CIVIL AVIATION GUIDANCE MATERIAL – 1404

# SAFETY ASSESSMENTS FOR AERODROMES

CIVIL AVIATION AUTHORITY OF MALAYSIA

**ISSUE 01**
REVISION 00 – 17TH DECEMBER 2021

**INTENTIONALLY LEFT BLANK**

# Introduction

This Civil Aviation Guidance Material 1404 (CAGM – 1404) is issued by the Civil Aviation Authority of Malaysia (CAAM) to provide guidance for the Safety Assessments, pursuant to Civil Aviation Directives 14 Vol. I – Standards for Aerodrome (CAD 14 Vol. I – Standards for Aerodrome).

Organisations may use these guidelines to ensure compliance with the respective provisions of the relevant CAD's issued. when the CAGMs issued by the CAAM are complied with, the related requirements of the CAD's may be deemed as being satisfied and further demonstration of compliance may not be required.

**(Captain Chester Voo Chee Soon)**
Chief Executive Officer
Civil Aviation Authority of Malaysia

## Civil Aviation Guidance Material components and Editorial practices

This Civil Aviation Guidance Material is made up of the following components and are defined as follows:

**Standards:** Usually preceded by words such as *"shall"* or *"must"*, are any specification for physical characteristics, configuration, performance, personnel or procedure, where uniform application is necessary for the safety or regularity of air navigation and to which Operators must conform. In the event of impossibility of compliance, notification to the CAAM is compulsory.

**Recommended Practices:** Usually preceded by the words such as "*should"* or "*may*", are any specification for physical characteristics, configuration, performance, personnel or procedure, where the uniform application is desirable in the interest of safety, regularity or efficiency of air navigation, and to which Operators will endeavour to conform.

**Appendices:** Material grouped separately for convenience, but forms part of the Standards and Recommended Practices stipulated by the CAAM.

**Definitions:** Terms used in the Standards and Recommended Practices which are not self-explanatory in that they do not have accepted dictionary meanings. A definition does not have an independent status but is an essential part of each Standard and Recommended Practice in which the term is used, since a change in the meaning of the term would affect the specification.

**Tables and Figures:** These add to or illustrate a Standard or Recommended Practice, and which are referred to therein, form part of the associated Standard or Recommended Practice and have the same status.

**Notes:** Included in the text, where appropriate, Notes give factual information or references bearing on the Standards or Recommended Practices in question but not constituting part of the Standards or Recommended Practices;

**Attachments:** Material supplementary to the Standards and Recommended Practices or included as a guide to their application.

It is to be noted that some Standards in this Civil Aviation Guidance Material incorporates, by reference, other specifications having the status of Recommended Practices. In such cases, the text of the Recommended Practice becomes part of the Standard.

The units of measurement used in this document are in accordance with the International System of Units (SI) as specified in CAD 5. Where CAD 5 permits the use of non-SI alternative units, these are shown in parentheses following the basic units. Where two sets of units are quoted it must not be assumed that the pairs of values are equal and interchangeable. It may, however, be inferred that an equivalent level of safety is achieved when either set of units is used exclusively.

Any reference to a portion of this document, which is identified by a number and/or title, includes all subdivisions of that portion.

Throughout this Civil Aviation Guidance Material, the use of the male gender should be understood to include male and female persons.

# Record of Revisions

Revisions to this CAGM shall be made by authorised personnel only. After inserting the revision, enter the required data in the revision sheet below. The *'Initials'* has to be signed off by the personnel responsible for the change.

| Rev No. | Revision Date | Revision Details | Initials |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**INTENTIONALLY LEFT BLANK**

# Summary of Changes

| ISS/REV no. | Item no. | Revision Details |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**INTENTIONALLY LEFT BLANK**

*Note 1. – The objective of a safety assessment, as part of the risk management process of an SMS, is described in 3.1.*

*Note 2. – Where alternative measures, operational procedures and operating restrictions have been developed arising from safety assessments, these should be reviewed periodically to assess their continued validity. The procedures in this CAGM do not substitute or circumvent the provisions contained in CAD 14 Vol. I. It is expected that infrastructure on an existing aerodrome or a new aerodrome will fully comply with the requirements in the Civil Aviation Directive (CAD).*

# 1 Introduction

1.1 A certified aerodrome operator implements an SMS acceptable to the Civil Aviation Authority Malaysia (CAAM) 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.

