GUIDANCE MANUAL FOR CONDUCTING SAFETY RISK MANAGEMENT ACTIVITIES IN AIR TRAFFIC MANAGEMENT

Civil Aviation Authority of Nepal

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RECORD OF AMENDMENTS AND CORRIGENDA

Amendments			
No.	**Date of Issue**	**Date Entered**	**Entered By**

Corrigenda			
No.	**Date of Issue**	**Date Entered**	**Entered By**

FOREWORD

This Manual has been prepared pursuant to Rule-82, Schedule-3 of Civil Aviation Regulation, 2058 (2002) for the guidance to the personnel working in the field of Air Traffic Services and Airspace Management, responsible for conducting SMS related activities especially the Safety Risk Management (SRM). However, this document is also significant to the personnel working in ANS Safety Standard Department (ANSSSD) responsible for oversight of SMS in ATM.

This manual provides step-by-step as well as elucidative guidelines to the ANSP personnel responsible for conducting Safety Risk Management activities in Air Traffic Management more specifically ATS and Airspace Management and brings uniformity in the procedures of executing such activities.Thus, this manual provides ANSP the clear-cut guidelines in implementing the safety assessment in Air Traffic Management as required by CAR11- Air Traffic Services and MATS Nepal.

ANSSSD will maintain this manual as complete, accurate and up-to-date as possible. Comments and suggestions for revision/amendment action to this manual should be forwarded to the Director of ANS Safety Standards Department.

Sanjiv Gautam
Director General
Civil Aviation Authority of Nepal

Table of Contents

GUIDANCE MANUAL FOR CONDUCTING SAFETY RISK MANAGEMENT ACTIVITIES IN AIR TRAFFIC MANAGEMENT

A. BACKGROUND

ICAO through its relevant Annexes and Manuals has mandated the State service providers to implement Safety Management System (SMS) and its components effectively. Rule 83a (2) of Civil Aviation Regulation 2002 requires all aviationservice providers to implement SMS in their services.Same provisions are also stipulated in the relevant Civil Aviation Requirements developed by Civil Aviation Authority of Nepal (CAAN). As per the Requirement 2.27 of Civil Aviation Requirement 11,Air Traffic Services (ATS) provider needs to execute safety assessment,in other words, Safety Risk Management (SRM) for introduction of any new system, equipment and procedure or any significant safety-related change to ATS systemto ensure that the acceptable levels of safety are met. Similarly, Standard 2.6.1.1 of MATS Nepal also mandates to implement the safety assessments in respect of proposals for significant airspace organization, for significant changes in the provision of ATS procedures and for the introduction of new system, equipment or procedure.

B. OBJECTIVE

This guidance document has been developed taking into consideration of the provision of ICAO Doc 9859, Safety Management Manual to fulfill the following objectives for Air Traffic Management (ATM):

1. to provide clear-cut guidelines to conduct Safety Risk Management (SRM)
2. to bring uniformity in conducting SRM activities

C. Scope

This guidance document is applicable to the following entities:

1. Service provider's organization or its personnel responsible for the provision of ATM
2. Regulatory Organization or its personnel responsible for the oversight of ATM

D. PRACTICAL APPROACH OF CONDUCTING SRM IN ATM

This document provides the clear and concise guidelines for the personnel involved in conducting the SRM in ATM.The document suggests step by step techniques to do the SRM.

Hence, to execute the SRM, personnel engaged in ATM should make the arrangements to perform the following phased activities:

1.Review System Description

Under this activity, study and analysis of new or significantly changed ATM systemor procedure being introduced is desirable in comprehensive and precise ways. This activity helps in understanding and describing the system or change therein, thereby, helps in identifying the potential hazardsin the new system, equipment and procedures or significant change therein. This activity also helps in understanding the organization's processes, activities andinterfaces that need to be assessed for hazardidentification and safety risk assessment concerning with new or changed system and procedure that is being introduced.Following functions are desirable under this activity:

1.1 Identify objective of introducing new ATM system, procedure or significant changein existing system (Why being introduced?). Examples:
   a. To support ATC
   b. To enhance the ATC capacity
   c. To enhance the safety of aircraft operation, etc.

