



DANGEROUS GOODS PANEL (DGP) WORKING GROUP MEETING

Montréal, 21 to 25 November 2022

Agenda Item 4: Managing safety risks posed by the carriage of lithium batteries by air (Ref: Job Card DGP.003.04)

REPORT OF THE DGP WORKING GROUP ON ENERGY STORAGE DEVICES

(Presented by DGP-WG/Energy Storage Devices)

SUMMARY

This information paper presents a summary of the activities of the DGP-WG/Energy Storage Devices.

1. INTRODUCTION

1.1 The DGP created the working group on energy storage devices (DGP-WG/Energy Storage Devices) to progress the work identified in ANC job card DGP.003.04 mitigating safety risks posed by the carriage of lithium batteries by air. During DGP/28, the panel requested DGP-WG/Energy Storage Devices to conduct of a safety risk assessment on lithium batteries packed with or contained in equipment and vehicles. The working group was tasked with conducting a safety risk assessment on extending the existing state of charge limit for UN 3480 to UN 3481, particularly for lithium batteries packed with equipment.

1.2 DGP-WG/Energy Storage Devices convened four virtual meetings since DGP/28 (10 May, 23 June, 3 August, and 13 October 2022). A summary of the discussions at these meetings is provided below.

1.2.1 DGP-WG/Energy Storage Devices agreed to utilize the bowtie method as a risk assessment tool for its ability to visualize the hazard, the risk, the resulting consequences, and the reactive and proactive controls/measures designed to prevent unwanted outcomes. If done properly, the bowtie method can identify the criticality and effectiveness of specific controls and can reveal additional previously unidentified barriers. The bowtie method is referenced in *Guidance for Safe Operations Involving Aeroplane Cargo Compartments* (Doc 10102) as a method to assist the conduct of a hazard analysis. The working group also consulted bowties developed by the Flight Operations Panel (FLTOSP) Safe Carriage of Goods Specific Working Group (SCG-SWG) and the United Kingdom Civil Aviation Authority (UK CAA) for lithium batteries transported in the cabin and lithium batteries transported in air cargo. The working group decided to focus first on lithium batteries packed with

equipment and lithium batteries contained in equipment. These configurations have similar controls and certain efficiencies can be realized with adding and validating various controls simultaneously for these scenarios. Lithium battery powered vehicles comprise a broad range of products and sizes that may warrant special consideration. The United Nations Sub-Committee of Experts on the Transport of Dangerous Goods is also considering creating a separate shipping description and packing instruction for lithium ion battery powered vehicles that may ultimately change the operational controls and packagings required for smaller battery powered vehicles.

1.2.2 The draft bowtie developed by this working group as shown in the appendix to this paper identifies threats associated with two configurations: 1) lithium batteries packed with equipment damaged at any point prior to loading on aircraft and 2) lithium batteries contained in equipment damaged at any point prior to loading on aircraft. The top event in this bowtie diagram is thermal runaway. The existing requirements contained in the Technical Instructions represent the active controls (or barriers) designed to prevent a thermal runaway event. The analysis also identified potential escalation factors that weaken the controls.

1.2.3 DGP-WG/Energy Storage Devices began by focusing on the left side of the bowtie diagram by indicating preventative measures which eliminate the threat entirely or prevent the threat from causing the top event. These barriers are also requirements found in the Technical Instructions and can be amended by the DGP. The group seeks to evaluate the criticality and effectiveness of specific controls based on available information. This would inform the DGP and enable it to make a purposeful decision based on relevant and documented supporting information. For example, it is recognized that cargo compartment fires are relatively rare events, and the discrete numbers of cargo compartment fires are themselves not informative. However, this could be coupled with some review of the likelihood that a cargo compartment fire, should one occur, would also involve lithium batteries packed with or contained in equipment, and whether such a fire can cause a catastrophic event. Later the group will populate the right side of the diagram with reactive controls designed to mitigate the consequences of a thermal runaway. Information from other sources including trends in the composition of air cargo could validate our understanding of the risk.

