July 5, 2018

Mr. Ali Bahrami
Associate Administrator for Aviation Safety
Federal Aviation Administration
800 Independence Ave, S.W.
Washington, D.C. 20591

Dear Ali,

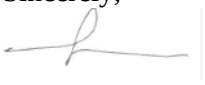
The Performance Based Operations Aviation Rulemaking Committee (PARC) is pleased to submit the following recommendation for your consideration. The PARC Navigation Work Group (NAV WG) completed an analysis addressing concurrent operations using procedures constructed with Radius-to-Fix (RF) leg types and procedures using Track-to-Fix (TF) leg types. When the recommendations were provided to the PARC Steering Group (SG) for review, the SG requested that the NAV WG provide their recommendation for the best method to enable the concurrent procedure process. i.e., how the charting and database creation should occur.

The desire to fly procedures that have different leg types serves to incent participation by more aircraft in performance based navigation operations. For example, there are specific fleets that will not be capable of flying RF procedures for years (or at all), but concurrent operations using TF construction will allow those aircraft to participate.

In addition, the NAV WG noted several candidate locations that may be suitable for initial roll out of concurrent ops.

The PARC appreciates your continued support of our activities and I personally commend the many participants across all lines of business who address a multitude issues, both technical and conceptual to foster progress of NextGen. Please call me if you have any questions or would like to setup a discussion. The PARC also respectfully requests the FAA provide us with a formal response to the recommendations.

Sincerely,



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RF.TF CONCURRENT OPS RECOMMENDATIONS

Background

In September 2016 the Navigation Working Group was asked by the SG to form an action team to identify options for implementing operations where either flyby fixes or a defined arc could be used to create the lateral path. The goal per the ToRs is to allow operators to without defined arc capability to fly a similar ground track using flyby fixes. The Nav WG was asked to identify pros and cons for each option and provide the SG with a map of the options for future discussion and recommendation. The action team eventually became the entire Nav WG since there was a broad interest in the subject. In meetings since the ToRs the WG has had the RF.TF Concurrent Ops task at the highest priority.

In the WG F2F in Seattle August 1 and 2, the WG finalized the options "tree" and accompanying pros and cons matrix, however the group wanted to add one further piece of information basically defining the end state of each branch down the options tree. There are three parts to this; 1. A diagram of the decision tree that defines the options (Figure 1), 2. A table defining the end state of each branch of the tree in terms of procedure, charting, navigation database, and operations and 3. A table identifying pros, cons and constraints for each of the decision branches in the tree. Use of all three together should enable a good understanding of the ramifications of selecting any one of the branches with the goal of making a decision regarding which path to take to enable concurrent operations.

This material is all available on the website or from Mike C or Carrie.

Nav WG Recommended RF.TF Overlay Options

The diagram below depicts the available options for RF.TF Concurrent Ops that the Nav WG identified for the SG under the first tasking. Pros and cons matrices, with other assorted detailed information on each option were supplied to the SG with the original submittal in August 2017 and were discussed on several occasions after that.

The Nav WG has now identified the most viable options which can be used together to put concurrent ops into effect when and where needed. In keeping with the PBN Strategic Plan, both options begin with design of a procedure using defined radius turns (RF). The concurrent ops path (A-B-E1-H), identified in green in the options tree (Figure 1) would be the preferred method for true concurrent ops where mixed equipage shows a need for such operations. The light blue branch (A-B-D) applies only if there is no need for fly by (TF) operations for some reason, e.g., lateral path too constrained for flyby, more consistent ground tracks needed, etc. The common factor to both options is that FAA only need publish and maintain one procedure (the RF version). Where concurrent ops are deemed necessary by the airport and operators,

the FAA would provide appropriate flyby fixes to define the TF overlay operation in the notes section of the 8260 forms.

