NAMIBIAN CIVIL AVIATION AUTHORITY

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SAFETY PERFORMANCE INDICATORS (SPIs) AND ESTABLISHING AMEASURABLE EFFECT

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4. Safety Management Systems and Occurrence Reporting is set out in the Schedule attached hereto.

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SCHEDULE

1. INTRODUCTION

1.1. This advisory pamphlet provides guidance material to Operators and Organization for establishing, implementing, and maintaining the performance monitoring and measurement components of an SMS system and the management of occurrence reporting.

2. BACKGROUND

2.1. All aviation organisations and operators, from airline operators to aviation recreational organisations, aircraft maintenance organisations to aerodrome operators, are required under Namibian Civil Aviation Regulation Part 140 to establish, implement, and maintain a Safety Management System (SMS).

2.2. NAMCATS-SMS 140.02.3 details the requirement for establishing approved Safety Performance Indicators (SPIs) and Targets (SPTs) as follows:

Component 5.3 Safety Performance Monitoring and Measurement – Element 3.1(i), the participant, document holder or service provider must:

5.3.1 Establish internal occurrence reporting and investigation procedure. This may include mandatory or major defect reports (MDR) where applicable.

5.3.2 Establish safety data collection, processing, and analysis for high consequence outcomes.

5.3.3 Establish high-consequence safety indicators (initial AloSP) and their associated target and alert settings. Examples of high consequence safety indicators are such as accident rates, serious incident rates, and monitoring of high-risk noncompliance outcomes.

5.3.4 Agreement reached with the NCAA on safety performance indicators and safety performance targets.

2.3. This document is created to assist operators and organisations in establishing and updating SPIs and SPTs and thus working to establishing and continually improving an Acceptable Level of Safety Performance (ALoSP).

3. REFERENCES

3.1. The following documents have been referenced in creating this advisory pamphlet. Those responsible for establishing and implementing SMS should become familiar with these documents:

a) NAMCAR and NAMCATS Part 140;

b) Safety Management Manual ICAO Document 9859;

c) ICAO Annex 19;

d) ICAO Doc 10004 – GASP, 2023-2025 Edition;

e) NCAA Advisory Pamphlet FSS-SPQ-140-01;

f) Forms FSS-GEN-FORM-603-03, 603-04, 604-02, 604-04.

Note 1. If you need access to any of these documents and cannot find them please do contact spq@ncaa.na.

4. DEVELOPING SPIs and SPTs

4.1. **Data Capturing and Analysis**

4.1.1. It is important to have an effective reporting system and a mechanism for capturing the data input to the SMS and for ensuring data can be easily analysed so that any recurrent trends can be established. Only with sufficient data can SPIs truly address your organisation's key safety risks.

4.1.2. For a simple system, a spreadsheet is effective in completing data analysis. An example of a simple safety spreadsheet can be found on the NCAA website, https://www.ncaa.com.na.

4.1.3. For more complex systems a dedicated database may be required. This can be established in-house, or contracted, there are many services offering database management for safety occurrences.

4.1.4. The output from your data management system should be a document called the occurrence and hazard register. This may be two separate documents or one master document containing sections for occurrences and hazards.

4.1.5. Data must include all available sources, for example, not just occurrence reports, but hazard register, audit findings, surveys, observations, training reports, etc. The data must be cast as wide as possible.

4.1.6. Only from effective data capture and analysis can the system monitor Safety Performance Indicators and react proactively when alert levels are reached.

4.2. **Safety Performance Indicators and Targets**

4.2.1. As the SMS matures your safety performance indicators and targets can grow and develop. Ideally you will see a reduction in safety critical occurrences as safety and operational training address the hazards established, and thus safety performance targets can be lowered accordingly.

4.2.2. While there should be a reduction in incidents there may also, as the SMS matures, be an increase in hazard reports and minor pre-cursor occurrences as the users become more proficient at recognising hazards before they become incidents moving into the aspired for predictive phase.

4.2.3. While establishing the SMS, SPIs and SPTs are initially guess work, when maintaining an SMS you can utilise all data captured for identifying critical SPIs and use occurrence levels or trends established to determine effective SPTs and alerts.

4.2.4. As a rough guideline, unless you plan to implement some form of drastic change which is projected to affect occurrence levels, it is recommended for a target to be set at 10% below the average for the preceding period.

4.3. **Leading and Lagging Indicators**

4.3.1. It is essential that indicators are both leading and lagging. Lagging indicators are measuring safety events, for example the number of bird strikes or the number

4.4. **Smart Objectives and Indicators**

4.4.1. SPIs and SPTs should follow the S.M.A.R.T concept, that is, specific, measurable, achievable, relevant, and time bound.

4.5. **Alert Levels**

4.5.1. ICAO's Safety Management Manual, (Doc 9859) refers to establishing alerts using the "Standard deviation method".

4.5.2. The standard deviation may be calculated using the formula below or using the calculation functions in a spreadsheet.

