



MALDIVES CIVIL AVIATION AUTHORITY
Republic of Maldives

AIR SAFETY CIRCULAR
ASC 139 - 13

Safety Risk Assessments for Aerodromes

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1. Regulatory Compliance

- 1.1 This ASC shall be used as a guidance material.

2. Related Regulations

- 2.1 This Circular relates specifically to MCAR 139 and ASC 139-5.

3. Applicability

- 3.1 This ASC applies to all civil aerodromes open for public use in Maldives.

4. Purpose

- 4.1 This circular provides guidance to aerodrome operators on how a Safety Risk Assessment can be undertaken as part of the Aerodrome's SMS.

5. Overview

- 5.1 A certified aerodrome operator implements an SMS approved by the CAA that, as a minimum:
- a) identifies safety hazards;
 - b) ensures that remedial action necessary to maintain safety is implemented;
 - c) provides for continuous monitoring and regular assessment of the achieved safety; and
 - d) aims to make continuous improvement to the overall safety of the aerodrome.
- 5.2 This circular describes how a safety assessment can be undertaken as part of the aerodrome's SMS. By applying the methodology and procedures described in this circular, the aerodrome operator can demonstrate compliance with the minimum requirements described in 5.1.
- 5.3 This circular presents a general methodology to conduct safety assessments on an aerodrome. Additional tools and particularly appropriate checklists, used as a part of aerodrome operators compliance monitoring, can help identify hazards, assess safety risks and eliminate or mitigate those risks when necessary. The suitability of the mitigation proposed and the need for alternative measures, operational procedures or operating restrictions for the specific operations concerned should be comprehensively evaluated.
- 5.4 The CAA will validate the conclusion of the safety assessment, when appropriate, to ensure safety is not compromised.
- 5.5 Clause 8 describes procedures on the acceptance of a safety assessment.

- 5.6 Clause 9 specifies how to promulgate appropriate information for use by the various aerodrome stakeholders and particularly by the pilots and aircraft operators.
- 5.7 The safety assessment process addresses the impact of a safety concern, including a change or deviation, on the safety of operations at the aerodrome and takes into consideration the aerodrome's capacity and the efficiency of operations, as necessary.

6. Basic Considerations

- 6.1 A safety assessment is an element of the risk management process of an SMS that is used to assess safety concerns arising from, inter alia, deviations from standards and applicable regulations, identified changes at an aerodrome as prescribed in ASC 139-7 or when any other safety concerns arise.
- 6.2 When a safety concern, change or a deviation has an impact on several aerodrome stakeholders, consideration shall be given to the involvement of all stakeholders affected in the safety assessment process. In some cases, the stakeholders impacted by the change will need to conduct a separate safety assessment themselves in order to fulfil the requirements of their SMSs and coordinate with other relevant stakeholders. When a change has an impact on multiple stakeholders, a collaborative safety assessment should be conducted to ensure compatibility of the final solutions.
- 6.3 A safety assessment considers the impact of the safety concern on all relevant factors determined to be safety significant. The list below provides a number of items that may need to be considered when conducting a safety assessment. The items in this list are not exhaustive and in no particular order:
 - a) aerodrome layout, including runway configurations; runway length; taxiway, taxi lane and apron configurations; gates; jet bridges; visual aids; and the RFF services infrastructure and capabilities;
 - b) types of aircraft, and their dimensions and performance characteristics, intended to operate at the aerodrome;
 - c) traffic density and distribution;
 - d) aerodrome ground services;
 - e) air-ground communications and time parameters for voice and data link communications;
 - f) type and capabilities of surveillance systems and the availability of systems providing controller support and alert functions;
 - g) flight instrument procedures and related aerodrome equipment;
 - h) complex operational procedures, such as collaborative decision-making (CDM);
 - i) aerodrome technical installations, such as advanced surface movement guidance and control systems (A-SMGCS) or other air navigation aids;
 - j) obstacles or hazardous activities at or in the vicinity of the aerodrome;
 - k) planned construction or maintenance works at or in the vicinity of the aerodrome;

- l) any local or regional hazardous meteorological conditions (such as wind shear); and
 - m) airspace complexity, ATS route structure and classification of the airspace, which may change the pattern of operations or the capacity of the same airspace.
- 6.4 Subsequent to the completion of the safety assessment, the aerodrome operator is responsible for implementing and periodically monitoring the effectiveness of the identified mitigation measures.
- 6.5 CAA will review the safety assessment provided by the aerodrome operator and it is identified mitigation measures, operational procedures and operating restrictions and will conduct oversight of their application.

