



**INTERNATIONAL CIVIL AVIATION ORGANIZATION**

*A United Nations Specialized Agency*



# **FPP QA Online Workshop**

## **Safety Assessment for flight procedure**

(25/May/2021-26/May/2021)

Virtual Classroom



- ➔ **Why do we need to do safety assessment for IFP?**
  - ICAO requirements & Guidance Material
  - Safety assessment methodology
- ➔ **Flight Operational Safety Assessment(FOSA) for RNP AR procedure**
- ➔ **Case study for ZULS RNP AR APCH**

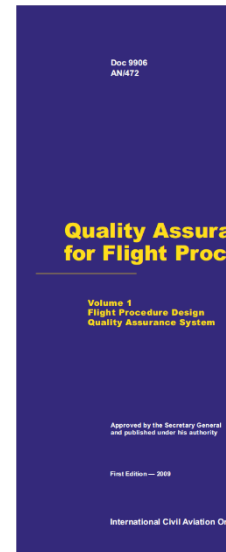
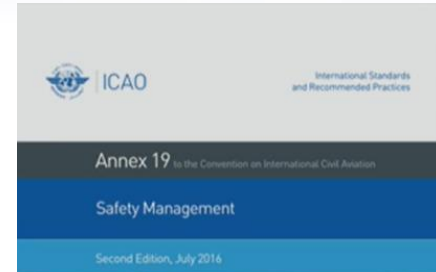
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# ICAO Guidance Material



## → Key Documents

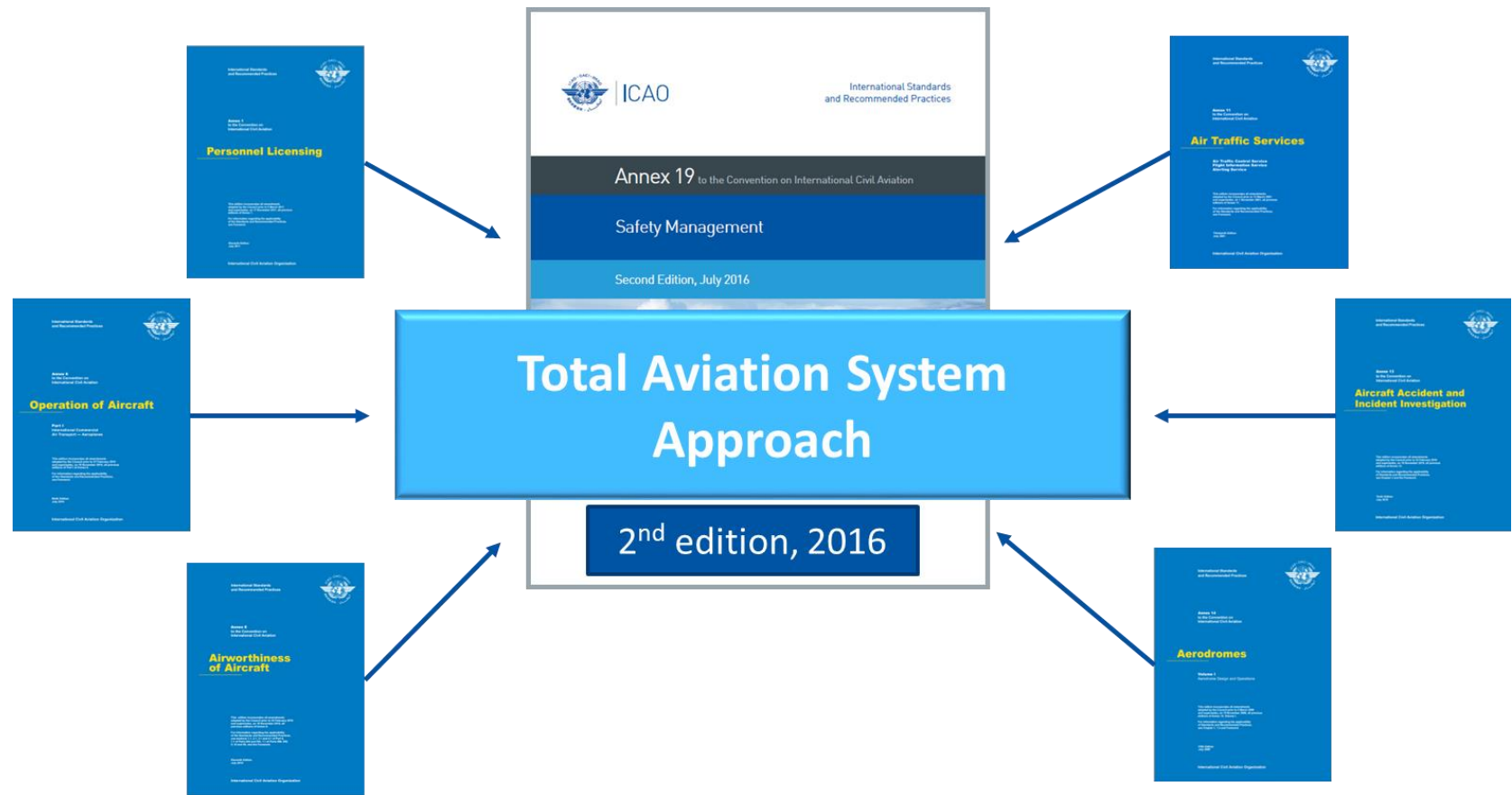
- **SARPs**
  - Annex 19(Safety Management)
- **Guidance Material**
  - Doc 10068(Regulatory Framework)
  - Doc 9859 (Safety Management Manual)
  - Doc 9906 (Quality Assurance System)
  - Doc 8168 (PANS-OPS)



# ICAO Guidance Material



## ➤ Annex 19 Safety Management



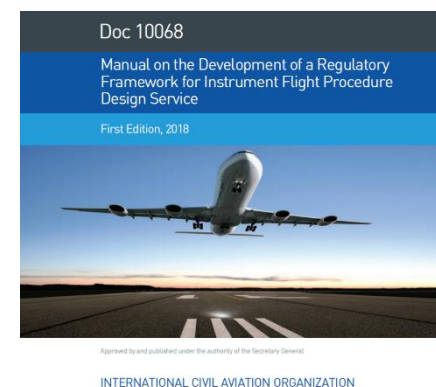
# ICAO Guidance Material



## ➤ Manual on the Development of a Regulatory Framework for Instrument Flight Procedure Design Service (Doc 10068)

### ➤ 1.6 SAFETY RISK ASSESSMENT

- 1.6.1 A safety risk assessment of an IFP is considered **completed when the IFPD is in compliance with the State regulatory framework.**
- 1.6.2 A safety risk assessment must be conducted when there is a **deviation from the State regulatory framework.**



# ICAO Guidance Material



## ✈️ **SAMPLE** STATE REGULATIONS (Doc 10068 Attachment to Chapter 2)

Title	Explanation
Title 14 CFR*, Part 77, Objects Affecting Navigable Airspace	Primary law on the restriction of obstacles affecting the safety of aircraft operations in the vicinity of an aerodrome, etc., including obstacle limitation surface.
Title 14 CFR*, Part 97, Instrument Flight Procedures	Primary law stipulating the responsibility by the State on Instrument Flight Procedure Design Service.
Order 8360.3B, Standard for Terminal Instrument Procedures (TERPS)	Design criteria by the State. (There exist other regulations providing design criteria, but these do not appear here.)
Order 8260.19F, Flight Procedures and Airspace	Operating procedures by the State's IFPDS function.
Order 8260.43B, Flight procedures Management Program	This document describes how to request to the State Authority the design, validation, revision or abolishment of instrument flight procedures. It also provides policy for the State Authority in the coordination, approval and prioritization of such request.
Order 8900.1 Flight Standards Information Management System (FSIMS), Volume 11, AFS Program, Chapter 12, Instrument Flight Procedure Validation	<p>This document includes operating procedures on the provision of flight validation service (Section 1) and on the certification of FVSPs (Section 2) in the State, specifically for the regulator, as follows:</p> <ul style="list-style-type: none"> <li>— Section 1, Requirements to conduct an Instrument Flight Procedure Validation;</li> <li>— Section 2, Issue of a Letter of Authorization to conduct an Instrument Flight Procedure Validation.</li> </ul> <p>(See also AC 90-113 for related information for service providers.)</p>
Order FS 8260.57, Oversight of Third Party Instrument Flight Procedure Service Providers	Guidelines for a State's regulatory functions on the process of oversight and audit of a third-party IFP service provider and FVSP.
Order 8260.60 Special Instrument Procedures	<p>Operating procedures for the development (including validation), processing and maintenance of a special instrument procedure (private procedure), for a State's regulator.</p> <p>(See also AC 90-112 for related information for service providers.)</p>

