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GAR
Subpart C - Safety Management Requirements

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SECTION 1

SUBPART C – SAFETY MANAGEMENT REQUIREMENTS

GAR 1.C005 General

As a part of certification requirements, an Aerodrome Operator shall have a system for managing safety. This system shall be readily identifiable by the Aerodrome Operator and the National Aviation Authority and shall be documented in an Aerodrome Manual.

GAR 1.C009 Safety objective

An Aerodrome with its facilities, equipment and systems shall be designed and operated so that, for any hazard, the combination of the probability of occurrence and the severity of the consequences of the hazard occurring shall not result in a risk that is unacceptable to the safety of aircraft.

GAR 1.C010 Safety Management Policy Statement

a) An Aerodrome Operator shall establish policy statements defining the fundamental approach to be adopted for managing safety and the organisation's commitment to safety. These statements shall be included in the Aerodrome Manual.

b) These policy statements shall incorporate a requirement that external providers of services or facilities, installations or equipment to the Aerodrome shall comply with the Aerodrome Operator's safety management standards and requirements.

GAR 1.C011 Safety Management Competency

An Aerodrome Operator shall ensure that staff are adequately trained and remain competent for the safety management tasks they are required to undertake.

GAR 1.C015 Safety Indicators and safety targets

Safety indicators and safety targets shall be determined, maintained and monitored for those facilities, installations or equipment and services delivered by the Aerodrome Operator that have an impact on aircraft safety.

GAR 1.C020 Safety Assessment

An Aerodrome Operator shall assess existing processes, proposed changes, additions or replacements for their safety significance. The Safety assessment shall ensure appropriate mitigation measures are carried out.

GAR 1.C025 Safety Assessment Records

An Aerodrome Operator shall identify and record:

(a) The safety requirements for a service or facility, installation or equipment;
(b) The results of the safety assessment process; and
(c) Evidence that the safety requirements have been met.

These records shall be maintained and kept up to date throughout the life of the service or facility, installation or equipment or as specified by the National Aviation Authority.

GAR 1.C035 Safety Management Organisation

An Aerodrome Operator shall ensure that there is a function at a suitable senior level in its organisation for the development and maintenance of the safety management system. This function shall be independent from line management and have direct access to the Accountable Manager.

GAR 1.C040 Safety Monitoring and reporting

(a) An Aerodrome Operator shall have in place suitable monitoring arrangements so that adverse trends in safety are recognised and subject to remedial action.

(b) In order to achieve (a) above the Aerodrome Operator shall:

(1) Establish a system for accident and incident reporting ensuring that the National Aviation Authority is informed of the aviation safety aspects in connection with the operation of the Aerodrome.

(2) Investigate all occurrences to identify safety significant aspects, failures of its management of safety and take all necessary corrective action.

GAR 1.C045 Safety Audits

An Aerodrome Operator shall carry out safety audits to confirm compliance with the safety requirements and the safety management system.

Safety Audits shall be conducted at such a frequency as determined necessary by the safety management system.

The internal audit shall be conducted independently from line management functions.

GAR 1.C047 Safety Promotion

The Aerodrome Operator shall ensure that lessons learnt through the safety assessment, safety monitoring, safety audit and investigation processes are disseminated throughout its organisation and relevant service providers.

GAR 1.C050 Document and Data control

The Aerodrome Operator shall establish and maintain procedures in order to trace all documents and data related to the Safety Management System.

The procedures must ensure that all safety related documents and data are available and up to date.

Invalid or obsolete documents and data must be eliminated and secured against unintended use.

GAR 1.C055 Safety Assurance Documentation

An Aerodrome Operator shall produce and maintain safety assurance documentation (SAD) contained or referenced within an Aerodrome Manual. This documentation shall include a description of:

[i] All safety related roles and functions of the aerodrome operator organisation

(ii) Arrangements for ensuring contractor competence and monitoring contractor performance

[iii] A process of reviewing identified risks

[iv] Safety Monitoring of all operations

[v] How changes are to be implemented and assessed to determine their potential impact on safety.

GAR 1.C060 Changes and modifications of a system

(a) The Aerodrome Operator shall be able to demonstrate to the National Aviation Authority before changes and modifications to a system are implemented that these changes and modifications satisfy the aerodrome's requirements as well as the requirements in this regulation.

(b) This demonstration shall include an assessment of the impact the new system or change will have on other systems or procedures that may be affected.

