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Foreword

This document has been compiled to enhance aviation safety in the aerodrome's environment. It is not intended to supersede or replace existing laws or regulations produced by the DGCA of the State of Kuwait. The distribution or publication of this document does not prejudice the State's ability to enforce existing National rules and regulations as stipulated in the KCASRs.

To the extent of any inconsistency between this document and National law, regulations (KCASRs), Safety Bulletins, or advisory publications, the National law, regulations (KCASRs), Safety Bulletins and advisory publications shall prevail.

Scope

This document is intended to provide guidance for aerodrome operators and other stakeholders involved in aeronautical studies.

Aviation Safety Director

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Aeronautical Studies

1. Purpose

An aeronautical study is conducted to assess the impact of deviations from the aerodrome standards specified in KCASR 14 Volume 1 to the Convention on International Civil Aviation, and the national regulations, to present alternative means of ensuring the safety of aircraft operations, to estimate the effectiveness of each alternative and to recommend procedures to compensate for the deviation.

2. Applicability

An aeronautical study may be carried out when aerodrome standards cannot be met. Such a study is most frequently undertaken during the planning of a new airport or during the certification of an existing aerodrome.

Note: *- Aeronautical studies may not be conducted in cases of deviations from the standards, if not specifically recommended in KCASR 14, Volume I.*

3. Definition

An aeronautical study is a study of an aeronautical problem to identify possible solutions and select a solution that is acceptable without degrading safety.

4. Technical Analysis

Technical analysis will provide justification for a deviation on the grounds that an equivalent level of safety can be attained by other means. It is generally applicable in situations where the cost of correcting a problem that violates a standard is excessive but where the unsafe effects of the problem can be overcome by some procedural means which offers both practical and reasonable solutions.

In conducting a technical analysis, inspectors will draw upon their practical experience and specialized knowledge. They may also consult other specialists in relevant areas. When considering alternative procedures in the deviation approval process, it is essential to bear in mind the safety objective of the aerodrome certification regulations and the applicable standards so that the intent of the regulations is not circumvented.

5. Approval of Deviations

In some instances, the only reasonable means of providing an equivalent level of safety is to adopt suitable procedures and to require, as a condition of certification, that cautionary advice be published in the appropriate AIS publications.

The determination to require caution will be primarily dependent on two considerations:

a) A pilot's need to be made aware of potentially hazardous conditions.

b) The responsibility of the CAA to publish deviations from standards that would otherwise be assumed under certificate status.

6. Safety Risk Management/ Aeronautical Study

The Airport operator shall develop and maintain a formal process that ensures that hazards associated with its aviation products or services are identified.

Hazard identification shall be based on a combination of reactive, proactive and predictive methods of safety data collection.

