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Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR)

Second Edition, 2020

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Second Edition 2020

**Doc 9643, *Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument
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FOREWORD

In the 1980s, ICAO invited States and selected international organizations to provide information on current practices and related questions with respect to minimum distances between parallel runways for simultaneous use under instrument flight rules (IFR). The result of this work was the publication of provisions for parallel operations in 1995. The first edition of the Manual on Simultaneous Operations on Parallel or Near-Parallel Instrument Runways (SOIR), which provided guidance material for the implementation of SOIR including minimum distances between parallel instrument runway operations, was published in 2004. While still in use today, those guidelines addressed the operations and technologies of the period to best support the growth air traffic was experiencing.

Today, enabling safe capacity growth remains key, but simultaneously, environmental stewardship has to be managed. Fortunately, new concepts, such as performance-based navigation and new technologies to support air traffic services (ATS) surveillance can be applied to SOIR. These modern capabilities provide more flexible approach procedure design options for SOIR, making SOIR applicable to more runway pairs. Improved navigation, surveillance and automation capability has enabled safe reductions in separation minima during SOIR for many locations. In addition, the flexibility and reduced separations offer improved capacity while also addressing many of the environmental and efficiency challenges at major airports around the globe.

The second edition of the SOIR leverages that work and the experiences of many States in applying both traditional and new practices, and complements the 2018 publication of simultaneous approach separation Standards in the Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444). This manual expands on these guidelines by providing details on the operation and implementation of these Standards.

This manual is intended to be a living document. Periodic amendments or new editions will be published on the basis of experience gained and of comments and suggestions received from users of this manual. Readers are therefore invited to address their comments, views and suggestions to:

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GLOSSARY OF TERMS AND ABBREVIATIONS/ACRONYMS

Terms that are defined in Standards and Recommended Practices (SARPs) and Procedures for Air Navigation Services (PANS) are used in accordance with the meanings and usages given therein. In this manual, however, there are a number of other terms describing facilities, services, procedures, etc., related to aerodrome operations and air traffic services that are not yet included in Annexes or PANS documents.

TERMS

Airborne collision avoidance system (ACAS). An aircraft system based on secondary surveillance radar (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

Approach procedure with vertical guidance (APV). A performance-based navigation (PBN) instrument approach procedure designed for 3D instrument approach operations Type A

Area navigation (RNAV). A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground- or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

ATS surveillance system. A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground-based system that enables the identification of aircraft.

Note.— A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than monopulse SSR.

Break-out procedure(s). Immediate evasive manoeuvres, which are performed on instruction by air traffic control.

Closely spaced runways. Runways that are parallel or near parallel and spaced less than 1 525 m (5 000 ft) but not less than 1 035 m (3 400 ft) apart

Correction zone. Additional airspace provided for the purpose of resolving conflicts.

Delay time. The time allowed for an air traffic controller to react, coordinate and communicate the appropriate command to the pilot, for the pilot to understand and react, and for the aircraft to respond.

Dependent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where ATS surveillance system separation minima between aircraft on adjacent extended runway centre lines are prescribed.

Deviation alert. An aural and visual alarm indicating situations where an aircraft deviates into the no transgression zone (NTZ) established between parallel runway approaches.

Glide path. A descent profile determined for vertical guidance during a final approach.

Independent parallel approaches. Simultaneous approaches to parallel or near-parallel instrument runways where ATS surveillance system separation minima between aircraft on adjacent extended runway centre lines are not prescribed.

Independent parallel departures. Simultaneous departures from parallel or near-parallel instrument runways.

Miss distance. The minimum lateral spacing achieved when the tracks of both aircraft are parallel after the threatened aircraft has executed the evading manoeuvre in the deviation analysis.

Mixed parallel operations. Simultaneous approaches and departures on parallel or near-parallel instrument runways.

Near-parallel runways. Non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less.

Normal operating zone (NOZ). Airspace of defined dimensions extending to either side of a published instrument approach procedure final approach course or track. Only that half of the normal operating zone adjacent to a no transgression zone (NTZ) is taken into account in independent parallel approaches.

No transgression zone (NTZ). In the context of independent parallel approaches, a corridor of airspace of defined dimensions located centrally between the two extended runway centre lines, where a penetration by an aircraft requires a controller intervention to manoeuvre any threatened aircraft on the adjacent approach.

Precision approach (PA) procedure. An instrument approach procedure based on navigation systems (ILS, MLS, GLS and SBAS CAT I) designed for 3D instrument approach operations Type A or B.

Segregated parallel operations. Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

Semi-mixed parallel operations. Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for departures while the other runway is used for a mixture of approaches and departures, or one runway is used exclusively for approaches while the other runway is used for a mixture of approaches and departures.

Standard instrument departure (SID). A designated instrument flight rule (IFR) departure route linking the aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.

Standard instrument arrival (STAR). A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point from which a published instrument approach procedure can be commenced.

ABBREVIATIONS/ACRONYMS

ADS-B	automatic dependent surveillance – broadcast
AIP	Aeronautical Information Publication
APCH	approach
APV	approach procedure with vertical guidance
ATC	air traffic control
ATIS	automatic terminal information service
ATS	air traffic service
CNS	communications, navigation, and surveillance

FAF	final approach fix
FAP	final approach point
GBAS	ground-based augmentation system
GLS	GBAS landing system
GNSS	global navigation satellite system
IAF	initial approach fix
IF	intermediate fix
IFR	instrument flight rules
ILS	instrument landing system
MLAT	multilateration
MLS	microwave landing system
NAVAID	navigation aid
NOZ	normal operating zone
NTZ	no transgression zone
PA	precision approach
PAOAS	parallel approach obstacle assessment surface
PBN	performance-based navigation
PRM	precision runway monitor
RA	resolution advisory
RF	radius to fix
RNP	required navigation performance
RNP AR	required navigation performance authorization required
RTF	radiotelephone
SBAS	satellite-based augmentation system
SOIR	simultaneous operations on parallel or near-parallel instrument runways
SSR	secondary surveillance radar
TA	traffic advisory
TCAS	traffic alert and collision avoidance system
VMC	visual meteorological conditions
VHF	very high frequency

Chapter 1

OPERATIONAL CONCEPTS AND CONSIDERATIONS

1.1 GENERAL

1.1.1 The use of parallel or near-parallel runways to maximize aerodrome capacity is not a new concept. In Annex 14, Volume I, Chapter 3, 3.1.11, it is recommended that where parallel runways are intended for simultaneous use, by medium or heavy aeroplanes, under visual meteorological conditions (VMC) only, the minimum distance between their centre lines should be 210 m (690 ft). Under instrument flight rules (IFR), however, the safety of parallel runway operations is affected by several factors such as the precision with which aircraft can navigate to the runway, the accuracy of the air traffic service (ATS) surveillance monitoring system, the ability of controllers to intervene when an aircraft deviates from the final approach course or track, and the controller, pilot and aircraft reaction times.

1.1.2 The continued impetus for considering simultaneous operations on parallel or near parallel instrument runways under IFR is provided by the need to increase capacity at busy aerodromes. This increase in capacity can be accomplished either by using existing parallel runways more efficiently or by building additional runways; the cost of the latter can be very high and politically and/or environmentally challenging. On the other hand, an aerodrome already having parallel runways could increase its capacity if these runways could be safely operated simultaneously under IFR with appropriate published instrument approach procedures. However, other factors, such as surface movement guidance and control, environmental considerations, and landside/airside infrastructure, may negate the advantages to be gained from simultaneous operations.

1.1.3 Near-parallel runways are defined as non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less. Simultaneous approach and departure operations may be viable on near-parallel runways on a case-by-case basis. See chapter 5 for details.

1.2 MODES OF OPERATION

1.2.1 Airports that have parallel runways can operate with some of the runways dedicated solely to arrivals and departures or choose to allow both types of operation from a single runway. Depending on this “mode”, four different simultaneous operations on parallel or near-parallel instrument runways (SOIR) apply, two for approach, one for departure, and one for a mix of both approach and departure.

1.2.1.1 *Mode 1, independent parallel approaches*

- Simultaneous approaches to parallel or near-parallel instrument runways where separation minima based on ATS surveillance systems between aircraft on adjacent extended runway centre lines **are not** prescribed.

1.2.1.2 *Mode 2, dependent parallel approaches*

- Simultaneous approaches to parallel or near-parallel instrument runways where separation minima based on ATS surveillance systems between aircraft on adjacent extended runway centre lines **are** prescribed.

1.2.1.3 *Mode 3, independent parallel departures*

- Simultaneous departures from parallel or near-parallel instrument runways. Not all runway pairs are eligible. When the spacing between two parallel runways is less than the specified value dictated by wake turbulence considerations, the runways are considered as a single runway with regard to separation between departing aircraft.

1.2.1.4 *Mode 4, segregated parallel operations*

1.2.1.4.1 Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

1.2.1.4.2 In the case of segregated parallel approaches and departures, there may be semi-mixed operations, i.e. one runway is used exclusively for departures, while the other runway is used for a mixture of approaches and departures, or one runway is used exclusively for approaches while the other is used for a mixture of approaches and departures. There may also be mixed operations, i.e. simultaneous parallel approaches with departures interspersed on both runways. In all cases, however, semi-mixed or mixed operations may be related to the other three basic modes listed in 1.2.1.1, 1.2.1.2, 1.2.1.3 as follows:

	<i>Mode</i>
a) <i>Semi-mixed parallel operations</i>	
1) One runway is used exclusively for approaches while:	
— approaches are being made to the other runway, or	1 or 2
— departures are in progress on the other runway.	4
2) One runway is used exclusively for departures while:	
— approaches are being made to the other runway, or	4
— departures are in progress on the other runway.	3
b) <i>Mixed parallel operations</i>	
All modes of operation are possible.	1, 2, 3, 4

1.3 FACTORS AFFECTING SIMULTANEOUS OPERATIONS ON PARALLEL INSTRUMENT RUNWAYS

1.3.1 In the case of simultaneous parallel approaches to two parallel or near-parallel instrument runways, each with an associated instrument approach procedure, the approach minima for each runway are not affected. The operating minima used are identical to those applied for single runway operations.

1.3.2 There are some special procedures that have been promulgated in States using independent parallel approaches. To make flight crews aware of the importance of executing precise manoeuvres to intercept and closely follow published procedures, they are notified prior to commencing approach that simultaneous parallel instrument approaches are in progress. This procedure also alerts flight crews to the possibility of an immediate evasive manoeuvre (break-out procedure) in case of a deviation by an aircraft on the adjacent extended centre line.

1.3.3 Theoretical studies indicate that the maximum arrival capacity may be achieved by operating independent parallel approaches, followed by dependent parallel approaches. These theoretical gains can, however, often be significantly lower in practice due to practical difficulties associated with implementation.

1.3.4 Further reductions in the theoretical capacity may arise through a lack of pilot familiarity with the procedures at aerodromes where there is a high proportion of unscheduled flights. Lack of familiarity can also result in the selection of incorrect instrument landing system (ILS) or microwave landing system (MLS) frequencies, ground-based augmentation system (GBAS) landing system (GLS) or satellite-based augmentation system (SBAS) channel numbers, or selection of an incorrect procedure from the database. Language difficulties, in particular lack of proficiency in the English language, may present communication problems between controllers and pilots.

1.3.5 When there are aircraft departing during mixed or semi-mixed operations, gaps have to be created in the landing stream. The effect of this is a reduction in the arrival capacity in order to accommodate departures; hence, it is a critical factor in determining the maximum runway capacity. Also, when operating departures on the landing runway, the probability of missed approaches increases with a corresponding reduction in capacity.

1.3.6 Factors that can affect the maximum capacity or the desirability of operating parallel runways simultaneously are not limited to runway considerations. Taxiway layout and the position of passenger terminals relative to the runways can make it necessary for traffic to cross active runways, a situation which may lead not only to delays but also to a reduction in the level of safety due to the possibility of runway incursions. The total surface movement environment must be carefully assessed when determining how particular parallel runways are to be used. In addition, when initiating parallel approach operations in visual meteorological conditions (VMC), consideration should be given to protecting the ILS signal from interference from ground movements.

1.3.7 The decision to implement simultaneous operations at a particular location must take into consideration all of the foregoing factors as well as any other constraints such as environmental considerations.

Chapter 2

SIMULTANEOUS APPROACHES TO PARALLEL RUNWAYS (MODES 1 AND 2)

2.1 GENERAL

2.1.1 This chapter presents the requirements for reduced spacing for independent and dependent approach operations to parallel runways under instrument flight rules (IFR).

2.1.2 The concepts, procedures, and dimensions applicable to independent and dependent parallel approaches are based on published procedures approved for simultaneous parallel approach operations. The use of other approach technology not covered in this manual may necessitate changes to the separation and spacing requirements of parallel runway operations.

2.1.3 The primary purpose for permitting simultaneous operations on parallel or near-parallel instrument runways is to increase arrival capacity. The largest increase in arrival capacity is achieved through the use of independent approaches (Mode 1) to parallel or near-parallel instrument runways.

2.1.4 A potential problem associated with simultaneous parallel approaches is the possibility that an aircraft will make the approach to the wrong runway. There are a number of possible causes, including:

- a) a controller may give an incorrect clearance to the wrong runway;
- b) the pilot may misinterpret the approach clearance;
- c) the pilot may select the incorrect approach procedure; and
- d) the pilot on an instrument approach may, after reaching visual conditions, visually acquire and line up for the wrong runway. Such an event might occur too quickly and too close to the threshold to be reliably detected or resolved by the controller. If this situation is determined to be a problem, some means of improving visual runway identification may be required.

2.1.5 Errors in both surveillance and navigation contribute to the uncertainty regarding an aircraft's flight path. Improvements in both surveillance and navigation performance may therefore be necessary to ensure that the number of false alarms is kept low and that true errors are identified in a timely manner. As the spacing between parallel runways decreases, it may become more difficult for the approach controller to determine whether an aircraft is correctly aligned as the controller intended. There are a number of ways to reduce the probability of an aircraft approaching the wrong runway, which include:

- a) employing high resolution displays as per the description in section 2.2.1;
- b) instituting procedures that require confirmation of the runway assignment, i.e. verbal verification of the frequency, channel number, or procedure;
- c) designing each procedure to have its own unique track to align with the different runways; and

- d) designing adjacent procedures that have clearly separate tracks, enabling early detection by air traffic control (ATC).

2.1.6 In addition, to reduce the possibility of runway misidentification, an improved surveillance system may provide early detection of an aircraft deviating off its expected flight path. Any reduction below the required separation may be detected sooner, allowing more time for the controller to act. Early detection of an unexpected deviation may have an effect on the resulting miss distance between aircraft on parallel approaches.

2.1.7 Automated alerting may also help identify potential and actual deviations.

2.2 INDEPENDENT PARALLEL INSTRUMENT APPROACHES (MODE 1)

2.2.1 Requirements and procedures

2.2.1.1 Surveillance requirements are dependent on runway centre line spacing. Annex 14 identifies recommended minimum distance between runway centre lines for parallel operations. The Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444), Chapter 6, Table 6-1 specifies what surveillance performance is required to conduct independent parallel approaches at various runway centre line spacings, repeated here as Table 2-1:

Table 2-1. Air traffic service (ATS) surveillance system criteria for different runway centerline spacings (PANS ATM, Table 6-1)

Runway centre line spacing	ATS surveillance system criteria
Less than 1 310 m (4 300 ft) but not less than 1 035 m (3 400 ft)	<ul style="list-style-type: none"> • a minimum accuracy for an ATS surveillance system as follows: <ul style="list-style-type: none"> – for secondary surveillance radar (SSR), an azimuth accuracy of 0.06 degrees (one sigma); or – for multilateration system (MLAT) or automatic dependent surveillance - broadcast (ADS-B), an accuracy of 30 m (100 ft); • an update period of 2.5 seconds or less; and • a high-resolution display providing position prediction and deviation alert is available.
Less than 1 525 m (5 000 ft) but not less than 1 310 m (4 300 ft)	<ul style="list-style-type: none"> • an ATS surveillance system with performance specifications other than those above, but equal to or better than: <ul style="list-style-type: none"> – for SSR, a minimum azimuth accuracy of 0.3 degrees (one sigma); or – for MLAT or ADS-B, a performance capability equivalent to, or better than, the SSR requirement can be demonstrated;

Runway centre line spacing	ATS surveillance system criteria
	<ul style="list-style-type: none"> • an update period of 5 seconds or less; and • when it is determined that the safety of aircraft operations would not be adversely affected.
1 525 m (5 000 ft) or more	<ul style="list-style-type: none"> • a minimum SSR azimuth accuracy of 0.3 degrees (one sigma) or, for MLAT or ADS-B, a performance capability equivalent to, or better than, the SSR requirement can be demonstrated, and • an update period of 5 seconds or less.

Note 1.— Information pertaining to use of ADS-B and MLAT and their system performance is contained in the Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation (Circ 326).

Note 2.— Refer to Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444) Chapter 2 Section 2.6.2.f) where ADS-B implementation envisages reliance upon a common source for surveillance and/or navigation.

2.2.1.2 As early as practicable after an aircraft has established communication with approach control, the aircraft is to be advised that independent parallel approaches are in use. The use of the automatic terminal information service (ATIS) is an accepted method to provide the flight crew with this information.

