Runway Excursion

Safety Risk Assessment

Version 1.0 July 2025

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Fact Sheet

Safety Issue			
Runway Excursion			
Regional Exposure	All Regions	Sector Exposure	Industry Wide
Key Risk Area	Runway Safety	Proximity	Current

Issue Description

A Runway Excursion is one of the main areas of concern in the runway safety domain. According to the IATA's Safety Report, Runway Excursions have been the most common type of accident over the past ten years, with the approach and landing phase being the most critical.

Runway Excursions involve aircraft veering off the runway (Lateral excursions) and aircraft exiting the upwind end of the runway (Runway overrun).

Various factors may drive this operational issue, such as approach path and energy management, deep landings, runway surface conditions, crosswind, incorrect performance calculation, and inadequate stopping device use.

The severity of a Runway Excursion consequence is related to two main factors: the speed at which an aircraft exits the runway surface area (high-energy excursions) and the characteristics of the runway end safety area (RESA) at a given aerodrome.

Safety Risk Assessment Purpose and Scope:

This document provides a structured approach for analyzing Runway Excursions to support air operators in assessing and mitigating the associated risk. It provides a standard description of potential threats, prevention controls, including those linked to IOSA standards and recommended practices, and escalation factors related to Runway Excursions, along with recovery controls that prevent them from escalating into accidents that cause damage to aircraft.
As a Safety Risk Assessment, it serves as a resource to assist IATA members in determining whether their risk controls effectively mitigate the risk of Runway Excursions or if additional mitigating actions are necessary.

Further supplementing the risk controls are linked to the Global Action Plan for the Prevention of Runway Excursions (GAPPRE) recommendations, IATA Accident Classification Task Force (ACTF) and the Global Recommendations to Prevent Accidents in Aviation and the collaborative Global Runway Safety Action Plan (GRASP). These provide key information on how the implementation of recommendations can strengthen the effectiveness of the risk controls. The recommendations are not only addressed to operators but industry more widely, with the content validated by IATA.

The full bow tie model is contained in Annex A and is made available in both MS Visio and BowTieXP files in the Safety Issue Hub. The risk control register is also provided as a complementary MS Excel file.

Recommendations to Air Operators

To proactively address runway excursions, IATA invites operators to set up a safety program, following the approach described below.

- **Build a Risk Model.** Organizations are encouraged to build their risk model using Bowtie or other appropriate risk analysis methods to ensure effective risk management. The risk model provided in this document should be used as a general reference only.

  Establish and Track Safety Performance Indicators (SPIs). Establish and track a Top Event safety performance indicator related to runway overruns and veer-offs, regardless of whether they were low-energy events. The main input to feed this SPI is typically the organization's safety reporting program.
- **Identify Runway Excursion Precursors.** Identify potential Runway Excursion precursors that the air operator might be exposed to, which should be integrated into the risk model for proactive risk monitoring through allocating SPIs against precursors. It is helpful to use all available hazard identification tools that the organization has within its SMS

- **Evolve Flight Monitoring Programs.** Assess the need for evolving the flight monitoring program to track precursors. For instance, monitoring deteriorating braking conditions through FDM may require developing additional FDM parameterization.

- **Document and Train on Controls.** Ensure that the listed controls in Tables 2 and 3 are documented, implemented, and trained as required. The provided controls can serve as a good baseline for a gap analysis; however, they may vary from operator to operator. A detailed description of the controls is given in here

- **Ensure SOPs Fit Operational Reality.** To ensure that SOPs fit operational reality, assess whether the SOPs incorporate the four key principles: Philosophy, Policy, Procedures, and Practices.

- **Develop Control-Based Safety Audits.** Develop control-based safety audits according to the risk model to assess the compliance with the linked ISARPs and the effectiveness of the controls in place. Evaluating the control effectiveness intends to determine to what extent preventive controls reduce the risk of Runway Excursions.

- **Operators are encouraged to evaluate their current runway excursion safety programs** in relation to the GAPPRE recommendations to assess their alignment with the global strategy for preventing runway excursions.

Recommendation to the IOSA standards Task Force

- Consider elevating the recommended practices, **FLT 3.12.6**, and **ORG 3.3.2** to standards. This is to ensure that these provisions effectively address runway excursion challenges and enhance operational safety.

- Consider reviewing the provisions **FLT 3.11.20** and **MNT 1.9.2** to ensure they effectively address the risks of runway excursions.

Introduction

Runway Excursion on the rise.

According to the IATA Safety report, Runway Excursions account for 21% of the aviation industry's total accidents over the last decade (2015-2024). During this period, the industry has recorded 104 Runway Excursion accidents, with an accident rate fluctuating around 0.36 accidents per million flights (pre-pandemic level).

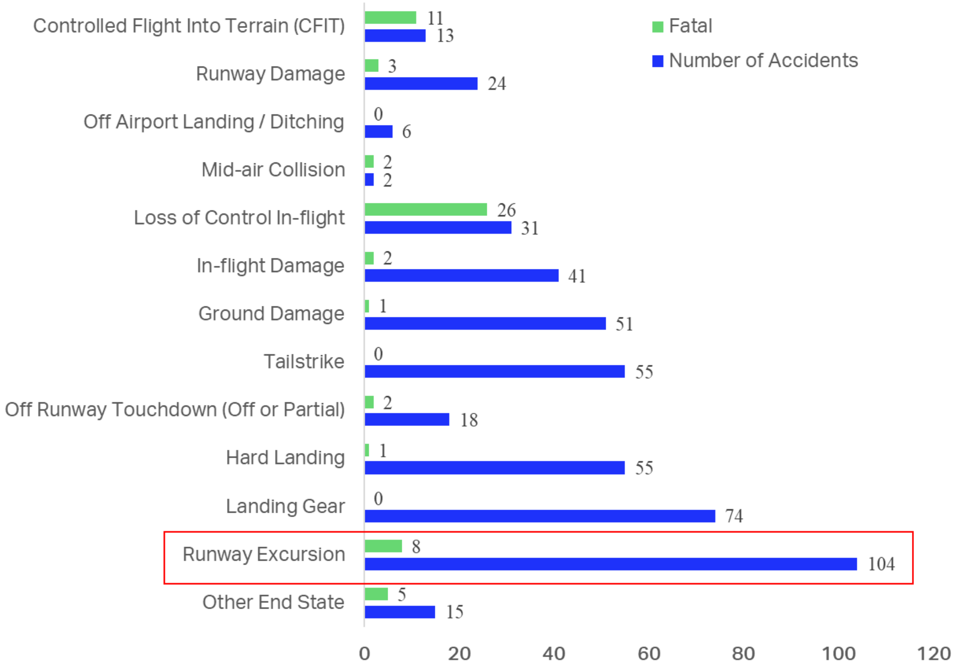


Figure 1. Runway excursions last decade vs other end states (IATA Annual Safety Report)

In 2021, there was a historic low of zero Runway Excursions in commercial aviation. However, the number of Runway Excursions considered accidents has increased over the past three years. In 2024, the Runway Excursion rate rose to its highest point since 2020.

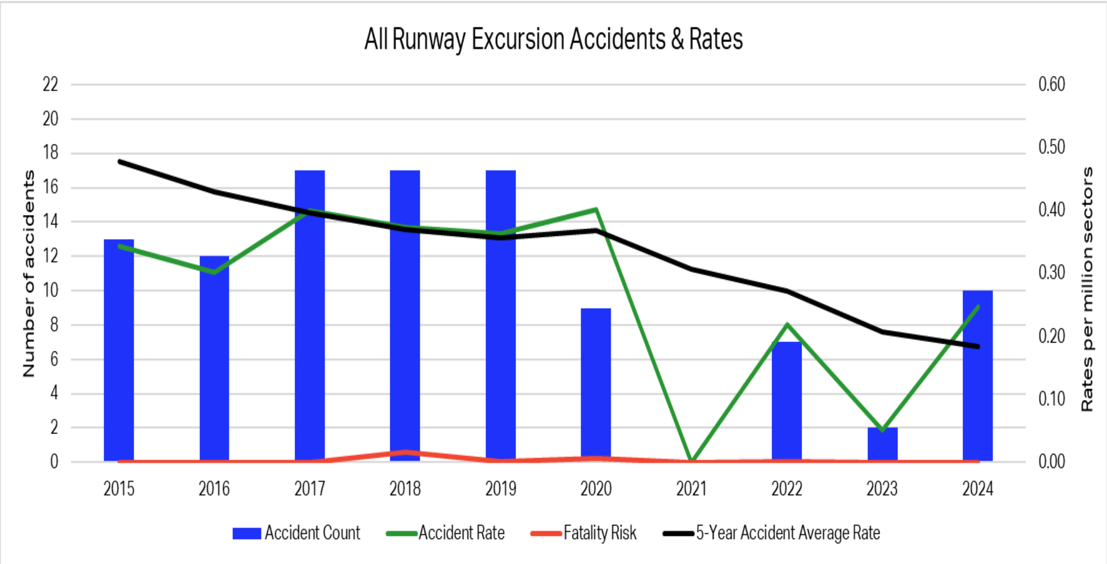


Figure 2. Runway excursions over the last decade (IATA Annual Safety Report)

Moreover, in 2024, Runway Excursions were one of the most common types of accidents. The performance recorded in 2024 is five times higher than that observed in 2023 and exceeds the average of the last five years.

