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The Civil Aviation Authority of Thailand

Guidance Material on Aeronautical Study

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Approved by

Air Chief Marshal

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Manat Chavanaprayoon

Director General of the Civil Aviation Authority of Thailand

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Record of Amendments

Issue	Revision	Date	Amendment Summary
01	00	10-May-2019	First issue regarding the conduct of aeronautical study
02	00	3-Nov-2025	Administrative changes, new format and structure, cross-reference to CAAT Exemption Policy and Procedure, safety assessments, aeronautical concern arising from the introduction of an obstacle, and amended details and examples, e.g., overview, the aeronautical study contents, submission of aeronautical study to CAAT, aeronautical study applicability, hazard log, risk probability and severity table, risk assessment matrix and tolerability, and aeronautical study checklist

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0. Introduction

0.1 Background

- A. The Director General (DG) of The Civil Aviation Authority of Thailand (CAAT) is responsible for providing regulatory oversight of the persons and entities conducting air operations in Thailand, operating and/or maintaining Thailand registered aircraft, operating and/or maintaining aerodromes and heliports in Thailand, or providing an air navigation service in Thailand. As part of CAAT's regulatory oversight responsibility, the DG may issue, modify, suspend, or revoke certificates, licenses, authorizations, and/or approvals.
- B. The DG may also make decisions and/or take actions to ensure appropriate compliance with the Aerodrome Regulations of Thailand.
- C. The Guidance Material (GM) is published by CAAT. The GM is a means of circulating essential information of an administrative or technical nature to holders of CAAT License and Certificate.

0.2 Purpose

- A. The purpose of this Guidance Material is to provide supplementary guidance to aerodrome operators and applicants applying for an Aerodrome Establishment License and a Public Aerodrome Operating Certificate on the conduct of aeronautical study. It provides guidance on what is acceptable to CAAT to demonstrate compliance with Aerodrome Regulations.

0.3 Applicability

- A. This Guidance Material applies to all persons or entities operating aerodromes and/or heliports in Thailand and applicants applying for an Aerodrome Establishment License and a Public Aerodrome Operating Certificate.

0.4 Reference

- A. The Requirement of The Civil Aviation Authority of Thailand on Aerodrome Standards
- B. The Notification of the Civil Aviation Authority of Thailand Re.: Exemption Policy and Procedure
- C. ICAO Doc 9774 Manual on Certification of Aerodromes
- D. ICAO Doc 9859 Safety Management Manual (SMM)
- E. ICAO Doc 9981 Procedures for Air Navigation Services – Aerodromes (PANS-Aerodromes)
- F. CAA New Zealand Advisory Circular (AC) 139-15 Aeronautical Studies for Aerodrome Operators
- G. CAA Singapore Advisory Circular (AC) 139-5-2 Conduct of an Aeronautical Study
- H. CAA UK CAP 760 Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases

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1. General

1.1 Aeronautical Safety

- A. An aeronautical study is a study of an aeronautical safety concern or non-compliance to identify possible solutions and select a solution that is acceptable without any reduction in the acceptable level of safety.
- B. A comprehensive aeronautical study allows the aerodrome operator / applicant and the CAAT to ensure safety and to be assured that the regularity of operations of aircraft is not unnecessarily compromised in the event of a non-compliance. However, regularity of operations might be compromised in order to maintain and achieve the acceptable level of safety.
- C. The study can be undertaken in a variety of ways using different analytical methods and various safety management tools that are appropriate to each specific aeronautical study requirement.
- D. An aeronautical study may contain many elements; however, hazard identification, risk assessment, risk mitigation, and risk elimination are key components. Additionally, there may be aviation system constraints.
- E. The goal of risk management in an aeronautical study is to identify hazards and assess risks, then to take appropriate action to minimise risk as much as is reasonably practicable to achieve the acceptable level of safety, as if the full compliance were in place.
- F. The objectives of an aeronautical study for aerodrome operator / applicant are as follows:
 - 1) To study the impact of deviations from the regulations;
 - 2) To present alternative solutions to ensure the level of safety remains acceptable;
 - 3) To estimate the effectiveness of each alternative;
 - 4) To recommend suitable operating procedures / restrictions or other measures to mitigate safety risk arising from the deviation;
 - 5) To check for any new hazards and their resulting risk arising from mitigation; and
 - 6) To indicate the timescale for removal or re-assessment of any non-compliance.
- G. Decisions made in respect of risks must balance the technical aspects of risk with the social and moral considerations that often accompany such issues.
- H. These decisions may have a significant impact on an aerodrome's operation. Therefore, for an effective outcome, there should be appropriate involvement, consultation, and a level of consensus as to their acceptability among all key stakeholders. However, in the end, some effect on operations may be necessary.
- I. While this Guidance Material focuses on the safety outcomes, there may also be non-safety consequences, such as service level and commercial implication, or financial loss and operational loss of the aircraft, increased insurance costs, and damage to reputation.

- J. This Guidance Material outlines the trigger factors that may lead to an aeronautical study, the key aspects of safety risk management, the conduct of the study, and the sample activities that should be included in the study.
- K. However, this Guidance Material does not, and cannot, include a formula that is guaranteed to give the correct solution, nor does it instruct the aerodrome operator / applicant what it should value. The appropriate constraints and goals are left to the judgement of those carrying out the study. The aeronautical study should be seen as a framework for effective decision-making, rather than as a guaranteed process to come up with the correct outcomes. Occasionally, an aeronautical study may prove that the intended change is not viable.
- L. This framework for conducting aeronautical studies proposes a systematic method for analysing risk issues, that may be complex, to help the aerodrome operator / applicant decide with confidence and, if necessary, to articulate these decisions for submission to the Aerodrome Standards Department (AGA) of The Civil Aviation Authority of Thailand.
- M. An aeronautical study is most frequently undertaken during the planning of a new aerodrome or new aerodrome 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 the Aerodrome Regulations.

