International Civil Aviation Organization

Aerodrome Safety & Planning Implementation Group

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Agenda Item 5: Implementation of Aerodrome Safety Priorities and Objectives

AERODROME SAFETY ASSESSMENT

(Presented by Sudan)

SUMMARY

This Paper provides material of factual information and references to Sudan Civil Aviation Regulations (SUCARs) Part 14, Subpart 1, on the specifications related to the development of an aerodrome safety assessment, and its use.

Action by the meeting is at paragraph 3.

REFERENCES

- ICAO Airport Design Manual Doc. 9157
- ICAO Manual Aerodromes Doc. 9981
- ICAO Manual Aerodromes Doc. 9859
- SUCAR 14 – Aerodromes
- SMS Regulation SUCAR 19

1. INTRODUCTION

1.1 Regulations of SUCAR Part 14, subpart 1 requires that a when the aerodrome accommodates an aeroplane that exceeds the certificated characteristics of the aerodrome, the compatibility between the operation of the aeroplane and aerodrome infrastructure and operations shall be assessed.

1.2 Also, SUCAR Part 14, subpart 1 requires that an application for an exemption be supported by an aerodrome safety assessment.

1.3 To facilitate a proper understanding and usage of the aerodrome safety assessment, Sudan Civil Aviation Safety Publication explains the concept of the method and how the aerodrome safety assessment is developed. It also discusses guidance for development of compatibility study.

2. DISCUSSION

2.1 Application for Exemptions

2.1.1 *Forms of Application*

a) an aerodrome operator who wishes to apply for an exemption from one or more requirements of the Sudan Civil Aviation Regulations (SUCAR) Part 14, may submit its application in the form prescribed by the Authority; and
b) the forms are available at the Directorate of Aerodrome Safety & Standards (DASS), Sudan Civil Aviation Authority (SCAA).

2.1.2 *Documents to be Submitted Together with the Form*

a) An application for exemption is to be accompanied with an aerodrome safety assessment.

2.2 Aerodrome safety assessment

2.2.1 *Outline of the Structure of the Aerodrome Safety Assessment*

a) An aerodrome safety assessment shall include as minimum the following 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.

2.2.2 *STEP 1: A Description of the Safety Concern*

a) In case of a non-compliance, the aerodrome operator identifies the aerodrome design, or facilities or services specifications that cannot be complied with, and the safety implications of not complying with such requirement (s). The objective of the aerodrome safety assessment shall be to identify the safety risks, and alternative means of compliance, to mitigate these safety implications.

b) 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.

c) 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.

d) An initial evaluation of compliance with the appropriate provisions in the regulations applicable to the aerodrome is conducted and documented.

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

f) 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 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.

2.2.3 ***Step 2: Hazard Identification and Analysis***

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) The initial identification of the hazards related to the non-compliance to the aerodrome design, or facilities or services specifications is based on analysis of past outcomes and events during the intended aircraft operations or similar operations at other aerodromes. The initial analysis can be complemented with an analysis of existing or real-time situations, through audits, evaluations, employee reporting, and associated analysis and assessment processes of the intended aircraft operations. It can then be followed by data gathering in order to identify possible negative future outcomes or events, analysing system processes and the environment to identify potential future hazards.

2.2.4 ***Step 3: Risk Assessment and Mitigation Measures***

a) The aerodrome operator specifies the safety risks and mitigating measures to be put in place to address the safety implications identified in step 1.

b) **Safety Risks:** Once the hazards have been identified, their consequences must be assessed to determine the safety risks which are the projected likelihood and severity of the consequences or outcomes from the identified hazards. While the outcomes may be an accident, an “intermediate unsafe event/consequence” may be identified as “the most credible outcome”.

c) **Safety Risk Probability:** The safety risk probability is the likelihood or frequency that a safety consequence or outcome might occur. The determination of likelihood of a safety risk can be aided by analysing the history occurrences during similar operations, caused by equipment, procedures, or operational context similar to those to be used or in place at the aerodrome. Table 2-1 presents a typical safety risk probability table. It includes five categories to denote the probability related to an unsafe event or condition, the description of each category, and an assignment of a value to each category. The aerodrome operator may opt to use a different categorization. In this case, an explanation of the values and meaning of each category must be provided.

