

# BowTie Exercise

## Fuel Contamination Risk Analysis

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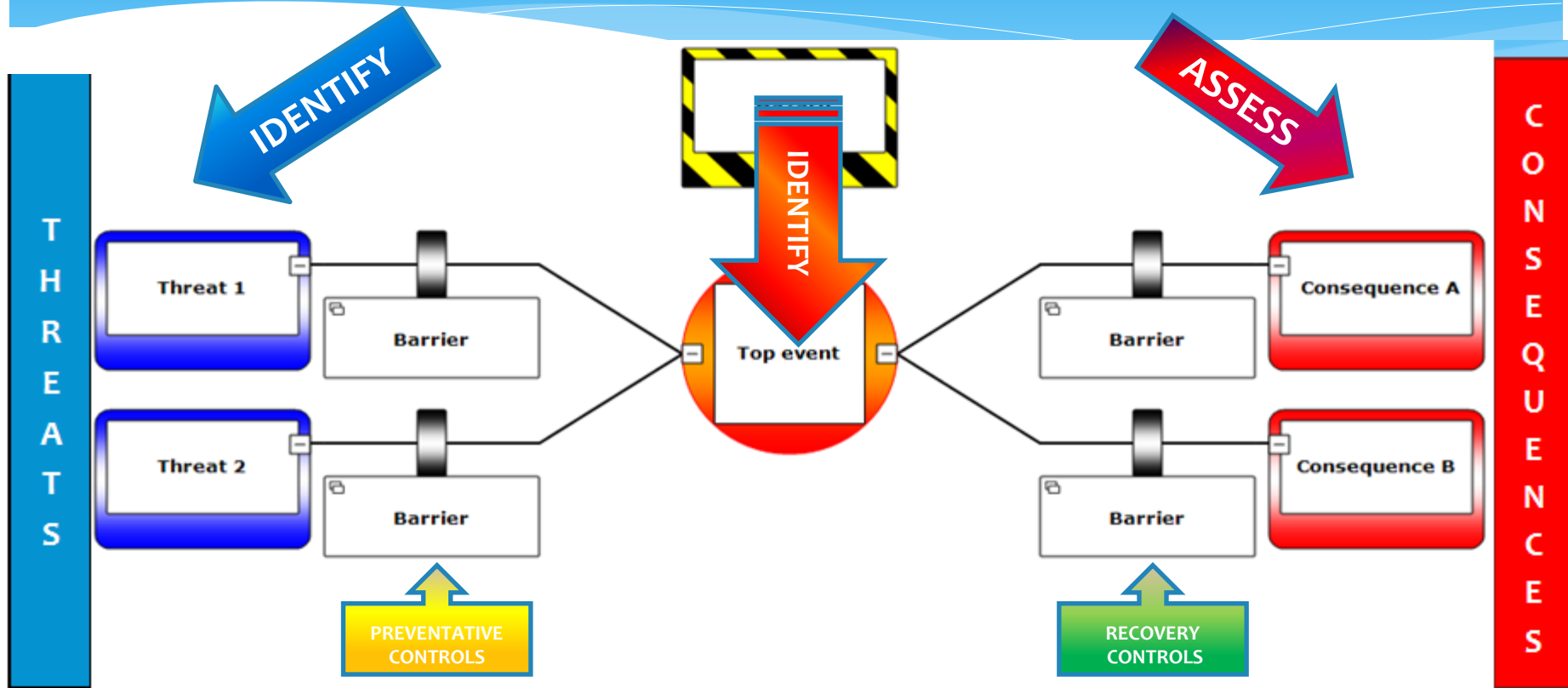
# CAA Strategy for BowTies

- CAA use bowties to analyse identified aviation safety risks
- Fuel quality/contamination has been identified as a risk
- Promote BowTie use to other parties such as EASA, other NAA, AAIB and Industry
- Use outputs from the bowtie to manage risk

# Bowtie Key Benefits

- Visual Depiction of Risk
- Provides safety information to meet elements of an effective Safety Management System (SMS):  
*Hazard identification, Risk Assessment, Risk Mitigation, Safety assurance, Safety promotion*
- Covers total aviation system including internal and external stakeholders
- Promotes increased awareness and understanding of precursor events
- Enables identification of critical risk controls and the assessment of their effectiveness.