1.2 Identify scope of introducing new system, procedure or significant changein existing system (Who are covered?) Examples:
   a. ATS Provider and Area Controllers
   b. Airspace Designers
   c. CNS Provider and concerned ATSEP personnel
   d. Operators and flight crews, etc.

1.3 Identify facts about the new system, procedure or significant change(How is it?) Examples:
   a. System brand
   b. System design
      - Automated, Semi-automatic or Manual
      - Simple, user-friendly or complicated
   c. System detail
      - Accuracy, resolution, reliability and integrity
   d. System use experience:
      - in-country, regional and/or global
   e. Procedure design detail
   f. Human-machine interface issues, etc.

1.4 Identify functions of new system, procedure or significant change (What are the functions?) Examples:
   a. System functions,
   b. Change functions, etc.

1.5 Identify how the new system, procedure or significant change will be applied in ATM (What methodology will be applied during transitioning?) Examples:
   a. Appropriate trainings to personnel
   b. Incorporation in SOP the operation of new system or change
   c. Training manual for personnel, etc.

1.6 Identify the whole environment or system where the new system, procedure or significant changewill operate (How is the workplace environment?) Examples:

a. Organizational set up
b. ATC unit or airspace where the new system, procedure or change will operate
c. Staff strength, experience, knowledge, trainings, skills and performance
d. Technologies adopted by organization to handle change
e. Rules, regulations, requirements, SOPs
f. Motivational factors
g. Workplace ergonomics, etc.

1.7 Plan SRM Activities (What are the activities necessary for SRM?) Examples:

a. Decide whether risk assessment is necessary or not
b. Plan for Hazard Identification and Risk Assessment session
c. Decide whom to coordinate for the SRM activities, etc.

To conduct the above activities, a committee must be developed which should also be held responsible for conducting whole SRM project, until there is the establishment of permanent safety committee with a Safety Manager.

