“Recent updates to BT&E UK Safety Risk Management”
<table>
<thead>
<tr>
<th>Role</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>GD Aerosystems Course</td>
<td>1996</td>
</tr>
<tr>
<td>OT&amp;E (Sea Harrier OEU)</td>
<td>1996-98</td>
</tr>
<tr>
<td>Senior Pilot 800 NAS</td>
<td>1998 -2000</td>
</tr>
<tr>
<td>USN China Lake OTD AV-8B, F/A-18C</td>
<td>2002-04</td>
</tr>
<tr>
<td>UK Mission Systems Lead, F35 JPO</td>
<td>Crystal City – 2004-06</td>
</tr>
<tr>
<td>UK Deputy Harrier Force Commander</td>
<td>2006-08</td>
</tr>
<tr>
<td>Chief Pilot (Defence) Rolls –Royce plc</td>
<td>2011-20</td>
</tr>
<tr>
<td>MSc Aviation Safety and Human Factors</td>
<td></td>
</tr>
<tr>
<td><strong>Currently, Flight Ops Safety Lead</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Boeing T&amp;E UK - since 2020</strong></td>
<td></td>
</tr>
<tr>
<td>Display pilot with Navy Wings Historic Flight –</td>
<td></td>
</tr>
<tr>
<td>Seafire Mk XVII</td>
<td></td>
</tr>
</tbody>
</table>
Boeing Test & Evaluation UK – Aviation Safety Risk Management

Boeing Aviation Safety

Purpose

This PRO defines the requirements and responsibilities for aviation product and operational safety at The Boeing Company. Aviation Safety programs must address all aircraft design, test, production, delivered and corporate aircraft operations, aircraft modification, maintenance and training activities, and the ground and flight operation of aircraft through the entire product lifecycle.

This PRO also establishes the Safety Management System (SMS) as an acceptable mechanism for actively managing aviation safety risk for those organizations that choose to or are required to adopt a formal SMS.

Use of the Authority Reference for this writing has been approved.
Boeing Test & Evaluation

**OUR MISSION:** Ensure the execution of safe, efficient, and effective testing & evaluation with our Business Partners

**OUR PRIORITIES**
- Safety Management System
- Quality Management System
- Program Performance
- Rebuild Trust
- Best Team and Talent
- Diversity and Inclusion
- Effectiveness, Efficiency and Productivity
- Functional Excellence and Capability Development

**OUR LOCATIONS**
- ~4,000 Global Employees
- ~250 Test Environments
- 54 Sites across U.S.
- 19 States
- 2 International Locations

**OUR CAPABILITIES**
- Aero, Noise & Propulsion Verification & Test
- Aeronautical Systems Integration & Test
- Autonomous Air Vehicle Test (UAS)
- Design-Build
- Electromagnetics Verification & Test
- Environmental Earth Verification & Test
- Environmental Space Verification & Test
- Fabrication, Assembly, Setup & Test (FAST)
- Flight Operations
- Flight Test – Commercial / Commercial Derivatives
- Flight Test – Military Fixed Wing
- Flight Test – Rotorcraft
- Instrumentation & Data Systems
- Metrology & Test Equipment
- Product Cybersecurity Verification & Test
- Space Systems Verification & Test
- Structures / Material Verification & Test
- System of Systems Verification & Test
MAA Defence Contractor Flying Organisation – Accountable Manager Military Flying AM(MF)

Regulation 1024(1)  

Roles and Responsibilities

1024(1) AM(MF)s **shall** actively manage Air Safety via an **Air System Safety Case (ASSC)**, managed via an **Air Safety Management System (ASMS)** to ensure that **RtL**² are ALARP and Tolerable **for each Air System** within their defined Areas of Responsibility (AoR).
IT’S WORTH HAVING A QUICK REVIEW OF “ALARP & TOLERABLE”

<table>
<thead>
<tr>
<th>BT&amp;E Probability</th>
<th>BT&amp;E Probability Definition</th>
<th>BT&amp;E Severity</th>
<th>BT&amp;E Severity Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent</td>
<td>Likely to occur immediately or within the period of the test</td>
<td>Catastrophic</td>
<td>May cause death or aircraft loss</td>
</tr>
<tr>
<td>Likely</td>
<td>Probably will occur within the period of the test</td>
<td>Critical</td>
<td>May cause severe injury or major aircraft damage</td>
</tr>
<tr>
<td>Occasional</td>
<td>May occur within the period of the test</td>
<td>Marginal</td>
<td>May cause minor injury or minor aircraft damage</td>
</tr>
<tr>
<td>Seldom</td>
<td>Unlikely but possible to occur during the test</td>
<td>Negligible</td>
<td>Will not result in injury or aircraft damage</td>
</tr>
<tr>
<td>Improbable</td>
<td>So unlikely that it is assumed occurrence may not be experienced</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 13. BT&E (US) Probability & Severity Definitions