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

Table 2-1 – Safety risk probability table

d) **Safety Risk Severity:** The safety risk severity is the extent of harm that might reasonably occur as a consequence or outcome of the identified hazard. The severity assessment needs to consider all possible consequences related to the hazards identified for the non-compliance, taking into account the worst foreseeable situation. It can be based upon:

i. Fatalities/injury. How many lives may be lost (employees, passengers, bystanders and the general public)?
ii. Damage. What is the likely extent of aircraft, property or equipment damage?

- Table 2-2 presents a typical safety risk severity table. It includes five categories to denote the severity related to an unsafe event or condition, the description of each category, and an assignment of a value to each category. The aerodrome operator may opt to use a different categorization. In this case, an explanation of the values and meaning of each category must be provided.

Severity	*Meaning*	*Value*
Catastrophic	• Aircraft / equipment destroyed • Multiple deaths	A
Hazardous	• A large reduction in safety margins, physical distress or a workload such that operational personnel cannot be relied upon to perform their tasks accurately or completely • Serious injury • Major equipment damage	B
Major	• A significant reduction in safety margins, a reduction in the ability of operational personnel to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency • Serious incident • Injury to persons	C
Minor	• Nuisance • Operating limitations • Use of emergency procedures • Minor incident	D
Negligible	• Few consequences	E

Table 2-2 – Safety Risk Severity Table

e) **Safety Risk Matrix:** The aerodrome operator uses the safety risk probability and severity assessment process to derive a safety risk index. The index created through the methodology described above consists of an alphanumeric designator, indicating the combined results of the probability and severity assessments. The respective severity/probability combinations are presented in the safety risk assessment matrix in table 2-3. The aerodrome operator may opt to use a different matrix. In this case, an explanation of the values and meaning of each category must be provided.

Safety Risk		*Severity*				
Probability		*Catastrophic A*	*Hazardous B*	*Major C*	*Minor D*	*Negligible E*
Frequent	5	5A	5B	5C	5D	5E
Occasional	4	4A	4B	4C	4D	4E
Remote	3	3A	3B	3C	3D	3E
Improbable	2	2A	2B	2C	2D	2E
Extremely improbable	1	1A	1B	1C	1D	1E

Table 2-3 – Safety Risk Assessment Matrix

f) **Safety Risk Identification Process:** The safety risk assessment is to be conducted by personnel (preferably a group of personnel) trained in safety risk assessment and knowledgeable of the types of aircraft operations, other activities at the aerodrome as well as possessing technical knowledge on the aerodrome design, or facilities or services specifications.

g) Once each hazard has been identified and analyzed 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.

h) All risk mitigation measures, whether currently being applied or still under development, are evaluated for the effectiveness of their risk management capabilities.

i) Mitigating **measures are generally:**

- Internal processes/procedures: introduction of new, or modification of existing internal processes o procedures,
- Training: design new training programme or review existing one,
- Technology: acquire new technology such as equipment, or revise the use of existing one, or
- Any combination of the three.

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

2.2.5 ***Step 4: Implementation Plan***

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.

c) The aerodrome operator reviews the mitigation measures listed in step 3 against the safety implications identified in step 1 in order to evaluate their relevance and effectiveness in addressing the safety implications.

2.3 Acceptance of an Aerodrome Safety Assessment

a) A safety assessment shall be submitted by the aerodrome operator to the acceptance of the Authority prior to implementation.

b) The Authority analyses the safety assessment and verifies that:
- appropriate coordination has been performed between the concerned stakeholders;
- the risks have been properly identified and assessed, based on documented arguments (e.g. physical or Human Factors studies, analysis of previous accidents and incidents);
- the proposed mitigation measures adequately address the risk; and
- the time frames for planned implementation are acceptable.

c) On completion of the analysis of the safety assessment, the Authority:
- either gives formal approval or acceptance of the safety assessment to the aerodrome operator; or
- if some risks have been underestimated or have not been identified, coordinates with the aerodrome operator to reach an agreement on safety acceptance; or
- if no agreement can be reached, rejects the proposal for possible resubmission by the aerodrome operator; or
- may choose to impose conditional measures to ensure safety.

