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Aeronautical Studies
&
Safety Risk Assessment

Preface

This Civil Aviation Publication (CAP) on criteria and associated guidelines on Aeronautical study mad risk assessment has been prepared by Aviation safety and security directorate (DASS) of Bahrain Civil Aviation Affairs (BCAA) to offer guidance to Aerodrome Operators on the conduct of Aeronautical studies and risk assessment

The guidance can be amended from time to time upon introduction of new methods and techniques through the International Civil Aviation Organization (ICAO).

Director, Aviation Safety and Security

15. JAN.2018

RECORD OF AMENDMENTS

Amendments				
Serial No.	Issue No.	Revision No.	Date	Description
01	01	0	30, Feb 2017	Initial Issue
02	01	01	15, Jan 2018	CAP. serial number revised (CAP- 63 revised as CAP.104)
03	01	01	18 July 2024	Change Logo (Cover)

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1. Intent

This Civil Aviation Publication (CAP) is to provides supplementary guidance to aerodrome operators on the conduct of aeronautical studies. It provides guidance on what is acceptable to the Aviation Safety and Security Directorate (ASSD) to demonstrate compliance with the requirements of the Civil Aviation Regulations CAR001

Section 5 of this publication(CAP) recommends and explains parts of a typical aeronautical study. By comprehensively addressing all the suggested parts, the aerodrome operator should be able to complete an aeronautical study to assess the viability of solutions to an aeronautical problem. An aeronautical problem may refer to an issue related to:

(a) operational regulations such as lack of procedures, insufficient maintenance programs and competency issue; or

(b) design regulations, such as terrain of object penetrating the Obstacle Limitation Surfaces (OLS), insufficient strip and Runway End Safety Area (RESA) (dimensions and/or quality), insufficient runway/taxiway separation and lack of or wrongly designed visual aids.

Appendix A to this CAP contains a suggested checklist with the requirements to be included in an aeronautical study. The checklist can be used by the aerodrome operator as a guide to ascertain that all the requirements have been taken into consideration and documented in the aeronautical study. However, not all the requirements found in Appendix A will be applicable to every aeronautical study conducted. The aerodrome operator should therefore examine each requirement carefully to determine what is applicable.

2. Applicability

This CAP applies to all aerodrome operators certified under Civil Aviation Regulation – CAR001 , aerodrome standard and Certificate Regulation(14 March 2016) under Chapter 2.3.2 d, Aerodrome manual requirement and C4.1.1 Hazards, Risks assessment supported by Aeronautical study.

3 Introduction

3.1 An aeronautical study is a study of an aeronautical problem to identify possible solutions, and to select a solution that is acceptable without degrading safety. A comprehensive aeronautical study allows both the aerodrome operator and the ASSD to be convinced that safety and regularity of operations of aircraft are not compromised in any way.

3.2 An aeronautical study is most frequently undertaken during the planning of a new airport or new airport facility, or during the certification of an existing aerodrome or subsequently, when the aerodrome operator applies for an exemption, as a result of development or a change in the aerodrome operational conditions from a specific Standard or Recommended Practice (SARP) contained in the CAR001

3.3 Aerodrome operators should consult their stakeholders, senior management and affected divisions/departments in their organizations prior to the conduct of an aeronautical study. These consultations would allow the proposed deviation to be viewed from different perspectives and the different parties involved would be aware of the proposed deviation. The aeronautical study should also be approved by the senior management of the organization before it is submitted to the ASSD for consideration of acceptance by Bahrain Civil Aviation Affairs (BCAA.)

3.4 Aerodrome operators should note that the ASSD official(s) , may choose to participate in the conduct of an aeronautical study as an observer where appropriate.

4 Objectives

4.1 The objectives of an aeronautical study are as follows:

a) To study the impact of deviations from the SARPs; and CAR001 .
b) To present alternative solutions to ensure the level of safety remains acceptable;
c) To estimate the effectiveness of each alternative; and
d) To recommend operating procedures/restrictions or other measures to compensate for the deviation.

5 A Typical Aeronautical Study

5.1 Parts of an Aeronautical Study

5.1.1 An aeronautical study submitted to the ASSD for determination of acceptability should comprise the following parts:

a) Aim of the Study;
b) Background;
c) Safety Assessment;
d) Recommendations;
e) Conclusion; and
f) Monitoring of the Deviation

5.2 Aim of the Study

5.2.1 The aim of the study should be explicitly stated. It should:

a) Address the safety concerns;
b) Identify safety measures to be put in place to ensure safe aircraft operations in an aerodrome; and
c) Make reference to the specific SARP in the CAR001 which the study is meant to address.