Formula	Explanation
$\sigma = \sqrt{\frac{\sum (X - \mu)^2}{N}}$	• σ = population standard deviation • $\sum$ = sum of... • X = each value • μ = population mean • N = number of values in the population

4.5.3. Once the standard deviation is calculated, ICAO recommends setting alerts based on:

4.5.3.1. The average plus one standard deviation not more than three times;

4.5.3.2. The average plus two standard deviations not more than twice;

4.5.3.3. The average plus three standard deviation not more than once.

4.5.4. When an alert is breached, the safety manager must take additional action, this could be calling an extra-ordinary meeting of the Safety Action Group or Safety Review Board, advising the accountable manager,

creating a detailed HIRM and CAP to determine required action, or normally all three.

4.6. **Moving from Reactive to Proactive and Predictive**

4.6.1. When SMS is completely effective the system will move from reactive, that is, only reacting only after an occurrence, to proactive, identifying hazards and acting before they become an occurrence, and predictive, projecting hazards from data trends.

4.6.2. A proactive SMS system will trap and identify hazards prior to incidents occurring. This can be in two ways. From complete and comprehensive analysis of occurrences to identify all the latent hazards that exist and by proactive trapping of hazards through user hazard reports.

4.6.3. A proactive system will create barriers and implement risk mitigation from occurrences and hazard reports prior to repeat occurrences.

4.6.4. A key component of the proactive safety system is a hazard register. This register will record hazards related to reports received and track barriers and mitigation implementation to effectively reduce risks to as low as reasonably practicable (ALARP).

4.6.5. To become predictive an organisation has to evaluate risks from normal operational data and discover hazards before they become incidents or accidents. This is an advanced stage of SMS and relies on comprehensive data collection and analysis and hazard recognition. Predictive SMS can also be exercised in the evaluation of risks in management of change.

4.7. **Relationship of Quality Management System**

4.7.1. It must be remembered that a robust quality management system (QMS) provides the tools and framework for SMS. The quality system provokes continual improvement and identifies the root cause of deficiencies which should feed into the hazard register. It is essential to ensure a link between the quality system and safety system – auditing by the former of the latter, inclusion of findings in the safety data collection and processing system, and ensuring continual improvement of processes.

4.8. **Key Performance Indicators versus Safety Performance Indicators**

4.8.1. When developing Safety Performance Indicators, it is important not to confuse SPIs with KPIs. SPIs are used to monitor and assess safety performance, while KPIs are used to monitor an organization's overall performance against its strategic goals and objectives. KPIs form part of the quality system or strategic business plan, whereas SPIs are an integral and ingrained component of the SMS.

4.9. **Information Sharing**

4.9.1. A key component of maintaining an SMS system is communication and information sharing. The organisation should have systems in place to communicate safety information from within the company and from external organisations such as safety bodies, CAAs, or manufacturers.

4.10. **Types of Occurrence Reporting**

4.10.1. A safety system needs a solid method of reporting occurrences and hazards both internally to the company safety department and externally to the responsible government departments, in our case NCAA and DAAII. Only with regular and all encompassing reporting across the board in your organisation will you be able to develop effective SPIs and SPTs.

4.10.2. The reporting system must be available for both hazards and occurrences and part of safety promotion is to encourage hazard identification.

4.10.3. A robust reporting system must make available confidential reports since no matter how sound your safety culture is there may still be times reporters do not want to identify themselves

4.10.4. A good way of establishing a confidential electronic reporting system for smaller operators, where a completely confidential database is not feasible, is to set up an email account that all users have the login. Therefore, any user can login to the account and send an anonymous email to the safety manager or safety department and the user's identity will remain confidential. NCAA maintains a confidential reporting system on the website, www.ncaa.com.na, whereby the completed form can be submitted online without any trace to the reporter. For hard copies a physical drop box is also recommended.

4.10.5. While confidential reporting is essential, a non-punitive reporting system, and a reporting culture is of vital importance, whereupon users are not afraid to report, for it is far more useful for investigation purposes to have the reporter's details.

4.10.6. An email group should be set up for sharing important safety reporting information with the safety user group, and with the safety management groups or safety committees.

4.10.7. Original reports should be kept in a secure location or a secure folder with login access by the safety manager and key safety personnel alone. Deidentified reports can then be created from the original reports for sharing with users in a group folder.

4.11. **Reporting Culture**

4.11.1. An effective safety management system is driven by reports. Only with the establishment of a reporting-culture can the SMS be maintained to its optimum level. With a reporting-culture the SMS should be able to capture hazards before they become occurrences and thus move from reactive to proactive and predictive.

4.11.2. To develop a reporting culture, participants are encouraged to ensure reporting is a topic at all user meetings. This will include feedback on reports filed, any trends established, and providing users with reasoning behind new procedures or barriers established for mitigation (including management of change).