7. Safety Risk Assessment Process

7.1 Introduction

- 7.1.1 The primary objective of a safety assessment is to assess the impact of a safety concern such as a design change or deviation in operational procedures at an existing aerodrome.
- 7.1.2 Such a safety concern can often impact multiple stakeholders; therefore, safety assessments often need to be carried out in a cross-organizational manner, involving experts from all the involved stakeholders. Prior to the assessment, a preliminary identification of the required tasks and the organizations to be involved in the process is conducted.
- 7.1.3 A safety assessment is initially composed of four basic steps:
- a) definition of a safety concern and identification of the regulatory compliance;
 - b) hazard identification and analysis;
 - c) risk assessment and development of mitigation measures; and
 - d) development of an implementation plan for the mitigation measures and conclusion of the assessment.

Note 1.— A safety assessment process flow chart applicable for aerodrome operations is provided in Appendix A to this circular; a generic safety risk management process can be found in Doc 9859.

Note 2. — Certain safety assessments may involve other stakeholders such as ground handlers, aeroplane operators, air navigation service providers (ANSPs), flight procedure designers and providers of radio navigation signals, including signals from satellites.

7.2 Definition of a Safety Concern and Identification of the Regulatory Compliance

- 7.2.1 Any perceived safety concerns are to be described in detail, including timescales, projected phases, location, stakeholders involved or affected as well as their potential influence on specific processes, procedures, systems and operations.
- 7.2.2 The perceived safety concern is first analysed to determine whether it is retained or rejected. If rejected, the justification for rejecting the safety concern is to be provided and documented.
- 7.2.3 An initial evaluation of compliance with the appropriate provisions in the regulations applicable to the aerodrome is conducted and documented.
- 7.2.4 The corresponding areas of concern are identified before proceeding with the remaining steps of the safety assessment, with all relevant stakeholders.

Note. — It may be useful to review the historical background of some regulatory provisions to gain a better understanding of the safety objective of those provisions.

- 7.2.5 If a safety assessment was conducted previously for similar cases in the same context at an aerodrome where similar characteristics and procedures exist, the aerodrome operator may use some elements from that assessment as a basis for the assessment to be conducted. Nevertheless, as each assessment is specific to a particular safety concern at a given aerodrome the suitability for reusing specific elements of an existing assessment is to be carefully evaluated.

7.3 Hazard Identification

- 7.3.1 Hazards related to infrastructure, systems or operational procedures are initially identified using methods such as brain-storming sessions, expert opinions, industry knowledge, experience and operational judgement. The identification of hazards is conducted by considering:
- a) accident causal factors and critical events based on a simple causal analysis of available accident and incident databases;
 - b) events that may have occurred in similar circumstances or that are subsequent to the resolution of a similar safety concern; and
 - c) potential new hazards that may emerge during or after implementation of the planned changes.
- 7.3.2 Following the previous steps, all potential outcomes or consequences for each identified hazard are identified.
- 7.3.3 The appropriate safety objective for each type of hazard should be defined and detailed. This can be done through:
- a) reference to recognized standards and/or codes of practices;
 - b) reference to the safety performance of the existing system;
 - c) reference to the acceptance of a similar system elsewhere; and
 - d) application of explicit safety risk levels.
- 7.3.4 Safety objectives are specified in either quantitative terms (e.g. identification of a numerical probability) or qualitative terms (e.g. comparison with an existing situation). The selection of the safety objective is made according to the aerodrome operator's policy with respect to safety improvement and is justified for the specific hazard.

7.4 Risk Assessment and Development of Mitigation Measures

7.4.1 The level of risk of each identified potential consequence is estimated by conducting a risk assessment. This risk assessment will determine the severity of a consequence (effect on the safety of the considered operations) and the probability of the consequence occurring and will be based on experience as well as on any available data (e.g. accident database, occurrence reports).