NOTE: *The exemption process shall be in accordance with the Notification of the Civil Aviation Authority of Thailand Re.: Exemption Policy and Procedure.*

- N. 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 the aerodrome operator / applicant to act upon. In all cases, the aeronautical study should document and demonstrate the site-specific need and rationale for the level of services, procedure designs, or operational requirements to provide an equivalent level of safety as if the study had not been required.

1.2 Trigger Factors

- A. The scope of studies can range from minor adjustments to large scale aerodrome configuration.
- B. The decision to undertake this type of study may be triggered by any one or more of a wide range of factors that may generate a non-compliance. These may include:
 - 1) the number of movements or step changes in traffic density, i.e., light / medium / heavy;
 - 2) the peak traffic periods;
 - 3) the ratio of IFR to VFR traffic;
 - 4) the type of operations – scheduled, General Aviation (GA), training, etc.;
 - 5) the types, and variety of types, of aircraft using the aerodrome (jet, turboprop, rotary, etc.); or on smaller operations, just an aircraft model change such as from B737-700 to B737-800 with winglets;
 - 6) aerodrome characteristics and layouts;

- 7) aerodrome operator management structure;
 - 8) runway or taxiway and associated manoeuvring areas;
 - 9) local development – whether structural or use, e.g., affecting wildlife or number of people congregating under flight paths; and/or
 - 10) introduction of any form of new operation or facility.
- C. An aeronautical study may be initiated by the CAAT, an aerodrome operator / applicant, or another interested party, such as an air traffic service provider or air operators.

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2. Overview

2.1 Aeronautical Study

- A. Where an aerodrome operator / applicant is not able to comply with any standard or requirement stipulated in the Aerodrome Regulations, appropriate risk assessment and/or aeronautical studies shall be conducted to assess the impact of deviations from the standards or requirements. The purpose of such studies is to present alternative means of ensuring the safety of aircraft operations, to estimate the effectiveness of each alternative and to recommend procedures and/or alternative measures to compensate for the deviation.
- B. An aeronautical study may only be undertaken in respect of subjects identified in Aerodrome Regulations or ICAO Annex 14 as appropriate for an aeronautical study, these are listed in Appendix A to this Guidance Material. In addition, an aeronautical study may be undertaken for reduced dimensions of a Runway End Safety Area (RESA), not for the absence of a RESA.
- C. 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).
- D. The initial baseline study will be followed by a review of operational issues; this will typically involve an in-depth safety analysis based on quantifiable data, where available, and extensive consultation with aerodrome users and stakeholders using various interview and data gathering processes including a hazard identification workshop. This study may identify any changes that are required to ensure the safe, orderly, and efficient operation of the aerodrome.
- E. The study will normally cover phases such as requirements definition, design evaluation, introduction to service, and routine operation. The aeronautical study can be presented in parts corresponding to these developing phases as information becomes available, but CAAT can only determine the acceptability of a study when it is complete.
- F. The aeronautical study should be done by the aerodrome operator's / applicant's technical experts with relevant practical experience and specialised knowledge. The aerodrome operator / applicant may also consult other specialists in relevant areas.

2.2 Consultation

- A. It is essential that, in conducting the aeronautical study, there is consultation with as wide a range of aerodrome users and other stakeholders as possible. The following may be included in the consultation:
 - 1) Aerodrome operators (including adjacent affected aerodrome operators);
 - 2) Aerodrome users;
 - 3) Airspace user groups;
 - 4) Aircraft operators and operator groups;
 - 5) Pilot organisations; and
 - 6) Air traffic service providers.

- B. These consultations allow the proposed deviation to be viewed from different perspectives and keep the different parties involved aware of the proposed deviation.

2.3 Technical Analysis

- A. 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 on 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 or other means which offer both practical and reasonable solutions.
- B. In conducting a technical analysis, an aerodrome operator / applicant should draw upon their practical experience and specialized knowledge. The aerodrome operator / applicant 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 Regulations and the applicable standards and/or requirements so that the intent of the regulations is not circumvented.

3. Aeronautical Study for Aerodromes

3.1 The Aeronautical Study Contents

- A. An aeronautical study is a study of an aeronautical problem carried out by an aerodrome operator / applicant to identify possible solutions and select a solution that is acceptable without degrading safety. The Aerodrome Standards Department (AGA) of The Civil Aviation Authority of Thailand will review these studies on a case by case basis and determine their acceptability.
- B. An aeronautical study submitted to The Civil Aviation Authority of Thailand (CAAT) for determination of acceptability should comprise the following parts:
 - 1) Aim of the study;
 - 2) Background including system description;
 - 3) Safety assessment;
 - 4) Recommendations;
 - 5) Conclusion; and
 - 6) Monitoring of the deviation.

