

# **SMS implementation in Part-145 AMOs**

### EASA views as Regulator, Competent Authority and Standardisation

FS1 Maintenance & Production department 24 November 2023

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# Agenda

- → Opening
- → Part 1: Overview of SMS transition in Maintenance (& Production)
- → Part 2: Sharing practice conducting MS assessment
- → Part 3: Standardisation feedback on SMS in CAMO
- → Part 4: Transition status in Foreign Part-145 AMOs







### **Overview of SMS transition in Maintenance (& Production)**

Jeremie Neveux Section manager – Airworthiness standard and implementation

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# **SMS transition in Maintenance & Production**





# **Key terminology**

- $\rightarrow$  <u>Valid approval</u>: An approval that is not revoked nor suspended.
- → **Transition phase:** It is the period from 2 December 2022 until 2 December 2024.
- → <u>Transition finding</u>: address the *new requirements* of Reg (EU) 2021/1963. The transition finding has the objective to identify that the implementation of Reg (EU) 2021/1963 is not yet completed in that organisation
  - $\rightarrow$  Generic transition finding
  - $\rightarrow$  Specific transition finding
- → PSOE: Present Suitable Operating Effective : the SMS assessment dimensions For initial implementation of SMS, only 'P' and 'S' are required



### **Implementation process for VALID Part-145 approvals**









# **Sharing practice - conducting MS assessment**

Alberto Nozal CAMO/MOA Expert



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# SMS ASSESSMENT METHODOLOGY





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To support authorities on the management systems assessment.

It focuses on both elements of a Management System:

the SMS elements (ICAO Annex 19 and framework sections 1 to 4), with the traditional <u>four pillars</u>;

- safety policy and objectives;
- safety risk management;
- safety assurance;
- safety promotion;

□ the **compliance monitoring** system (section 5).

Complemented by the evaluation of the **interface management** (providers).

Is designed to be used by Competent Authorities, but it could also be used by organisations.







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#### 2.2 Safety risk assessment and mitigation

#### Annex 19 reference & text

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2.2.1 The service provider shall develop and maintain a process that ensures analysis, assessment [and control] of the safety risks associated with identified hazards.

Note: The process may include predictive methods of safety data analysis.

Present	Suitable	Operating	Effective
There is a process for the analysis and assessment of safety risks.	The risk assessment methodology, including 'severity' and 'likelihood' usable criteria are defined and fit the service provider's actual environment, including consideration to the expert judgement when data are not available. The used definitions are sufficiently explicit or detailed. For the acceptance of the risk's level, the right level of organisation's authority within the organisation (responsibilities) in cooperation with the stakeholders is clearly defined.	Risk analysis and assessments are carried out in a consistent manner based on the defined process. Appropriate risks controls are being applied to reduce safety risks to an acceptable level, including timelines and allocation of responsibilities, agreed with the stakeholders. Operational, technical, human and organisational factors are considered as part of the development of risks controls. Senior management is actively involved in medium and high risks and their mitigation and controls. Understanding of external inputs and outputs of safety risk management that should be addressed.	Risk analysis and assessments are reviewed for consistency and to identify improvements in the processes. Risk assessments are regularly reviewed to ensure they remain current. Risk acceptability criteria are used routinely, consistently applied in management decision making processes, and are regularly reviewed.
	Assessm	ient results	
	What t	o look for	

- Review risk classification scheme and procedures.
- Check the methodology used to assess the risks; how this is documented, accurately defined, and used; check how the staff using that methodology is trained.
- Check any assumptions made and whether they are reviewed.
- Check that the process defines who can accept what level of risk.
- Check that the level of risk that the organisation is willing to accept is defined.
- Severity and likelihood definitions and criteria are sufficiently defined (or that an alternative methodology is described) and adapted to the activities. Severity 'of what' ('possible worst scenario' and consequence) is also described. Differentiation between 'likelihood' and 'frequency' is understood.
- Review whether risk assessments are carried out consistently and coherently across the organisation (e.g. consideration of various safety perspectives and views to
  make the relevant decision).
- Review how issues are classified when there is insufficient quantitative data available. When expert judgement is used, a collaborative risk assessment process is
  used (e.g. various expert judgement through cross-functional disciplines such as Flight operations, Design, Production, Human Performance experts), taking into
  account different safety perspectives and views to make the relevant decision, to ensure the reproducibility of the assessment.
- Consider how human performance is evaluated through the safety risk management and mitigation process (refer to ICAO Doc.10151)
- Check whether the outcome of the safety reporting system, including the mandatory and voluntary occurrence reporting systems, is used to test the robustness the
  risk assessment, including when the expert judgement was used (see section 3.1). Is the network of stakeholders involved in the collection of data and safety
  information informing the risk assessments, notably for the risk at the interfaces? (See also Section 5.1 of this tool).
- Verify whether the risk assessments are updated when new data from the safety reporting system are available. Review what triggers a risk assessment and its
  review over time. Check that the risk register is being reviewed and monitored by the appropriate safety committee(s), where appropriate. Verify how experience,
  feedback and monitoring of recently published safety information serves that regular update.
- Review layout of risk register e.g. initial assessment, residual risk, mitigation actions, ownership, associated safety performance and follow-up.
- Sample identified hazards and how these are processed and documented.
- Check which safety committee(s) or person(s) oversee the 'acceptability'. Check the availability of instructions about implementation of 'As Low As Reasonably
  Practical' (ALARP). Check the right level of authority for decision-making.
- Evidence of risk reduction, evaluation of residual risk and risk acceptability, when appropriate, being applied in the data-driven decision-making.
- Evidence that risks, including those that are not generated by the organisation itself, are analysed and mitigated, without further transfer of risks.
- Check how trends and emerging issues are identified and managed.

Corresponding EU/EASA regulatory references					
Air Operations	Aircrew	Aerodromes	ATM/ANS	ATC Training Org.	1





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Present	There is evidence that the relevant item is documented within the organisation's Management System Documentation.	
Suitable <sup>18</sup>	The relevant item is suitable based on the size, nature, complexity of the organisation and the inherent risk in the activity.	
Operating	There is evidence that the relevant item is in use and an output is being produced.	
Effective	There is evidence that the relevant item is achieving the desired outcome and has a positive safety impact.	



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#### What to look for

This column in the matrix guides the inspector when looking at each individual item and is not meant to be a checklist. The items listed are not specific to an individual PSOE level but remind the inspector of areas they may want to consider. Some items in this column may not be relevant depending on the type or nature of the organisation.



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- The tool should be used ONLY as a guide, not as a checklist. Assessing an SMS is not a ticking box exercise to verify that each and every line of the tool are complied with.
- The tool has been designed to capture the generic MS requirements so it is valid for all domains. However, it may also be customized.
- May be used for initial evaluation and continuing oversight.
  - Present / Suitable / Operating / Effective
  - Desktop review + interviews + remote/on-site audit
    - Desktop review only is not sufficient.
- Can be used to assess any size of organization. Consideration should be given to the size/nature/complexity of organization/activities; Annex 2 'scalability' and 'suitability'.
- No particular order/sequence preference for the assessment.

### **Example of SMS assessment sequence**

Hazard identification	Risk management	Safety performance monitoring
azard log content, safety data sources; internal reporting, occ report, audit repetitive findings, customer complaints, other external inputs, etc.	risk analysis (likelihood and severity), assessment (tolerability) and control (mitigating actions)	effectiveness of safety risk controls, SPIs, SPTs, etc. Link with safety objectives and policy.
Safety objectives and policy	Meetings/boards	Safety promotion
	SRB, SAG, etc.	safety training and communication.

- All organisations, regardless of their size, are exposed to risks, some of them being potentially significant, even for a limited business. Therefore, all elements of a MS should apply.
- It is not just the size of the organization that matters but also the nature/complexity/potential risks of the activity; small AMO providing only on-call line maintenance services maintenance errors probability
- > Is about adapting a MS with all its elements to the specific operational context of the organisation.
- > An SMS does not need to be complex to be effective.
- > Examples;
  - □ Roles: AM exercising SM and CMM roles Vs three nominated Managers
  - □ Safety committees: SRB (and where applicable SAG) and frequency of meetings
  - □ safety communication: safety bulletins and safety recurrent training Vs board publication
  - □ Hazard log and risk management: Paper form Vs dedicated software. Simple/Complex process



#### Hazard Log for a Small Organization

lssue (hazard)	What is the result (consequence)	How bad is the result	How likely is it to occur	What action are we taking (Who and when)	Follow-up (if applicable)

#### Severity and Likelihood Definitions

Severity of Consequences						
Definition	Value					
Fatal Accident	Results in a serious accident or incident with fatalities	5				
Serious Incident	Results in a Serious Incident (without fatalities) that would be reportable to the NAA	3				
Negligible	Results in minor incident that would not be reportable to the NAA	1				

Qualitative Definition	Meaning	Value
ely	Likely to reoccur or to occur several times in a year	3
ossible	Possibly reoccur or to occur at least once a year	2
Jnlikely	Very unlikely to reoccur or occur	1

#### Risk Acceptability Matrix

		Likelihood		
		Unlikely (1)	Possible (2)	Likely (3)
'erity	Fatal Accident (5)	REVIEW (5)	UNACCEPTABLE (10)	UNACCEPTABLE (15)
Seve	Serious Incident (3)	REVIEW (3)	REVIEW (6)	UNACCEPTABLE (9)
	Negligible (1)	ACCEPTABLE (1)	ACCEPTABLE (2)	REVIEW (3)

#### **Risk Acceptance Actions**

Actions will be prioritized by the score from the Risk Acceptability Matrix but the following table will determine the appropriate action to be taken.

Unacceptable	Risk Intolerable, Accountable Executive immediately informed and action must be taken to reduce the risk to a tolerable level.
Review	Risk reduction / mitigation must be considered. Where risk reduction / mitigation is not practical or viable acceptance by Accountable Executive is required.
Acceptable	Risk is considered acceptable but would be reviewed if reoccurs.



Generic Hazard	Unsafe Event	Location	Risk Remarks		Initial Defences to Control Safety Risks, and Safety Risk Index				Initial Defences to Control Safety Risks, and Safety Risk Index		Priority	Root Cause	Mitigating actions Due date		Mitigating actions	Due date	Reponsible Department		ences to Con Ind Safety Ri	trol Safety sk Index	SPI	Follow-up	Status
				Severity	Probability	Risk Index						Severity	Probability	Risk Index									
																	4						
																	4						
																	4						
																	4						
																	4						



#### Figure 10 : Risk Severity Classifications

SEVERITY OF CONSEQ	SEVERITY OF CONSEQUENCES								ntrol Safety			
Definition	Meaning	Value	Root Cause				Risks, a	and Safety R	isk Index		Follow-up	
Catastrophic	The following situations, but are not limited to, may have a potential to result in catastrophic consequences:			Mitigating actions	Due date	Reponsible Department	Severity	Probability	Risk Index	SPI		Status
	<ul> <li>Quality escape on a critical part (level 4 may be also considered according to the extent of the nonconformity, type of part (rotating or non-rotating), etc.)</li> <li>Release of a component to service without implementing ADs</li> <li>Deviation from the mandatory maintenance practices defined by the TCH. (The mandatory maintenance practices must be done as written in the engine manual. No changes to the specified operations, sequence of operations, limits, or tooling are permitted.)</li> </ul>	5										
Hazardous	<ul> <li>The following situations, but are not limited to, may have a potential to result in hazardous consequences:</li> <li>Quality escape on a critical part (level 5 may be also considered according to the extent of the nonconformity, type of part (rotating or non-rotating), etc.)</li> <li>Quality escape on a non-critical part</li> <li>Irreversible nonconformity on a critical part or an LLP-influencing part entailed by maintenance organisation activities.</li> </ul>	4										
Major	<ul> <li>The following situations, but are not limited to, may have a potential to result in major consequences:</li> <li>Irreversible nonconformity on non-critical or non-LLP influencing parts entailed by maintenance organisation activities.</li> <li>Nonconformity entailed by maintenance organisation and beyond the limits or outside the scope of the maintenance data (restored to serviceable condition only by approval of TCH or DOA holder).</li> </ul>	3										
Minor	The following situations, but are not limited to, may have a potential to result in minor consequences:     Reversible nonconformity entailed by maintenance organisation activities (restored to serviceable condition with rework and/or repair).     Any case that does not induce any safety effect on the components.	2										
невивные	Any case that does not induce any safety effect on the components.	1										

