SOUTH AFRICAN CIVIL AVIATION AUTHORITY

TECHNICAL GUIDANCE MATERIAL

Conducting Aeronautical Studies or Risk Assessment

Advisory Circular

SUBJECT: **GUIDANCE ON CONDUCTING AERONAUTICAL STUDIES OR RISK ASSESSMENT**

EFFECTIVE DATE: 31 MARCH 2017

REFERENCE:

i. ICAO Annex 14 – Volume I
ii. ICAO Doc 9774 – Manual on Certification of Aerodromes
iii. ICAO Doc 9734 – Safety Oversight Manual
iv. ICAO Doc 9859 – Safety Management Manual
v. Civil Aviation Regulation Part 11 – Subpart 4 Procedure for granting of Exemptions and Recognition of Alternative means of Compliance
vi. Civil Aviation Regulation Part 139 – Aerodromes and Heliports
vii. Civil Aviation Regulation Part 140 – Safety Management

LIST OF ABBREVIATIONS:

ABBREVIATION	DESCRIPTION
ATS	Air Traffic Services
DCA	Director of Civil Aviation
CAR	Civil Aviation Regulation
SACAR	South African Civil Aviation Regulation
GA	General Aviation
ICAO	International Civil Aviation Authority
SACAA	South African Civil Aviation Authority

1. PURPOSE

An aeronautical study is conducted to assess the impact of deviations from the aerodrome standards specified in Volume I to Annex 14 to the Convention on International Civil Aviation, SACAR 139 and Part 11, 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 or risk assessment may be carried out when aerodrome standards cannot be met as a result of development. Such a study is most frequently undertaken during the planning of a new airport or during the certification of an existing aerodrome.

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

4.1 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.

4.2 In conducting a technical analysis, inspectors will draw upon their practical experience and specialised knowledge or consult other specialists in relevant areas.

4.3 When considering alternative procedures in the deviation approval process, it is essential to bear in mind the safety objective of the CAR 139 and the applicable standards so that the intent of the regulations is not circumvented.

5. APPROVAL OF DEVIATIONS

5.1 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.

5.2 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; and
b) the responsibility of the DCA to publish deviations from standards that would otherwise be assumed under certificate status.

6. AERONAUTICAL STUDY

6.1 An aeronautical study is a tool used to review aerodrome and airspace processes and procedures to ensure that safety criteria in place are appropriate. The study can be undertaken in a variety of ways using various analytical methods appropriate to the aeronautical study requirements. An aeronautical study should include the use of:

a) current state review (baseline position)
b) quantifiable data analysis
c) stakeholder interviews
d) safety/risk matrix

6.2 In general an aeronautical study should be viewed as providing an overarching document giving a holistic view of an aerodrome's operational environment e.g. the macro perspective as compared to a safety case study which is a task specific document e.g. the micro view.

6.3 An aeronautical study may contain many elements; however risk assessment, risk mitigation and risk elimination are key components.

6.4 An aeronautical study can be undertaken at any time. It is constructed to consider all relevant factors, including traffic volume, mix and distribution, weather, aerodrome role, aerodrome and airspace configuration, surface activity and the efficiency requirements of operators using the service. The scope of studies can range from minor adjustments to aerodrome configuration, e.g. from the widening of a taxiway to a complete review of aerodrome airspace with the introduction of a new runway.

6.5 The scope of an aeronautical study usually reflects one of three situations:

a) the existing operation, e.g. the aerodrome, airspace or ATS (or sometimes just a particular part of the operation);
b) a change to the existing operation;
c) a new operation.

6.6 Where the aeronautical study is used to consider a change to existing operations or a new operation, it may not initially be possible to provide all the safety assessment and evidence required. An aeronautical study can identify and evaluate aerodrome service options, including service increases or decreases or the introduction or termination of services (such as the introduction of a rapid exit taxiway or removal of a grass runway).

6.7 The goal of risk management in an aeronautical study is to identify risks, and take appropriate action to minimise risk as much as is reasonably practicable. Decisions made in respect of risks must balance the technical aspects of risk with the social and moral considerations that often accompany such issues.

6.8 These decisions may have significant impact on an aerodrome's operation and for an effective outcome there should be a level of consensus as to their acceptability among the key stakeholders.

6.9 Aerodrome operators should also undertake aeronautical studies when the aerodrome operating environment changes. These changes are normally precipitated by a trigger event such as a change, or a proposed change in; airspace design, aircraft operations, aerodrome infrastructure or the provision of an air traffic service.

6.10 It is the aeronautical study process that determines the site-specific need for services, and identifies and recommends a course of action, or presents options for decision makers to act upon. In all cases the aeronautical study should document and demonstrate the site-specific need and rationale for the level of service, procedure design or operational requirements.