*Note 1. – CAD 19 — Safety Management contains the framework for the implementation and maintenance of an SMS by a certified aerodrome. CAD 19, Appendix 2, contains a description of the four components comprising the framework, i.e. safety policy and objectives, safety risk management, safety assurance and safety promotion.*

*Note 2. – Further guidance on SMS is available in Doc 9859, Safety Management Manual (SMM).*

1.2 This chapter describes how a safety assessment can be undertaken as part of the aerodrome's SMS. By applying the methodology and procedures described here, the aerodrome operator can demonstrate compliance with the minimum requirements described in 1.1.

# 2 Scope and Applicability

2.1 The following chapters present, inter alia, a general methodology to conduct safety assessments on an aerodrome. Additional tools and particularly appropriate checklists, such as those found in Chapter 2 of Doc 9981, 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. Chapter 4 details how the CAAM will validate the conclusion of the safety assessment, when appropriate, to ensure safety is not compromised. Chapter 5 describes procedures on the approval or acceptance of a safety assessment. Chapter 6 specifies how to promulgate appropriate information for use by the various aerodrome stakeholders and particularly by the pilots and aircraft operators.

2.2 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.

# 3 Basic Considerations

3.1 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 specified in Section 2.4.4 of Doc 9981, or when any other safety concerns arise.

*Note. – Changes on an aerodrome can include changes to procedures, equipment, infrastructures, safety works, special operations, regulations, organization, etc.*

3.2 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.

3.3 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, taxilane 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.

*Note – Chapter 4 of Doc 9981 outlines the methodology and procedures to assess the adequacy between aeroplane operations and aerodrome infrastructure and operations.*

3.4 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.

3.5 The CAAM reviews the safety assessment provided by the aerodrome operator and its identified mitigation measures, operational procedures and operating restrictions, as required in Chapter 4, and is responsible for the subsequent regulatory oversight of their application.

*Note. – A list of references to existing studies that may assist aerodrome operators in developing their safety assessments is available in Appendix B to Circular 305 — Operation of New Larger Aeroplanes at Existing Aerodromes. New and updated references will be included in other appropriate documents as they become available. However, it is to be noted that each study is specific to a particular deviation or change; hence, caution should be exercised in considering applicability to other situations and locations. Inclusion of these references does not imply ICAO endorsement or recognition of the outcome of the studies, which remains the ultimate responsibility of the CAAM in accordance with the Convention on International Civil Aviation.*

# 4 Safety Assessment Process

## 4.1 Introduction

*Note. – Guidance on continuous improvement of the SMS as part of the safety assurance component of the SMS framework is available in Doc 9859.*

4.1.1 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.

4.1.2 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.

4.1.3 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 Attachment A to this chapter; 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.*

## 4.2 Definition of a safety concern and identification of the regulatory compliance

4.2.1 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.

4.2.2 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.

4.2.3 An initial evaluation of compliance with the appropriate provisions in the regulations applicable to the aerodrome is conducted and documented.

4.2.4 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.*

4.2.5 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.

## 4.3 Hazard identification

4.3.1 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.

4.3.2 Following the previous steps, all potential outcomes or consequences for each identified hazard are identified.

*Note. – Further guidance on the definition of risk can be found in Doc 9859.*

4.3.3 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.

4.3.4 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.

## 4.4 Risk assessment and development of mitigation measures

4.4.1 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).

4.4.2 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.

4.4.3 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.*

4.4.4 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.

4.4.5 All risk 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.*

4.4.6 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. – Chapter 4 of Doc 9981 provides a list of typical challenges related to each part of the aerodrome infrastructure and the potential solutions proposed.*

4.4.7 CAAM has provide suitable guidance on risk assessment models for aerodrome operators.

*Note 1. – Risk assessment models are commonly built on the principle that there should be an inverse relationship between the severity of an incident and its probability.*

*Note 2. – Methodologies for risk management can be found in Attachment B to this CAGM.*

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

## 4.5 Development of an implementation plan and conclusion of the assessment

4.5.1 The last phase of the safety assessment process is the development of a plan for the implementation of the identified mitigation measures.

4.5.2 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.

# 5 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. The CAAM may, for specific reasons, require the submission of the specific safety assessment for approval/acceptance.*

5.1 The CAAM establishes the type of safety assessments that are subject to approval or acceptance and determines the process used for that approval/acceptance.