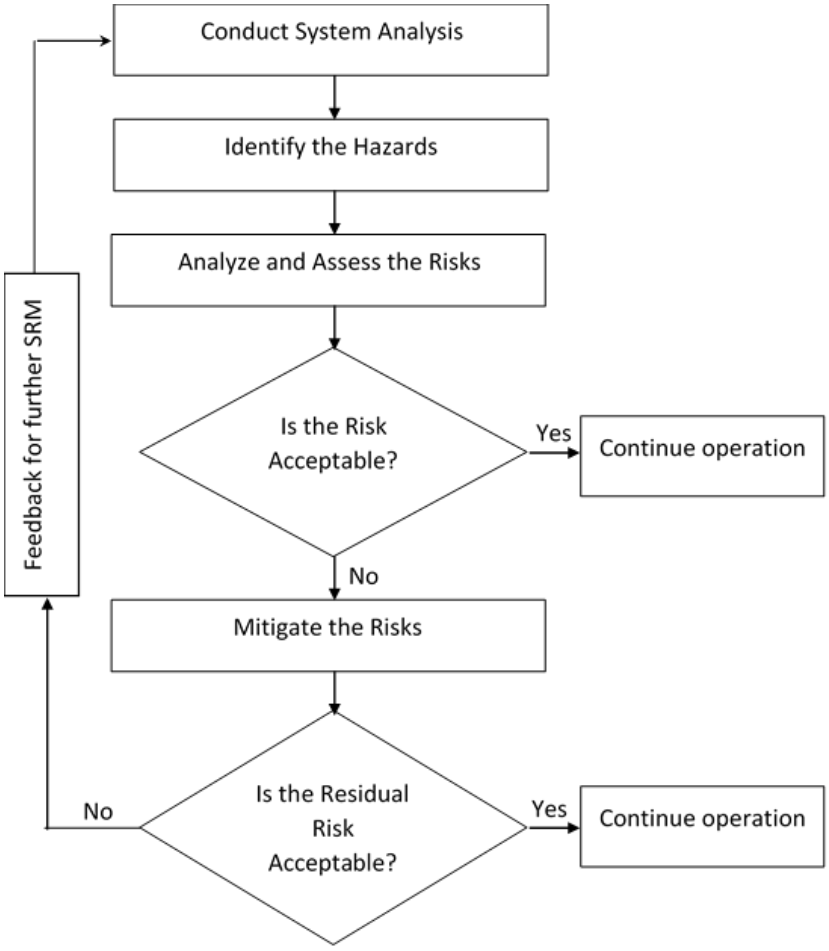

Fig.1 SRM process flow chart

1. Identify the Hazards

Under this activity, formulate a team of subject matter experts trained and/or experienced in SRM. The team will identify the hazards in new systems, proceduresor significant change, its causes and consequences.

2.1 In accomplishing this activity, the team must give proper attention to the system description, along with the review of the following sources of information:

a. Reports concerning:
   - Safety Investigation
   - Safety Audit
   - Safety Occurrences

b. Relevant past SRM documentation, if any
c. Hazards Reports
d. Hazard Logs
e. Stakeholders' feedback, their experience and lessons learnt

2.2 Taking into consideration of all these things mentioned above, the team of subject matter experts so formulated should brainstorm to find all the operational hazards and prepare a list of all possible hazards to do the risk analysis in systematic way.

2.3 While doing Hazard Identification, following steps are to be followed:

a. Identify the generic hazard, e.g. introduction of new ATS route, procedure
b. Break down the generic hazard into specific hazards, e.g. introduction of new RNAV route
c. Link specific hazards to unsafe event and thereby, potentially specific operational consequences, e.g. ATC's unawareness of the new route leading to loss of separation
d. Document the hazards and associated consequences in the Hazard Registration Sheet as mentioned in Appendix A.

2. Analyze and Assess the Safety Risk

Under this activity, evaluation of each hazard in viewpoint of existing defenses is desirable. So, start doing it once hazard identification task is finished. ATM System description will give overall ideas about the inbuilt as well organizational defenses. Brainstorming among team members and review of existing regulations, policies, procedures and guidelines will lay down the proper direction in exploring the defenses.

Once hazards and existing defenses are identified, evaluated and analyzed, risk associated with the introduction of new system or significant change in existing systemare then analyzed in the manner as mentioned below:

3.1 Assess severity of each consequence. For this, plan a brainstorming session within the group of experts. Rational subjective judgement is applied in doing this assessment.

3.1.1 Determine the severity

Severity is independent of likelihood. So, assess the severity in isolation with likelihood and taking into consideration of all the possible worst potential consequences (also called as most credible effects) of the hazard which is nothing but the extent of harm that might reasonably occur. The severity can be determined through the assessment of harm in terms of the fatalities/injuries, damage to the people or properties or any other bad consequences.

3.1.2 Identify the severity value to each UC with the help of Safety Risk Severity and Likelihood Table as shown in Table 6.

3.2 Assess likelihood of each consequence. Rational subjective judgement as well as the objective tools are applied in doing this assessment. In doing the likelihood assessment, following steps are to be adopted.

3.2.1 Determine likelihood

Likelihood is dependent upon the number and quality of barriers deployed in controlling or mitigating the Ultimate Consequence (UC) of hazard. Following steps to be followed in identifying the likelihood:

a. Identify Barrier Quality Score (BQS), Total BQS (TBSQ) and Barrier Strength Value (BSV) for each barrier. Better the quality of barrier better will be the BSV for each barrier. Use Tables 1 and 2 below to ultimately find the BSV for each barrier.

Table 1 - Barrier Quality Assessment

Barrier Quality Element	**Barrier Quality Descriptor** [High, Moderate,Low, Poor]	**Barrier Quality Score** [3 (H), 2 (M),1 (L), 0 (P)]
1. Effectiveness	**Low**	
2. Cost-benefit	**High**	
3. Practicality	**Moderate**	
4. Acceptability	**Moderate**	
5. Enforceability	**High**	
6. Durability	**Moderate**	
Total Barrier Quality Score (TBSQ) >>		
BSV (using Table 2 below to correlate with TBSQ)		

1. Effectiveness:

Extent to which the Barrier can mitigate (reduce likelihood/ severity) of UC.