2.4 Compatibility Study

2.4.1 ***Requirements for a Compatibility Study***

a) A compatibility study is required when the aerodrome intends to accommodate an aeroplane that exceeds the certificated characteristics of the aerodrome.

2.4.2 ***Scope of a Compatibility Study***

a) The objective of the compatibility study is to assess the compatibility between the operation of the intended aeroplane and aerodrome infrastructure and operations. It follows the procedure outlined below:
- identify the aeroplane's physical and operational characteristics;
- identify the applicable requirements under SUCAR PART 14, subpart 1;
- establish the adequacy of the aerodrome infrastructure and facilities vis-à-vis the requirements of the new aeroplane;
- identify the changes required to the aerodrome;

- document the compatibility study; and
- perform the required safety assessments identified during the compatibility study following the guidelines provided in section 2.

2.5 Consideration of Aeroplane's Physical Characteristics

2.5.1 The aeroplane's physical characteristics may influence the aerodrome dimensions, facilities and services in the movement area. These characteristics include:

a. The **fuselage length**, which may have an impact on the dimensions of the movement area (taxiway, holding bays and aprons), passenger gates and terminal areas; the aerodrome category for Rescue and Fire Fighting; ground movement and control (e.g. reduced clearance behind a longer aeroplane holding at an apron or a runway/intermediate holding position to permit the passing of another aeroplane); and clearances at the aircraft stand.

b. The **fuselage width** which is used to determine the aerodrome category for Rescue and Fire Fighting (RFF).

c. The **door sill height** which may have an impact on the operational limits of the air bridges; mobile steps; catering trucks; persons with reduced mobility; and dimensions of the apron.

d. The **nose characteristics** which may have an impact on the location of the runway-holding position of the aeroplane which should not infringe the Obstacles Free Zone.

e. The **tail height** which may have an impact on the location of the runway-holding position; ILS critical and sensitive areas; the dimensions of aeroplane maintenance services; aeroplane parking position (in relation to aerodrome Obstacles Limitation Surfaces); runway/parallel taxiway separation distances; and the clearance of any aerodrome infrastructure or facilities built over stationary or moving aeroplanes.

f. The **wingspan** which may have an impact on taxiway/taxilane separation distances (including runway/taxiway separation distances); the dimensions of the Obstacles Free Zone (OFZ); the location of the runway-holding position (due to the impact of the wingspan on OFZ dimensions); the dimensions of aprons and holding bays; wake turbulence; gate selection; aerodrome maintenance services around the aeroplane; and equipment for disabled aeroplane removal.

g. The **wing tip vertical clearance** which may have an impact on taxiway separation distances with height-limited objects; apron and holding bay clearances with height-limited objects; airfield signage clearances; and service road locations.

h. The relevant geometric parameters to assess the cockpit view are cockpit height, cockpit cut-off angle and the corresponding obscured segment. The **cockpit view** may have an impact on: runway visual references (aiming point); runway sight distance; taxiing operations on straight and curved sections; markings and signs on runways, turn pads, taxiways, aprons and holding bays; the number and spacing of visible lights when taxiing in low visibility conditions; and calibration of PAPI/VASIS (pilot eye height above wheel height on approach).

i. The **distance from the pilot's eye position to the nose landing gear** which is relevant for taxiway fillets (wheel track); the dimensions of aprons and holding bays; and the dimensions of turn pads.

j. The aeroplane **landing gear design** is such that the overall mass of the aeroplane is distributed so that the stresses transferred to the soil through a well-designed pavement are within the bearing capacity of the soil. The landing gear layout also has an effect on the manoeuvrability of the aeroplane and the aerodrome pavement system.