7.4.2 Understanding the risks is the basis for the development of mitigation measures, operational procedures and operating restrictions that might be needed to ensure safe aerodrome operations.

7.4.3 The method for risk evaluation is strongly dependent on the nature of the hazards. The risk itself is evaluated by combining the two values for severity of its consequences and probability of occurrence.

Note. — A risk categorization tool in the form of a safety risk (index) assessment matrix is available in Doc 9859.

7.4.4 Once each hazard has been identified and analysed in terms of causes, and assessed for severity and probability of its occurrence, it must be ascertained that all associated risks are appropriately managed. An initial identification of existing mitigation measures must be conducted prior to the development of any additional measures.

7.4.5 All risks mitigation measures, whether currently being applied or still under development, are evaluated for the effectiveness of their risk management capabilities.

Note. — The exposure to a given risk (e.g. duration of a change, time before implementation of corrective actions, traffic density) is taken into account in order to decide on its acceptability.

7.4.6 In some cases, a quantitative approach may be possible, and numerical safety objectives can be used. In other instances such as changes to the operational environment or procedures, a qualitative analysis may be more relevant.

Note 1. — An example of a qualitative approach is the objective of providing at least the same protection as the one offered by the infrastructure corresponding to the appropriate reference code for a specific aeroplane.

Note 2. — Methodologies for risk management can be found in Appendix B to this chapter.

7.4.7 In some cases, the result of the risk assessment may be that the safety objectives will be met without any additional specific mitigation measures.

7.5 Development of an Implementation Plan and Conclusion of the Assessment

- 7.5.1 The last phase of the safety assessment process is the development of a plan for the implementation of the identified mitigation measures.
- 7.5.2 The implementation plan includes time frames, responsibilities for mitigation measures as well as control measures that may be defined and implemented to monitor the effectiveness of the mitigation measures.

8. Approval or Acceptance of a Safety Assessment

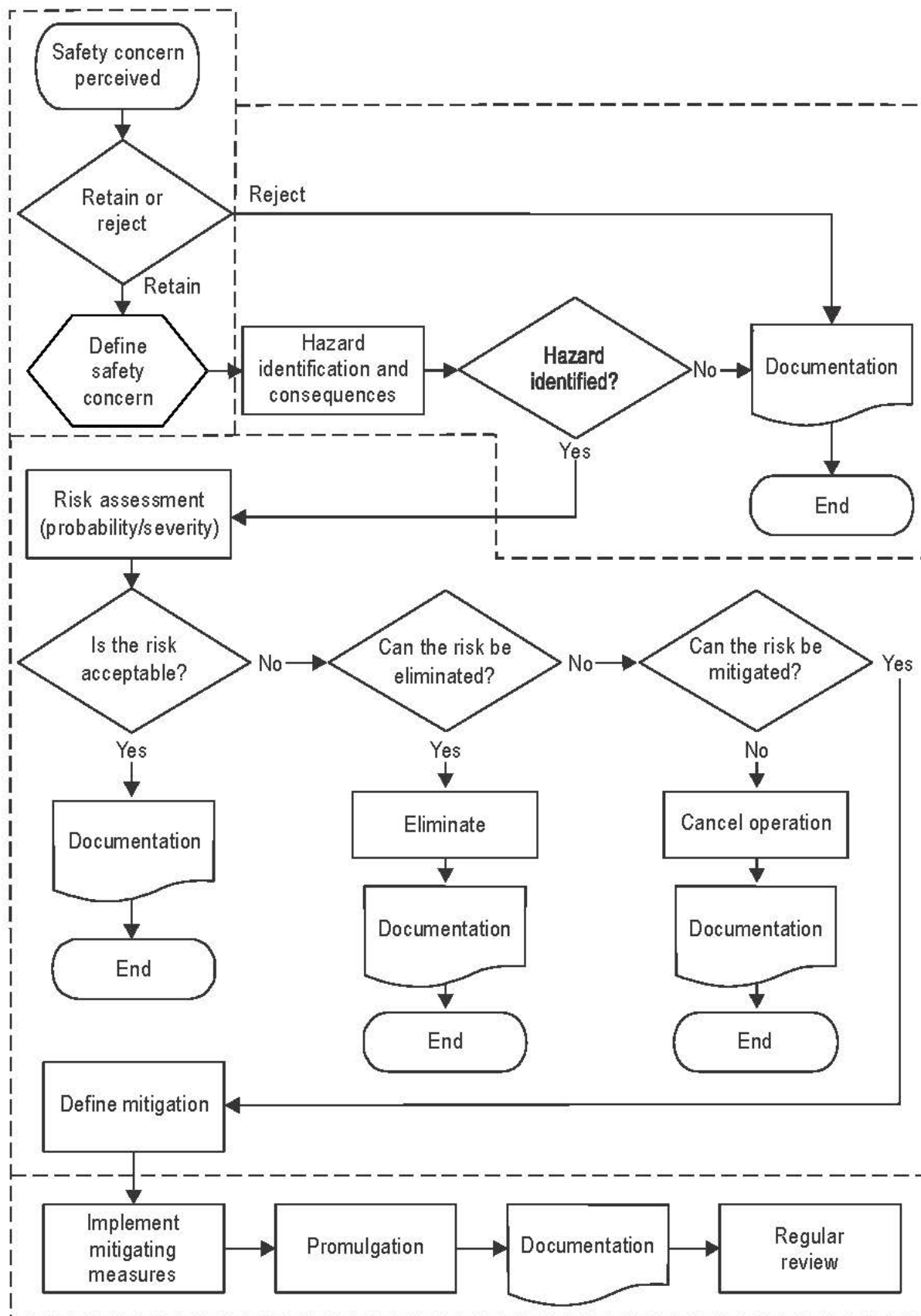
Note. — The safety assessment conducted by the aerodrome operator is a core SMS function. Management approval and implementation of the safety assessment, including future updates and maintenance, are the responsibility of the aerodrome operator.