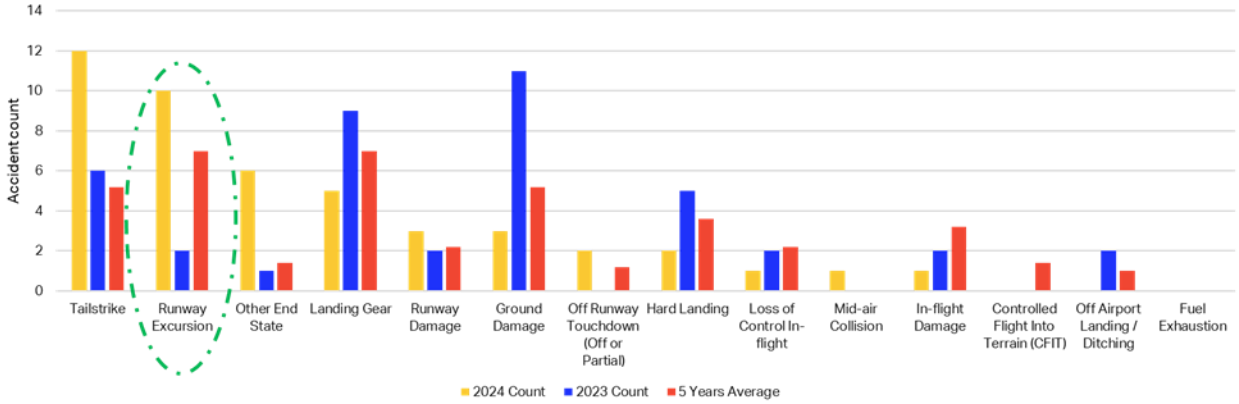


Figure 3. Runway excursions 2024 vs 2023 and 5-year average (IATA Annual Safety Report)

Despite their frequency, runway excursions rank as the fourth leading cause of fatalities in the industry. Over the last ten years, there have been eight fatal runway excursions, resulting in a total of 88 on-board and other fatalities. This aligns with [Boeing Statistical Summary of Commercial Jet Airplane Accidents Worldwide Operations | 19592023], published in August 2024, during the last decade 2014 /2023. Where it is concluded that Runway Excursions (RE), constitute the fourth leading factor in fatal accidents.

According [to Airbus Statistical Analysis of Commercial Aviation Accidents 1958 – 2023], published in Feb 2024. Runway Excursions (RE), including lateral and longitudinal (overruns) types, are the primary cause of hull losses. Emerging energy- and performance-based technologies show promising trends for preventing longitudinal Runway Excursion accidents (overruns).
The most critical operational phase is landing, which accounts for 80% of the runway excursions recorded in the last decade. Typically, runway excursions involve aircraft veering off the runway (lateral excursions), 52%.

Aircraft exiting the upwind end of the runway (runway overrun) 45%. The remaining 3% correspond to runway excursions that occurred during take-off and rejected take-off. Also, most overruns accidents are related to aircraft energy management. An improvement of runway excursion accident rates should be expected with the introduction of real-time energy and landing performance-based warning systems, such as the Runway Overrun Protection System (ROPS) available for Airbus aircraft. In 2023 the number of aircraft equipped with ROPS increased to 13% of the worldwide fleet. Other technologies available is Runway Overrun Awareness and Alerting Systems (ROAAS), and Runway Awareness and Advisory System (RAAS) for Boeing aircraft.

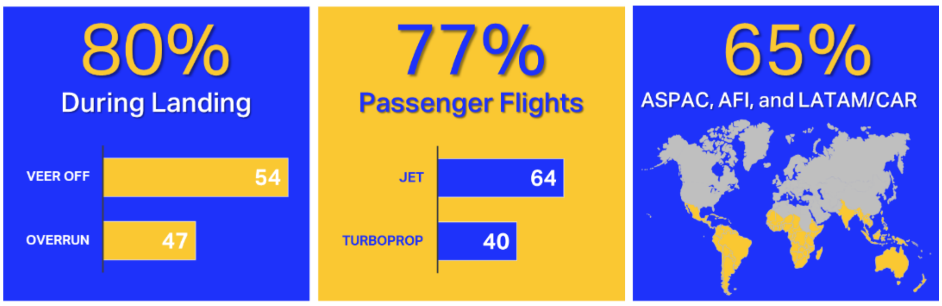


Figure 4. Operational phase, Operation type, and region. (IATA Annual Safety Report)

Accident data reveal that most runway excursions involve passenger flights, 61% of which involve jet aircraft and 39% of which involve turboprop aircraft. Although Runway excursion is a worldwide issue, it is important to highlight that 65% of the runway excursions in the last decade are linked to operators from Asia Pacific, Africa, Latin America, and the Caribbean.

In summary, runway excursions are not only the most frequent accident type in the industry but also rank as the fourth cause of fatalities and the first cause of hull losses.

Runway excursion prevention is complex due to the multiplicity of combined factors that may lead to it, such as approach path and energy management, landing far down the runway, runway condition, flight crew's adherence to standard operating procedures, landing technique, the use of stopping devices, and go-around decision-making.

The key to managing runway excursion risk is understanding and awareness of the main precursors or threats that all operators must face when mitigating operational risk in this area, and that is the goal of this Safety Risk Assessment.

Bowtie as a Risk Assessment Methodology

One effective way to manage risk is using the bowtie model. This model is useful in identifying and mapping potential threats and unsafe operational states that could lead to undesirable consequences. In addition, the bowtie model also considers the risk controls that can help organizations mitigate the risk of undesirable outcomes.

Leveraging the different components of the bowtie model, organizations can attain a comprehensive overview of potential safety risks, allowing them to take proactive measures to prevent occurrences.

The runway excursion safety issue has been divided into two separate bow tie models: one addressing a runway overrun, and the second focusing on a Veer Off.

Runway Excursion – Inability to stop within the Expected Landing Distance available (LDA)

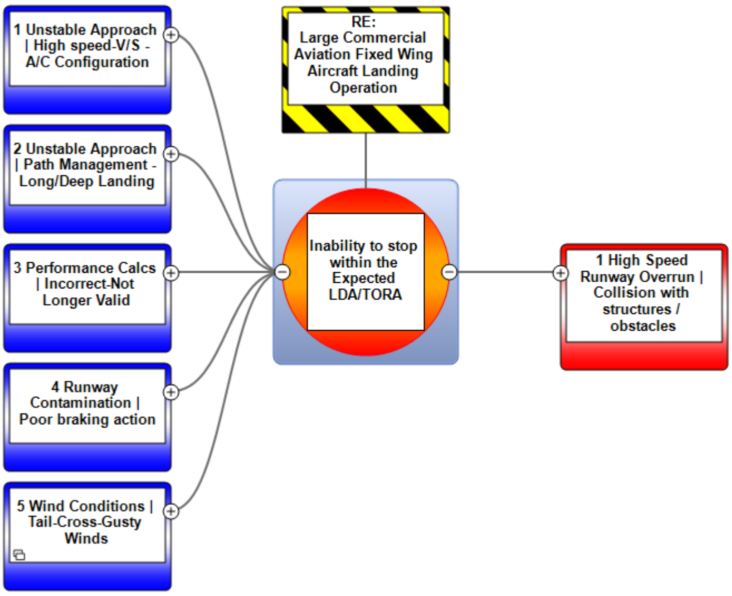


Figure 5 Runway Excursion Bow Tie Risk model – Inability to stop within the Expected LDA

Runway Excursion – Loss of directional control on the runway

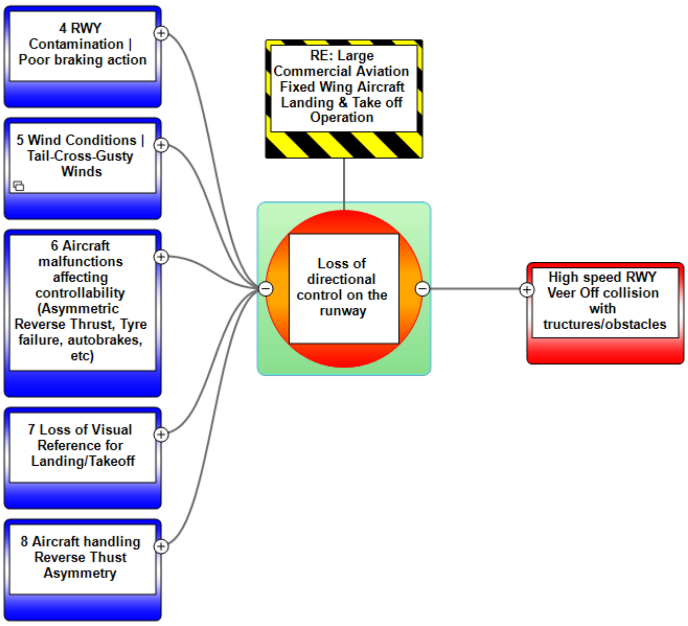


Figure 6 Runway Excursion Bow Tie Risk model – Loss of directional control on the runway

Proactive Risk Management

How to use bow ties as an effective tool.

A bowtie is a tool used in risk management that helps safety practitioners describe, depict, and comprehend the safety risk landscape of specific operational scenarios. When a bowtie is completed, it gives a tailored overview of the risk and provides a framework for targeting data collection to improve the risk management strategy.