SECTION 2

SUBPART C: SAFETY MANAGEMENT REQUIREMENTS

GAR (IEM) 1.C005, General

Background

An overall management system demonstrates an identifiable and easily audited systematic control of the management of safety at an Aerodrome. It will be able to display to the Aerodrome organisation and prove to the National Aviation Authority that the Safety Assurance activities result in continuous compliance with the safety requirements. In this approach the safety aspect should be appropriately emphasised. Whilst this regulation only has a safety mandate, this should not stop an Aerodrome Operator applying Total Management approach; the Safety Management Requirements are also designed to reflect contemporary Quality System Standards.

In line with this overall management approach, an Aerodrome Operator should identify the safety significant issues, analyse and assess safety risks as a result of their monitoring, and thereafter take remedial action as required. The Aerodrome Operator should state the facts, analyse, assess and prove to the National Aviation Authority that all existing operations and all changes, additions or replacements will be at an acceptable risk level

GAR (AMC) 1.C010 Safety management overview

Safety Management in general terms is that part of the overall management function, which determines and implements an organisation's safety policy. The most senior level of management within the organisation should endorse and follow a logical programme that ensures the implementation of a safety management system:

- Safety management policy statements should define the organisation's fundamental approach to the management of safety and should commit the organisation at all levels to the fulfilment of its stated safety policy.

- From the policy statements, the organisation should define its safety management strategy.

- Having defined the policy statements and the organisation's strategy, the procedures designed to achieve this should be clearly documented.

- The responsibilities and accountabilities of all individuals in respect of safety should be clearly defined.

GAR (IEM) 1.C010 (1) Safety Policy Statements
Priority of safety

The highest priority shall be attached to safety in relation to all business activities. Organisations that do not manage their safety risks carry a business risk. It should be the duty and obligation of all aerodrome staff to comply with safety standards and requirements. The competitive strength of an organisation not only depends on efficiency but also on a commitment to safety.

GAR (IEM) 1.C010 (2) Safety Policy Statements
Business objective for safety

To reduce the risk to “as low as reasonably practicable” (ALARP) means that risk in a particular activity can be balanced against the time, cost and difficulty of taking measure to avoid the risk. The greater the risk to safety, the more likely it is that it is reasonable to go to substantial efforts to reduce it. It is implicit, therefore, that hazards have to be identified and the risk assessed before a judgement can be made upon their tolerability” To estimate the tolerability of a risk, see Safety Assessment Methodology below.

GAR (IEM) 1.C010 (3) Safety Policy Statements
Commitment of the Aerodrome for safety and pro-activity

Safety is more than the absence of accidents as hazardous conditions may be present but not have resulted in an accident yet. An intuitive or ad hoc approach to safety is not acceptable. In order to manage and control hazards and reduce risks to ALARP, it will be necessary to take a pro-active approach to safety management.

GAR (IEM) 1.C010 (4) Safety Policy Statement
A statement of safety-related responsibilities throughout the organisation

1. The safety management system depends upon individuals' understanding and accepting their delegated responsibility within the organisation. Accountability for safety belongs to all levels of management and the attainment of satisfactory safety performance implies the commitment and participation of all members of the organisation. Making "a statement of safety-related responsibilities throughout the organisation" should be understood this way: everybody in the organisation should be made aware of the consequences of mistakes and strive to avoid them and management should foster this basic motivation within members of an organisation, so that everybody accepts their responsibility for safety".

2. An acceptable means to comply with the Safety Management Policy Statement would be to make sure that everyone has an individual responsibility for the safety of their actions and that managers are accountable for the safety performance of the activities for which they have responsibility. Safety is not the sole responsibility of a special function in the organisation. Where a procedure accommodates a safety requirement, the operator should be aware of the consequences of mistakes, and the procedures should eliminate such risks as much as possible. Additionally, the organisation should identify who is ultimately accountable for safety and how this accountability is delegated.

To assure the proper function of a Safety Management System, the implementation process and the continuous improvement process should be a Top Down process in any organisation striving to do business. The responsibility rests with the higher level of management to see that all staff has knowledge and understanding of the Business Plan.

GAR 1.C010 (5) Safety Policy Statement
Compliance with all appropriate safety standards

Adopting the minimum safety standards may not always achieve the organisation's safety objectives. However, compliance with safety standards and requirements can form a part of a robust safety argument and facilitates the safety assessment process. More stringent internal safety management standards can be added to this basis afterwards if need be.

GAR (IEM) 1.C010 (b) Safety Policy Statements
Externally supplied service or facility, installation or equipment and services

When establishing agreements with external suppliers, the delivery of services or facilities, installations or equipment should comply with the safety objectives of the Aerodrome Operator. If not, these services and products may be the weak link in the operations process.

GAR (IEM) 1.C015 Safety targets and safety indicators

If the safety performance of a service or a product at an Aerodrome is to be assessed and monitored, the definition of the safety objective that needs to be met should be set first.