- 8.1 As a part of change management process, some changes require prior approval of CAA, such cases required the submission of the specific safety assessment for acceptance. The changes which require prior approval is explained in ASC 139-7.
- 8.2 A safety risk assessment subject to acceptance by the CAA shall be submitted by the aerodrome operator prior to implementation.
- 8.3 The CAA analyses the safety assessment and verifies that:
 - a) appropriate coordination has been performed between the concerned stakeholders;
 - b) the risks have been properly identified and assessed, based on documented arguments (e.g. physical or Human Factors studies, analysis of previous accidents and incidents);
 - c) the proposed mitigation measures adequately address the risk; and
 - d) the time frames for planned implementation are acceptable.
- 8.4 On completion of the analysis of the safety assessment, CAA
 - a) either gives formal acceptance of the safety assessment to the aerodrome operator as required in 8.1; or
 - b) if some risks have been underestimated or have not been identified, coordinates with the aerodrome operator to reach an agreement on safety acceptance; or
 - c) if no agreement can be reached, rejects the proposal for possible resubmission by the aerodrome operator; or
 - d) may choose to impose conditional measures to ensure safety.

9. Promulgation of safety information

- 9.1 The aerodrome operator determines the most appropriate method for communicating safety information to the stakeholders and ensures that all safety-relevant conclusions of the safety assessment are adequately communicated.
- 9.2 In order to ensure adequate dissemination of information to interested parties, information that affects the current integrated aeronautical information package (IAIP) or other relevant safety information is:
 - a) promulgated in the relevant section of the IAIP or automatic terminal information service (ATIS); and
 - b) published in the relevant aerodrome information communications through appropriate means.

