



Engineering, Test & Technology
Boeing Test & Evaluation

European Flight Test Safety Workshop Technical Presentation

13 October 2022

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Boeing Test & Evaluation UK
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Engineering, Test & Technology
Boeing Test & Evaluation

“Recent updates to BT&E UK Safety Risk Management”



Bill Dean – Flight Ops / Flight Test background - Very quick!



FLY NAVY

GD Aerosystems Course – 1996

OT&E (Sea Harrier OEU) – 1996-98

Senior Pilot 800 NAS – 1998 -2000

USN China Lake OTD AV-8B, F/A-18C – 2002-04

UK Mission Systems Lead, F35 JPO
@ Crystal City – 2004-06

UK Deputy Harrier Force Commander, 2006-08

Chief Pilot (Defence) Rolls –Royce plc 2011-20

MSc Aviation Safety and Human Factors

**Currently, Flight Ops Safety Lead
Boeing T&E UK - since 2020**

Display pilot with Navy Wings Historic Flight –

Seafire Mk XVII

Boeing Test & Evaluation UK – Aviation Safety Risk Management



PROCEDURE PRO-265

PRO-265
Issue Date
February 5, 2021

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.

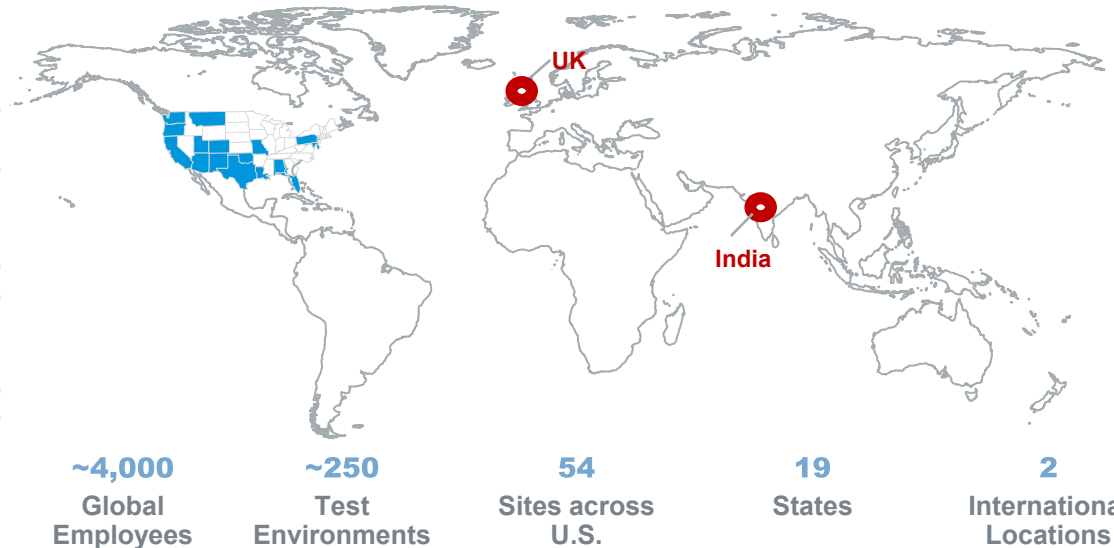
Boeing Test & Evaluation

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



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).