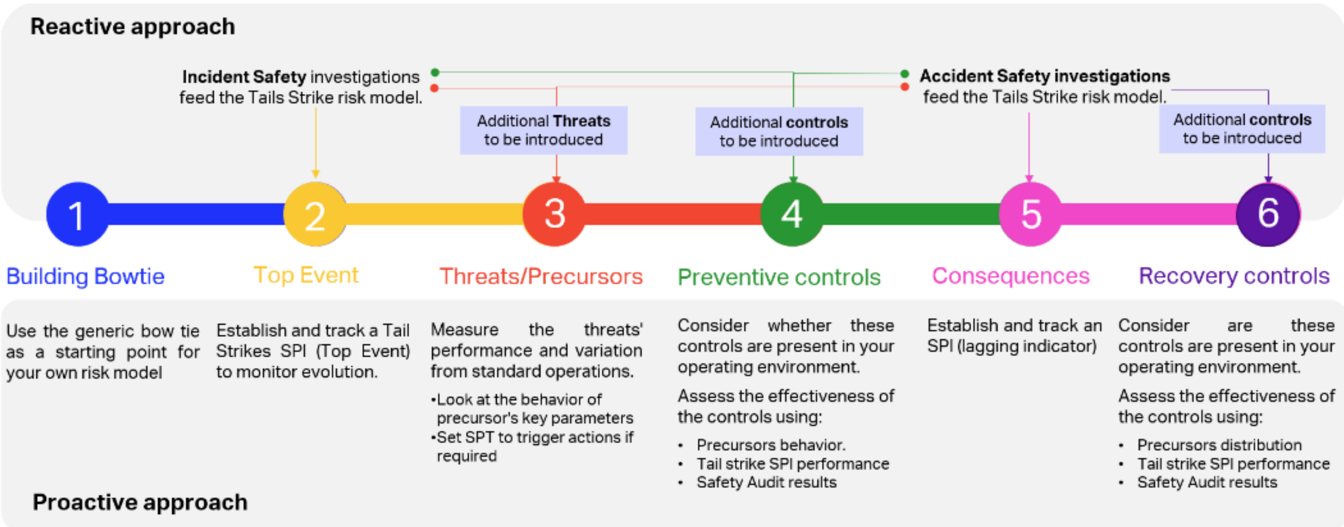


Figure 7 How to use a Bowtie.

Consideration. Proactive safety management is sometimes assumed to be only identifying *non-compliance* and *unreported hazards*. However, solely focusing on these activities still results in a reactive approach. Truly proactive safety management involves collecting data and analyzing operations to uncover trends, identify patterns, and relationships to transform data into safety knowledge, develop mitigations, and measure their effectiveness. As outlined below, risk management can evolve from a reactive to a proactive, data-driven approach.

In general terms, the recommendations given by multiple industry publications aimed to mitigate runway excursions are valid. However, they might not fit all operators' needs or pain points. To establish an effective runway excursion mitigation strategy, it is essential to identify the precursors that are most likely to lead to a runway excursion within the air operators' operational context and network.

A single generic recipe does not work for mitigating the operational risk, as the operational context varies from one operator to another due to the runways they operate, the approach types they perform, the geographic location and its associated weather conditions, their pilot experience, the aerodrome infrastructure, and ground aids to record and report runway wind and surface conditions among others.
Based on safety performance trends, it can be argued that the adoption of generic runway safety programs aimed at reducing runway excursions has contributed to significant progress in the past, but this is no longer the case. However, adopting tailored safety strategies will mark a turning point in driving further improvements in this longstanding issue across the industry.

Call to action. Organizations are encouraged to build their risk model using Bowtie or other appropriate risk analysis methods to ensure effective risk management. The risk model provided in this document should be used as a general reference only.

Top Event

The Top Event is a point in time that describes the organization's loss of control over a hazard resulting in an unsafe operational state or undesired safety state. Therefore, this risk assessment outlines the **Inability to stop within the expected LDA/TORA (Overrun)**, and the **Loss of directional control on the runway (Veer-Off)** as the top event.

The bowtie risk model is considered a snapshot of the risk at a given time. However, when combined with the appropriate Safety Performance Indicators (SPI), it becomes a dynamic analysis tool that helps to make informed decisions, ensure appropriate management strategies, and address resource allocation.

Consideration. Monitoring Runway Excursions is a reactive approach since it only considers the unsafe operational state after it has occurred. However, this SPI is still an essential parameter for tracking runway excursion as a current safety issue. It will prompt further risk model analysis when the frequency of occurrence deviates from the organization's objectives.
Furthermore, it provides a valuable data point that can be used to assess the effectiveness of preventive controls against threats or precursors.

Call to action. Establish and track a Top Event safety performance indicator related to runway overruns and Veer-Off, regardless of whether they were low-energy events. The main input to feed this SPI is typically the organization's safety reporting program.

Threats

Threats are potential causes of a top event and can be described as precursors to an undesired safety state. In the context of this risk assessment, an analysis of Runway Excursion accident reports from the past ten years (2015-2023) was performed to identify the main precursors. About 54% of the final accident reports reveal the precursors in Table 1, which were validated by an industry workshop.

Threat	Overrun	Veer Off
Tht 1. **Unstable Approach** | High speed-V/S -A/C Configuration	X	
Tht 2. **Unstable Approach** | Path Management - Long/Deep Landing	X	
Tht 3. **Performance Calcs** | Incorrect- Not Longer Valid	X	
Tht 4. **Runway Contamination** | Poor braking action	X	X
Tht 5. **Wind Conditions** | Tail-Cross-Gusty Winds	X	X
Tht 6. **Aircraft malfunctions affecting controllability** | Asymmetric Reverse Thrust, Tyre failure, autobrakes, etc.		X
Tht 7. **Loss of Visual Reference** for Landing/Take-off		X
Tht 8. **Aircraft Handling** | Reverse Thrust Asymmetry		X

Table 1 Runway Excursion Threats

Considerations. Runway Excursions are the most persistent aviation operational safety issue that often escalates to accidents that pose risks to passengers and increase financial stress on air carriers' operating profitability. These accidents must be mitigated.

Call to action. Identify potential Runway Excursion precursors that the air operator might be exposed to, which should be integrated into the risk model for proactive risk monitoring. It is helpful to use all available hazard identification tools that the organization has within its SMS, including participation in Local Runway Safety Teams. Annex B lists runway excursion accidents worldwide from 2018.

Consideration. Understanding, measuring, and tracking Runway Excursion's precursors rather than waiting for a Runway Excursion is a proactive risk management approach. It involves expanding the scope of safety performance monitoring activities to closely examine all operations, including lower severity events, and not only high severity events such as Runway Excursions.

Call to action. Assess the need for evolving the flight monitoring program to track precursors. For instance, monitoring deteriorating braking conditions through FDM may require developing additional FDM parameterization; slippery runways can be identified from the recorded brake pressure. Low cycling brake pressure can serve as an indication of friction-limited braking. If the brake pedal inputs are also recorded, this data can be used to indicate the brake effort being made. Additionally, differential braking can be identified from these recordings.

Also, a strategy to monitor the crosswinds experienced during landing cannot be tracked easily from the FDM program, given the inaccuracies in calculating the drift angle from the aircraft sensor data. However, some methods can be developed, such as groundspeed and airspeed, as well as headings and information available in FDM data. This requires the development of data analytics skills. More details can be found in the "Guidance for the Implementation of Flight Data Monitoring Precursors (EASA 2022)". It is a useful document that provides recommendations and industry best practices for measuring and monitoring runway excursion precursors. Operators can also find guidance on customizing the flight data recorder's data frame to monitor specific precursors.

When investigating a Runway Excursion, it is advisable to review the influence of the precursors included in Table 1. New precursors and threats identified by the investigation process should be integrated into the bowtie. The purpose is to enable future proactive risk monitoring and to focus on the effectiveness of controls, as well as the need to strengthen existing controls or introduce new controls. The bowtie risk model can also support the investigation by identifying which controls were eroded and which, if any, remained effective.

Preventive Controls

Prevention controls are barriers that prevent a threat from becoming a top event. Collectively, they comprise the strategy to reduce and control a runway excursion risk. The table below lists the main preventive controls for mitigating Runway Excursion threats.

Preventive controls against threats – Runway Overrun	Tht 1	Tht 2	Tht 3	Tht 4	Tht 5
Stabilized Approach Policy	X	X			
Safe landing criteria policy	X	X			
Go-Around policy	X	X			
Cross/Tail/Gusty winds limit policy	X	X			X
Not accepting ATC clearances compromising safety margins	X	X			
PNF Active monitoring & intervention	X	X			X
Managing runway/load sheet last-minute changes	X	X	X	X	X
Flight training on operators' policies and SOPs	X	X	X	X	X
EBT/CBT for simulator training programs	X	X	X	X	X
Runway Overrun Awareness and Alerting System (ROAAS)	X	X		X	X
Safety Management – Critical runway identification	X	X	X	X	X
FDM Program	X	X	X	X	X
Safety Management – additional hazard identification tools	X	X	X	X	X
Use of Autoland policy		X			
Handling bounced landings		X			X
Approach navigation aids, check, and maintenance		X			
RWY touchdown zone markings, lighting, and signs		X			
Independent calculations and crew cross-check			X		
Landing performance assessment			X	X	X
Runway conditions confirmation			X	X	X
Electronic Flight Bag			X	X	X
Procedures for calculating/providing RWY reduced distances.			X		
Request a more favorable runway				X	X
Consideration of RWY conditions to select/accept approach & landing				X	X
Use of stopping device				X	
Landing technique for all RWY conditions and environmental scenarios				X	X
Runway's surface changing information				X	
Runway friction level and drainage				X	
Wind speed/direction accurate information indicators					X
Digital transmission of ATIS					X

