Ethiopian Civil Aviation Authority
Aerodrome Safety and Standards Directorate

Aeronautical Risk Assessment Guidance

November, 2012
Addis Ababa

This Aeronautical risk assessment guidance has been prepared by Aerodrome Safety and Standard Directorate to aid the Ethiopian Airport Enterprise on the conduct of the aeronautical risk assessment study where the aerodrome is unable to meet requirements and need to identify alternative means to achieve an equivalent level of safety.

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It is important to note that this Aeronautical risk assessment guidance is applicable to all Ethiopian Aerodromes.

The Director General of Ethiopian Civil Aviation Authority has here approving this guidance by the power given on proclamation No.616/2008 on November 30, 2012 to be implemented by EAE. The guidance can be amended from time to time upon introduction of new methods and techniques through the International Civil Aviation Organization (ICAO).

Regulatory Statement

Aeronautical Risk Assessment Guidance issued pursuant to Civil Aviation proclamation number 616/2008 by the Director General of the Authority and contain instructions, requirements and information pertaining Aerodrome.

This material provides guidance to aerodrome operators on the conduct of Aeronautical Study and Risk Assessment where the aerodrome is unable to meet requirements and need to identify alternative means to achieve an equivalent level of safety. These guidance shall be applied by all aerodromes operate in Ethiopia starting from the date of publication. Amendment of this guidance shall be made when necessary and will be provided to all concerned.

It is the responsibility of the operator to ensure this guidance is complied with, kept up to date and made available to all personnel responsible for Aerodrome Operations.

Any inquiry related to ECAA Aeronautical Risk Assessment Guidance should be addressed to:

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Ethiopian Civil Aviation Authority	**Advisory Circular** **ECAA-AC-AGA003** **November, 2012**

GUIDANCE MATERIAL ON CONDUCTING AERONAUTICAL STUDIES AND RISK ASSESSMENT

1. GENERAL

This Advisory Circular (AC) contains information about standards, practices and procedures that the Authority has found to be an Acceptable Means of Compliance (AMC) with the associated rule.

An AMC is not intended to be the only means of compliance with a rule, and consideration will be given to other methods of compliance that may be presented to the Authority. When new standards, practices or procedures are found to be acceptable, they will be added to the appropriate Advisory Circular.

2. INTRODUCTION

2.1 Draft Ethiopian Civil Aviation Regulations part 12 contains basic provisions on the use of Aeronautical Studies as a means to identify alternative means to achieve an equivalent level of safety by means other than full compliance with a specific requirement.

2.2 It is acknowledged that there could be some other cases where full compliance with requirements cannot be achieved, and for which a deviation from a regulatory requirement will have to be sought. A safety case based on the same principles as an Aeronautical Study should accompany any application for a deviation.

2.3 It is important to note that the preferred option must always be to seek compliance with the requirements. In order to achieve an equivalent level of safety by other means, one must usually establish mitigating measures that affect the efficiency and usability of the aerodrome.

3. Purpose

This Advisory Circular (AC) provides guidance to aerodrome operators on the conduct of Aeronautical Study and risk assessment where the aerodrome is unable to meet requirements and need to identify alternative means to achieve an equivalent level of safety. Although this guidance material relates to aerodromes, the principles contained in it may be applied more widely in circumstances where requirements cannot be met and an alternative means of compliance is proposed.

4. DEFINITION

ICAO Doc 9774 defines an aeronautical study as:
"a study of an aeronautical problem to identify possible solutions and select a solution that is acceptable without degrading safety.

5. RESPONSIBILITY OF CONDUCTING AERONAUTICAL STUDY

If the aerodrome cannot meet the requirements it needs to propose, and have accepted, an alternative means of compliance or a deviation from the requirement. Consequently, the burden of justifying an application by means of an Aeronautical Study rests with the aerodrome operator.

6. PARTICIPANTS IN THE AERONAUTICAL STUDY

Both aerodrome and flight operational expertise is needed. In some cases ATS and/or PANS - OPS expertise must be involved. Finally, depending on the complexity of the issue, specialists on risk analysis may have to be brought in to assess the degree of risk resulting from the aeronautical study and proposed deviances.

7. TRIGGER FACTORS

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 Quality Assurance and Safety Management Systems.

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.

These may include changes to:

- the number of movements
- the peak traffic periods
- the ratio of instrument flight rules (IFR) to Visual flight rules(VFR) traffic
- the type of operations - scheduled, General Aviation (GA), training, etc
- the types, and variety of types, of aircraft using the aerodrome
- aerodrome layout

- aerodrome management structure
- runway or taxiway and associated maneuvering areas
- operations of a neighboring aerodrome or adjacent airspace.

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

An aeronautical study may be initiated by the Director of Ethiopian Civil Aviation Authority, an aerodrome operator or another interested party. The ECAA can assist in identifying whether an aeronautical study is required and the appropriate methodology for the aeronautical study and in reviewing the aeronautical study.