Safety levels that the organisation seeks to achieve need thus to be defined, in quantitative or qualitative terms, in order to be able to measure the performance of the organisation and consequently to render input to change in procedures or objectives. To assist the aerodrome in its effort to determine safety levels for each, see Safety Assessment below.

When quantitative safety levels cannot be determined, a qualitative reasoning shall be performed, in order to meet the safety objectives

In some cases, data may be available which will allow direct numerical estimates to be made, leading to a quantitative safety level. For example, for the hardware elements of a system, data is often available on historical component failure rates. However, the estimation of numerical values associated with human before will involve a greater degree of subjective assessment, thus quantitative safety levels are more appropriate. In such cases, the concept of acceptable level of safety can be defined through the setting of safety performance indicators and safety performance targets. Safety performance indicators and targets are expressed as a metric or measure.

Further guidance is contained within the ICAO Safety Management Manual (doc 9859)

GAR (IEM) 1.C020 Safety Assessment see GAR (IEM) 1.C060

GAR (IEM) 1.C025, Safety Assessment Records

In a state of continued operation, there is also a requisite for maintaining, improving and recording of the processes. When there is safety significance in a procedure, the Aerodrome operator should continuously assure that the level of safety is maintained or improved. All safety critical procedures should be described both in writing and by word of mouth training.

GAR (AMC) 1.C030 Aviation Safety Competency

The Aerodrome Operator should establish the minimum level of safety-related training for all personnel with access to the movement area, and the required frequency of refresher training. The detail and curriculum will vary according the responsibilities, accountabilities and safety-related duties of each post. For example, customer service staff may need to know the safety implications and procedures for escorting passengers on the apron, whilst other staff will need to be aware of local driving and relevant movement area regulations.

Authority to hold a post should cease to be valid if an individual has not fulfilled the requirements of the aerodrome manual or has not completed the programme for recurrence training. The final assessment for acceptability rests with the Aerodrome Operator.

GAR (AMC) 1.C035, Safety Management Organisation

If the Aerodrome organisation is too small to employ a dedicated person it is acceptable to combine with another management functions provided care is taken to avoid conflict of interest with line management functions.

GAR (IEM) 1.C035, Safety Management Organisation

The Head of the Aerodrome Organisation should retain ultimate accountability for safety significant matters. This will emphasise to all staff and users the importance that the Aerodrome organisation places on safety. He may delegate responsibility to others who possess the necessary technical and operational skills or qualifications, but remains ultimately accountable.

GAR (IEM) 1.C040, Safety performance monitoring

Safety monitoring has the goal of measuring performance in specific processes and activities to establish whether they are carried out in accordance within established safety levels and against published procedures. Regular monitoring will enable the identification of undesirable trends in service or product performance before an adverse event manifests itself. Without such a monitoring system neither the Aerodrome Operator nor the National Aviation Authority can observe the performance of operations.

In relation to the suitable monitoring indicators “to have in place so that undesirable trends in service or product performance can be recognised”, it should be appreciated that such indicators are also to some extent a measure of the trend to report minor occurrences. Because even where there are established

reporting systems the willingness to report vary. They should be evaluated carefully in order not to penalise those organisations with a low reporting threshold.

When it comes to safety improvements in an Aerodrome organisation, one usually relies upon the experience and competence of the staff. To accomplish and channel proposals for solutions to malpractice in the procedures, it is essential that the staff should be encouraged to report safety occurrences.

The National Aviation Authority should also appraise how effective and quick the organisation is in finding out the causes of occurrences and implementing corrections.

It is possible to develop a limited set of parameters that are easy to follow up and which gives a sufficiently clear picture of the safety status of the aerodrome, and which at an early stage will give the Aerodrome operator a hint that some aspect of the operation is about to deteriorate, so that corrective action can be initiated before the situation gets out of hand.

Accidents are the result of a series of unplanned events or factors, whether related or independent, that result in damage, loss, injury or death. Whereas the result of these factors being present does not necessarily result in an accident, the potential is there. So, it is important to identify record and minimise the existence of such factors.

Below is a list of possible factors and critical conditions relating to airport operations have the potential to result in accidents or incidents. They may be developed into safety performance indicators. The list is non-exhaustive and aerodrome operators should develop indicators in accordance with the physical and operational characteristics of their aerodrome:

- Movement area safety
    - Violation of local traffic rules (vehicles)
    - Unauthorised personnel on the airside
    - Incidents and accidents on the apron involving, personnel, aircraft or ground equipment
    - Errors in the reporting chain
    - Etc

- Pavement maintenance
    - FOD cases actual
    - FOD cases potential
    - Bird strikes
    - Occasions when birds were scared away
    - Worn markings
    - Etc