Boeing T&E HRM

<table>
<thead>
<tr>
<th>Severity</th>
<th>Likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negligible</td>
<td>10</td>
</tr>
<tr>
<td>Marginal</td>
<td>11</td>
</tr>
<tr>
<td>Critical</td>
<td>5</td>
</tr>
<tr>
<td>Catastrophic</td>
<td>2</td>
</tr>
</tbody>
</table>

Figure 14. BT&E (US) Hazard Risk Matrix

Description in Terms of Levels of Risk (LoR)

- A LoR considered unacceptable regardless of the benefits associated with the activity.
- A LoR is where the consequence and/or likelihood is of concern.
- A LoR where the consequence and/or likelihood is of concern.
- A LoR that achieves the target risk at the lowest cost.

Associated Conditions on the Management of the Risks

- An LoR should be based on the benefits associated with the activity.
- An LoR should be based on the benefits associated with the activity.
- An LoR that achieves the target risk at the lowest cost.
- An LoR that achieves the target risk at the lowest cost.

- Residual risk must be below the level of As Low As Reasonably Practicable (ALARP).
- Residual risk must be at a level of As Low As Reasonably Practicable (ALARP).
- Residual risk must be below the level of As Low As Reasonably Practicable (ALARP).
- Residual risk must be below the level of As Low As Reasonably Practicable (ALARP).

- Continue to review and reduce risks wherever it is reasonably practicable to do so. In those cases where the cost is insignificant, or where the law so requires it.
- Continue to review and reduce risks wherever it is reasonably practicable to do so. In those cases where the cost is insignificant, or where the law so requires it.

Increasing Societal Concern

Unacceptable

Tolerable

Acceptable
BT&E UK SRM – AM(MF) “Risk Picture” provided Quarterly at Safety Action Group

On behalf of The Boeing Company, the Risks to Life for Boeing Flight Operations under the CFAOS approval are ALARP and Tolerable

Accountable Manager (Military Flying)
MUCH DEBATE INITIALLY ON WHETHER TO HAVE TLC 4 OR NOT

Top Level Claim 1: Air System is Safe to Operate
- ARGUMENT
- EVIDENCE

Top Level Claim 2: Continuing AW is Managed
- ARGUMENT
- EVIDENCE

Top Level Claim 3: Air System is Operated Safely
- ARGUMENT
- EVIDENCE

Top Level Claim 4: ASMS is Effective
- ARGUMENT
- EVIDENCE
Boeing T&E UK - Air System Safety Cases: - ASSC format = Excel

Monthly updates and regular signed reviews by FOPH

Quarterly SAG – AM(MF) “Risk Picture” format

Annual ASSC – R with associated AM(MF) RtL Safety Statement

13. Operating Duty Holders (ODHs) / AM(MF)s should record and justify an argument that Risks are ALARP and Tolerable in their Air System’s annual Safety Statements, which support the appropriate Live Air System Safety Case (ASSC) and Latest ASSC Report3.

- Specific ASSC metrics in development
- Independent assurance is key early on – Boeing used 3PA
Enduring Risks

Bow Tie representation of the DCFO Top Events with detailed barriers, escalation factors etc

Hazard Communication Flow - Reaches All Levels
Enduring Risks
## BOWTIE TOP 5 EVENTS – “ENDURING RISKS”