2.2.1.3 During simultaneous independent approach operations:

- a) controllers are required to advise aircraft as early as possible of the assigned runway or instrument approach procedure and any additional information considered necessary to confirm correct selection;
- b) the final approach course or track is to be intercepted by use of:
 - 1) vectoring; or
 - 2) a published approach procedure transition from an initial approach fix (IAF) or intermediate fix (IF);
- c) a no transgression zone (NTZ) of at least 610 m (2 000 ft) wide needs to be established equidistant between extended runway centre lines (Figure 2-1) and is depicted on an ATS surveillance system situation display (see 2.2.2 for more information on NTZ);
- d) the approaches are monitored by:
 - 1) a separate monitoring controller for each runway; or
 - 2) a single monitoring controller for no more than two runways, if determined by a safety assessment and approved by the appropriate ATS authority (2.2.1.7 and 2.2.4 refer);

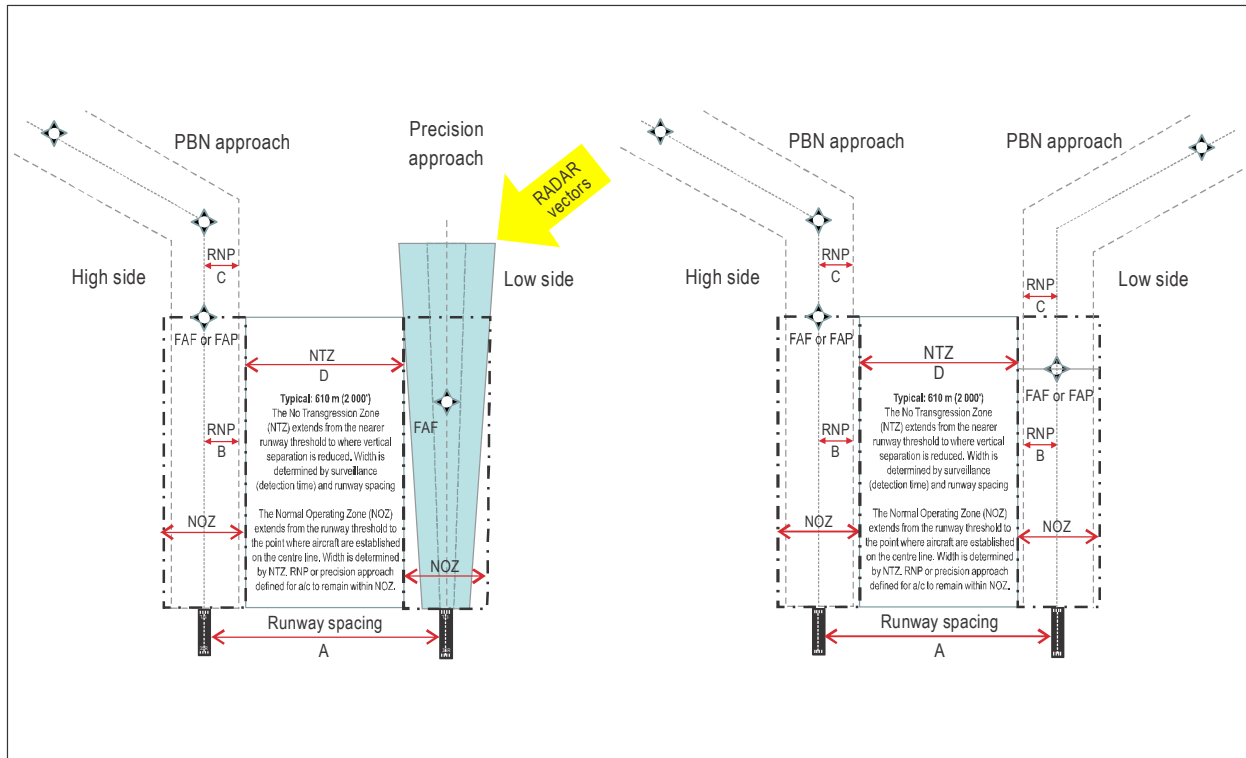


Figure 2-1. Vectors or PBN transitions for Final Course Intercept

- e) monitoring is to be provided from the point at which the 300 m (1 000 ft) vertical separation is reduced as per 2.2.1.10 and continued until as detailed in 2.2.1.16;
- Monitoring ensures that appropriate action is taken when an aircraft deviation is anticipated to, or already has, penetrate the NTZ. Monitoring also ensures that the applicable minimum longitudinal separation between aircraft on the same instrument approach procedure is maintained.
- f) the transfer of communication between the aircraft and the respective monitoring controller's channel is to be effected before monitoring is required; and
- g) communication between the aircraft and the respective monitoring controller is to be provided by either:
 - 1) a dedicated radio channel(s); or
 - 2) the capability to override transmissions of aerodrome control on the respective radio channels for each arrival flow.

2.2.1.4 To conduct independent parallel approaches, the instrument approach procedures that align the aircraft with the extended runway centre lines need to be designed to support the operation.

- a) The procedures are identified for simultaneous use in Table 2-2;
- b) the tracks of adjacent missed approach procedures diverge by at least 30 degrees; and
- c) an obstacle survey and evaluation is completed, as appropriate, for the areas adjacent to the final approach segments.

Table 2-2. Approach Types available for Mode 1 Operations

<i>Instrument Approach</i>	<i>Can this approach type be used for Simultaneous Approaches?</i>
ILS	Yes
GLS	Yes
MLS	Yes
SBAS CAT I Applicable in Final Approach Segment	Yes
RNP AR APCH	Yes
RNP AR APCH (non-conforming to 2.2.1.5)	Provided an approach and mitigation-specific, documented safety assessment has shown that an acceptable level of safety can be met, and operations are approved by the appropriate ATS authority.
RNP APCH (LNAV/VNAV) (LPV)	Provided an approach and mitigation-specific, documented safety assessment has shown that an acceptable level of safety can be met, and operations are approved by the appropriate ATS authority.
RNP APCH (LNAV)	No
LOC	No
NDB	No
VOR	No

2.2.1.5 Approaches with segments designed exclusively with either precision approach or required navigation performance (RNP) authorization required (AR) approach (APCH) criteria may be used provided that:

- a) for any RNP AR segment, the designated RNP value is required to ensure separation from traffic on a simultaneous approach procedure by not exceeding one quarter of the distance between runway centre lines (Refer to Appendix C, Figure C-2, 2(i)); and
- b) for any RNP AR segment, the designated RNP value is required to protect the NTZ from infringement during normal operations and minimize nuisance transgression alerting by not exceeding half the difference between runway centre lines and the designated NTZ (Refer to Appendix C, Figure C-2, 2(ii)).

2.2.1.6 The approach procedure with vertical guidance (APV) procedures designed using the RNP APCH navigation specification (or procedures using the RNP AR APCH navigation specification) that do not meet 2.2.1.5 may be used, provided that:

- a) a documented safety assessment has shown that an acceptable level of safety can be met. The safety demonstration should consider: the collision risk from normal and residual (not mitigated) atypical errors; the likelihood of ACAS nuisance alerting during normal operations; wake hazard; monitoring and available levels of system automation; data base management; flight management system input and related crew workload; impacts of meteorological conditions and other environmental factors; missed approach guidance, training, and published ATC break-out procedures;
- b) the instrument approach is demonstrated to protect the NTZ from infringement during normal operations; and
- c) operations and the safety assessment are approved by the appropriate ATS authority.

2.2.1.7 States conducting safety assessments to enable the monitoring of not more than two runways by a single controller (2.2.1.3 d) 2) refers) should review factors such as, but not limited to: complexity, times of operation, traffic mix and density, arrival rate, available levels of system automation, availability of back-up systems, the impacts of meteorological conditions, and other environmental factors (2.2.4 refers).

2.2.1.8 Whenever independent parallel approaches are being conducted, separate controllers should be responsible for the sequencing and spacing of arriving aircraft to each runway.

2.2.1.9 When an aircraft is being vectored to intercept the final approach course or track, the final vector is required to meet the following conditions:

- a) enable the aircraft to intercept at an angle not greater than 30 degrees;
- b) provide at least 1.9 km (1.0 NM) straight and level flight prior to final approach course or track intercept; and
- c) enable the aircraft to be established on the final course or track in level flight for at least 3.7 km (2.0 NM) prior to intercepting the glide path or vertical path for the selected instrument approach procedure.

2.2.1.10 A minimum of 300 m (1 000 ft) vertical separation or a minimum of 5.6 km (3.0 NM) horizontal separation is to be provided using an appropriate ATS surveillance system until aircraft are established:

- a) inbound on the final approach course or track, and within the normal operating zone (NOZ); or
- b) on an RNP AR APCH, in accordance with 2.2.5.

2.2.1.11 In the application of vertical separation where required in 2.2.1.10, a “high side” and a “low side” is to be used to position aircraft until they are both established inbound on their respective instrument approach procedure. The low-side altitude should be such that the aircraft will be established on the final approach course or track well before glide path or vertical path interception (see low side, Figure 2-2).

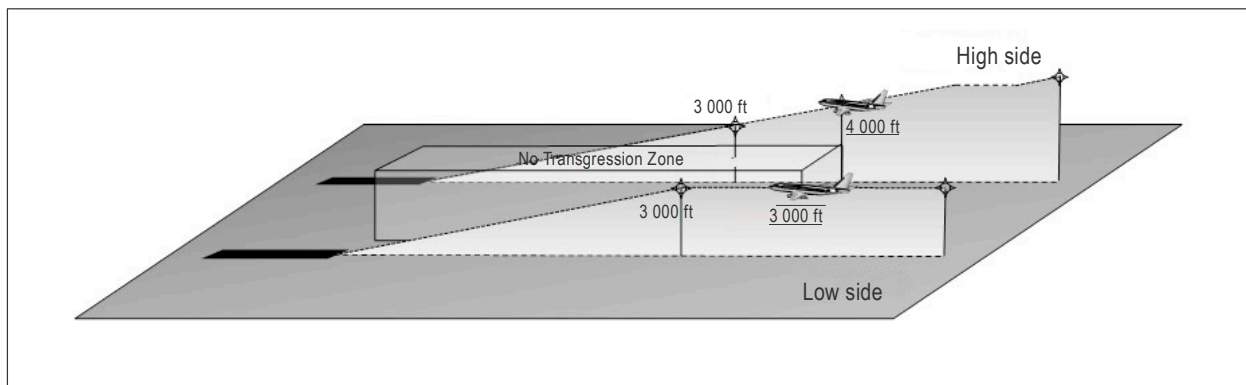


Figure 2-2. High Side/Low side for mode 1 approach operations

2.2.1.12 Subject to ATS surveillance system capabilities, a minimum of 5.6 km (3.0 NM) horizontal separation, or 4.6 km (2.5 NM) as prescribed by the appropriate ATS authority, is to be provided between aircraft on the same final approach course or track unless increased longitudinal separation is required due to wake turbulence or for other reasons. See *Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444)* Chapter 8, 8.7.3.2 and 8.7.3.4.

2.2.1.13 An aircraft established on the final approach course or track is separated from another aircraft established on an adjacent parallel final approach course or track, provided neither aircraft penetrates the NTZ as depicted on the situation display.

2.2.1.14 The application of vertical separation may be discontinued when an aircraft is established on an RNP AR APCH procedure, in accordance with the “Established on RNP AR APCH” procedure detailed in 2.2.5 and Appendix A.

2.2.1.15 If an aircraft is observed to deviate from its cleared approach procedure towards the NTZ boundary, the appropriate monitoring controller is to instruct the aircraft to return to the correct course or track immediately. In the event an aircraft is observed to penetrate the NTZ, the appropriate monitoring controller will instruct the aircraft on the adjacent procedure to immediately climb and turn to an assigned altitude and heading (break-out procedures) in order to avoid the deviating aircraft. Any heading instruction cannot exceed a 45 degree change. Where parallel approach obstacle assessment surfaces (PAOAS) criteria are applied to the obstacle assessment, the monitoring controller cannot issue the heading instruction to aircraft below 120 m (400 ft) above the threshold elevation.

2.2.1.16 Flight path monitoring using an ATS surveillance system cannot be terminated until:

- a) visual separation is applied, provided procedures ensure that both controllers are advised whenever visual separation is applied; or
- b) the aircraft has landed or, in case of a missed approach, is at least 1.9 km (1.0 NM) beyond the departure end of the runway and adequate separation with any other traffic is established. There is no requirement to advise the aircraft that flight path monitoring is terminated.

2.2.2 No transgression zone (NTZ)

2.2.2.1 Since ATS surveillance system separation is not provided between traffic on adjacent extended runway centre lines in Mode 1 approaches, there needs to be an established means of determining when an aircraft deviates too far from the final approach course or track or out of its NOZ. This is achieved through the concept of the NTZ.

2.2.2.2 The NOZ is airspace of defined dimensions extending to either side of a published instrument approach procedure final approach course or track (PANS ATM, Chapter 6 6.7.3.2.5 c)). The size of the NOZ should be consistent with the track-keeping performance of the specified instrument approach procedure for a runway used in simultaneous operations.

2.2.2.3 The NTZ is a corridor of airspace established equidistant between two extended runway centre lines. The NTZ has a minimum width of 610 m (2 000 ft) and extends from the nearest threshold out to the point where the 300 m (1 000 ft) vertical and/or 5.6 km (3.0 NM) horizontal separation will no longer be provided.

- a) The size of NOZs and the NTZ is determined according to the runway situation. In the case of existing parallel runways, the NTZ is to have a minimum width of 610 m (2 000 ft) and is based on the safety considerations described earlier. The remaining airspace can then be allocated to the two inner halves of the NOZs associated with each extended runway centre line. The results then dictate the required level of precision of the approach guidance system that is necessary to ensure the aircraft does not penetrate the NTZ in normal operations (Examples of NTZ are at Appendix C); and
- b) when there is only one runway and the question is how close can a parallel runway be built to it, the answer is derived in a similar fashion: first, the desired width of the NTZ is determined based on safety considerations; then, the desired widths of the inner halves of the two NOZs are determined. The lateral spacing for the new runway would thus be the sum of the NTZ width and the width of the two inner halves of the NOZs (See Figure 2-3, an example of the relationship between the NTZ, NOZ, and runway centre line spacing for 1310 m).

2.2.2.4 The significance of the NTZ is that the monitoring radar controllers must intervene to establish separation between aircraft if any aircraft is observed to penetrate the NTZ. The width of the NTZ depends on the following four factors:

- a) *Detection zone.* Some airspace allowance must be made for limitations of the surveillance system and for controller observation/reaction time in the detection of a deviating aircraft. The allowance is dependent on the updated rate and accuracy of the radar system and the resolution of the radar display used.
- b) *Delay time/reaction time.* Some airspace allowance must be made:
 - 1) for the time during which the controllers identify the deviation, determine the appropriate resolution manoeuvre, and communicate the appropriate instructions to achieve separation;

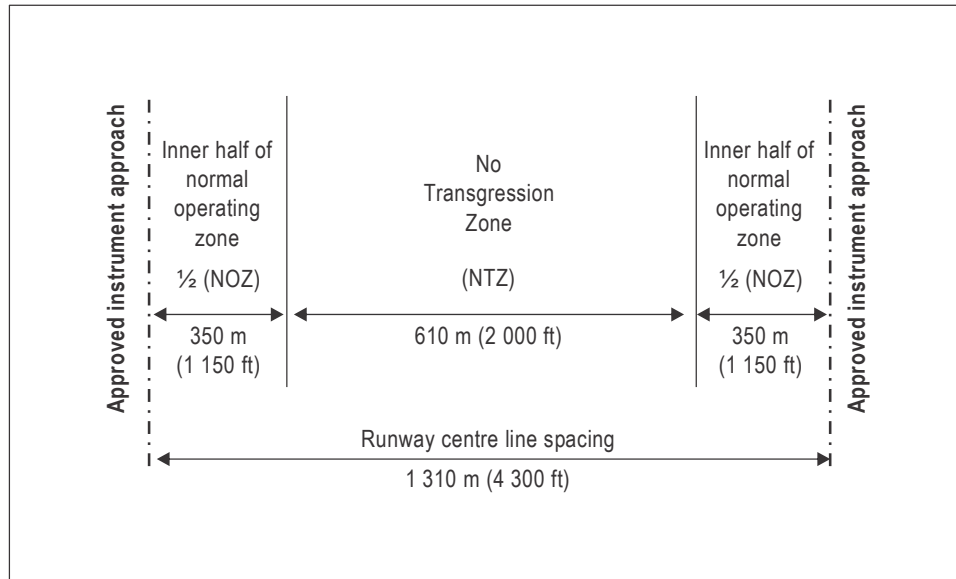


Figure 2-3. NOZ and NTZ example for one runway centre line spacing

- 2) for the time it takes the pilot to understand the instructions and react; and
 - 3) for the aircraft to respond to the control inputs.
- c) *Correction zone.* An additional airspace allowance must be made for the completion of the resolution manoeuvre by the threatened aircraft.
- d) *Miss distance.* In the deviation analysis, allowance must be made for adequate track spacing. It must include lateral spacing and an allowance for the fact that the threatened aircraft may not be exactly on the extended runway centre line of the adjacent runway.

2.2.2.5 The determination of airspace allowances for the detection zone, delay time/reaction time, correction zone, and miss distance is based on several assumptions. One of the most complicated and important tasks of the monitoring radar controller is the determination of the appropriate manoeuvre for the threatened aircraft following a failure of the deviating aircraft to return to its appropriate final approach course or track. Turning away from the threat may not always provide the optimum separation. The amount of time allocated to the controller for determining the proper resolution manoeuvre must therefore be generous.

2.2.2.6 *Nuisance alerting.* Individual false, or nuisance, alerts due to aircraft performance may lead to inadvertent break outs for aircraft on the other approach, increasing both controller and flight crew workload. Nuisance alerts can lead to a lack of confidence in the alerting function and this, in turn, may affect controller reaction time if there is an actual NTZ infringement. The result of a delayed controller intervention during an actual NTZ infringement can be a significantly smaller separation between the two aircraft at a late stage of the approach. Confidence in the alerting function should ensure that the controller reacts on actual NTZ infringements in a timely fashion. Therefore, monitoring and reporting on NTZ violations or lateral deviations should be undertaken to ensure that false deviation rates are not too high.