- Winter operation
    - Temporarily cleared runway in relation to movements or business hours
    - Fully cleared runway in relation to movements or business hours
    - Movements on friction levels below 0.30, 0.25 or at 9.
    - Etc

- Electrical services
    - Disruption of primary power supply
    - Reduced serviceability of one or more light systems
    - Un-serviceability of one or more light systems
    - One or more obstacle lights unserviceable more than x hours at a time.
    - Signs out of service
    - Etc

- Fire fighting and rescue
    - Cases of increased alert level (should be greater than zero)
    - Exercise frequency, all types
    - Response time more than 90 seconds
    - Reduced category in relation to traffic

- Certain resources out of service more than xx hours at a time (ex rescue boats if they are part of the emergency plan)
- Use of not fully qualified personnel
- Etc

- Examples of possible timeframes (denominators), which must be chosen for each type of occurrence.
  - Per x movements
  - Per hour of business
  - Per day, week, month, year
  - In relation to what it should have been
  - etc

GAR (IEM) 1.C045, Safety Audits

Audits are an in-depth look at the overall management system. In the context of overall management systems, an internal audit function should be established as a tool to review the safety management and critical safety systems. It is acceptable to employ external resources to perform this function. They should be conducted by independent person(s) with a direct communication link to the Aerodrome Manager. All significant findings should be considered and appropriate remedial action put in place. The effectiveness of remedial actions should be reviewed at regular intervals.

The National Aviation Authority may also wish to audit the Aerodrome. This audit should not take the place of internal safety Audits, but is part of the regulatory authority of the NAA to ensure highest possible safety standards. It should be viewed as an additional useful tool to Aerodrome Management.

GAR (IEM) 1.C047 Safety Promotion

In order to promote safety in the Aerodrome community, lessons learned should be disseminated, not only within the Aerodrome organisation, but also to others, including the National Aviation Authority, through the means of accident/incident reporting.

In combination with lesson learned the Aerodrome organisation should also promote safety goals and objectives.

GAR (IEM) 1.C055, Safety Assurance Documentation (SAD)

All activities need to be documented in order to be able to demonstrate effective safety management when required from the National Aviation Authority. An Aerodrome Operator has total freedom to organise its Aerodrome Manual as long as it is functional from an aerodrome operational view and the results from safety monitoring and corrective actions can be displayed to the National Aviation Authority. Such a system gives continuous opportunities to maintain and improve safety.

GAR (IEM) 1.C020 Safety Assessment and 1.C060 Changes and modifications of a system

1. Background

The Aerodrome Operator should, through its internal assessment function, show compliance with the safety requirements for any system to be operationally used. This can only take place after the applicant has been convinced that the safety requirements are met.

In the safety assessment the term ”Failure condition” is used to indicate a malfunction of “The hardware” or operator functions. It is an internationally accepted terminology for risk assessment.

Failure conditions in Aerodrome systems can be defined quantitatively for certain aspects but not all, particularly those which are procedural and human based.

The basis for the safety assessment originates from the fact that the end result of the safety assessment will have effect on the airworthiness of aircraft and in its origin states the probabilities per Flight hour allowed for failure conditions with various flight safety consequences. All Aviation activities within its main processes – Aerodromes and Ground Aids, Air Traffic Management and Flight Operations contribute to risk for the flight operations process.

For instance, in the flight operations process an aircraft system failure condition, which implies a catastrophe, may not occur more frequently than once in a billion (10^9) Flight hours. One underlying condition is that normally there are less than 100 such failure conditions that can occur in an aircraft which makes it possible that the total probability for a catastrophe due to all failures in an aircraft’s systems is less than once in 10 million (10^7) flight hours. This is also the present statistical result for modern aircraft in the Western world.

2. Assumption for the aerodrome design and operations

In order to draw up the corresponding allowed probabilities for failure conditions in Aerodrome systems the following assumptions could be made:

To start out with, a comparison can be made with applications in the field of Air Traffic Services. The example below is there to give insight into the calculation principle for quantitative determination.

One single active sector or single ATS unit is responsible for 10 aircraft on each occasion on the average. This supports the idea that a failure condition in one single sector or one single ATS unit should not be allowed to contribute to a catastrophe for an aircraft more frequently than once in a hundred million (10^8) working hours. This provided that the number of failure conditions that might lead to catastrophe does not exceed 100 in a single sector or in a single ATS unit. This assumption may be valid for an Aerodrome where quantitative methods are suitable.

Normally a sector/area has not even traffic intensity. It might therefore be more suitable to start from the maximum traffic intensity. For that reason the concept ”operative hour” will be used as defined below instead of ”working hour”, maintaining the same goals concerning safety.

