UN Intercessional WG Meeting on Large Format Lithium Batteries

Day 1 – October 2, 2013

1. The UN Working Group on Large Format Lithium Batteries was held from October 2-4, 2013 in Washington, DC. The meeting was hosted by PRBA and supported by RECHARGE and COSTHA.
2. Mr. Kerchner welcomed the group and participants introduced themselves. **Mr. Kerchner noted that the attendance list and all documents from the meeting will be posted on PRBA website's at http://www.prba.org/laws-regulations/ under the heading "UN WG Meeting on Large Lithium Batteries – October 2013."**
3. Mr. Claude Pfauvadel (UN Vice Chair and Chairman of the Working Group) opened the session by noting the four (4) objectives which will guide the progress of the Working Group. The Chairman noted that there are two groups within the UN which have or are developing lithium battery regulations relating to large format batteries, the UNSCOE on TDG as well as Working Party 29 dealing with automotive safety applications.
4. The Chairman noted the process to review and update the regulations for large format batteries only began with this meeting, and expected the process to continue through the biennium. These are:
    a. Review and contrast relevant testing requirements applicable to large lithium batteries in particular those used in the automotive, aviation and other major sectors of the industry;
    b. Consider practicability of the test provisions for battery assemblies in 38.3.3(f) of the Manual of Tests and Criteria and consider the need to review the existing definitions of large batteries;
    c. Identify means of harmonizing existing testing requirements or recognizing test equivalents;
    d. Develop proposals for regulatory text for inclusion in Section 38.3 of the Manual, if needed.
5. A number of presentations were prepared prior to the meeting and the Chairman recommended each presentation be reviewed and discussed.
6. To set expectations, the Chairman noted the future work of the WG would include:
    a. a summary of the discussions at this meeting presented to the UNSCOETDG
    b. a 2nd meeting to further develop the discussion and prepare proposals. Possible location to be held in Europe in February;
    c. a possible 3rd meeting to finalize issues and prepare formal proposals for the UN
    d. a formal document submitted to the UNSCOETDG 46th Session

History of Lithium Battery Tests

(UN lithium battery tests 1985-2013 on PRBA website.)

7. PRBA presented the history of the lithium battery tests, originating 1985. The original tests included thermal, altitude, shock, short circuit, and vibration. In 1990, the UN adopted tests as a condition of classification as a Class 9 material. In 1992, the US and Canada proposed a difference between small and large batteries. Small batteries did not need testing; large batteries required UN testing. Large batteries limited to 500 g lithium metal. The notes of the meeting indicate the tests were generally consistent with IEC standards (IEC Standard 68-2-27 in particular) which had been developed at the time.
8. In 1998, significant work on lithium regulations introducing lithium ion battery technology (equivalent lithium content) was conducted. Germany noted up to 40 g shock encountered in automobile crashes. New definitions were adopted for large batteries, and the shock tests were revised. Further work was conducted in 1999 and 2000, which resulted in minor changes to the UN tests.
9. In 2005-2006, the UN replaced the concept of ELC with Watt hours for lithium ion, created separate entries for lithium ion, and defined new tests. During the 2007-2008 and 2009-2010 bienniums, new definitions of large format batteries (12 kg) as well as exceptions for battery assemblies was adopted. Four Working Group meetings were held which resulted in significant changes to the UN tests including a change to the Vibration test for large format batteries.
10. RECHARGE pointed out the optimum nominal energy per battery weight today is 150-200 Wh/kg. Therefore a 12 kg battery would have a nominal energy of 2,400 Wh. The Chairman reminded the Working Group the tests are classification tests, but the tests also serve as qualification tests to allow batteries to be transported by any mode. The UN views lithium batteries as an electric storage system which could release electricity, heat, etc. Due to this approach, the Chairman suggested it is difficult to identify limits. The Working Group must identify why these limits exist. If these tests are difficult to perform due to the size of the battery, then the concept of Wh rating is irrelevant. However, if the limit is based on safety (i.e. limiting the energy capacity), then Wh is a relevant.
11. Canada commented the need to discuss module testing and differences between cells connected in parallel and those in series, and the different hazards those conditions reflect. The UK suggested that was a critical point since a module connected in series may only be a set of cells, and did not pose additional hazards like that of a battery.
12. **Action:No actions taken from this discussion.**