#### Figure 11 : Risk Likelihood Classifications

LIKELIHOOD OF OCCURRENCE							
Definition Meaning							
Frequent	Likely to occur many times (has occured frequently, e.g. 1/25)	5					
Occasional	Likely to occur sometimes (has occurred infrequently, e.g. 1/100)	4					
Remote	Unlikely to occur but possible (has occurred rarely, e.g. 1/250)	3					
Improbable	Very unlikely to occur (not known to have occurred, e.g. 1/500)	2					
Extremely improbable	Almost inconceivable that the event will occur (e.g. 1/1000)	1					



	Figure 10 : Risk Severity Classifications													
SEVERITY OF CONSEQU	UENCES		1							ences to Cont				
Definition	Meaning	Value	Ro	ot Cause						ind Safety Ris	k Index	F.	ollow-up	
Catastrophic	The following situations, but are not limited to, may have a potential to result in catastrophic				N	litigating actions	Due date	Reponsible Depart	sible Department			SPI		Status
	consequences:								Severity	Probability	Risk Index			
	<ul> <li>Quality escape on a critical part (level 4 may be also considered according to the extent of the nonconformity, type of part (rotating or non-rotating), etc.)</li> </ul>	5												
	<ul> <li>Release of a component to service without implementing ADs</li> <li>Deviation from the mandatory maintenance practices defined by the TCH. (The mandatory maintenance practices must be done as written in the engine manual. No changes to the</li> </ul>						Figu	re 12 : Risk To	olerability N	latrix				
	specified operations, sequence of operations, limits, or tooling are permitted.)													
Hazardous	The following situations, but are not limited to, may have a potential to result in hazardous consequences:									Risk Se	everity			
	<ul> <li>Quality escape on a critical part (level 5 may be also considered according to the extent of the nonconformity, type of part (rotating or non-rotating), etc.)</li> </ul>	4						Catastrophic	Hazardous	Ma	ajor	Minor	Ne	gligible
	<ul> <li>Quality escape on a non-critical part</li> <li>Irreversible nonconformity on a critical part or an LLP-influencing part entailed by maintenance organisation activities.</li> </ul>							5	4	3	3	2		1
Major	The following situations, but are not limited to, may have a potential to result in major consequences:				Frequent	:	5	Unacceptable	Unacceptable	Unacce	eptable	Review	Acc	eptable
	<ul> <li>Irreversible nonconformity on non-critical or non-LLP influencing parts entailed by maintenance organisation activities.</li> </ul>	3		poor	Occasion	al	4	Unacceptable	Unacceptable	Rev	view	Review	Acc	eptable
	<ul> <li>Nonconformity entailed by maintenance organisation and beyond the limits or outside the scope of the maintenance data (restored to serviceable condition only by approval of TCH or DOA holder).</li> </ul>			Likelihood	Remote		3	Unacceptable	Review	Rev	view	Acceptable	e Acc	eptable
Minor	The following situations, but are not limited to, may have a potential to result in minor consequences:	2		Risk	Improba	ble	2	Review	Review	Accep	ptable	Acceptable	Acc	eptable
	Reversible nonconformity entailed by maintenance organisation activities (restored to serviceable condition with rework and/or repair).	2			Extreme improba	•	1	Review	Acceptable	Accep	ptable	Acceptable	e Acc	eptable
Negligible	Any case that does not induce any safety effect on the components.	1		•	UNACCEP	TABLE: The risk is	sunaccentable	and major mitig	ation measure	s are requ	ired to re	duce the le	vel of risk t	to as low
						bly practicable.	s unacceptable		action measure.	s are requ		auce the le	VCI OI H3K I	.0 u3 10W

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#### Figure 11 : Risk Likelihood Classifications

LIKELIHOOD OF OCCURI	RENCE	
Definition	Meaning	Value
Frequent	Likely to occur many times (has occured frequently, e.g. 1/25)	5
Occasional	Likely to occur sometimes (has occurred infrequently, e.g. 1/100)	4
Remote	Unlikely to occur but possible (has occurred rarely, e.g. 1/250)	3
Improbable	Very unlikely to occur (not known to have occurred, e.g. 1/500)	2
Extremely improbable	Almost inconceivable that the event will occur (e.g. 1/1000)	1



**REVIEW:** The level of risk is of concern and mitigation measures are required to reduce the level of risk to as low as reasonably practicable. Where further risk reduction/mitigation is not practical or viable, the risk may be accepted, provided that the risk is understood and has the endorsement of the Accountable Manager.

• ACCEPTABLE: Risk is considered acceptable but should be reviewed if it reoccurs.

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

TABLE	2: SEVERITY	ABLE
Value	Severity	Meaning
A	Catastrophic	Aircraft / equipment destroyed     Multiple deaths
в	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
с	Major	<ul> <li>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</li> <li>Serious incident</li> <li>Injury to persons</li> </ul>
D	Minor	Nulsance     Operating limitations     Use of emergency procedures     Minor incident
E	Negligible	Few consequences. No significance to operational safety

#### TABLE 3: SAFETY RISK INDEX

	Severity														
Probability	A (Catastrophic)	B (Hazardous)	C (Major)	D (Minor)	E (Negligible)										
5 (Frequent)	5A	5B	5C	5D	5E										
4 (Occasional)	4A	4B	4C	4D	4E										
3 (Remote)	3A	ЗВ	зC	3D	ЗE										
2 (Improbable)	2A	2B	2C	2D	2E										
1 (Extremely improbable)	1A	1B	1C	1D	1E										



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

TABLE	2: SEVERITY	TABLE	
Value	Severity	Meaning	
A	Catastrophic	Aircraft / equipment destroyed     Multiple deaths	
в	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	
с	Major	<ul> <li>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</li> <li>Serious incident</li> <li>Injury to persons</li> </ul>	
D	Minor	Nuisance     Operating limitations     Use of emergency procedures     Minor incident	
Е	Negligible	Few consequences. No significance to operational safety	

TABLE 3: SAFETY RISK	INDEX					
			Severity			-
Probability	A (Catastrophic)	B (Hazardous)	C (Major)	D (Minor)	E (Negligible)	
5 (Frequent)	5A	5B	5C	5D	5E	
4 (Occasional)	4A	4B	4C	4D	4E	
3 (Remote)	ЗA	3B	зc	3D	ЗE	
2 (Improbable)	2A	2B	2C	2D	2E	
1 (Extremely improbable)	1A	1B	1C	1D	1E	

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

TABLE 5: DEFINIT	TIONS
Barrier	A generic term, referring to a PC or RM, or a set thereof.
Barrier Strength Value (BSV)	The Value of a specific Barrier's (PC/ RM) quality or strength.
Consolidated Barrier Strength Value (CBSV)	The Consolidated (SUM) Value of a set (line) of Barrier's (PCs/ RMs) pertaining to a given UE/ UC.
Escalation Control (EC)	A mitigating action or defence to block or prevent an Escalation Factor from compromising or weakening a Preventive Control (or Recovery Measure). Use where applicable only.
Escalation Factor (EF)	Possible deficiency or latent factor/ condition which may weaken the effectiveness of a Preventive Control (or Recovery measure). Use where applicable only.
Preventive Control (PC)	A mitigating action or defence to block or prevent a hazard from escalating into an Unsafe Event or Ultimate Consequence. Existing PCs refer to current/ known/ established PCs which have been in place before the current HIRM exercise. New PCs refer to new/ additional/ modified PCs being recommended, proposed or which have been put in place as a result of the current HIRM exercise.
Recovery Measure (RM)	A mitigating action, barrier or defence to block or prevent an Unsafe Event from escalating into an Ultimate Consequence or Accident. Existing RMs refer to current/ known/ established RMs which have been in place before the current HIRN exercise. New RMs refer to new/ additional/ modified RMs being recommended, proposed or which have been put in place as a result of the current HIRN exercise.
Ultimate Consequence (UC)	Ultimate event or accident; most credible ultimate outcome.
Unsafe Event (UE)	Most credible unsafe situation, not yet amounting to an Ultimate Consequence or Accident. Usually an intermediate event' situation before an Ultimate Consequence/ Accident. Identification of an Unsafe Event is applicable only where there is a need to distinguish and establish mitigating actions upstream and downstream of such an intermediate event (before the Ultimate Consequence/ Accident). If this Intermediate UE state is not applicable for a particular operation, then it may be bypassed as appropriate.



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   | TABLE 6: HAZARD IDENTIFICATION & RISK MITIGATION (HIRM) REGISTER   |  
   
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| <ul> <li>Major equipm</li> </ul>    | ent damage   |  |   |  | Barrier Strength  
   
   
   | E-PC2 There is a towing procedure stated in IETP Chapter 09-10 for A109. BSV   |  
   
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| Few consequences                    | ences. No significa  | nce to operation   | al safety   |  |   
   
   
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| A<br>(Catastrophic)                 | B<br>(Hazardous)   | C<br>(Major)   | D<br>(Minor)  | E<br>(Negligible)  | Recovery Measure  
   
   
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| 5A                                  | 5B   | 5C   | 5D  | 5E   | (RM)  
   
   
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| 4A                                  | 4B   | 4C   | 4D  | 4E   | Ultimate<br>Consequence (UC)  
   
   
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   | Most credible unsafe situation, not yet amounting to an Ultimate Consequence or  |  
   
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| 2A                                  | 2B   | 2C   | 2D  | 2E   | Unsafe Event (UE)   
   
   
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| 1A                                  | 1B   | 1C   | 1D  | 1E   |   
   