2. Cost-Benefit:

Extent to which the perceived benefits of the Barrier outweigh the costs.

3. Practicality:

Extent to which the Barrier can be implemented, in terms of technology, financial and administrative resources.

4. Acceptability:

Extent to which the Barrier is consistent with other stakeholders' paradigms or requirements.

5. Enforceability:

Extent to which the Barrier can be monitored or surveyed for compliance/ implementation.

6. Durability:

Extent to which the Barrier will be sustainable.

Table 2 – TBQS to BSV Correlation			
TBQS Range	**Barrier Strength**	**Strength Description**	**BSV**
0 to 3	Poor	Weak, superficial or insignificant Barrier	**1**
4 to 7	Fair	Barely viable or adequate Barrier	**2**
8 to 11	Good	Reasonable or acceptable Barrier	**3**
12 to 15	Very Good	Effective, recognized and established Barrier	**4**
16 to 18	Excellent	Best, most robust and standard Barrier	**5**

b. Identify Optimum Number of Barriers (ONB) for respective Severity Value of UC

Table 3 - Optimum Number of Barriers & Applicable CBSV-Likelihood Tables				
Severity Value of UC	**Severity Descriptor**	**Optimum Number of Barriers (ONB)**	**Optimum CBSV** (ONB x 5 [Max BSV])	**Applicable CBSV-Likelihood Table**
E	Negligible	2	10	**Table 5.1**
D	Minor	3	15	**Table 5.2**
C	Moderate	4	20	**Table 5.3**
B	Major	6	30	**Table 5.4**
A	Catastrophic	8	40	**Table 5.5**

c. Identify Consolidated BSV (CBSV) and Optimum CBSV

Table 4 - Consolidated Barrier Strength Value (CBSV) Assessment		
Barrier Sequence No.	**Assessed BSV** (from Table 2for each Barrier)	***Note to Optimum CBSV**:* *Where actual number of barriers exceed the Optimum Number of Barriers (ONB) as mentioned in Table 3 above, select the barriers with the highest BSVs to obtain your CBSV.*
1		
2		
3		
4		
5		
6		
7		
8		
		<<< CBSV (BSV of all barriers) ***Note:****CBSV is the summation of BSVof all barriers.*
		<<< Optimum CBSV ** **(CBSV of optimum number of barriers (ONB) only, where applicable)**

3.2.2 Identify the Likelihood Value of each UCby correlatingOptimum CBSV to Likelihood with the help of Tables 5.1 to 5.5 as appropriate to the Severity Value of each UC.

Table 5.1: Optimum CBSV-Likelihood Correlation (Severity Value E)		
OCBSV Range	**Likelihood Value**	**Likelihood Descriptor**
0-1	5	Certain/ frequent
2-3	4	Likely/ occasional
4-5	3	Possible/ remote
6-7	2	Unlikely/ improbable
8-10	1	Exceptional/ Extremely Improbable

Table 5.2: Optimum CBSV-Likelihood Correlation (Severity Value D)		
OCBSV Range	**Likelihood Value**	**Likelihood Descriptor**
0-2	5	Certain/ frequent
3-5	4	Likely/ occasional
6-8	3	Possible/ remote
9-11	2	Unlikely/ improbable
12-15	1	Exceptional/ Extremely Improbable

Table 5.3: Optimum CBSV-Likelihood Correlation (Severity Value C)		
OCBSV Range	**Likelihood Value**	**Likelihood Descriptor**
0-3	5	Certain/ frequent
4-7	4	Likely/ occasional
8-11	3	Possible/ remote
12-15	2	Unlikely/ improbable
16-20	1	Exceptional/ Extremely Improbable