Competent Authority Discretion

13. PRBA highlighted the provision in the UN Manual which permits a Competent Authority to dispense with the UN tests and require an alternate testing regime (Section 1.1.2). PRBA asked if the approvals would be recognized internationally. Germany noted there are three parts of the UN ManualParts I and II give the Competent Authority the ability to design and approve testing which they would conduct as a Competent Authority. Part III is the testing to be conducted by the shipper. Since no Competent Authority has developed a different testing requirement, no such approvals have been issued. The UK commented they had been approached by the aerospace industry previously but did not issue an approval. Competent Approvals issued, for example, to permit untested batteries to be transported under the ICAO Technical Instructions are issued based on the issuing Competent Authority jurisdiction.
14. The WG was reminded the way the transport of dangerous goods may be exempted from some requirements is defined differently under the conditions of the applicable international conventions.
15. **Action:No actions taken from this discussion.**

Definitions in the UN Manual of Tests and Criteria

(See PRBA definition presentation on PRBA website.)

16. PRBA introduced several definitions which could be considered for inclusion in the UN Manual. These include Module or Component Module and Battery System. Additionally, PRBA suggested the distinguishing factor for a large versus small should be industrial versus consumer. Therefore, PRBA proposed redefining a large battery as one greater than 5 kg. The UK agreed that the definition of a module does not mean the same to everyone. However, they suggested the definition for a large format battery may increase, not decrease. COSTHA reminded the Working Group this was discussed in previous WG sessions and the idea of modules or component modules is different between Competent Authorities around the world. Germany suggested the problem may be in the use of the term “Battery Assembly” and removing the term may resolve some confusion. The Chairman noted that different languages have different meanings. Replacing the terms with values or limits would be a better approach. Regulations should not be driven by definitions, definitions should support regulations.
17. Canada requested feedback from the WG on whether component cells and batteries must be tested, or just the battery which is intended to be transported. Germany indicated unless excepted, both would need to be tested. JARI pointed out a monitoring system which would be covered under a Battery System may not always be part of the battery pack and only becomes attached when the battery is installed. Therefore JARI

cautioned using the term Battery System. The UK suggested the reason for definitions is to identify which tests are applicable, and reiterated the concept of mass should be considered.

(See RECHARGE presentation on PRBA website.)

18. RECHARGE provided visual examples of both stationary and mobile battery systems and described the problem of scaling up automotive and stationary battery systems using modules. Numerous configurations create significant costs if all configurations need to be tested. For large batteries, more terms than cells and batteries is needed. Germany described how each of the battery components and components would be tested under the current testing regime. Germany also pointed out new E-bikes have a 11 kg battery, therefore large batteries are in consumer devices. The Chairman reminded the WG the intention is to review the technical nature of the texts and not to discuss the use of batteries by different industries. To convince the UNSCOETDG to change a definition, the WG needs to prove the existing definition does not fully address the current conditions. Proposed definitions could include standards. PRBA reminded the WG the term Battery Assembly is used multiple times and needs to be defined.
19. The Chairman indicated specific examples are needed to support changes to the UN 38.3 tests. He requested industry provide 3 or so examples which could each be reviewed looking at the existing text, and clearly identify the problems.