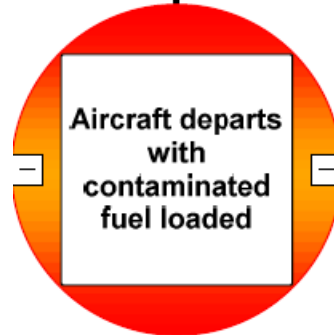
# BowTie Methodology



# The Hazard and Top Event



1. **Hazard** - anything that is a potential source of loss or damage
  - Sets the scope of the BowTie



2. **Top Event** - A point in time that describes the release or loss of control over a hazard
  - It is the undesired system state or precursor event.

# Threats

**3. Threats** – A possible direct cause that will potentially release a hazard by producing a top event

- The why or how the top event could occur.

Fuel loaded is contaminated (e.g. particulate/water within pipelines/ ships/ tankers/ aerodrome storage/ dispensing equipment)

Commonly exposed

# Threats

Fuel loaded is contaminated (e.g. particulate/water within pipelines/ ships/ tankers/ aerodrome storage/ dispensing equipment)

**Commonly exposed**

Fuel loaded is mixed with other fuel types during transportation (pipelines/ ships/ tankers) (e.g. FAME)

**Commonly exposed**

Loaded fuel becomes contaminated within fuel tanks by maintenance/ manufacturer

**Limited exposure**

Fuel loaded has incorrect blending of additive package (mostly GA)