An operative hour comprises an hour when the most engaged sector or area, which will use the system, has its maximum approved traffic intensity. That maximum intensity should be determined and stated by the Aerodrome.

It is assumed that the system maintains the safety level that is a consequence of the goal for an operative hour also during other times.

As a more suitable alternative to the term ”operative hour”, an Aerodrome could sensibly use number of movements per sector as incidents and accidents on or near aerodromes necessarily take place in connection with landings or take-offs, i.e. movements. Aerodromes will also have highly reliable data on movements, whereas, especially smaller aerodromes may find it difficult to define operational hour.

The following are goals for the design of technical systems or Aerodrome systems and equipment:

- A failure condition, which can lead to a **catastrophic or serious occurrence**, may not occur in a sector/area more frequently than $1x10^{-9}$ per operative hour (once in 100 million operative hours).

- A failure condition, which can lead to a **hazardous occurrence**, may not occur in a sector/area more frequently than $1x10^{-7}$ per operative hour.

-A failure condition that can lead to a **major occurrence** may not occur in a sector/area more frequently than $1x10^{-5}$ per operative hour.

- A failure condition which can lead to a **minor occurrence** may not occur in a sector/area more frequently than $1x10^{-3}$ per operative hour and consequently a **Low effect occurrence** can be assumed to take place in less than 10^{-1} per operative hour.

It can sometimes be hard to differentiate between failure conditions which can lead to **catastrophic or serious occurrence** and those which can lead to a **hazardous occurrence**, alternatively between failure conditions which can lead to a **hazardous occurrence** and those which can lead to a **major occurrence**. Analyses should be made however, with the highest possible grade of detail.

3. The safety assessment process in general

3.1 Purpose

The prime concern of both the Civil Aviation Authority and the Aerodrome Operator should be focused on eliminating or minimising conditions at an Aerodrome that contributes to an unacceptable risk level for aircraft. It is the goal of a safety assessment to provide assurances that this is the case.

3.2 Frequency

Safety assessments should be performed both at set-up of an organisation and throughout the life of the organisation.

3.3 Practicalities

Since both the Aerodrome Operator and the Civil Aviation Authority have an interest in how the Aerodrome organisation will be operated, whether it concerns the existing operations or introduction of new elements at the Aerodrome, the Aerodrome Operator should present evidence through a safety assessment process.

A safety assessment process best satisfies both requirements, assessment of existing operations and introduction of new elements.

The requirement for system safety assessment processes can create a competency and a personnel resource gap within the Aerodrome organisation which might create the need for hiring of consultants. Apart from this element in the requirement, there is always a requirement for staff to remain adequately trained and qualified for their work assignments and shouldn't keep the aerodrome management from having the necessary insight and participation in the safety assessment process.

Consequently, it is not advisable that the system safety assessment be outsourced to consultants, although it is recognised that this may have to be the case while the aerodrome operator builds a skill base.

3.4 Qualitative or quantitative safety assessments

When a Safety assessment of a system (Aerodrome or sub-system of the aerodrome) is presented to the Civil Aviation Authority, it can be based on a Qualitative or a Quantitative basis, depending on the circumstances, and be based on the principle of ALARP, "As Low As Reasonably Practicable". It is up to the Aerodrome Operator to choose which basis that is the most suitable with reference to expected achievements.

The safety assessment can be performed as quantitative or qualitative or combinations thereof. Quantitative reasoning can more generally be applied to infrastructures and qualitative where individuals and human processes are involved.

4. The Safety Assessment Methodology

4.1 Introduction

The Safety Management System Requirements in Subpart C to this regulation requires that the organisation should assess all aspects of its operation, and changes to it, for safety significance.

Safety Assessments should be performed and documented to ensure that due consideration is given to the safety of all parts of the system.

The Safety Assessment should be conducted to ensure that the management of any hazards is commensurate with the risk involved and the safety objectives that have been identified.

4.2 Safety assessment process (or risk analysis)

The generic process for a safety assessment is described in the check list below.

2.1 Systematically identify Possible Hazards to aircraft = Hazard Identification.
2.2 Evaluate the seriousness of the consequences of the hazard occurring and consider the chances of it happening = Risk Estimation.
2.3 Determine whether the consequent risk is acceptable and within the organisation's and the Civil Aviation Authority's safety performance criteria = Risk Evaluation.
2.4 If not, take action to reduce the severity of the hazard or the probability of it arising to reduce the risk to an acceptable level = Risk reduction.