    (See UL presentation on PRBA website.)
20. SAFT presented information prepared by UL addressing the differences between various standards and regulations applicable to lithium batteries. In particular, the similarities and differences between the UN38.3 and UL/RTCA DO tests for aviation. T.5 and T.7 both create problems due to fuses installed in the system prevent the short circuit from reaching the battery. Thus T.7 is testing the fuse. JARI pointed out on slide 3 that IEC 62660 does include vibration, shock, and short circuit testing. SAFT and PRBA indicated they would revise the presentation and circulate the revised version to the WG. PRBA asked how many batteries are tested by other standards. SAFT responded that the number of batteries to be tested varies. For example for the DO series, 5-10 are typically used because the tests are not sequential (batteries for shock and vibration cannot be used for other tests). The UK requested the charts be updated to indicate whether the tests are sequential or not. PRBA pointed out that there are standards which are more restrictive than the UN38.3. The Chairman asked whether the standards were mandatory. SAFT indicated the aviation standards are used to receive type certificates so that they could be used for approval on various aircraft. Many of the standards originated from Air Force MIL standards. GM pointed out some corrections for J2929. COSTHA suggested reviewing the fail conditions of certain tests when the open voltage drops to zero. SAFT stated they test the circuit before and after the fuse

and compare the voltage to prove the test has passed. Therefore a blown fuse and a fail-safe condition would not be considered by SAFT as a failure of the test. Germany noted UN38.3 deals with both rechargeable and non-rechargeable cells and batteries. The WG noted that many of the other standards are applicable only to rechargeable batteries.

21. The Chairman noted the WP29 ECR100 Rev 2 related to the testing of electric battery systems to be installed in the vehicle. This document has the same standing as the UN Manual yet has tests which are significantly different than UN38.3. The Chairman noted the list of standards is quite daunting but questioned which specifics can be used to change UN38.3. WG participants explained the standards are used to prove safety then competent authorities, such as the US FAA, adopt the standards as their requirements for approval. Germany pointed out the the UN38.3 and two other standards are mentioned in all test descriptions, but the conditions of each test are not identical. Based on the comparison, the UN38.3 is the most restrictive because all the tested must be in sequence. The Chairman pointed out the purpose of the exercise is to identify which tests are most applicable and appropriate so that redundant testing does not result. Of the tests identified in the presentation, only two are mandatory. The rest are business to business and used as examples. The WG will not attempt to harmonize with these standards but will use these standards to make the UN38.3 tests more representative of necessary testing parameters. RECHARGE noted the standards are based on specific conditions applicable to the standard. Therefore the UN38.3 tests should be based on the foreseeable abuse to the battery which may cause hazards in transport. Canada agreed with RECHARGE but pointed out the normal conditions of transport can change by mode, and that extreme conditions are encountered. Further, Canada asked why an internal short circuit is not included in the tests to determine propagation potential. The Chairman responded that while the internal short circuit test has been discussed extensively, no one was able to present a test which could be used in all cell and battery types. Canada suggested they would prefer to see a test to determine if a failure within the battery would propagate from cell to cell. The Chairman commented that the WG could consider a “reactivity” test such as a bonfire test where the worst case condition is simulated, and depending on the results of the test, the battery could be identified as a non-reactive battery, low reactive battery, or high reactive battery. The UK cautioned the WG to realize the real world is too complicated to fully address through testing. Instead, the UN38.3 testing should be a simple system which ensures safety in transport, but is not too complicated that industry cannot comply.
22. The Chairman noted that the acceleration requirement in the T.4 could be related to the mass and the energy in the system. The UK supported the thought but referenced the

concept of damage boundary analysis which could be considered. COSTHA/DELPHI pointed out they had submitted several documents on the point and would support effort in this area.

23. **Action:**
    a. **See UL presentation on PRBA website.**
    b. **Sliding scale for T.4 acceleration provided later in the session and at the next WG meeting.**

Changes to T.5

()See Samsung presentation on T5 short circuit test on PRBA website.)