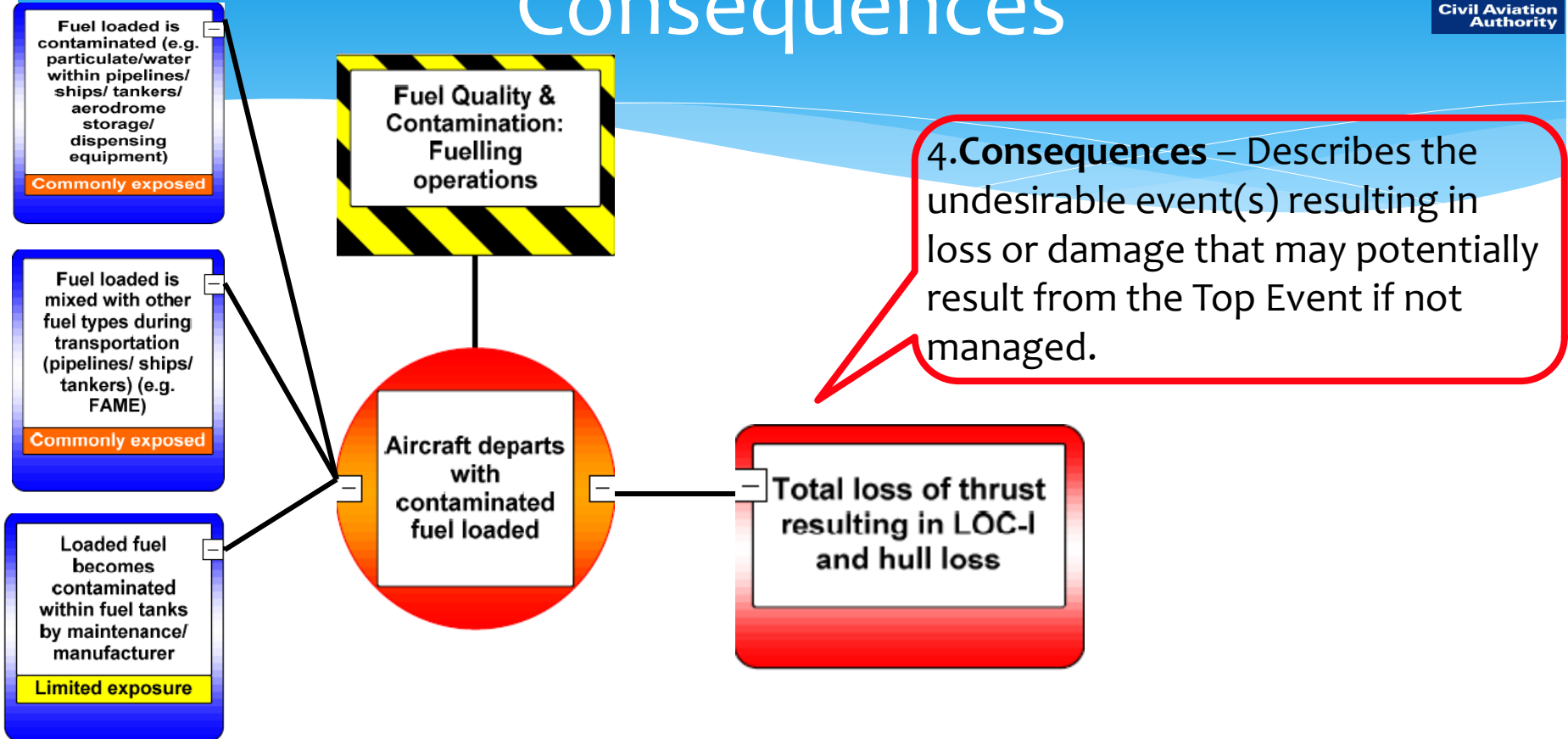
**Limited exposure**

Fuel loaded is out of specification (produced by Refinery)