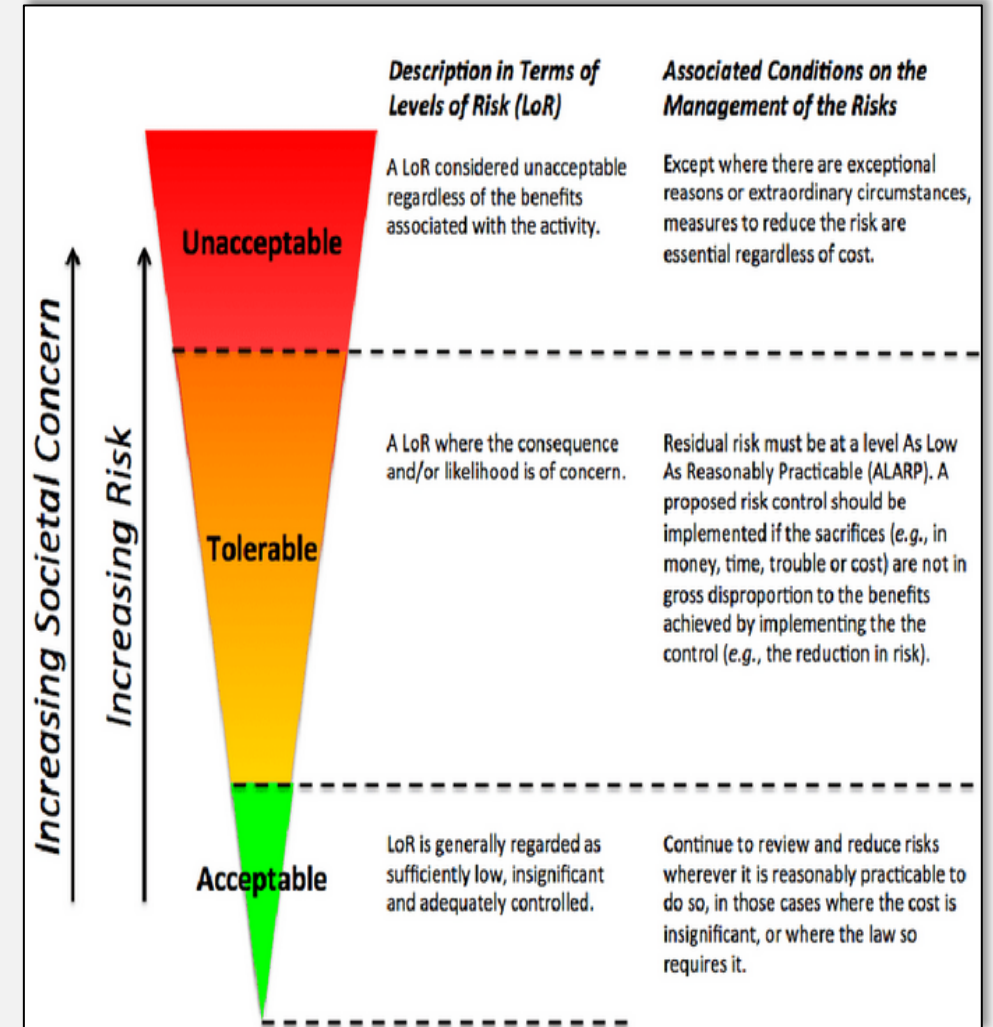
IT'S WORTH HAVING A QUICK REVIEW OF "ALARP & TOLERABLE"

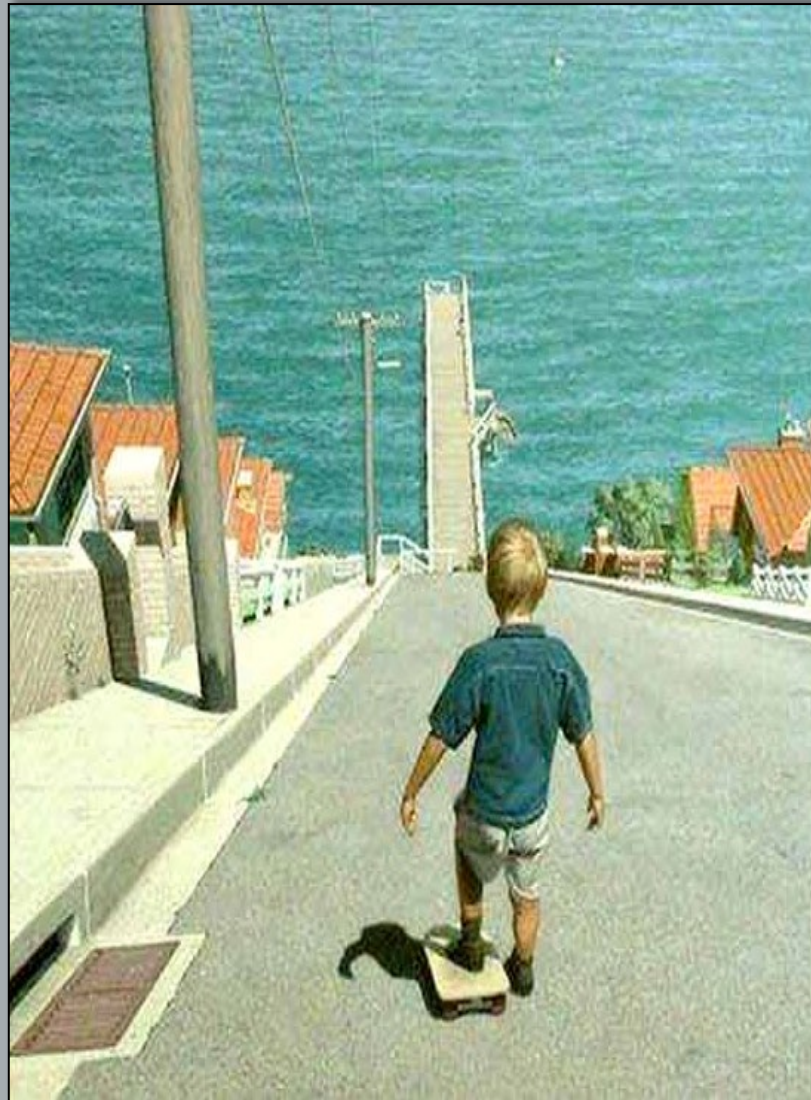
BT&E Probability	BT&E Probability Definition	BT&E Severity	BT&E Severity Definition
Frequent	Likely to occur immediately or within the period of the test	Catastrophic	May cause death or aircraft loss
Likely	Probably will occur within the period of the test	Critical	May cause severe injury or major aircraft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