24. Samsung stated there is confusion in industry and testing laboratories regarding the failure conditions of T.5. Noting that the range currently could be interpreted to be zero to 0.1 ohm, Samsung suggested modifying the test limitations from "less than 100 mohms" to industry standards which are "80 +/- 20 mohm".
25. The US Navy indicated they have test conditions today which are at 20 mohm where 80 mohm is simply a discharge condition. Therefore a change would not permit their testing and battery conditions. JARI indicated the standard from which the 80 mohm reference comes from is divided into two parts. Part 1 includes the 80 mohm reference, but Part 2 includes a 20 mohm reference. The UN requirement therefore covers both. The WG agreed the interpretation that the test should start at 0 ohms and move up to 100 mohms is *not appropriate*. Thus the wording should be changed to reflect one test should be conducted with one value which may be chosen anywhere below 100 mohms. However the WG debated on how precise the language needed to be. The UK suggested that when test parameters are being set, it is generally good practice to set a tolerance on values. The UK also questioned the view that was expressed that the test purpose was simply to ensure the fuse or safety device will perform as intended. The WG further discussed the issue of how to address conditions where 100 mohms does not represent a short circuit. COSTHA proposed language changes to the Purpose and Test Procedure for T.5 to address the issue. The Chairman cautioned the WG about agreeing to language which could be misinterpreted and pose legal uncertainty in the event of an incident.
26. **Action:The WG will consider how to clarify the position that only a single test with a single value below 100 mohms is required under T5.**

UN Intercessional WG Meeting on Large Format Lithium Batteries

Day 2 – October 3, 2013

1. The UN Working Group on Large Format Lithium Batteries was held from October 2-4, 2013 in Washington, DC. The meeting was hosted by PRBA and supported by RECHARGE and COSTHA.
2. The Chairman noted that the WG would continue the discussion on T.5 before moving on to T.4.
3. Mr. Kerchner reminded the WG that the attendance list and all documents from the meeting will be posted on PRBA website's at http://www.prba.org/laws-regulations/ under the heading "UN WG Meeting on Large Lithium Batteries – October 2013."

T.5 External Short Circuit

(See RECHARGE presentation on PRBA website.)

4. RECHARGE presented a single proposal on adjusting the tolerance in T.5 from 55 +/-2 to +/-4, noting difficulty in equipment available in laboratories and workshops. Germany and the UK disagreed suggesting the equipment is available based on experience and can be readily competed. One of the test laboratories noted difficulty in meeting the test depending on where the thermostat is placed in the oven and where the fan is located. Another test lab indicated they do not have a problem with meeting the tolerance, but older equipment may be a struggle. However they did comment that their understanding is that the short circuit test should be conducted while in the oven. SAFT noted that a large format battery with a large mass would take considerable time to drop more than 1 degree. JARI questioned the reason for the testing on the battery assembly given that the test is to check cell protection but the battery assembly is composed of cells which have all been tested.
5. The Chairman clarified the discussion by noting there are two separate issues being discussed. First, is the tolerance appropriate and reproducible? There are two solutions:
    a. Reword the procedure to require a temperature of at least 55 ^{o}C then consider a tolerance which would include 55^{o}C.
    b. Revise the tolerance to +/- 4
6. However the second issue addresses the actual procedure, whether the short circuit test must be conducted in the oven or outside the oven. The test method in UN38.3.4.5.2 is not sufficiently detailed to answer this question. The WG discussed the practicality of performing the test as written given the differing opinions in the room. The UK pointed out this discussion highlights the problem with the way all the tests are

written. The UK added their interpretation is that the test is to be conducted outside the oven/chamber. The WG discussed the fact that the length of the test is also affected by what temperature is used to end the test. Germany related similar test procedures conducted for Classification of 4.2. JARI pointed out the other standards referenced in the UL document for T.5 have a wide range of tolerances (+/- 2, +/- 4, +/- 6). They recommended +/-2. JARI, RECHARGE, and PRBA all pointed out the difficulty is that these batteries are large and temperature variances across the case will not likely return in a uniform manner and 2 degrees may take additional hours or days. The UK added that the real point is to see if the battery heats above 170 ^{o}C. Therefore as the battery cools down, the test should continue until the battery is fully drained.