2.2.3 Safety-related issues affecting independent approaches to closely spaced parallel instrument runways spaced between 1 035-1 310 m (3 400-4 300 ft)

2.2.3.1 Closely spaced runways are defined as parallel runways spaced less than 1 525 m (5 000 ft), but not less than 1 035 m (3 400 ft) apart. This section addresses independent operations below 1 310m (4 300 t) specifically (see Table 2-1). Some states refer to this operation as “PRM” (precision runway monitor). Independent operations with such runway spacings are extremely safety-critical and should be undertaken only after considerable attention has been devoted to safety-related issues. In particular, the issues listed below need to be addressed before any implementation.

- a) *Weather limitations.* Independent instrument approaches to parallel runways spaced by less than 1 525 m (5 000 ft), but not less than 1 035 m (3 400 ft), between centre lines is required to be suspended under certain adverse weather conditions, as prescribed by the appropriate ATS authority (e.g. windshear, turbulence, downdrafts, crosswind, and severe weather such as thunderstorms). These adverse weather conditions might increase final approach course or track deviations to the extent that safety may be impaired and/or an unacceptable number of deviation alerts would be generated. ATS authorities should establish criteria for the suspension of simultaneous operations on parallel or near-parallel instrument runways under these conditions and ensure that independent/dependent parallel approaches are only conducted when aircraft are able to adequately follow the final approach course or track. Consideration should be given to the weather characteristics at each individual aerodrome.
- b) *Wake Turbulence.* Related to weather limitations (above) wake turbulence hazard is known to “linger” in certain conditions (e.g. a combination of an inversion layer and a light tailwind on final). As with weather limitations, consideration should be given to the wake turbulence characteristics at each individual aerodrome.
- c) *Track keeping on approved instrument approaches.* Aircraft executing instrument approach procedures are subject to variable performance from several sources, including the accuracy of the navigation source, the accuracy of the airborne equipment, and the ability of the pilot or autopilot to follow the navigational guidance. Deviations from the instrument approach may vary with the approach under consideration; it is therefore essential that the integrity of any instrument approach navigation source used for SOIR be protected, track keeping is monitored, and the procedures are adapted to ensure that false deviation alerts are kept to a minimum.
- d) *Track keeping on visual approaches.* The integrity of any instrument approach navigation source used for SOIR must be protected, and the procedures adapted, to ensure that false deviation alerts are kept to a minimum. When aircraft are established on their appropriate instrument approaches, consideration should be given to protecting the instrument guidance during the visual phase of that approach as some aircraft may, based on operational procedures, continue following instrument guidance. Local requirements, such as flight crew confirming that the cleared runway has been visually acquired, could help ensure proper runway operations; this can be enhanced by regular practice of this type of operation.
- e) *Communications.* When there is a large deviation from the final approach track, communication between the controllers and pilots involved is critical. For independent parallel approaches, monitoring controllers with separate control frequencies are required for each runway. The monitoring controller(s) can transmit on either of these frequencies, automatically overriding transmissions by the other aerodrome controllers, or can use dedicated radio channels, if available. It is essential that a check of the override capability at each monitor position be performed prior to the monitoring controllers assuming responsibility of the position. ATS authorities should take steps to ensure that, in the event of a deviation, the monitoring controller will be able to contact the deviating aircraft and the endangered aircraft immediately. This will involve studying the proportion of time during which

communications are blocked. In accordance with 2.2.1.3 d), monitoring of approaches to no more than two runways by a single monitoring controller may be permitted if determined by a safety assessment and approved by the appropriate authority, 2.2.4 refers.

- f) *Obstacle evaluation.* Since aircraft may need to be turned away from the final approach track at any point during the approach, an obstacle survey and evaluation must be completed for the area opposite the other parallel runway. This is in order to safeguard early turns required to avoid potential intruding aircraft from the adjacent final approach. This check can be made using a set of defined PAOAS. Any obstacle that, in the opinion of the appropriate ATS authority, would adversely affect a break-out procedure during independent parallel approaches to closely spaced parallel runways should be depicted on the display to help the monitoring radar controller. An example of a method to assess these obstacles is included in the PANS OPS, Volume II, Part III.
- g) *Pilot training.* Pilots must be aware of the different operating procedures for independent operations on closely spaced runways. As a minimum, pilot training should cover the following:
- 1) Closely spaced runway procedures, as documented in the State's Aeronautical Information Publication (AIP) or equivalent operational documents, together with the break-out procedure and phraseology. Simulator training in break-out procedures is recommended, particularly in aircraft fitted with automatic flight guidance systems.
 - 2) How to identify that closely spaced parallel independent approaches are in operation; this information can be transmitted over the ATIS and will notify the flight crew that closely spaced independent approaches are in operation.
 - 3) Awareness that there could be separate approach charts issued specifically for closely spaced independent approaches.
 - 4) If the procedure requires dual very high frequency (VHF) equipment: The two receivers to be used must have volumes set to the same level. One radio will be set to the tower frequency and the other radio to the monitor frequency. The tower controller and the monitoring controller will broadcast on both frequencies with the monitoring controller possessing communication override. Pilots must not transmit on the monitoring frequency. Communications from pilots with the tower controller will be conducted on the tower radio frequency only. A "break-out" instruction would be issued by the monitoring controller on both frequencies. In the event of frequency congestion or over-transmission on the tower frequency, the pilot will still hear the break-out instruction on the monitoring frequency.
 - 5) Advise ATC if unable to participate in closely spaced independent runway operations as soon as possible. Pilots unable to comply with closely spaced independent runway operations will be cleared for a dependent runway operation.
 - 6) If the ATC surveillance system display indicates that an aircraft will penetrate the NTZ, an advisory broadcast will be issued to the aircraft. The phraseology will be: "(call sign), radar indicates you are deviating (left/right) of the final approach path". Note that pilots are not required to acknowledge this deviation advice.
 - 7) Traffic alert and collision avoidance system (TCAS) is not required to participate in a closely spaced operation. However, if the controller's climb/descend instruction differs from the TCAS resolution advisory (RA), pilots are required to follow the RA while continuing to follow the controller's turn instruction. Report this deviation to ATC as soon as practical.

- 8) Break out: ATC is required to issue instructions to break off the approach to any aircraft that enters the NTZ. Any aircraft in conflict on the approach to the adjacent runway will also be turned away. Phraseology for the break out will be as follows: "Break-out alert, (call sign), turn (left/right) immediately heading (...). Climb/descend to (altitude)."
- 9) Hand Fly a "break out": A break out is a different procedure entirely to a missed approach procedure. Pilots issued with "break-out" instructions are in a situation of minimal lateral separation with another aircraft with little or no advance warning of impending break-out, therefore time is critical. To obtain the quickest response, all "break-out" procedures must be hand flown. Pilots will be given instructions on break out that will not conform to a standard track or level. Pilots will be instructed to turn, climb, or descend immediately to routes and levels that maintain traffic and terrain clearance. In unusual circumstances, descending break-out instructions may be given but this will not be an altitude below the minimum vectoring altitude (MVA).
- h) *Controller training.* Prior to being assigned monitoring duties, air traffic controllers must receive training, including instruction in the specific duties required of a monitoring radar controller.
- i) *Airborne collision avoidance system (ACAS).* Unnecessary missed approaches could occur as a result of "nuisance" ACAS resolution advisories (RAs). Accordingly, procedure pairs intended for simultaneous use should minimize nuisance alerting with track, speed, and altitude designs that will not induce an RA during normal operations. If no design solution is possible, the use of "traffic advisory (TA) only" mode during parallel approach operations could be recommended and indicated on the published approach charts.
- j) *Transponder failure.* ATS surveillance systems used for independent approaches to closely spaced parallel instrument runways (SSRs and PRMs) are dependent on the aircraft transponder for detection and display of aircraft to the monitoring radar controller. If an aircraft without an operating transponder arrives at an aerodrome, ATC will create a gap in the arrival flow so that the aircraft will not require monitoring. If an aircraft transponder fails during an instrument approach, the monitoring radar controller will instruct any adjacent aircraft to break out.
- k) *Awareness that approach charts issued specifically for closely spaced independent approaches may contain additional notation.* The charts showing instrument approach procedures to closely spaced runways used for simultaneous parallel instrument operations may indicate such operations, particularly using the term "closely spaced parallel runways", when identifying any unique requirements that exist specifically for SOIR operations.
- l) In addition, a location-specific "attention all users page" (AAUP) or a similar publication containing appropriate information should be included, for example:
 - 1) General piloting procedures for operating when closely spaced independent approaches are in use;
 - 2) Specific requirements of the particular approach;
 - 3) Navigation and communication requirements;
 - 4) Break-out phraseology; and
 - 5) Requirement to follow TCAS RA climb/descent.

- m) *Missed approach*: Consideration should be given to the designated navigation aid providing lateral guidance in the missed approach; the availability of the navigation aid(s) (NAVAID(s)) and the sensor equipment on the aircraft required for safe extraction;
- n) *Unnecessary break outs*. An unnecessary break-out is a situation in which the monitoring controller initiates a break out and the deviating aircraft subsequently remains in the NOZ. The number of alerts, both true and false, should be monitored as a method of assessing the performance of the alerting mechanism. It may be necessary to amend the parameters of the alerting mechanism if too many false alerts are experienced;
- o) *Flight path management and related crew workload*. Pilot workload and error assessment should take into account such things as manual input requirements, pilot training, database applicability, etc.;
- p) *Common mode failure*. Where ADS-B implementation envisages reliance upon a common source for surveillance and/or navigation, an assessment should take account of adequate contingency measures to mitigate the risk of either degradation or loss of this common source;
- q) *Airspace complexity*. Airspace should be designed to fully protect the instrument flight procedures associated with parallel runway operations in controlled airspace including space for vectoring when required. The class of airspace should be determined by analysing the existing and proposed mix of traffic. The proximity to other aerodromes and controlled airspace should be considered, e.g. location of adjacent aerodromes and their arrival and departure flows, integration of terminal and en-route operations, and strategic deconfliction of the traffic flows to reduce pilot and controller workload; and
- r) *Airport configuration*. Where possible, aerodromes considering closely spaced parallel runway operations should consider runway occupancy times and reduce runway crossings as much as possible. Protection of the ILS sensitivity and critical area is extremely important during parallel approach operations based on ILS performance. Where the ILS critical area cannot be protected, alternative types of parallel approach operation should be considered.

2.2.4 Safety-related issues affecting the use of a single monitoring controller during parallel independent instrument runways

2.2.4.1 During simultaneous independent approach operations, participating aircraft are established on guidance to instrument approach procedures that have been designed to not interfere with one another. By remaining on their guidance, the aircraft are, by design, not threats to each other and are considered separated. If either aircraft deviates from its lateral path, defined by its assigned instrument approach, separation is no longer assured. To protect against operational errors, system or equipment failures, etc., SOIR procedures require air traffic controller monitoring to provide intervention as necessary. Air traffic controllers are required to identify and respond to such traffic transgressions in a timely manner to protect proximate traffic and minimize collision risk. Their responsibility is to recognize a deviation from a cleared lateral path, determine a manoeuvre for any nearby traffic that might be threatened by this deviation that will avoid a collision, and transmit this manoeuvre instruction to the threatened aircraft. If there is no threatened traffic, or after the threatened traffic has begun its escape manoeuvre, the controller will also attempt to instruct the deviating aircraft.

2.2.4.2 The time budgeted for controller recognition of potential collision during non-nominal events in simultaneous parallel approaches is in the order of seconds. Controller alerting that can differentiate quickly and accurately between normal and non-nominal situations will be an enabling element of the operation. A region known as NTZ is used to provide ATC time to identify that one aircraft on a simultaneous approach may threaten the other, and to then take appropriate action to avoid a collision. Normally, a dedicated monitor controller is assigned to each approach during simultaneous operations. However, since a single NTZ is defined in the space between simultaneous approaches,

it may be possible for a single controller to effectively monitor and correct any transgressing aircraft. Approval of an alternate to the otherwise-required approach-specific monitor control positions should consider, as a minimum, the following elements unique to a specific approach pairing:

- a) approach geometry complexity:
 - 1) displaced thresholds which cause non-coincident altitudes along the parallel tracks;
 - 2) use of curved course transitions to final; and
 - 3) short finals.
- b) traffic mix and density:
 - 1) mix of light-heavy traffic necessitating varying longitudinal wake spacing; and
 - 2) approach speed variations.
- c) arrival rate and density:
 - 1) total traffic volume vs. approach capacity; and
 - 2) flow management consistency with traffic demand.
- d) available levels of system automation:
 - 1) conformance monitoring tools; and
 - 2) non transgression alerting.
- e) availability of back-up systems to provide continuity of:
 - 1) communication;
 - 2) approach navigation (approach technology);
 - 3) surveillance (independent, redundant sources); and
 - 4) interdependency of communications, navigation, and surveillance (CNS).
- f) the impacts of local meteorological conditions and other environmental factors:
 - 1) inversion on final that can cause wake vortices to not dissipate;
 - 2) excessive tailwind;
 - 3) high x-winds;
 - 4) gusty winds; and
 - 5) inconsistent wind patterns (e.g. caused by nearby obstacles or terrain).

2.2.5 Established on RNP AR APCH

2.2.5.1 Established on RNP AR APCH is an operation for simultaneous approaches that considers aircraft conducting an RNP AR APCH procedure eligible for SOIR. More details of the operation are available in Appendix A — Established on RNP AR APCH. Additional considerations for the design of the approach procedures can be found in the ICAO *Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual* (Doc 9905) and Appendix B — Examples of Established on RNP AR Approaches. The procedure is similar to the laterally based separation afforded in the parallel final segments of all SOIR operations.

2.2.5.2 An aircraft conducting an RNP AR APCH procedure (designed to criteria in 2.2.1.5) is considered eligible for SOIR when established after the IAF/IF provided that:

- the aircraft confirms that it is established on the RNP AR APCH procedure prior to a designated point, the location of such point to be determined by the appropriate ATS authority;
- the designated point is positioned on the RNP AR APCH to ensure the applicable horizontal separation minimum (e.g. 5.6 km (3 NM)) from the adjacent approach procedure (Figure 2-4 refers). The designated point may normally be coincident with the IAF/IF; and
- the designated point is readily apparent to the approach and monitoring controllers. The designated point may be depicted on the situation display.

2.2.5.3 Application of appropriate wake turbulence separation is required between aircraft on the same approach.

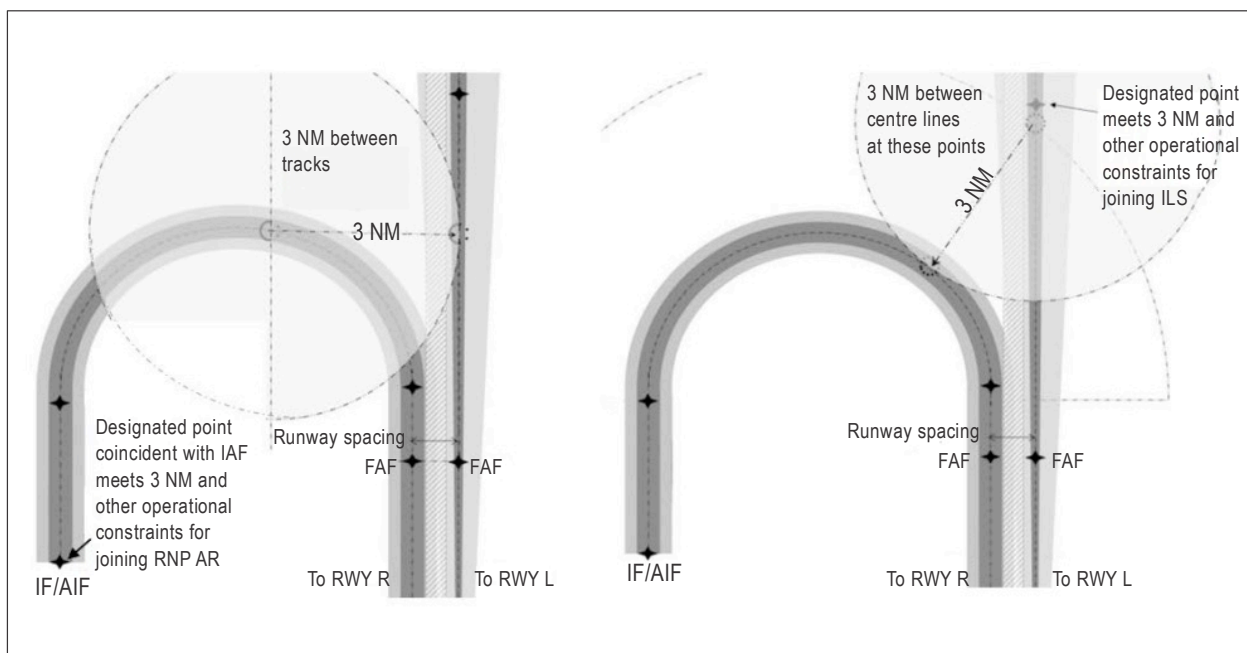


Figure 2-4. Established on RNP AR APCH Concept (RNP AR APCH/Precision approach with 3 NM separation minimum example)

2.2.5.4 If, after 'established' on the RNP AR APCH procedure, the aircraft is unable to execute the procedure, the pilot is required to notify the controller immediately with a proposed course of action and thereafter follow ATC instructions (e.g. break-out procedure).

2.2.5.5 In circumstances where a break-out procedure becomes necessary during the application of the independent parallel approach procedure (for example an aircraft penetrating the NTZ), the monitoring controller may issue climb and/or heading instructions to an aircraft established on an RNP AR APCH.

2.2.5.6 An obstacle assessment is required to support the break-out instructions. Guidance on obstacle assessment is provided in 2.2.3 f) and Doc 8168, *Procedures for Air Navigation Services — Aircraft Operations, Volume II, Part III*.