2. DISCUSSION

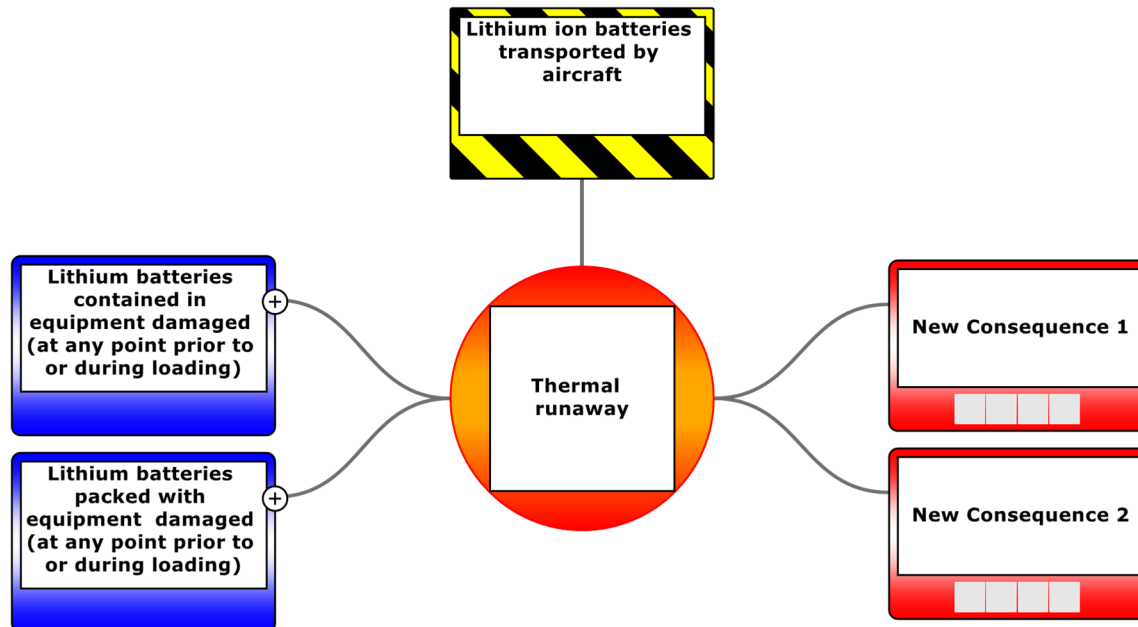
2.1 The DGP is invited to:

- a) Review the draft bowtie diagram in the appendix to this paper with the view of finalizing the two threat lines in the draft. Discuss and confirm, as appropriate, the consideration of each separate threat line.
 - b) Consider presentations on available data sources that could be used to assess the effectiveness of the preventive barriers. Discuss data collection and analysis timelines.
 - c) Consider a scoring mechanism to quantify the safety risk probability based on the value and effectiveness of each control. Discuss next steps and timelines for drafting a narrative report representing the risk assessment.
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APPENDIX