Table 5.4: Optimum CBSV-Likelihood Correlation (Severity Value B)		
OCBSV Range	**Likelihood Value**	**Likelihood Descriptor**
0-5	5	Certain/ frequent
6-11	4	Likely/ occasional
12-17	3	Possible/ remote
18-23	2	Unlikely/ improbable
24-30	1	Exceptional/ Extremely Improbable

Table 5.5: Optimum CBSV-Likelihood Correlation (Severity Value A)		
OCBSV Range	**Likelihood Value**	**Likelihood Descriptor**
0-7	5	Certain/ frequent
8-15	4	Likely/ occasional
16-23	3	Possible/ remote
24-31	2	Unlikely/ improbable
32-40	1	Exceptional/ Extremely Improbable

3.2.3 Assess the safety risk. It is the combination of likelihood and severity of the consequence assessed above and is also termed as Risk Index. Distinguish whether the risk is acceptable, tolerable or intolerable in MSSR operation with the help of Safety Risk Tolerability Matrix as shown in Table 7

Likelihood	Meaning	Value	Severity	Meaning	Value
Frequent	Likely to occur many times (has occurred frequently)	5	Catastrophic	• Equipment destroyed • Multiple deaths	A
Occasional	Likely to occur sometimes (has occurred infrequently)	4	Hazardous	• A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely • Serious injury • Major equipment damage	B
Remote	Unlikely to occur, but possible (has occurred rarely)	3	Major	• A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of an increase in workload or as a result of conditions impairing their efficiency • Serious incident • Injury to persons	C
Improbable	Very unlikely to occur (not known to have occurred)	2	Minor	• Nuisance • Operating limitations • Use of emergency procedures • Minor incident	D
Extremely improbable	Almost inconceivable that the event will occur	1	Negligible	• Few consequences	E

Table6. Safety Risk Likelihood and Severity Table

Tolerability Description	Assessed Risk Index	Suggested Criteria
Intolerable Region	**5A, 5B, 5C, 4A, 4B, 3A**	Unacceptable under the existing circumstances.
Tolerable Region	**5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C, 1A**	Acceptable based on risk mitigation. It may require management decision.
Acceptable Region	**3E, 2D, 2E, 1B 1C, 1D, 1E**	Acceptable

Table7. Safety Risk Tolerability Matrix

3. Mitigate Safety Risk

Under this activity, decision will be takenregarding the requirement for risk mitigation. Mitigation measures here are some additional barriers or defenses that should be employed to lessen the risk effects. In the risk mitigation process, following methods are adopted:

4.1 If the safety risk associated to ultimate consequence falls in intolerable region, introduction ofthe new system, equipment and procedures or significant change therein into ATM operation is rejected until and unless the risk is brought down to acceptable region with the employment of extensive barriers or defenses.

4.2 If the safety risk falls in the tolerable region, reduce the level of risk to acceptable level by lessening the severity or likelihood of the consequences with the application of appropriate risk mitigation measures.

a. Generally, the cost is involved in applying the barriers or risk mitigation measures. In such situation, a high-level management decision may be required in accepting the risk. Normally, if the costs of employing the barriers are less than or equal to the benefits of employing them, the tolerable risks are accepted, otherwise no.
b. In some cases, when it is not possible or almost impracticable to lessen the risk to an acceptable level even after employing all possible recovery measures, such risk can be accepted based on management decision. While taking such decision, management must ensure that there is the effective mechanism of continuous tracking and monitoring of:
    i. ATM operational activities, and
    ii. Implementation of adopted recovery measures.

4.3 If the associated safety risk falls in acceptable region, accept the risk in as is situation and continue the operation. No mitigation is required.

4.4 Complete SRM task in the worksheet as mentioned in Appendix B.

4. Submission of Safety Risk Mitigation Report

Submit Safety Risk Mitigation Report for approval. The template of report is mentioned in Appendix C. However, the complete report supplementing all necessary information in the other format is also acceptable.

5. Documentation and Record

Document and record whole SRM procedures appropriately so that it could provide appropriate guidelines and feedback for future SRM projects.