8. AERONAUTICAL STUDY

An aeronautical study can be undertaken at anytime. 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.

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

1. the existing operation, e.g. the aerodrome, airspace or ATS (or sometimes just a particular part of the operation)
2. a change to the existing operation
3. a new operation.

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).

The objectives of an aeronautical Study are as follows

1. To study the impact of deviations from the Aerodrome standards;
2. To present alternative solutions & to ensure the level of safety remains acceptable;
3. To estimate the effectiveness of each alternative; and
4. To recommend operating procedures/restrictions or other measures to compensate the deviation.

9. STEPS OF AN AERONAUTICAL STUDY

An Aeronautical Study implies a systematic and documented approach to a problem. Thus it consists of certain steps, notably:

1. A description of problems and objectives.
2. Background

3. Selection of procedures, methods and data sources.
4. Identification of undesired events.
5. An analysis of causal factors, severity and likelihood.
6. Risk Assessment.
7. Estimating the effect of mitigating measures
8. Choice of mitigating measures
9. Presentation of results.
10. Recommendation
11. Conclusion
12. Monitoring of the Deviation

9.1 A description of problems and objectives

The first step of any risk analysis is to define the problem and the objective of the exercise. The problem will be to identify the safety implications of not complying (in full) with a certain requirement or requirements. The objective will be to identify suitable mitigating measures, which will mitigate these safety implications. Thus, it is important to understand which hazards and scenarios the requirement(s) in question are designed to protect against.

9.2 Background

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 subsection. Clear explanation should be provided, particularly on the following:

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

9.3 Procedures, methods and data sources

A main issue is whether the study shall follow a quantitative or qualitative approach. The answer will to a large extent dependent upon the data-sources available. A qualitative approach based on common sense and qualified expert opinion will probably, in many cases, yield results that are far better than nothing, and better than a quantitative approach based on a limited set of unrepresentative or unreliable data. Even if it is possible to carry out a quantitative approach, qualified expert opinion is necessary, particularly in the conduct of hazard identification and risk analysis.

9.4 Identification of hazards

Hazards are any situation or condition that has the potential to cause damage or harm. The basic question one must ask is: what can go wrong, when and where?

Examples of 'what' include, but are not limited to:

- Aircraft colliding with terrain, aircraft, vehicles or objects.
- Aircraft landing in front of the threshold, running off the far end of the runway or veering off the side of the runway.
- Aircraft colliding with, or ingesting wildlife or foreign objects debris

Example of 'where' include, but are not limited to:

- On the ground (Runway, taxiway, apron, strips, RESAs, or outside these areas)

Example of 'When' include, but not limited to:

- During flight (approach, landing, balked landing, take-off, climb-out)

The key is to identify hazards that the requirement in question is designed to protect against.

9.5 An analysis of causal factors, severity and probability

9.5.1 Causal factors

The basic questions are: why can it go wrong, what is the consequence if it does go wrong and how likely is it that it will go wrong?

Examples of 'why' include, but are not limited to:

- Lack of guidance (non-visual aids, lights, markings, signs, charts)
- Confusing guidance (non-visual aids, lights, markings, signs, and charts).
- Inaccurate obstacle surveys and obstacle publications
- Inaccurate aeronautical data
- Insufficient protected areas (strips and RESAs)
- Insufficient separation distances
- Insufficient surface widths
- Insufficient maintenance programmes

In some cases these factors can contribute to an accident. In other cases they can increase the consequences of an incident so that it becomes an accident.

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

This is a probability issue. How often is it likely to occur within a certain number of movements? The Table below also extracted from ICAO doc 9859 – Safety Management Manual gives the probability levels and their descriptions.

	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**

9.5.3 Safety Risk Severity

What are the (potential) consequences if it occurs?

The severity of the occurrence is better described by using the table below extracted from ICAO doc 9859 – Safety Management Manual

Severity of occurrence	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**

9.6 Risk Assessment

9.6.1 Risks are the potential adverse consequences of a hazard, and are assessed in terms of their severity and probability.

9.6.2 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 shown below. If the risk comes out as medium or above, risk reduction measures must be identified.

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

Region and Risk Index	Suggested Criteria
Intolerable region 5A, 5B, 5C, 4A, 4B, 3A	The consequence is unacceptable under the existing circumstances.
Tolerable region 5D, 5E, 4C, 4D, 4E, 3B, 3C, 2A, 2B, 2C	Mitigating measures should be taken to reduce the probability or the severity of the consequence. This may often require senior management decision.
Acceptable region 3D, 3E, 2D, 1A, 1B, 1C, 1D, 1E	The consequence is extremely improbable or not severe enough to be of concern.

9.6.3 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 severity of an occurrence. Some measures could conceivably do both.

9.6.4 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.