5.2.2 An example to illustrate this would be as follows:

"The aim of this aeronautical study is to address the operation of Code F aircraft in a Code 4E airport, <name of airport> and to put in place <list of safety measures> necessary to ensure safe operation of Code F aircraft in <name of airport> with reference made to <reference to specific SARP>... "

5.3 Background

5.3.1 Information on the current situation faced by the aerodrome operator, current procedures that have been put in place and other relevant details should be clearly stated and explained in this sub-section. Clear explanation should be provided, particularly on the following:

a) What is the current situation?
b) Where are the areas that will be affected by the proposed deviation?
c) When will the operator be able to comply with the specific standard if it is due to development of the aerodrome?
d) Why is there a need to review the current processes and procedures?
e) How will the proposed deviation affect the operation of aircraft at the aerodrome?

5.3.2 An example to illustrate this would be as follow:

"Currently, <name of airport> is Code 4E airport with some Code 4F ASCabilities. These Code 4F ASCabilities includes <list of the Code 4F ASCabilities>... <Name of airport> is required to handle Code F aircraft by

<proposed date> and the following <list of affected areas> will be affected. Development of the <affected areas> is proposed to commence on <proposed date> and to be completed by <proposed date>. By then, <name of airport> will be upgraded to a Code 4F airport.

Upgrading <name of airport> from Code 4E to Code 4F airport requires the reviewing <name of processes and procedures that need to be reviewed> to ensure safe aircraft operation.

In addition, during this development, operation of aircraft at <name of airport> will be affected in the following ways..."

5.4 Safety Assessment

5.4.1 Safety assessment is the identification, analysis and elimination, and/or mitigation of risks to an acceptable level of safety. This should be in accordance with the aerodrome Safety Management System (SMS) that is required to be put in place by the aerodrome operator - a key aerodrome certification requirement. A safety assessment usually consists of the following:

(a) Identification of hazards and consequences; and
(b) Risk management.

5.4.2 There is no standard methodology to conduct a safety assessment and it is up to the aerodrome operator to determine the appropriate methodology for each aeronautical study, depending on the size and complexity of the situation and the severity of the safety implications. However, the methodology adopted should be consistent with that established in the aerodrome operator's SMS.

Identification of hazards and consequences

5.4.3 Hazards and its consequences should be identified and recorded in a hazard log. Aerodrome operators have to exercise caution when identifying the hazards and their consequences as stating a hazard as its consequence would disguise the nature of the hazard and at the same time, interfere with identifying other important consequences.

5.4.4 An example would be *"Operation of Code F aircraft in a Code 4E airport"* and *"Wingtip collision in parking bays"*. The former is a hazard whereas the latter is one of its consequences. The associated risks and control/mitigation measures should also be recorded in the hazard log when information becomes available. This log should be constantly updated throughout the aeronautical study life-cycle.

5.4.5 Appendix - B of this ASC contains a sample hazard log. The aerodrome operator may use this to formulate its own hazard log to suit the aeronautical study.

Risk management

5.4.6 Risk is the assessment, expressed in terms of predicted probability and severity, of the consequence(s) of a hazard taking as reference the worst foreseeable situation. Risk management is the identification, analysis and elimination, and/or mitigation of such risk identified to an acceptable level.

5.4.7 The probability and severity of the consequence identified can be qualitative or quantitative. The aerodrome operator is free to use any method appropriate to the aeronautical study, but in accordance with the risk management methodology established in the aerodrome operator's SMS. Some examples to assess the probability and severity of a consequence occurring are provided in Appendix - C to this ASC.

5.4.8 A risk assessment matrix should be developed. This matrix provides a relationship between the probability and severity of a consequence of a hazard occurring. The risk indexes (combinations of the risk probability values and the risk severity values) should be placed in a risk tolerability table. Appendix - C also gives an example of risk assessment matrix and risk tolerability.

(a) **Acceptable -** the consequence is extremely improbable or not severe enough to be of concern;
(b) **Tolerable --** Mitigating measures should be taken to reduce the probability or the severity of the consequence. This may often require senior management decision; and
(c) **Unacceptable -** The consequence is unacceptable under the existing circumstances.

5.4.9 Risk control/mitigation measures should be developed to address the potential hazard or to reduce the risk probability or severity of the consequence when the risk is classified to be tolerable to a level acceptable by the aerodrome operator. There are three broad categories for risk control/mitigation and they are as follows:

(a) **Avoidance -** the operation or activity is cancelled as the risks exceed the benefits of continuing the operation or activity;

An example to illustrate this would be as follow:

"To prohibit Code F aircraft to land or take-off from <name of airport>, which is a Code 4E airport with some Code 4F capabilities."