   
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|                                     | Multiple death     A large reduct     operational generational     Serious injury     Major equipm     A significant ru     personnel to c     workload or av     Serious incide     Injury to persc     Nuisance     Operating limi     Use of emergy     Minor incident     Few conseque     K INDEX     A     (Catastrophic)     5A     A     3A     2A | ng       Itelevite         ant       Likely to occur         ant       Likely to occur         te       Unlikely to occur         able       Very unlikely         very unlikely       Almost inc         Alter       Almost inc         ABLE       Almost inc         • Alurge reduction in safety margi<br>operational personnel cannot be<br>completely       Serious injury         • Major equipment damage       • A significant reduction in safety margi<br>operational personnel to cope with adverse +<br>workload or as a result of conditi         • Serious injury       • Major equipment damage         • A significant reduction in safety i<br>personnel to cope with adverse +<br>workload or as a result of conditi         • Serious incident       • Injury to persons         • Nuisance       • Operating limitations         • Use of emergency procedures       • Minor incident         • Few consequences. No significa         • K INDEX       • Catastrophic)         • CA       58         • 4A       48         • 3A       38         • 2A       28 | ng         Likelihoc           ant         Likely to occur many times (has           onal         Likely to occur sometimes (has           te         Unlikely to occur, but possible           able         Very unlikely to occur (not known probable           Almost inconceivable that it           ABLE         Meaning           • Aircraft / equipment destroyed         Muntiple deaths           • Alarge reduction in safety margins, physical dist operational personnel cannot be relied upon to p completely         Serious injury           • Major equipment damage         • A significant reduction in safety margins, a reduct personnel to coope with adverse operating conditions impairing the Serious incident           • Disperting limitations         Use of emergency procedures           • Minor incident         • Misorce           • Few consequences. No significance to operation           • K INDEX         Serverity           • Catastrophic)         6 (Hazardous)         C (Major)           • 5A         5B         5C           • 4A         4B         4C           3A         3B         3C           2A         2B         2C | ing       Likelihood         ant       Likely to occur many times (has occurred infrequencies)         ant       Likely to occur, but possible (has occurred infrequencies)         able       Very unlikely to occur (not known to have occurred infrequencies)         Almost inconceivable that the event will occur         ABLE         Meaning         • Aircraft / equipment destroyed         • Multiple deaths         • Alarge reduction in safety margins, physical distress or a worklow operational personnel cannot be relied upon to perform their task completely         • Serious injury         • Major equipment damage         • A significant reduction in safety margins, a reduction in the ability personnel to cope with adverse operating conditions as a result of workload or as a result of conditions impairing their efficiency         • Serious incident         • Nuisance         • Operating limitations         • Use of emergency procedures         • Minor incident         • Few consequences. No significance to operational safety         *K INDEX         • A sagnificant can all the same same same same same same same sam | Imp       Likelihood         ant       Likely to occur many times (has occurred frequently)         onal       Likely to occur sometimes (has occurred infrequently)         te       Unlikely to occur sometimes (has occurred requently)         able       Very unlikely to occur (not known to have occurred)         probable       Almost inconceivable that the event will occur         Adble         Meaning         Alrorative quipment destroyed         Meaning         A large reduction in safety margins, a reduction in the ability of operational personnel cannot be relied upon to perform their tasks accurately or completely         Serious incident         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 <tr< td=""><td>Image       Likelihood         ant       Likely to occur many times (has occurred frequently)         onal       Likely to occur sometimes (has occurred infrequently)         te       Unlikely to occur, but possible (has occurred rarely)         able       Very unlikely to occur (not known to have occurred)         probable       Almost inconcelvable that the event will occur         ABLE       Meaning         • Aircraft / equipment destroyed       Multiple deaths         • Alarge reduction in safety margins, physical distress or a workload such that operational personnel cannot be relied upon to perform their tasks accurately or completely       3E, 2D, 2E, 1B, 1C, 1D, 1E         • A large 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       TABLE 5: DEFINIT         • 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       TABLE 5: DEFINIT         • Nuisance       Severity       Escalation Control (EC)         • Nuisance       Severity       Escalation Control (EF)         • Ki NDEX       Severity       Escalation Control (PC)         • A a       B       C       D         •</td><td>Category:         TY TABLE         TABLE 4: SAFETY F         Safety Risk Index         Safety Risk Index         TABLE 4: SAFETY F         Unlikely to occur sometimes (has occurred infequently)         the Unlikely to occur sometimes (has occurred requipt)         A significant inconceivable that the event will occur         TABLE 3: DEFINITION         Major equipment destroyed         A significant reduction in safety margins, physical distress or a workload such that operational personnel cannot be relied upon to perform their tasks accurately or completely       TABLE 5: DEFINITION         Serious Induced         A significant reduction in safety margins, a reduction in the ability of operational personnel incident       TABLE 5: DEFINITION         Serious Indicent       A significant reduction in safety margins, a reduction in the ability of operational personnel social transitions       Serious Indicent         Serious Indicent       <th cos<="" td=""><td>TY TABLE         TY TABLE         TABLE 4: SAFETY F         Safety Risk Index<br/>Range         TABLE 4: SAFETY F         Safety Risk Index<br/>Range         Category:<br/>Hazard         TABLE 4: SAFETY F         Safety Risk Index<br/>Range         DA SE SC. 14, 4B<br/>Sofety Risk Index<br/>Range         Category:<br/>Hazard         TABLE 4: SAFETY F         Safety Risk Index<br/>Range         DA SE SC. 14, 4B<br/>Sofety Risk Index<br/>Range         Category:<br/>Hazard         A likely to occur mouth know to have 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Hazard         rg       Likely to occur many times (has occurred frequently)       Safety flak index       Pic. EF       EC       Ri       RT       No. EF       EC       Ri       RT       RT       RS       RT       RT       RS       RT       RT       RT       RT       RT       RT       RT</td></td<> | TY TABLE       Category:       HUM - Hazard         rg       Likely to occur many times (has occurred frequently)       Safety flak index       Pic. EF       EC       Ri       RT       No. EF       EC       Ri       RT       RT       RS       RT       RT       RS       RT       RT       RT       RT       RT       RT       RT | TABLE 4: SAFETY         TABLE 4: SAFETY         TABLE 4: SAFETY         TABLE 4: SAFETY         Safety Risk Index         Category:         HUM - Hazar 10.00022: Im         Category:         Category:         HUM - Hazar 10.00022: Im         Category:         A large reduction in safety margins,
an eduction in the estimation of the marging intervent with the type of colspane in the osterm 10% | TY Table       Category:       Hum       Hum       Human (D 00022): Investore         Int       Likelihoo ccurrenting finas occurred infrequently)       Safet, Risk Index       Risk Index       Risk Index         Safet, Risk Index       Raining       Safet, Risk Index       Risk Index       Risk Index         Amount Inconceivable that the event will occur       Safet, Risk Index       Risk Index       Risk Index         Amount Inconceivable that the event will occur       Safet, Risk Index       Risk Index       Risk Index         Amount Inconceivable that the event will occur       Safet, Risk Index       Risk Index       Risk Index         Amount Inconceivable that the event will occur       Safet, Risk Index       Risk Index       Risk Index         Amount Inconceivable that the event will occur       Safet, Risk Index       Risk Index       Risk Index         Amount Inconceivable that the event will occur       Safet, Risk Index       Risk Index       Risk Index         Amount Inconceivable that the event will occur       Safet, Risk Index       Risk Index       Risk Index         Amount Inconceivable that the event will occur       Safet, Risk Index       Risk Index       Risk Index         Amount Inconceivable that the event will observe Intermed that the event will observe Intermed that the event will be that the event will observe Intermed that the event will observe Interme | TY Table       Category:       HUM - Hazard (D 2022: Investmation Reg         ng       Likelihood       Likelihood       Row 1       Row 2       Row 2 | TABLE         HALE 4: SAFETY F         HALE 5: DEF (HT C)         Call The F is a procedure in Colspan="2">HALE 5: DEF (HT C)         HALE 5: DEF (HT C)         HALE 5: DEF (H | TABLE 4: SAFETY 6Model and the second requestly in the second request requestly in the second request requestly in the second requestly in the second requestly in the second requestly in the second request requestly in the second request requestly in the second requestly in the second requestly in the seco | Category:       HUM - Hazer D 2022: Investance Report MCA448224         TABLE 4: SAFETY         Materia Support         TABLE 4: SAFETY         Materia Support         Materia Supp | Category:       HUM - Hazwir D 2022: Insertation Record Mu2AAR22-20         TABLE 4: SAET T         Marker description         Category:       HUM - Hazwir D 2022: Insertation Record Mu2AAR22-20         Marker description         Category:       HUM - Hazwir D 2022: Insertation Record Mu2AAR22-20         Marker description       Factor description         Category:       HUM - Hazwir D 2022: Insertation Record Mu2AAR22-20         Marker description       Hum - Hazwir D 2022: Insertation Record Mu2AAR22-20         TABLE 4: SAET T         Marker description       Hazwir description         Marker description       Hum - Hazwir D 2022: Insertation Record Mu2AAR22-20         Marker description       Hum - Hazwir D 2022: Insertation Record Mu2AAR22-20         Marker description       Hum - Hazwir D 2022: Insertation Record Mu2AAR22-20         A Cate description         A Cate description         A Cate description         Marker description       Harker description         A Cate description         A Cate description <t< td=""><td>If the image of the second sequence is a product of the second sequence is a second s</td><td>Y TABLE         Y TAB</td><td>With - taxant D         With - taxant D       With -</td><td>Hut - Latelinood         Hut - Latelinood         TABLE - SAFETY         Categor:       Hut - Latelinood         Categor:       Hut - Latelinood         Categor:       TABLE - SAFETY         Categor:       Hut - Latelinood       TABLE - SAFETY         Categor:       TABLE - SAFETY       Hut - Latelinood       Hut - Latelinood         Categor:       TABLE - SAFETY       Hut - Latelinood       TABLE - SAFETY         Categor:       TABLE - SAFETY       Hut - Latelinood       Hut - Latelinood         A model finate research       TABLE - SAFETY       TABLE - SAFETY         Name: Categor:       TABLE - SAFETY       Hut - Latelinood       Hut - Latelinood         A model finate research       TABLE - SAFETY       TABLE - SAFETY         A model finate research       TABLE - SAFETY       Nume: Categor: Cate</td></t<> | If the image of the second sequence is a product of the second sequence is a second s | Y TABLE         Y TAB | With - taxant D         With - taxant D       With - | Hut - Latelinood         Hut - Latelinood         TABLE - SAFETY         Categor:       Hut - Latelinood         Categor:       Hut - Latelinood         Categor:       TABLE - SAFETY         Categor:       Hut - Latelinood       TABLE - SAFETY         Categor:       TABLE - SAFETY       Hut - Latelinood       Hut - Latelinood         Categor:       TABLE - SAFETY       Hut - Latelinood       TABLE - SAFETY         Categor:       TABLE - SAFETY       Hut - Latelinood       Hut - Latelinood         A model finate research       TABLE - SAFETY       TABLE - SAFETY         Name: Categor:       TABLE - SAFETY       Hut - Latelinood       Hut - Latelinood         A model finate research       TABLE - SAFETY       TABLE - SAFETY         A model finate research       TABLE - SAFETY       Nume: Categor: Cate |



TABLE 1: PROBABILITY TA

TABLE 2: SEVERITY TABLE

TABLE 3: SAFETY RISK IN Probability 5 (Frequent) 4 (Occasional) 3 (Remote) 2 (Improbable) 1 (Extremely improbable)