7. The Chairman suggested that the purpose of the test must be considered. Intertek indicated the test on the cell is to determine the ability for a cell to withstand the short circuit without dissipating the heat in the casing. However for batteries, the test is to determine if short circuit protection is maintained. Therefore the starting temperature of the test is irrelevant. Germany commented the entire battery should be at 55 ^{o}C. The UK reiterated their point that if there is a broad disagreement as to how the procedure is to be conducted, discussing the minute details is not constructive.
8. The WG recognized there is an issue of tolerance and it was easy to solve, but the conditions of test needed to be further clarified, particularly what is the appropriate starting and ending temperature, and where the temperature is to be measured. Germany pointed out the T.2 has a “soak” period of 6 hours for small cells and batteries and 12 hours for large cells and batteries. The WG debated the value of the soak, but did not come to any conclusions.
9. RECHARGE presented additional changes to the T.5 test. They pointed out the short circuit test may not actually increase the external temperature significantly due to the size of the battery itself, and the short circuit test may not increase the external temperature rapidly. Instead checking the open voltage of the battery may be a better measurement. To rectify this, RECHARGE proposed adding a statement that if the battery is in an open circuit, the observation time can be reduced to one hour. **(See JARI presentation on PRBA website.)**
10. JARI described the design of large format batteries pointing out the cells must pass T.1-T.5, and the battery assembly must pass T.1-T.5. However the modules which are only stacks of cells are not necessarily equipped with a short circuit protection. Therefore, the modules should not be subject to T.5. JARI proposed language to UN38.3.3 which would exclude battery modules or components of batteries not equipped with short circuit protection from T.5. The issue raised by JARI was discussed, regarding whether a component module or as set of component cells without short circuit protection was really subject to T.5. The majority of the Competent Authorities in the WG indicated

they believed component batteries are subject to T.5 as a battery if the component battery is transported by itself.

11. The Chairman brought the discussion back to the issue of temperature and suggested the WG consider the concept noted by Germany which includes a "soak" time. The UK supported the idea but cautioned that the time required to achieve the temperature may vary with materials to be used and the mass of the battery. OICA indicated the time to conduct the exam is important, and suggested the temperature is irrelevant at a certain range for a large format battery. The key is to determine if the short circuit protection is in place. The Chairman noted the WG could consider two options for testing:
    a. Heating the battery to a given temperature and then conducting the test outside the chamber; or
    b. Conducting the battery in a heating chamber.
12. This issue would need to be developed further.
13. In reviewing when the test should be stopped, the UK suggested measuring the current flow. If an open circuit condition exists, the test could be stopped. If there is a current flow, the test would complete when the current flow drops below a given level, regardless of the temperature. The WG continued discussing the relevance of temperature to the test procedure and whether an open circuit test would require a 6 hour observation time.
14. The WG reviewed draft language which identified 3 conditions under which the test can be concluded. The concept was discussed and changes were suggested. Germany suggested before performing the T.5, a current must be confirmed to ensure the test is relevant. The Chairman recognized the issue but recommended the WG address that issue separately. The language proposed by COSTHA was agreed as a starting point for development in future sessions.

    38.3.4.5.2 Test Procedure

    The cell or battery to be tested shall be temperature stabilized so that its external case temperature reaches 55 ±2 ^{o}C and then the cell or battery shall be subjected to a short circuit condition with a total external resistance of less than 0.1 ohm at 55 ±2 ^{o}C. ~~This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to 55 ±2 ^{o}C.~~ <u>The test is completed when any of the conditions exist:</u>

    - <u>An open circuit condition is confirmed through direct measurement;</u>
    - <u>[The current flow as measured from the short circuit drops below XXX];</u>
    - <u>One hour after the temperature of the external case temperature case returns to 55 ±2 ^{o}C.</u>

15. Action:

a. **WG to develop more detailed testing procedures;**
b. **WG to define two procedures for conducting the test, both in a heating chamber and outside a heating chamber;**
c. **Modify COSTHA proposed language to allow three ending conditions for T.5;**
d. **Define current flow for bullet #2.**