2.2.5.7 Break-out procedures are required to be prescribed in the AIP and local instructions.

2.2.5.8 The monitoring controller is required to protect the NTZ in accordance with 2.2.1.3 e).

2.3 DEPENDENT PARALLEL INSTRUMENT APPROACHES (MODE 2)

2.3.1 General

2.3.1.1 If the spacing between runway centre lines is not adequate (refer to Table 2-1) for independent parallel approaches, a dependent approach procedure may be used when the runways are spaced by 915 m (3 000 ft) or more (see Annex 14, Volume I). During dependent operations, controller monitoring requirements are eased compared to the requirements for independent parallel approaches. The operation requires a specified ATS surveillance system separation between aircraft on the adjacent approaches, measured diagonally between aircraft. Longitudinal spacing of aircraft on the same approach is consistent with wake separation and flow management requirements.

2.3.1.2 For dependent parallel approaches, the minimum separation between aircraft on adjacent approaches (detailed below) gives an equivalent level of protection which is provided by the NOZ and NTZ for independent parallel approaches. Consequently, dependent parallel approaches can be conducted at closer runway spacing than independent parallel approaches. See the *Procedures for Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444), Chapter 6, 6.7.3.4.

2.3.2 Requirements and procedures

2.3.2.1 Dependent parallel approaches may be conducted to parallel runways provided:

2.3.2.1.1 the runway centre lines are spaced by 915 m (3 000 ft) or more.

2.3.2.1.2 the final approach course or track is intercepted by use of either:

a) vectoring; or

b) a published arrival and approach procedure that intercepts with the IAF or IF.

2.3.2.1.3 An ATS surveillance system with a minimum SSR azimuth accuracy of 0.3 degrees (one sigma) or, for MLAT or ADS-B, a performance capability equivalent to, or better than, the SSR requirement can be demonstrated and an update period of 5 seconds or less is available.

2.3.2.1.4 The instrument approach procedures that align the aircraft with the extended runway centre lines need to be designed to support the operation:

- a) the nominal tracks of adjacent missed approach procedures are required to diverge by at least 30 degrees; and
- b) an obstacle survey and evaluation is completed, as appropriate, for the areas adjacent to the final approach segments.

2.3.2.1.5 Examples of approach types that may be used for parallel runway procedures are shown at Table 2-3.

Table 2-3. Approach Types available for use for Mode 2 operations

<i>Instrument Approach</i>	<i>Can this approach type be used for simultaneous approaches?</i>
ILS	Yes
GLS	Yes
MLS	Yes
SBAS CAT I Applicable in Final Approach Segment	Yes
RNP AR APCH	Yes
RNP AR APCH (non-conforming to 2.3.2.2)	Provided an approach and mitigation-specific, documented safety assessment has shown that an acceptable level of safety can be met, and operations are approved by the appropriate ATS authority.
RNP APCH (LNAV/VNAV) (LPV)	Provided an approach and mitigation-specific, documented safety assessment has shown that an acceptable level of safety can be met, and operations are approved by the appropriate ATS authority.
RNP APCH (LNAV)	No
LOC	No
NDB	No
VOR	No

2.3.2.2 Approaches with segments exclusively designed with either precision approach or RNP AR APCH criteria may be used for parallel dependent approaches provided that for any RNP AR segment, the designated RNP value ensures separation from traffic on a simultaneous approach procedure by not exceeding one quarter of the distance between runway centre lines (see Figure 2-5).

2.3.2.3 APV procedures designed using the RNP APCH navigation specification or procedures using the RNP AR APCH navigation specification that do not meet the provisions in 2.3.2.2 may be used for dependent parallel approaches, provided that:

- a) a documented safety assessment has shown that an acceptable level of safety can be met. The safety demonstration is required to consider: the collision risk from normal and residual (not mitigated) atypical errors; the likelihood of ACAS nuisance alerting during normal operations; wake hazard; available levels of system automation; data base management; flight management system input and related crew workload; impacts of meteorological conditions and other environmental factors; missed approach guidance, training, and published ATC break-out procedures; and
- b) operations and the safety assessment are approved by the appropriate ATS authority.

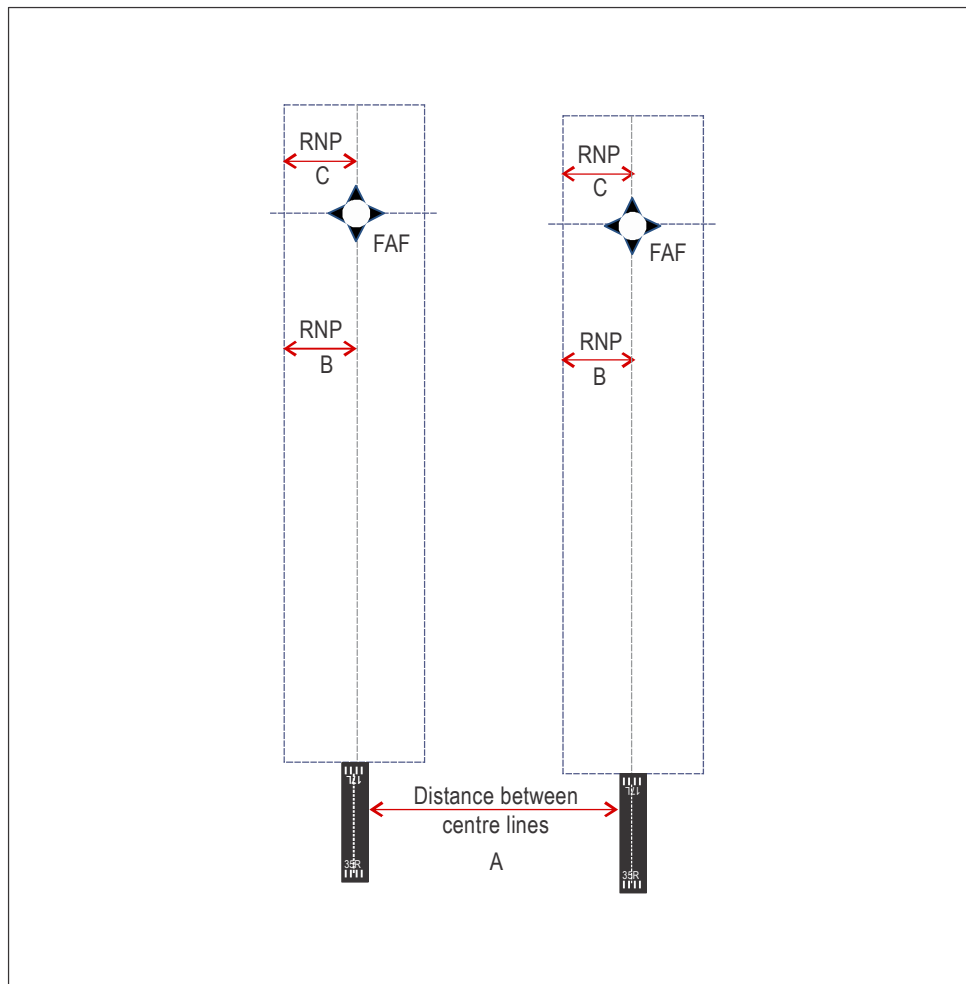


Figure 2-5. RNP Values and Distance Between Centre Lines

2.3.2.4 ATC is required to advise the aircraft approaches to both runways are in use; this information may be provided through the ATIS for dependent parallel approaches.

2.3.2.5 The communications system must enable the approach control unit to override transmissions of the aerodrome control unit.

2.3.2.6 The minimum horizontal separation to be provided between aircraft established on the same final approach course or track is to be 5.6 km (3.0 NM) or 4.6 km (2.5 NM) as prescribed by the appropriate ATS authority unless increased longitudinal separation is required due to wake turbulence. See Procedures for *Air Navigation Services — Air Traffic Management* (PANS-ATM, Doc 4444) Chapter 8, 8.7.3.2 and 8.7.3.4 for wake separation.

2.3.2.7 The minimum horizontal separation to be provided diagonally between successive aircraft on adjacent final approach courses or tracks is required to be:

- a) 3.7 km (2.0 NM) between successive aircraft on adjacent final approach courses or tracks more than 2 529 m (8 300 ft) apart (Figure 2-6); or
- b) 2.8 km (1.5 NM) between successive aircraft on adjacent final approach courses or tracks more than 1 097 m (3 600 ft) but not more than 2 529 m (8 300 ft) apart. (Figure 2-7); or
- c) 1.9 km (1.0 NM) between successive aircraft on adjacent final approach courses or tracks more than 915 m (3 000 ft) but not more than 1 097 m (3 600 ft) apart. (Figure 2-8).

Note.— The geometry of closer runway spacings creates more longitudinal spacing for a given diagonal spacing between aircraft. As the distance between centre lines decreases, the minimum required diagonal spacing also decreases because it can provide a sufficient miss-distance between a deviating or “blundering” leading aircraft to the aircraft in-trail. Figures 2-6 to 2-8 depict these spacings and the resultant relative trailing position of aircraft on the parallel approach.

2.3.2.8 A minimum of 300 m (1 000 ft) vertical separation or a minimum of 5.6 km (3.0 NM) horizontal separation is required to be provided using an appropriate ATS surveillance system until aircraft are established inbound on the final approach course or track. In the application of vertical separation, this creates a “high side” and a “low side” until they are both established inbound on their respective instrument approach procedures. Separation can then be reduced once the aircraft are ensured to be at, or greater than, the minimum diagonal spacing.

2.3.2.9 The low-side altitude should be such that the aircraft will be established on the final approach course or track well before glide path or vertical path interception (see low side, Figure 2-9).

2.4 DIFFERENCES BETWEEN INDEPENDENT AND DEPENDENT PARALLEL APPROACHES

2.4.1 The primary difference between the simultaneous parallel approach operations is the application of a NTZ for independent parallel approaches and the application of a longitudinal stagger between adjacent flight paths for dependent parallel approaches. The differences in the concepts and geometries of Mode 1 and Mode 2 have led to differences in the assumptions, and occasionally the methodologies, of the analyses of the two modes of operation.

2.4.2 For dependent parallel approaches, the diagonal separation between the aircraft is significant; although there is a lateral component to this separation, it includes a longitudinal measure. A combination of the ATS surveillance, system range error and longitudinal display errors are, therefore, inputs to the dependent parallel approach analysis. Only the lateral component of the track separation is considered in the case of independent parallel approaches; although a longitudinal component may exist as well, it has not been taken into consideration in the modelling.

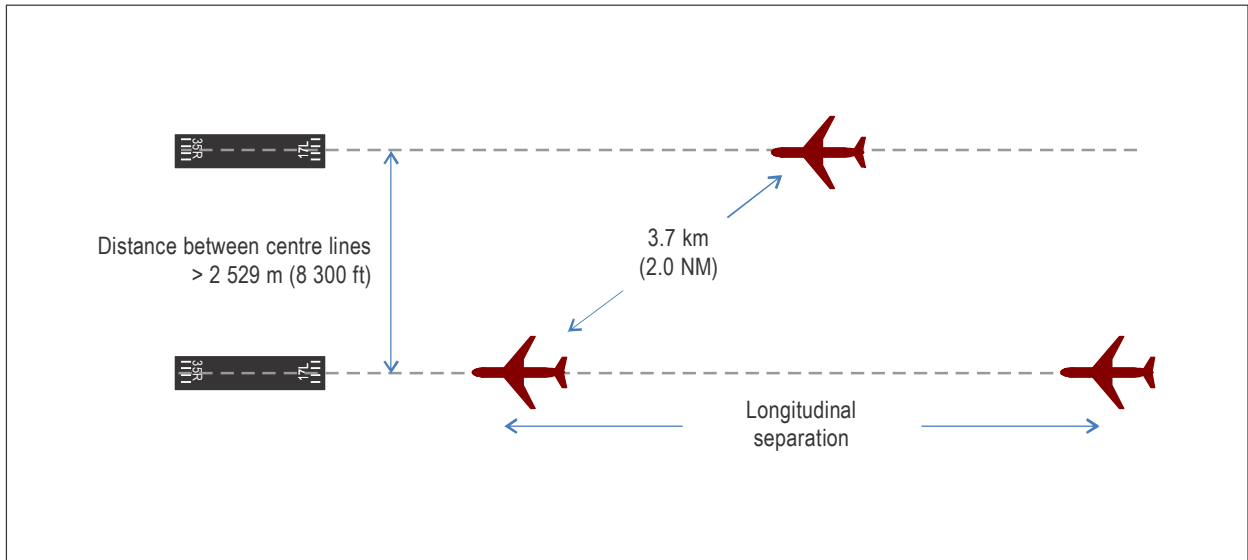


Figure 2-6. Diagonal separation for distance between centre lines greater than 2 529 m (8 300 ft)

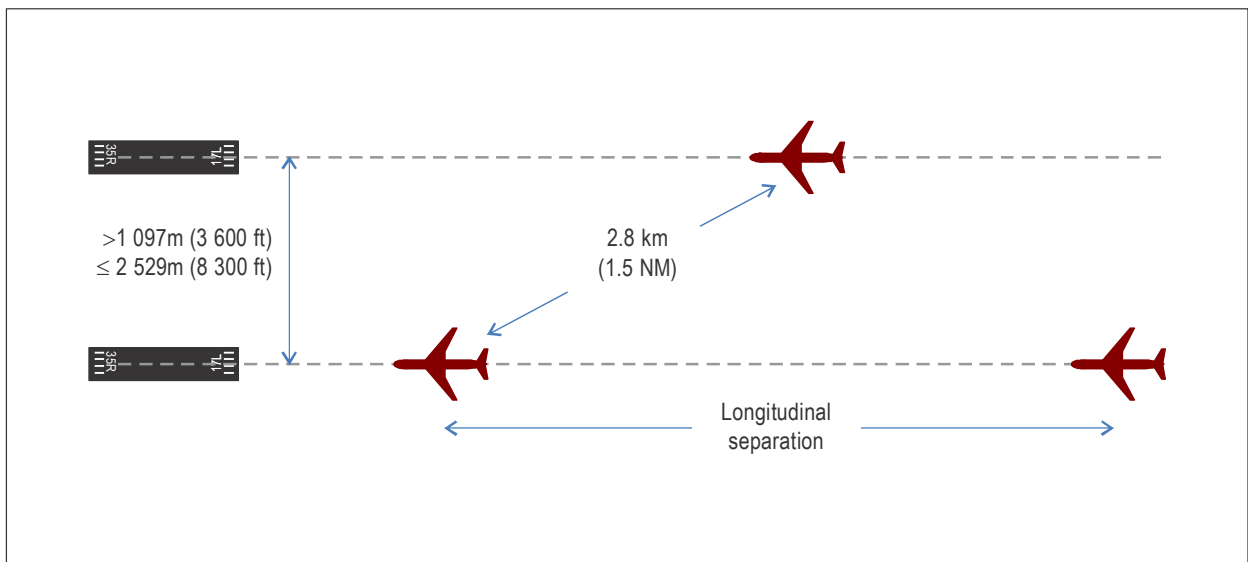


Figure 2-7. Diagonal separation for distance between centre lines greater than 1 097 m (3 600 ft) but less than or equal to 2 529 m (8 300 ft)

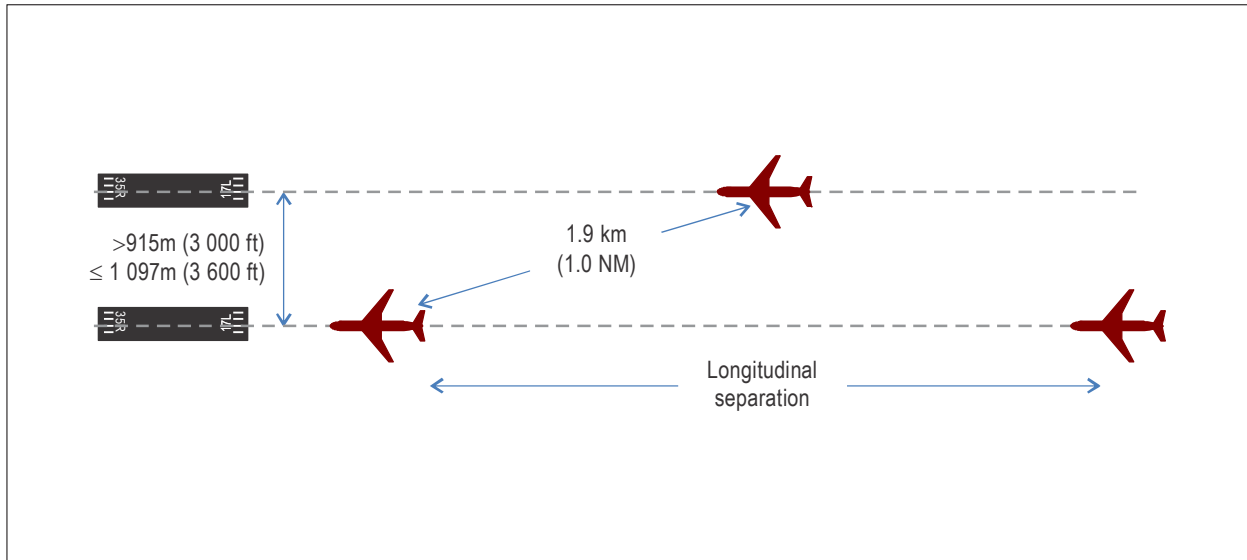


Figure 2-8. Diagonal separation for distance between centre lines greater than 915 m (3 000 ft) but less than or equal to 1 097 m (3 600 ft)

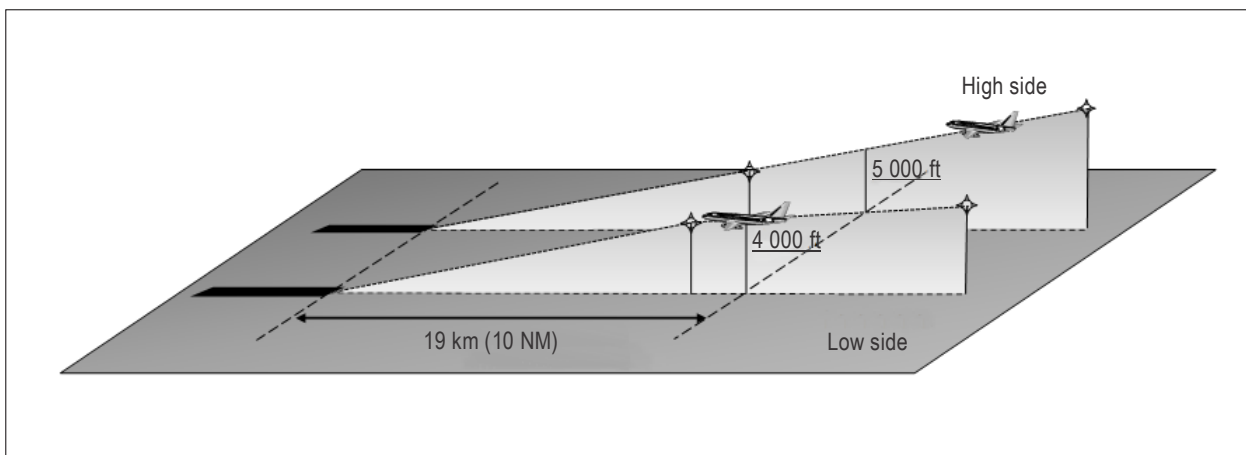


Figure 2-9. High Side/Low Side for Dependent (Mode 2) Approach Operations

2.4.3 Dedicated monitoring is required for independent (but not dependent) parallel approaches. Collision risk modelling presumed that a monitoring controller will detect any penetration of an NTZ immediately. For dependent parallel approaches without separate monitoring controllers, consideration needs to be given to the fact that the approach controller's attention may, at times, be directed elsewhere.

