which were not so fitted. A similar incident occurred earlier this year when two vehicles collided. In this case all receptacles were fitted with PRDs and the majority of receptacles relieved rather than exploded. None travelled farther than approximately 10metres. Consequently, the incident site was confined to a small area which enable evacuation to be completed quickly.

TABLE 1

Brief Results of UK probability assessments

PROBABILITY (YR) OF MISSILE FROM LPG CYLINDER INVOLVED IN FIRE HITTING A TARGET OF AREA 0.5m^2

		TONNES	
	QUANTITY OF LPG	25	100
	NO. OF RECEPTACLES	1000	4000
	RANGE (METRES)		
RECEPTACLES WITH PRDs	20-40	1.8×10^{-7}	7.2×10^{-7}
RECEPTACLES WITHOUT PRDs	0-25	2.5×10^{-5}	1×10^{-4}
	25-100	2.5×10^{-7}	1×10^{-6}
	100-220	2×10^{-8}	8×10^{-8}
	220-310	5×10^{-9}	2×10^{-8}
	310-400	1.3×10^{-9}	5.2×10^{-9}

ANNEX 2

FIRE TESTS ON ACETYLENE RECEPTACLES FITTED WITH PRDs

1. Between 1994 and 1995, a number of fire tests on Acetylene receptacles were conducted at the laboratories of the UK Health and Safety Executive. The tests involved Acetylene receptacles fitted with either fusible plugs or bursting discs.

2. The receptacles were subjected to different types of fires in order to determine the effectiveness of these devices in preventing failure of receptacles.

3. The Acetylene was dissolved in a solvent (Acetone) which was absorbed in an inert porous filler or 'mass' containing no asbestos. The solvent prevents the formation of pockets of Acetylene inside the main body of the receptacle and also acts as a stabiliser.

4. **Fire tests on Acetylene receptacles fitted with fusible plugs.** The receptacles were tested under both pool fire and torch (jet) fire conditions. The torch fire tests used a flame burning from an Acetylene source as this more accurately simulated an Acetylene hose fire.

   The conclusions of the fire tests were that;

a) 50% of the receptacles failed catastrophically,

b) receptacles could be heated to the point of failure without the fusible plugs reaching their operating temperature,

c) receptacles could still fail even after the fusible plugs had operated,

d) the fireball from a catastrophic failure of 30 to 50Litre receptacles can reach a diameter of approximately 16metres,

e) there are serious doubts over the capability of fusible plugs to prevent explosions when fitted to Acetylene receptacles subjected to attack by fire.

5. **Fire tests on Acetylene receptacles fitted with bursting discs.** The receptacles were tested under both pool fire and torch (jet) fire conditions, as in the previous tests. The same procedures were adopted as in the previous tests.

   The conclusions of the tests were that;

a) none of the bursting discs ruptured before the receptacles exploded,

b) the set pressures of the bursting discs were well above the maximum receptacle failure pressures found during the tests,

c) bursting discs were ineffective in preventing this type of receptacle from failure when subjected to attack by fire.