Table 2 Preventive controls to threats – aircraft excursion

Preventive controls against threats – Runway Veer Off	Tht 4	Tht 5	Tht 6	Tht 7	Tht 8
Request a more favorable runway.	X	X			
Consideration of RWY conditions to select/accept approach & landing	X	X			
Landing performance assessment	X	X			
Runway conditions confirmation	X	X			
Use of stopping device	X				
Landing technique for all RWY conditions and environ scenarios	X	X			
PNF Active monitoring & intervention	X	X			
Managing runway/load sheet last-minute changes	X				
Flight training on operators' policies and SOPs	X	X	X	X	X
EBT/CBT for simulator training programs	X	X	X		X
Safety Management – Critical runway identification	X				
FDM Program	X	X			
Safety Management – additional hazard identification tools	X	X			
Runway's surface changing information	X				
Runway friction level and drainage	X				
Cross/Tail/Gusty winds limit policy		X			
Handling bounced landings		X			
Wind speed/direction accurate information indicators		X			
Digital transmission of ATIS		X			
A/C Preventive Maintenance			X		
FOD-free operating environment			X		
A/C warning systems for failure recognition			X		
Abnormal procedures Execution			X		
Runway Lighting				X	
Minimum Visibility Requirements for Take Off / Landing				X	
Go Around / RTO Execution				X	
Proficiency in manual handling skills					X

Table 3. Preventive controls to threats – aircraft excursion

Consideration. Most of the risk controls the industry has in place to mitigate runway excursions relate to policies and procedures. By nature, these are prone to errors, given that flight crews constantly need to adapt and make decisions to meet the demands of a complex and dynamic operating environment. This often leads to a tendency to deviate from standard operating procedures (SOPs), since SOPs realistically cannot account for the various challenges flight crews might encounter.

Call to action. To ensure that SOPs fit operational reality, assess whether the SOPs incorporate the four key principles.

- **Philosophy**: This represents management's overarching view on how to conduct operations. It can be a "wide road" philosophy, granting operational personnel discretion commensurate with the situation. This empowers operational personnel to make informed decisions based on real-time circumstances. Alternatively, a "straitjacket" philosophy provides a highly strict approach with minimal individual discretion. The organizational culture, safety culture, and operational context will help to assess which approach suits the air operator better.

- **Policy**: It relates to how policies are set out, broad specifications for how the organization expects personnel to conduct operations, and exercise authority

- **Procedures**: It involves checking whether the specific sequence of actions personnel should take to complete a task is consistent with established policies and outlines the "who, what, how, when, and where" of each step. It might be relevant for Pilot monitoring and task sharing for normal and abnormal procedures.

- **Practices**. It refers to what happens in the workplace. These can either reflect adherence to established procedures or deviations. Ideally, procedures and practices should be closely aligned. However, unforeseen circumstances may require deviations. Effective SOP design includes mechanisms for capturing and analyzing these deviations to inform future revisions of policies and procedures.

Call to action. Ensure that the listed controls in Tables 2 and 3 are documented, implemented, and trained as required. The provided controls can serve as a good baseline for an operator's Runway excursion mitigation strategy gap analysis; however, they may vary from operator to operator.

The bowtie risk model developed in this SRA provides information not only on the controls listed in Table 2 for Overruns and Table 3 for Veer-off, but also provides information as follows. Check the controls details here

- Accountability – the organization/actor primarily accountable for the risk control and typically able to directly impact its effectiveness. E.g. '*Aircraft operator*', '*aerodrome*' or 'MRO (Maintenance Repair Organization)'

- Risk control type – whether the control is an:
  - Policy/procedure
  - Engineered device
  - Training/proficiency (including associated training-specific policy)
  - Safety Management
  - Human sensory action
- ISARP – IOSA Standards and Recommended Practices are identified and linked to risk controls (for risk controls where an operator is carrying out the activity associated with the risk control). E.g. ORG 1.1.1. – Management System Overview

- GAPPRE Activity – Actions identified in the Global Action Plan for the Prevention of Runway Excursion that link with the risk control and which may improve the effectiveness of the risk control. For example, "*OPS7 - Aircraft operators should implement policies for safe descent and approach planning, stabilized approach, safe landing and go-around*"

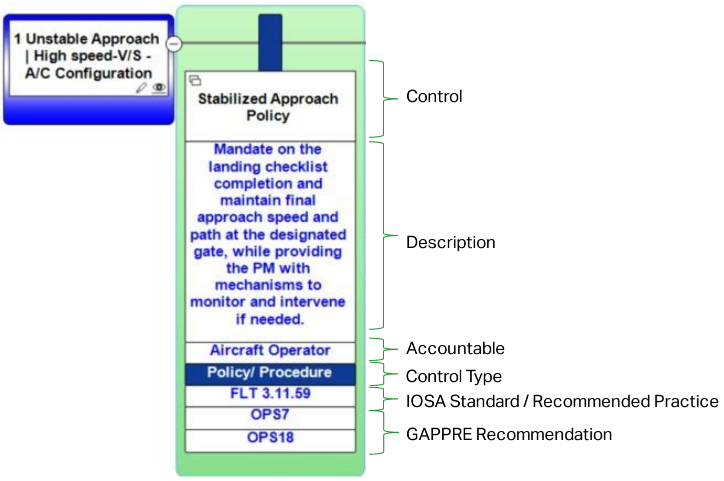


Figure 10. Risk Control Tagging

Consideration. In addition to the SOP limitation of including all variables that flight crews may encounter in daily operations, and the fact that flight crews might deviate from established SOP, human factors play a significant role in reducing the effectiveness of the preventive controls. Therefore, they can be considered escalation factors in the risk model.

IATA performed an analysis of the collected Runway Excursion accident reports (48) from the past ten years (2015-2023) using the HFACS (Human Factor Analysis and Classification System) to identify the human actions or decisions that led to unintended outcomes. The analysis shows that nearly 90% of runway excursion accidents involve human error, and 80% involve environmental factors linked to physical environment (Meteorological conditions and poor runway conditions) and technological environment (System failures/ ineffectiveness).

From this analysis, the following errors were identified:

- Skill-based Errors. Most prominent: **Thrust Lever Misuse**.

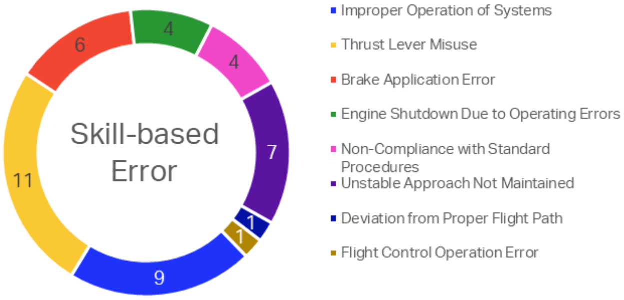


Figure 8. Skill-based errors

- Decision-making Errors. Most prominent: **Persistent Landing**

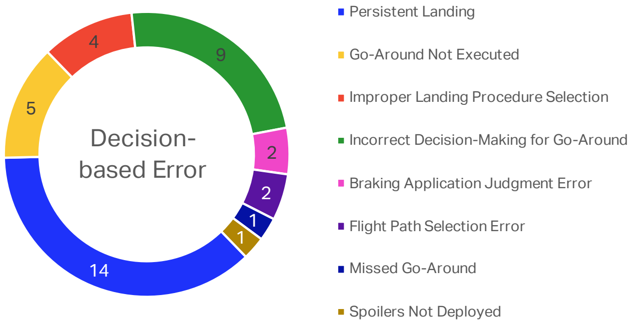


Figure 9 Decision-based errors

Escalation factors, such as the reluctance to execute a go-around due to fixation, personal or organizational pressure, deviation from prescribed procedures, and degradation of active monitoring influenced by human performance, are topics that should be addressed through training.

Consideration. SOPs, Flight crew training on operators' policies and procedures, decision making, and evidence-based simulator training are key to mitigating runway excursions as they are controls across all threats. Additionally, safety management activities such as identifying critical runways, developing the flight data monitoring program capacity, and incorporating technology-related controls like the Runway Overrun Awareness and Alerting System (ROAAS) are the foundation of a solid runway excursions safety strategy.

Call to action. Develop control-based safety audits according to the risk model to assess the compliance with the linked ISARPs and the effectiveness of the controls in place. Evaluating the control effectiveness intends to determine to what extent preventive controls reduce the risk of Runway Excursions.

Measuring Preventive control's effectiveness

Evolving to a proactive and controls-oriented management approach is about understanding how and when safety controls become ineffective before an event occurs. It helps identify areas where resources could be allocated to proactively reduce the risks of runway excursions.

Adopting the controls-based proactive approach expands safety audits' scope beyond focusing on regulatory compliance. A control in place does not necessarily mean that it is effective. This concept is linked to the evolving Risk-based IOSA Program. Measuring the effectiveness of risk controls has always been challenging. However, to ensure a comprehensive effectiveness assessment, IATA proposes to follow three essential steps, as shown in the following Figure.