3.2 Aim of the Study

- A. The aim of the study should be explicitly stated. It should:
 - 1) address the safety concerns;
 - 2) identify safety measures to be put in place to ensure safe aircraft operations in an aerodrome;
 - 3) make reference to the specific regulations which the study is meant to address; and
 - 4) indicate how the acceptable level of safety will be achieved and maintained.
- B. An example to illustrate this would be as follows:

“The aim of this aeronautical study is to address the operation of <name of aerodrome> with high ground on its north side that infringes the inner horizontal surface, and to put in place <list of safety measures> necessary to ensure safe operation of all aircraft at <name of aerodrome> with reference made to <reference to specific regulation>...”

or

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

3.3 Background

- A. 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 part. A clear explanation should be provided, particularly on the following:

- 1) What is the current situation? i.e., a system description
- 2) Where are the areas that will be affected by the proposed deviation?
- 3) When will the aerodrome operator / applicant 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?

B. An example to illustrate this would be as follows:

“All aerodromes are required by the regulation to comply with specific obstacle limitation surfaces according to the operation of the aerodrome. Due to high ground to the north of <name of aerodrome>. This study is undertaken to ensure the safe and efficient operation of <name of aerodrome> by identifying the hazards of the high ground, assessing the safety risks, and determining appropriate actions and procedures...”

or

“Currently, <name of aerodrome> is Code 4E aerodrome with some Code 4F capabilities. These Code 4F capabilities includes <list of the Code 4F capabilities>... <Name of aerodrome> 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 aerodrome> will be upgraded to a Code 4F aerodrome.

Upgrading <name of aerodrome> from Code 4E to Code 4F aerodrome 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 aerodrome> will be affected in the following ways...”

3.4 Safety Assessment

3.4.1 Basic Consideration

- A. 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 Safety Management System (SMS).
- B. The safety assessment should be presented in this part of the report, including the hazard logs.

NOTE: Appendix B contains a sample of hazard log. An aerodrome operator / applicant may use this to formulate its own hazard log to suit the aeronautical study.
- C. It is to be noted that each study is specific to a particular deviation or non-compliance; hence, caution should be exercised in considering applicability to other situations and locations.

- D. Where alternative measures, operational procedures, and operating restrictions have been developed arising from safety assessments, these should be reviewed periodically to assess their continued validity.
- E. The suitability of the mitigation proposed and the need for alternative measures, operational procedures, or operating restrictions for the specific operations concerned should be comprehensively evaluated.

3.4.2 Safety Assessment Process

- A. 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.

NOTE: *In this Chapter, the term “safety concern” refers to deviation or non-compliance only.*

- B. 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.

- C. A safety assessment is initially composed of four basic steps:

- 1) definition of a safety concern and identification of the regulatory compliance;
- 2) hazard identification and analysis;
- 3) risk assessment and development of mitigation measures; and
- 4) development of an implementation plan for the mitigation measures and conclusion of the assessment.

NOTE 1: *A safety assessment process flow chart applicable for aerodrome operations is shown in Figure 1.*

NOTE 2: *Certain safety assessments may involve other stakeholders such as ground handlers, aircraft operators, Air Navigation Service Providers (ANSPs), flight procedure designers, and providers of radio navigation signals, including signals from satellites.*

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

- A. 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.
- B. The perceived safety concern is first analysed to determine whether it is retained or rejected. If rejected, the justification for rejecting the safety concern is to be provided and documented.
- C. An initial evaluation of compliance with the appropriate provisions in the regulations applicable to the aerodrome is conducted and documented.

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

NOTE: *It may be useful to review the historical background of some regulatory provisions to gain a better understanding of the safety objective of those provisions.*

- E. 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 / applicant 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.

3.4.2.2. Hazard identification

- A. 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:
- 1) accident causal factors and critical events based on a simple causal analysis of available accident and incident databases;
 - 2) events that may have occurred in similar circumstances or that are subsequent to the resolution of a similar safety concern; and
 - 3) potential new hazards that may emerge during or after implementation of the planned changes.
- B. Following the previous steps, all potential outcomes or consequences for each identified hazard are identified.
- C. The appropriate safety objective for each type of hazard should be defined and detailed. This can be done through:
- 1) reference to recognized standards and/or codes of practices;
 - 2) reference to the safety performance of the existing system;
 - 3) reference to the acceptance of a similar system elsewhere; and
 - 4) application of explicit safety risk levels.
- D. 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 / applicant's policy with respect to safety improvement and is justified for the specific hazard.

3.4.2.3. Risk assessment and development of mitigation measures

- A. 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).
- B. 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.
- C. 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.

NOTE: *An example of a risk categorization tool in the form of a safety risk (index) assessment matrix is available in Appendix C.*

- D. Once each hazard has been identified and analysed 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.
- E. All risk mitigation measures, whether currently being applied or still under development, are evaluated for the effectiveness of their risk management capabilities.

NOTE: *The exposure to a given risk (e.g., duration of a change, time before implementation of corrective actions, traffic density) is taken into account in order to decide on its acceptability.*

- F. 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.

NOTE: *An example of a qualitative approach is the objective of providing at least the same protection as the one offered by the infrastructure corresponding to the appropriate reference code for a specific aeroplane.*