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

Boeing T&E HRM					
Severity					
Negligible	Marginal	Critical	Catastrophic		
16	11	6	1	Frequent	Likelihood
17	12	7	2	Likely	
18	13	8	3	Occasional	
19	14	9	4	Seldom	
20	15	10	5	Improbable	

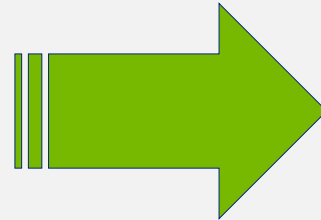
Figure 14. BT&E (US) Hazard Risk Matrix





BOEING PROPRIETARY

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

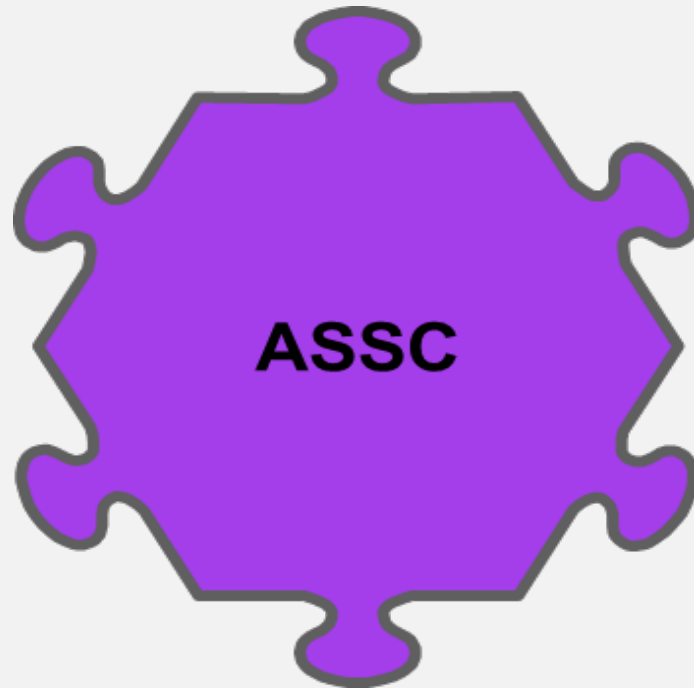


AM(MF) SAG Risk Acceptance

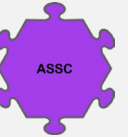
Regulation 1024(1)	<p>Roles and Responsibilities</p> <p>1024(1) AM(MF)s shall actively manage Air Safety via an ▶ Air System Safety Case (ASSC), managed via an ◀ Air Safety Management System (ASMS) to ensure that RTL² are ALARP and Tolerable ▶ for each Air System ◀ within their defined Areas of Responsibility (AoR).</p>
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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)



BT&E UK Air System Safety Case: TLC 1-4



MUCH DEBATE INITIALLY
ON WHETHER TO HAVE
TLC 4 OR NOT

Top Level Claim 1:
**Air System is Safe
to Operate**

Top Level Claim 2:
**Continuing AW is
Managed**

Top Level Claim 3:
**Air System is
Operated Safely**

Top Level Claim 4:
**ASMS
is Effective**

ARGUMENT
EVIDENCE

ARGUMENT
EVIDENCE

ARGUMENT
EVIDENCE

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.