5.2 Where required in 5.1, a safety assessment subject to approval or acceptance by the CAAM shall be submitted by the aerodrome operator prior to implementation.

5.3 The CAAM 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.

*Note. – It is preferable to work with a team of the CAAM's operational experts in the areas considered in the safety assessment.*

5.4 On completion of the analysis of the safety assessment, the CAAM:

a) either gives formal approval or acceptance of the safety assessment to the aerodrome operator as required in 5.1; 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.

5.5 The CAAM should ensure that the mitigation or conditional measures are properly implemented and that they fulfil their purpose.

# 6 Promulgation of Safety Information

6.1 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.

6.2 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.

# 7 Attachment

## 7.1 Attachment A. Safety Assessment Flow Chart

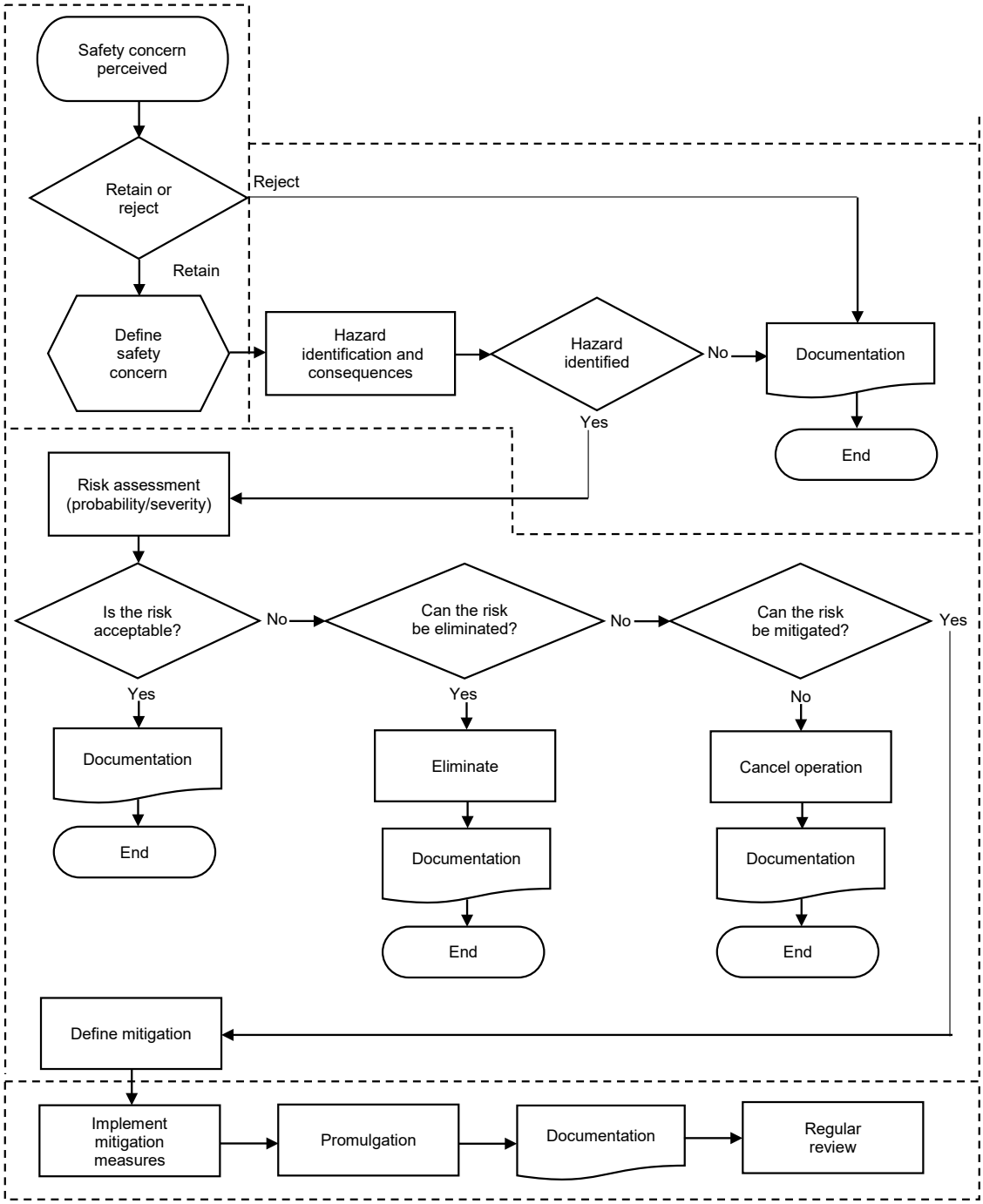


**Figure I-Att A-1. Flow chart to be used for the conduct of a safety assessment**

## 7.2 Attachment B. Safety Assessment Methodologies for Aerodromes

*Note. – Further guidance on safety risk probability, severity, tolerability and assessment matrix can be found in Doc 9859 — Safety Management Manual (SMM).*

1. Depending on the nature of the risk, three methodologies can be used to evaluate whether it is being appropriately managed:

   a) Method type “A”. For certain hazards, the risk assessment strongly depends on specific aeroplane and/or system performance. The risk level is dependent upon aeroplane/system performance (e.g. more accurate navigation capabilities), handling qualities and infrastructure characteristics. Risk assessment, then, can be based on aeroplane/system design and validation, certification, simulation results and accident/incident analysis;

   b) Method type “B”. For other hazards, risk assessment is not really linked with specific aeroplane and/or system performance but can be derived from existing performance measurements. Risk assessment, then, can be based on statistics (e.g. deviations) from existing operations or on accident analysis; development of generic quantitative risk models can be well adapted;

   c) Method type “C”. In this case, a “risk assessment study” is not needed. A simple logical argument may be sufficient to specify the infrastructure, system or procedure requirements, without waiting for additional material, e.g. certification results for newly announced aeroplanes or using statistics from existing aeroplane operations.

Risk assessment method

2. 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.
3. 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.
4. The severity classification includes five classes ranging from “catastrophic” (class A) to “not significant” (class E). The examples in Table I-Att B-1, adapted from Doc 9859 with aerodrome-specific examples, serve as a guide to better understand the definition.