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

3.4.2.4. Development of an implementation plan and conclusion of the assessment

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

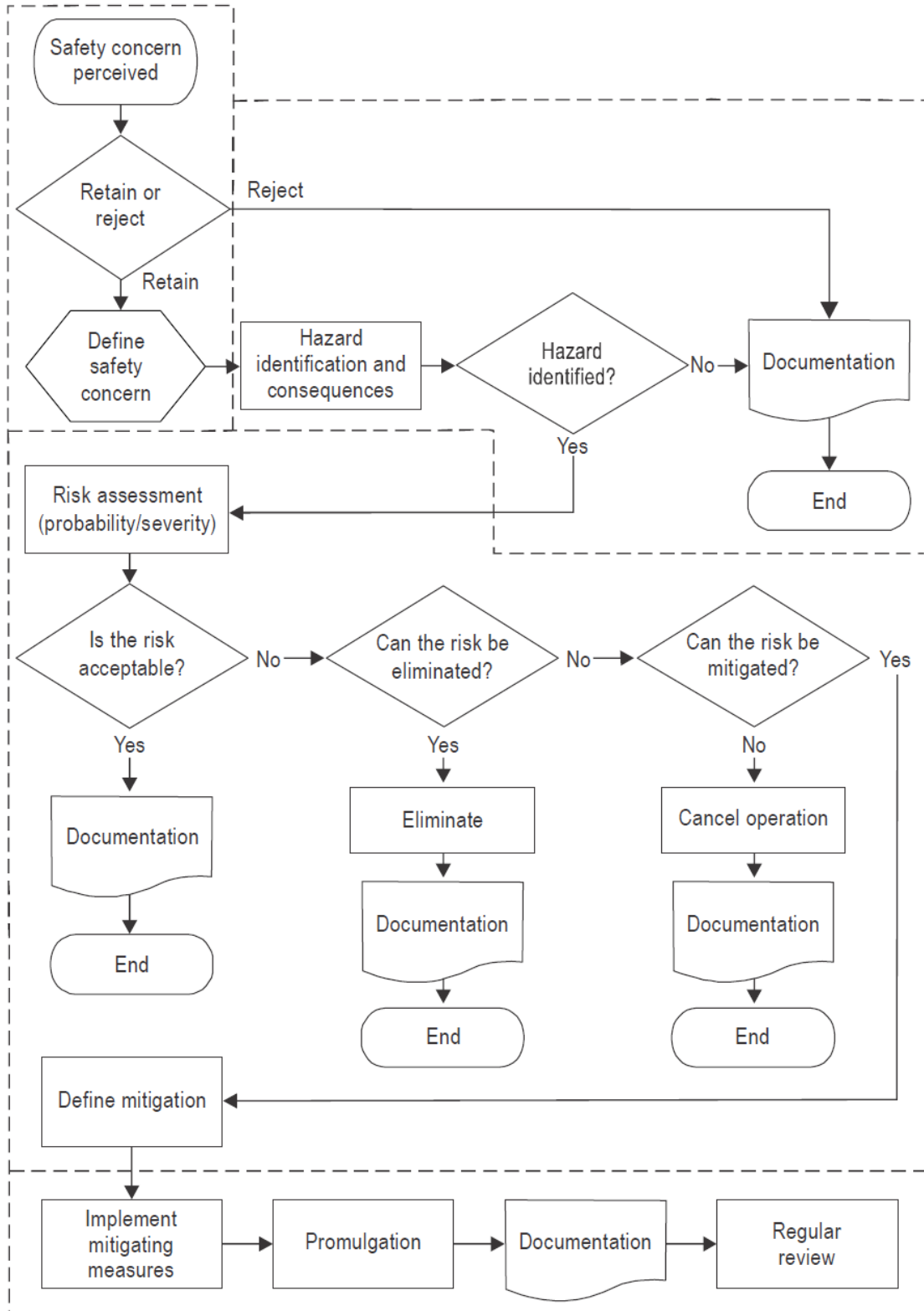


Figure 1 Safety Assessment Flow Chart

3.5 Recommendations

- A. To allow the aerodrome operator / applicant and CAAT to be assured that the proposed deviation will not pose a reduction 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 to identify the best means to address the proposed deviation.
- B. The aerodrome operator / applicant should also ensure that the affected parties are well informed of such changes (e.g., inform pilots of potentially hazardous conditions). The notification procedure including process flow, time frame, and different means of notification such the Aeronautical Information Publication (AIP) in accordance with the AIRAC cycle, if applicable, and Notice to Airmen (NOTAM) should be included in the study.
- C. An example to illustrate this would be as follows:

“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 aerodrome>:

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

The notification procedure to the affected parties is as follows:

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

3.6 Conclusion

- A. The aerodrome operator / applicant, after taking into account all the necessary considerations, 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, as well as stating the interim measures until all such safety measures are implemented.
- B. An example to illustrate this would be as follows:

“The results of this aeronautical study have concluded that <obstacle in the inner horizontal surface> would have posed a reduction in the level of safety. However, by adopting prohibition of flight on that side of the aerodrome, this reduction 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, the same level of safety can be achieved as if the <the cause of the study> had not occurred due to segregation of the hazard from the operation.”

or

“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 reduction 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>...”

3.7 Monitoring of the Deviation

A. The aerodrome operator / applicant should devise methods to monitor the status of the deviation to ensure that the implemented recommendations can be effectively carried out, and that the level of safety is not compromised at any time. This assessment also provides feedback on the recommendations.

B. The aerodrome operator / applicant should review the aeronautical study regularly or whenever there may be significant changes that would affect the relevance of the study. Any changes to the aeronautical study should be evaluated and properly documented.

C. An example to illustrate this would be as follows:

“<Name of the aerodrome operator / applicant> will monitor the deviation’s status <fixed period of time> and ensure the safety measure has been effectively carried out and the level of safety is not compromised at any time. <Name of the aerodrome operator / applicant> will review the safety assessment process, if required. Any inadvertent flight on the north side of the aerodrome shall be investigated and reported to CAAT, together with any necessary enhancement of procedures to avoid any repetition.”

or

“<Name of the aerodrome operator / applicant> 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 / applicant> will review the safety assessment <specify time frame>...”