2.4.4 The absence of separate monitoring positions also leads to a difference in the delay times used in the modelling calculations. The evaluation of independent operations assumed that it will take 8 seconds for the monitoring controller to react, coordinate with the other controllers and determine the appropriate resolution manoeuvre, communicate the instructions to achieve separation, and for the pilot and aircraft to respond. For dependent parallel approaches, the modelling assumed that the controller would wait for the next ATS surveillance update to verify that a deviation has actually occurred.

Chapter 3

INDEPENDENT INSTRUMENT DEPARTURES FROM PARALLEL RUNWAYS (MODE 3)

3.1 GENERAL

Parallel runways may be used for independent instrument departures if:

- a) both runways are used exclusively for departures (independent departures); or
- b) one runway is used exclusively for departures, while the other runway is used for a mixture of arrivals and departures (semi-mixed operation); or
- c) both runways are used for mixed arrivals and departures (mixed operation).

3.2 REQUIREMENTS AND PROCEDURES

3.2.1 Procedures for independent instrument departures from parallel runways are contained in the PANS-ATM, Chapter 6, 6.7.2.2. It states that independent IFR departures may be conducted from parallel runways provided:

- a) the runway centre lines are spaced by a minimum distance of 760 m (2 500 ft) (see Annex 14, Volume I); however, when the spacing between two parallel runways is less than the specified value dictated by wake turbulence considerations, the runways are considered as a single runway with regard to separation between departing aircraft. For further detail regarding wake turbulence on departure, refer to Circular 350, *Guidelines for the Implementation of Reduced Divergence Departures*.
- b) the nominal departure tracks diverge by at least (see Figure 3-1):
 - 1) 15 degrees immediately after take-off; or
 - 2) 10 degrees where:
 - i) both aircraft are flying an RNAV or RNP instrument departure; and
 - ii) the turn commences no more than 3.7 km (2.0 NM) from the departure end of the runway;
- c) a suitable ATS surveillance system capable of identifying the aircraft within 1.9 km (1.0 NM) from the end of the runway is available; and
- d) ATS operational procedures ensure that the required track divergence is achieved.

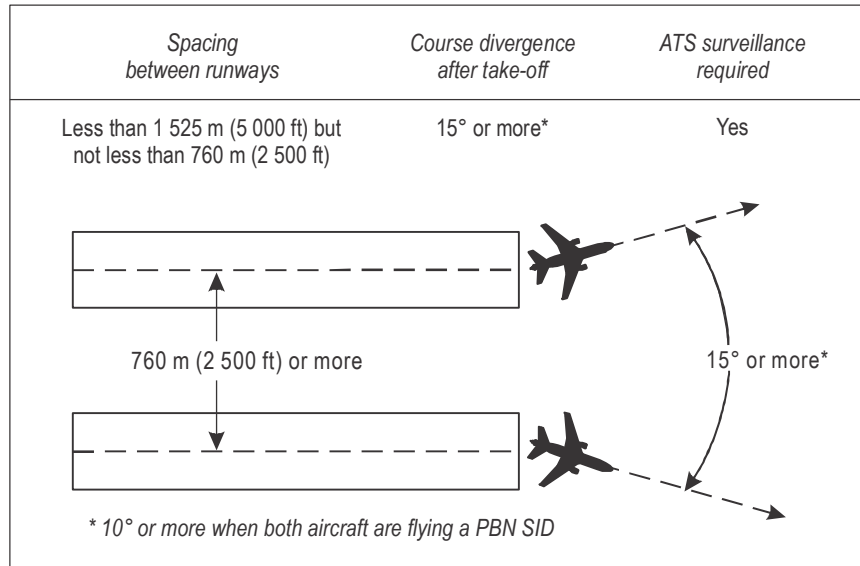


Figure 3-1. Independent instrument departures when parallel runway spacing is less than 1 525 m (5 000 ft) but no less than 760 m (2 500 ft)

3.2.2 There is no requirement, other than satisfactory two-way radio communications, for any other specialized form of control or navigation aid facility for the conduct of independent instrument departures when the spacing between parallel runways is 1 525 m (5 000 ft) or more and a course divergence after take-off of 45 degrees or more can be achieved (see Figure 3-2).

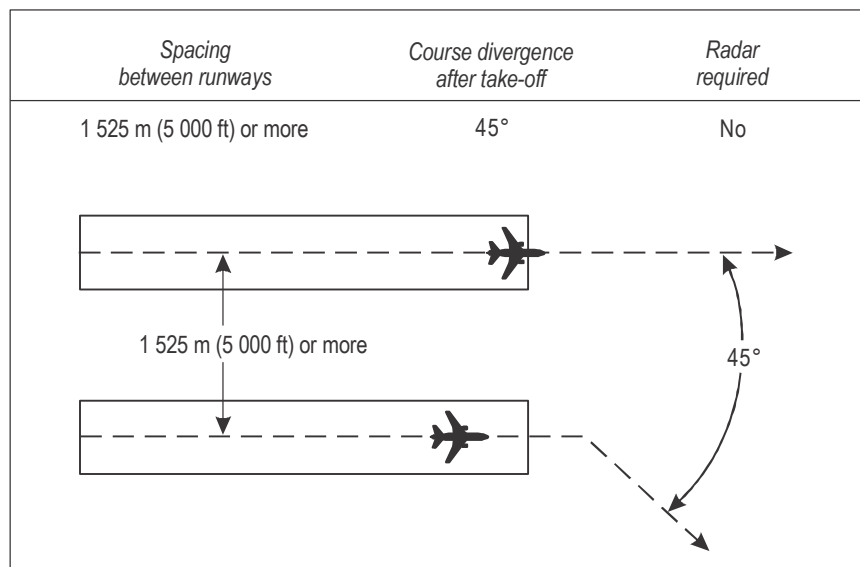


Figure 3-2. Independent instrument departures when parallel runway spacing is 1 525 m (5 000 ft) or more

Chapter 4

SEGREGATED OPERATIONS ON PARALLEL RUNWAYS (MODE 4)

4.1 GENERAL

4.1.1 Theoretical studies and practical examples indicate that maximum aerodrome capacities can be achieved by using parallel runways in a mixed mode of operation. In many cases, however, other factors (such as the landside/airside infrastructure, the mix of aircraft types, and environmental considerations) result in a lower, achievable capacity.

4.1.2 Other factors (such as non-availability of landing aids on one of the parallel runways or restricted runway lengths) may preclude the conducting of mixed operations at a particular aerodrome.

4.1.3 Because of these constraints, maximum aerodrome capacity may, in some cases, only be achieved by adopting a fully segregated mode of operation, i.e. one runway is used exclusively for landings, while the other is used exclusively for departures.

4.1.4 The advantages to be gained from segregated parallel operations, as compared with mixed parallel operations, are:

- a) separate monitoring controllers are not required;
- b) no interaction between arriving and departing aircraft on the same runway and consequential reduction in the number of potential missed approaches;
- c) an overall less complex ATC environment for both radar approach controllers and aerodrome controllers; and
- d) a reduced possibility of pilot error due to selecting the incorrect instrument approach procedure.

4.2 REQUIREMENTS AND PROCEDURES

4.2.1 Segregated parallel operations may be conducted on parallel runways provided:

- a) the runway centre lines are spaced by 760 m (2 500 ft) (see Annex 14, Volume I); and
- b) the nominal departure track diverges immediately after take-off, by at least 30 degrees, from the missed approach track of the adjacent approach.

4.2.2 The following types of approaches clearances may be used in accordance with segregated parallel operations, provided that an ATS surveillance system and the appropriate ground facilities conform to the standard necessary for the specific type of approach:

- a) precision approaches and/or APV (RNP AR APCH and/or RNP APCH);
- b) surveillance radar or precision radar approach; and
- c) visual approach.

4.3 RUNWAY SPACINGS

4.3.1 When parallel runway thresholds are even and the runway centre lines are at least 760 m (2 500 ft) apart, simultaneous operations between an aircraft departing on one runway and an aircraft on final approach to another parallel runway may be authorized if the departure course diverges immediately after take-off by at least 30 degrees from the missed approach track of the adjacent approach until other separation is applied (see Figure 4-1).

4.3.2 The minimum distance between parallel runway centre lines for segregated parallel operations may be decreased by 30 m (98 ft) for each 150 m (500 ft) that the arrival runway is staggered toward the arriving aircraft, to a minimum of 300 m (984 ft) (see Figure 4-2), and should be increased by 30 m (98 ft) for each 150 m (500 ft) that the arrival runway is staggered away from the arriving aircraft (see Figure 4-3).

Note 1.— In the event of a missed approach by a heavy aircraft, wake turbulence separation should be applied or, alternatively, measures taken to ensure that the heavy aircraft does not overtake an aircraft departing from the adjacent parallel runway.

Note 2.— Procedures for segregated parallel operations are contained in the PANS-ATM, Chapter 6, 6.7.3.5, and the PANS-OPS, Volume I, Part VII, Chapter 1.

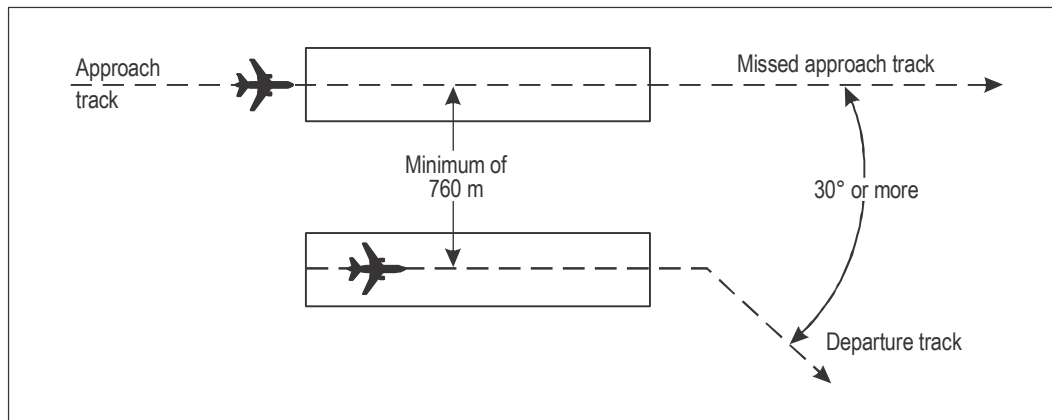


Figure 4-1. Segregated parallel operations where thresholds are even

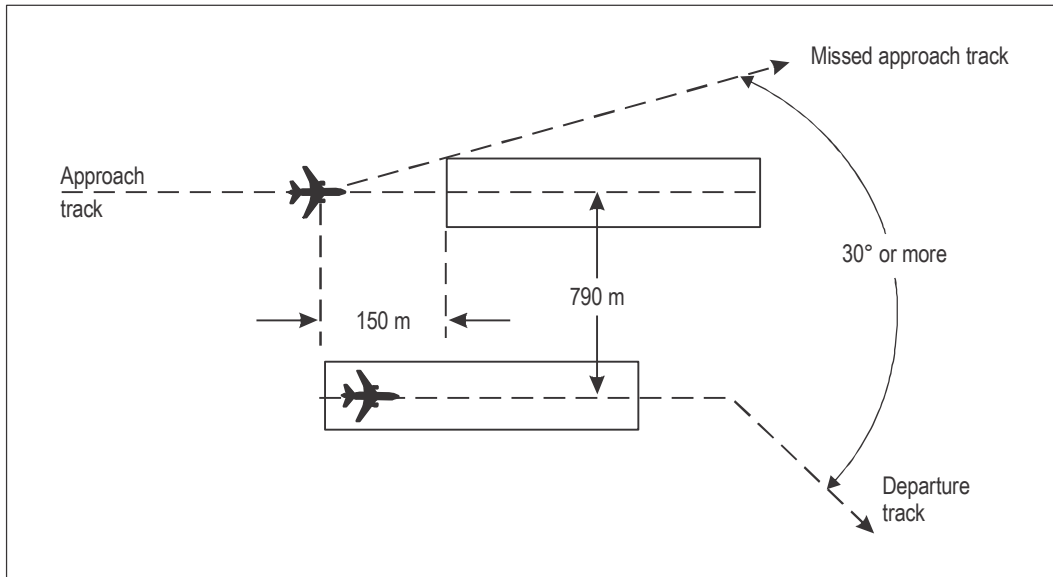


Figure 4-2. Segregated parallel operations where runways are staggered

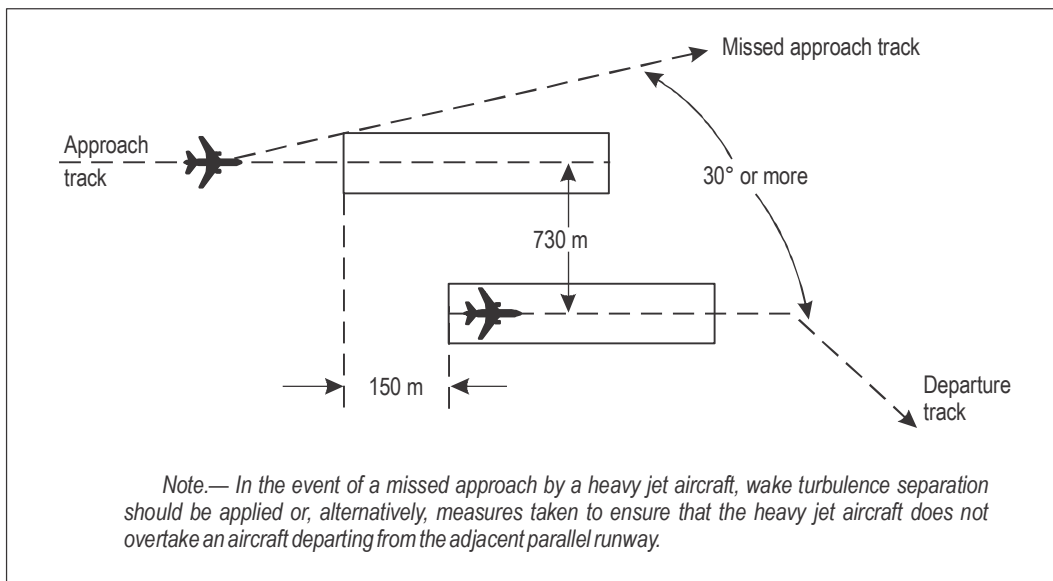


Figure 4-3. Segregated parallel operations where runways are staggered

Chapter 5

NEAR-PARALLEL RUNWAYS

5.1 GENERAL

5.1.1 Near-parallel runways are non-intersecting runways whose extended centre lines have an angle of convergence/divergence of 15 degrees or less.

5.1.2 No special procedures have been developed for simultaneous operations to near-parallel runways. Each situation is considered on a case-by-case basis and is dependent on a number of variable conditions.

5.1.3 The most important factor to be considered in developing procedures for simultaneous operations to near-parallel runways is the point at which the runway centre lines converge. This point depends on the relative position of the two runways (even or staggered) and the angle of convergence.

5.1.4 It is also important to consider whether the two runways are used simultaneously in the converging or diverging direction. In the diverging direction of two near-parallel runways, independent approaches are not possible where there are intersecting approach paths. On the other hand, for independent departure or segregated operations, the diverging direction leads to a natural lateral separation and is acceptable (see Figure 5-1).

5.1.5 The various modes of operation described in the preceding chapters should also be considered for near-parallel runway operations. A study must be made for each mode of operation for each specific aerodrome before such procedures can be implemented.