Appendix A — Safety Assessment Flow Chart



Appendix B — Risk Assessment Methodologies

1) Risk assessment method

- a) The risk assessment takes into account the probability of occurrence of a hazard and the severity of its consequences; the risk is evaluated by combining the two values for severity and probability of occurrence.
- b) Each identified hazard must be classified by probability of occurrence and severity of impact. This process of risk classification will allow the aerodrome to determine the level of risk posed by a particular hazard. The classification of probability and severity refers to potential events.
- c) The severity classification includes five classes ranging from “catastrophic” (class A) to “not significant” (class E). The examples in Table I-3-Att B-1, adapted from Doc 9859 with aerodrome-specific examples, serve as a guide to better understand the definition.
- d) The classification of the severity of an event should be based on a “credible case” but not on a “worst case” scenario. A credible case is expected to be possible under reasonable conditions (probable course of events). A worst case may be expected under extreme conditions and combinations of additional and improbable hazards. If worst cases are to be introduced implicitly, it is necessary to estimate appropriate low frequencies.

Table -1 Severity classification scheme with examples

Severity	Meaning	Value	Aerodrome Specific Example
Catastrophic	<ul style="list-style-type: none"> – Equipment destroyed – Multiple deaths 	A	<ul style="list-style-type: none"> – collision between aircraft and/or other object during take-off or landing
Hazardous	<ul style="list-style-type: none"> – A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely – Serious injury – Major equipment damage 	B	<ul style="list-style-type: none"> – runway incursion, significant potential for an accident, extreme action to avoid collision – attempted take-off or landing on a closed or engaged runway – take-off/landing incidents, such as undershooting or overrunning

Severity	Meaning	Value	Aerodrome Specific Example
Major	<ul style="list-style-type: none"> – A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency – Serious incident – Injury to persons 	C	<ul style="list-style-type: none"> – runway incursion, ample time, and distance (no potential for a collision) – collision with obstacle on apron/ parking position (hard collision) – person falling down from height – missed approach with ground contact of the wing ends during the touchdown – large fuel puddle near the aircraft while passengers are on-board
Minor	<ul style="list-style-type: none"> – Nuisance – Operating limitations – Use of emergency procedures – Minor incident 	D	<ul style="list-style-type: none"> – hard braking during landing or taxiing – damage due to jet blast (objects) – expendables are laying around the stands – collision between maintenance vehicles on service road – breakage of drawbar during pushback (Damage to the aircraft) – slight excess of maximum take-off weight without safety consequences – aircraft rolling into passenger bridge with no damage to the aircraft needing immediate repair – forklift that is tilting – complex taxiing instructions/procedures
Negligible	<ul style="list-style-type: none"> – Few consequences 	E	<ul style="list-style-type: none"> – slight increase in braking distance

Severity	Meaning	Value	Aerodrome Specific Example
			<ul style="list-style-type: none"> – temporary fencing collapsing because of strong winds – cart losing baggage

- e) The probability classification includes five classes ranging from “extremely improbable” (class 1) to “frequent” (class 5) as shown in Table I-3-Att B-2.
- f) The probability classes presented in Table I-3-Att B-2 are defined with quantitative limits. It is not the intention to assess frequencies quantitatively; the numerical value serves only to clarify the qualitative description and support a consistent expert judgement.

2) Probability classification scheme

Probability class		Meaning
5	Frequent	Likely to occur many times (has occurred frequently)
4	Reasonably probable	Likely to occur sometimes (has occurred infrequently)
3	Remote	Unlikely to occur (has occurred rarely)
2	Extremely remote	Very unlikely to occur (not known to have occurred)
1	Extremely improbable	Almost inconceivable that the event will occur

- 3) The classification refers to the probability of events per a period of time. This is reasoned through the following:
- a) many hazards at aerodromes are not directly related to aircraft movements; and
 - b) the assessment of hazards occurrence probabilities can be based on expert judgement without any calculations.
- 4) The aim of the matrix is to provide a means of obtaining a safety risk index. The index can be used to determine tolerability of the risk and to enable the prioritization of relevant actions in order to decide about risk acceptance.
- 5) Given that the prioritization is dependent on both probability and severity of the events, the prioritization criteria will be two-dimensional. Three main classes of hazard mitigation priority are defined in Table I-3-Att B-3:
- a) hazards with high priority — intolerable;
 - b) hazards with mean priority — tolerable; and
 - c) hazards with low priority — acceptable.

The risk assessment matrix has no fixed limits for tolerability but points to a floating assessment where risks are given risk priority for their risk contribution to aircraft operations. For this reason, the priority classes are intentionally not edged along the probability and severity classes in order to take into account the imprecise assessment.