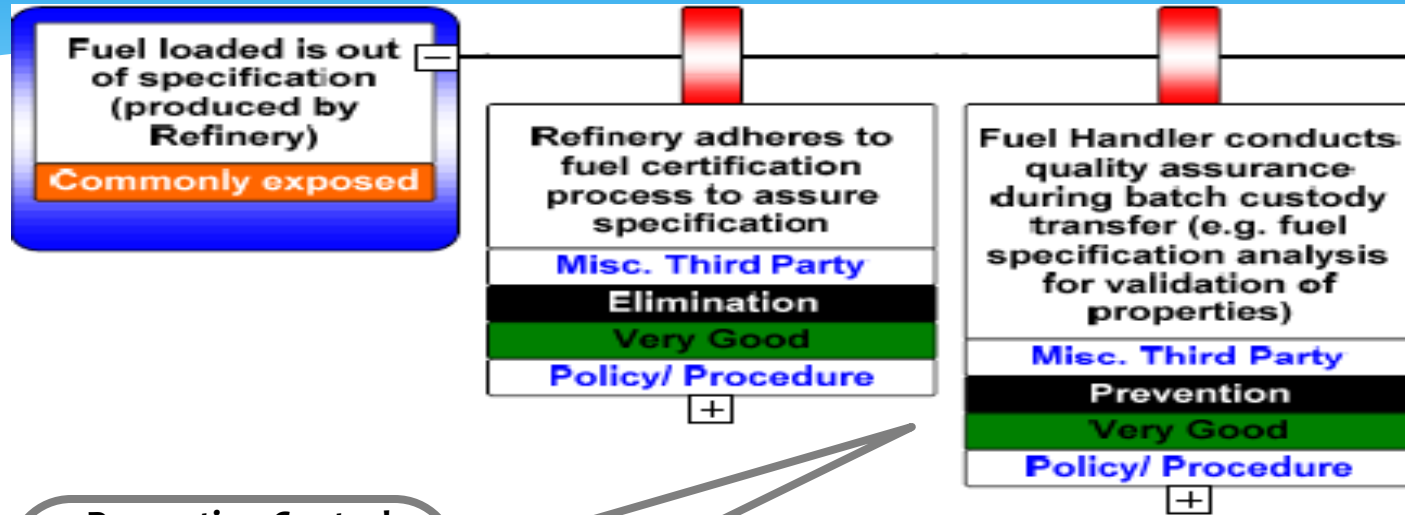
**Commonly exposed**



# Consequences



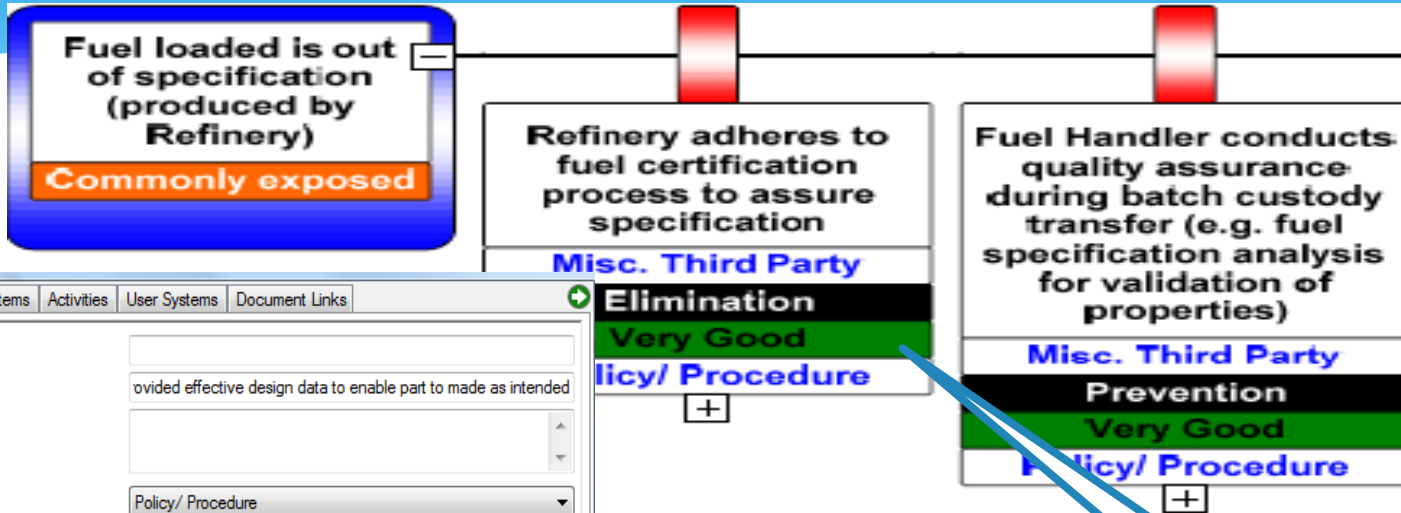
# Preventative Controls



## 5. Prevention Controls

– Any measure which eliminates the threat completely or prevents the threat developing into a top event. Also referred to as layers of Swiss Cheese

# Preventative Controls



Prevention  
Control  
Parameters

Editor User Data Systems Activities User Systems Document Links

Code:

Name:

Description:

Control Type:

Effectiveness:

Accountable:

Control Functionality:

