

An Aircraft Operators Safety Case for Managing Fume Risk.

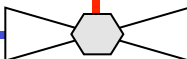
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Management Consultant





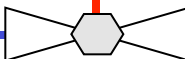
Background

- The purpose of this presentation is to offer a possible argument for the management of risks of fume contamination of the cockpit or passenger cabin during operational flights.
- Cliff has spent much of his career leading in developing aviation safety systems for aircraft operators.
- He has no specialist skills in aircraft design, or specialist knowledge in fume contamination.



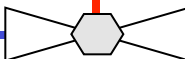
The Operational Safety Case

- The Safety Case proposed herein is a simplified document that tries to make fume risk management understandable to the aircraft operators including flight crews and maintenance engineers.
- The core element of this case is based upon a bowtie hazard analysis.
- It attempts to offer a modelled approach that is not specific to any aircraft type or aircraft operator.



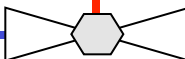
The Operational Safety Case

- Safety Case includes a generic Risk Assessment.
- Fume contamination may not be a major risk to the aircraft operator in their risk profile, it nonetheless exists.
- As a risk that can impair the health of both flight crews and the operator's clients it should not continue to be ignored.
- The airline's Accountable Manager is accountable for the management of their risks and this could be a future issue.

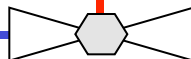
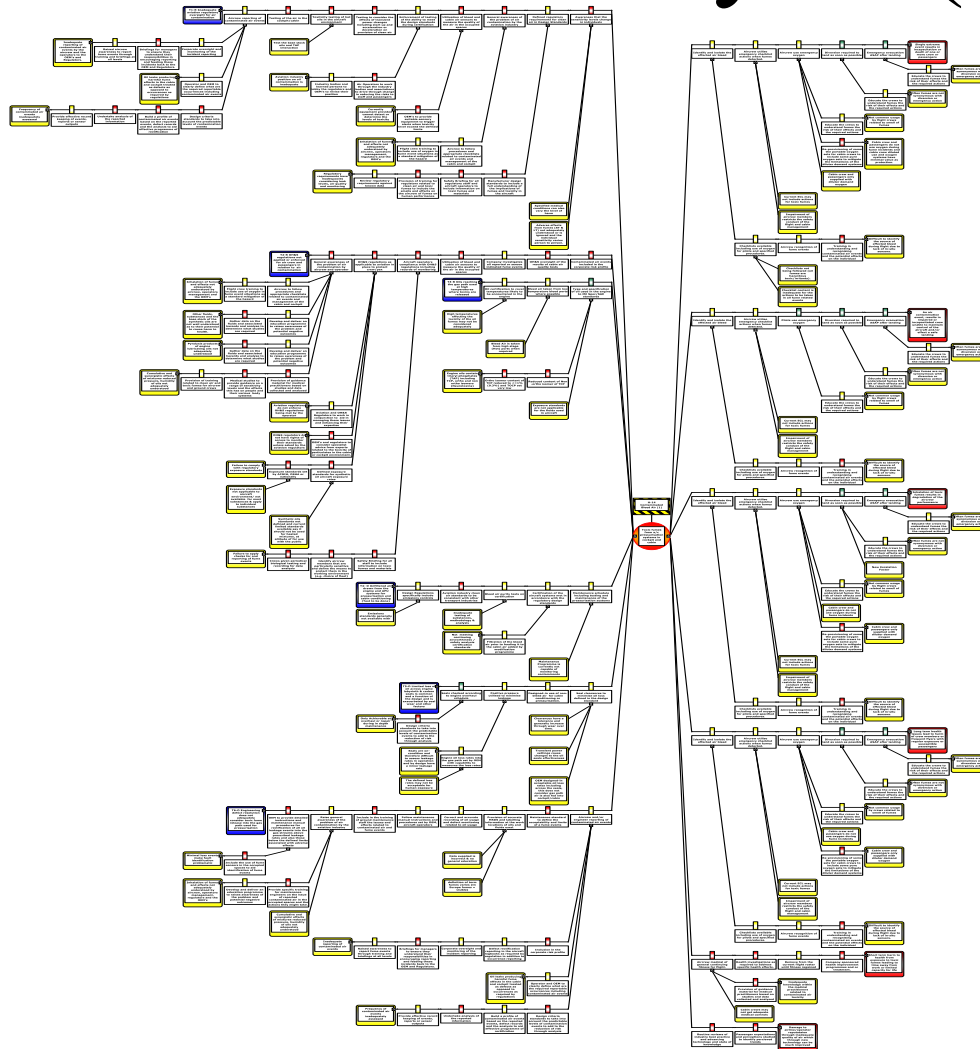