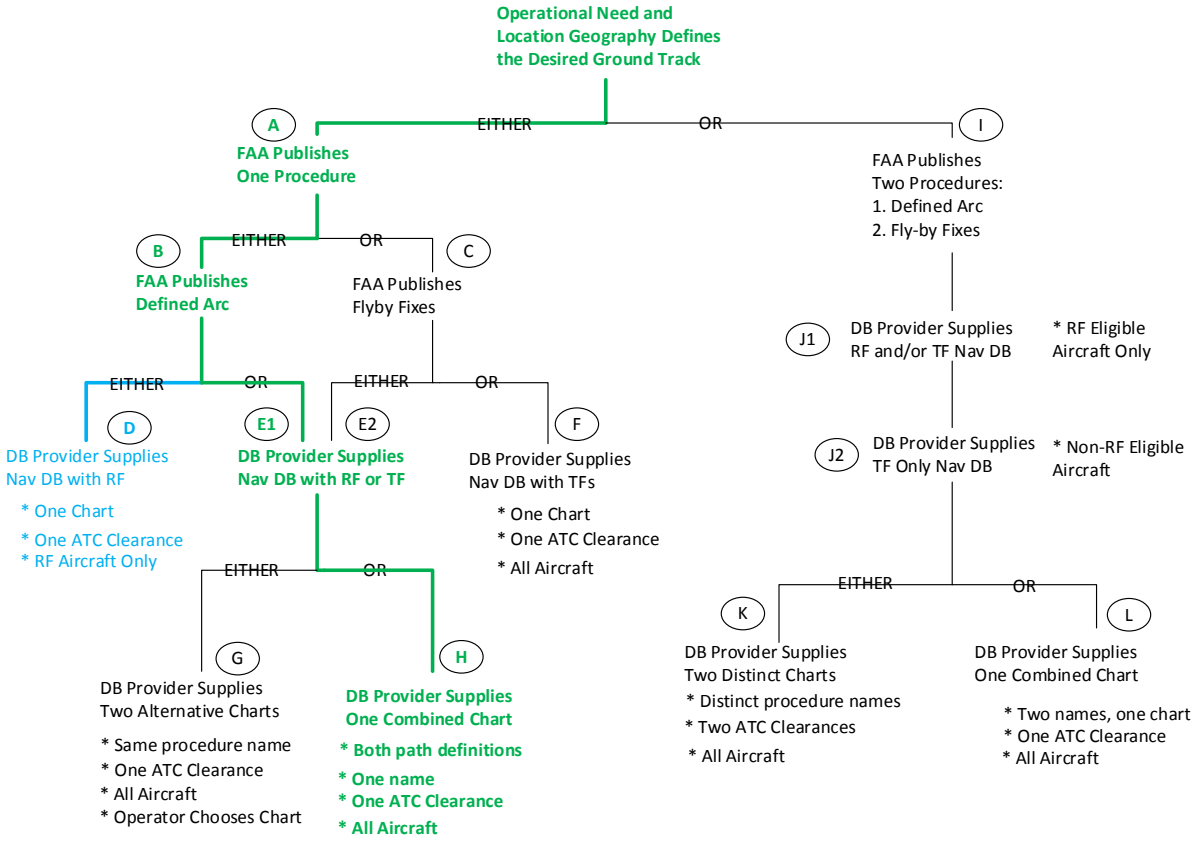


Figure 1 Implementation of Defined Radius and Fly-by Fix Operations

Selection of the appropriate branch depends upon location, traffic mix, airport operations or geometric constraints. Geometry could drive an RF only solution, while traffic mix could drive a concurrent ops solution; the choice will be dependent on many factors which will need to be evaluated by the airport, air traffic, environment and operators. The two pathways allow for many flexible solutions as needed. The paths are discussed individually below.