Value

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Value

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					TABLE 6: HAZA	ABLE 6: HAZARD IDENTIFICATION & RISK MITIGATION (HIRM) REGISTER																				
				TABLE 4: SAFETY F	Category:								ним	- <u>Haz</u>	zard ID	020/22- Investi	gation F	Report L	.M/QA	AIR/	/22-02	2				
	Likelihoo	4		Safety Risk Index	Hazard	E- PC	EF	EC	RI	RT	N- PC	EF	EC	RI	RT	Unsafe Event	E- RM	EF	EC	RI	RT	N- RM	EF	EC F	R.	Ultimate Consequence
Likely to occur	many times (has		ently)	Range	1. The towing	E-		Nil		_	N-	Nil	Nil			Event	TXIVI			_		rxivi	-			Potential
•	sometimes (has				personnel	PC1	EF1				PC1					AW109										damage to
	cur, but possible		**	5A, 5B, 5C, 4A, 4B, 3A	proceed with the towing without	E- PC2	EF2	Nil		BLE	N- PC2	Nil	Nil		ACCEPTABLE	trekker RH										aircraft (low probability)
,	o occur (not kno			~~	carrying out a pre-	PCZ			3D	ERAE	PCZ			1D	PTA	FWD towing equipment			_				-			and the tow
Almost inco	onceivable that th	he event will occ		tow briefing first 2. The towing team					Б					U U	(safety pin) found										equipment itself.	
				5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B,	is not familiar with					F					A	damaged.										
				2C, 1A	this type of towing equipment											-										
	Meaning																					_		_		
aent destroyed 3E, 2D, 2E, 1B, 1C						TABLE 7: DESCRIPTION OF EXISTING PREVENTIVE CONTROLS (E-PC) There is a procedure in EDM Chapter 04.02 outline towing of aircraft procedure and precautions to be undertaken by																				
5		1D, 1E													ft proc	edure	and	prec	cautio	ons to I	be u	Inderta	ken t	y BSV:3		
on in safety margir sonnel cannot be i																iefings. ead by the toy	ving n	orson	nol							
Somer cumor be	relied upon to pe		succurately of	TABLE 5: DEFINITIO	EF>E-PC1 There is a possibility that this procedure is not being read by the towing personnel. EC>EF>E-PC1																					
nt damage				Barrier A																						
5	Barrier Strength	E-PC2	There	is a to	wing	proce	edure	e state	ed in	IETP	Chap	oter 0	9-10 for A109										BSV:3			
duction in safety m ope with adverse o				Value (BSV)	EF>E-PC2 There is a possibility that this procedure is not being read by the towing personnel.																					
a result of condition				Consolidated T	Consolidated T EC>EF>E-PC2																					
nt ns				Value (CBSV)	alue (CBSV)																					
				Escalation Control A																						
ations				(EC) 0	EF>EPC3																					
ncy procedures				Escalation Factor F	EC>EF>E-PC3																					
nces. No significar	no to operations	a cofoty		TABLE 8: D	ESCRIPTION OF	NEW	PRE	VEN.	TIVE	co	NTR	OLS	(N-P	C)												
nces. No significar	ice to operationa	ai salely		Pr	Alert Sticker to								•	· ·	holes	so that the p	erson	who h	andle	es th	ne ea	uipme	nt is	sawar	e that	David
				N-PC1	certain action						1.400			P.41.												BSV:4
	Severity			EF>N-PC1																						
В	С	D	E	EC>EF>N-PC	1																					
(Hazardous)	(Major)	(Minor)	(Negligible)	r.e																						
5B	5C	5D	N-PC2	Once off briefi																	o all to	win	g pers	onnel	BSV:4	
4B	4C	4D		This is to ensu	ire tha	t the to	owing	crew	v is fa	amilia	r with	n all th	ne typ	pes of	towing equip	ment	availa	ble ir	I LM	1.						
			4E		2																					
3B	3C	3D	ЗE	EC>EF>N-PC	2																					
2B	2C	2D	2E	Ur N-PC3																						DCV:
	10																									BSV:
1B	1C	1D	1E	EF>N-PC3																						
_			EC>EF>N-PC	3																						



TABLE	2: SEVERITY	TABLE
Value	Severity	Meaning
А	Catastrophic	Aircraft / equipment destroyed     Multiple deaths
в	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
с	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
D	Minor	Nuisance     Operating limitations     Use of emergency procedures     Minor incident
Е	Negligible	<ul> <li>Few consequences. No significance to operational safety</li> </ul>

#### TABLE 3: SAFETY RISK INDEX

	Severity											
Probability	A (Catastrophic)	B (Hazardous)	C (Major)	D (Minor)	E (Negligible)							
5 (Frequent)	5A	5B	5C	5D	5E							
4 (Occasional)	4A	4B	4C	4D	4E							
3 (Remote)	ЗA	3B	зC	3D	ЗE							
2 (Improbable)	2A	2B	2C	2D	2E							
1 (Extremely improbable)	1A	1B	1C	1D	1E							



ſ	EXISTING RISK INDEX (HAZARD > UNSAFE EVENT)		ח ה	TABLE 6: HAZA		IFICA	TION	& RI	sk міт	<b>FIGAT</b>	TION (H	RM)	REGISTER										
_			"[]	Category:						1	HUM - <u>H</u> a	azard II	D 020/22- Investig	ation F	Report	L <i>M/</i> Q	A/AIR/22-	02					
T \	<ol> <li>Assessed Existing Severity level of the Unsafe Event (UE)</li> <li>Therefore, UE's Optimum No of Barriers (ONB) [Table 16]:</li> </ol>	D 3		Hazard	PC E		RI	RT	N- PC		EC RI	RT	Unsafe Event	E- RM	EF	EC	RI RT	 F	N- RM EF	EC	RI	RT	Ultimate Consequence
	<ol> <li>Applicable CBSV-Probability Table for this severity level [Table 16]:</li> <li>Assessed BSV of individual E-PCs [Table 14]:</li> </ol>	Table 17D           E-PC1         3           E-PC2         3           E-PC3         -           E-PC4         -           E-PC5         -		1. The towing personnel proceed with the towing without carrying out a pre- tow briefing first     2. The towing team is not familiar with this type of towing equipment	E- PC1 EF PC2 EF	Nil	3D	TOLERABLE	N- PC1 N- PC2	Nil		ACCEPTABLE	AW109 trekker RH FWD towing equipment (safety pin) found damaged.										Potential damage to aircraft (low probability) and the tow equipment itself.
	5) Therefore, CBSV (SUM) of all E-PCs [Table 15]:	6	ווב	TABLE 7: DESC									• •										
Η	<ul> <li>Assess CBSV of ONB (NA if number of E-PCs &lt; ONB): (Choose barriers with highest BSVs for this ONB-CBSV calculation)</li> </ul>	NA	┛	E-PC1	the towing	perso	onnel ir	nclud	ling car	rrying	out pre	tow b		<u> </u>			i precau	tion	is to be	unde	rtake	n by	BSV:3
	7) Existing CBSV of UE (item 5 or 6, whichever is lesser):	6		EF>E-PC1	There is a	possi	bility th	nat th	nis proc	edure	e is not l	being	read by the tow	ing p	erson	nel.							
	<ol> <li>Existing Probability of the UE (CBSV-Probability) [Table 17]:</li> </ol>	3	_ A	ECSERSE-PUT																			
H	<ol><li>Existing Risk Index of the UE (Probability x Severity):</li></ol>	3D	┙╞	E-PC2	There is a	towin	g proc	edure	e state	d in IE	ETP Cha	apter (	09-10 for A109.										BSV:3
			Ľ		There is a	possi	bility th	nat th	nis proc	edure	e is not l	being	read by the tow	ing p	erson	nel.							
	NEW RISK INDEX (HAZARD > UNSAFE EVENT)		113	EC>EF>E-PC2																			
			ľ	E-PC3																			BSV:
	1) Assessed Existing Severity level of the Unsafe Event (UE)	D		EF>E-PC3																			B3V.
	<ol><li>Therefore, UE's Optimum No of Barriers (ONB) [Table 16]:</li></ol>	3	_ P	EC>EF>E-PC3																			
	3) Applicable CBSV-Probability Table for this severity level [Table 16]:	Table 17D		<u> </u>																			
	Assessed BSV of individual Existing PCs & New PCs [Table 14]:     E-PC1 3	N-PC1 4		ESCRIPTION OF							· /												
	E-PC1 3 E-PC2 3	N-PC2 4	-	Alert Sticker to certain action (					placed	d neai	r the pin	hole	s so that the pe	rson	who ł	nand	les the e	qui	ipment	is awa	are tł	nat	BSV:4
H	E-PC3	N-PC2	-	certain action (	(pin remo	al) is	require	eu.															
	E-PC4	N-PC4		1																			
	E-PC5	N-PC5	Ē	· .																			
			Ţ										that specific ty					to a	all towi	ng pe	rsonr	nel.	BSV:4
	5) Therefore total (SUM) BSV of all E-PCs plus N-PCs [Table 15]:	14		This is to ensu	ire that the	e towir	ig crev	N IS f	amılıar	with	all the ty	/pes d	of towing equip	ment	availa	able	in LM.						
Н	<ul> <li>Assess total BSV of ONB (NA if number of E-PCs + N-PCs &lt; ONB): (Choose barriers with highest BSVs for this ONB-CBSV calculation)</li> </ul>	10	C2	2																			
H	<ol><li>Resultant CBSV of UE (item 5 or 6, whichever is lesser):</li></ol>	14																					
Ц	8) Resultant Probability of UE (CBSV-Probability) [Table 17]:	1																					BSV:
	9) Resultant Risk Index of the UE (Probability x Severity):	1D	1																				
_		EC>EF>N-	PC3	3																			



EXISTING RISK INDEX (HAZARD > UNSAFE EVEN	Т)		TABLE 6: HAZARD IDENTIFICATION & RISK MITIGATION (HIRM) REGISTER																
			Category:				HUI	M - <u>Haza</u>	ard ID 020/	'22- <u>Investi</u>	igation	Report	LM/Q	A/AIR/22-	02				
1) Assessed Existing Severity level of the Unsafe Event (	,	D	Hazard	E- PC EF	EC RI	RT PC	EF EC	RI	RT	Unsafe Event	E- RM	EF	EC	RI RT	N- RM	EF EC	RI	RT	Ultimate Consequence
<ol> <li>Therefore, UE's Optimum No of Barriers (ONB) [Table</li> <li>Applicable CBSV-Probability Table for this severity lev</li> </ol>		Table 17D	1. The towing	E- FF4	Nil		Nil Nil			Lvent	TXIVI				T XIVI				Potential
<ul> <li>4) Assessed BSV of individual E-PCs [Table 14]:</li> </ul>		PTION OF EXISTING	RECOVERY MEA	SURES (	RM)												1		damage to aircraft (low
,	E-RM1				,										B	SV:			probability) and the tow
	EF>E-RM1																		equipment
	EC>EF>E-RM1																		itself.
																	1		
	E-RM2														В	SV:	1		
5) Therefore, CBSV (SUM) of all E-PCs [Table 15]:	EF>E-RM2																		
<ul> <li>Assess CBSV of ONB (NA if number of E-PCs &lt; ONB (Choose barriers with highest BSVs for this ONB-CBS)</li> </ul>	EC>EF>E-RM2																rtake	n by	BSV:3
<ul> <li>(Choose barriers with highest BSVs for this ONB-CBS</li> <li>7) Existing CBSV of UE (item 5 or 6, whichever is lesser)</li> </ul>																			
<ol> <li>Existing Probability of the UE (CBSV-Probability) [Tal</li> </ol>	E-RM3														В	SV:			
<ul> <li>9) Existing Risk Index of the UE (Probability x Severity):</li> </ul>	EF>E-RM3																		BSV:3
	EC>EF>E-RM3																		B3V:3
NEW RISK INDEX (HAZARD > UNSAFE EVENT)																	1		
NEW RISK INDEX (HAZARD > UNSAFE EVENT)	TABLE 10: DESC	RIPTION OF NEW REC	OVERY MEASU	RES (N-R	VI)														
1) Assessed Existing Severity level of the Unsafe Event (	N-RM1														В	SV:	_		BSV:
2) Therefore, UE's Optimum No of Barriers (ONB) [Table	EF>N-RM1																		
<ol> <li>Applicable CBSV-Probability Table for this severity lev</li> </ol>	EC>EF>N-RM1																		
4) Assessed BSV of individual Existing PCs & New PCs															-		1		
	N-RM2														B	SV:	rare t	nat	BSV:4
	EF>N-RM2																		
	EC>EF>N-RM2																		
	N-RM3														D	SV:	1		
5) Therefore total (SUM) BSV of all E-PCs plus N-PCs [T															D	37.	irson	nel.	BSV:4
· · · ·																			
6) Assess total BSV of ONB (NA if number of E-PCs + N- (Choose barriers with highest BSVs for this ONB-CBS																	1		
7) Resultant CBSV of UE (item 5 or 6, whichever is lesse		14																	
8) Resultant Probability of UE (CBSV-Probability) [Table		1																	BSV:
9) Resultant Risk Index of the UE (Probability x Severity)		1D																	
		EC>EF>N-PC	03																