For all practical purposes the safety assessment process should be performed having a dialogue between the Aerodrome and the NAA. The procedure can be seen as three steps where the Aerodrome;

Step 1

1. Defines and describes the system to be assessed
2. Establishes a list of compliance with applicable regulations
3. Establishes a preliminary hazard list and safety critical risks
4. Sends Documentation to the NAA

Step 2

1. Sends the documentation to be scrutinized by the NAA
2. Receives a message from the NAA to make the documentation complete and/or continue with the assessment

Step 3

Sends the complete documentation to the NAA and/or receives if so decided an amended Aerodrome Operations Certificate.

4.3 Risk Analysis

Initially, a high level assessment of the reasonably foreseeable hazards should be carried out. Suitable techniques might include:

4.3.1 Checklists

Review experience and available data from accidents, incidents or similar systems and draw up a hazard checklist. Checklists identify potentially hazardous areas, which will require further detailed evaluation.

4.3.2 Group Review

This may be a true brainstorming session or may be based on a review of the checklist. The group should consist primarily of people with as wide a background as possible and chosen for their relevant experience and competence.

4.4 Evaluate the seriousness of the consequences of the hazard occurring.

The consequence of each identified hazard occurring should be assessed for its effect on aircraft safety. The table Safety criticality classification provides the safety criticality classification scheme that systems on aerodromes should be assessed against.

Table, Safety criticality classification

Catastrophic or Serious Occurrence	Hazardous Occurrence	Major Occurrence	Minor Occurrence	Low effect Occurrence
Accident, i.e. loss of or substantial damage to the aircraft and or serious injury or death of occupants. Near accident, i.e. or serious incident where an accident nearly occurs. No safety barriers remaining. The outcome is not under control and could very likely lead to an accident.	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 only one or very few going to none, Minor Injury to occupants and/or minor damage to aircraft may occur. Single fatality or serious injury to occupants may occur.	A significant reduction in safety margins but several safety barriers remains to prevent an accident. Reduced ability of the flight crew to cope with the increase in workload or as a result of the conditions impairing their efficiency. Minor injury to occupants and/or aircraft may occur.	Operating limitations and/or use of alternative or emergency procedures. Only during rare occasions can the occurrence develop into an accident. The occurrence may indicate deficiencies in the Safety management/quality system. Nuisance to the occupants may occur.	No direct or low safety impact. Use of good operational praxis and/or existing safety barriers to avoid safety impact.

One or more of the specified criteria in table Safety criticality classification defines severity classification. The difference between an accident and a serious incident lies only in the result.

4.5 Risk estimation

The probability of occurrence can be defined in both qualitative and quantitative terms.
Numerical (quantitative) methods may be required to further support the analysis of systems, which have the potential to produce catastrophic or hazardous results. For lower levels of classification of risk, qualitative methods will often produce valid and acceptable results.

It will be noted that many of the hazards identified are acceptably mitigated by the application of existing Standards, regulations, procedures or practices.

The table Probability of occurrence illustrates the relationship between qualitative and quantitative probability of occurrence. It is worth noting that either Quantitative or Qualitative methods, as tools of analysis, can achieve more than a demonstration of figures or reasoning based on assumptions. Clearly both ways are indicative and the assessments should be acceptable to the Civil Aviation Authority.

Table, Probability of occurrence

Probability of Occurrence Classification	Extremely improbable	Extremely Remote	Remote	Reasonably probable	Frequent
Qualitative definition	Should virtually never occur.	Unlikely to occur but nevertheless, has to be considered as being possible	Unlikely to occur but may occur several times.	May occur once or a few times.	May occur once or several times.
Quantitative definition	$< 10^{-9}$ per flight hour	10^{-7} to 10^{-9} per flight hour	10^{-5} to 10^{-7} per flight hour	10^{-3} to 10^{-5} per flight hour	10^{-3} per flight hour

The table Probability of occurrence is developed from accepted European and North American Airworthiness standards and is specifically related to the probability of an event occurring during flight. It is considered that the definitions are equally valid for aircraft movements at an aerodrome but with probabilities adapted to movements per sector of the aerodrome.

The actual classification used in a safety assessment should be indicated.

The probability or likelihood for an event to occur can be expressed based on the measure exposure time, operational cycles, per unit or per aircraft movements or other relevant measures

The risk assessment or grading methodology defines the probability or likelihood per Flight hour allowed for a failure or deviation condition related to defined Flight safety consequences. The consequences are defined as Severity, which is not to be considered as the same as the real outcome. The severity should be looked upon as the threat for a possible outcome or consequence. For instance an aircraft system failure condition, which implies a catastrophe, may not occur with a higher probability than once in a billion (10^9) Flight hours. An underlying condition is that it can be assumed that there are less than 100 such failure conditions that can occur in an aircraft, which makes it possible that the total probability for a catastrophe due to all failures in an aircraft's systems is less than once in 10 million (10^7) flight hours. This value corresponds to the present empirical statistical outcome for modern transport category aircraft in the Western world.