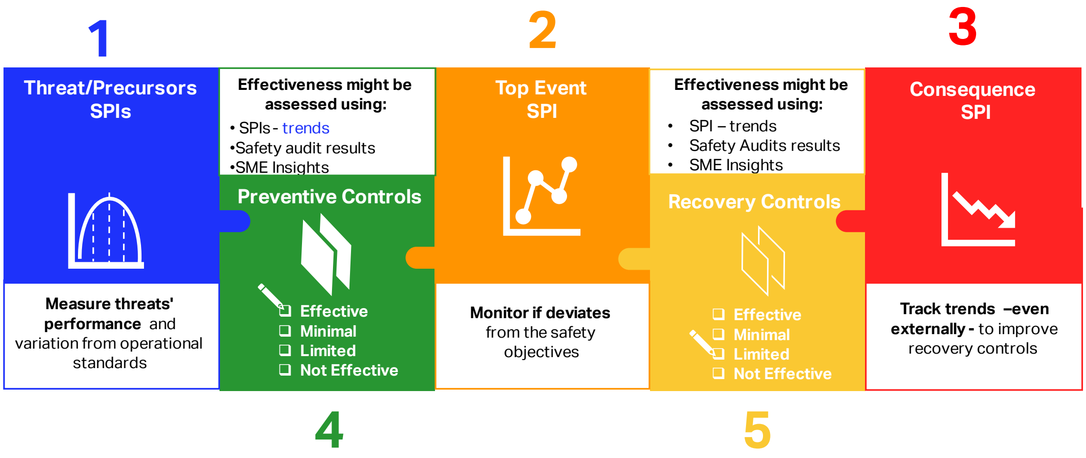


Figure 11. Assessing Controls Effectiveness

Measuring threat performance/behavior enables operators to assess operational risk proactively. This approach allows operators to make interventions to strengthen controls and reduce the risk of experiencing a non-desired outcome.

Table 4 provides general guidance on assessing the effectiveness of the Runway Excursion risk model's safety controls.

Threats SPIs	Top Event SPIs	Control Effectiveness
Trend Up ⬆	Trend Up ⬆	Non-effective, controls are in place, but don't mitigate the risk
Trend Up ⬆	Constant ➡	Non-Effective, controls are not working as expected
Trend Up ⬆	Trend Down ⬇	Most of the controls are non-effective, there is a control containing the risk
Constant ➡	Trend Up ⬆	Non-Effective, Controls are not working as expected
Constant ➡	Constant ➡	Limited, Controls have a restricted action over the threads
Constant ➡	Trend Down ⬇	Limited, there is a weak control unable to turn the threats trend down
Trend Down ⬇	Trend Up ⬆	Limited, there is a weak control failing to contain the top event trend
Trend Down ⬇	Constant ➡	Limited, there is a weak control unable to turn the Top Event down
Trend Down ⬇	Trend Down ⬇	Effective, controls work as expected

Table 4 Control's Effectiveness Assessment

Gaining insights from subject matter experts is crucial in refining the effectiveness of runway excursion risk controls. It is important to consider the nature of the controls, which can be technology, procedures, regulations, or training, as they might be weakened by human performance.

The control effectiveness assessment is relevant to allocating resources efficiently, strengthening the appropriate controls, and achieving an efficient and successful runway excursion mitigation strategy to avoid any further associated consequences.

In addition to assessing the effectiveness of individual risk controls, the combined effect of risk controls for a specific threat or consequence should be reviewed collectively. To effectively mitigate a threat, it is essential to pursue a combination of risk controls that vary in type and involve different accountable parties.

Consequence

Defined as a potential accident scenario resulting from the top event that directly results in loss or damage. A Runway Excursion may lead to the following accident scenario.

Consequence	**RE Overrun**	**RE Veer-Off**
Csq 1 **High Speed Runway Overrun** | Collision with structures/obstacles	**X**	
Csq 2 **High speed Runway Veer Off** | Collision with structures/obstacles		**X**

Table 5 Potential consequences.

Recovery controls

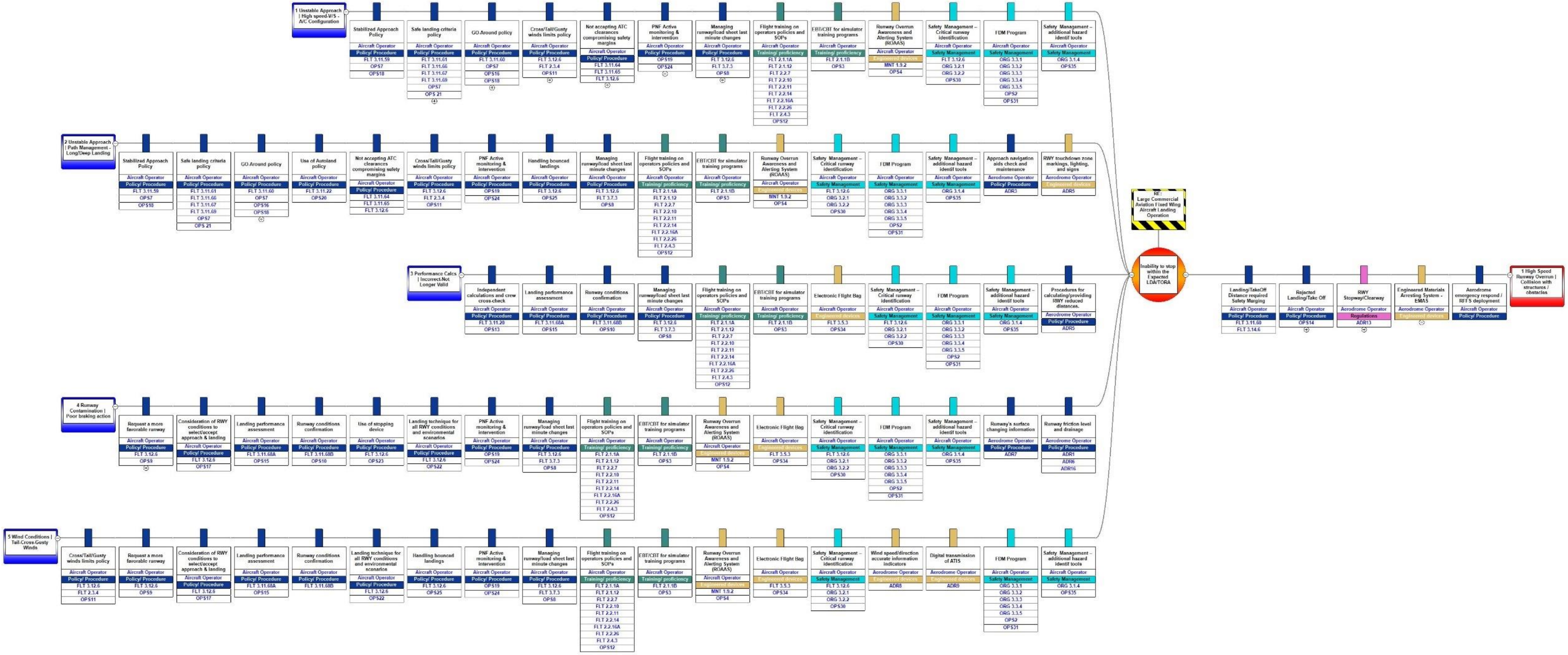
Considered as the barriers that prevent the top event from developing into an accident scenario or reduce the severity of the accident.

Recovery controls to Top event – Runway Excursion	**Csq 1**	**Csq 2**
Landing/Take Off Distance required Safety Margin	X	
Rejected Landing/Take Off	X	
RWY Stopway/Clearway	X	
Engineered Materials Arresting System	X	
Aerodrome emergency response/RFFS deployment	X	X
Runway End Safety Area (RESA)		X
Flight crew aircraft handling to recover control		X

Table 6 Recovery controls for consequences

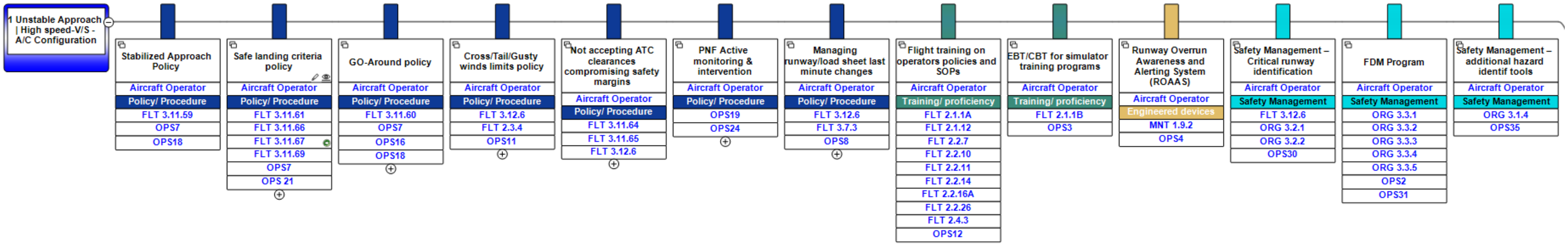
Consideration. Several of the recovery controls relate to activities carried out by third parties. In addition, recovery controls are split into those that may lessen the likelihood of the consequence and those that will not prevent the excursion but may reduce the severity (e.g., aerodrome rescue and firefighting service).