The Operational Safety Case

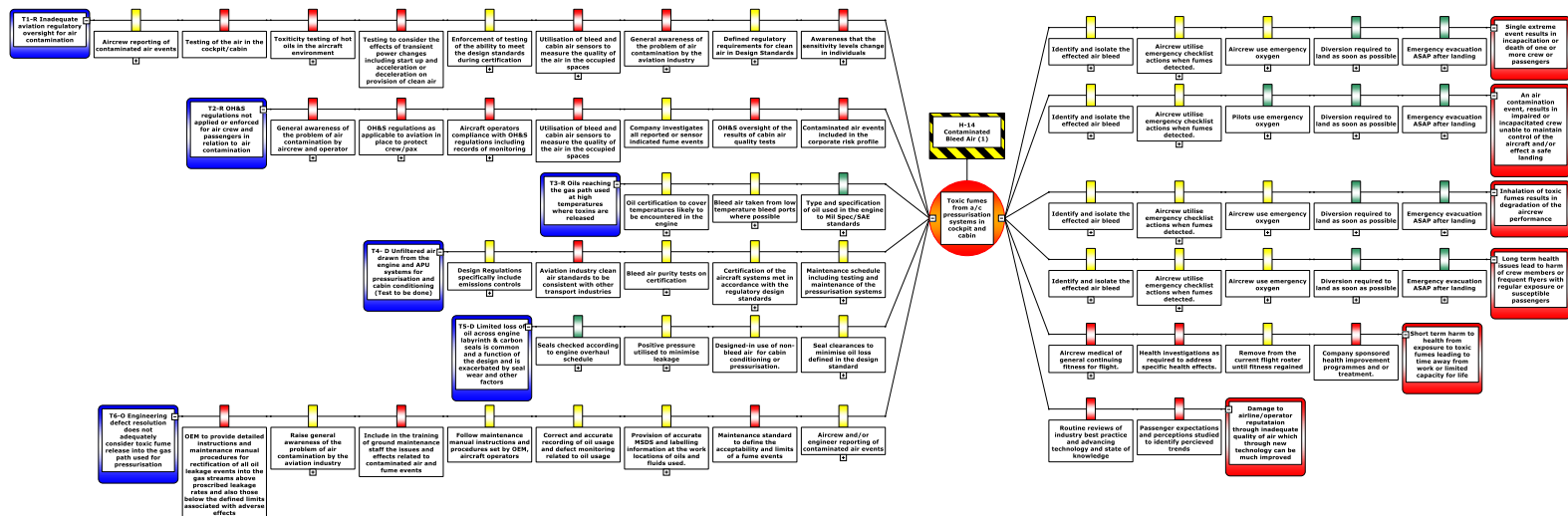
- The level of risk is not the key issue driven herein, but that it exists and has caused harm to the occupants of pressurised aircraft makes it relevant.
- That risk needs to be acknowledged and managed by the individual operators into the future.
- If not appropriately addressed it will leave aircraft operators exposed to challenges and potential liabilities.



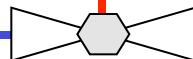
The Hazard Analysis (HA)



Core Elements of the HA



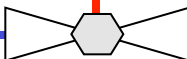
- One Hazard (Contaminated Bleed Air)
- One Top Event (Toxic fumes from a/c pressurisation and conditioning systems in cockpit and cabin)
- 6 Primary threats
- 6 Potential consequences of varying significance.



One Hazard

“Fume contaminated air” - is able to enter the cabin and cockpit through the designed-in air management systems.

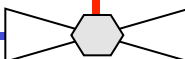
- This is of course a variable, that is dependent on the engines’ current condition, design limits and aircraft type.
- Nonetheless, the fumes from superheated oils used in the aircraft engines are demonstrably toxic if breathed in sufficient amounts.



