Aerodrome Safety Publication

Civil Aviation Authority of Singapore

Number: ASP 08/2017 **Issued: 5 April 2017**

AERONAUTICAL STUDY AND SAFETY ASSESSMENT

CONTENTS

Aerodrome Safety Publications are published by the CAAS for purposes of promulgating supplementary guidance materials to the Standards and Recommended Practices (SARPs) in the Manual of Aerodrome Standards. The publications are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with SARPs. Aerodrome Safety Publications may explain certain regulatory requirements by providing interpretive and explanatory materials.

1 Purpose

1.1 The purpose of this Aerodrome Safety Publication (ASP) is to provide supplementary guidance to aerodrome operators and applicants applying for an aerodrome certificate on the conduct of aeronautical studies. It provides guidance on what is acceptable to the Aerodrome and ANS Regulation Division (AAR) to demonstrate compliance with regulatory requirements in Section 2.1.4 of the Manual of Aerodrome Standards (MOAS).

1.2 Paragraph 5 of this ASP 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.

1.3 Appendix A to this ASP 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 of the requirements have been taken into consideration and documented in the aeronautical study. However, not all the requirements found in the 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

2.1 This ASP applies to all aerodrome operators certified under paragraph 67 of the Singapore Air Navigation Order (ANO) and applicants applying for an aerodrome certificate.

3 Cancellation

3.1 This ASP supersedes ASP 01/2009.

4 Effective Date

4.1 This ASP takes effect on 5 April 2017.

5 Introduction

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

5.2 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/applicant applies for an exemption, as a result of development or a change in the aerodrome operational conditions from a specific Standard or Recommended Practices (SARP) contained in the MOAS.

5.3 Aerodrome operators/applicants should consult their stakeholders, senior management and affected divisions/departments in their organisations prior to the conduct of an aeronautical study. These consultations 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 organisation before it is submitted to the AAR for consideration of acceptance.

5.4 Aerodrome operators/applicants should note that AAR may choose to participate in the conduct of an aeronautical study as an observer where appropriate.

6 Objectives

6.1 The objectives of an aeronautical study are as follows:

(a) To study the impact of deviations from the SARPs;
(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.

7 A Typical Aeronautical Study

7.1 Parts of an Aeronautical Study

7.1.1 An aeronautical study submitted to the AAR 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.

7.2 Aim of the Study

7.2.1 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 MOAS which the study is meant to address.

7.2.2 An example to illustrate this would be as follow:

"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>…"

7.3 Background

7.3.1 Information on the current situation faced by the aerodrome operator/applicant, 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 applicant 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?

7.3.2 An example to illustrate this would be as follows:

"Currently, <name of airport> is Code 4E airport with some Code 4F capabilities. These Code 4F capabilities includes <list of the Code 4F capabilities>... <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…"

7.4 Safety Assessment

7.4.1 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/ applicant – a key aerodrome certification requirement. A safety assessment usually consists of the following:

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

7.4.2 There is no standard methodology to conduct a safety assessment and it is up to the aerodrome operator/applicant 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/applicant's SMS.

<u>Identification of hazards and consequences</u>

7.4.3 Hazards and its consequences should be identified and recorded in a hazard log. Aerodrome operators/applicants 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.

7.4.4 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.

7.4.5 Appendix B of this ASP contains a sample hazard log. The aerodrome operator/applicant may use this to formulate its own hazard log to suit the aeronautical study.

Risk management

7.4.6 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.

7.4.7 The probability and severity of the consequence identified can be qualitative or quantitative. The aerodrome operator/applicant 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/applicant's SMS. Some examples to assess the probability and severity of a consequence occurring are provided in the Appendix C of this ASP.

7.4.8 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 tolerable table. Appendix C also gives an example of risk assessment matrix and risk tolerability.

(a) **Intolerable** – Unacceptable under the existing circumstances.

(b) **Tolerable** – Acceptable based on risk mitigation. It may require management decision**.**

(c) **Acceptable** – Acceptable as is. No risk mitigation required.

7.4.9 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."

7.5 Recommendations

7.5.1 To allow the aerodrome operator/applicant and AAR to be convinced and assured that the proposed deviation will not pose a drop in the level of safety, the aerodrome operator/applicant should recommend operating procedures/restrictions or other measures that will address any safety concerns. In addition, the aerodrome operator/applicant 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.

7.5.2 The aerodrome operator/applicant 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 the Aeronautical Information Publication (AIP) and Notice to Airmen (NOTAM) should be included in the study.

7.5.3 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>

7.6 Conclusion

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

7.6.2 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>..."

7.7 Monitoring of the Deviation

7.7.1 After the completion of the aeronautical study, the aerodrome operator/applicant 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.

7.7.2 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…"

7.7.3 For temporary deviations, the aerodrome operator/applicant should also notify AAR after the deviation has been corrected.

8 Submission of Aeronautical Study to AAR

8.1 The aerodrome operator/applicant should note the guidance provided in this ASP and use the suggested checklist provided in Appendix A to ensure that any aeronautical study submitted to AAR for consideration of acceptance is thoroughly conducted and documented.

9 Reference

Singapore Air Navigation Order (ANO);
Manual of Aerodrome Standards (MOAS);
ICAO Annex 14, Volume I;
Doc 9774 – Manual on Certification of Aerodromes;
Doc 9859 – Safety Management Manual; and
Doc 9981 – PANS-Aerodromes

10 Queries

If there are any queries with regard to this Aerodrome Safety Publication, please address them to:

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Checklist for Aeronautical Study

NOTE: Appendix A provides aerodrome operators with a suggested checklist for reviewing of an aeronautical study. An aerodrome operator may use this checklist as a guide for developing an aeronautical study tailored to its 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 MOAS;	☐	☐	
2. Consultation with stakeholders, senior management team and divisions/departments affected;	☐	☐	
3. The study is approved by a senior executive of the organisation;	☐	☐	
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 AAR once the temporary deviation has been corrected.	☐	☐	

Hazard Log

NOTE: Appendix B provides aerodrome operators 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/N	Type of operation or activity	Hazard and Description	Consequences Identified	Risk Index	Risk Tolerability	Risk Control/Mitigation	Residual Risk Index	Residual Risk Tolerability	Action, if any to further reduce risk(s) and the resulting risk index and the residual risk tolerability
1	Aircraft operation	Operation of Code 4F aircraft in <*name of airport*>. Code F aircraft using runway for landing and take-off…	• Wing tip collision at <*parking bay numbers*>. • Loss of control of aircraft during pushback / towing operations	3C	Tolerable	• 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*>.	2C	Tolerable	• Conduct trials to study the effectiveness of the implementation. • Resulting risk index : 1C • Residual risk tolerability : Acceptable

Risk Probability & Severity, Risk Assessment Matrix and Risk Tolerability

NOTE: Appendix C 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		
Severity	**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 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 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

Risk Index	Tolerability	Suggested Criteria
3A, 4A, 4B, 5A, 5B, 5C	Intolerable	Unacceptable under the existing circumstances.
1A, 2A, 2B, 2C, 3B, 3C, 3D, 4C, 4D, 4E, 5D, 5E	Tolerable	Acceptable based on risk mitigation. It may require management decision.
1B, 1C, 1D, 1E, 2D, 2E, 3E	Acceptable	Acceptable as is. No risk mitigation required.