Table I-3-Att B-3. Risk assessment matrix with prioritization classes

<i>Risk probability</i>		<i>Risk severity</i>				
		<i>Catastrophic A</i>	<i>Hazardous B</i>	<i>Major C</i>	<i>Minor D</i>	<i>Negligible E</i>
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely Improbable	1	1A	1B	1C	1D	1E

Appendix C — Checklist for Safety Risk Assessment

This appendix provides aerodrome operators as well as Aerodrome Inspectors with a suggested checklist for reviewing of a safety risk assessment. An aerodrome operator may use this checklist as a guide during the process of safety risk assessment tailored to its individual situation.

CHECKLIST FOR SAFETY RISK ASSESSMENT	YES	NO	REMARKS
1. Consultation with stakeholders, senior management team and divisions/ departments affected;			
2. If the assessment result is in tolerable risk index, the assessment is approved by a senior executive of the organization as stated in the SMS Manual.			
3. The risks have been properly identified and assessed, based on documented arguments (e.g., physical or Human Factors studies, analysis of previous accidents and incidents);			
4. Proposed mitigation measures adequately address the risk			
5. Time frames for planned implementation are acceptable.			

Appendix D — Generic Risk Probability, Severity, Risk Assessment Matrix and Risk Tolerability Sample

Note. — This appendix provides aerodrome operators with a suggested risk probability & severity and risk assessment matrix to be included in an aeronautical study. Aerodrome operators may use this as a guide for developing their own risk probability & severity and risk assessment matrix tailored to his individual situation.

Risk Probability

Probability of Occurrence		
Likelihood	Meaning	Value
Frequent	Likely to occur many times (has occurred frequently)	5
Occasional	Likely to occur sometimes (has occurred infrequently)	4
Remote	Unlikely to occur, but possible (has occurred rarely)	3
Improbable	Very unlikely to occur (not known to have occurred)	2
Extremely Improbable	Almost inconceivable that the event will occur	1

Risk Severity

Severity of Occurrence			
Likelihood	Meaning	Value	Examples
Catastrophic	— Equipment destroyed — Multiple deaths	A	
Hazardous	— A large reduction in safety margins, physical distress, or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely — Serious injury — Major equipment damage	B	
Major	— A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency — Serious incident — Injury to persons	C	
Minor	— Nuisance — Operating limitations — Use of emergency procedures — Minor incident	D	
Negligible	— Few consequences	E	

Risk Assessment Matrix

			Risk Severity				
			Catastrophic	Hazardous	Major	Minor	Negligible
			A	B	C	D	E
Risk Probability	Frequent	5	5A	5B	5C	5D	5E
	Occasional	4	4A	4B	4C	4D	4E
	Remote	3	3A	3B	3C	3D	3E
	Improbable	2	2A	2B	2C	2D	2E
	Extremely Improbable	1	1A	1B	1C	1D	1E

Risk Tolerability

RISK INDEX	TOLERABILITY	SUGGESTED CRITERIA
3A,4A,4B,5A,5B,5C	INTOLERABLE	Unacceptable under the existing circumstance.
1A,2A,2B,2C,3B,3D,4C,4D,4E,5D,5E	TOLERABLE	Acceptable based on risk mitigation. It may require management decision.
1B,1C,1D,1E,2D,2E	ACCEPTABLE	Acceptable as it is. No risk mitigation required

Attachment E — Risk Register

The results of the assessment of the potential adverse consequences or outcome of each hazard may be recorded by the organisation in a risk register, an example of which is provided below.

ID	ORIGINATOR	SOURCE	LOCATION(ICAO) INDICATOR	DATE ADDED TO Risk register	FUNCTIONAL AREA	NEGATIVE SAFETY IMPACT AND REASON	EXISTNG CONTROL

Hazard		Incident Sequence Description	Existing Controls	Outcome (Pre- Mitigation)			Additional Mitigation required	Outcome (Post- Mitigation)			Actions and Owners	Monitoring and Review Requirements
No.	Description			S	L	R		S	L	R		

KEY: S = Severity; L = Likelihood; R = Risk