# ICAO Guidance Material



## ✈ **SAMPLE** STATE REGULATIONS (Doc 10068 Attachment to Chapter 2)

Title	Explanation
AC 90-110 Authorization Guidance for Development of Required Navigation Performance Procedures with Authorization Required by Third Party Instrument Flight Procedure Service Providers	Applicable means of compliance for the approval of third-party IFPDS providers designing RNP AR APCH (Required navigation performance procedures with authorization required approach).
AC 90-112 Development and Submission of Special Instrument Procedures	Operating procedures for the development (including validation), processing and maintenance of a special instrument procedure (private procedure), for service providers.  (See also Order 8260.60 for related information for a State's regulator.)
AC 90-113, Instrument Flight Procedure Validation (IFPV) of Satellite-based Instrument Flight Procedures (IFP)	Applicable means of compliance for FVSPs for the establishment of their operating framework and work procedures.  (See also Order 8900.1.)



# ICAO Guidance Material



## ➤ Requirements for IFPDS (Doc 10068)

### ➤ 3.2 PROCESS AND PROCEDURES TO BE ESTABLISHED FOR A SERVICE PROVIDER

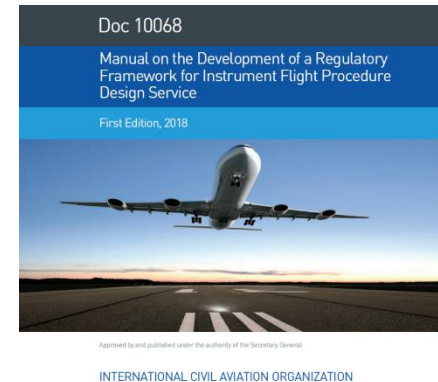
#### ➤ 3.2.2 Operations manual

➤ 3.2.2.1 An organization responsible for the service provision should establish its own operations manual **in accordance with the State regulatory framework.**

➤ Table 3-1. **Sample contents** of an operations manual for a service provider



PART / Chapter	Contents	Reference
<b>PART IV. Safety and Quality</b>		
<b>Chapter 1. SMS and QA system</b>	<ul style="list-style-type: none"> <li>● Define how to be involved in the SMS (e.g. the SMS of an entire ANSP)</li> <li>● Provide a reference to the organization's quality manual</li> <li>● Provide a statement on the resolution of safety/quality-related issues</li> </ul>	<b>Annex 19 — Safety Management</b> Doc 9859 Doc 9906, Vol. 1
<b>Chapter 2. Oversight by regulator</b>	<ul style="list-style-type: none"> <li>● Describe how to manage the oversight</li> </ul>	



# ICAO Guidance Material

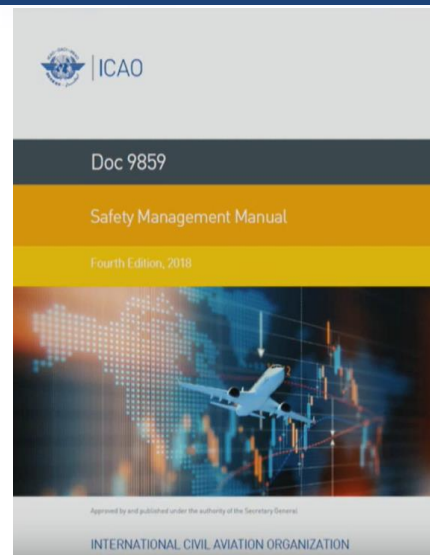


## ✈ What is Safety? (Doc 9859)

Safety

The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level.

*From Doc 9859 Definitions*



- Does it mean “0 risk”?
- Should every organizations have the same level of safety profile?

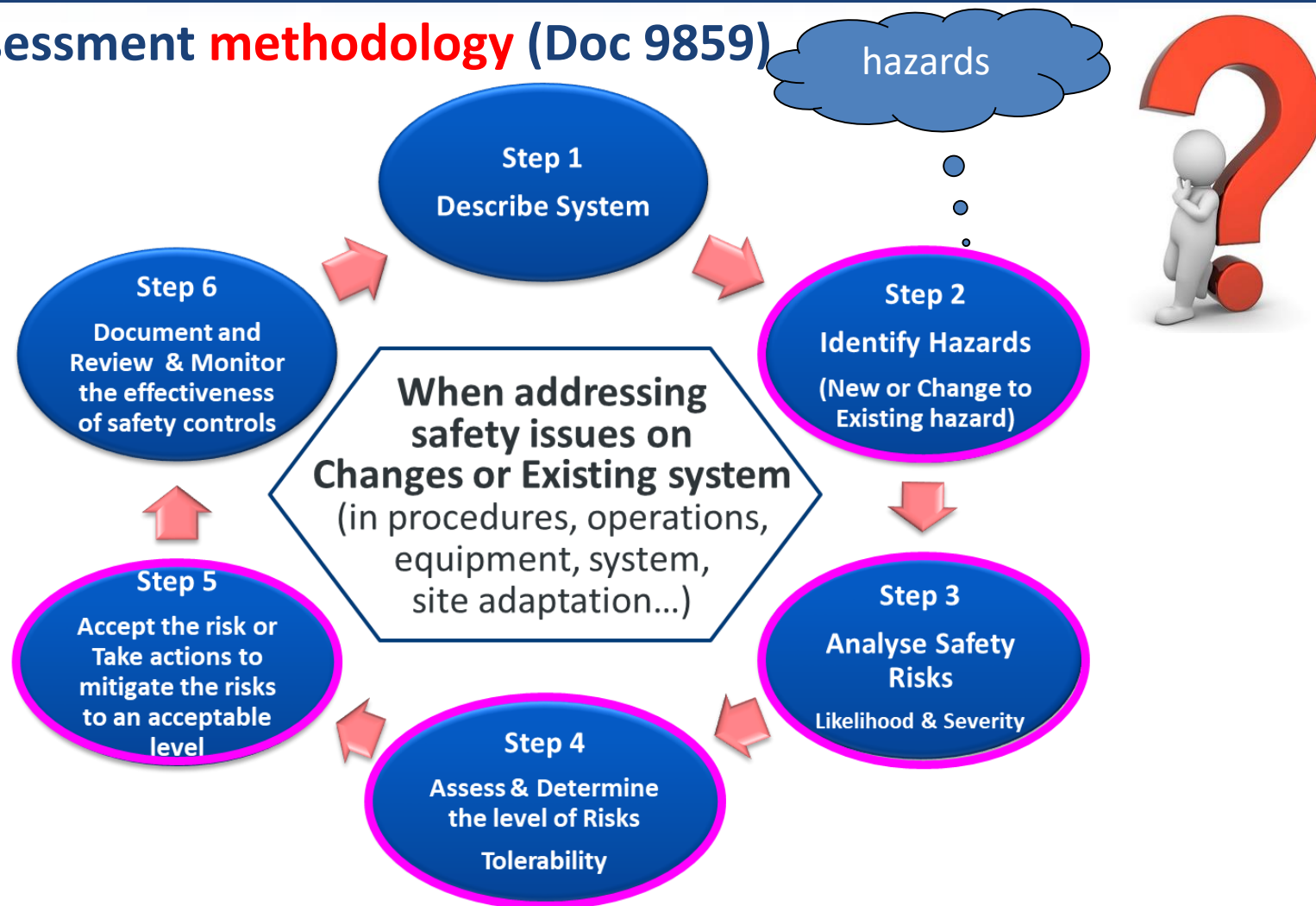
### Acceptable Level of Safety Performance (ALoSP)

agreed by State authorities to be achieved, as defined in its **State safety programme**, **expressed in** safety performance targets (**SPTs**) and safety performance indicators (**SPIs**).