When using flight hours for risk exposure quantification it should be stressed that there is a relation between flight hours and number of flights. If the aircraft fleet and route structure is homogeneous and the time period considered is relatively short, in practice let's say 5 years, there is a conversion constant to be determined in the conversion formula below.

A homogenous fleet may be defined as mainly the same class (jets; or another class for turboprops), the same level of weight category and similar type of operation including certain Characteristics. Such Characteristics could be defined as Domestic Short Haul, Domestic Normal and International Short Haul or International Long Distance Flights. The result ends up with a table expressing the conversion constant values, **c**, as defined below for each class created using the proposed structure based on collected real data for the aircraft fleet.

If the following variables are defined:

Flight hours=h
Conversion Constant=c
Number of flights=f

Thus:

h=c x f

The conversion constant expresses thus the average endurance in hours of a flight based on defined conditions mentioned above.

In order to apply this concept to operation on and in the vicinity of an aerodrome it is necessary to make an estimate or measure of the exposure time per each movement to find the value of the constant **k**, in the formula.

To get an empirical value of the exposure data it might be necessary to study the movement flow during a significant time period and measure the actual times spent for each movement on the specific aerodrome or for all aerodromes under consideration. The average value of the time then forms the basis for exposure expressed in time (hours)

Thus:

T= k x m

Where

T=exposure time (hours)
m=number of movements
k=empiric constant

Unit of measurement of probability

Probability (formally a number between 0 and 1) is usually expressed in terms of pr (million) flight hours. This in reality is probability given an exposure.

When talking safety in connection with aerodromes, it is more fruitful to express probability in terms of movements (or million of movements).
It is sensible to do so for two reasons.
Firstly, an incident/accident at an aerodrome usually takes place in connection with take-off or landing, i.e. in connection with movements.
Secondly, aerodromes usually have good statistical data on movements, as these data form the basis for income (landing fees).
Probability can also be expressed in qualitative terms like Extremely Improbable, Extremely Remote, Remote, Reasonably Frequent or Frequent, as presented in Table Probability of occurrence

4.6 Determine whether the consequent risk is acceptable and within the organisation's acceptable safety performance criteria.

Once the severity of a hazard has been assessed and the probability of it arising has been estimated, a judgement can be made on whether the consequent risk is acceptable or not, and whether it can be further reduced at reasonable cost.
Common sense dictates that a major consequence of an undesired event with a high probability of occurrence is unacceptable; however, it may be tolerable if the probability of occurrence is very low although it may be undesirable.

The process of judging acceptability of risks and the results can be presented in tabular form as illustrated below:

Table, Risk Assessment Matrix

Catastrophic or serious occurrence	Unacceptable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Hazardous Occurrence	Review	Review	Unacceptable	Unacceptable	Unacceptable
Major Occurrence	Acceptable	Review	Review	Review	Unacceptable
Minor Occurrence	Acceptable	Acceptable	Acceptable	Review	Review
Low effect Occurrence	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
	Extremely Improbable	**Extremely Remote**	**Remote**	**Reasonably Probable**	**Frequent**

The words acceptable and unacceptable are self-explanatory. The term “review” means that if a scenario falls into a review category, an exercise should be carried out to see if it is possible to put in place mitigating measures to either reduce the probability or the consequences (or both) of the scenario in order to reclassify it as acceptable.

4.7 Measures to reduce the severity of the hazard or the probability of it arising, to reduce the risk to a tolerable level (managing risks).

Where the table indicates that the risk is currently unacceptable, action should be taken to reduce the probability of occurrence and/or the severity of the hazard. If neither mitigating measure is available, the system clearly does not satisfy the safety objectives. In any process where judgement is applied there will be situations where the tolerability is not clearly defined. An issue that falls into this area of uncertainty is likely to require, before implementation, the endorsement of the individual ultimately accountable for safety within the organisation.

Even if the risk falls within the “review” or “acceptable” categories, an effort should be made to further reduce the risk to ALARP. Safety assessments should be reviewed when conditions change, or at a frequency as determined by the Safety Management System.

When addressing the safety assessment, especially when it comes to huge and complex systems, the task can seem to be too enormous to deal with. The wise thing to do might be to establish a plan on how to perform the whole safety assessment, although it is not a requirement per se. Since the safety assessment process can be rather lengthy in time and comprising several subsystems to be dealt with,

it is convenient to handle the systems in small portions when seeking the approval from the Civil Aviation Authority. When the safety assessment process in finished the aerodrome operator has a "Case" to present or argue to the Civil Aviation Authority which is called in generic terms a "Safety Case".