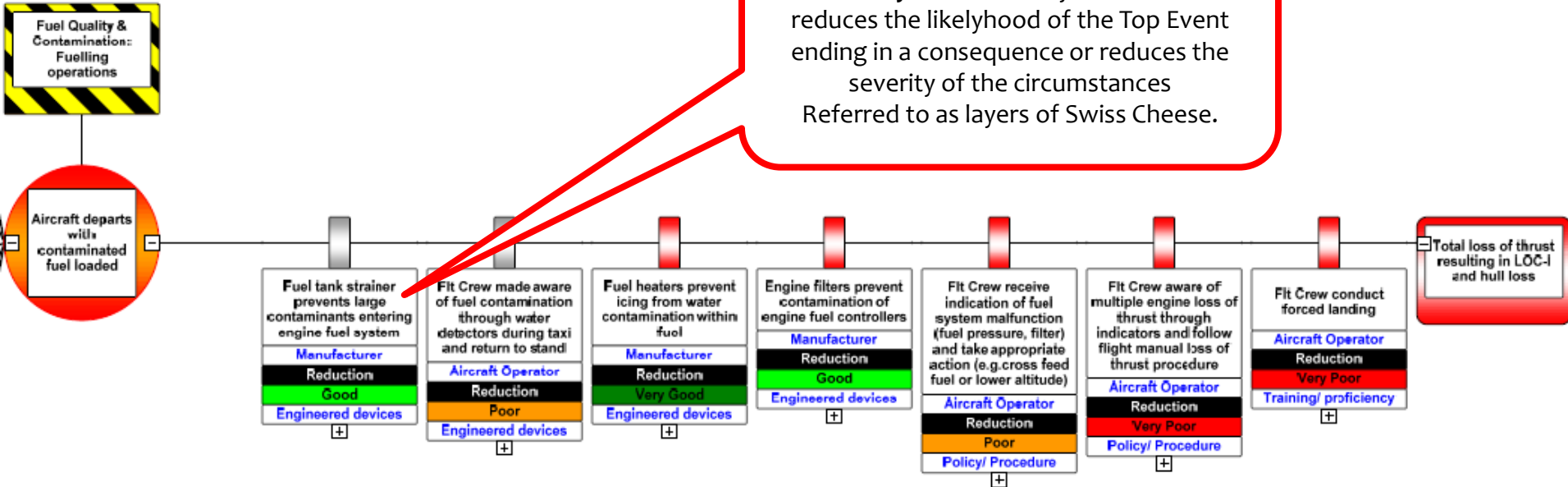
Criticality:

Equivalent Top Event:

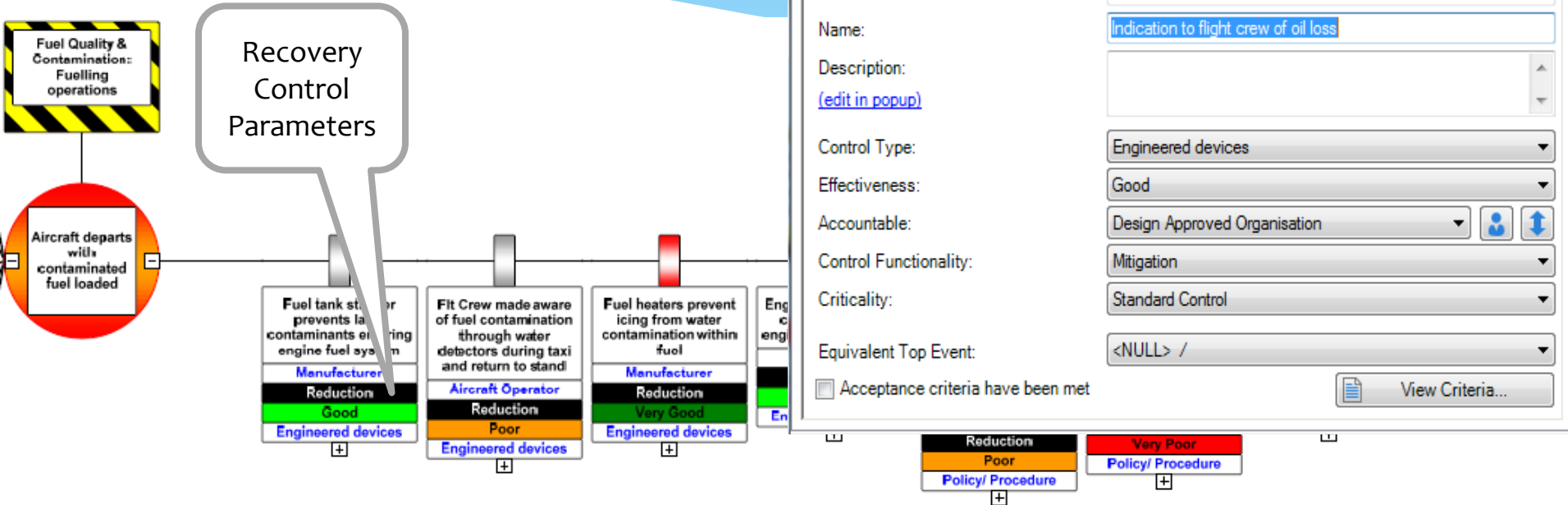
☐ Acceptance criteria have been met

# Recovery Controls

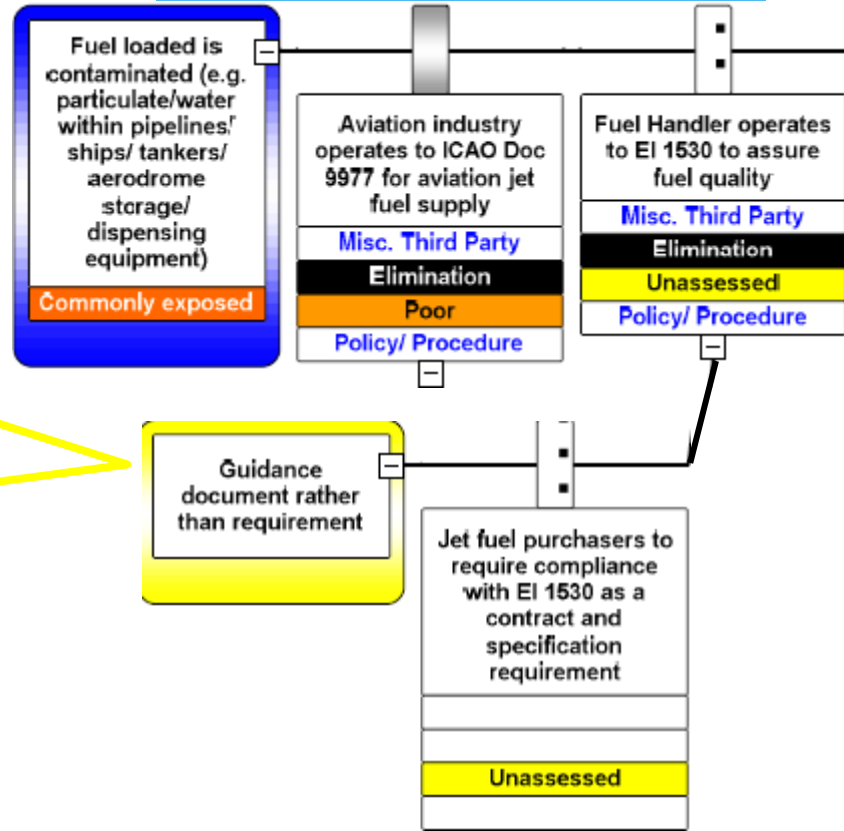
**6. Recovery Controls** - Any measure which reduces the likelihood of the Top Event ending in a consequence or reduces the severity of the circumstances  
Referred to as layers of Swiss Cheese.