# ICAO Guidance Material



## ✈ Safety Assessment **methodology** (Doc 9859)



## ✈ Hazard Identification (Doc 9859)

### ✈ What is a hazard and consequences?

✈ **A hazard:** A condition or an object with the potential to cause or to contribute to an aircraft accident or incident (Annex 19 and Doc 9859).

- ✈ anything that could cause harm to people, property or environment
- ✈ injury, illness, or death to people;
- ✈ damage to, or loss of, a system (hardware or software), equipment, or property; and/or
- ✈ damage to the operating environment
- ✈ a dormant potential for harm in one of the following: a system or its environment (SMM 2.5.1.1)

✈ Safety risks: **Measurements** of the outcome

Example

- ✈ Bad weather,
- ✈ Mountainous terrain,
- ✈ Lack of emergency equipment,
- ✈ High workload
- ✈ Use of alcohol and other drugs.
- ✈ Lack of training,
- ✈ Effects of long-term fatigue

# ICAO Guidance Material



## ➤ Safety Risk Analysis & Assessment (Doc 9859)

### ➤ What is the safety risk?

➤ Risk is the composite of the predicted probability (or likelihood) and severity of each possible consequence (result) of each identified hazard (a condition).

➤ The risk matrix may be customized.

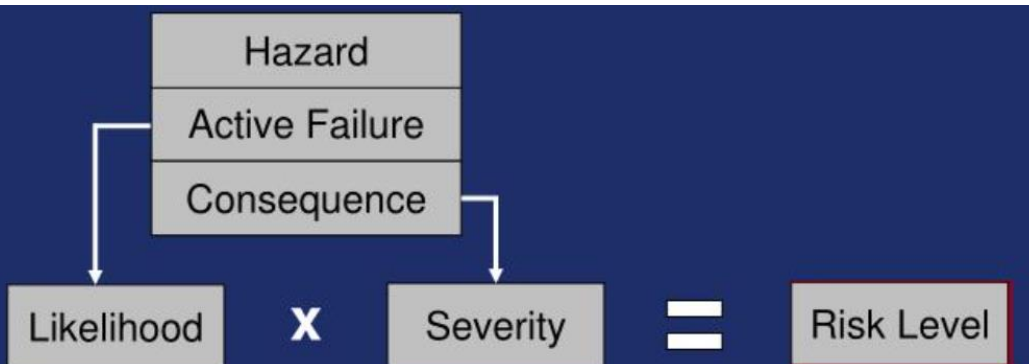
Doc 9859 Table 3. Example safety risk matrix

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

High (5A, 5B, 5C, 4A, 4B, 3A, 3B, 3C, 2A, 2B, 2C, 1A, 1B, 1C)  
Medium (4C, 4D, 3C, 3D, 2C, 2D, 1C, 1D)  
Low (3E, 2E, 1E)

Table 4. Example of safety risk tolerability

Safety Risk Index Range	Safety Risk Description	Recommended Action
<b>High</b> 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.
<b>Medium</b> 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
<b>Low</b> 3E, 2D, 2E, 1B, 1C, 1D, 1E	ACCEPTABLE	Acceptable as is. No further safety risk mitigation required.



# ICAO Guidance Material



## ➤ Safety **Risk Probability/likelihood** Analysis (Doc 9859)

### ➤ Safety risk probability is:

- The likelihood or probability that a safety consequence or outcome will occur
  - Consider a different variety of scenarios to capture all potential consequences.
  - Ask following questions to determine probability:

Doc 9859

- ✓ Is there a history of similar occurrences or is this an isolated occurrence?
- ✓ What other similar equipment or components might have identical issues?
- ✓ What is the number of personnel following the procedures in question?
- ✓ What is the exposure of the hazard under consideration?

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

Table 1. Safety risk probability table

- This table uses qualitative terms
- Quantitative terms could be defined to provide a more accurate assessment



# ICAO Guidance Material



## ✈ Safety **Risk Severity** Analysis (Doc 9859)

### ✈ Safety risk severity is:

- ✈ The extent of harm that might reasonably be expected to occur as a consequence or outcome of the identified hazard
  - ✈ Fatalities or serious injury as a result of: being in the a/c, direct contact with any a/c part, direct exposure to jet blast
  - ✈ Damage: a/c damage or structural failure which adversely affect a/c's performance, major repair or replacement, ATC or aerodrome equipment damage, adversely affected separation minima or landing capability
  - ✈ all possible consequences related to a hazard, considering the worst foreseeable situation

# ICAO Guidance Material



## ✈ Safety Risk Severity Analysis (Doc 9859)

✈ Safety risk severity is:

Severity	Meaning	Value
<b>Catastrophic</b>	<ul style="list-style-type: none"><li>• Aircraft / equipment destroyed</li><li>• Multiple deaths</li></ul>	A
<b>Hazardous</b>	<ul style="list-style-type: none"><li>• 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</li><li>• Serious injury</li><li>• Major equipment damage</li></ul>	B
<b>Major</b>	<ul style="list-style-type: none"><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>	C
<b>Minor</b>	<ul style="list-style-type: none"><li>• Nuisance</li><li>• Operating limitations</li><li>• Use of emergency procedures</li><li>• Minor incident</li></ul>	D
<b>Negligible</b>	<ul style="list-style-type: none"><li>• Few consequences</li></ul>	E



# ICAO Guidance Material



## ➤ Safety **Risk Tolerability** Analysis (Doc 9859)

### ➤ Determine the level of the Safety Risk Tolerability:

➤ Assign the **alphanumeric safety risk index** in the safety risk matrix:

➤ the combination of the results of **probability x severity**

➤ Apply the safety risk index into the safety risk tolerability table:

➤ in a narrative form, the tolerability criteria of an organization:

**Intolerable/Tolerable/Acceptable**

➤ If the risk assessment results falls in the **intolerable and unacceptable under any circumstances, mitigation action is required or activities are stopped**



Safety Risk Index Rank	Safety Risk Description	Recommended Action
5A, 5B, 5C, AA, AB, 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.