7. TRIGGER FACTORS

7.1 The aeronautical study is a tool for the aerodrome management to use as part of its operations and strategic planning and is an integral part of the aerodrome's Safety Management Systems.

7.2 One of the purposes of the aeronautical study is to determine levels of operational safety, service or procedures that should apply at a particular location. The decision to undertake this type of study may be triggered by any one or more of a wide range of factors.

7.3 These may include changes to:

7.3.1 the number of movements;
7.3.2 the peak traffic periods;
7.3.3 the ratio of IFR to VFR traffic;
7.3.4 the type of operations - scheduled, General Aviation (GA), training, etc.;
7.3.5 the types, and variety of types, of aircraft using the aerodrome (jet, turbo-prop, rotary, etc.);
7.3.6 aerodrome layout;
7.3.7 aerodrome management structure;
7.3.8 runway or taxiway and associated manoeuvring areas;
7.3.9 operations of a neighbouring aerodrome or adjacent airspace.

7.4 Feedback about any changes should be sought from aviation stakeholders including pilots, individuals and other representative groups as part of the study.

7.5 An aeronautical study may be initiated by an aerodrome operator or another interested party, such as an air traffic service provider or air operators.

8. THE CONCEPT OF RISK

8.1 Risk Management is a key area in an aeronautical study. ICAO Doc 9859: Safety Management Manual defines risk as following:

a) **Risk mitigation.** The process of incorporating defences or preventive controls to lower the severity and/or likelihood of a hazard's projected consequence.
b) **Safety risk.** The predicted probability and severity of the consequences or outcomes of a hazard.

9. SAFETY RISK

Safety risk management is also a key component of safety management system and aeronautical study. The term safety risk management is meant to differentiate this function from the management of financial risk, legal risk, economic risk and so forth. This section presents the fundamentals of safety risk and includes the following topics:

- Definition of Safety Risk;
- Safety Risk Probability;
- Safety Risk Severity;
- Safety Risk Tolerability; and
- Safety Risk Management.

9.1 Definition of Safety risk

Safety risk is the projected likelihood and severity of the consequence or outcome from an existing hazard or situation. While the outcome may be an accident, an "intermediate unsafe event/consequence" may be identified as "the most credible outcome".

9.2 Safety Risk Probability (How likely is it that it will occur?)

The process of controlling safety risks starts by assessing the probability that the consequences of hazards will materialize during aviation activities performed by the organization. Safety risk probability is defined as the likelihood or frequency that a safety consequence or outcome might occur. The determination of likelihood can be aided by questions such as:

9.2.1 Is there a history of occurrences similar to the one under consideration, or is this an isolated occurrence?
9.2.2 What other equipment or components of the same type might have similar defects?
9.2.3 How many personnel are following, or are subject to, the procedures in question?
9.2.4 What percentage of the time is the suspect equipment or the questionable procedure in use?
9.2.5 To what extent are there organizational, managerial or regulatory implications that might reflect larger threats to public safety?

Any factors underlying these questions will help in assessing the likelihood that a hazard may exist, taking into consideration all potentially valid scenarios. The determination of likelihood can then be used to assist in determining safety risk probability. The table below presents a typical safety risk probability table, in this case, a five-point table. The table includes five categories to denote the probability related to an unsafe event or condition, the description of each category, and an assignment of a value to each category.

LIKELIHOOD	MEANING	VALUE
Frequent	Likely to occur many times (has occurred frequently)	5
Occasional	Likely to occur sometimes (has occurred frequently)	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

Table 1: Safety risk probability

9.3 Safety Risk Severity

Once the probability assessment has been completed, the next step is to assess the safety risk severity, taking into account the potential consequences related to the hazard. Safety risk severity is defined as the extent of harm that might reasonably occur as a consequence or outcome of the identified hazard. The severity assessment can be based upon:

a) Fatalities/injury: How many lives may be lost (employees, passengers, bystanders and the general public)?

b) Damage: What is the likely extent of aircraft, property or equipment damage?

The severity assessment should consider all possible consequences related to an unsafe condition or object, taking into account the worst foreseeable situation. Table 2 presents a typical safety risk severity table. It includes five categories to denote the level of severity, the description of each category, and the assignment of a value to each category. As with the safety risk probability table, this table is an example only.

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 task 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

Table 2: Safety risk severity

9.1 Risk Assessment

Risks are the potential adverse consequences of a hazard, and are assessed in terms of their severity and probability. Thus, for each hazard resulting from the non-compliance, one can now describe the risk by placing the combination of severity and probability in the Risk assessment matrix table shown below. If the risk comes out as medium or above, risk reduction measures must be identified.