4.11.3. The SMS requires encouragement of all users to keep vigilant and be mindful of the concept: "**when in doubt – report**". Users should be encouraged to include as many details as possible on reports, and with a reporting culture anonymity should not be required with a non-punitive policy, however it should also be readily available for those who need it so that learning is possible from all events.

5. Globally Aligned Metrics:

5.1. The National Aviation Safety Plan has some globally and some locally aligned metrics. While it is understood that these may not apply to every organisation, since a metric that is consistently zero or 100% is not considered monitorable they should still be considered when developing metrics, and in

many cases precursor events can also be tracked for alignment, for example unstable approaches, terrain warnings, or TCAS alerts, regardless of whether they were considered an actual event, they are all precursors to an event.

5.2. The following categories of recommended globally and nationally aligned metrics shall be considered:

a. Bird strikes and wildlife encounters;
b. Runway incursions;
c. Runway excursions;
d. Abnormal runway contact;
e. Loss of separation;
f. Maintenance / Technical events;
g. Loss of control in flight;
h. Controlled flight into terrain;

6. SUMMARY

6.1. SMS in aviation is not so much a process as a way of life and should be an integral part of every participant in your aviation organisation, from users to employees to senior managers. Only working together with a proactive safety culture can an organisation grow and establish an effective safety management system.

6.2. The NCAA actively seeks your contribution, communication, and reporting with respect to your safety management system. If you have any information you wish to share or any questions on the content herein, please contact your assigned safety inspector, and/or our safety promotion and quality (SPQ) department at spq@ncaa.na. The growth of our state safety program (SSP) depends on your contribution.

APPENDIX 1 EXAMPLES OF SAFETY PERFORMANCE INDICATORS AND TARGETS

EXAMPLE 1 Estimations of Alerts in Eary Phases

Alert levels → Indicator ↓	Alert Level 0 Low risk (target)*	Alert Level 1 moderate risk*	Alert Level 2 high risk*
Hazard identification rate	10 Per 200 flight hours	5 Per 200 flight hours	2 Per 200 flight hours
Safety training completion rate	100%	75%	50%
Air Proximity Event reports (Air Prox.)	1 Per 2000 flight hours	2 Per 2000 flight hours	3 Per 2000 flight hours
FOD encountered on runway, taxiway, or apron	1 Per 1000 flight hours	3 Per 1000 flight hours	4 Per 1000 flight hours
Runway Incursion	1 Per 2000 flight hours	2 Per 2000 flight hours	3 Per 2000 flight hours
Number of safety meetings held over preceding 12 months	12 safety meetings 12 safety committee meetings	8 safety meetings 8 safety committee meetings	6 safety meetings 6 safety committee meetings

*Once service providers have a full year of data these figures can be replaced by metrics, for example target should be approximately 10% below previous year. Alert levels would be first, second, and third standard deviations.

EXAMPLE 2 HRC with numerical data and SD method applied)

		Airprox/LOS A	CFIT	Rwy Excurs.	Wildlife	LOCI	Rwy Incurs.	Maint & Tech
49758	**Average**	0.122	0.000	0.105	0.855	0.121	0.161	2.531
3715	**JAN '23**	0.000	0.000	0.269	1.346	0.000	0.000	3.769
3646	**FEB '23**	0.000	0.000	0.274	1.097	0.549	0.549	1.646
4291	**MAR '23**	0.233	0.000	0.000	1.398	0.000	0.233	3.030
4308	**APR '23**	0.232	0.000	0.000	0.696	0.000	0.000	2.089
4813	**MAY '23**	0.000	0.000	0.000	0.623	0.208	0.208	1.247
4141	**JUN '23**	0.483	0.000	0.000	0.966	0.241	0.000	3.381
4248	**JUL '23**	0.000	0.000	0.000	0.471	0.235	0.471	1.177
4569	**AUG '23**	0.000	0.000	0.000	0.438	0.219	0.000	2.408
3809	**SEP '23**	0.000	0.000	0.263	0.525	0.000	0.000	1.838
4194	**OCT '22**	0.238	0.000	0.000	1.192	0.000	0.477	3.577
4388	**NOV '22**	0.000	0.000	0.456	0.684	0.000	0.000	3.191
3636	**DEC '22**	0.275	0.000	0.000	0.825	0.000	0.000	3.025
	Target 2023	0.276	0.152	0.123	1.795	0.110	0.138	1.958
	Avg 2022	0.315	0.192	0.137	1.106	0.094	0.145	2.198
	SD 2022	0.279	0.208	0.172	0.599	0.141	0.237	0.719
Three of	**Alert 3**	0.593	0.399	0.310	1.705	0.236	0.382	2.917
Two of	**Alert 2**	0.872	0.607	0.482	2.305	0.377	0.619	3.636
One	**Alert 1**	1.151	0.815	0.654	2.904	0.518	0.856	4.354