# ICAO Guidance Material



## ✈ Safety Risk Mitigation/Control Strategies (Doc 9859)

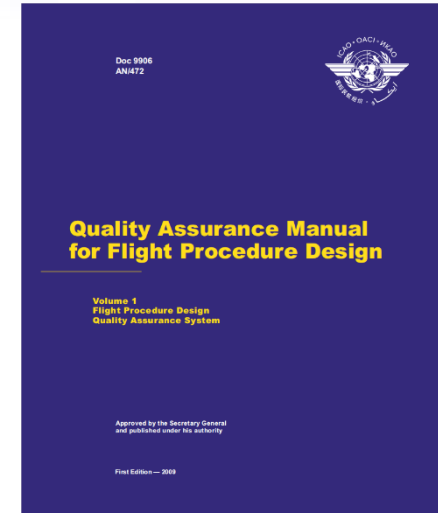
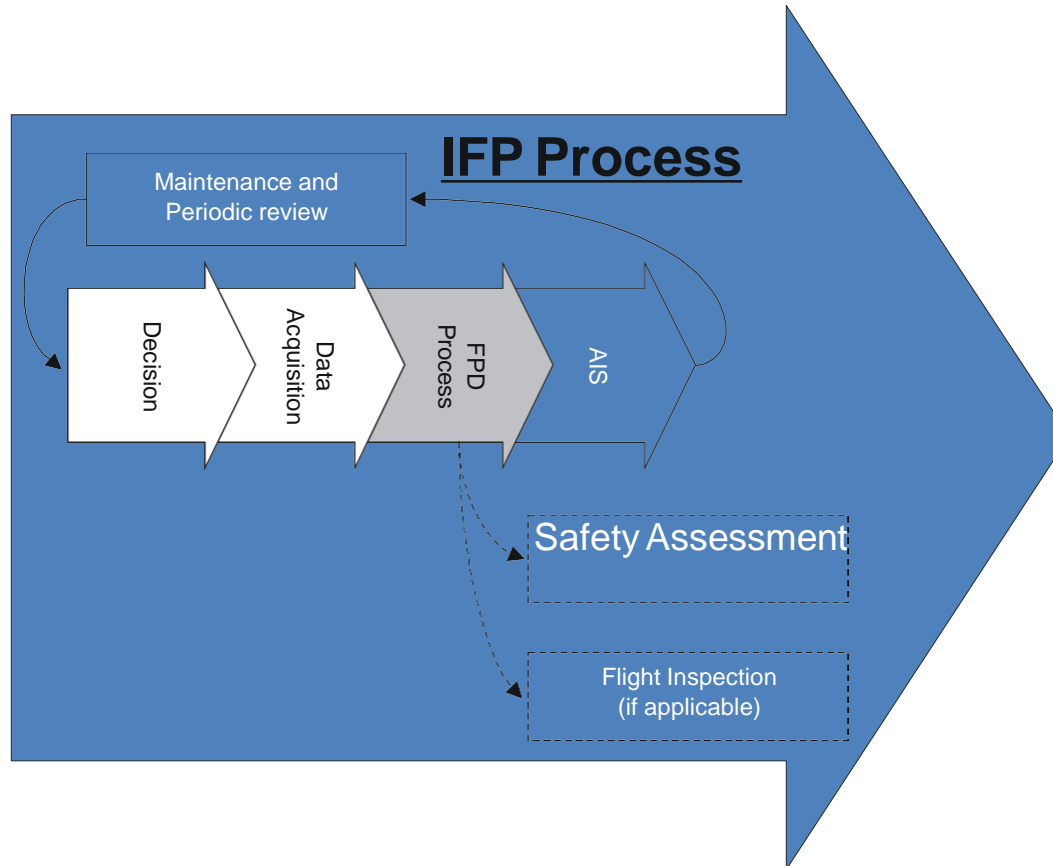
### ✈ Safety Risk Mitigation/Control Action should:

- ✈ Be balanced against the time, cost and difficulty of taking action to reduce or eliminate the safety risk (**conduct cost benefit or cost effectiveness analysis**)
- ✈ Be managed to an acceptable level by mitigating the safety risk through application of appropriate safety control:
  - ✈ By reducing the severity of the potential consequences
  - ✈ By reducing the likelihood of occurrence or by reducing exposure to that safety risk
  - ✈ By using both
- ✈ Be bringing changes to the existing **operational procedures, equipment or infrastructure**
- ✈ **It is easier and more common to reduce the likelihood than the severity**

# ICAO Guidance Material



## ✈ IFP development Process (Doc 9906&8168)



This edition incorporates all amendments approved by the Council prior to 19 May 2020 and supersedes on 5 November 2020 all previous editions of Doc 8168, Volume II.  
INTERNATIONAL CIVIL AVIATION ORGANIZATION

# ICAO Guidance Material



## ✈ IFP development Process step#7 (**Doc 9906&8168**)

### ✈ 7.7 CONDUCT SAFETY ACTIVITIES:

- ✈ This section provides a **minimum of information** on safety activities. **For more detailed information please refer to the Safety Management Manual (Doc 9859).**
- ✈ **Safety assessments for the FPD** should therefore focus on two main elements. These are:
  - ✈ **application of methods for the design of a flight procedure**, looking at the methods from the reception of the requests, the application of the criteria, the handling of data throughout the process, the design aspects, including cross-checking, the publication process, etc.; and
  - ✈ **the implementation of a procedure**, looking at the interface with other procedures available in that location, the complexity and the workload imposed on ATC, cockpit workload, flyability, etc.

## ✈ IFP development Process step#7 (**Doc 9906&8168**)

### ✈ 7.7 CONDUCT SAFETY ACTIVITIES:

- ✈ The overall aim should be to address the following **five safety assurance goals**:
  - ✈ the underlying concept of the whole procedure is intrinsically safe;
  - ✈ everything necessary to achieve a safe implementation of the procedure—related to equipment, people and airspace design issues — has been specified;
  - ✈ the design is correct;
  - ✈ the design is robust
  - ✈ the risks due to internal failure have been mitigated sufficiently such that, overall, the safety criteria are still satisfied.

# ICAO Guidance Material



## ✈ IFP development Process step#7 (**Doc 9906&8168**)

### ✈ 6.3 Process Description

Step	Description	Input	Output	Parties involved	Quality records	References
7	<p><b>CONDUCT SAFETY ACTIVITIES</b> Determine Level Of Safety Impact Perform an assessment of the magnitude of change to determine the amplitude needed for the safety case.</p> <p>Develop Safety Documentation Safety documentation to be provided for the implementation of a new procedure should be agreed at this stage. Normally the Safety Management System to be used is defined for the ANSP affected by the change or by the regulator responsible for the area where the procedure will be implemented.</p>	<ul style="list-style-type: none"> <li>• FPD containing draft procedure layout, report, calculation outputs, coordinates, textual description of the procedure.</li> </ul>	<ul style="list-style-type: none"> <li>• Formal statement on the significance of change, allowing to determine the amplitude of the safety case that needs to be performed.</li> </ul>	<ul style="list-style-type: none"> <li>• Quality and safety officer, affected stakeholders , supported by designers.</li> </ul>		<ul style="list-style-type: none"> <li>• EUROCONTROL Safety Regulatory Requirement (ESARR 4, Section 5).</li> <li>• Doc 9859.</li> <li>• ISO 9001:2000.</li> <li>• European Air Traffic Control Harmonisation and Integration Programme (EATCHIP) Safety Assessment Method.</li> <li>• State Safety Management System documentation (e.g. UK CAA Doc 675).</li> </ul>

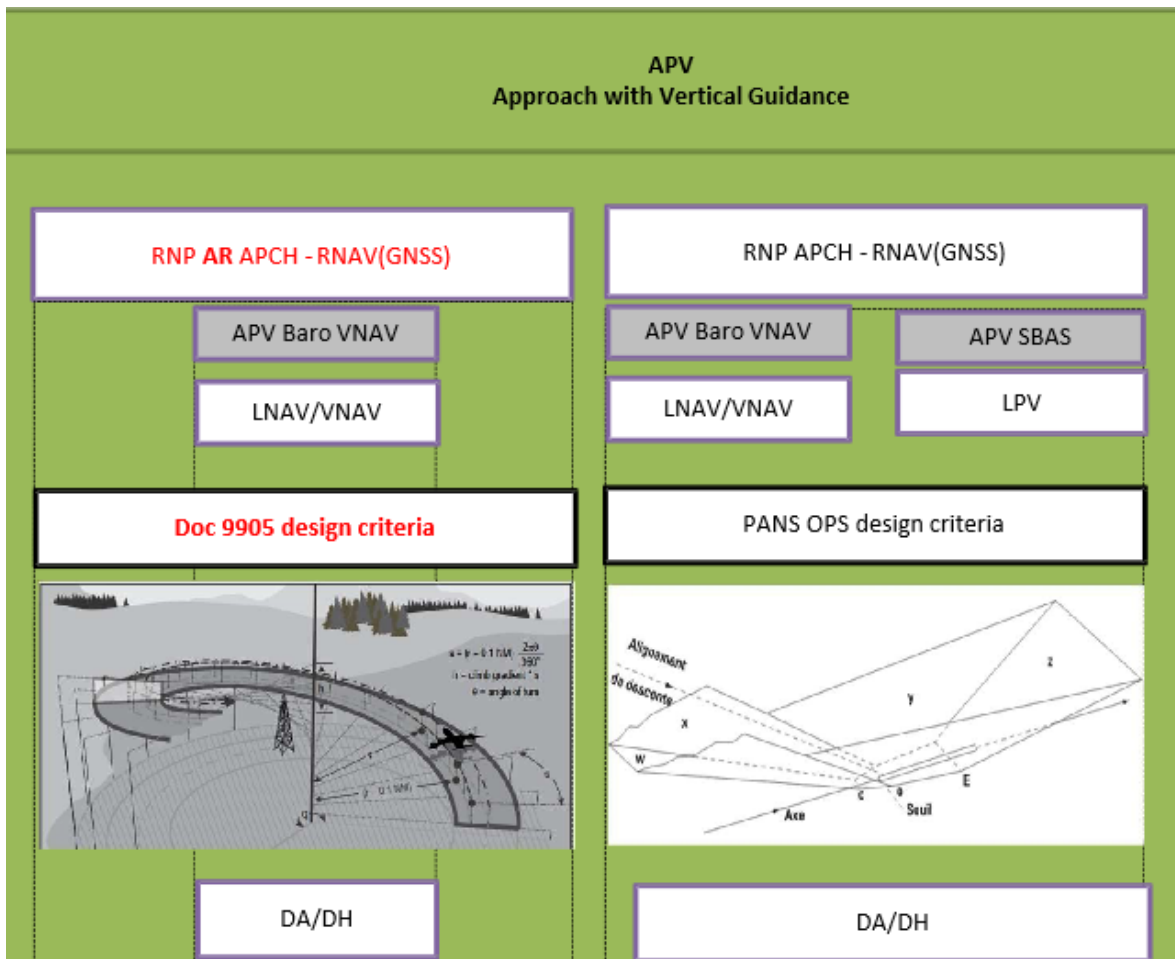
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# FOSA for RNP AR procedure