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

3.8 Submission of an Aeronautical Study to The Civil Aviation Authority of Thailand

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

B. The CAAT can assist in identifying whether an aeronautical study is required, as well as the appropriate format, topics, and details that should be included in accordance with applicable regulations and guidance materials.

C. An aeronautical study subject to acceptance by CAAT, as part of the exemption process, shall be in accordance with the Notification of the Civil Aviation Authority of Thailand Re.: Exemption Policy and Procedure.

- D. An aeronautical study submitted to CAAT must be signed by the Accountable Executive, as well as by representatives of all stakeholders involved in the study.
- E. Once an aeronautical study has been accepted by CAAT, the aerodrome operator / applicant should update the Aerodrome Manual to include details of the deviation or exemption granted by CAAT and ensure that such information is published in AD 2 of the AIP.
- F. The aerodrome operator / applicant should ensure that the mitigation or conditional measures are properly implemented and that they fulfil their purpose.

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4. Aeronautical Concern Arising from the Introduction of an Obstacle

4.1 Aeronautical Study of an Obstacle Process

- A. To investigate an aeronautical concern arising from the introduction of an obstacle, an aeronautical study is used to evaluate the impact of the obstacle on flight operations and identify possible measures that can mitigate these concerns.
- B. The process of conducting an aeronautical study of an obstacle should include:
- 1) data gathering;
 - 2) stakeholder engagement and impact assessment;
 - 3) identifying mitigations (if applicable); and
 - 4) acceptance or rejection.

NOTE: A flow chart showing the aeronautical study of an obstacle is shown in Figure 2.

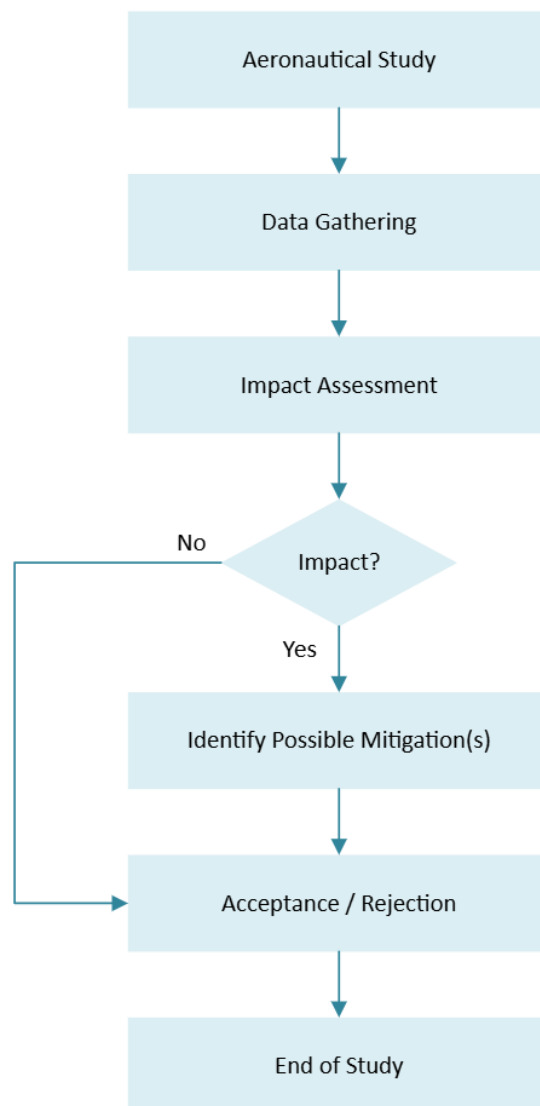


Figure 2 Aeronautical Study of an Obstacle Flowchart

4.1.1 Data Gathering

A. Information collected should include but not be limited to:

- 1) national regulations and procedures (zoning laws, land use policy);
- 2) use of the aerodrome (day / night, IFR / VFR, public / private use, certified / uncertified);
- 3) dimensions of approach lighting system;
- 4) existing and future runway and taxiway characteristics;
- 5) mix of aircraft operating at the aerodrome;
- 6) number of regular flights (commercial air transport);
- 7) procedures specific to the aerodrome;
- 8) flight procedures (existing and future);
- 9) contingency procedures;
- 10) details on existing obstacles and mitigations;
- 11) existing or planned visual navigation aids / electronic navigation aids / surveillance aids / communication aids etc.; and
- 12) airspace structure and details of nearby aerodromes.

NOTE: For non-flight operations related aeronautical studies, other information may be required.

B. Details of the proposed obstacle or terrain should include but are not limited to:

- 1) location;
- 2) obstacle evaluation;
- 3) classification (e.g., building, crane, tree(s), antenna(s), power lines);
- 4) dimensions as well as height, top elevation including ground elevation;
- 5) frangibility;
- 6) permanence (permanent / temporary);
- 7) presence (fixed / mobile);
- 8) visibility (e.g., marking and lighting); and
- 9) material (as it may interfere with electronic signals).