5. 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 I-Att B-1. Severity classification scheme with examples**
(adapted from Doc 9859 with aerodrome-specific examples)

| Severity | Meaning | Value | Example |
|---|---|---|---|
| Catastrophic | – Equipment destroyed<br>– Multiple deaths | A | – collision between aircraft and/or other object during take-off or landing |
| 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<br>– Serious injury<br>– Major equipment damage | B | – runway incursion, significant potential for an accident, extreme action to avoid collision<br>– attempted take-off or landing on a closed or engaged runway<br>– take-off/landing incidents, such as undershooting or overrunning |
| 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<br>– Serious incident<br>– Injury to persons | C | – runway incursion, ample time and distance (no potential for a collision)<br>– collision with obstacle on apron/parking position (hard collision)<br>– person falling down from height<br>– missed approach with ground contact of the wing ends during the touchdown<br>– large fuel puddle near the aircraft while passengers are on-board |
| Minor | – Nuisance<br>– Operating limitations<br>– Use of emergency procedures<br>– Minor incident | D | – hard braking during landing or taxiing<br>– damage due to jet blast (objects)<br>– expendables are laying around the stands<br>– collision between maintenance vehicles on service road<br>– breakage of drawbar during pushback (damage to the aircraft)<br>– slight excess of maximum take-off weight without safety consequences<br>– aircraft rolling into passenger bridge with no damage to the aircraft needing immediate repair<br>– forklift that is tilting<br>– complex taxiing instructions/procedures |

| | | | |
|---|---|---|---|
| Negligible | – Few consequences | E | – slight increase in braking distance<br>– temporary fencing collapsing because of strong winds<br>– cart losing baggage |

6. The probability classification includes five classes ranging from “extremely improbable” (class 1) to “frequent” (class 5) as shown in Table I-Att B-2.

7. The probability classes presented in Table I-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.

**Table I-Att B-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 |

8. 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.

9. 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.

10. 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-Att B-3:

a) hazards with high priority — intolerable;

b) hazards with mean priority — tolerable; and

c) hazards with low priority — acceptable.

11. 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-Att B-3. Risk assessment matrix with prioritization classes**

| *Risk probability* | | *Risk severity* *Catastrophic A* | *Hazardous B* | *Major C* | *Minor D* | *Negligible E* |
|---|---|---|---|---|---|---|
| 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 |

**INTENTIONALLY LEFT BLANK**