## ✈ RNP AR APCH review (**Doc 9905&9997**)



Doc 9905

Required Navigation Performance  
Authorization Required (RNP AR)  
Procedure Design Manual

Second Edition, 2016



Approved by and published under the authority of the Secretary General.

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Doc 9997  
Annex



**Performance-based  
Navigation (PBN)  
Operational Approval  
Manual**

Approved by the Secretary General  
and published under his authority

Second Edition — 2018

International Civil Aviation Organization



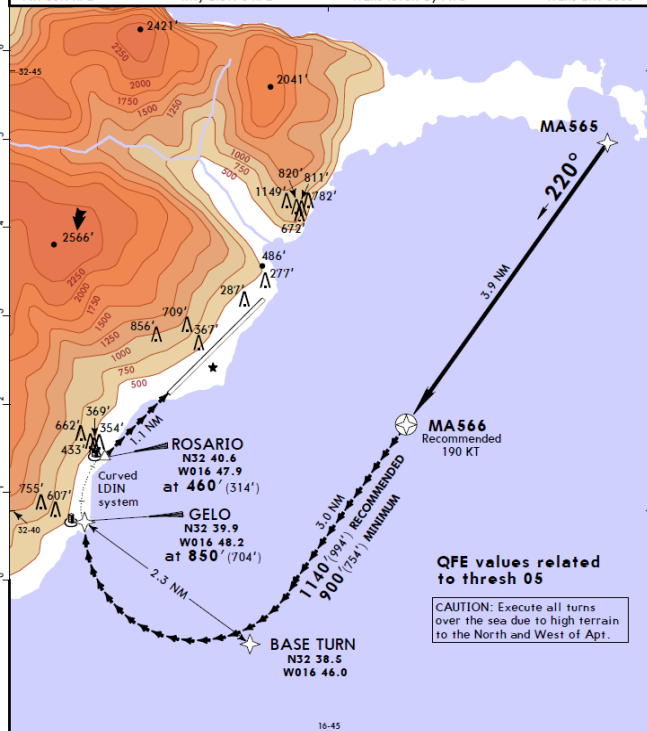
# FOSA for RNP AR procedure



## ✈ RNP AR APCH review (Doc 9905)

LPMA/FNC MADEIRA 15 JUN 18 (12-1A) RNAV (GNSS) VISUAL APPROACH Rwy 05

ATIS	*MADEIRA Approach	MADEIRA Tower
130.350	119.6	118.350
RNAV	Final Aptch Crs 220°	Apt Elev 191' Rwy 146'
Alt Set: hPa	Rwy Elev: 5 hPa	Trans level: By ATC
		Trans alt: 5000'



By night the rwy 05 approach lights **MUST BE ON**. If those lights fail before the aircraft is in such a position, over those lights, that will ensure that the high ground on their left side will be avoided, a missed approach (RIGHT turn) should be initiated.

PAPI (Both sides offset 5° to the Right. Right side not visible on short final) should be followed. They are set to define a 3.0° descent path crossing the thresh at 57'. Rwy slope is 0.8-1% up.

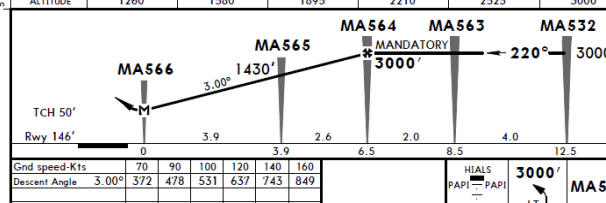
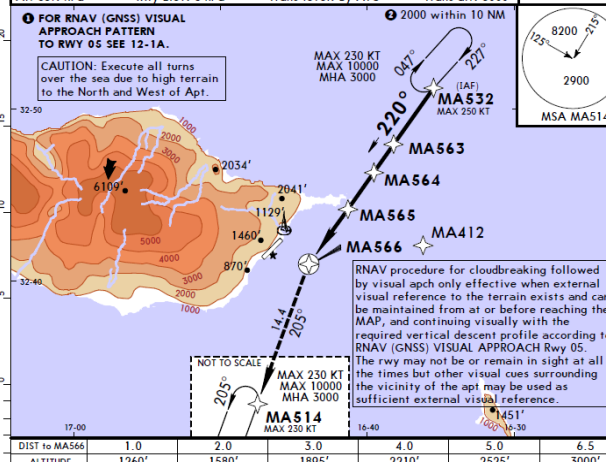
Due to high terrain **CAUTION** should be exercised not flying left of approach lights path.

**Wind limitations for landing (relative to the touchdown anemometer two minutes mean values only): max permissible wind.**

Relative to the MID or Rosario anemometers including gusts.

LPMA/FNC MADEIRA 15 JUN 18 (12-1) Eff 21 Jun RNAV (GNSS) A Rwy

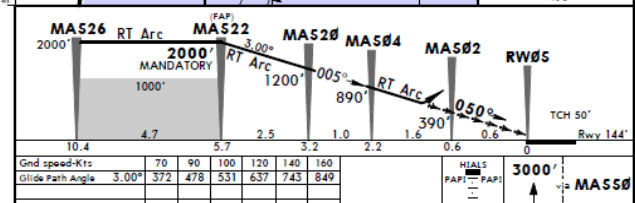
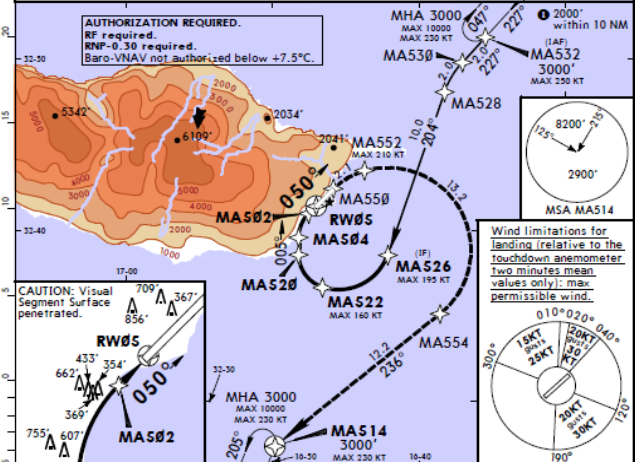
ATIS	*MADEIRA Approach	MADEIRA Tower
130.350	119.6	118.350
RNAV	Mandatory Alt MA564 3000' (2854')	Apt Elev 191' Rwy 146'
Alt Set: hPa	Rwy Elev: 5 hPa	Trans level: By ATC
		Trans alt: 5000'