T.4 Shock Testing

16. The Chairman proposed reviewing all the presentations before taking a discussion. **(See PRBA presentation on PRBA website.)**
17. PRBA noted a lack of general data relating to shock values encountered in transport and indicated PRBA and COSTHA will be contracting Intertek to collect typical shock values using data loggers in road and rail transport. PRBA pointed out the 50 gn acceleration value is very large compared to other standards including SAE J2464 and RTCA DO-160F for equipment installed aboard aircraft. Preliminary data from a shipment by rail indicated maximum values of 2.9 G. **(See Intertek presentation on PRBA website.)**
18. Intertek described the proposed data collection project. The data loggers would be installed on pallets and small parcels moving by ground and rail. Testing would be on the package, not the device although additional testing within the package could be collected. Accelerometers would be set to collect pulse shocks and testing would be modified to account for lessons learned during the early testing period. **(See Samsung presentation on PRBA website.)**
19. Samsung pointed out the concern that batteries containing large cells may be tested as small batteries, but large cells themselves are tested as large cells. This means that the test conditions for the cells and final battery may be different. Samsung proposed that battery containing large cells be tested as a large battery. RECHARGE supported the discussion noting they are experiencing the same issue.
20. The Chairman noted that previous testing for packaging design involving vibration let to regulations which mimic transport conditions. Further, the Chairman questioned whether the shock testing could be merged with random vibration testing. Intertek indicated they are working on a project with the US National Highway Transportation Safety Administration (NHTSA), but their impression was that the existing vibration testing already mimicked transport conditions. The UK clarified the shock test was designed to transmit abuse conditions inside the battery, not just to the outer casing. The UK also cautioned that data needed to be statistically valid and capture perhaps 100's of data points. The UK offered to be involved in the data collection. The Chairman pointed out transport is defined within the UN texts as beginning when a

material is offered for transport all the way until it is delivered, including intermediate storage and handling.

21. Germany supported Samsung's proposal with slight modification, noting that batteries containing large cells should be tested as a large battery. With regards to the PRBA/COSTHA data collection project, it is important to note that road and rail conditions may vary from country to country, and the procedure to collect the data must be clearly defined.

(See COSTHA data on PRBA website.)

22. COSTHA presented data from a previous WG session proposing a curve which could be used to determine acceleration using a set force. The WG had general consensus that the approach could be valid, but the UK pointed out many testing systems may not be able to adjust to all levels of acceleration. The Chairman noted that problem could be addressed by a stepped or tiered approach based on the mass of the battery. The Chairman also questioned what would be the appropriate force or energy which should be chosen. Should the value be set based on the force or energy current applied to a 12 kg battery at 50 gn? Should the application time vary as well? It was also noted that during a crash test, the force of 13kN is applied. With the existing approach, the force applied in the T.4 would exceed 50 kN for the large batteries above a certain mass.
23. JARI pointed out the battery assemblies would be constructed of cells which have all passed the T.1-T.5 tests. Given that the battery assembly will have a dampening effect on the test, the battery case would protect the cells. COSTHA questioned whether a battery which resulted in a failure because of a drop in voltage would be considered a failure. Some participants indicated that such a fault would not automatically result in a failure, but instead the interior of the battery casing would need to be inspected to determine if the failure was mechanical which could result in an unsafe condition. If the battery contained a resettable fail-safe design feature which operated during the test but could be reset, the battery would not be considered to fail T.4.
24. RECHARGE pointed out the sliding scale on T.4 for batteries could also be applied to large cells.
25. The WG has looked at options for improving T.4 and agreed that away forward would be to have a relationship between mass and acceleration. The WG will investigate the point further and request the UN Subcommittee to endorse the effort. The data collected by industry will be reported at a future session. The WG felt the tests are not designed to exactly reproduce conditions experienced in transport, but instead are conventional tests to ensure the cells and batteries are safe to transport.