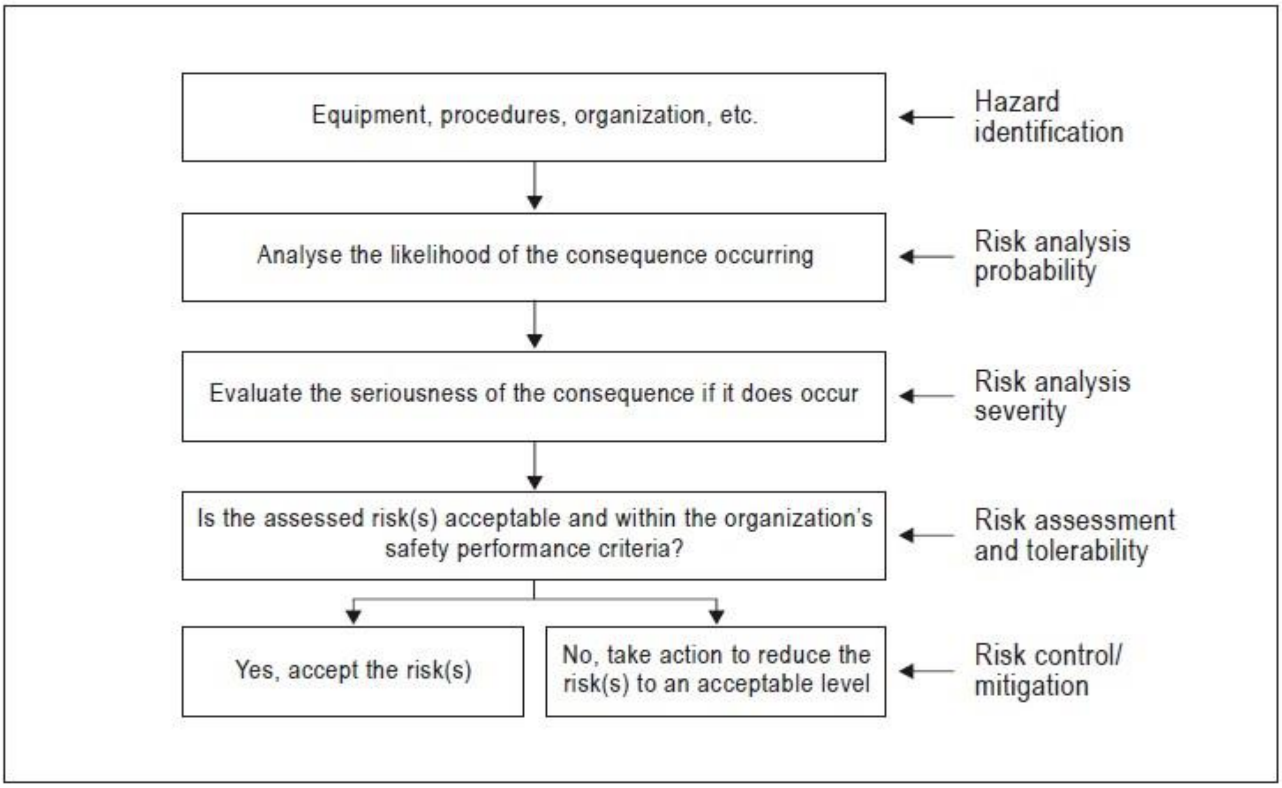

Figure 1. The safety risk management process

7. Implementation Strategy

The following may be considered while engaged in the hazard identification process:

- Design factors, including equipment and task design.
- Human performance limitations (e.g. physiological, psychological and cognitive).
- Procedures and operating practices, including their documentation and checklists and their validation.
- Under actual operating conditions.
- Communication factors, including media, terminology and language.
- Organizational factors, such as those related to the recruitment, training and retention of personnel.
- Compatibility of production and safety goals, the allocation of resources, operating pressures and the corporate safety culture.
- Factors related to the operational environment of the aviation system (e.g. ambient noise and vibration).
- Temperature, lighting and the availability of protective equipment and clothing.
- Regulatory oversight factors, including the applicability and enforceability of regulations.
- Certification of equipment, personnel and procedures.
- Performance monitoring systems that can detect practical drift or operational deviations.
- Human-machine interface factors.

Hazards may be identified through proactive and predictive methodologies or as a result of accident or incident investigations. There are a variety of data sources of hazard identification that may be both internal and external to the organization. Examples of the internal hazard identification data sources include:

- Normal operation monitoring schemes (e.g. flight data analysis for aircraft operators).
- Voluntary and mandatory reporting systems.
- Safety surveys.
- Safety audits.
- Feedback from training.
- Investigation and follow-up reports on accidents/incidents.
- Examples of external data sources for hazard identification include:
    a) Industry accident reports.
    b) State mandatory incident reporting systems.
    c) State voluntary incident reporting systems.
    d) State oversight audits.
    e) Information exchange systems.

The type of technologies used in the hazard identification process will depend upon the size and complexity of the Airport operator and its aviation activities. In all cases the service provider's hazard identification process is clearly described in the organization's SMS/safety documentation. The hazard identification process considers all possible hazards that may exist within the scope of the service provider's aviation activities including interfaces with other systems, both within and external to the organization. Once hazards are identified, their consequences (i.e. any specific events or outcomes) should be determined.

8. Safety risk assessment and mitigation

The Airport operator shall develop and maintain a process that ensures analysis, assessment and control of the safety risks associated with identified hazards.

Table 1. Example of a safety risk (index) assessment matrix

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

9. Safety Assessment Process

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.

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.

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.
- any local or regional hazardous meteorological conditions (such as wind shear).
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.

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.
d) Development of an implementation plan for the mitigation measures and conclusion of the assessment.

10. Definition of a safety concern and identification of the regulatory compliance

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.

The perceived safety concern is first analyzed to determine whether it is retained or rejected. If rejected, the justification for rejecting the safety concern is to be provided and documented.

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

The corresponding areas of concern are identified before proceeding with the remaining steps of the safety assessment, with all relevant stakeholders.

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.

11. Hazard identification

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.
c) Potential new hazards that may emerge during or after implementation of the planned changes.

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

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.
d) Application of explicit safety risk levels.

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.

12. Risk assessment and development of mitigation measures

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).

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.

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.

Once each hazard has been identified and analyzed 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.

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

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.

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

12.1 Development of an implementation plan and conclusion of the assessment

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

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.

13. Approval or Acceptance of a Safety Assessment

The DGCA / ASD 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.
d) The time frames for planned implementation are acceptable.

On completion of the analysis of the safety assessment The DGCA / ASD:

a) Either gives formal approval or acceptance of the safety assessment to the aerodrome operator as required.
b) If some risks have been underestimated or have not been identified, coordinates with the aerodrome operator to reach an agreement on safety acceptance.
c) If no agreement can be reached, rejects the proposal for possible resubmission by the aerodrome operator.
d) May choose to impose conditional measures to ensure safety.

14. Promulgation of Safety Information

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.

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).
b) Published in the relevant aerodrome information communications through appropriate means.