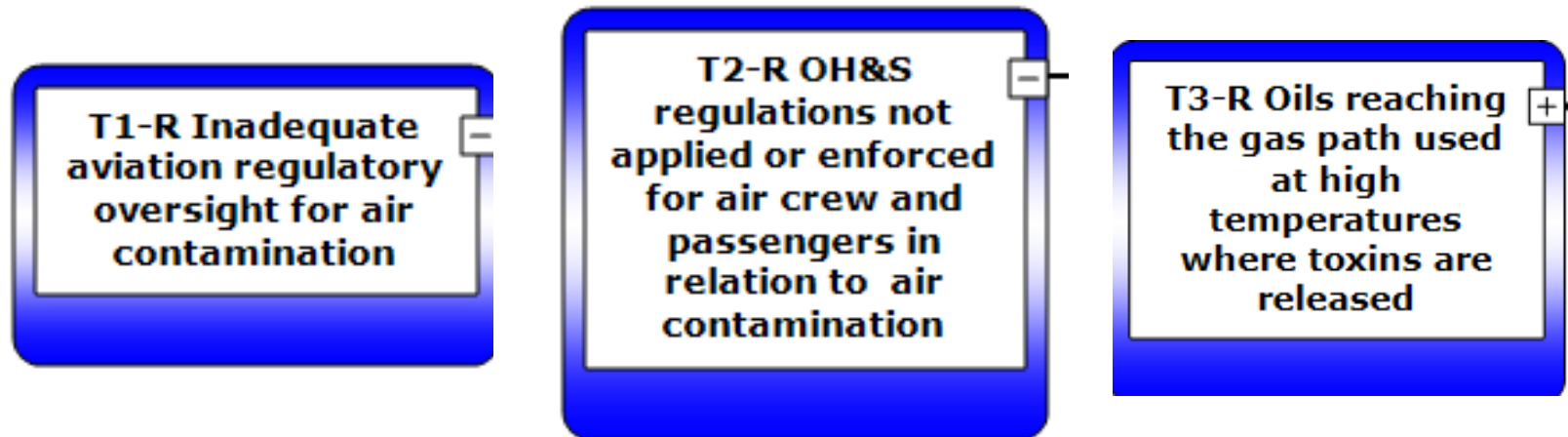
One Top Event

Toxic fumes from the aircraft pressurisation and conditioning systems enters into the cockpit & cabin.

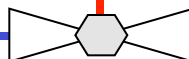
- The top event defines the first point of loss of control
- This also is a variable, that is dependent on the engines' current condition, design limits and aircraft type.



6 Primary Threats



Each threat has differing controls defined in the Hazard Analysis, most of which are not currently in practical use



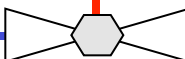
6 Primary Threats

T4- D Unfiltered air drawn from the engine and APU systems for pressurisation and cabin conditioning

T5-D Limited loss of oil across engine labyrinth & carbon seals is common and a function of the design and is exacerbated by seal wear and other factors

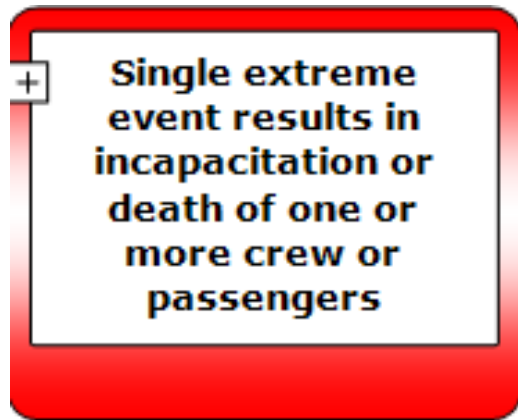
T6-O Engineering defect resolution does not adequately consider toxic fume release into the gas path used for pressurisation

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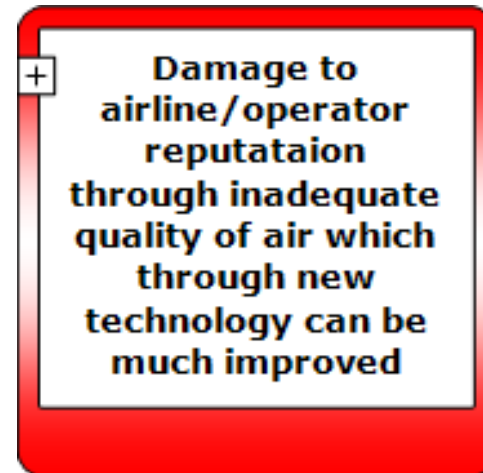


6 Consequences

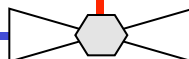
1st consequence



6th consequence

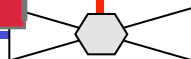


The consequences range from the single extreme event in decreasing order of severity to damage to reputation



Risk Matrix

Potential Consequence of an Toxic Fume -Incident			Increasing Probability				
Rating	People	Increasing Severity ↓	A Extremely Improbable < 1x10-9	B Extremely Remote < 1x10-8	C Remote < 1x10-5	D Probable > 1x10-5	E Frequent > 1x10-3
0	No adverse effect	No identifiable effect.					
1	Slight adverse effect	Discomfort to the individual but still able to complete the task.	Impairment				
2	Minor adverse effect	Limited effect on the individuals capability to perform assigned tasks to required standards.	Impairment			incorporate risk reduction measures	
3	Major adverse effect	Significant impairment and or the failure to be able to complete the assigned task.	Significant Impairment		incorporate risk reduction measures		
4	Single fatality	Loss of life caused by the effects of toxic fumes in the occupied spaces of an aircraft	Single Death		Intolerable		
5	Multiple fatality	Multiple loss of life caused by the effects of toxic fumes.	Intolerable				



Conclusion

- This operator based safety case demonstrates the possible threats and controls needed to manage the hazard and avoid the potential consequences.
- It is simplified in this presentation to make it understandable
- Detailed copies of the generic safety case could be made available to aircraft operators that want to address the potential risks.