k. The **outer main gear wheel span** which may have an impact on the runway width; the dimensions of turn pads; taxiway width; taxiway fillets; the dimensions of aprons and holding bays; and the dimension of the OFZ.

l. The **wheelbase** which may have an impact on the dimensions of turn pads; taxiway fillets; the dimensions of aprons and holding bays; and terminal areas and aeroplane stands.

m. The **gear steering system** which may have an impact on the dimensions of turn pads and the dimensions of aprons and holding bays.

n. The **engine characteristics** include engine geometry and engine airflow characteristics, which may affect aerodrome infrastructure as well as ground handling of the aeroplane and operations in adjacent areas which are likely to become affected by jet blast. The engine geometry aspects are the number of engines; the location of engines (span and length); the vertical clearance of engines; and the vertical and horizontal extent of possible jet blast or propeller wash. The engine airflow characteristics are idle, breakaway and take-off thrust exhaust velocities; thrust reverser fitment and flow patterns; and inlet suction effects at ground level. The engine characteristics may be relevant for the following aerodrome infrastructure and operational aspects such as runway shoulder width and composition (jet blast and ingestion issues during take-off and landing); shoulder width and composition of runway turn pads; taxiway shoulder width and composition (jet blast and ingestion issues during taxiing); the dimensions and location of blast protection fences; the location and structural strength of signs; the characteristics of runway and taxiway edge lights; the separation between aeroplanes and adjacent ground service personnel, vehicles or passengers; the design of engine run-up areas and holding bays; the design and use of functional areas adjacent to the maneuvering area; and the location of refueling pits on the aircraft stand.

o. The maximum **passenger- and fuel-carrying capacity** which may have an impact on terminal facilities; fuel storage and distribution; aerodrome emergency planning; aerodrome rescue and firefighting; and air bridge loading configuration.

p. The **flight performance** which may have an impact on runway width; runway length; the OFZ; runway/taxiway separation; wake turbulence; noise; and aiming point marking.

2.6 Consideration of Aeroplane Operational Characteristics

2.6.1 The operational characteristics can include the infrastructure requirements of the aeroplane as well as ground servicing requirements. These characteristics include ground servicing characteristics and requirements may affect the available aerodrome infrastructure. This list is not exhaustive; additional items may be identified by the stakeholders involved in the compatibility assessment process:

a) ground power;
b) passengers embarking and disembarking;
c) cargo loading and unloading;
d) fueling;
e) pushback and towing;
f) taxiing and marshalling;
g) aeroplane maintenance;
h) Rescue and Fire Fighting;
i) equipment areas;
j) stand allocation; and
k) disabled aircraft removal.

2.7 Aerodrome Physical characteristics

2.7.1 The aerodrome physical characteristics shall be included in the evaluation process. These characteristics include:

1. Runway length;
2. Runway width;
3. Runway shoulders;
4. Runway turnpads;
5. Runway strip dimensions;
6. Obstacles in the runway strips;
7. Runway end safety areas;
8. Taxiways system, taxiways curves, taxiways shoulders, and taxiways strips;
9. Taxiways and runways separation distances;
10. Taxiways and taxilane minimum separation distances;
11. Clearance on aircraft stands; and
12. Pavement design.

2.8 Outcomes of a Compatibility Study

2.8.1 The compatibility study aims at enabling decisions to be made and must provide:

a) the aerodrome operator with the necessary information in order to make a decision on allowing the operation of the specific aeroplane at the given aerodrome;
b) the aerodrome operator with the necessary information in order to make a decision on the changes required to the aerodrome infrastructure and facilities to ensure safe operations at the aerodrome with due consideration to the harmonious future development of the aerodrome; and
c) the Authority with the information which is necessary for its safety oversight and the continued monitoring of the conditions specified in the aerodrome certification.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information in this working paper;

b) agree on the SCAA practices; and

c) take appropriate actions to encourage States for the important of aerodrome safety assessment to be implemented.

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