C. Aerodrome details (this list is not exhaustive and may include others):

- 1) ICAO code;
- 2) CNS facilities;
- 3) procedures specific to the aerodrome;
- 4) use of aerodrome (IFR / VFR day / low visibility operations);
- 5) visual aids;
- 6) type of aircraft;

- 7) runway characteristics (number of runways, dimensions, type);
 - 8) airspace;
 - 9) nearby aerodromes; and
 - 10) aerodrome noise zones.
- D. Affected surfaces:
- 1) surfaces penetrated; and
 - 2) extent of penetration.
- E. Flight operations related to instrument flight procedures (this list is not exhaustive and may include others):
- 1) instrument approach procedures (initial, intermediate, final and missed approaches as well as visual segment and circling);
 - 2) SIDs (Standard Instrument Departure Routes and/or omni-directional departures);
 - 3) Standard Arrival Routes (STAR);
 - 4) Minimum Sector Altitudes (MSA) and Terminal Arrival Altitudes (TAA);
 - 5) holding patterns;
 - 6) ATC surveillance minimum altitudes; and
 - 7) en route ATS routes.
- F. Flight operations (visual flight procedures and visual approaches):
- 1) visual departures;
 - 2) traffic patterns (standard circuit patterns or other published patterns, including patterns for entry and exit to/from circuit patterns); and
 - 3) VFR routes and VFR reporting points.

4.1.2 Stakeholder Engagement and Impact Assessment

- A. The proponent of the aeronautical study can either be an agency of the State, aerodrome operators, or by any appropriate authority. In conducting the study, it is critical to have the participation of all relevant stakeholders. The stakeholders should include but are not limited to:
- 1) the Civil Aviation Authority of Thailand (CAAT);
 - 2) proponent of the proposed construction / development;
 - 3) the aerodrome operator;
 - 4) air navigation services providers;
 - 5) flight procedure designers;
 - 6) aircraft operators (commercial aviation and the military); and
 - 7) other appropriate authorities (e.g., land use planner, military, etc.).

NOTE 1: *The level of stakeholders' involvement may vary depending on the needs of the study.*

NOTE 2: *The design of procedures in accordance with PANS-OPS (Doc 8168) criteria assumes normal operations. It is the responsibility of the operator to provide contingency procedures for abnormal and emergency operations. It might be necessary to involve aircraft operators in the aeronautical study process.*

- B. There could be a situation where more than one Obstacle Limitation Surface (OLS) is penetrated. Due to different purposes each OLS serves, every surface needs to be evaluated individually to assess its impact.

NOTE: *Explanations on how impact assessments are conducted can be found in the Airport Services Manual, Part 6 – Control of Obstacles (Doc 9137).*

4.1.3 Identifying Mitigations

- A. Identifying the mitigating measures and assessing their impact on stakeholders is a key task in the aeronautical study process. Different measures are required to address Obstacle Limitation Surface (OLS) penetrations. Certain mitigation measures, while acceptable, may not be desirable due to the penalty it imposes on aerodrome operations.
- B. The mitigation measure identified should consider the OLS that is/are being penetrated.
- C. Obstacles penetrating the OLS will impose an adverse effect on the safety of flight operations and should be removed. Where removal is not practicable, the penetrations are to be mitigated by means of limiting operations at the aerodrome such as designating the runway for departure only or allowing only visual approaches to the runway, before considering other measures. Other measures include, but are not limited to:
 - 1) displacing the threshold; and/or
 - 2) raising the glide slope and PAPI angle.
- D. Obstacles penetrating the OLS may have an adverse impact to the safety or accessibility of intended aircraft operations. Mitigation measures may include, but are not limited to:
 - 1) adjusting flight procedures (e.g., increased minimum obstacle clearance altitudes, increased minimum climb gradients, change of routing);
 - 2) including the obstacles in the relevant ICAO charts;
 - 3) promulgating safety information to the users of the aerodrome (particularly concerning the change);
 - 4) increasing approach minima (OCA/H);
 - 5) increasing minimum climb gradient for departures (Procedure Design Gradient (PDG));
 - 6) increasing descent gradients;
 - 7) increasing flight altitude;
 - 8) revising traffic / circuit patterns;
 - 9) revising VFR routes and/or reporting points; and

10) adjusting / including marking and lighting.

- E. Upon completion of the aeronautical study, it may be necessary to conduct a safety risk assessment to quantify the risk probability and severity and the acceptability of any proposed mitigation measures in reducing the risk to an acceptable level.

NOTE: *Guideline on safety risk assessment are detailed in Chapter 3, 3.4 of this GM.*

4.1.4 Acceptance or Rejection

- A. The aeronautical study may result in one of the following outcomes where the obstacle is:
- 1) acceptable, because the risk is already mitigated;
 - 2) acceptable, only if the risk is mitigated; or
 - 3) not acceptable, because the risk cannot be mitigated.
- B. The aeronautical study is to be submitted by the aerodrome operator or an appropriate authority prior to development or installation of the proposed obstacle.
- C. The aerodrome operator or an appropriate authority should analyse the aeronautical study and verify that:
- 1) appropriate coordination has been performed between the stakeholders;
 - 2) aeronautical concerns have been properly investigated and assessed, based on current and future flight operations and procedures;
 - 3) proposed mitigation measures adequately address the impact posed by the obstacle; and
 - 4) the subsequent safety risk assessment, when required, has been conducted in accordance with Chapter 3, 3.4 of this GM and meets the acceptability criteria specified by CAAT.

NOTE: *It is preferable to have relevant experts from the industries, as required, on the team that conducts the aeronautical study.*

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Appendix A: Aeronautical Study Applicability

NOTE: Appendix A provides example of list of non-compliance which an aeronautical study may be applied or considered.