(b) **Reduction --** The frequency of the operation or activity is reduced, or action is taken to reduce the magnitude of the consequences of the accepted risks; and
An example to illustrate this would be as follow:

"To reduce the number of Code F aircraft to land or take-off from <name of airport>."

(c) **Segregation of exposure -** Action is taken to isolate the effects of the consequences of the hazard or build-in redundancy to protect against it.
An example to illustrate this would be as follow:

"To ensure <name of airport> staff liaise with the Aeronautical Information Services (AIS) on the promulgation of aerodrome circulars with the necessary aerodrome information to <names of aircraft operators> and <names of other airports> <fixed period of time> stated in their new process and/or new procedures,"

5.5 Recommendations

To allow the aerodrome operator and ASSD to be convinced and assured that the proposed deviation will not pose a drop in the level of safety, the aerodrome operator should recommend operating procedures/restrictions or other measures that will address any safety concerns. In addition, the aerodrome operator should estimate the effectiveness (through trials, surveys, simulations etc.) of each recommendation listed so as to identify the best means to address the proposed deviation.

5.5.1 The aerodrome operator should also ensure that the affected parties are well informed of such changes. The notification procedure including process flow, time frame and different means of notification such as the Aeronautical Information Publication (AIP) and Notice to Airmen (NOTAM) should be included in the study.

5.5.2 An example to illustrate this would be as follow:

"The following are some of the operating procedures/restrictions or other measures as well as their measured effectiveness, which could be adopted to ensure safe aircraft operations in <name of airport>:

<Name of the operating procedures/restrictions or other measures and their corresponding measured effectiveness>

The notification procedure to the affected parties is as follow:

Description of the notification procedure including process flow, time frame and different means of notification>

Conclusion

5.6.1 The aerodrome operator, after taking into account all the necessary considerations listed above, should be able to summarize and conclude the results of the aeronautical study, and come to a decision on any safety measures that should be adopted. The aerodrome operator should also specify a date to put in place all the necessary safety measures and show how they maintain same level of safety with recommended safety measures mentioned in the Aeronautical study.

5.6.2 An example to illustrate this would be as follow:

"The results of this aeronautical study have concluded that <the proposed deviation> will indeed pose a drop in the level of safety. However, by adopting <type of the safety measures>, this drop in the level of safety can be safely addressed... These safety measures will be put in place on <proposed date> to address the proposed deviation. With these safety measures put in place, <to explain how to maintain the same level of safety>... "

5.7 Monitoring of the Deviation

5.7.1 After the completion of the aeronautical study, the aerodrome operator should monitor the status of the deviation and ensure that the implemented recommendations have been effectively carried out, and that the level of safety is not compromised at any time. This assessment is to allow feedback into the safety assessment process, if required.

5.7.2 An example would be as follow:

"<Name of the aerodrome operator> will monitor the deviation's status <fixed period of time> and ensure the safety measures has been effectively carried out and the level of safety is not compromised at any time. <Name of the aerodrome operator> will review the safety assessment process, if required..."

5.7.3 For temporary deviations, the aerodrome operator should also notify ASSD after the deviation has been corrected.

6 Submission of Aeronautical Study to ASSD

6.1 The aerodrome operator should note that the guidance provided in this CAP and use the suggested checklist provided in Appendix - A to ensure that any aeronautical study submitted to ASSD for consideration of acceptance is thoroughly conducted and documented.

6.2 The Aerodrome operator is responsible for implementing and periodically monitoring the effectiveness of the identified the effectiveness and validity of The identified mitigation measures or whether the cause can be removed.

6.3 And such actions mentioned in the sec. 6.2 shall be brought to the notice of BCAA for review and approval prior to any changes .

7 Reference

Civil Aviation Regulation-CAR001 -14.03.16
ICAO Annex 14, Volume I – Aerodrome Design and Operations;
ICAO Doc 9774 - Manual on Certification of Aerodromes; and
ICAO Doc 9859 -- Safety Management Manual

Appendix – A: Checklist for Aeronautical Study

NOTE: The purpose of this Appendix - A is to provide aerodrome operators with a suggested checklist for reviewing of an aeronautical study. Aerodrome operators may use this checklist as a guide for developing an aeronautical study tailored to his individual situation.