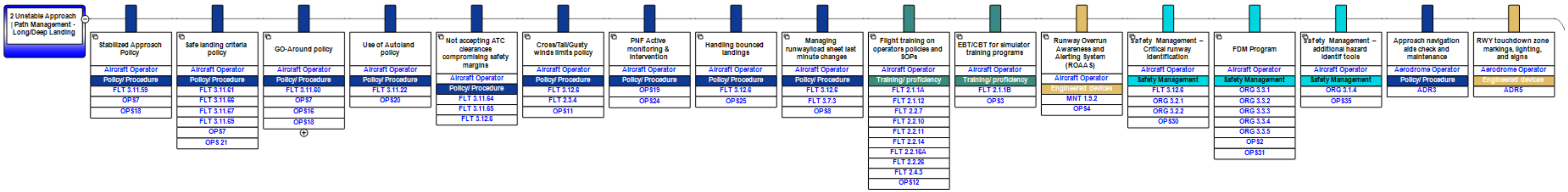
Annex A - Expanded Bow Tie Model



Runway Excursion – Overrun

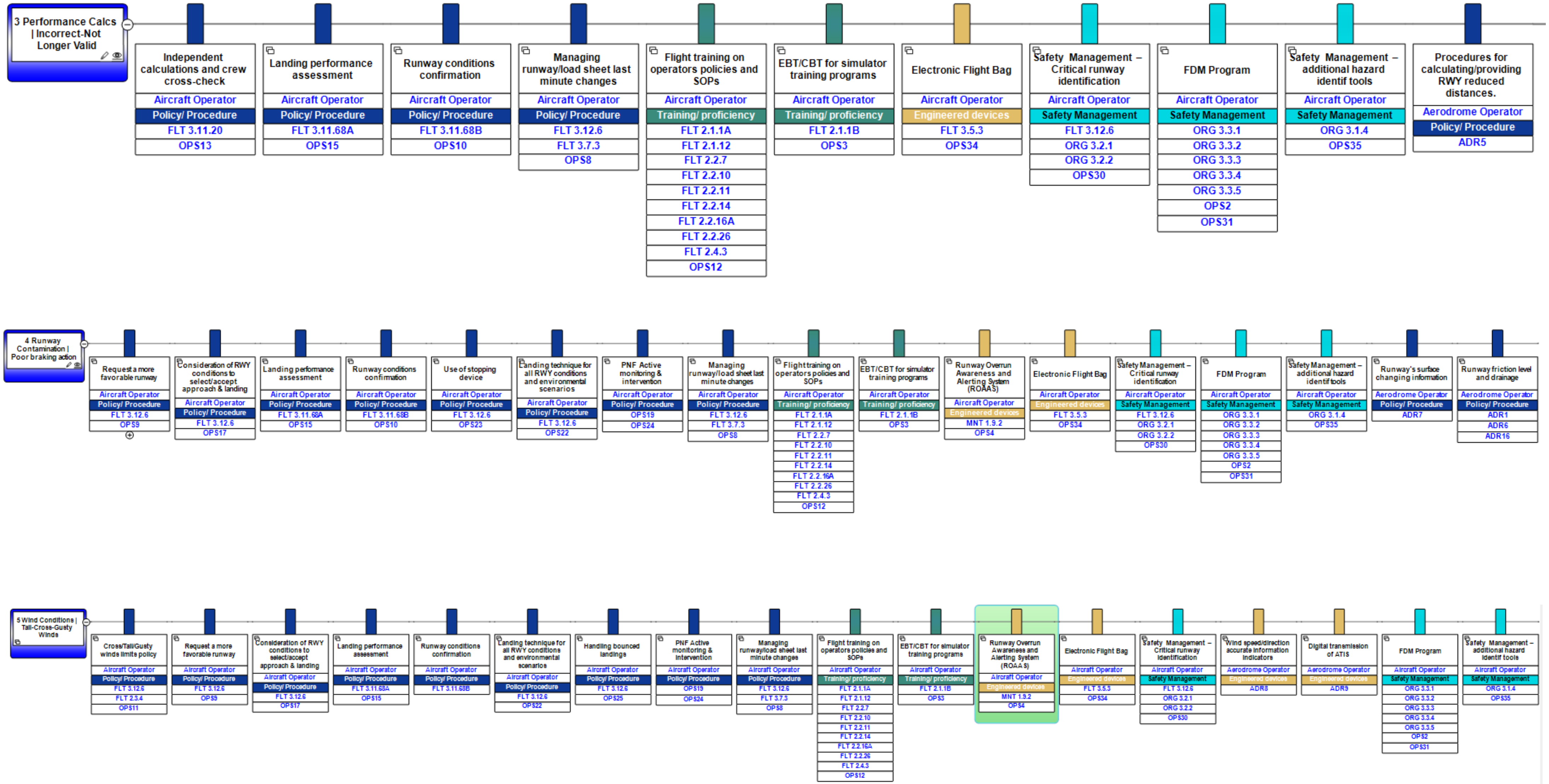
Threats & Controls





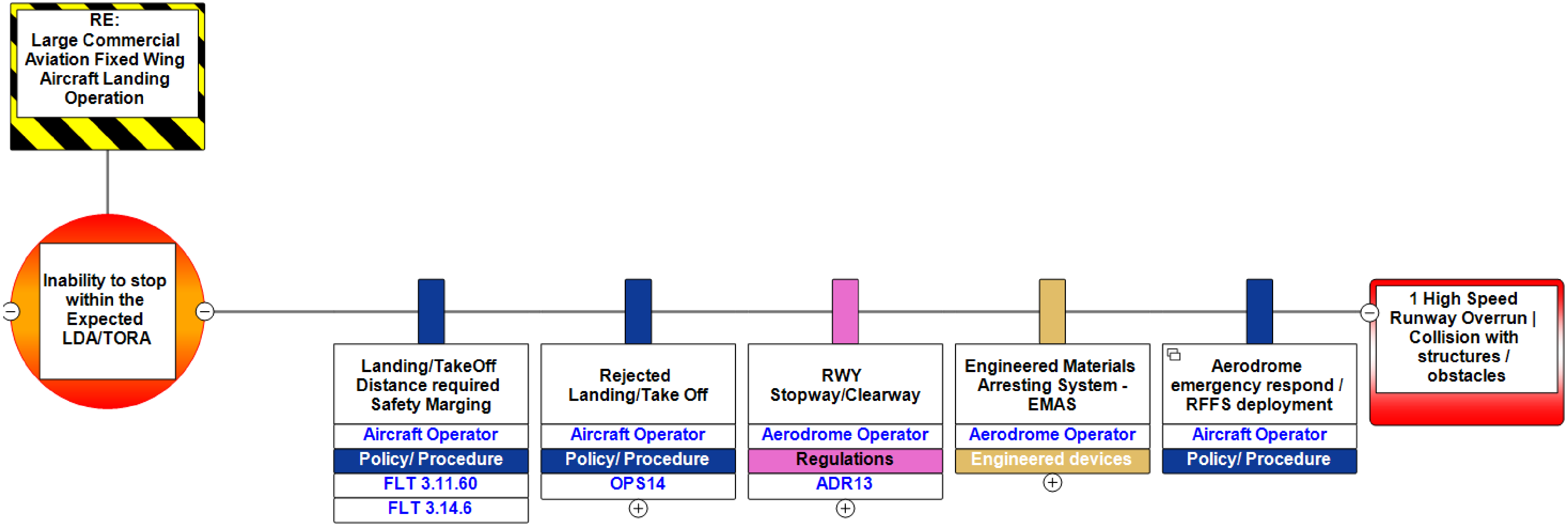
Runway Excursion – Overrun

Threats & Controls



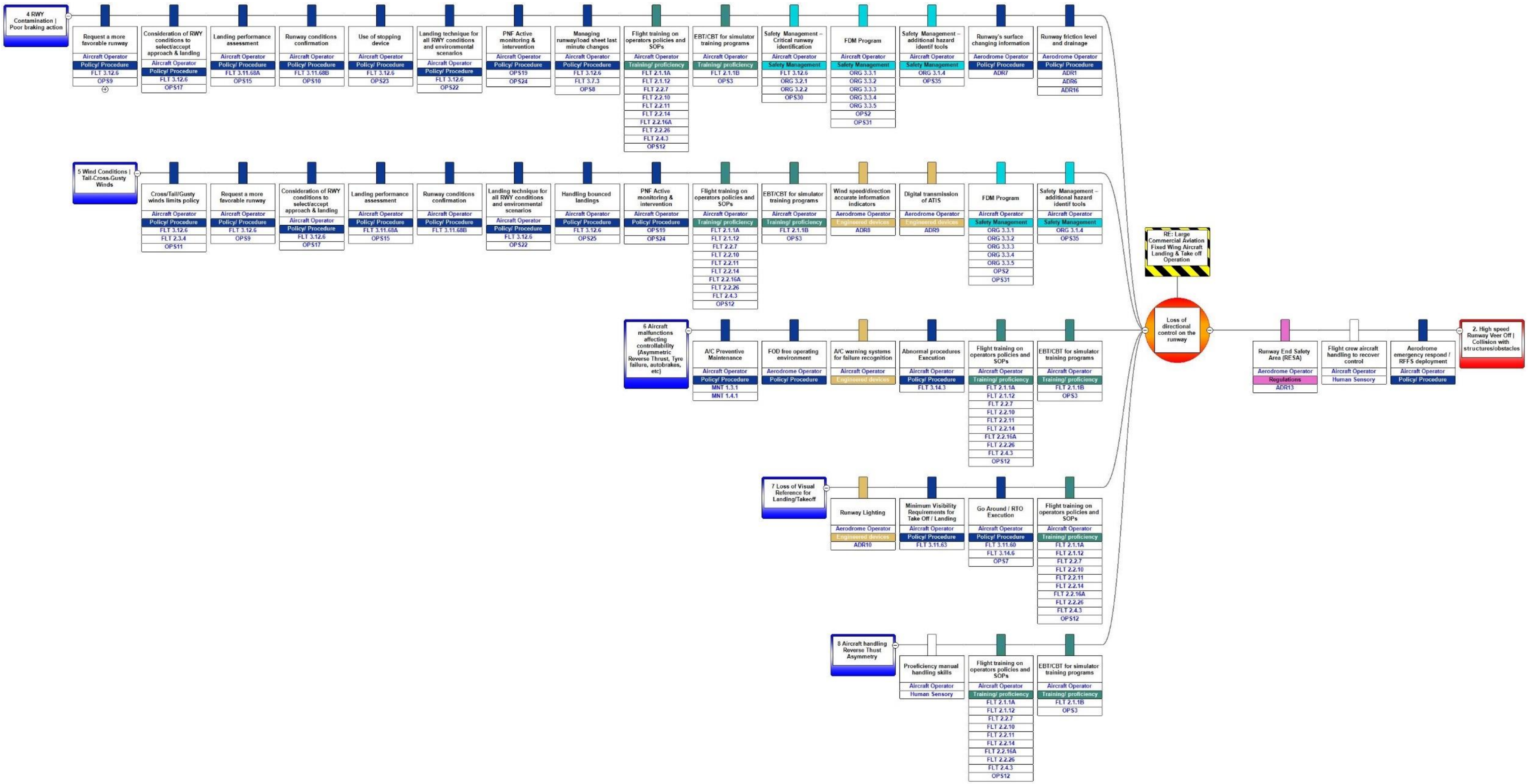
Runway Safety – Overrun

Consequences & Recovery Controls



Check the Preventive and recovery controls details in the following link: [Runway Excursion - Controls Summary]