Examples of mitigating measures include, but are not limited to:

a) Publication in the AIP as a minimum. (This is an ICAO Annex 15 Standard and is also necessary in order that the airlines can take their precautions, as they are obliged to do according to ICAO Annex 6.)

b) Aerodrome operational procedures are in some cases relevant. One example is to restrict traffic on a parallel taxiway if runway/taxiway or taxiway/taxiway separation distance is insufficient.

c) Infrastructure and/or additional visual and/or non-visual aids.

d) Operational restrictions that might be necessary. These may include restrictions on all-weather operations, increased spacing between aircraft (in the air or on the ground).

e) Restrictions on aircraft operators that might be necessary, such as:

i) Operations restricted to operators/crew who can demonstrate special competence.
ii) Requirements that aircraft carry special equipment or certifications
iii) Requirements that operators set special wind limits

9.6.5 Mitigating measures usually means reduced usability for an aerodrome. Safety and usability is a balancing act.

9.7 Estimating the effect of mitigating measures

The mitigating measures should be fed back into the consideration listed earlier in order to evaluate their relevance and effectiveness in reducing risk.

9.8 Choice of mitigating measures

If one or more measures enable the risk to be sufficiently reduced, one can recommend a choice, bearing in mind that the preferred option should be accident prevention, and prepare the final report. Thus the final description should recommend mitigating actions and list the consequences and their probabilities when these are taken into account

9.9 Presentation of results

9.9.1 The work shall be documented in such a way that it is possible to see what has been done. The steps referred to above should be identifiable.

Other key issues:
a) What essential assumptions, presuppositions and simplifications have been made?

b) Any uncertainty about the results due to the choice of and availability of methods, procedures and data sources should be discussed.

9.9.2 The results of the study should emphasize which undesired event contributes the most to risk, and factors influencing these undesired events. Recommendations for measures to mitigate risk, their character and their estimated effect shall be stated.

9.10 Recommendation

To allow the aerodrome operator and ECAA 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.

The aerodrome operator should also ensure that the effected 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.

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 effected parties is as follow:

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

9.11 Conclusion

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 they maintain the same level of safety with the recommended safety measures mentioned in the aeronautical study.

An example to illustrate this would be as follow:

“The results of this aeronautical study have concluded that (name proposed deviation) will indeed pose a drop in the level of safety. However, by adopting (type of 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)…”

9.12 Monitoring of the Deviation

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.

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…”

For temporary deviations, the aerodrome operator should also notify to ECAA before the deviation corrected.

10. ACCEPTANCE BY THE REGULATOR

The right to accept or reject the results of the Aeronautical Study rests fully with the regulator. The aerodrome operator should note the guidance provided in this circular and use the suggested checklist provided in Appendix A to ensure that any aeronautical study submitted to ECAA for consideration of acceptance is thoroughly conducted and documented.

11. EXEMPTION

The regulatory Authority, where satisfied with the results of the aeronautical study, equivalent level of safety and mitigating measures provided, may offer an exemption to the compliance with the provision of the regulations

12. REFERENCE

4.1 Draft Ethiopian Civil Aviation Regulations
4.2 ICAO ANNEX 14 – Volume I
4.3 ICAO Doc 9774
4.4 ICAO Doc 9859

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 development an aeronautical study tailored to the airport individual situation.

The suggested checklist for reviewing of an aeronautical study is a show below:

CHECKLIST FOR AERONAUTICAL STUDY	Yes	No	Remarks
1. Aim of the study including Address safety concerns, identify safety measures, and make reference to specific SARP in MOIS;			
2. Consultation with stakeholders, senior management team and divisions/departments effected;			
3. The study is approved by a senior executive of the organization;			
4. Background information on the current situation;			
5. Safety assessment including (a) identification of hazards and consequences, and (b) risk management;			
6. The safety assessment used in the study (e.g. hazard log, risk probability and severity, risk assessment matrix, risk tolerability and risk control/mitigation);			
7. Recommendation (including operating procedures/restrictions or other measures to address safety concern) of the aeronautical study and how the proposed deviation will not pose in the level of safety;			
8. Estimation of the effectiveness of each recommendation listed in the aeronautical study;			
9. Notification procedure including process flow, time frame and the publication used to promulgate the deviation;			
10. Conclusion of the study;			
11. Monitoring of the deviation; and			
12. Notification to ECAA once the temporary deviation has been corrected.			

Appendix B – Hazard Log

Note: The purpose of this Appendix B is to provide aerodrome operator with a suggested hazard log safety assessment of an aeronautical study with example log. Aerodrome operators may use this log as a guide to formulate his how 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 a shown below:

S/N	Type of operation or activity	Hazard and Description	Consequence 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 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 number). - 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).	2D	Acceptable	- Conduct trials to study the effectiveness of the implementation. - Resulting risk index: 2E - Residual risk tolerability: Acceptable