The suggested checklist for reviewing of an aeronautical study is as shown below:

Checklist for Aeronautical Study	Yes	No	Remarks
1. Aim of the study including (a) Address safety concerns, (b) Identify safety measures, and (c) Make reference to Specific SARP in CAR - 14, PART 1;	❑	❑	
2. Consultation with stakeholders, senior management team and divisions/ departments affected;	❑	❑	
3. The study is approved by a senior executive of the organization;	❑	❑	
4. Background Information on the current situation;	❑	❑	
5. Proposed date for complying with the SARPs, if the deviation is due to development of the aerodrome;	❑	❑	
6. Safety assessment including (a) identification of hazards and consequences and (b) risk management;	❑	❑	
7. The safety assessment used in the study (E.g. hazard log, risk probability and severity, risk assessment matrix, risk tolerability and risk control/mitigation);	❑	❑	
8. Recommendations (including operating procedures/ restrictions or other measures to address safety concern) of the aeronautical study and how the proposed deviation will not pose a drop in the level of safety;	❑	❑	
9. Estimation of the effectiveness of each recommendation listed in the aeronautical study;	❑	❑	
10. Notification procedure including process flow, time frame and the publication used to promulgate the deviation;	❑	❑	
11. Conclusion of the study;	❑	❑	
12. Monitoring of the deviation; and	❑	❑	
13. Notification to ASSD once the temporary deviation has been corrected.	❑	❑	

Appendix – B: Hazard log

Note: The purpose of this Appendix – B is to provide aerodrome operations with a suggested hazard log for safety assessment of an aeronautical study. Aerodrome operators may use this log as a guide to formulate his own log. This log should be constantly updated throughout the aeronautical study life cycle.

A sample hazard log for safety assessment of an aeronautical study is as shown below:

S. Nº	Type of operation or activity	Generic hazard	Specific components of the hazard	Hazard-related consequences	Existing defenses to control safety risk(s) and safety risk index	Further action to reduce safety risk(s) and resulting safety risk index
1	*Aircraft operation*	*Operation of Code 4F aircraft in <name of airport>. Code F aircraft using runway for landing and takeoff…..*		• *Wing tip collision at <parking bay numbers>.* • *Loss of control of aircraft during pushback/towing operations.*	• *Use of wing walkers;* • *Aircraft to taxi at <speed value>.* • *Training of staff for pushback/towing operations;* • *Restrictions on other aircraft movements within <parking bay number>* *Safety risk index: 3C* *Safety risk tolerability: Tolerable*	• *Conduct trials to study the effectiveness of the implementation.* • *Resulting risk index: 2E* *Safety risk index: 2D* *Safety risk tolerability: Acceptable*

Appendix – C: Risk Probability & Severity, Risk Assessment Matrix and Risk Tolerability

NOTE: The purpose of this Appendix - C is to provide aerodrome operators with a suggested risk probability and 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 and severity and risk assessment matrix tailored to his individual situation.

Risk Probability

Probability of Occurrence		
Qualitative Definition	***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**

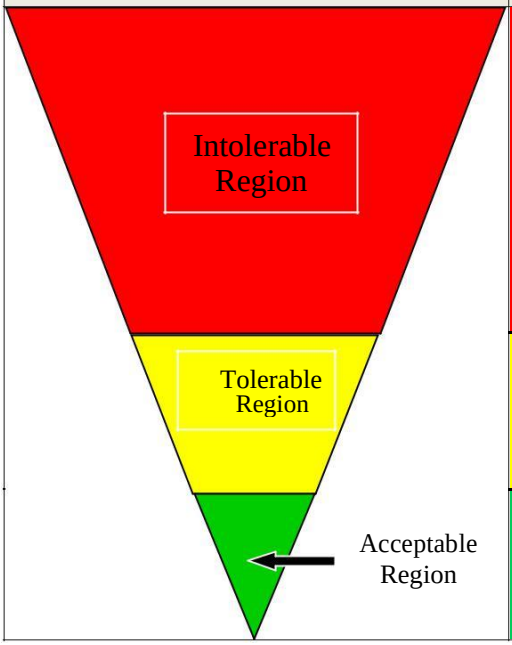
Risk Severity

Severity of occurrence		
Aviation Definition	***Meaning***	***Value***
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 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	— Little consequences	**E**

Risk 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

Risk Tolerability

Suggested Criteria	Assessment Risk Index	Suggested Criteria [Acceptability/Action Required]
	**5A, 5B, 5C,** **4A, 4B,** **3A**	Unacceptable under the existing circumstances. [Do not permit any operation until sufficient control measures have been implemented to reduce risk to an acceptable level.]
	5D, 5E, **4C, 4D, 4E,** **3B, 3C, 3D** **2A, 2B, 2C**	Acceptable based on risk mitigation. It may require management decision.
	3E, **2D, 2E,** **1A, 1B, 1C, 1D, 1E**	Acceptable