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

Table 3: Risk assessment matrix table

As can be seen from the risk classification matrix, risk reduction measures can aim towards either reducing the likelihood of an occurrence, or reducing the probability of an occurrence.

The first priority should always be to seek measures that will reduce the likelihood of an occurrence (i.e. accident prevention). When contemplating mitigating measures, it is always necessary to look to the intent of the requirement that is not (fully) complied with.

9.2 Risk mitigation strategies may include:

9.2.1 revision of the system design;
9.2.2 modification of operational procedures;
9.2.3 changes to staffing arrangements;
9.2.4 training of personnel to deal with the hazard;
9.2.5 development of emergency and/or contingency arrangements and plans;
9.2.6 ultimately, ceasing operation.

9.3 Safety Risk Tolerability

The safety risk probability and severity assessment process can be used to derive a safety risk index. The index created through the methodology described above consists of an alphanumeric designator, indicating the combined results of the probability and severity assessments. The respective severity/probability combinations are presented in the safety risk assessment matrix in table 3.

The third step in the process is to determine safety risk tolerability. First, it is necessary to obtain the indices in the safety risk assessment matrix. For example, consider a situation where a safety risk probability has been assessed as occasional (4), and safety risk severity has been assessed as hazardous (B). The composite of probability and severity (4B) is the safety risk index of the consequence.

The index obtained from the safety risk assessment matrix must then be exported to a safety risk tolerability matrix (Table 4) that describes the tolerability criteria for the particular organization. Using the example above, the criterion for safety risk assessed as 4B falls in the "unacceptable under the existing circumstances" category. In this case, the safety risk index of the consequence is unacceptable.

9.3.1 The organization must therefore:

a) take measures to reduce the organization's exposure to the particular risk, i.e. reduce the likelihood component of the risk index;

b) take measures to reduce the severity of consequences related to the hazard, i.e. reduce the severity component of the risk index; or

c) cancel the operation if mitigation is not possible.

TOLERABILITY DESCRIPTION	ASSESSED RISK INDEX	SUGGESTED CRITERIA
Intolerable	5A, 5B, 5C 4A, 4B, 3A	Unacceptable in the existing circumstances.
Tolerable		Acceptable based on risk mitigation. It may require Management decision.
Acceptable	3E, 2D, 2E, 1B, 1C, 1D, 1E	Acceptable

Table 4: Safety risk tolerability matrix

9.4 Example of an Aeronautical Study Methodology

A generic model of an Aeronautical Study methodology consists of initiation, preliminary analysis, risk estimation, risk evaluation, risk control and action or monitoring.

9.4.1 Step 1: Initiation

This step consists of defining the opportunity or problem and the associated risk issues; setting up the risk management team; and beginning to identify potential users who may be affected by any change.

9.4.2 Step 2: Preliminary Analysis

The second step consists of defining the basic dimensions of the risk problem and undertaking an initial identification, analysis and evaluation of potential risks. This preliminary evaluation will help determine:

a) whether a situation exists that requires immediate action;
b) whether the matter requires further study prior to any action being taken; or,
c) whether the analysis should be ended as the risk problem is determined not to be an issue.

9.4.3 Steps 3 and 4: Risk Estimation

These steps estimate the degree of risk. Step 3 estimates the severity of the consequences and step 4 estimates the probability of their occurrence.

9.4.4 Step 5: Risk Evaluation

The benefits and operational costs of the activity are integrated into the analysis and the risk is evaluated in terms of the safety implications of the activity and of the needs, issues, and concerns of affected users.

9.4.5 Step 6: Risk Control

This step identifies feasible risk controls and mitigations which will act to reduce either the probability of the event or the consequence of the event should it occur.

9.4.6 Step 7: Action or Monitoring

This step entails implementing the chosen risk control options, evaluating the effectiveness of the risk management decision process, and implementing an on-going monitoring program.

10 ACCEPTANCE BY THE SACAA

The Aeronautical Study and Risk assessment results need to be submitted to SACAA for the granting of exemptions.

DEVELOPED BY:		
	**MARY-ANN JOUBERT**	**31 MARCH 2017**
SIGNATURE OF MANAGER: AERODROME OPERATIONS	**NAME IN BLOCK LETTERS**	**DATE**
REVIEWED & VALIDATED BY:		
	**NELSON NKABITI**	**31 MARCH 2017**
SIGNATURE OF SENIOR MANAGER: AERODROME & FACILITIES	**NAME IN BLOCK LETTERS**	**DATE**
APPROVED BY:		
	**GAWIE BESTBIER**	**31 MARCH 2017**
SIGNATURE OF EXECUTIVE: AVIATION INFRASTRUCTURE	**NAME IN BLOCK LETTERS**	**DATE**

END