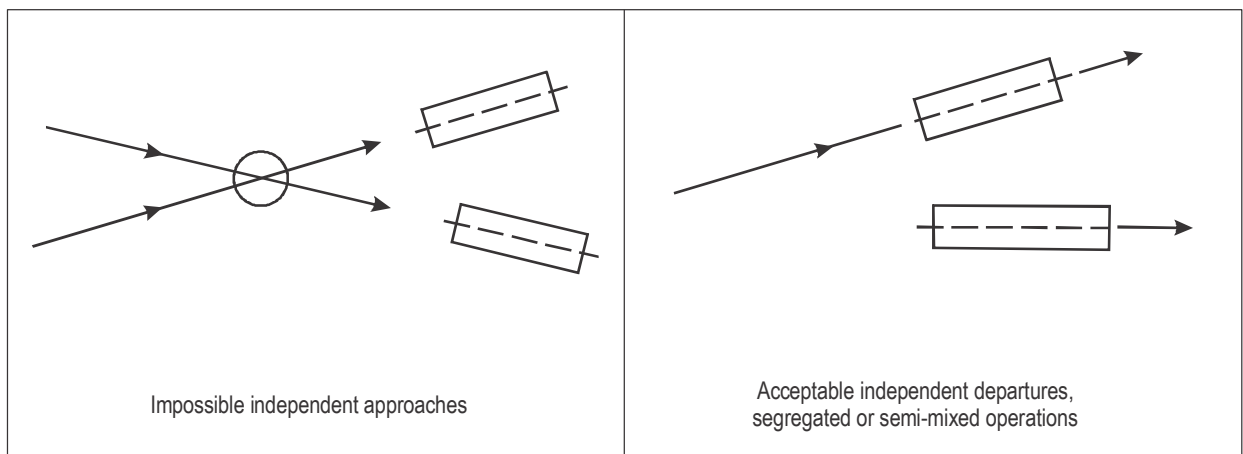


Figure 5-1. Operations on near parallel runways

5.2 GROUND EQUIPMENT

Ground equipment should conform to the standard necessary for the type of approaches conducted at the aerodrome. An ATS surveillance system should be required.

Chapter 6

TRAINING OF ATS PERSONNEL

6.1 GENERAL

6.1.1 Training of ATS personnel is a prerequisite for the introduction of operations on parallel instrument runways. This chapter describes only the additional training that should be given to aerodrome controllers at units where they may be assigned a limited responsibility for separation of IFR flights. In the case of approach controllers, only those additional measures that are specific to simultaneous parallel operations are described.

6.1.2 When parallel approaches are contemplated, the training plan should include training in a simulator so that controllers learn to observe, detect, and react to deviating aircraft situations.

6.1.3 The training should be incorporated into the unit training plan and the required knowledge and skill levels should be satisfactorily demonstrated to the competent authority.

6.1.4 Training should be divided into two categories: training for approach controllers and training for aerodrome controllers.

6.2 TRAINING FOR APPROACH CONTROLLERS

Since approach controllers are already fully qualified in both surveillance and non-surveillance procedures, the only additional training required for them would be:

- a) an explanation of additions and changes to the procedures and agreements between the approach control unit and the aerodrome control tower;
- b) instructions in the application of vertical separation until the aircraft is at least 19 km (10 NM) from the threshold and is within the NOZ established on the approved instrument approach procedure;
- c) instructions in the application of procedures when an aircraft is established on RNP AR APCH in accordance with Appendix A and additional considerations on RNP AR APCH detailed in the *Performance Based Navigation (PBN) Manual* (Doc 9613);
- d) the role and responsibilities of a monitoring controller (including the number of runways to be monitored);
- e) instructions in the monitoring of aircraft on approaches to ensure containment within the NOZ and avoidance of the NTZ;
- f) instructions regarding action to be taken if aircraft stray from their approved instrument approach procedure;

- g) instructions in the procedures to follow in the event of a missed approach; and
- h) appropriate radiotelephony (RTF) phraseology.

6.3 TRAINING FOR AERODROME CONTROLLERS

Aerodrome controllers at aerodromes where simultaneous parallel approaches/departures are to be used may provide separation, within prescribed limits, between IFR aircraft. It will therefore be necessary to train them in some or all of the following areas:

- a) basic ATS surveillance system theory;
 - b) operation, set-up, and alignment of ATS surveillance system equipment in use at the unit;
 - c) identification of aircraft;
 - d) separation minima based on ATS surveillance system and their application;
 - e) provisions regarding terrain clearance;
 - f) provision of vectors and position information, including:
 - 1) when vectors may or shall be used;
 - 2) methods of vectoring aircraft; and
 - 3) termination of vectoring;
 - g) action to be taken in the event of ATS surveillance system or communications failure, including:
 - 1) air-ground communication failure procedures; and
 - 2) procedures for communications failure during vectoring;
 - h) action to be taken and instructions to be issued in the event of a missed approach;
 - i) action to be taken and instructions to be issued in the event of a break-out procedure for aircraft conducting RNP AR APCH;
 - j) consideration of possible wake turbulence affects during approaches to parallel runways as a result of crosswind;
 - k) the terms, procedures, and agreements (and their application) between the approach control unit and the aerodrome control tower. In particular, they should know the provisions governing the release of successive IFR departures (where authorized) and the release of independent parallel departures with reference to arriving aircraft (including those carrying out missed approaches); and
 - l) appropriate RTF phraseology.
-

Chapter 7

IMPLEMENTATION

7.1 TRIALS

7.1.1 A decision to implement independent or dependent operations on parallel or near-parallel instrument runways should only be taken after a trial and familiarization period, during which it has been satisfactorily proven that all the elements, such as ground equipment, personnel qualifications, and ATC procedures, are properly integrated in the overall system.

7.1.2 The trials should be monitored by a group that should include ATS experts, representatives of operators, and aerodrome authorities. The trial period should cover a sufficient number of approaches in various conditions so that the monitoring group can evaluate the level of risk of inadvertent intrusion of the NTZ by an aircraft and the capability of ATC to react adequately to such a situation. For example, the trial period should include a number of operations in adverse wind conditions in order to assess the ability of the ATC personnel to cope with deviations. The trials should also determine the ability of the ATC personnel to establish and maintain the required ATS surveillance system separation while monitoring the operations in various weather conditions.

7.1.3 It is advisable during the trial period to specify weather conditions allowed in the first stage of the trial so that the “see-and-avoid” principle can be applied by the pilot. These weather conditions should then be cautiously and progressively reduced as the trials progress satisfactorily.

7.2 IMPLEMENTATION

7.2.1 Before implementing operations on parallel instrument runways, it should be ensured that:

- a) the runways concerned are suitably equipped;
- b) the procedures appropriate to such operations have been determined and tested; and
- c) the local ATC units are suitably equipped and personnel are properly trained.

7.2.2 The procedure should be promulgated by the aeronautical information regulation and control (AIRAC) system, giving a notice of 56 days, and should contain the following elements:

- a) runways involved, with their respective approach characteristics (frequency, identification, category);
- b) a general description of runway usage;
- c) periods of availability;
- d) special status (e.g. on trial, with weather limitations), if any;

- e) description of the NOZ and the NTZ (independent parallel approaches only);
- f) airborne equipment requirements; and
- g) description of the procedures, including ATS surveillance monitoring, missed approach procedure, missed approach NAVAID for RNP APCH operations, and advisory and corrective ATC actions vis-à-vis one or both aircraft when an aircraft is observed leaving the final approach course or track, or approaching the edge of the NOZ, or penetrating the NTZ.

7.2.3 The appropriate ATS authority should provide information and guidance for pilots relevant to the selected mode(s) of operation associated with the use of parallel and near-parallel instrument runways. Following the trials, information on the modes of simultaneous operation selected should be included in the Aeronautical Information Publication (AIP).

7.2.4 Instrument approach charts for a runway where simultaneous independent or dependent parallel approaches are permitted should contain a note indicating clearly the runways involved and whether they are “closely spaced” parallel runways.

7.2.5 ATIS broadcasts should include the fact that independent parallel approaches or independent parallel departures are in progress, specifying the runways involved.

7.2.6 For independent parallel approaches, particular emphasis is to be placed on the levels of the glide path or vertical path interception (“high side” and “low side”) and on the requirement to maintain these levels until the aircraft is established on both the final approach course (or track) and glide path (or vertical path). For the application of Established on RNP AR APCH, see Appendix A for limitations and considerations; additional information on RNP AR APCH is detailed in the *Performance Based Navigation (PBN) Manual* (Doc 9613).

Appendix A

ESTABLISHED ON RNP AR APCH

1. GENERAL

1.1 *Established on RNP AR APCH* is a procedure for simultaneous parallel independent approach that takes advantage of benefits of RNP AR. The operation considers aircraft stabilized on an RNP AR APCH to be similarly established to aircraft flying an ILS for the purpose of simultaneous parallel approach separation. Vertical separation in accordance with the requirements of paragraphs 2.2.1.10 and 2.2.1.11 is not required between an aircraft “Established” on a RNP AR APCH after a nominated point, or “gate”, on a qualified RNP AR approach procedure and an aircraft established on the approach course or track to an adjacent parallel runway. See Figure A-1.

1.2 This procedure provides an alternate means to separate aircraft during the turn to final approach phase of simultaneous independent parallel approach operations. Other requirements for simultaneous independent parallel approaches will continue to apply, including the monitoring requirements detailed in 2.2.1.3 e).

1.3 Established on RNP AR APCH can provide substantial flexibility in the design of simultaneous approach operations. Many RNP designs will provide shorter track miles and optimized descent profiles compared to traditional SOIR, resulting in increased operational efficiency whilst providing environmental benefits such as a reduction in noise and greenhouse gas emissions.

1.4 Use of the procedure can enhance safety for close proximity parallel runway operations as a result of a significant reduction in the exposure time where both aircraft are “side by side”, e.g. at the same altitude on final approach. In addition, the procedure should enable earlier aircraft approach stabilization.

2. OPERATIONS

2.1 RNP AR APCH aircraft will descend optimally via a STAR/transition that connects to the RNP AR APCH approach procedure at either an IAF or an IF, though they could be vectored to join the RNP AR APCH procedure. It is necessary to give the approach clearance, via STAR or vectors, in sufficient time to allow the pilot of the aircraft to prepare for the approach procedure. When the approach is executed, the FMS will provide navigation inputs to the flight director or auto-pilot to enable precise lateral and vertical path tracking per the operator’s RNP AR authorization approval.

2.2 Figure A-2 shows a theoretical “Established on RNP AR APCH” environment, with a published RNP AR APCH instrument procedure to runway “R” extending from the IAF on the downwind, through one or more curved radius-to-fix (RF) legs, to a course-aligned final segment. In this example, a precision approach procedure is established to the adjacent parallel runway “L”. An RNP AR APCH aircraft may transition to the RNP AR APCH procedure by flying a published standard terminal arrival route or via vectors. An aircraft on approach to the adjacent runway will transition to the precision approach final course by vectoring, or a published arrival and approach procedure.

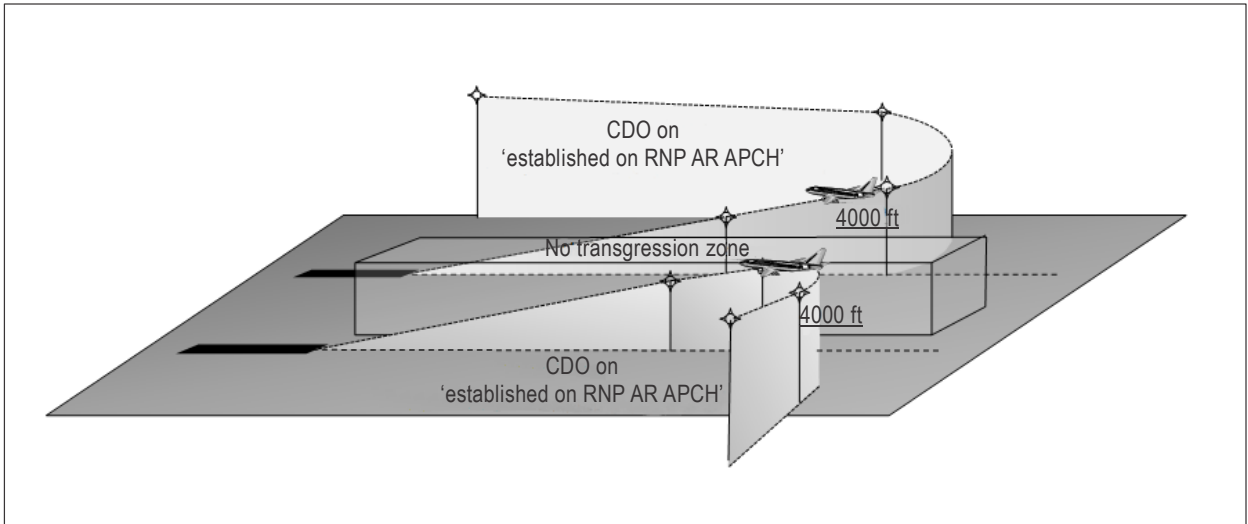


Figure A-1. Lateral separation provided by RNP AR procedures during simultaneous operations

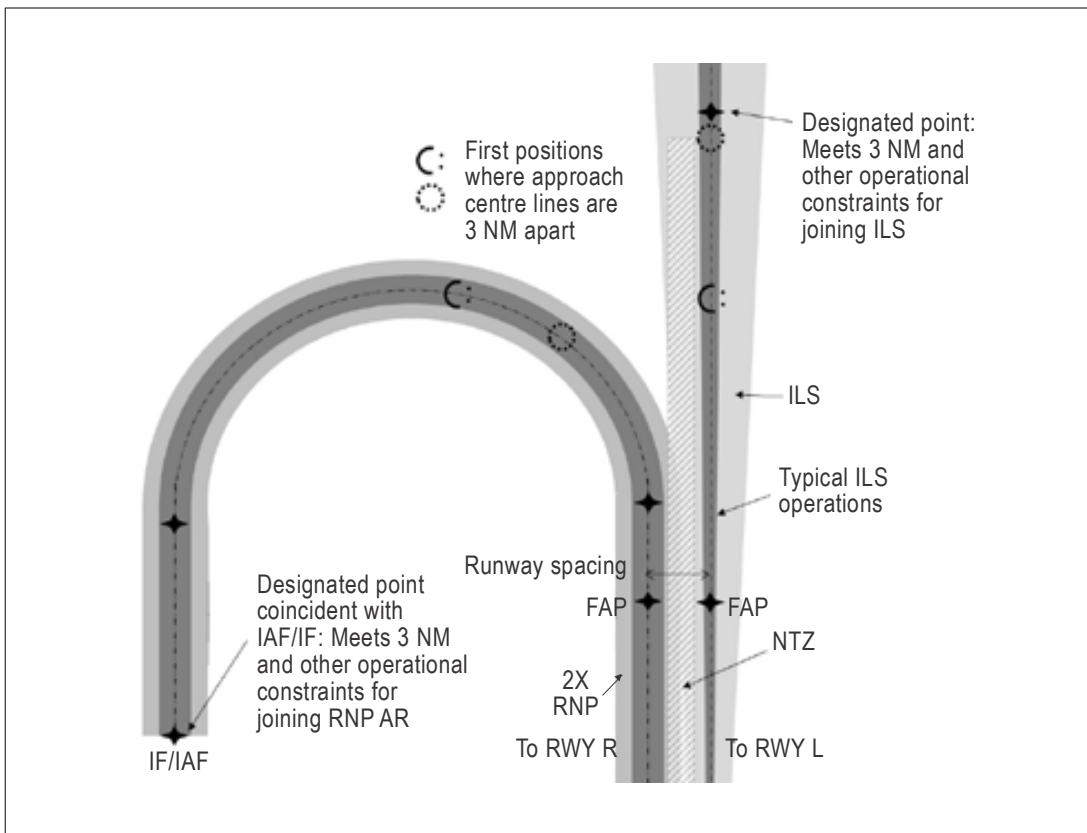


Figure A-2. Theoretical 'Established on RNP AR APCH' Environment

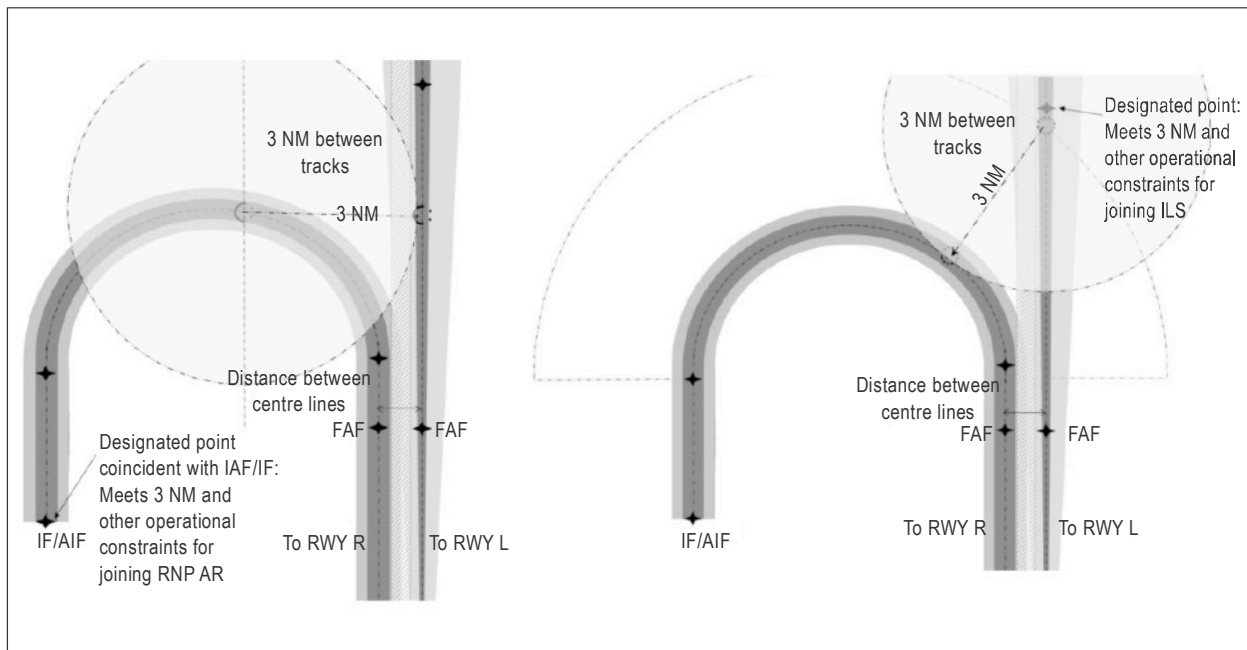
2.3 The procedure geometry enables the aircraft to maintain either 5.6 km (3 NM) lateral or 300 m (1 000 ft) vertical separation while transitioning on the STARS/transitions or vectors, prior to both being established on their respective instrument approach procedures prior to designated points. Figure A-2 shows the RNP AR APCH path an aircraft would fly on the approach to runway R in relation to an aircraft on the straight-in precision approach course to runway "L".