Standard	CIRCLE-TO-LAND TO Rwy 05	CEILING REQUIRED	Wind limitations for landing (relative to the touchdown anemometer two minutes mean values only): max permissible wind.
A	Not authorized Northwest of rwy	800' - 5000m	Relative to the MID or Rosario anemometers including gusts.
B	940' (794')	245m	
C			
D			

LPMA/FNC MADEIRA 20 APR 18 (12-20) Eff 29 Apr RNAV (GNSS) RNP Z Rwy 05 (AR)

ATIS	*MADEIRA Approach	MADEIRA Tower
130.350	119.6	118.350
RNAV	Mandatory Alt MA522 2000' (1856')	Apt Elev 191' Rwy 144'
Alt Set: hPa	Rwy Elev: 5 hPa	Trans level: By ATC
		Trans alt: 5000'



Standard	STRAIGHT-IN LANDING Rwy 05	CEILING REQUIRED	Wind limitations for landing (relative to the touchdown anemometer two minutes mean values only): max permissible wind.
A	Not authorized Northwest of rwy	800' - 5000m	Relative to the MID or Rosario anemometers including gusts.
B	940' (794')	245m	
C			
D			

# FOSA for RNP AR procedure



## ✈ FOSA Overview (**Doc 9997**)

### ✈ **Why** is a FOSA needed?

- ✈ In some cases the operational needs of stakeholders lead to **procedure designs which may or may not comply with Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual (Doc 9905)** ;
- ✈ The FOSA process helps to ensure that the operational needs, the limits of safe and efficient aircraft performance, the means of assuring repeatable and predictable flight operations, the means of safe flight operations when faced with aircraft failures and hazardous conditions, etc., are understood by all relevant stakeholders;
- ✈ the aircraft operations, procedure design, contingency arrangements, training and maintenance will all be at the level necessary for **flight and operational safety**.

# FOSA for RNP AR procedure



## ✈ FOSA Overview (**Doc 9997**)

### ✈ **When** should a FOSA be conducted?

- ✈ A FOSA should be conducted for each RNP AR approach procedure where the **more stringent aspects of the nominal procedure design criteria** (as per Doc 9905) are applied (i.e. RF legs after the FAF, RNP missed approaches less than 1.0, RNP final approaches less than 0.3) or where the application of the default procedure design criteria is in an **operating environment with special challenges or demands**.

### ✈ **How** should a FOSA be carried out?

- ✈ each specific set of **operating conditions, aircraft and environment, all failure conditions are assessed** and, where necessary, mitigations are implemented to meet the safety criteria;
- ✈ the inter-dependence of the **elements of procedure design, aircraft capability, crew procedures and operating environment**

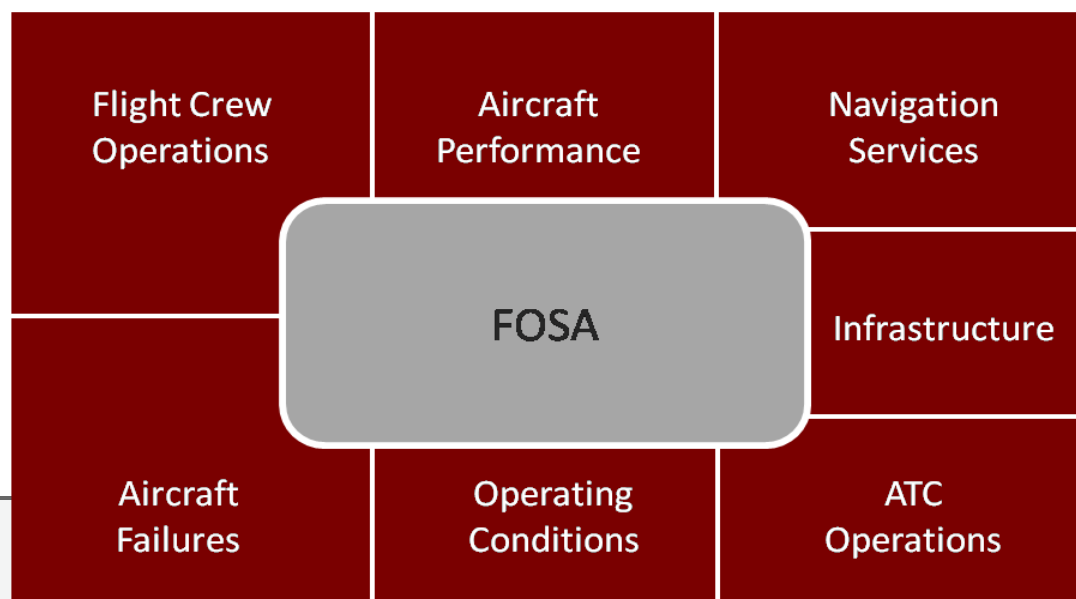
# FOSA for RNP AR procedure



## ✈ FOSA Overview (**Doc 9997**)

### ✈ **Required Depth** for FOSA

- ✈ Three factors that influence the required depth of a FOSA are:
  - ✈ how challenging the proposed procedure design is relative to the airworthiness approval/qualification;
  - ✈ the operational and obstacle environment; and
  - ✈ the previous experience of stakeholders and the availability of appropriate previous safety assessments.

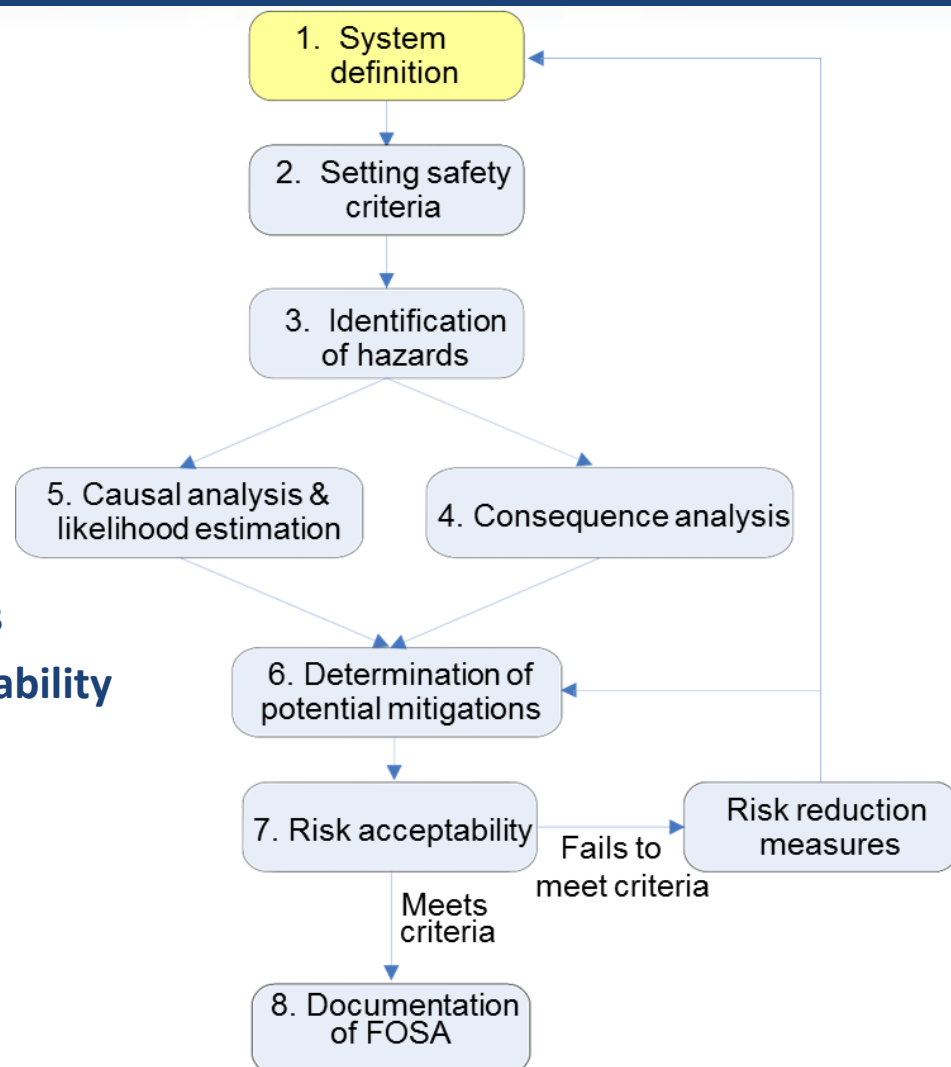


# FOSA for RNP AR procedure

## ✈ FOSA Overview (**Doc 9997**)

### ✈ **Main steps** in a FOSA

- ✈ #1 system definition
- ✈ #2 setting safety criteria
- ✈ #3 identification of hazards
- ✈ #4 consequence analysis
- ✈ #5 casual analysis&likelihood estimation
- ✈ #6 Determination of mitigations
- ✈ #7 Determination of risk acceptability
- ✈ #8 Documentation of FOSA