1. Dimensions of a runway end safety area and strip;
2. Objects in a runway end safety area and strip;
3. Width of a radio altimeter operating area;
4. The separation distance between the centre line of a taxiway and the centre line of a runway, the centre line of a parallel taxiway, or an object;
5. Anything which may endanger aeroplanes on the movement area or in the air within the limits of the inner horizontal surface and conical surface;
6. Permitting new objects or extensions of existing objects above approach surface, transitional surface, conical surface, and inner horizontal surface; or above any of the surfaces required by Aerodrome Regulations;
7. Permitting existing objects above the approach surface, transitional surface, take-off climb surface, conical surface, and inner horizontal surface; or above any of the surfaces required by Aerodrome Regulations;
8. Objects which extend to a height of 150 m or more above ground elevation;
9. Marking and lighting of a fixed obstacle that extends above a take-off climb or an approach surface within 3,000 m of the surface's inner edge; or above a transitional surface; or above a horizontal surface; or other objects that could constitute a hazard to aircraft;
10. Marking and lighting of overhead wires, cables, etc., crossing a river, waterway, valley, or highway; and their supporting towers; and other objects outside the obstacle limitation surfaces;
11. Extended beam spread of medium and high-intensity obstacle lights;
12. Use of high-intensity obstacle lights;
13. Marking and lighting of wind turbine rotor blades, nacelle, and supporting mast;
14. The wheel clearances above threshold;
15. The azimuth spread of the PAPI/APAPI light beam;
16. Removal of, or actions for objects above a PAPI/APAPI obstacle protection surface; and
17. Not providing a location sign in conjunction with a direction sign.

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Appendix B: Hazard Log

NOTE: Appendix B provides aerodrome operator / applicant with a suggested hazard log for safety assessment of an aeronautical study. Aerodrome operator / applicant may use this log as a guide to formulate his own log. This log should be constantly updated throughout the aeronautical study life-cycle.

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	High ground north of the aerodrome intruding into the inner horizontal surface	<ul style="list-style-type: none"> Flight into terrain 	5A	Unacceptable	<ul style="list-style-type: none"> Prohibit flight north of aerodrome Publish prohibited area for circling with altitude 	1A	Acceptable	<ul style="list-style-type: none"> Monitor compliance
2	Aircraft Operation	High ground north of the aerodrome intruding into the inner horizontal surface	<ul style="list-style-type: none"> Turbulence and windshear effects 	4B	Unacceptable	<ul style="list-style-type: none"> Publish warning of turbulence and windshear for relevant wind direction 	3C	Tolerable	<ul style="list-style-type: none"> Monitor reports from pilots, review need for improved wind sensors
3	Aircraft Operation	Operation of Code 4F aircraft in a Code 4E Aerodrome	<p>Loss of control of aircraft during pushback / towing operations</p> <p>Wing tip collision at <parking bay numbers>.</p>	3C	Tolerable	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Conduct trials to study the effectiveness of the implementation. Resulting risk index: 1C Residual risk tolerability: Acceptable

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

NOTE 1: Appendix C provides aerodrome operator / applicant with a suggested risk probability and severity, risk assessment matrix, and risk tolerability to be included in an aeronautical study. Aerodrome operator / applicant may use this as a guide for developing their own risk probability and severity, and risk assessment matrix tailored to his individual situation.

NOTE 2: The level of detail and complexity of risk tables and matrices should be adapted to the particular needs and complexities of each aerodrome. Both qualitative and quantitative criteria should be applied, where appropriate. Quantitative definitions (e.g., number of events in a given time period or events per number of flights) should be considered based on the type of operation and the availability of relevant data.

1. Risk Probability

1.1 Example 1: Probability of Occurrence Classification

Probability of Occurrence		
Likelihood	Meaning	Value
Frequent	Likely to occur many times (has occurred frequently)	5
Occasional / Reasonably Probable	Likely to occur sometimes (has occurred infrequently)	4
Remote	Unlikely to occur, but possible (has occurred rarely)	3
Improbable / Extremely Remote	Very unlikely to occur (not known to have occurred)	2
Extremely Improbable	Almost inconceivable that the event will occur	1

1.2 Example 2: Probability of Occurrence Definitions

	Probability of Occurrence Definitions				
	Extremely Improbable	Extremely Remote	Remote	Reasonably Probable	Frequent
Qualitative Definition	Should virtually never occur	Very unlikely to occur	Unlikely to occur during the total operational life of the system	May occur once during total operational life of the system	May occur several times during operational life
Quantitative Numerical Definition	< 10 ⁻⁹ per hour	10 ⁻⁷ to 10 ⁻⁹ per hour	10 ⁻⁵ to 10 ⁻⁷ per hour	10 ⁻³ to 10 ⁻⁵ per hour	1 to 10 ⁻³ per hour
Quantitative Annual / Daily Equivalent (Approximate)	Never	Once in 1,000 years to once in 100,000 years	Once in 10 years to once in 1,000 years	Once per 40 days to once in 10 years	Once per hour to once in 40 days

2. Risk Severity

2.1 Example 1: Severity of Occurrence Classification

Severity of Occurrence		
Severity	Meaning	Value
Catastrophic	<ul style="list-style-type: none"> — Equipment destroyed — Fatality 	A
Hazardous	<ul style="list-style-type: none"> — 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	<ul style="list-style-type: none"> — 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	<ul style="list-style-type: none"> — Nuisance — Operating limitations — Use of emergency procedures — Minor incident 	D
Negligible	<ul style="list-style-type: none"> — Few consequences 	E

2.2 Example 2: Severity of Occurrence Definitions

Severity of Occurrence Definitions	
Accidents	<ul style="list-style-type: none"> — Accident – as defined in Annex 13 – Aircraft Accident and Incident Investigation. — Also includes loss of or substantial damage to major aerodrome facilities. Serious injury or death of multiple staff / members of public at the aerodrome.
Serious Incidents	<ul style="list-style-type: none"> — Serious Incident – as defined in Annex 13 – Aircraft Accident and Incident Investigation. — For the aerodrome, an event where an accident nearly occurs. No safety barriers remaining. The outcome is not under control and could very likely lead to an accident. — Damage to major aerodrome facilities. — Serious injury to staff / members of public at the aerodrome.
Major Incidents	<ul style="list-style-type: none"> — A major incident associated with the operation of an aircraft, in which safety of aircraft may have been compromised, having led to a near collision between aircraft, with ground or obstacles. — A large reduction in safety margins. The outcome is controllable by use of existing emergency or non-normal procedures and/or emergency equipment. The safety barriers are very few approaching none. — Minor injury to occupants of the aircraft or staff / members of public at the aerodrome. — Minor damage to aircraft or major aerodrome facilities may occur.