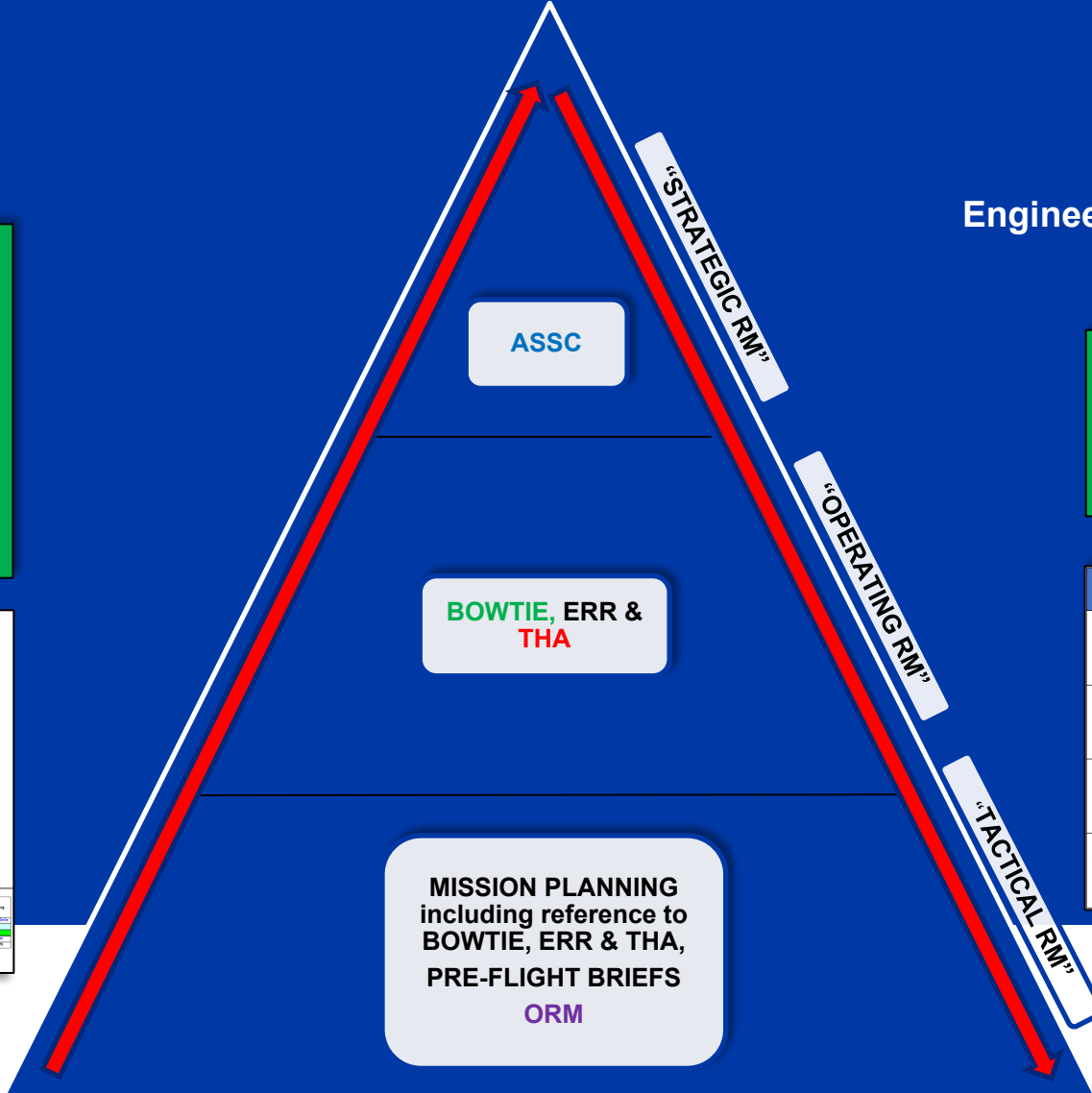
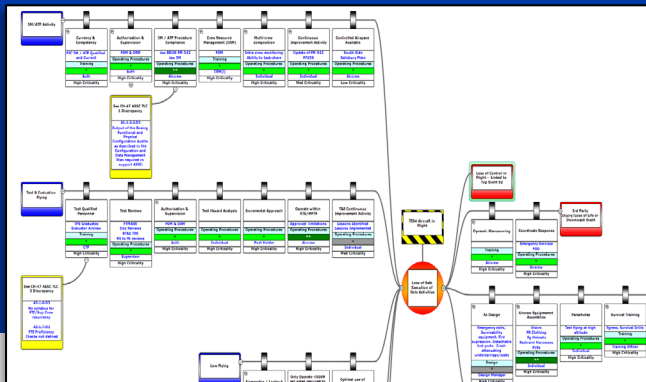
- Specific ASSC metrics in development
- Independent assurance is key early on – Boeing used 3PA