# Contents



- ➔ **Why do we need to do safety assessment for IFP?**
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# Case study for ZUNZ RNP AR APCH



## ✈ ZULS Overview

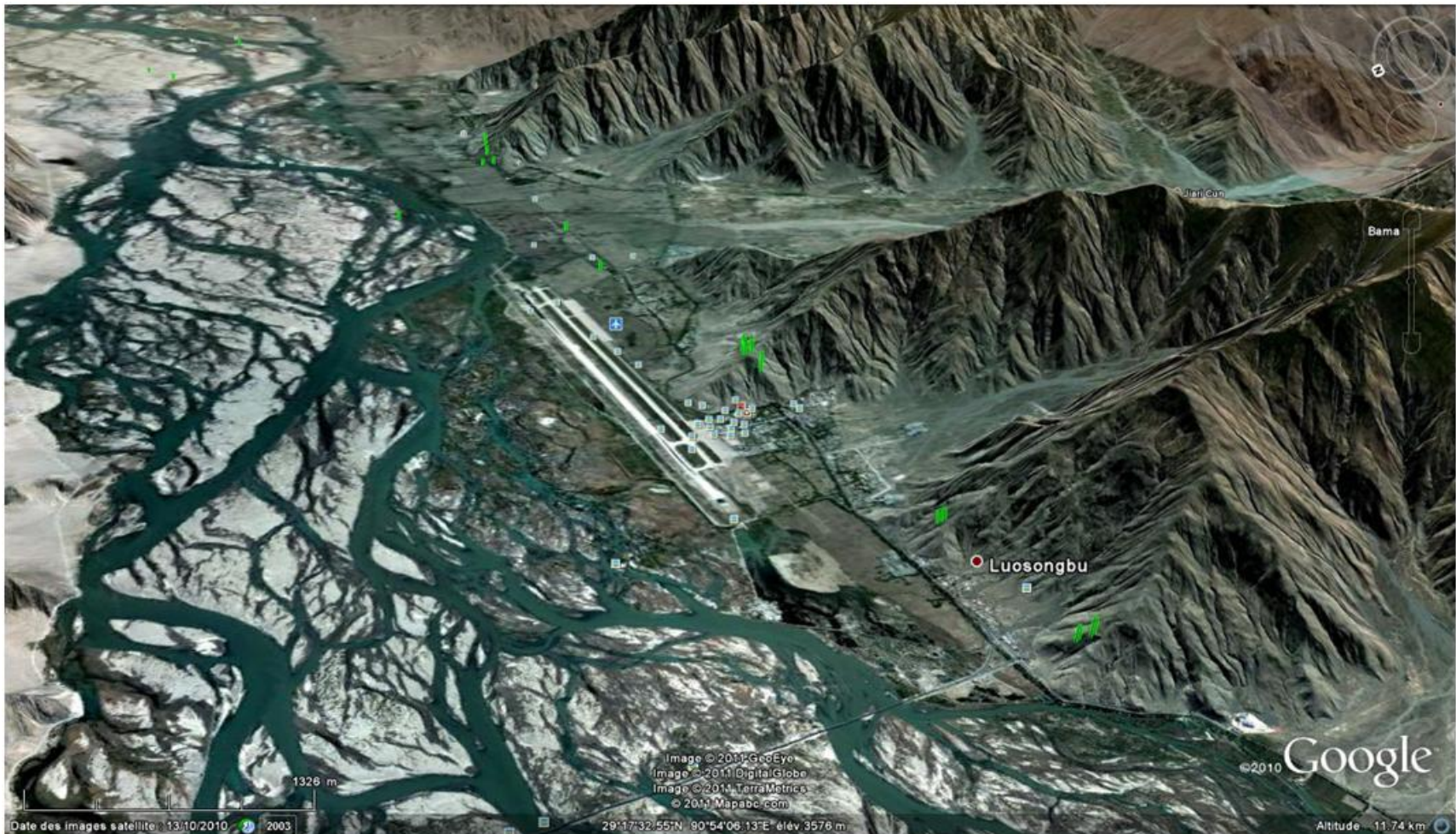


视频为固定机位拍摄  
不会影响飞行安全

# Case study for ZUNZ RNP AR APCH



## ➔ ZULS Overview





# Case study for ZUNZ RNP AR APCH



## ✈ ZULS Operation Condition(sample element)

Ref	Hazard description	Severity	Probability	Risk Index	Proposed mitigation	Residual Risk
OP01	Excessive Tailwind Conditions	MAJOR	REMOTE	3C	ZULZ procedures have been designed in accordance with the appropriate ICAO criteria and criteria that take into consideration the effect of high tailwind conditions, as per ICAO wind table [REF 5.] Specific cases where public ICAO criteria were not used are investigated in section 3.3.	2C
OP02	Wind conditions and effect on Flight Technical Error	MINOR	REMOTE	3D	ZULS procedures have been designed in accordance with the appropriate ICAO criteria and criteria that take into consideration the effect of wind conditions. The effect of wind conditions on the flight technical error have been assessed on full flight simulator session, refer to Section 3.2.	2D
OP03	Extreme Temperature and effect on barometric measures in FINAL APP mode	MAJOR	REMOTE	3C	ZULS procedures have been designed in accordance with the appropriate criteria that limit the effect of temperature deviation. Refer to ZULS technical report [REF 14.].	2C
OP04	Poor Meteorological Conditions	MINOR	FREQUENT	5D	Charts indicate weather minima to be applied for each procedure. Crew procedures and training provide guidance on related go-around procedures.	5E

# Case study for ZUNZ RNP AR APCH



## ✈ ZULS Aircraft Performance(sample)

Ref	Hazard description	Severity	Probability	Risk Index	Proposed mitigation	Residual Risk
PE01	Inadequate performance to conduct the RNP procedure	HAZARDOUS	REMOTE	3B	Aircraft performance evaluation has been conducted to determine specific performance conditions for ZUNZ. Refer to Section 4.2 below for conclusions	1B
PE02	Loss of one engine	MAJOR	REMOTE	3C	Single engine performance evaluation has been conducted to evaluate specific performance conditions for ZUNZ. Refer to Section 4.2 below for conclusions	1C