3. DESIGNATED POINT

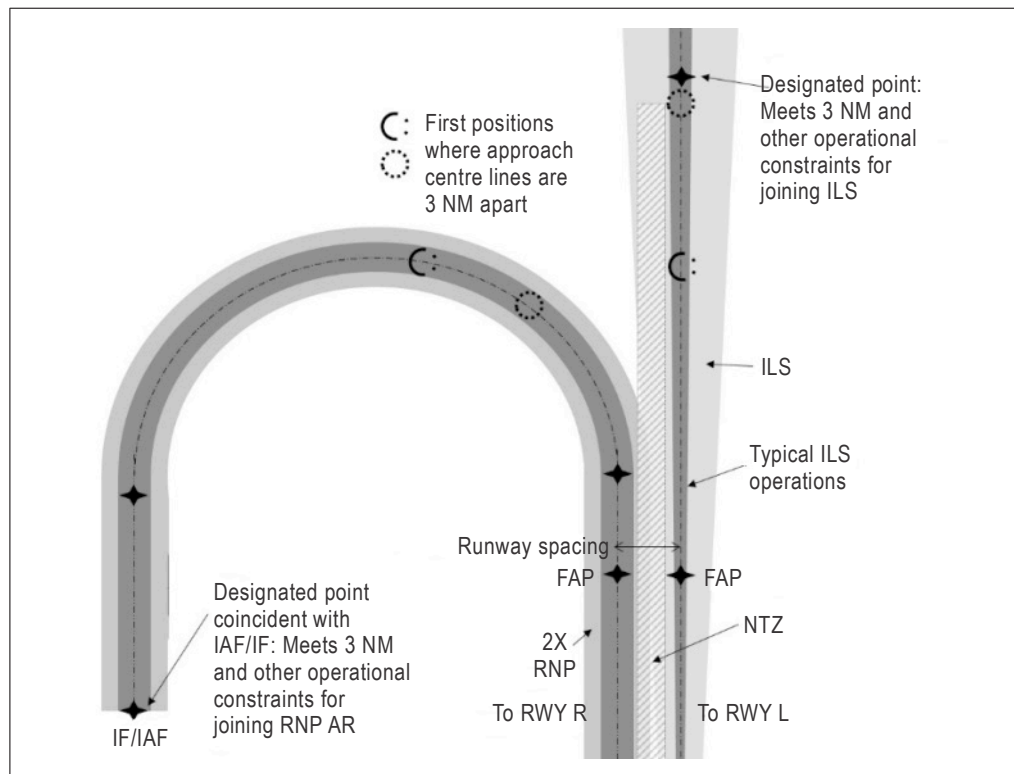
3.1 The aircraft is required to be established on their respective approach procedures before discontinuing 5.6 km (3 NM) surveillance separation which implies a specific point or designated point on each procedure. Designated points are defined to ensure 3 NM lateral separation physically between the procedures in the procedure design and safety validation process. Once a flight continues on the procedures beyond the designated points, there is no geometric guarantee of 3 NM lateral separation. Thus, aircraft must be established on their approach guidance to ensure safe separation beyond these points when traffic is operating simultaneously during Established on RNP AR.

3.2 The designated point is required to be visually displayed to the controller. It may be identified by a waypoint or other symbol/hash on their traffic display or map.

3.3 To show where these designated points might be placed, Figure A-3 shows the edge of 5.6 km (3 NM) boundaries from their respective centre lines. If a circle were to follow an aircraft progressing on its procedure during a simultaneous approach operation, this circle will trace a 5.6 km (3 NM) arc on either side of centre line as shown. This boundary will eventually intersect with the centre line of the other approach, identifying where on both procedures 5.6 km (3 NM) separation is no longer applicable. If the approach procedures are not symmetrical, as shown in the figures, a circle tracing along the other centre line can create different 5.6 km (3 NM) intercept points dependent on which aircraft leads the other. These intersections will define the points by which, at the very latest, an alternative form of separation must be achieved and identify the concept of designated points. See Figure A-4.



**Figure A-3. Established on RNP AR APCH' Concept
(RNP AR APCH/Precision approach with 3 NM Separation minimum example)**



**Figure A-4. Established on RNP AR APCH' Concept
(RNP AR APCH/Precision approach example) – 'Designated Point' Principle**

3.4 Additional considerations for the approach intercept point include the designated point, stabilization distances, and other rules related to vectoring for approach procedures. An upstream waypoint or intersection that meets all criteria should be identified.

3.5 The RNP AR APCH aircraft is to be established on the procedure prior to a designated point on the procedure.

3.6 From the designated point, the aircraft will follow the published lateral and vertical path of the procedure. The aircraft on the adjacent precision approach procedure is also required to be established on a published procedure prior to a designated point (Figures A-4 and A-5).

3.7 It should be noted that there may be further operational restrictions on the definition of this designated point. For example, RNP AR operational requirements do not allow for joining a procedure inside a designated IF. In the example shown, the IF location meets the criteria of the 5.6 km (3 NM) designated point, and therefore can be used as a connecting point to the arrival airspace.

3.8 Figure A-5 illustrates a set of RNP AR approaches that could utilize Established on RNP AR APCH. The designated points define the points at which vertical or horizontal separation is no longer required, provided that both aircraft are established on their respective approach procedures. Once established, an aircraft will comply with the published vertical profile, and may be descending during the turn to align with the runway. The pilots of RNP AR APCH aircraft have primary responsibility for path conformity, as do pilots flying precision approaches during simultaneous operations.

3.9 Once the aircraft have passed their appropriate designated points, the controller should not intervene to alter the lateral or vertical path of the aircraft, allowing them to follow the published procedure. Similarly, the controller should not provide a clearance direct to any waypoint on the procedure past the “Designated Point”. These control restrictions are consistent with required practice when managing aircraft on RNP AR procedures (see PBN Manual, Doc 9613).

3.10 When both aircraft are established on their respective approach procedure/operation, vertical or horizontal separation can be discontinued and simultaneous operations are invoked.

3.11 For Mode 1 independent use of the procedures, a no transgression zone (NTZ) and monitoring function is required in accordance with Section 2.2.2.

3.12 If, after reporting that it is established on the RNP AR APCH procedure, the aircraft is unable to execute the procedure, the pilot is required to notify the controller immediately with a proposed course of action and thereafter follow ATC instructions (e.g. break-out procedure).

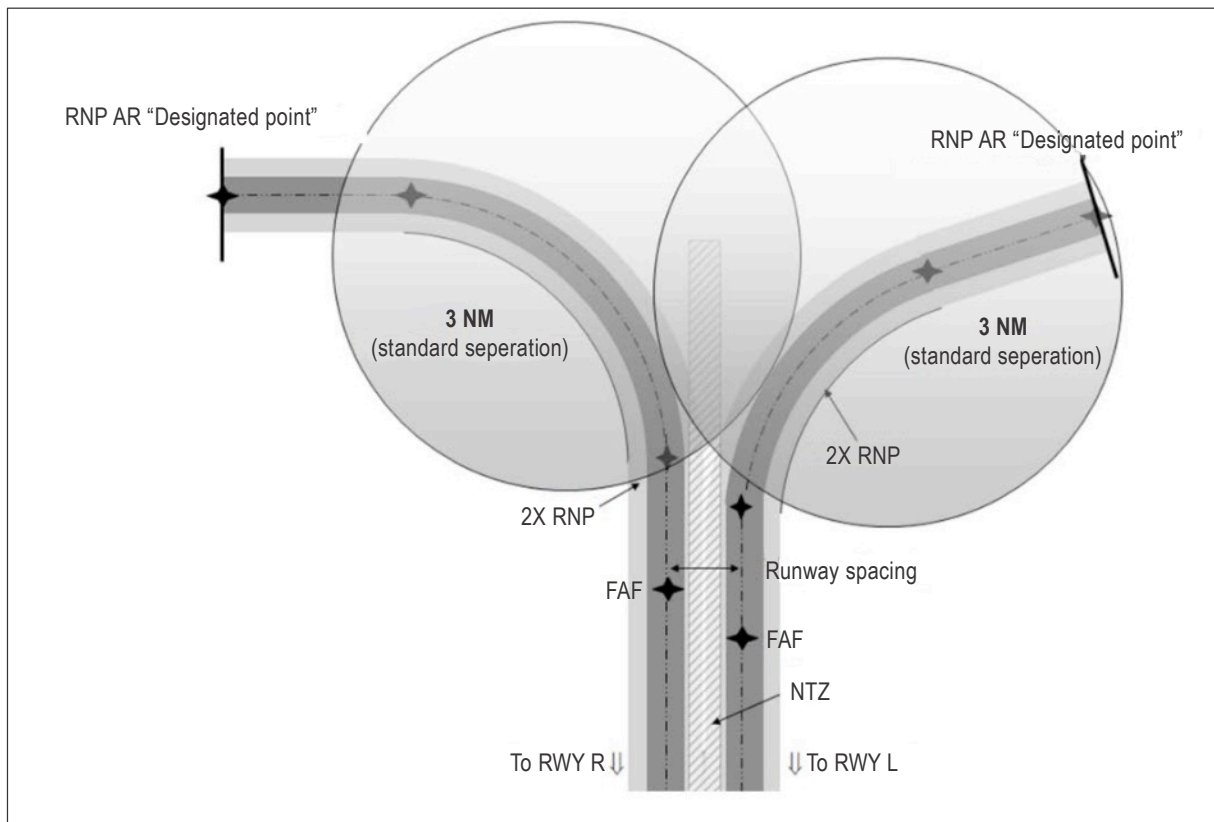


Figure A-5. Established on RNP AR APCH Concept (RNP AR APCH/Precision approach example) — Designated Point Principle

4. APPROACH DESIGN CONSIDERATION SPECIFIC TO SOIR

4.1 RNP AR APCH approaches need to be designed in accordance with ICAO *Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual* (Doc 9905) or other procedure design criteria approved by the appropriate State authority.

4.2 Approach design should ensure nuisance TCAS alerts are not generated. TCAS modelling may be used as part of the design process, and approach tracks altered accordingly.

4.3 An important safety requirement is to mitigate incorrect runway selection. One way of mitigating the hazard of incorrect runway selection is by design.

4.4 There may be several different design mitigations available, dependent on airspace and terrain restrictions, noise considerations, and traffic patterns. Figure A-6 shows a potential design mitigation where the incorrect runway selection will be evident to the controller in a timely manner. Where available, a selective airspace warning filter can also be used to alert the controller. Further mitigation could also be achieved by only publishing RNP AR APCH approach to the “near” runway.



Figure A-6. An example of “wrong runway” mitigation by design

5. ATC AND PILOT PROCEDURES

5.1 The following procedures for Established on RNP AR APCH should be considered and have been included in Section 2.2.5 of this Manual:

5.1.1 The approach clearance is required to be given in sufficient time to allow the pilot of the aircraft to prepare for the approach procedure.

5.1.2 If the controller cannot issue the approach clearance in accordance with 5.1.1, or if there is some difficulty that prevents the pilot from accepting the clearance prior to this point, ATC will need to issue control instructions to vector the aircraft to final with at least 300 m (1 000 ft) vertical separation or 5.6 km (3 NM) lateral separation from aircraft on approach to the other runway, as per 2.2.1.10.

5.1.3 It is necessary for the controller to ensure that an aircraft on the adjacent approach is established on the published approach course or track prior to reaching a designated point or "gate". That "gate" is to be positioned to ensure at least 5.6 km (3 NM) lateral separation from the RNP AR APCH approach procedure and may be depicted on the surveillance display.

5.1.4 Appropriate wake turbulence separation is required to be applied between aircraft on the same approach.

5.1.5 Consideration is to be given by both the pilot and the controller that, due to traffic or other circumstance, a controller may need to issue break-out instructions to an aircraft on an RNP AR APCH procedure in this operation.

5.1.6 To support a break-out instruction, it is necessary for an obstacle assessment to have been completed. In addition, aircrew must be aware that break-out instructions are possible during these simultaneous operations, and that they are required to comply with controller instruction.

5.1.7 A monitoring controller is required to protect the NTZ, in accordance with 2.2.2.

5.1.8 Pilots will brief the approach procedure and configure the aircraft prior to commencing the published procedure. If the pilot is unable to complete the execution of the procedure, the flight crew are required to notify ATC immediately and will execute a missed approach unless instructed otherwise.

Appendix B

EXAMPLES OF ESTABLISHED ON RNP AR APPROACHES

The use of the following examples of approach operations should be applied following the “Established on RNP AR APCH” operation: They show how RNP AR can be used for both the final and intermediate segments of approaches employed while SOIR is in use, and combined with the use of a precision approach final segment, or a complete precision approach.