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Γ	EXISTING RISK INDEX (HAZARD > UNSAFE EVEN	Т	TABLE 6: HAZARD IDENTI	EXISTING RISK INDEX (UNSAFE EVENT > ULTIMATE CONSEQUENCE)
Т \	<ol> <li>Assessed Existing Severity level of the Unsafe Event</li> <li>Therefore, UE's Optimum No of Barriers (ONB) [Table</li> <li>Applicable CBSV-Probability Table for this severity level</li> </ol>	UE) D 16]: 3 UTable 161: Table 17D	Category:           Hazard         E- PC         EF           1. The towing         E- EF         EF	1) Assessed Existing Severity level of the Ultimate Consequence (UC)       Image: Consequence (UC)         2) Therefore, UC's Optimum No of Barriers (ONB) [Table 16]:       Image: Consequence (UC)         3) Applicable CESV-Probability Table for this severity level [Table 16]:       Image: Cesv-Probability Table 16]:
	<ol> <li>Assessed BSV of individual E-PCs [Table 14]:</li> </ol>	TABLE 9: DESCRIPTION OF EXISTING I           E-RM1           EF>E-RM1           EC>EF>E-RM1	RECOVERY MEASURES (	4) Assessed BSV of individual E-RMs [Table 14]: 000 E-RM1 010 E-RM2 000 E-RM3 000 E-RM4 000 E-RM4 000 E-RM5 000
	<ol> <li>Therefore, CBSV (SUM) of all E-PCs [Table 15]:</li> <li>Assess CBSV of ONB (NA if number of E-PCs &lt; ONB (Choose barriers with highest BSVs for this ONB-CBS</li> <li>Existing CBSV of UE (item 5 or 6, whichever is lesser;</li> <li>Existing Probability of the UE (CBSV-Probability) [Ta</li> <li>Existing Risk Index of the UE (Probability x Severity):</li> </ol>			5) Therefore, CBSV (SUM) of all E-RMs [Table 15]:         6) Assess CBSV of ONB (NA if number of E-RMs < ONB):
	NEW RISK INDEX (HAZARD > UNSAFE EVENT)           1)         Assessed Existing Severity level of the Unsafe Event           2)         Therefore, UE's Optimum No of Barriers (ONB) (Table           3)         Applicable CBSV-Probability Table for this severity level	TABLE 10: DESCRIPTION OF NEW REC           N-RM1           EF>N-RM1           EC>EF>N-RM1	OVERY MEASURES (N-R	NEW RISK INDEX (UNSAFE EVENT > ULTIMATE CONSEQUENCE)       V         1) Assessed Existing Severity level of the Ultimate Consequence (UC)       V         2) Therefore, UC's Optimum No of Barriers (ONB) [Table 16]:       V
T	<ol> <li>Assessed BSV of individual Existing PCs &amp; New PCs</li> </ol>	N-RM2 EF>N-RM2 EC>EF>N-RM2		3) Applicable CBSV-Probability Table for this severity level [Table 16]:     4) Assessed BSV of individual E-RMs & N-RMs [Table 14]:     E-RM1 N-RM2     R-RM2 N-RM2     E-RM3 N-RM2     R-RM4 N-RM4     E-RM4 N-RM5     N-RM5
	<ul> <li>5) Therefore total (SUM) BSV of all E-PCs plus N-PCs [T Assess total BSV of ONB (NA if number of E-PCs + N (Choose barriers with highest BSVs for this ONB-CBS)</li> <li>7) Resultant CBSV of UE (Item 5 or 6, whichever is lesses) Resultant Probability of UE (CBSV-Probability) [Tabil 9) Resultant Risk Index of the UE (Probability x Severity)</li> </ul>	EF>N-RM3         14           EC>EF>N-RM3         11           r):         11           17]:         10		5)       Therefore total (SUM) BSV of all E-RMs plus N-RMs [Table 15]:         6)       Assess total BSV of ONB (NA if number of E-RMs + N-RMs < ONB):
		EC>EF>N-PC		9) Resultant Risk Index of the UC (Probability x Severity):