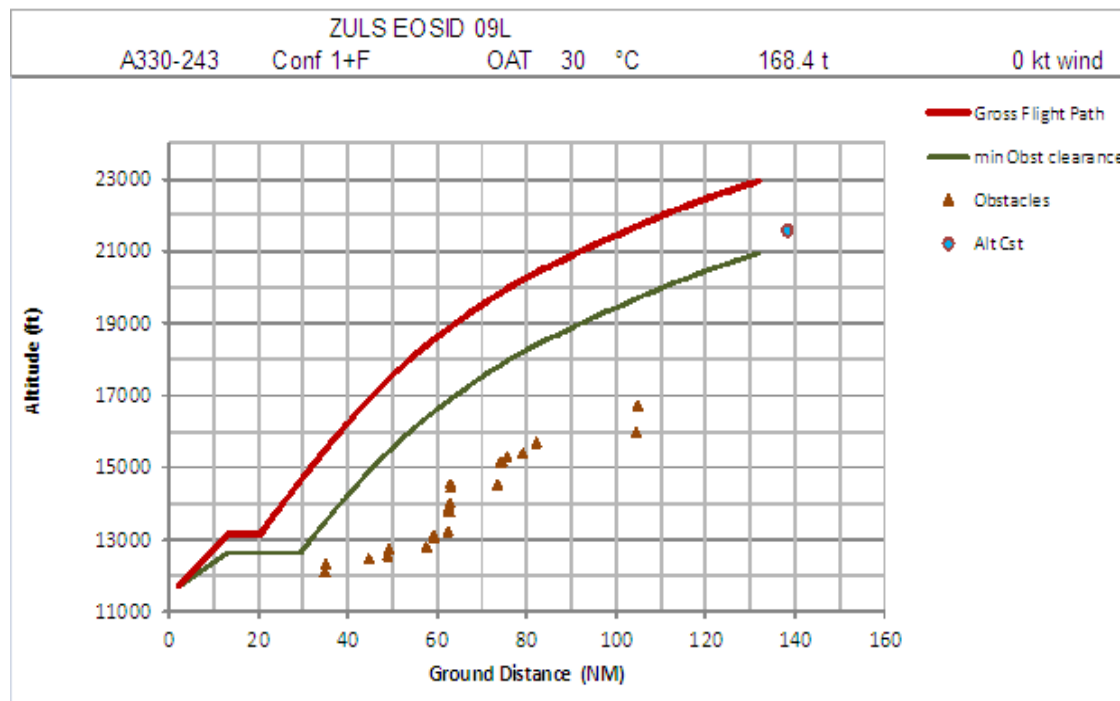




# Case study for ZUNZ RNP AR APCH



## ➔ ZULS Aircraft Performance(sample EOSID 09L)



THR RED / ACC 13200 / 14700  
A330-243: EO ACC 13000

A330243 - JAA		RR TRENT 72C engines		Lhasa - Lhasa LSA - ZULS		09 RNP AR		28.0.4 31-Jan-13 AR24303 V13		
QNH 1013.25 HPA		Air cond. Off		Elevation 11711 FT TORO 3985 M Isa temp -8 °C TODA 3985 M run slope -0.05% ASDA 4045 M Wing up limit 9000 ASOS 31.1 14.2 FT		0 obstacle		DRY TOGA		
Anti-icing Off				NOT FOR OPERATIONAL USE V01						
OAT		CONF 1+F			CONF 2					
C	TAILWIND -10 KT	WIND 0 KT	HEADWIND 10 KT	TAILWIND -10 KT	WIND 0 KT	HEADWIND 10 KT				
-20	188.0 3/3 144/45/50	192.7 3/3 152/53/57	194.0 3/3 155/56/60	186.7 3/3 144/47/50	189.1 3/3 153/55/58	189.2 3/3 152/56/59				
-15	187.3 3/3 143/44/49	192.1 3/3 151/52/56	193.5 3/3 154/55/59	186.2 3/3 143/45/49	188.9 3/3 152/54/57	189.2 2/3 153/56/59				
-10	186.6 3/3 142/43/48	191.6 3/3 150/51/55	192.9 2/3 153/54/58	185.6 3/3 142/44/48	188.7 3/3 150/53/56	189.2 2/3 153/55/59				
-5	185.9 3/6 141/42/46	191.0 3/3 149/50/54	192.4 3/3 151/53/57	185.1 3/3 141/43/47	188.5 3/3 149/51/55	189.0 3/3 152/54/58				
0	185.2 3/6 140/41/45	190.3 3/3 148/49/53	191.8 3/3 150/52/56	184.6 3/3 140/42/46	188.2 3/3 148/50/54	188.8 3/3 151/53/57				
5	182.5 3/3 139/40/44	187.5 3/3 147/48/52	188.9 3/3 149/51/54	181.9 3/3 139/41/45	185.4 3/3 147/49/53	186.0 3/3 150/52/55				
10	178.7 3/3 138/39/43	183.4 2/3 146/47/51	184.7 3/3 148/49/53	177.9 3/3 138/40/44	181.1 3/3 146/48/51	181.6 3/3 149/51/54				
12	177.8 3/3 138/39/43	182.5 2/3 145/46/50	183.9 3/3 148/49/53	177.1 3/3 138/40/43	180.3 3/3 146/48/51	180.8 3/3 149/51/54				
14	177.0 3/3 138/38/42	181.7 3/3 145/46/50	183.0 2/3 148/49/52	176.3 3/3 138/39/43	179.5 3/3 145/47/51	179.9 3/3 148/50/53				
16	176.2 3/3 137/38/42	180.8 3/3 145/46/49	182.1 3/3 147/48/52	175.4 3/3 137/39/43	178.6 3/3 145/47/50	179.1 3/3 148/50/53				
18	175.2 3/3 137/38/42	179.8 3/3 144/45/49	181.1 3/3 147/48/51	174.5 3/3 137/39/42	177.6 3/3 145/47/50	178.1 3/3 147/49/52				
20	174.0 3/3 137/37/41	178.5 3/3 144/45/48	179.8 3/3 146/47/51	173.3 3/3 137/38/42	176.4 3/3 144/46/49	176.8 3/3 147/49/52				
22	172.1 3/3 136/37/41	176.6 3/3 144/44/48	177.8 3/3 146/47/50	171.4 3/3 136/38/41	174.3 3/3 144/46/49	174.7 2/3 147/48/51				
24	170.2 3/3 136/36/40	174.6 3/3 143/44/47	175.8 3/3 146/46/50	169.5 3/3 136/37/41	172.2 3/3 144/45/48	172.6 3/3 146/48/51				
25	169.3 3/3 135/36/40	173.6 3/3 143/44/47	174.8 2/3 145/46/50	168.5 3/3 136/37/40	171.2 3/3 143/45/48	171.6 3/3 146/48/51				
26	168.3 3/3 135/36/40	172.6 2/3 143/43/47	173.8 3/3 145/46/49	167.5 3/3 135/37/40	170.2 3/3 143/45/48	170.5 2/3 146/47/50				
28	166.4 3/3 135/35/39	170.6 3/3 142/43/46	171.7 2/3 145/45/49	165.5 3/3 135/37/40	168.0 3/3 143/44/47	168.4 2/3 145/47/49				
30	164.4 3/3 134/35/38	168.4 3/3 142/42/46	169.5 3/3 144/45/48	163.4 3/3 134/36/39	165.8 3/3 142/44/47	166.0 2/3 144/46/49				
LABEL FOR INSULTION		MTOGA(1000 RVR) codes		USE	Trrail (OAT)= 3 °C Tmax(OAT)= 3 °C		Min sea height	1300 FT	Min QNH alt	13000 FT
MINIMUM QNH (1000 RVR)		LIMITATION CODES		LIMITATION		Min sea height		1726 FT	Min QNH alt	13437 FT
1=1st segment 2=2nd segment 3=runway length 4=obstacles		5=tail speed 6=brake energy 7=mass weight 8=final take-off 9=VMU						CHECK WIND LIMITATION		
								Correct V1/VR/V2= 0.3 KT/1000 KG		

# Case study for ZUNZ RNP AR APCH



## ✈ ZULS Flight Crew Operation(sample)

Type	RWY	Procedure Ident	Segment	Procedure Bank angle	Mitigation
MA	05	Missed approach	LZ290	15.4°	See (1) below
			LZ300		
MA	05	Missed approach	LZ504	30°	See (2) below

### ✈ See (1) below

- ✈ Procedure design bank angle between LZ290 and LZ300 is 15.4° . This assumes Max IAS 220kt, 55kt tailwind and Max altitude 13000ft.
- ✈ With All engine operating (AEO), this bank angle is fully manageable with AP/FD On.
- ✈ In case of One engine inoperative (OEI), the aircraft will be flying at maximum 210kts (Green Dot), resulting in a bank angle of maximum 14.2° , which is fully manageable with AP/FD On.



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