Severity of Occurrence Definitions	
Significant Incidents	<ul style="list-style-type: none"> — Significant incident involving circumstances indicating that an accident, a serious or major incident could have occurred, if the risk had not been managed within safety margins, or if another aircraft had been in the vicinity. — A significant reduction in safety margins but several safety barriers remain to prevent an accident. — Reduced ability of the flight crew or air traffic control to cope with the increase in workload as a result of the conditions impairing their efficiency. — Only on rare occasions can the occurrence develop into an accident. — Nuisance to occupants of the aircraft or staff/members of public at the aerodrome.
No Effect Immediately	<ul style="list-style-type: none"> — No immediate effect on safety. — No direct or low safety impact. — Existing safety barriers come into play to avoid the event turning into a significant incident or accident.

3. Risk Assessment Matrix

3.1 Example 1: Risk Assessment Matrix with Prioritization Classes

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

3.2 Example 2: Risk Classification Matrix

		Probability of Occurrence (Likelihood)				
		Extremely Improbable	Extremely Remote	Remote	Reasonably Probable	Frequent
		< 10 ⁻⁹ per hour	10 ⁻⁷ to 10 ⁻⁹ per hour	10 ⁻⁵ to 10 ⁻⁷ per hour	10 ⁻³ to 10 ⁻⁵ per hour	1 to 10 ⁻³ per hour
Severity of Occurrence	Accidents	Review	Unacceptable	Unacceptable	Unacceptable	Unacceptable
	Serious Incidents	Acceptable	Review	Unacceptable	Unacceptable	Unacceptable
	Major Incidents	Acceptable	Acceptable	Review	Unacceptable	Unacceptable
	Significant Incidents	Acceptable	Acceptable	Acceptable	Review	Unacceptable
	No Effect Immediately	Acceptable	Acceptable	Acceptable	Acceptable	Review

4. Risk Tolerability

4.1 Example 1: Safety Risk Tolerability

Safety Risk Description	Safety Risk Index Range	Suggested Criteria
Intolerable	5A, 5B, 5C, 4A, 4B, 3A	Take immediate action to mitigate the risk or stop the activity. Perform priority safety risk mitigation to ensure additional or enhanced preventative controls are in place to bring down the safety risk index to tolerable.
Tolerable	5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A	Can be tolerated based on the safety risk mitigation. It may require management decision to accept the risk.
Acceptable	3E, 2D, 2E, 1B, 1C, 1D, 1E	Acceptable as is. No further safety risk mitigation required.

4.2 Example 2: Risk Tolerability Regions

Risk Region	Description
Acceptable	The consequence is so unlikely or not severe enough to be of concern. The risk is tolerable and the Safety Objective has been met. However, consideration should be given to reducing the risk further to As Low As Reasonably Practical (ALARP) in order to further minimise the risk of an accident or incident.
Review	The consequence and/or likelihood is of concern; measures to mitigate the risk to ALARP should be sought. Where the risk still lies within the “Review” region after ALARP risk reduction has been undertaken, then the risk may be accepted provided that the risk is understood and has the endorsement of the individual ultimately accountable for safety within the organisation.
Unacceptable	The likelihood and/or severity of the consequence is intolerable. Major mitigation or redesign of the system may be necessary to reduce the probability / likelihood or severity of the consequences associated with the hazard.

NOTE: *As Low As Reasonably Practical (ALARP) means a risk is low enough that attempting to make it lower, or the cost of assessing the improvement gained in an attempted risk reduction, would actually be more costly than any cost likely to come from the risk itself. This does not automatically mean the risk is acceptable though; a judgement will need to be made and justified.*

Appendix D: Aeronautical Study Checklist

NOTE 1: The purpose of this form is to provide aerodrome operator / applicant with a suggested checklist for reviewing of an aeronautical study. Aerodrome operator / applicant may use this checklist as a guide for developing an aeronautical study tailored to his individual situation.

NOTE 2: It is recommended that the aerodrome operator / applicant include the completed Aeronautical Study Checklist with the aeronautical study when submitting it to CAAT for acceptance.

AERONAUTICAL STUDY CHECKLIST			
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 standards or requirements in Aerodrome Regulations.			
2. Consultation with stakeholders, senior management team, and divisions / departments affected.			
3. The study is approved by the accountable executive of the organization.			
4. Background information on the current situation.			
5. Proposed date for complying with the standards / requirements, 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 aeronautical study (e.g., hazard identification workshop, hazard log, risk probability and severity, risk assessment matrix, risk tolerability, risk control / mitigation, and re-assessment of the risk).			
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 reduction 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 aeronautical study.			
12. Monitoring of the deviation.			
13. Notification to Aerodrome Standards Department (AGA) of The Civil Aviation Authority of Thailand (CAAT) once the temporary deviation has been corrected.			

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