26. Action:

a. WG to request Subcommittee endorse a mass/acceleration relationship for T.4.

b. **WG to propose possible force or energy values for relationship as well as consider time period of impact.**
c. **Draft additional language that addresses the fail-safe designs and OCV requirement.**
d. **WG to consider language to solve the issue of large cells in small batteries if this is not solved by the mass/acceleration relationship.**

T.7 Overcharge Test

(See Samsung presentation on PRBA website.)

27. Samsung pointed out the T.7 test is interpreted to apply to batteries even overcharge protection is not provided. PRBA reminded the WG the current provision in UN38.3.3(d) excepts batteries(i.e., modules) without overcharge protection that are designed only for use in a battery assembly from the T.7 test. The Chairman agreed and noted the intention of the current provisions was to test a rechargeable battery with or without overcharge protection to ensure an overcharge condition would not make the battery unstable, even if it does not have overcharge protection. Germany and UK supported the point made by the Chairman and did not support changing the purpose of the T.7 test to indicate the test was to evaluate the overcharge protection system when it is installed.
28. Samsung further noted the charging current in the UN38.3 is more stringent than SAE or IEC standards (2 x the SAE or IEC limits, and proposed the charging current be reduced to the standard charging current. In essence this would allow for the charging time to be extended for longer periods. OICA further explained the concern. The Chairman questioned the meaning of manufacturer's recommended charging current. RECHARGE clarified the manufacturer's recommended charging current will never be exceeded by the manufacturer or the consumer. Instead it is a competitive advantage for a company to have a faster recharge limit. The WG discussed the need for the T.7 test to be more aggressive than industry standards to test the ability for the battery to withstand an accidental high overcharge rate. OIAC indicated the speed of charge does have an impact to the test and results in a more severe test. RECHARGE agreed with the previous comments and suggested the 2X is too severe. The UK acknowledged the concern but was not convinced a reduced rate is supported at this time.
29. The Chairman noted that this issue was reviewed by the WG but that additional information would be needed to modify the condition of the T.7 test conditions.
30. **Action: No specific actions on this item but the WG will consider additional information at a future session.**

UN Intercessional WG Meeting on Large Format Lithium Batteries

Day 3 – October 4, 2013

1. The UN Working Group on Large Format Lithium Batteries was held from October 2-4, 2013 in Washington, DC. The meeting was hosted by PRBA and supported by RECHARGE and COSTHA.
2. Mr. Kerchner reminded the WG that the attendance list and all documents from the meeting will be posted on PRBA website's at http://www.prba.org/laws-regulations/ under the heading "UN WG Meeting on Large Lithium Batteries – October 2013."

Stationary Battery Systems

(See RECHARGE Presentation on PRBA website.)

3. RECHARGE described the types and sizes of stationary lithium ion batteries. The representative pointed out the stationary units may not be of a size which is practical to transport, and therefore such systems are often separated into multiple units: Cells, modules/stacks, battery assembly intermediate, large battery assembly, very large assembly. The testing conditions for each of these components differ depending on the size of the battery. For example, a battery assembly greater than 6,200 Wh is not required to undergo any tests but a monitoring system is required. Yet a 6,000 Wh system is not required to have a monitoring system but is required to pass T.3 through T.5 and T.7. This creates significant costs for module testing when the module will only be used in a battery system. To address this issue, RECHARGE proposed revising the exceptions in UN38.3.3(f) and the last paragraph in UN38.3.3 to remove reference to the size and replace with the following conditions:
    a. Battery assembly must be composed of cells/batteries which pass all relevant tests;
    b. Assembly must be equipped with a monitoring system;
    c. The component batteries must be firmly secured to the mechanical structure of the battery assembly;
    d. The design of the battery assembly integrates protections against heat propagation.
4. The UK suggested the exception might be more relevant in a special provision in the UN Recommendations rather than in UN38.3. JARI inquired as to the requirements of the mechanical structure referenced in the proposal. RECHARGE explained there is a point where testing becomes impractical and conformance is assured through quality assurance programs and integrated monitoring systems. The requirements of the mechanical structure would not be strictly defined but would be subject to the same