Appendix A

Hazard Registration Sheet										
Item No.	Area/Operation/ Equipment	Hazard (H)				Unsafe Event (UE) [Reported/ Projected]	Consequence (C) [Reported/ Projected]	Recommended Acton		
		Generic Hazard (original report)	Specific Hazard	Hazard ID	Source of Information			Corrective Action [Yes/No]	SRM Action [Yes/No]	SRM Priority Level [H, M, L]

Explanatory Note with examples:

1. *Source of Information: Hazard information as may be extracted from - Voluntary Hazard Rpt, Occurrence Notification/ Investigation Rpt, Internal Audit Rpt, External Audit Rpt, Hazard Survey Rpt, Operational Data Review Rpt, Operational Trial Report*
2. *Specific Hazard/ Threat: If more than one Hazard/ Threat identified, register such additional Hazard/ Threat under new row/ item*
3. *Hazard ID code:*
    a. *Area: OPS, ANS, AGA, ….*
    b. *Organization: TIA ATS*
    c. *Hazard No: 001*
    d. *Priority Level: High (H)- Accident, Medium (M)- Severe Incident, Low (L)- Incident*
    e. *Year: 2018*
    f. *Example: ANS-TIA ATS-001-H-2018*
4. *Reported/ Projected (UE/ C): Annotate UE/ C description as a "Reported" occurrence or a "Projected" occurrence. If multiple H>UE>C combinations involved, register each combination under a new Row (Each single H>UE>C combination will constitute one potential SRM Task)*
5. *Corrective Action: If the Hazard can be effectively eliminated through conventional corrective action (eg disposal, repair, replacement, modification), annotate YES with the action taken/ recommended. Otherwise annotate NO.*
6. *SRM Action: Annotate YES to indicate systematic SRM action is recommended (or has been taken already). Annotate NO if systematic SRM action is not recommended (or not necessary).*
7. *Priority Level: SRM or Corrective Action Priority Level based on (Annex 13) occurrence category of the projected (or reported) Unsafe Event or Consequence. Accident – High (H); Serious Incident - Medium; Incident - Low.*

Appendix B

Safety Risk Management Worksheet

Note: Fill the SRM Worksheet for each hazard in the order from (a) to (r).

Generic Hazard: ……..(a)

Specific Hazard: ……..(b)

Hazard ID (c)	Type of operation or activity (d)	Unsafe event (e)	Consequence (f)	Existing Measure		Future Measures	
				Mitigating Barriers (h)	BSV* (i)	Mitigating Barriers (n)	BSV* (o)
				OCBSV		OCBSV (taking into consideration of existing barriers in 'h' as well)	

SRM Project Team (Name and Signature)

1. Team Leader
2. Member
3. Member
4. Member
5. Member
6. Member

Existing Risk Probability (j)		**Resultant Risk Probability (p)**	
Existing Risk Severity (g)		**Resultant Risk Severity (m)**	
Existing Risk Index (k)		**Resultant Risk Index (q)**	
Existing Risk Tolerability (l)		**Resultant Risk Tolerability (r)**	

*BSV- Barrier Strength Value

Appendix C

Safety Risk Mitigation Report

Organization Name		SRM Report No:
Operation / Process / Area		Date:
Specific Hazard Description		Department: Division:
Hazard ID Code**		

SRM start date:	SRM completion date:	Next Review date:
Existing Risk Index & Level:	*Resultant Risk Index & Level:	

Documents Attached (as indicated below):

Item	Document	Yes/ No
1	Schematic output of the completed SRM project (eg completed HIRM Wsht)	
2	Summary of modified/ new defenses and required actions.	
3	Other attachments (documents, drawings, references, standards, exceptions, etc.), if any	

SRM Project Team Leader:

Sign-Date	Name	Designation

SRM Project Team Members:

Reviewed by SMS/ Safety Manager:

Sign-Date	NameDesignation

Approved by(Department Head, etc):

Date	Name/ Designation	Signature

Note: Upon approval, forward Copy to SMS Office for HRM Master Register update/ closure.