I Ass       TABLE 11:9 ELEMENTS OF BARRIER EFFECTIVENESS       Description         1 Ass       No.       Element       Description         3 Applicable CBSV-Probability Table for this severity level (Table 16):       Assessed Existing Severity level of the Ultimate Consequence (UC)         4 Ass       2       Costhematic The extent bwitch the generated barefits of the migation autweights the costs.       Feedowidts         3 Applicable CBSV-Probability Table for this severity level (Table 16):       Assessed Existing Severity level of the Ultimate Consequence (UC)         4 Assessed Existing CBSV-Probability Table for this severity level (Table 16):       Assessed Existing Severity level (Table 16):         5 The extent bwitch the alternative (tarrier) is acceptable to those paople that will be expected to apply it.       Fer.NL (Letter CBSV (SUM) of all E-RMs [Table 15):         6 Ass       6       Durability       The extent bwitch the migation and winderstative resources.       Fer.NL (Letter CBSV (SUM) of all E-RMs [Table 15):         7 Existing CBSV of DUC (Ims 0 Ge, whichewer Is is exceptable and effective.       Fer.NL (Letter CBSV (SUM) of all E-RMs [Table 15):       Assess CBSV of this United CBSV-Probability of the UC (Rel SO Ce, Whichewer Is is essociated with the integeneration of the alternative.         9 Existing Probability of the UC (CBSV-Probability of the UC (Rel SO Ce, Whichewer Is is essociated with the alternative.       Fer.NL (Letter CBSV (SUM) of all E-RMs [Table 15):       Assess CBSV of this Unitable consequence (UC)         <	V:3
1) Ass       No.       Description       Image: Construction of the atternative (barrier) reductor of eliminate the safety risk. Construction of the atternative (barrier) reductor of eliminate the safety risk. Construction of the atternative (barrier) reductor of eliminate the safety risk. Construction of the atternative (barrier) reductor of eliminate the safety risk. Construction of the atternative (barrier) reductor of eliminate the safety risk. Construction of the atternative (barrier) reductor of eliminate the safety risk. Construction of the atternative (barrier) reductor of eliminate the safety risk. Construction of the atternative (barrier) reductor of eliminate the safety risk. Construction of the atternative (barrier) is acceptable to those people that will be atternative (barrier) is acceptable to those people that will be eliminate the secure eliminate eliminate the secure eliminate eliminatelino eliminate eliminate eliminate eliminate e	al to ow ent V:3
2)       The additional to which the attentional to addet visits and and additional the safety risks.       1       Implemented to USS Optimum No of Barners (UNS) [Table 16]:         4)       Ass       1       Effectiveness and the addet visits in the safety risks.       1       Implemented to USS Optimum No of Barners (UNS) [Table 16]:       2         4)       Ass       2       Costbenefit       The extent to which the perceived benefits of the mitigation and administrative resources, legislation, political will, expected to appropriate its in terms of available and effective.       5       Assessed BSV of Individual E-RMs [Table 15]:       E-RM1         4       Acceptability       The extent to which the attentive (barrier) is acceptable to those people that will be expected to appropriate its in terms of available and effective.       5)       Therefore, CBSV (SUM) of all E-RMs [Table 15]:       E-RM1         5)       The degree of administrative secures, legislation, or the mitigation and administrative resources, legislation, or the mitigation attenative (barrier) is acceptable to these people that will be expected to appropriate its in terms of available end effective.       5)       Therefore, CBSV (SUM) of all E-RMs [Table 15]:       E-RM1         6       Assess CBSV of ONB (NA if number of E-RMs < ONB):	al to ow ent V:3
1) App 1     1: Effectiveness     2: Costibenefit     1: Ass     2: Costibenefit     1: Pre-extent to which the precived banefits of the miligation curvelysis the costs.     3: Practically     4: Acceptability     The extent to which the atternative (barrier) is acceptable to those people that will be     expected to apply it.     4: Acceptability     The extent to which compliance with new rules, regulatory     for the implementation of the miligation curvels, legislation, sor operating procedures can     be monitored.     for the implementation of the miligation curvels, legislation, sor operating procedures can     be monitored.     for the implementation of the miligation curvels, legislation, sor operating procedures can     be monitored.     for the implementation of the miligation attemative.     for the implementation of the miligation attemative.     for the implementation of the miligation attemative.     for the implementation of the satestrip with measures.     for the implementation of the satestrip with measures.     for the implementation of the miligation attemative.     for the implementation of the satestrip with measures.     for the implementation of the satestrip with the measures.     for the implementation of the satestrip with the measures.     for the implementation of the satestrip with measures.     for the implementation of the satestrip with the main measures.     for the implementation of any miligation atternative.     for the implementation of any miligation atternative.     for the implementation of any miligation atternative.     for theadding the miligating thead the	view constraints of the second
4) Ass       idefences that can reduce or eliminate safety risks.       G RECOVERY MEASURES (1)       Assessed BSV of individual E-RMs [Table 14]:       E-RM1         2       Costbeneft       The extent to which the perceived barries of the implemented and how appropriate it is in terms of operational realities, exc.       Final Acceptability       Assessed BSV of individual E-RMs [Table 14]:       E-RM1         4       Acceptability       The extent to which the eliminate or eliminate administrative resources, ligitation, pointed will.       E-RM1       E-RM3         5)       The effect which the eliminate subsequent to the implementation of the entry is acceptable to those people that will be entry is acceptable to the peoplementation of the initial mitigation and which the eliminate subsequent to the implementation of the initial mitigation and which the mitigation and which may necessitate additional safety risk associated with the initiagation and which may necessitate additional safety risk associated with the finitigation alternative.       5)       Therefore, CBSV (SUM) of all E-RMs [Table 15]:       Assess CBSV of ONB [NA if number of E-RM3 < ONB):	view constraints of the second
3       Practicality       The extent to which miligation can be implemented and how appropriate it is in terms of available technology, financial and administrative resources, legislation, political will, operational resources, legislation, political will, operational resources, legislation, political will, expected to apply it.       E-RM2         4       Acceptability       The extent to which miligation can be implemented and how appropriate it is in terms of available technology, financial and administrative resources, legislation, political will, expected to apply it.       E-RM4         5)       The extent to which melligation will be sustainable and effective.       5)       Therefore, CBSV (SUM) of all E-RMs [Table 15]:         6, ICT       7       Residual       The extent to which melligation add which may necessital addition at ster risk control measure.       5)         7)       Exit       8       Uninhended       The inflam illigation attendive.       5)         8)       Exit operational of which may necessital addition attendive.       7)       Exit applicability of the UC (CBSV-Probability) Table 17]:       6)         9)       Exit applicability       The extent to which melligation attendive.       8)       ECOVERY MEASURES (N-R       Netweents is associated with the prementation of any militam applicability if the implementation of any militam applicabilita attendive.       6)       ECOVERY MEASURES (N-R	v:3
3       Practicality       available technology, financial and administrative resources, legislation, political will, operational realities, etc.       E-RM3         4       Acceptability       The extent to which the alternative (barrier) is acceptable to those people that will be expected to apply it.       E-RM4         5)       The       E Enforceability       The extent to which mentages on apply it.       E-RM4         6)       Acs       Durability       The extent to which mentages on apply it.       E-RM3         6)       Acs       Durability       The extent to which the mitigation will be sustainable and effective.       5)       Therefore, CBSV (SUM) of all E-RMs [Table 15]:       E-RM4         6)       Acs       Durability       The extent to which the mitigation will be sustainable and effective.       6)       Assess CBSV of ONB (NA if number of E-RMs < ONB):	V:3
i       i       operational realities, etc.       i	
i       i       intervention	
i       Acceptability       Expected to apply it.       E-RM5         i       Find complexity       The extent to which compliance with new rules, regulations or operating procedures can be monitored.       i         i       S       Enforceability       The extent to which the miligation will be sustainable and effective.       initial miligation and which the miligation and which may necessitie additional safety risk that remains subsequent to the implementation of new hazards and related safety risk that remains used additional aster risk in the miligation alternative.       initial miligation and which may necessitie additional safety risk with remains used additional aster risk in the miligation alternative.       initial miligation and which may necessitie additional aster risk in the main subsequent to the implementation of any miligation alternative.       initial miligation and which may necessitie additional aster risk in the main subsequent to the implementation of any miligation alternative.       initial miligation alternative.       initial miligation alternative.         i       i       i       Maximum required for the implementation of the safety risk mitigation alternative.       i       ixisting Probability of the UC (CBSV-Probability) (Table 17):       ixisting Probability ixist miligation alternative.         i       i       Maximum required for the implementation of the safety risk mitigation alternative.       ixisting Probability of the UC (CBSV-Probability) (Table 17):       ixisting Probability ixist interative.         i       Absceptite freetoreness       Effectiveness Score <td< td=""><td></td></td<>	
5)       The second secon	
5)       The second secon	
Ass       6       Durability       The extent to which the mitigation and mile sustainable and effective.         6)       (Cr       7       Residual       The degree of safety risk initial miligation and which may necessitate addition desares.         7)       Exit       8       Unintended       The introduction of new hazards and related safety risk associated with         8)       Exit       8       Unintended       The introduction of any miligation and which may necessitate addition desares.         9)       Exit       9       Time       Time equired for the implementation of any miligation alternative.         9)       Exit       9       Time       Time equired for the implementation of the safety risk associated with         9)       Exit       9       Time       Time equired for the implementation of the safety risk mitigation alternative.         9)       Exit       9       Time       Time equired for the implementation of the safety risk associated with         1)       Asse       Element       (High, Moderate, Low)       3 (H), 2 (M), 1 (L)         1)       Asse       Element       (High, Moderate, Low)       3 (H), 2 (M), 1 (L)         1)       Assessed Existing Severity level of the Ultimate Consequence (UC)       1       Assessed Existing Severity level of the Ultimate Consequence (UC)       2         1) <td></td>	
7       Residual The degree of safety risk that remains subsequent to the implementation of the safety risk control measures.       5)       (Choose barriers with highest BSVs for this ONB-CBSV calculation)         7)       Exit 8       Unintended consequences       The introduction of new hazards and related safety risk associated with the implementation of any mitigation alternative.       5)       (Choose barriers with highest BSVs for this ONB-CBSV calculation)         9)       Exit 8       Unintended consequences       The introduction of new hazards and related safety risk associated with the implementation of any mitigation alternative.       7)       Exitsting Probability of the UC (CBSV-Probability) [Table 17]: 9)       8)         9)       Exitsting Probability of the UC (Probability X Severity):       9)       Exitsting Risk Index of the UC (Probability X Severity):       9)         1)       Ass       1       Effectiveness 1       Effectiveness 1       Effectiveness 1       New RISK INDEX (UNSAFE EVENT > ULTIMATE CONSEQUENCE)         1)       Ass       1       Effectiveness 1       1       Assessed Existing Severity level of the Ultimate Consequence (UC)       1         2)       The 2       Costbenefit       1       Assessed Existing Severity level of the Ultimate Consequence (UC)       1         3)       Apt 4       Acceptability       1       Assessed Existing Severity level of the Ultimate Consequence (UC)       1 <tr< td=""><td></td></tr<>	
7) Exit       Safefy risk       Initial mitgation and which may necessitate additional safety risk control measures.         8) Exit       8 Unintended consequences       The introduction of new hazards and related safety risk associated with the implementation of any mitgation alternative.       7) Existing CBSV of UC (item 5 or 6, whichever is lesser):         9) Exit       9       Time       Time required for the implementation of any mitgation alternative.       8) Exitsing Probability of the UC (CBSV-Probability) [Table 17]:         9) Exit       9       Time       Time required for the implementation of the safety risk mitigation alternative.       9) Exitsing Risk Index of the UC (Probability x Severity):         1) Ass       1       Effectiveness       Effectiveness Score (High, Moderate, Low)       3 (H), 2 (M), 1 (L)         1) Ass       1       Effectiveness       1       Assessed Existing Severity level of the Ultimate Consequence (UC)       1         2) The       2       Costbenefit       1       Assessed Existing Severity level of the Ultimate Consequence (UC)       1         3) Aprit       4       Acceptability       1       Effectiveness       1         4) Ass       5       Enforceability       1       Assessed BSV of individual E-RMs & N-RMs [Table 16]:       4         4) Assessed BSV of individual safety risk       1       Residual safety risk       1       N-RMI	
8) Ext       8) Confidence of the implementation of any mitigation alternative.         9) Ext       9       Time       Time required for the implementation of any mitigation alternative.         9) Ext       9       Time       Time required for the implementation of the safety risk mitigation alternative.         1       Ass       Effectiveness       Effectiveness       Second (High, Moderate, Low)         1) Ass       1       Effectiveness       Effectiveness       Fife (High, Moderate, Low)         2) The       2       Costbenefit       1       Assessed Existing Severity level of the Ultimate Consequence (UC)         3) Apr       4       Acceptability       1       Assessed Existing Severity level of the Severity level (Table 16]:         4) Ass       5       Enforceability       1       Fieldulity       1         4       Acceptability       1       Fieldulity       1         4       Acceptability       1       Fieldulity       1         4       Acceptability       1       Endoced Severity level (Table 16]:       1         4       Acceptability       1       Assessed BSV of individual E-RMs & N-RMs [Table 14]:       N-RM1	V:3
9) Ext       9       1 <td>V:3</td>	V:3
NEW R       TABLE 12: BARRIER EFFECTIVENESS ASSESSMENT         No.       Barrier Effectiveness       Effectiveness Description (High, Moderate, Low) 3 (H), 2 (M), 1 (L)         1)       Ass       1       Effectiveness       Effectiveness Correspondence (High, Moderate, Low) 3 (H), 2 (M), 1 (L)         1)       Ass       1       Effectiveness       Effectiveness Correspondence (High, Moderate, Low) 3 (H), 2 (M), 1 (L)         2)       The       2       Costbenefit       1)       Assessed Existing Severity level of the Ultimate Consequence (UC)       2)         3)       Apri       4       Acceptability       2)       Therefore, UC's Optimum No of Barriers (ONB) [Table 16]:       2)         4)       Ass       Enforceability       3)       Applicable CBSV-Probability Table for this severity level [Table 16]:       4)         7       Residual safety risk       E-RM1       N-RM1	
NEW R         No.         Barrier Effectiveness         Effectiveness Description (High, Moderate, Low)         Effectiveness Score 3 (H), 2 (M), 1 (L)         Effectiveness Construction (High, Moderate, Low)         Effectiveness Score 3 (H), 2 (M), 1 (L)         Effectiveness Construction (High, Moderate, Low)         Effectiveness Score 3 (H), 2 (M), 1 (L)         Effectiveness Construction (High, Moderate, Low)	
No.         Barrier Enectiveness         Element         Element         Element         Element         Element         Element         Element         Element         Element         N: Write ASORES (N-R)         NEW RISK INDEX (UNSAFE EVENT > ULTIMATE CONSEQUENCE)           1)         Ass         1         Effectiveness         3 (H), 2 (M), 1 (L)         1         1         Assessed Existing Severity level of the Ultimate Consequence (UC)         1           2)         The         2         Cost/benefit         1         Assessed Existing Severity level of the Ultimate Consequence (UC)         1           3)         Appr         4         Acceptability         2)         Therefore, UC's Optimum No of Barriers (ONB) [Table 16]:         1           4)         Ass         5         Enforceability         3)         Applicable CBSV-Probability Table for this severity level [Table 16]:         4           6         Durability         -         -         -         -         -           7         Residual safety risk         -         -         -         -         -	1
Instruction       Image: Construction of the problem of	
1) No.       2       Cost/benefit       1)       Assessed Existing Severity level of the Ultimate Consequence (UC)         2) The       3       Practicality       2)       Therefore, UC's Optimum No of Barriers (ONB) [Table 16]:         3) Apr       4       Acceptability       2)       Therefore, UC's Optimum No of Barriers (ONB) [Table 16]:         4) Ass       5       Enforceability       3)       Applicable CBSV-Probability Table for this severity level [Table 16]:         6       Durability       4)       Assessed BSV of individual E-RMs & N-RMs [Table 14]:         7       Residual safety risk       E-RM1       N-RM1	V:
2)       ITTR       3       Practicality       2)       Therefore, UC's Optimum No of Barriers (ONB) [Table 16]:         3)       Apr       4       Acceptability       2)       Therefore, UC's Optimum No of Barriers (ONB) [Table 16]:         4)       Ass       5       Enforceability       3)       Applicable CBSV-Probability Table for this severity level [Table 16]:         6       Durability       4)       Assessed BSV of individual E-RMs & N-RMs [Table 14]:       4)         7       Residual safety risk       E-RM1       N-RM1	
3) Apr       4       Acceptability       2) Interest, Gos Opmant of Damographic Table Top, Trade	
4) Ass       5       Enforceability       5) Applicable CBSV-Probability Table for this sevenity level [Table 14]:         6       Durability       4) Assessed BSV of individual E-RMs & N-RMs [Table 14]:         7       Residual safety risk       E-RM1	
6         Durability           7         Residual safety risk	
7 Residual safety fisk	V:4
	V.4
8         Unintended consequences         E-RM2         N-RM2	
9 Time E-RM3 N-RM2	
Total Barrier Effectiveness Score E-RM4 N-RM4	
TABLE 13: CORRELATION OF BARRIER EFFECTIVENESS TO BSV	V:4
5) The Barlier Effectivenese Search	
Ass Range BSV Barrier Strength Barrier Strength Description 5) Therefore total (SUM) BSV of all E-RMs plus N-RMs [Table 15]:	
1 Poor Weak, superficial or insignificant Assess total BSV of ONB (NA if number of E-RMs + N-RMs < ONB);	
7) Res 10 to 14 2 Fair Barely viable or adequate b) (Choose barriers with highest BSVs for this ONB-CBSV calculation)	
8) Res 15 to 19 3 Satisfactory Reasonable or acceptable 7) Resultant CBSV of UC (item 5 or 6, whichever is lesser):	5 <b>V</b> :
9) Res 20 to 24 4 Good Effective, recognised and established 8) Resultant Probability of U.C. (CRSV/Probability) (Table 17)	
25 to 27 5 Excellent Best or most robust	