quality assurance programs. JARI pointed out the new proposal takes a different approach, and raises the question how would the manufacturer prove compliance without testing, particularly with regards to heat propagation. Experience in the automotive industry is that testing for heat propagation is very difficult. Germany did not support the proposal suggesting removing the size limit could result in very small assemblies with monitoring systems not being subject to any testing. The Chairman reminded the WG the proposal was drafted prior to the WG discussions during the week, as well as pointing out the exceptions noted in these sections were drafted as a compromise recognizing there are very large assemblies which are extremely difficult or impossible to test. But to extend the exception to testing assemblies without reference to size would not likely be adopted by the UN Subcommittee. The Chairman proposed the WG review the requirement once the new revised tests have been decided; particularly reviewing is the rated capacity or the mass of the assembly the limiting factor. Germany commented that during the COSTHA presentation, the WG noted difficulty addressing batteries having a mass of 30-40kg. Therefore, the limit may be a mass limit of 50 kg for example. However Germany also noted that such an exception would not cover battery assemblies which do not have a monitoring system and therefore they would be required to pass the tests. PRBA reminded the WG of the discussion regarding other existing industry or military standards, and suggested a competent authority could exempt a battery assembly <6,200 Wh without testing if the design met an equivalent standard. Such standards could be listed in UN38.3.3(f). Canada questioned if there is a way to validate through tests or models compliance with the heat propagation component. The WG discussed the fact that industry does have such tests built in quality control procedures, but these procedures may not be universal across all industries and geographies.

5. The WG looked at the issue of testing regime for large battery assemblies or systems and noted that the existing system works but is based on compromise to allow practicality. Given new technologies, the conditions should be reconsidered. The WG will consider redesigning the tests and look at possible new battery technologies and define design specifications which will more precisely define the requirements which could prove equivalent safety.
6. **Action:**
    a. **WG to review the conditions under which a battery assembly is impractical or impossible to test and determine the appropriate limiting factor (mass, rated capacity, etc.).**
    b. **WG to consider design requirements which could be considered to meet an equivalent level of safety.**

OTHER ISSUES

T.7 Overcharge

(See PRBA Presentation on PRBA website.)

7. PRBA raised a concern regarding single cell rechargeable batteries. The UN previously adopted provisions requiring T.7 for single cell rechargeable batteries. However, the question has been asked whether a "bare" cell installed directly into a piece of equipment is subject to the T.7 test. PRBA proposed adding language to clarify that a component cell tested by T.1 to T.6 and T.8 are not subject to T.7. Germany noted the proposed language creates a circular argument within the paragraph, but supported the idea of clarifying the exception from T.7. The WG discussed the definition of a single cell battery, component cell and the applicability of the test.

    38.3.2.1 All cell types shall be subjected to tests T.1 to T.6 and T.8. All non-rechargeable battery types, including those composed of previously tested cells, shall be subjected to tests T.1 to T.5. All rechargeable battery types, including those composed of previously tested cells, shall be subjected to tests T.1 to T.5 and T.7. In addition, rechargeable single cell batteries with overcharge protection shall be subjected to test T.7. A component cell that is not transported separately from the battery it is part of needs only to be tested according to tests T.6 and T.8. A component cell that is transported separately from the battery shall be ~~tested as a cell~~ subjected to tests T.1 to T.6 and T.8.

8. The WG agreed that there was an issue to be clarified, but that the language proposed was not completely adequate. Further, clarifying the difference between a cell equipped with additional features and a single cell battery needed additional work.
9. **Action:WG will continue to review the definitions for cell, single cell battery, component cell and the sequence of language in 38.3.2.1.**
10. The WG was able to read the report and provisionally approve its content.
11. The WG agreed to explore the possibility of scheduling the next meeting for the week of February 10, 2014 in Brussels.