Enduring Risks

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



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Emerging Risk Register (ERR)

Air Safety Hazard (SC&P Determined)	Associated ASSC Link	RLL Consequences (SC&P Determined)	BT&E Risk Level Of Most Credible (Post Mitigation)	Risk Owner & Manager	Review Dates
Aircrew loss of flying skills due to low flying hours	Aircrew will remain current and proficient in role	CFIT	Blue 5 Catastrophic/ Improbable*	Owner • AM(MF) Manager • BT&E UK CP	Last Review • Next Review •
E-7 M&CAMO resource	There exists a competent E-7 CAMO organisation	Loss of Control leading to major on-board injuries	Blue 5 Catastrophic/ Improbable*	Owner • AM(MF) Manager • BT&E UK CP	Last Review • Next Review •
Release of a non-airworthy aircraft due to Organisational Change (Extension of Part 145 operating location to MW & Odiham)	There exists a competent maintenance organisation	Loss of Control leading to major on-board injuries	EXAMPLE ONLY Yellow 9 Critical/ Occasional*	Owner • AM(MF) Manager • AM(MF)	Last Review • Next Review •
Operating from MoD airfields with degraded radar provision	Safe airfield operating environment is provided	MAC	Blue 5 Catastrophic/ Improbable*	Owner • AM(MF) Manager • BT&E UK CP	Last Review • Next Review •

← Hazard Communication Flow →
- Reaches All Levels



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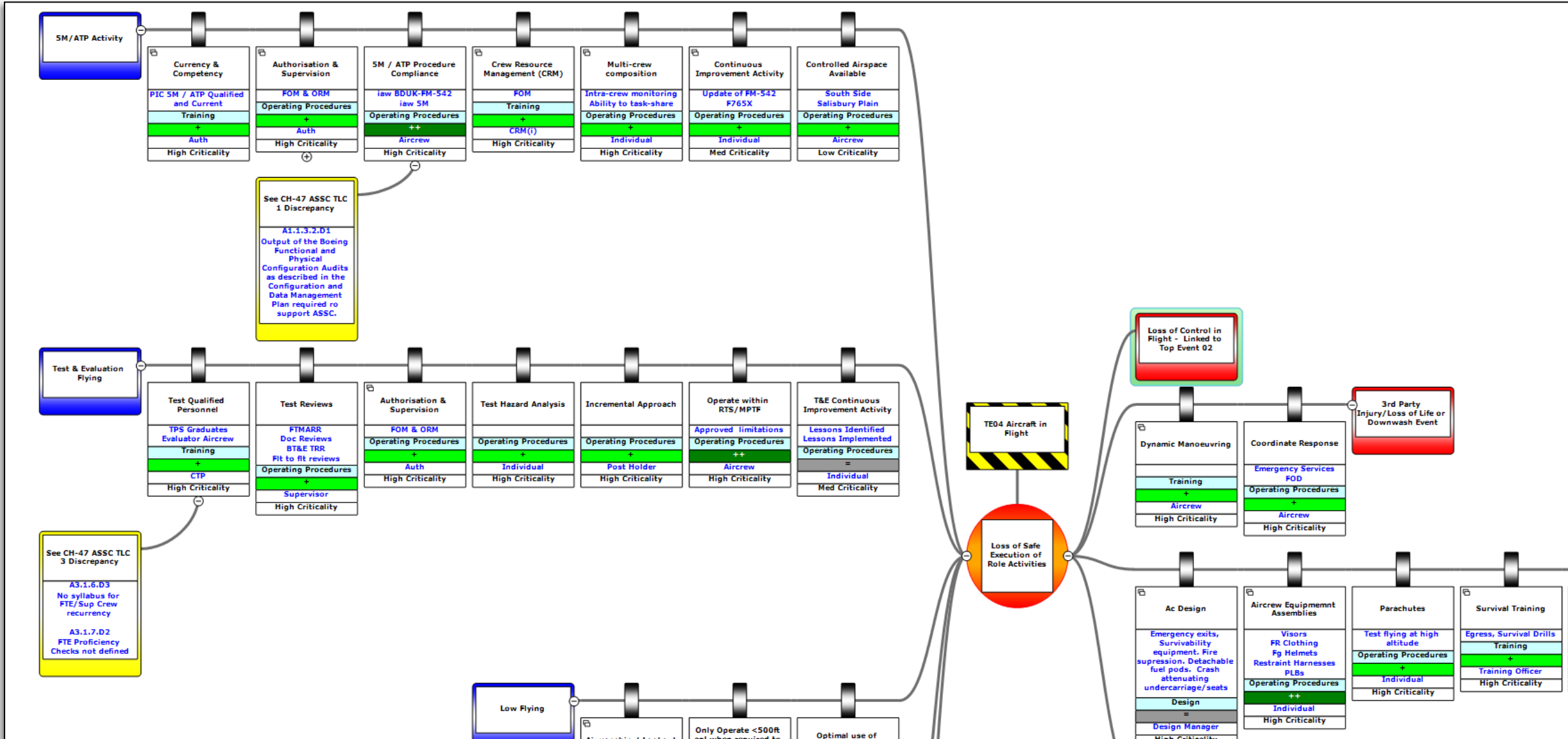
Enduring Risks