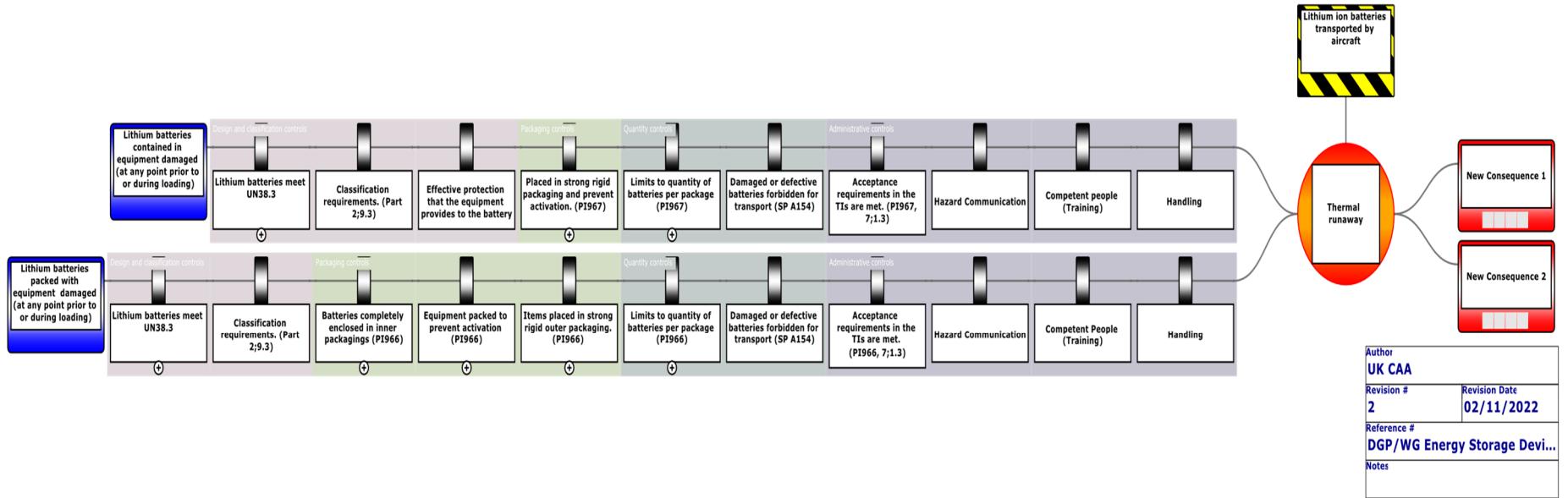
THE DRAFT BOWTIE DIAGRAM — VIEW OF FINALIZING THE TWO THREAT LINES

VIEW #1 — THREATS AND CONSEQUENCES

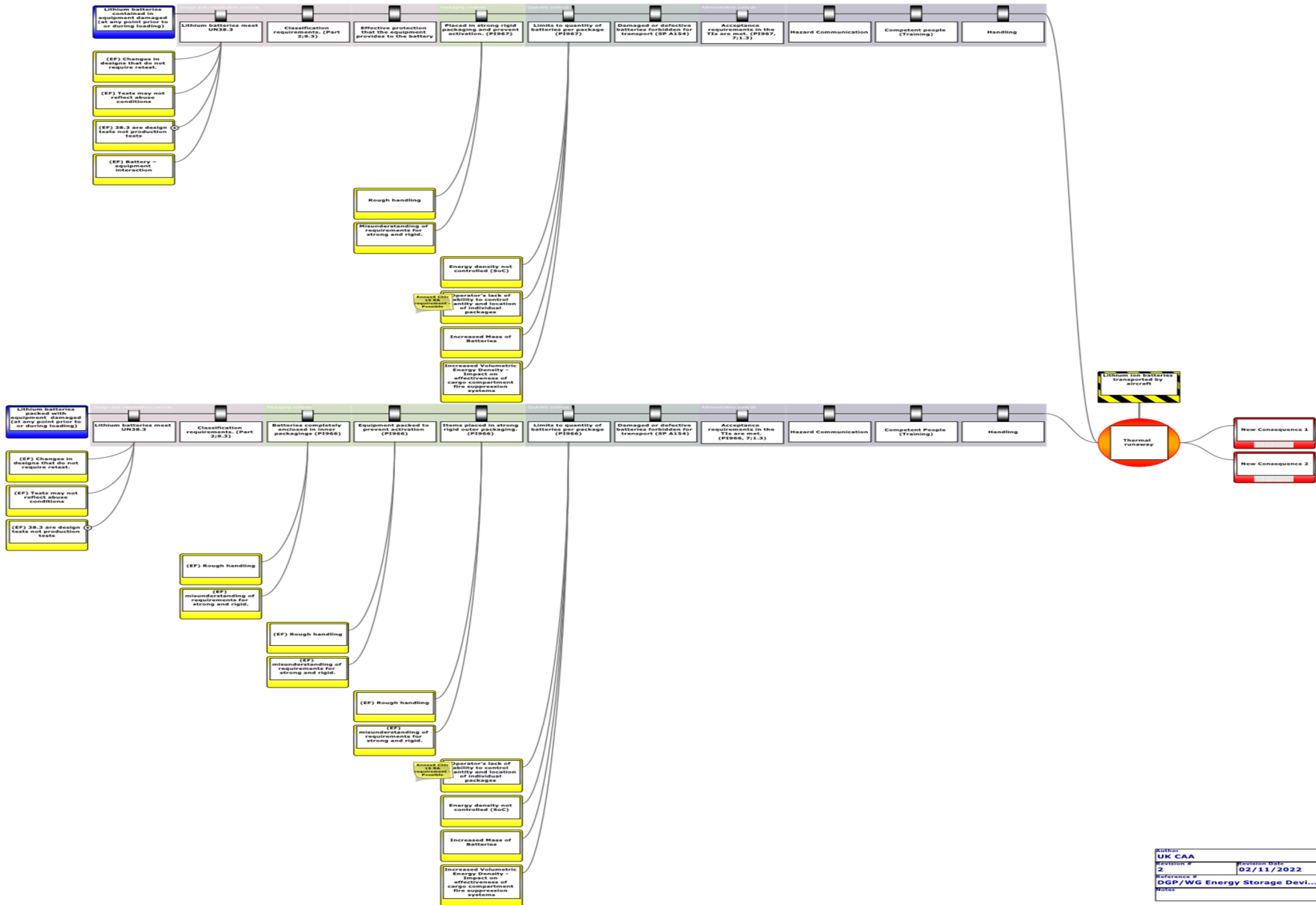


Author UK CAA	
Revision # 1	Revision Date 31/10/2022
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Notes	

VIEW #2 – CONTROLS



VIEW #3 — FULL VIEW



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