The Safety Case

In order to satisfy the Safety Management Requirements, it is advisable to establish a safety plan that corresponds to the work to be accomplished. The Civil Aviation Authority may require that the safety assessment of the system be manifested as a Case i.e. Safety Case

The Safety Case is a document giving evidence that systems or equipment fulfil the requirements for Aviation Safety.

The Safety Case can comprise analysis reports, test protocols, certificates of test, calculations or descriptions of constructions and so forth. If judged appropriate, reference can be made to other collections of documents.

The Safety Plan

The Safety Plan is a document which presents and defines safety responsibility, procedures for management and operators engaged in the design, installation and maintenance of a system with its components for the duration of its technical and operational life.

(i)The Safety Plan can be:

- Included as a part of a Safety Management System, preferably within or at least referenced to the Aerodrome Manual through the SAD.
- Included as a separate document or part of a Quality System, but identifiable as a safety plan cross-referenced to the SMS.

(ii) The Safety Plan should present statements concerning:

a) Scope and purpose of the Safety Plan.
b) Policies and strategies along with the methods for analysis and assessment and in which way this is going to be disseminated throughout the organisation to create a safety culture.
c) Organisational entities and staff with defined safety responsibilities to oversee the procedures and take action at detection of variations.
d) Description of the relation between the Civil Aviation Authority and the Aerodrome.
e) Description of the established safety procedures.
f) Procedures for:

    1. How the organisation's safety plan will apply through the life cycle of a system.
    2. Assurance of the competency of the staff with regard to design, installation and maintenance of a system with its components.
    3. Analysis and assessment of hazardous and potentially hazardous events to eliminate or minimise reoccurrence of risks.
    4. Monitoring and analysis of operation and maintenance for systems.
    5. Initiation of modifications to systems with internal approval for systems
    6. Measures for training and information both internally and externally.

END

Terms and definitions to be included into Subpart A.

- Aerodrome Management: The function at an aerodrome together with the aerodrome manager established to manage the day to day business
- Aerodrome Manager: The person appointed to be the person accountable for the aerodrome.
- Airside: An area specified in the Aerodrome Certificate documentation.
- Aerodrome Operator: The holder of an approval to operate an aerodrome issued by the national aviation authority.
- ALARP: "As Low As Reasonably Practicable". The risk in a particular activity can be balanced against the time, cost and difficulty of taking measures to avoid the risk. The greater the risk to safety, the more likely it is that it is reasonable to go to substantial efforts to reduce it.
- **Hardware: Tangible entities constructed and installed for production purposes**.
- Hazard: "A hazard is a scenario which, if it occurs, can have negative consequences to personnel, material or the environment".
- Regulator: The national aviation authority with the mandate to regulate and oversee the approved certificate holders
- Risk: The combination of probability and severity
- Risk Assessment: see safety assessment
- Safety assessment: A systematic, comprehensive evaluation of an implemented system to evaluate whether the safety requirements are met.
- Safety Assurance: The actions of a service provider to ensure that all necessary safety measures are taken.
- Safety audit: An inspection activity encompassing a certificate holder's systems by the regulator or the service provider to ascertain fulfilment of requirements.
- Safety case: Documenting evidence, arguments and assumptions to show that system or equipment hazards have been identified and controlled, both in engineering and operational areas and those safety requirements have been satisfied.
- Safety level, or level of safety: A level of how far safety is to be pursued in a given context, assessed with reference to an acceptable risk, based on current values of society.
- Safety management: Systematic measures undertaken by an organisation in order to attain and maintain a level of safety that complies with defined objectives. (wp066)
- Safety management system: Entirety of the organisational structure, responsibilities, procedures, processes and provisions for the implementation of the operation of the license certificate holder, which provides for control of safety at, and the safe use of, the aerodrome and in addition for the control of overlaps with other aspects relevant to operations so as to achieve continuous improvement in safety performance.
- Safety objective: The planned and considered goal that has been set by a design or project authority.
- Safety Performance Indicator: A specific parameter or indicator which can be used to assess the level of safety.
- Safety Policy: Defines the fundamental approach to managing safety and that is to be adopted within an organisation and its commitment to achieving safety. (NATS)

- Service provider: The production entities within the aviation community operating or delivering services.
- Safety Requirement: The regulatory text established by the aviation safety authority in order to regulate the service provider and give the authority enforcement possibilities.
- Safety Significance: Properties of a technical or operational entity or system that can affect safety in a way that can not be omitted
- Software: Entities of intangible nature constructed and installed for production purposes
- System: An entity consisting of parts – equipment units, methods, procedures, activities, groups , individuals etc – chosen and assembled in such a way that the entity can perform a specific assignment.
- Safety System analysis: A measure or action taken to determine the safety level of a system against a safety objective.
- Products: Products are defined as goods and services