<table>
<thead>
<tr>
<th>Ref</th>
<th>Top Event Title</th>
<th>BowTie effective date</th>
<th>Risk Level / Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE 01</td>
<td>Loss of Safe Separation with Other Aircraft</td>
<td>REV G 20 JULY 2022</td>
<td>BLUE 5 risk level – next review 20 Jan 23</td>
</tr>
<tr>
<td>TE 02</td>
<td>Loss of Control in Flight</td>
<td>REV K 20 JULY 2022</td>
<td>BLUE 5 risk level – next review 20 Jan 23</td>
</tr>
<tr>
<td>TE 03</td>
<td>Loss of Safe Separation with Ground/Obstructions</td>
<td>REV H 20 JULY 2022</td>
<td>BLUE 5 risk level – next review 20 Jan 23</td>
</tr>
<tr>
<td>TE 04</td>
<td>Loss of Safe Execution of Role Activities</td>
<td>REV H 20 JULY 2022</td>
<td>BLUE 5 risk level – next review 20 Jan 23</td>
</tr>
<tr>
<td>TE 05</td>
<td>Loss of Situational Awareness</td>
<td>REV C 20 JULY 2022</td>
<td>BLUE 5 risk level – next review 20 Jan 23</td>
</tr>
</tbody>
</table>
ASSC Discrepancies can flow down to BowTie barrier EF for SQEP review
Emerging Risks

Regulation 1210(4)

Emerging Hazards and Risks

1210(4) ADHs / AM(MF)s **shall** be involved in the understanding and management of emerging Hazards and Risks.

Acceptable Means of Compliance

Emerging Hazards and Risks

28. ADHs / AM(MF)s **should** identify, record and manage emerging Hazards that undermine RtL mitigations, within the relevant ASSC.
## EXAMPLE ONLY – Emerging Risks Register

<table>
<thead>
<tr>
<th>Air Safety Hazard (SQEP Determined)</th>
<th>Associated ASSC link</th>
<th>RIL Consequences (SQEP Determined)</th>
<th>BT&amp;E Risk Level Of Most Credible (Post Mitigation)</th>
<th>Risk Owner &amp; Manager</th>
<th>Actions to Mitigate</th>
<th>Review Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degradation of core flying skills due to period of reduced flying</td>
<td>Aircrew will remain current and proficient in role</td>
<td>MAC</td>
<td>EXAMPLE ONLY Blue 5</td>
<td>Owner • AM(MF)</td>
<td>Manager • BT&amp;E UK CP</td>
<td>See Centrik Action MRB Ref xxxxx</td>
</tr>
<tr>
<td>CAMO resource challenges in short term</td>
<td>There exists a competent CAMO organisation</td>
<td>Loss of Control</td>
<td>EXAMPLE ONLY Yellow 9</td>
<td>Owner • AM(MF)</td>
<td>Manager • BT&amp;E UK CP</td>
<td>See Centrik Action MRB Ref xxxxx</td>
</tr>
<tr>
<td>Release of a new maintenance instruction</td>
<td>There exists a competent maintenance organisation</td>
<td>Loss of Control leading to major on-board injuries</td>
<td>EXAMPLE ONLY Blue 5</td>
<td>Owner • AM(MF)</td>
<td>Manager • BT&amp;E UK CP</td>
<td>See Centrik Action MRB Ref xxxxx</td>
</tr>
<tr>
<td>Operating from airfields with degraded radar provision</td>
<td>Safe airfield operating environment is provided</td>
<td>MAC</td>
<td>EXAMPLE ONLY Blue 5</td>
<td>Owner • AM(MF)</td>
<td>Manager • BT&amp;E UK CP</td>
<td>See Centrik Action MRB Ref xxxxx</td>
</tr>
</tbody>
</table>

SQEP DETERMINED / REVIEWED AT MONTHLY AIR SAFETY WORKING GROUP
<table>
<thead>
<tr>
<th>Air Safety Hazard (SQEP Determined)</th>
<th>Associated ASCC link</th>
<th>RTL Consequences (SQEP Determined)</th>
<th>BT&amp;E Risk Level of Most Credible (Post Mitigation)</th>
<th>Risk Owner &amp; Manager</th>
<th>Actions to Mitigate</th>
<th>Review Dates</th>
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<tr>
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<td>Last Review</td>
</tr>
</tbody>
</table>

The Feast or Famine of T&E!

Post Mitigation Assessment
SUMMARY OF RECENT CHANGES TO BOEING T&E UK SRM:

• CREATION OF ASSC FOR EACH PLATFORM – currently CH-47 & C-17. Soon to have E-7 Wedgetail ASSC

• INTRODUCTION OF TWO TYPES OF RISK REGISTER - both briefed at the Quarterly AM(MF) Safety Action Group

  ▪ ENDURING RISKS / TOP EVENTS – BowTie framework - review period depending on risk level for each of the top events – accountable manager or FOPH hold risk depending on the HRM risk level
  ▪ EMERGING RISKS REGISTER – captures current context of operations/environmental hazards, where actions to mitigate are managed during monthly BT&E review board – chaired by FOPH