Runway Safety – Veer-Off



Runway Safety – Veer-Off

Threats & Controls

4 RWY Contamination | Poor braking action

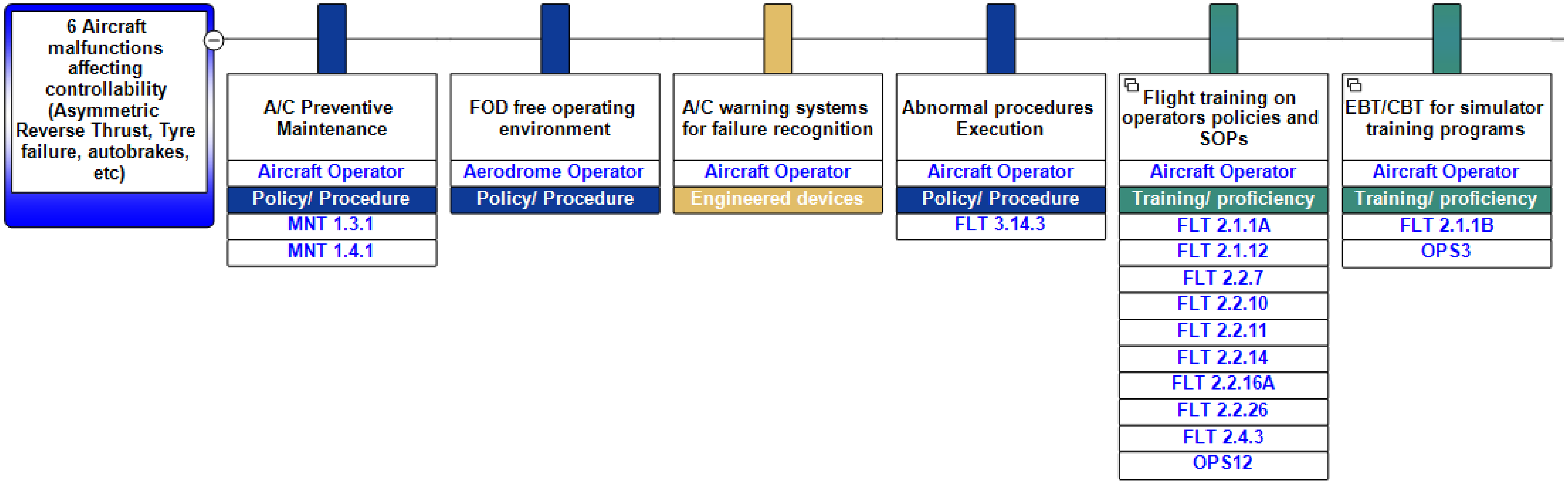
Control	Responsible	Type	References
Request a more favorable runway	Aircraft Operator	Policy/ Procedure	FLT 3.12.6, OPS9
Consideration of RWY conditions to select/accept approach & landing	Aircraft Operator	Policy/ Procedure	FLT 3.12.6, OPS17
Landing performance assessment	Aircraft Operator	Policy/ Procedure	FLT 3.11.68A, OPS15
Runway conditions confirmation	Aircraft Operator	Policy/ Procedure	FLT 3.11.68B, OPS10
Use of stopping device	Aircraft Operator	Policy/ Procedure	FLT 3.12.6, OPS23
Landing technique for all RWY conditions and environmental scenarios	Aircraft Operator	Policy/ Procedure	FLT 3.12.6, OPS22
PNF Active monitoring & intervention	Aircraft Operator	Policy/ Procedure	OPS19, OPS24
Managing runway/load sheet last minute changes	Aircraft Operator	Policy/ Procedure	FLT 3.12.6, FLT 3.7.3, OPS8
Flight training on operators policies and SOPs	Aircraft Operator	Training/ proficiency	FLT 2.1.1A, FLT 2.1.12, FLT 2.2.7, FLT 2.2.10, FLT 2.2.11, FLT 2.2.14, FLT 2.2.16A, FLT 2.2.26, FLT 2.4.3, OPS12
EBT/CBT for simulator training programs	Aircraft Operator	Training/ proficiency	FLT 2.1.1B, OPS3
Safety Management – Critical runway identification	Aircraft Operator	Safety Management	FLT 3.12.6, ORG 3.2.1, ORG 3.2.2, OPS30
FDM Program	Aircraft Operator	Safety Management	ORG 3.3.1, ORG 3.3.2, ORG 3.3.3, ORG 3.3.4, ORG 3.3.5, OPS2, OPS31
Safety Management – additional hazard identif tools	Aircraft Operator	Safety Management	ORG 3.1.4, OPS35
Runway's surface changing information	Aerodrome Operator	Policy/ Procedure	ADR7
Runway friction level and drainage	Aerodrome Operator	Policy/ Procedure	ADR1, ADR6, ADR16

5 Wind Conditions | Tail-Cross-Gusty Winds

Control	Responsible	Type	References
Cross/Tail/Gusty winds limits policy	Aircraft Operator	Policy/ Procedure	FLT 3.12.6, FLT 2.3.4, OPS11
Request a more favorable runway	Aircraft Operator	Policy/ Procedure	FLT 3.12.6, OPS9
Consideration of RWY conditions to select/accept approach & landing	Aircraft Operator	Policy/ Procedure	FLT 3.12.6, OPS17
Landing performance assessment	Aircraft Operator	Policy/ Procedure	FLT 3.11.68A, OPS15
Runway conditions confirmation	Aircraft Operator	Policy/ Procedure	FLT 3.11.68B
Landing technique for all RWY conditions and environmental scenarios	Aircraft Operator	Policy/ Procedure	FLT 3.12.6, OPS22
Handling bounced landings	Aircraft Operator	Policy/ Procedure	FLT 3.12.6, OPS25
PNF Active monitoring & intervention	Aircraft Operator	Policy/ Procedure	OPS19, OPS24
Flight training on operators policies and SOPs	Aircraft Operator	Training/ proficiency	FLT 2.1.1A, FLT 2.1.12, FLT 2.2.7, FLT 2.2.10, FLT 2.2.11, FLT 2.2.14, FLT 2.2.16A, FLT 2.2.26, FLT 2.4.3, OPS12
EBT/CBT for simulator training programs	Aircraft Operator	Training/ proficiency	FLT 2.1.1B, OPS3
Wind speed/direction accurate information indicators	Aerodrome Operator	Engineered devices	ADR8
Digital transmission of ATIS	Aerodrome Operator	Engineered devices	ADR9
FDM Program	Aircraft Operator	Safety Management	ORG 3.3.1, ORG 3.3.2, ORG 3.3.3, ORG 3.3.4, ORG 3.3.5, OPS2, OPS31
Safety Management – additional hazard identif tools	Aircraft Operator	Safety Management	ORG 3.1.4, OPS35