T

Γ	EXIS	STIN	G RIS	K INDEX (H	AZARD > U	INSAFE EV	ENT)				TABLE	E 6: HAZ	ARD IDEN	TIFEXIS	STING R	ISK INDEX	(UNSA	FE EVEN	NT > ULTI	MATE C	ONSEQ	JENCE)				
Т	4)		TABL	.E 11: 9 ELEM	ENTS OF BA	ARRIER EFFE	CTIVENESS				Cat	tegory:		1)	Assassad	Existing Sev	verity lev	el of the l	Iltimate Co	nsequenc						
	.,	Ass	No.	Element		1					÷	and and	E	- <sup>1</sup> /	A3363360		venty iev		Jillinale Co	nsequent					10	~
	2) 3)	App	1	Effectiveness	The extent to Effectiveness	which the alte s can be deterr	TABLE 14: EG	QUIVALENT	BSV F	OR EA	CH PRE	VENTI	VE CON	TROLS		RECOVER	RY ME	ASURE	ES (EXP				12 & 1		al	
H	4)	Ass	2	Cost/benefit		t can reduce o which the per	Eleme	nts	E-PC1	E-PC2	E-PC3	5	N-PC2	N-PC3	N-PC4	N-PC5	Σ	E-RM2	E-RM3	N-RM1	N-RM2	N-RM3	N-RM4	N-RM5	ow tv)	
			2	Cost/benefit		which mitigati	3 (H), 2 (N	l), 1 (L)	1	L LL		N-PC1	L-Z	L L L	L Z	Ž	E-RM1	е Ш	L R L	ц Ч	r Z	z z	r Z	z l	ow	1
Ц			3	Practicality	available tech operational re	hnology, finance ealities, etc.	Effectiveness		1	1		3	3													
Т			4	Acceptability	The extent to expected to a	which the alte	Cost/benefit		3	3		2	1													
N			5	Enforceability	The extent to	which complia	Practicality		2	2		3	3													_
	5)	The	6	Durability	be monitored The extent to		Acceptability		3	3		3	3													_
	6)	Ass (Ch	7	Residual	The degree of	of safetv risk th	Enforceability		1	1		3	3												V:3	3
	• /	Exis	'	safety risk Unintended		ion and which r tion of new haz	Durability	-21-	2	2		2	2													_
	- /	Exis Exis	8	consequences	the implement	ntation of any n	Residual safety Unintended con		2	2		1	1													_
	3)		9	Time	Time require	d for the impler	Time	sequences	2	2		3	3												V:3	3
	NEV		TABL	E 12: BARRIE					17	17		21	21													
		V IX	No.		ffectiveness ment	Effe (H	BSV		3	3		4	4												V:	
	1)	Ass	1	Effectiveness															••			••				-
	2)	The	2	Cost/benefit Practicality			TABLE 15: AN	IALYSIS OI		OLIDA	TED BA	RRIER		GTH V	ALUE (	(CBSV)										
	3) 4)	App	4	Acceptability																						_
Ц	-,	/	5	Enforceability Durability			All E-PCs	Equivalent	BSV		All N-PO	Cs	Equivale	nt BSV	1 [	All E-R	Ms	Equiva	alent BSV		All	N-RMs				_
Т			7	Residual safet	ty risk		E-PC1	3			N-PC1		4		-	E-RM				_		I-RM1			V:4	:4
			8	Unintended co	onsequences		E-PC2	3			N-PC2		4		-	E-RM				_		I-RM2				
			9	Time		Total	E-PC3				N-PC3	3				E-RM	13			-	N	I-RM3				
H											N-PC4	4			1	E-RM	14			_	N	I-RM4				
H	5)	The	TABLE 13: CORRELATION OF BARRIER EF								N-PC5	5			1	E-RM	15				N	I-RM5			IV:4	:4
Н	6)	Ass Range BSV B (Ch 1 to 9 1				6			CBSV (S	UM)	8			CBSV (S	SUM)				CBS	V (SUM)			+			
H	7)	7) Res 10 to 14 2 Max CBSV 15							Max CB	SV	15	5		Max CE	BSV				Ma	x CBSV				_		
														7)	Resultant	CBSV of UC	C (item 5	or 6, whic	chever is le	sser):					6V:	1:
	9)	Res		20 to 24 25 to 27		4 5	Good Effect Excellent	tive, recognised ar Best or most re						8)	Resultant	Probability	of UC (C	CBSV-Pro	bability) [Ta	able 17]:						
_		Ľ						I-P	C3			9)	Resultant	Risk Index o	of the UC	C (Probabi	lity x Sever	ity):								



_																			
[	EXISTI		ISK INDEX (H	AZARD > UNSAFE EV	ENT)					6: HAZARI	TABLE 16: TABLE	: OPTIMUM	NUMBER OF B	ARRIERS (ONE	8) & APPL	ICABLE CBSV	PROBABILITY		
T	1) Ass	TAB No.	BLE 11: 9 ELEM Element	ENTS OF BARRIER EFFE	CTIVENESS				R	egory:	Severity V UE / U		Severity Description	Optimum Num of Barriers (O		CBSV Range B x 5 (Max BSV)]	Applicable CBSV- Probability Table		
H	<ol><li>The</li></ol>			The extent to which the alte	TABLE 14: EC		BSV FO	R F/		VENTIVE	A		Catastrophic	8		40	Table 17A	_	alle
	3) Ap	1	Effectiveness	Effectiveness can be deterr			1 1				В		Hazardous	6		30	Table 17B		to
H	4) Ass			defences that can reduce o	Eleme	nts	E-PC1	E-PC2	E-PC3	N-PC1	С		Major	4		20	Table 17C		ow
		2	Cost/benefit	The extent to which the per	3 (H), 2 (M		l d	ď	l d	ă,	D		Minor	3		15	Table 17D		(y) ow
		3	Practicality	The extent to which mitigati available technology, finance	0 (11), 2 (11	/, ' (=)	ш	Ш	ш	Z	E		Negligible	2		10	Table 17E		ent
		°	Practicality	operational realities, etc.	Effectiveness		1	1		3		I							
T		4		The extent to which the alte	Cost/benefit		3	3		2	TABLE 17	: CORRELA	TION OF BARR	IER EFFECTIV	ENESS TO	O BSV			
		4	Acceptability	expected to apply it.			-	2		3									
H		5	Enforceability	The extent to which complia	Practicality		2				Table 17A					Table 1	7B		
	5) The			be monitored.	Acceptability		3	3		3	CBSV	Probabili	tv		CBSV	Probability			
	6) Ass	6	Durability	The extent to which the miti	Enforceability		1	1		3	Range	Value	Descrip	otion	Range	Value	Description		V:3
	/ (Cr	7	Residual safetv risk	The degree of safety risk th initial mitigation and which r	Durability		2	2		2	0-7	5	Frequ	ent	0-5	5	Frequent		
	7) Exi		Unintended	The introduction of new haz		2.1.	-			2	8-15	4	Occasi	onal	6-11	4	Occasional		
	8) Exi	8	consequences	the implementation of any n	Residual safety		2	2		1	16-23	3	Remo	te	12-17	3	Remote		
	9) Exi	9	Time	Time required for the impler	Unintended cons	sequences	1	1		1	24-31	2	Improb	able	18-23	2	Improbable		V:3
		TABLE 12: BARRIER EFFECTIVENESS ASS		Time		2	2		3	32-40	1	Extrem	nely	24-30	1	Extremely			
				Total Score		17	17		21	32-40	1	improb	able	24-30	1	improbable			
	NEW R	No.		Barrier Effectiveness Effe															
		110.	Effectiveness										Table 1	7D		IV:			
	1) As:	2	Cost/benefit								CBSV	Probabili	ty Descrip	tion	CBSV	Probability	Description		
	2) The	2	Practicality		TABLE 15: AN	IALYSIS OF	CONSO	LID	ATED BA	<b>RRIER S</b>	Range	Value			Range	Value	•		
	3) Ap	4	Acceptability								0-3	5	Frequ		0-2	5	Frequent		
	4) As	5	Enforceability				DOM	Г			4-7	4	Occasi		3-5	4	Occasional		
		6	Durability		All E-PCs	Equivalent	BSV		All N-PO		8-11	3	Remo		6-8	3	Remote		V:4
Т		7	Residual safe		E-PC1	3			N-PC1		12-15	2	Improb		9-11	2	Improbable		
		8	Unintended co	onsequences	E-PC2	3			N-PC2	2	16-20	1	Extrem		12-15	1	Extremely	_	
		9	Time	Total	E-PC3				N-PC3	2			improb	able			improbable	_	
		L		Totai				-				Tabl	e 17E						
		TAB	LE 13: CORRE	LATION OF BARRIER EF	E-PC4				N-PC4		CBSV	Probabili	it						V:4
	5) The	Ba	arrier Effectivene	ss Score	E-PC5				N-PC5	5	Range	Value	Descrip	otion					
	6) As		Range	BSV B	CBSV (SUM)	6			CBSV (S	UM)	0-1	5	Frequ	ant					
	/ (Cr		1 to 9	1	Max CBSV	15		F	Max CB	,	2-3	4	Occasi						
H	7) Re	1	10 to 14	2						3v	4-5	3	Remo						
	8) Re	1	15 to 19	3	Satisfactory	Reasonable or acc					6-7	2	Improb						5 <b>V</b> :
	9) Re	1	20 to 24 25 to 27	4	Good Effect Excellent	tive, recognised an Best or most ro						-	Extrem						
			2010/27	5		Dest of most fo	ภมนอเ		PC3		8-10	1	improb						
		_										1							



Γ	EXISTI	NG RI	SK INDEX (HAZARD > l	UNSAFE EV	ENT)	W		BSV -	PROBABILITY		
Т	1) Ass 2) The	TAB No.	LE 11: 9 ELEMENTS OF B	ARRIER EFFE	-	1.	Fill out <b>Table 6</b> . Be very precise in naming each entity, especially the Hazard. Refer <b>Table 5</b> for definitions of each entity.	e 3SV)]	Applicable CBSV- Probability Table		le ence
	<ol> <li>App</li> <li>App</li> <li>Ass</li> </ol>	1	Effectiveness Effectiveness defences the	to which the alte ss can be deterr at can reduce o	TABLE	2.	In Table 6, annotate the hazard, its potential unsafe event and ultimate consequence in the respective columns.		Table 17A Table 17B Table 17C		al to ow
		2	The extent t	to which the per to which mitigati chnology, financ	3 (	3.	In Table 6, annotate existing PCs identifier codes and/ or RMs identifier codes.	_	Table 17D Table 17E		ow
T		4	operational	realities, etc. to which the alte	Effective Cost/bei	4	Describe in detail the Existing Preventive Control (E-PC), New Preventive Control (N-PC), Existing Recovery Measure (E-RM) and New Recovery Measure (N-RM) in Table 7, 8, 9 and 10 respectively.				-
	5) The	5	Enforceability be monitore		Practica Accepta		Where a PC/ RM may be affected (compromised) by an EF (Escalation Factor), then the EF & EC (Escalation Control) columns should be applied and completed accordingly for that PC/ RM.	ble 17 lity	7B Description		
	6) Ass (Ch 7) Exi:	6 7	Residual The degree	to which the miti of safety risk th ition and which r	Enforce: Durabilit		Based on these existing PCs/ RMs being in place, assess the Existing Risk Index of the projected UE/ UC. Annotate the result in the applicable columns of [Table 6] for both UE and UC. Refer <b>Table 1, 2, 3, 4, and</b>		Frequent Occasional		V:3
	8) Exi 9) Exi	) Exi: 9 Time Time required for the implementation of any r			Residua Uninten	5.	12 until 17.		Remote		V:3
	NEW R	TABLE 12: BARRIER EFFECTIVENESS ASS Total 3		Time Total Sc		Note: The Probability component of each UE/ UC's Risk Index is to be derived from the Consolidated Barrier Strength Value (CBSV) to Probability correlation Table in [Table 17].		Extremely improbable			
	1) Ass	<b>No.</b>	Barrier Effectiveness Element Effectiveness	Effe (H	BSV	6.	Based on Existing Risk Index obtained above, annotate its corresponding Risk Tolerability description in Table 6.	ble 17 lity			iV:
	<ol> <li>2) The</li> <li>3) App</li> </ol>	2 3 4	Cost/benefit Practicality Acceptability		TABLE	7	If the Existing Risk Tolerability is in intolerable on tolerable region, proceed to re-evaluate possible enhancement of Existing PCs/ RMs or New (additional) PCs/ RMs in order to reduce the Risk Index to an		Description Frequent		
	4) Ass	5	Enforceability Durability		All E-		acceptable level.		Occasional Remote Improbable		V:4
		7 8 9	Residual safety risk Unintended consequences Time		E-P E-P		With any modified or New PCs/ RMs in place, together with the Existing PCs/ RMs, proceed to re-assess the Resultant Risk Index of the projected UE/ UC as applicable. Annotate the result in applicable column of <b>Table 6</b> . Refer <b>Table 1, 2, 3, 4</b> . and <b>12 until 17</b> .		Extremely		
	5) The	ТАВ	LE 13: CORRELATION OF	Total	E-P E-P	8.	Note: The Probability component of each UE/ UC's Resultant Risk Index is to be derived from the				V:4
	6) Ass (Ch	Ва	rrier Effectiveness Score Range 1 to 9	BSV B	E-P CBSV		Consolidated Barrier Strength Value (CBSV) to Probability correlation Table in [Table 17].				
	<ol> <li>7) Res</li> <li>8) Res</li> <li>9) Res</li> </ol>		10 to 14 15 to 19 20 to 24	2 3 4	Max C Satisfactory Good		Based on the Resultant Risk Index obtained above, annotate its corresponding Resultant Risk Tolerability description in <b>Table 6</b> as applicable. This Resultant Risk Index & its corresponding Resultant Tolerability description is the final outcome of the HIRM exercise.				sv:
	3) Ke		25 to 27	5	Excellent	9.	Upon completion of the risk mitigation exercise, proceed to fill out the Safety Risk Management (SRM)				
		1	ΊΔςΔ				Report Form. This Form will serve as the formal report (and record) of the completed SRM exercise.			35	