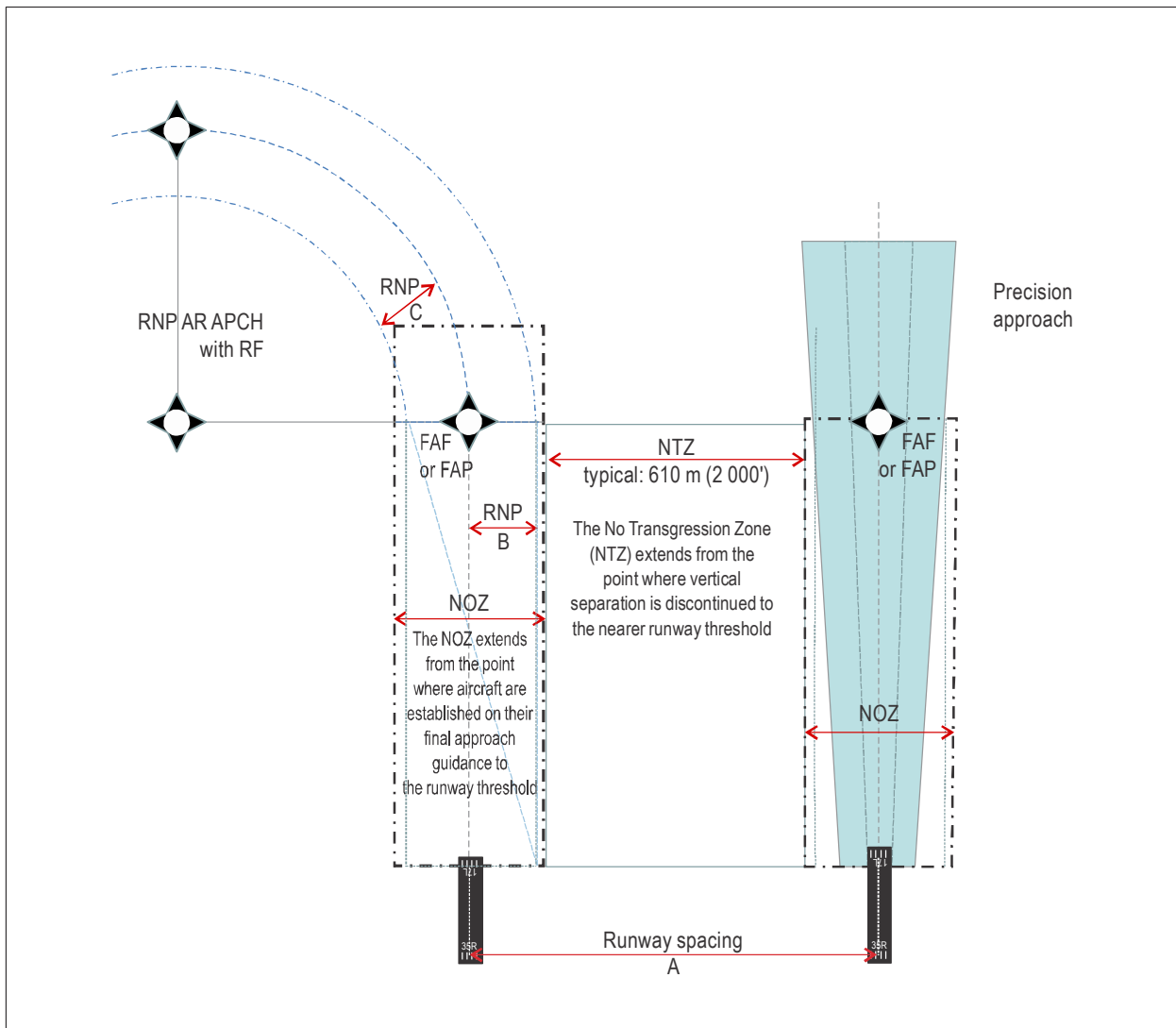


Figure B-1. Example SOIR with established on RNP AR APCH and ILS/GLS

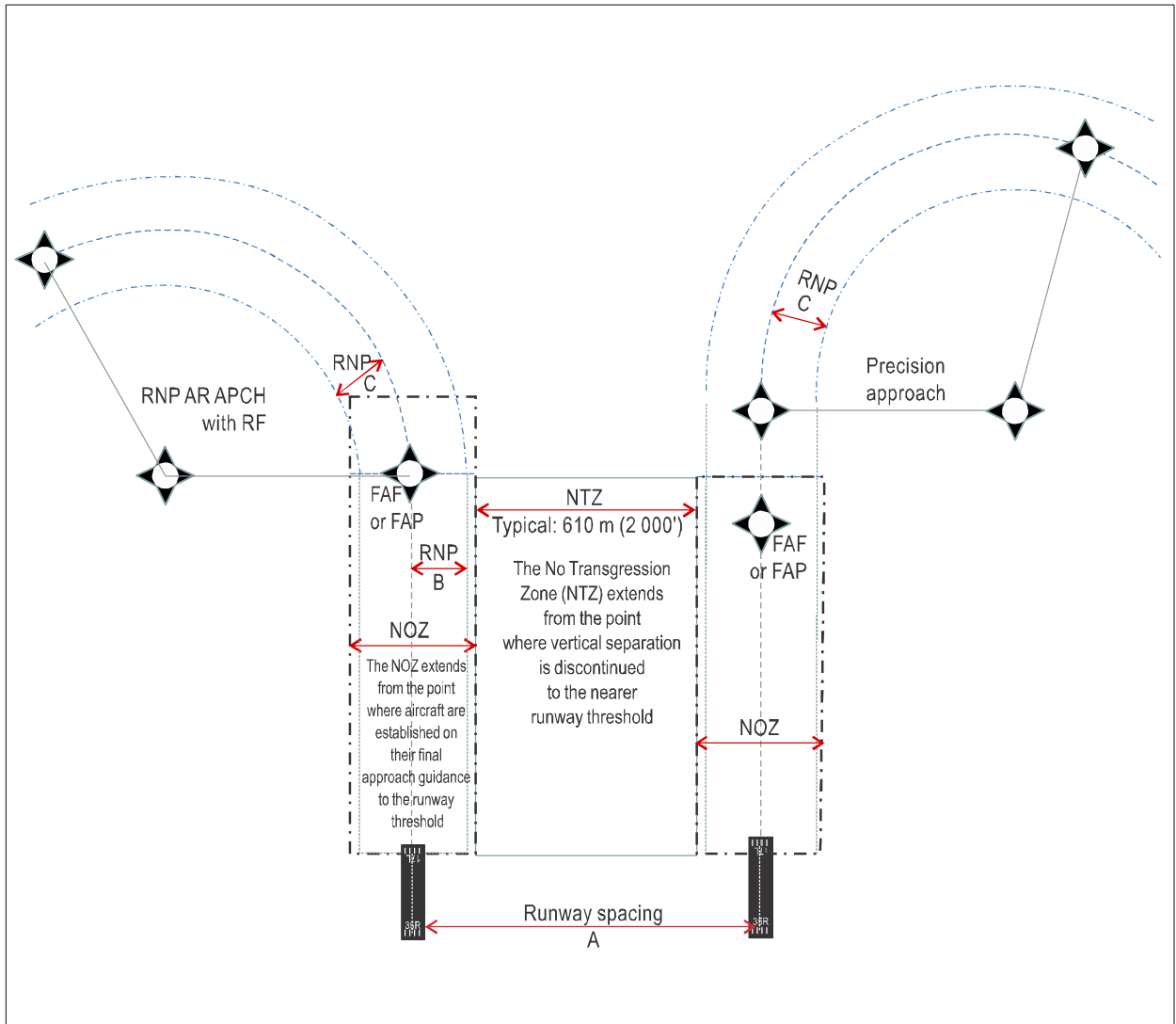


Figure B-2. SOIR with established on RNP AR APCH

Appendix C

WORKING EXAMPLES OF MODES 1 AND 2 — DEPENDENT AND INDEPENDENT PARALLEL APPROACHES

1.1 The lateral guidance performance on the final segment of an instrument approach is either linear or angular, depending on the navigation system used. The expected navigation performance in the initial, intermediate, and final approach segments is given below (Figure C-1). Linear performance is provided where noted in the figure. Those that cannot meet minimum SOIR requirements with any mitigation are greyed/hashed. The last rows identify the navigation performance of the procedure.

1.2 The performance-based navigation (PBN) approaches can provide either linear or angular guidance from the FAP to the threshold. All guidance from APV procedures, and potentially the intermediate approach transitions for precision approaches, will be linear and defined by an RNP value before the final approach fix (FAF)/final approach point (FAP). Approaches with RNP values inconsistent with the minimum required values defined in PANS ATM, Chapter 6, require additional safety assessment prior to SOIR applicability. Figure C-2, a summary of the PANS ATM, Chapter 6, paragraph 6.7.3.2.1 b), describes the required RNP values.

1.3 The approaches for simultaneous operations in the PANS ATM afford implementation options. For PBN operations to support simultaneous approach operations, where other forms of separation are discontinued prior to the FAF/FAP, runway spacings of less than 7 408 m (24 320 ft) will require a navigation performance of 1 NM or better, which is currently only available with the RNP AR APCH navigation specification. Subject to aircraft qualification and flight crew approval, RNP AR APCH can support final approach operations from 0.3 NM to 0.1 NM.

1.4 A-RNP with scalability may, in the future, offer a better performance prior to the FAF/FAP, however, this will only provide a navigation performance of, at best, 0.3 NM. Therefore, this performance will only meet runway spacings of less than 2 224 m (7 301 ft) without a specific safety assessment.

1.5 The inherent nature of the examples in Figure C-3, a precision approach and a RNP AR procedure with RNP values (B) and (C) meeting the requirements in Figure C-2 2) for example, provide sufficient enough safety and operational margins that they are recommended for SOIR.

1.6 For other approaches, the PANS ATM requires a documented safety assessment. Collision risk, both normal and recovery from faulted conditions, as well as missed approach procedures need to be considered. Additional safety considerations include wake turbulence encounters and potential for approach destabilization in a high-workload environment.

1.7 PBN transitions can be used in parallel approach operations in the intermediate segment. For runway spacings of less than 2 224 m (7 301 ft), either a navigation performance of 0.3 NM or better is required or vertical separation (e.g. a high-side/low side) can be coded into the transitions (see example of PBN transitions to “traditional” ILS finals in Figure C-4).

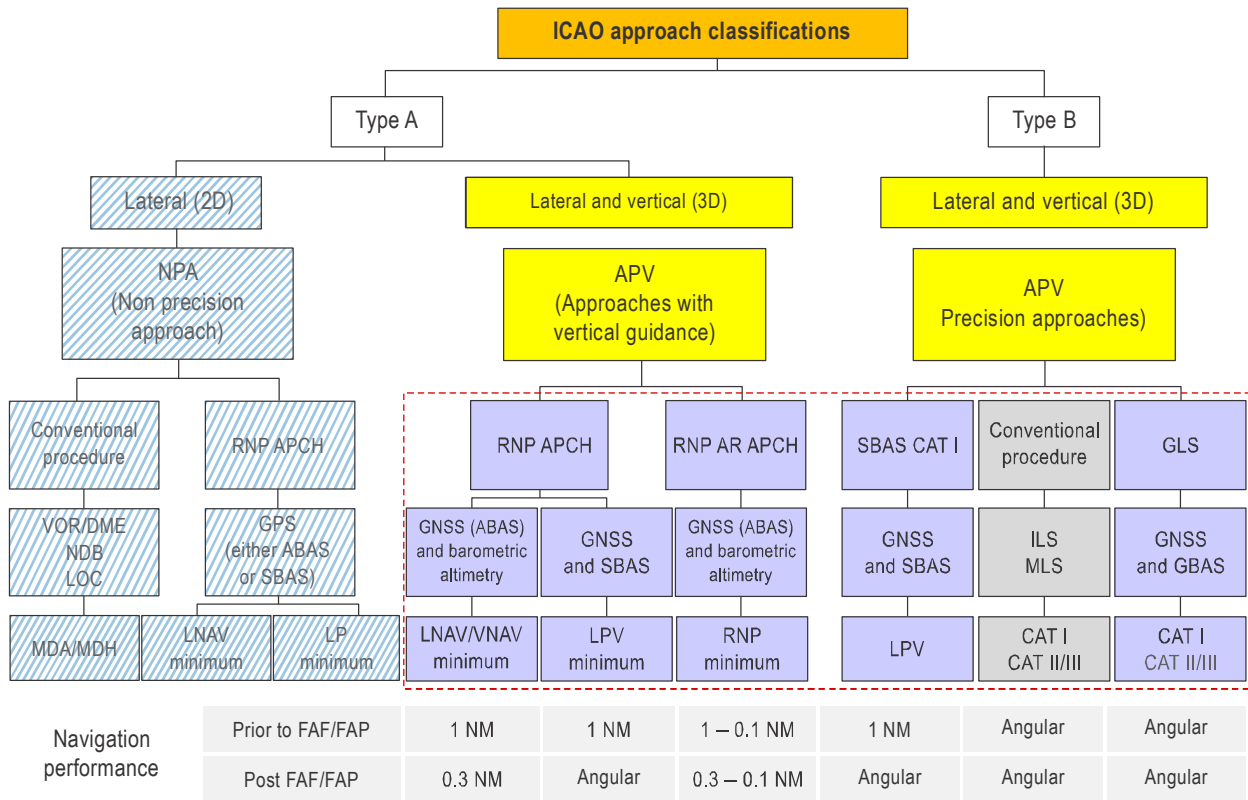


Figure C-1. ICAO Approach Types and Classifications for SOIR

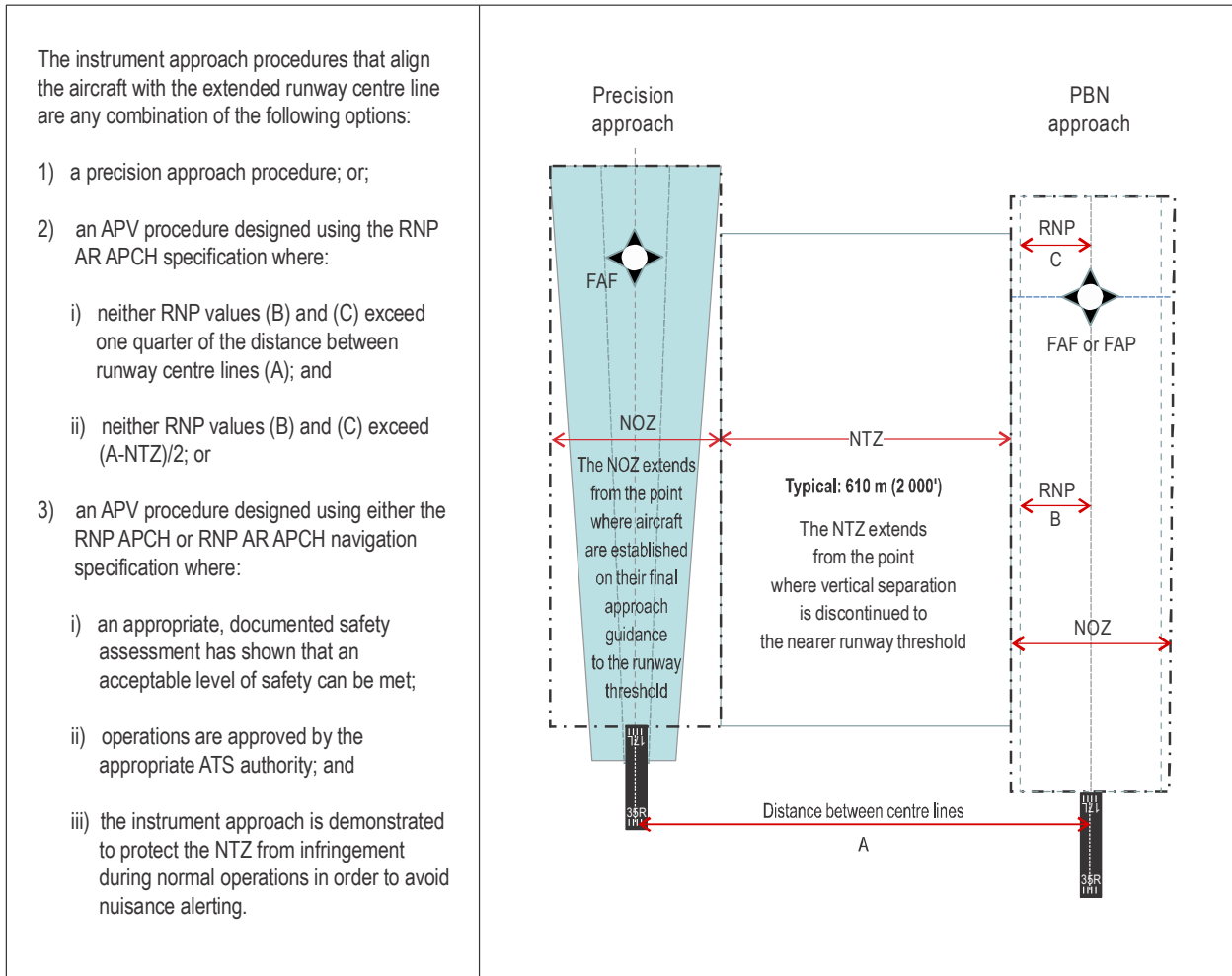


Figure C-2. SOIR with Precision Approach, RNP AR, or Additional Safety and Operational Assessment

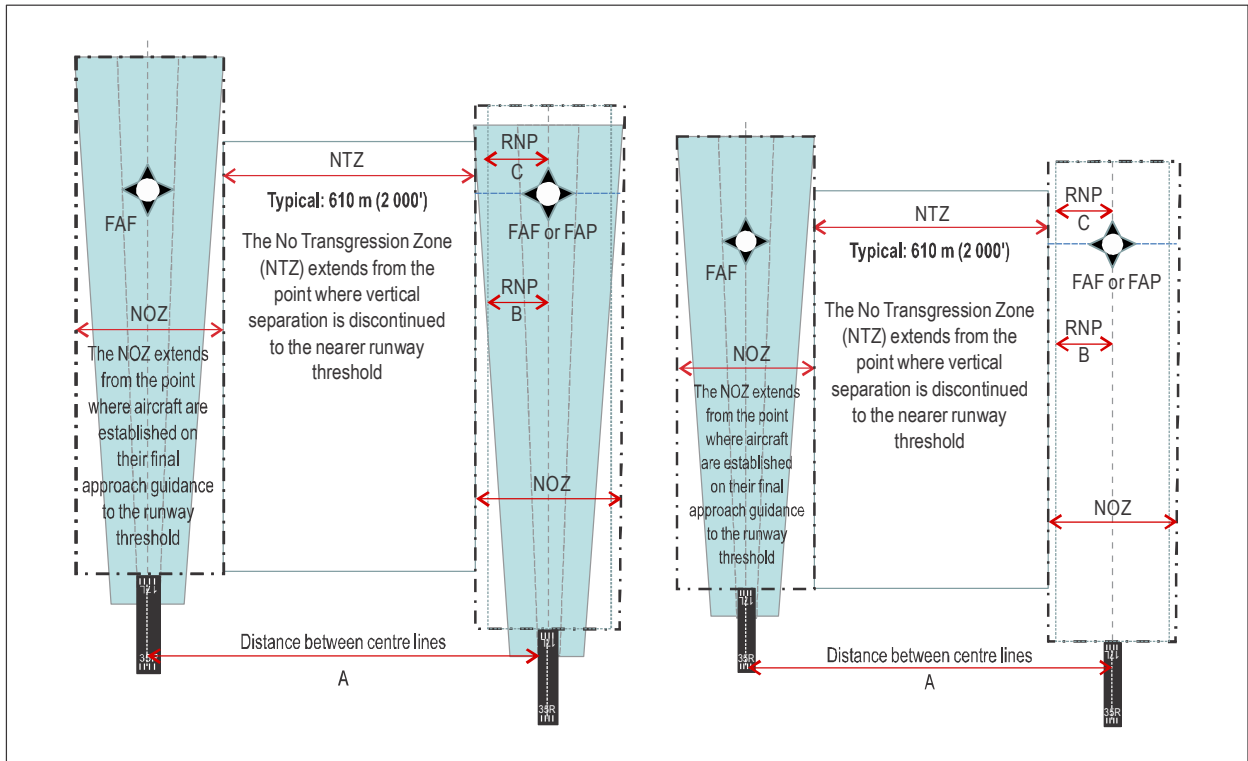


Figure C-3. Some Independent Parallel approach Type Options with RNP and precision approach (mode 1 and 2)

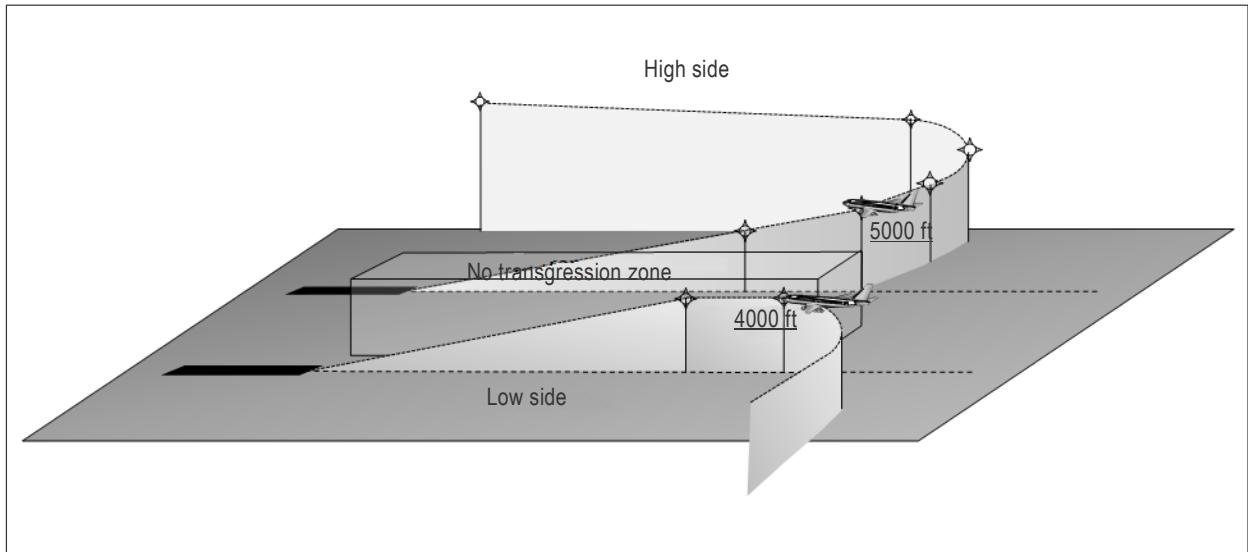


Figure C-4. Example of Independent parallel approaches (Mode 1) with high/low and PBN transitions to ILS finals

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