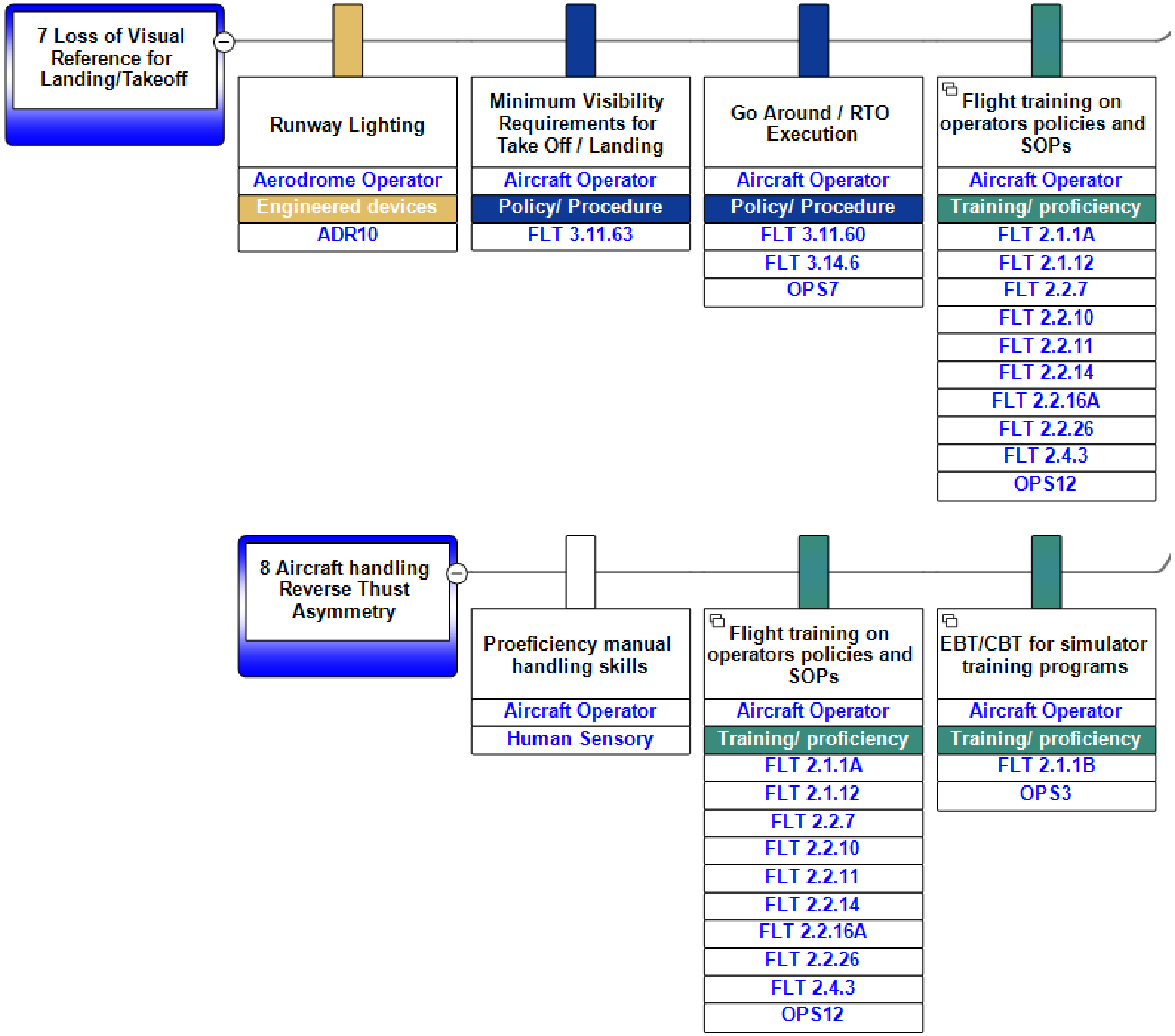
Runway Safety – Veer-Off

Threats & Controls



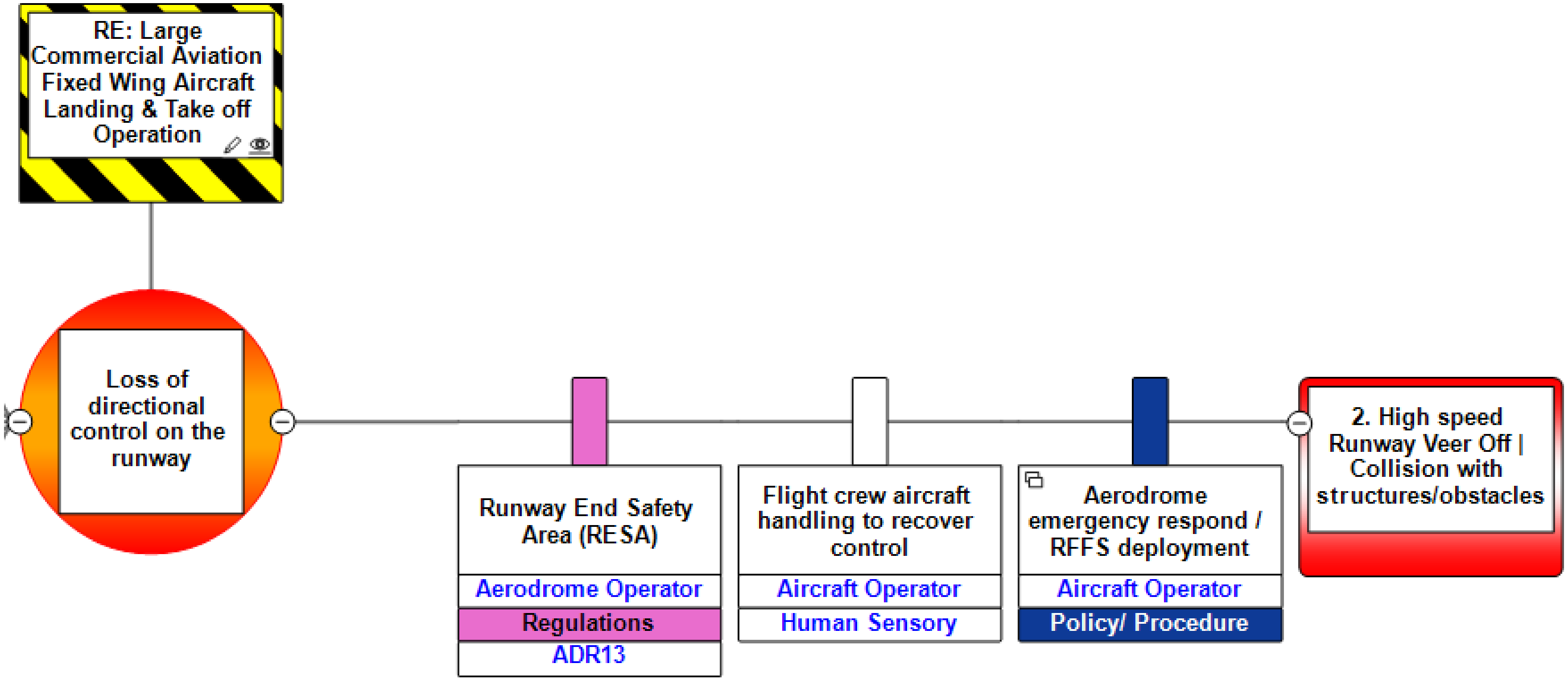
Runway Safety – Veer-Off

Threats & Controls



Consequences

Runway Safety – Veer-Off



Check the Preventive and recovery controls details in the following link: Runway Excursion - Controls Summary

Annex B Runway excursions – Rated as Accidents last 5 Years

Accident Date	Aircraft Registration	Aircraft Model	Type	RE Type	Phase	Fatal	Final Report Published
Wednesday, Jan 23, 2019	C-GTCO	Bombardier DHC-8-100	Turboprop	Veer off	Take off	Non-Fatal	Yes
Saturday, Feb 16, 2019	PK-LPS	Boeing 737-800 Passenger	Turbojet	Overrun	Landing	Non-Fatal	No
Monday, Apr 08, 2019	HI1038	BAE Systems Jetstream 41	Turboprop	Unknown	Landing	Non-Fatal	No
Tuesday, Apr 23, 2019	AP-EDA	Airbus A320 Passenger	Turbojet	Overrun	Landing	Non-Fatal	No
Friday, May 03, 2019	N732MA	Boeing 737-800 Passenger	Turbojet	Overrun	Landing	Non-Fatal	Yes
Wednesday, May 08, 2019	S2-AGQ	Bombardier DHC-8-400	Turboprop	Veer off	Landing	Non-Fatal	Yes
Thursday, Jun 27, 2019	YV2536	BAE Systems Jetstream 32	Turboprop	Veer off	Landing	Non-Fatal	No
Thursday, Jun 27, 2019	RA-47366	Antonov An-24	Turboprop	Veer off	Landing	Fatal	Yes
Monday, Jul 01, 2019	VT-SYK	Boeing 737-800 Passenger	Turbojet	Overrun	Landing	Non-Fatal	Yes
Friday, Jul 12, 2019	9N-AMM	ATR 72 Passenger	Turboprop	Veer off	Landing	Non-Fatal	No
Saturday, Jul 20, 2019	AP-BHP	ATR 42 Passenger	Turboprop	Overrun	Landing	Non-Fatal	Yes
Wednesday, Aug 07, 2019	HK-4540	BAE Systems Jetstream 32	Turboprop	Veer off	Landing	Non-Fatal	Yes, Not English
Friday, Oct11, 2019	5Y-IZO	Fokker 50 Passenger	Turboprop	Overrun	Take off	Non-Fatal	No
Thursday, Oct 17, 2019	N686PA	Saab 2000	Turboprop	Overrun	Landing	Fatal	Yes
Monday, Nov 11, 2019	N619AE	Embraer RJ145	Turbojet	Veer off	Landing	Non-Fatal	Yes
Thursday, Nov 21, 2019	TC-JGZ	Boeing 737-800 Passenger	Turbojet	Veer off	Landing	Non-Fatal	Yes
Tuesday, Dec 10, 2019	ET-AQC	Bombardier DHC-8-400	Turboprop	Overrun	Take off	Non-Fatal	No
Tuesday, Jan 07, 2020	TC-CCK	Boeing 737-800 Passenger	Turbojet	Veer off	Landing	Non-Fatal	Yes, Not English
Sunday, Jan 19, 2020	C-GWVH	Fairchild (Swearingen) SA26	Turboprop	Overrun	Landing	Non-Fatal	No
Monday, January 27, 2020	EP-CPZ	(Douglas) MD-83 Passenger	Turbojet	Overrun	Landing	Non-Fatal	Yes
Wednesday, Feb 05, 2020	TC-IZK	Boeing 737-800 Passenger	Turbojet	Overrun	Unknown	Fatal	No
Monday, February 24, 2020	C-GJVB	Fairchild (Swearingen) SA26 /	Turboprop	Veer off	Take off	Non-Fatal	Yes
Friday, August 07, 2020	VT-AXH	Boeing 737-800 Passenger	Turbojet	Overrun	Landing	Fatal	Yes