# Recovery Controls

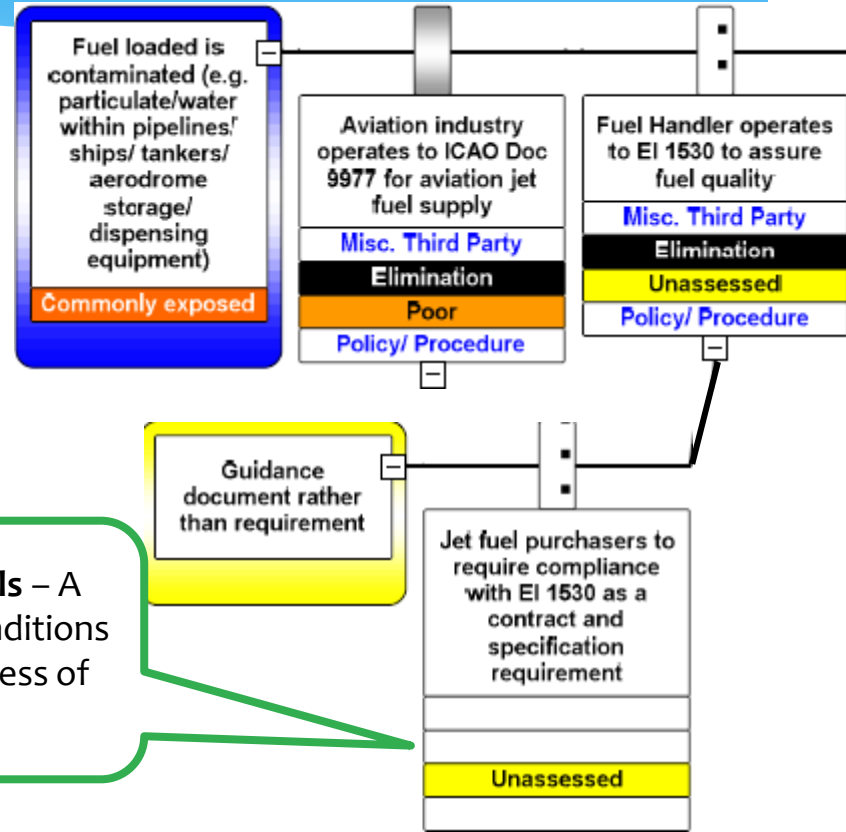


# Escalation Factor



**7. Escalation Factor -**  
A condition that leads to increased risk by defeating or reducing the effectiveness of controls (or the reasons for the holes in your Swiss Cheese)

# Escalation Factor Controls



**8. Escalation Factor Controls** – A control that manages the conditions which reduce the effectiveness of other controls

# Fuel BowTie Summary

## ‘POOR’ PREVENTION CONTROLS or ‘Barriers’

ICAO 9977	Policy	3 <sup>rd</sup> Party	Elimination
Maintenance of transport	Training	3 <sup>rd</sup> Party	Elimination
Basic quality checks (eg tanker driver)	Training	3 <sup>rd</sup> Party	Prevention
Maintain dispensing equipment	Policy	Ground Service Provider	Prevention
Flight crew check	Policy	Aircraft operator	Prevention
Aerodrome ANO/ADR requirements	Policy	Aerodrome Operator	Prevention
Aerodrome adheres to blending instructions	Policy	Aerodrome Operator	Elimination
Aircraft operator blending instructions	Policy	Aircraft Operator	Elimination
On site ‘clear and bright’	Policy	Aerodrome Operator	Prevention



# Fuel BowTie Summary

## ‘POOR’ or ‘VERY POOR’ RECOVERY CONTROLS

Aircraft water detectors (eg B747)	Engineering Devices	Aircraft Operator	Reduction
Flight crew reaction to fault or malfunction indication	Policy	Aircraft operator	Reduction
Flight crew aware of multiple engine loss	Policy	Aircraft operator	Reduction
Flight crew conduct forced landing	Training	Aircraft operator	Reduction

# Conclusions

- The 'upstream' activities are where the controls are most effective or most critical
- The 'recovery' controls have limited effectiveness
- Some critical upstream activities are unregulated from an aviation safety aspect

# Feedback

Please provide your feedback on:

- Are the threats reasonable and complete?
- Are the barriers – prevention and recovery, complete and properly assessed?
- What improvements can be made to the poor barriers?