Appendix

Appendix 1. Flow chart to be used for the conduct of a safety assessment

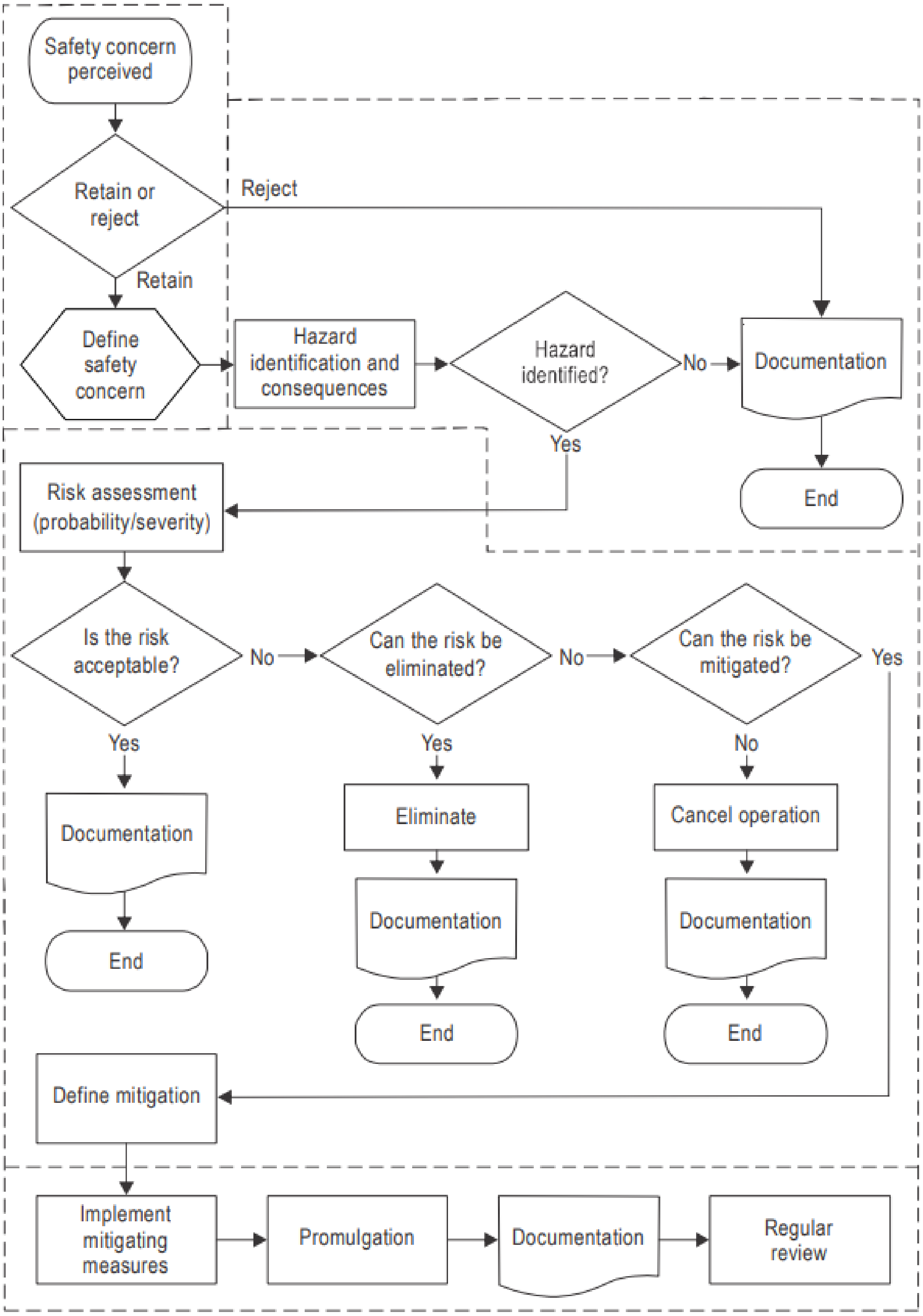

Figure 2. Safety Assessment Flowchart

Appendix 2. Severity classification scheme with examples

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 aircraft and/or system performance. The risk level is dependent upon aircraft/system performance (e.g. more accurate navigation capabilities), handling qualities and infrastructure characteristics. Risk assessment, then, can be based on aircraft/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 aircraft 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 aircrafts or using statistics from existing aircraft 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-3-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 2. Severity classification and examples

Severity	*Meaning*	*Value*	*Example*
Catastrophic	– Equipment destroyed – 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 – Serious injury – Major equipment damage	B	– 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
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	– 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	– Nuisance – Operating limitations – Use of emergency procedures – Minor incident	D	– 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

Severity	*Meaning*	*Value*	*Example*
			– forklift that is tilting – complex taxiing instructions/procedures
Negligible	– Few consequences	E	– slight increase in braking distance – temporary fencing collapsing because of strong winds – 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-3-Att B-2.

7. 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.

Table 3. 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-3-Att B-3:

a) hazards with high priority — intolerable;

b) hazards with medium 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 4. Risk assessment matrix with prioritization classes

				Risk severity		
Risk probability		*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

End