# Safety policy and objectives

#### $\rightarrow$ Safety policy content in line with AMC1 145.A.200(a)(2)

- Comply with legislation, meet requirements, and continuously improve safety standards.
- Provide necessary resources for the implementation of the safety policy.
- Organisational commitment regarding safety, including promotion of a positive safety culture.
- internal safety reporting and just culture.
- $\rightarrow$  Safety objectives in line with safety policy, plus additional ones relevant to organisation/activity (customised).
- $\rightarrow$  Pay attention on safety objectives suitability;



X "improvement of the current SPI's from the previous year by at least 3%".

A general number may not be appropriate (reducing 3% number of mandatory occurrence reports where only 1 was reported last year).



K "Reduce the number of occurrence reports".

Reporting culture improvement or maintenance performance deterioration? Alternative ones:

Increasing safety and reporting culture (number of reports per year).

- Reduction of the annual number of maintenance errors (or customer complaints).
## Hazard identification / Risk management

- → During the first SMS evaluations, it is better to have less hazards but relevant to the Organisation (can be properly risk assessed) rather than many general ones requiring too many assumptions for the risk assessment.
- → Non-aviation safety hazards; Health and safety or environmental related hazards not under aviation safety domain. They may be included but falls under national Regulation.

#### $\rightarrow$ Likelihood and severity definitions.

- ICAO definitions general  $\rightarrow$  may not be useful for objective classification when not further customized.
- Check whether likelihood definitions are properly used (frequency vs probability).

E.g. use of new tool (occurrence) classified as remote as it happened only once (first time used).

- Check that severity levels definition minimize the possibility for a consequence to be classified in more than one grade.
- → Complex risk assessment method does not ensure a better result.
- → Risk controls/mitigations reduce risk ONLY AFTER EFFECTIVE IMPLEMENTATION



## Safety performance monitoring

- → In many cases, effectiveness of mitigating actions is not assessed. Whenever possible, precursors should be used (when possible, don't wait till the occurrence happens again).
   E.g. wrong aircraft damage assessment; interviews/surveys/audits Vs waiting customer complains.
- → SPIs focused on what is important rather than what is easy to measure. For example, an overall number (maintenance errors) may be easy to measure, but may not allow to assess which mitigating action was effective. The number of maintenance errors may have decreased in one area and increased in another one.
- $\rightarrow$  Risk management should be reviewed when SPI shows a negative trend.



 $\rightarrow$  to identify inappropriate SPI or ineffective mitigating actions

## Interfaces

- → AMO undesired situation: CRS after maintenance not properly carried out
- → CAMO undesired situation: non-airworthy aircraft ready for take-off
- → Operator undesired situation; unsafe aircraft operation

AMO undesired situation becomes a CAMO hazard, and a CAMO undesired situation becomes an operator hazard. External interface.

- → Internal interfaces with other departments may have a significant contribution to safety (component going through different workshops during the maintenance process).
- → It is not about replacing/duplicating the provider/customer quality system/SMS (if available), it is about considering the main hazards/consequences coming from those interfaces and managing those risks with them (safety information/promotion, reporting system, mitigating actions, etc.).



# **Typical hazards/undesired state for AMO**

- → Facilities not meeting the requirements specified in maintenance data (e.g. CMM)
- → Storage conditions not in line with the manufacturer's instructions (temperature, humidity, shelf life, etc.)
- → Insufficient competent staff
- $\rightarrow$  Line maintenance time pressure
- → Tool/equipment calibration/servicing not controlled/overdue.
- → Use of incorrect tool
- → Installation of non-effective parts (wrong P/N, outdated software, etc)
- → Use of outdated maintenance data
- $\rightarrow$  Deviation from maintenance instructions  $\rightarrow$  **Top risk**
- → Errors and missing of information in maintenance records
- → Maintenance data no readily available for use by maintenance personnel
- → Control of providers (suppliers, contractors and subcontractors)
- → Change of nominated staff
- → Internal reporting system not functioning
- → Incorrect defect/damage assessment → Safety Issue (EPAS) inadequate management of repetitive defects
- → Undesired situation: CRS after maintenance not properly carried out







### Standardisation feedback on SMS in CAMO

Erik Roozen Airworthiness expert



## **Standardisation feedback**

#### →ECMA SMS CAMO

→To monitor SMS level implementation in Part-CAMO across the EASA Member States (ECMA SMS CAMO)

- →February June 2023
- →18 Member State authorities
- → Standardisation Inspections



## **ECMA SMS CAMO - Main subjects**

→ Training of NCA inspectors on assessment of management systems

- → Authority procedures for training on Theoretical & Practical element
- $\rightarrow$  Sampling of actual trainings followed
- → Safety Manager acceptance
  - → Assessment process
  - $\rightarrow$  Practical assessments
- → Management System assessments
  - $\rightarrow$  Authority procedures
  - $\rightarrow$  Practical assessments

→ Oversight program based on size, complexity and performance (RBO)

- $\rightarrow$  Authority procedures
- → Sampling of CAMOs which differ in size/complexity



## **Possible outcome of ECMA**

Possible outcomes	Colour
Good/best practices identified	
The information reviewed did not show non-compliances with the applicable rules. However, areas for improvement identified	
Difficulties in the implementation of regulatory changes identified, however without being a non-compliance. To be discussed with the Competent Authorities.	
Non-compliances detected. Notification of off-site findings.	
Immediate safety concern detected. Notification of off-site 'class G' finding.	



## Main outcome

2	Inspector	Safety	1	Management	Risk Based	
Country	training	Manager		System	Oversight	
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						



## Main outcome – Inspector training

- $\rightarrow$ In general appropriate
  - →theoretical training provided
  - →In some cases, CAMO inspector already performing MS assessments for AOC/CAMO
- →Improvement opportunities
  - →Use of external training organisations on theoretical knowledge of SMS [observation] → Meeting NCA needs and procedures?
  - →Not evident that practical training of a management system <u>assessment</u> was part of 'initial' training program before authorisation



## Main outcome – Safety Manager acceptance

- $\rightarrow$ In general appropriate
- $\rightarrow$ Improvement opportunity

Not clear if assessment was limited to desktop review or also interview of person (which is expected)
AMC1 CAMO.A.305(c) Personnel requirements

### →<u>Note</u>: use of AltMoC and/or amended AMC

KNOWLEDGE, BACKGROUND AND EXPERIENCE OF NOMINATED PERSON(S)
The Ppersons or group of persons nominated in accordance with points CAMO.A.305(a) and CAMO.A.305(b) should have:
[...]
(e) a relevant engineering degree or an aircraft maintenance technician qualification with additional education that is acceptable to the competent authority. 'Relevant engineering degree' means an engineering degree from aeronautical, mechanical, electrical, electronic, avionicg or other studies that are relevant to the maintenance and/or continuing airworthiness of aircraft/aircraft components;
The above recommendation may be replaced by 5 years of experience in addition to those already recommended by paragraph (d) above. These 5 years should cover an appropriate combination of experience in tasks related to aircraft maintenance and/or continuing

airworthiness management and/or surveillance of such tasks:

For the person to be nominated in accordance with point (a)(4) or (a)(5) of point CAMO.A.305, in the case where the organisation holds one or more additional organisation certificates within the scope of Regulation (EU) 2018/1139 and that person has already an equivalent position (i.e. compliance monitoring manager, safety manager) under the additional certificate(s) held, the provisions set out in the first two paragraphs of point (e) may be replaced by the completion of a specific training programme acceptable to the competent authority to gain an adequate understanding of maintenance standards and continuing airworthiness concepts and principles.



## Main outcome – Management System assessment

#### →Improvement opportunities

- →Several cases of 'ticked checklists' with regulation and/or CAME
  - →Present ('P')
  - →no assessment (e.g. suitable 'S')
- →Inconsistencies between NCA documented procedure and records of sampled organisation Management System assessment
- $\rightarrow$  'O' & 'E' assessed without documenting / substantiating the evidence
  - → E.g. referring to CAME/SMM procedure instead of outcome of process such as risk register dated xxx, SRB meeting dated yy, etc.



## Main outcome – Risk Based Oversight

→Good practices

- →Often Management System assessment as separate audit, sometimes together with OPS
- →Several cases of 'organisation risk profile'

#### →Improvement opportunities

- →Link between 'risk profile' and oversight program
- →Size and complexity and performance as input for Nr. of audits/inspections
- →(Sufficient) samples of product audits and airworthiness reviews

→Duration and scope of planned audit not included



## **Conclusion & recommendation**

→Training of inspectors and acceptance of Safety Managers reasonable

→Recommend practical training for MS assessment

→Weaknesses in management system assessments and RBO principles

 $\rightarrow$ CAMO lessons learned to be used in Part-145 and POA

→Uniform application of the rules by the NCA ?→ not fully uniformly applied but being worked on







#### **Transition status in Foreign Part-145 AMOs**

Lorenzo Pellegrini Section Manager - Maintenance Organisation Oversight

#### Your safety is our mission.

#### SMS Implementation for VALID approvals ("SMS Change")

- → SMS implementation is managed as a "change" for each valid Part-145 approval
  - → assigned to Inspector when the SMS application is received
  - → When the SMS change is approved the AMO is considered "SMS compliant"
  - → The approval of the SMS change requires the SMS to be at least Present and Suitable





## **Status of SMS implementation Foreign Part-145 approvals**

SMS change created in IT tool allows real time tracking status of SMS implementation during transition





# **EASA CA - SMS implementation milestones**

- → <u>SMS info letter published on EASA website in June 22</u> (Foreign Part-145 page)
- → Revised EASA Guidance material published in Nov. 2022 (i.e. MOE UG)
- → By assumption any valid Part-145 approval shall comply with SMS at applicability date of Regulation (EU) 2021/1963, on 2 Dec. 2022
  - → Case of suspended approval (reinstatement shall be with SMS compliance)
- → In absence of evidence of compliance, transition finding was issued on 2 Dec. 2022 to all valid Foreign AMOs (due date 2 June 2024- intentionally anticipated by 6 months to the end of transition date of 2 December 2024)
- → for all cases where SMS is not yet approved on 2 June 2024, EASA will start to send preconsultation letters anticipating suspension/limitation on 2 December 2024
- → On 2 December 2024, EASA will limit/suspend all Part-145 approvals where SMS in not approved.

54



#### Any Questions in **Slido**?

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S Passcode: d4jqxx



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## Thank you!

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