BOWTIE TOP 5 EVENTS –"ENDURING RISKS"

Ref	Top Event Title	BowTie effective date	Risk Level / Comment
TE 01	Loss of Safe Separation with Other Aircraft	REV G 20 JULY 2022	BLUE 5 risk level – next review 20 Jan 23
TE 02	Loss of Control in Flight	REV K 20 JULY 2022	BLUE 5 risk level – next review 20 Jan 23
TE 03	Loss of Safe Separation with Ground/Obstructions	REV H 20 JULY 2022	BLUE 5 risk level – next review 20 Jan 23
TE 04	Loss of Safe Execution of Role Activities	REV H 20 JULY 2022	BLUE 5 risk level – next review 20 Jan 23
TE 05	Loss of Situational Awareness	REV C 20 JULY 2022	BLUE 5 risk level – next review 20 Jan 23

Boeing T&E THA				
Severity				Likelihood
Negligible	Marginal	Critical	Cat	
16	11	6	1	Frequent
17	12	7	2	Likely
18	13	8	3	Occasional
19	14	9	4	Seldom
20	15	10	5	Improbable

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

Air Safety Hazard (SQEP Determined)	Associated ASSC link	RtL Consequences (SQEP Determined)	BT&E Risk Level Of Most Credible (Post Mitigation)	Risk Owner & Manager	Actions to Mitigate	Review Dates
Degradation of core flying skills due to period of reduced flying	Aircrew will remain current and proficient in role	MAC	EXAMPLE ONLY Blue 5 <i>Catastrophic/Improbable*</i>	Owner • AM(MF) Manager • BT&E UK CP	See Centrik Action MRB Ref <u>xxxx</u>	Next Review •
CAMO resource challenges in short term	There exists a competent CAMO organisation	Loss of Control leading to major on-board injuries	EXAMPLE ONLY Blue 5 <i>Catastrophic/Improbable*</i>	Owner • AM(MF) Manager • BT&E UK CP	See Centrik Action MRB Ref <u>xxxx</u>	Last Review • Next Review •
Release of a new product due to a change in configuration	There exists a competent maintenance organisation	Loss of Control leading to major on-board injuries	EXAMPLE ONLY Yellow 9 <i>Critical/Occasional*</i>	Owner • AM(MF) Manager • AM(MF)	See Centrik Action MRB Ref <u>xxxx</u>	Last Review • Next Review •
Operating from airfields with degraded radar provision	Safe airfield operating environment is provided	MAC	EXAMPLE ONLY Blue 5 <i>Catastrophic/Improbable*</i>	Owner • AM(MF) Manager • BT&E UK CP	See Centrik Action MRB Ref <u>xxxx</u>	Last Review • Next Review •

SQEP DETERMINED / REVIEWED AT MONTHLY AIR SAFETY WORKING GROUP

EXAMPLE ONLY – Emerging Risks Register

Air Safety Hazard (SQEP Determined)	Associated ASSC link	Rtl. Consequences (SQEP Determined)	BT&E Risk Level Of Most Credible (Post Mitigation)	Risk Owner & Manager	Actions to Mitigate	Review Dates
Degradation of core flying skills due to period of reduced flying	Aircrew will remain current and proficient in role	MAC	EXAMPLE ONLY Blue 5 <i>Catastrophic / Improbable*</i>	Owner • AM(MF) Manager • BT&E UK CP	See Centrik Action MRB Ref <u>xxxx</u>	Last Review • Next Review •

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

THANK YOU FOR LISTENING!