The Primary Pathway A-B-E1-H (Green)

At airports where concurrent operations are necessary or beneficial, the FAA will design, validate and publish an instrument approach procedure using defined radius turns (RF) and defined tracks (A & B). Per previous recommendations, the primary design constraints are:

1. Minimum RF radius of 2 NM,
2. Speed restriction of 210 KT or lower on the initial fix of an RF turn to final,
3. Intermediate segment aligned with final segment of correct length and flight path angle (approximately 2 degrees) to allow capture from below for up to +40 ΔISA,

4. Final segment at or near 5 NM in length, with a recommended minimum length of 3 NM. For RF only designs shorter finals can be allowed.

The flyby fixes needed to overlay the RF version of the IAP will be contained in the notes section of 8260 forms. The notes will specify the location of flyby fixes to define the flyby lateral path; for a 180 degree turn downwind to final there will be three fixes. To constrain the vertical path there will be appropriate speed restrictions and/or altitude constraints.

Depending upon the customer (RF capable and qualified or not) the database provider will provide an airborne database containing the defined radius version or the flyby version of the IAP (E1). The IAP will have the same name in both databases for ATC clearance purposes. The NavWG recognizes that to meet this requirement it is likely that the ARINC 424 standard will have to be updated. This might not be necessary if an implementation method can be found to meet the desired single ATC clearance (agnostic to the ARINC coding in the database) in an alternative way.

Lastly, the database provider will provide a single charted version of the IAP which depicts both versions of the procedure (H). The Nav WG has identified three ways in which this could be done:

1. Use a chart inset depicting the alternative version while the main chart shows the primary, see Attachment 1
2. Depict the RF version as primary with the additional flyby points ghosted, see Attachment 2
3. Depict the flyby version as primary with the RF ghosted, see Attachment 3.

The Nav WG recommends that the alternative chart depictions be taken to the Instrument Flight Procedures Panels (US-IFPP and/or IFPP) and the Aeronautical Charting Forum for discussion and recommendation.

Alternate Pathway A-B-D

This alternative pathway will allow operations where either a) the design constraints 1 and/or 4 above must be violated to provide an IAP for access to the airport, or b) where the traffic is all RF capable and qualified. The other design constraints (2 & 3 above) will still apply. Like the concurrent operations described above, FAA will design, validate and publish an IAP that utilizes defined radius turns as needed to accomplish the required lateral path. There will be no flyby overlay defined in the notes section in this case. Database providers will produce and deliver a single chart and a single navigation database version of the IAP to only RF capable and qualified aircraft / operators.

Candidate Trial Locations

During the May meeting, the NavWG discussed the SG ask for potential places where concurrent ops might be tried. The group thought that we needed to pick locations that were

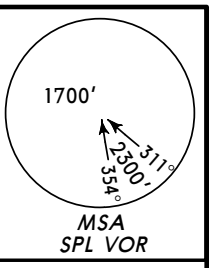
not complicated by nearby airports (metro areas), that had a good mix of RJ and mainline traffic, were not too busy, and which represented both dual independent and single runway operations. It was also thought useful to try to overlay a relatively complex RF procedure. Each of the suggested options already has some RNP AR procedures which would provide initial designs. Operations and traffic mix for each are available from the PBN dashboard.

For single runway operations Bradley International (KBDL) and Norfolk International (KORF) might be suitable. Bradley has approximately 85,000 operations per year, dominated by four major operators followed by general aviation and a mix of regionals. Norfolk has fewer operations (65,000) with about 30% of the operations flown by CRJ200 and ERJ145, which are TF only aircraft.

For two runway operations Kansas City (KMCI) and Austin (KAUS) were suggested. They have parallel runway operations but are not as busy as the major hub airports. KAUS has about 170,000 operations per year, and KMCI has around 122,000. They also have a reasonable traffic mix of regional and mainline carriers, plus general aviation.

When discussing a more complex RF operation, Palm Springs (KPSP) was thought to be an example where the TF operation might not be possible. This would provide a stress test for the methodology of doing the overlay.

SCHIPHOL Departure (R)	Apt Elev	Trans level: By ATC Trans alt: 3000′
121.2	-11′	

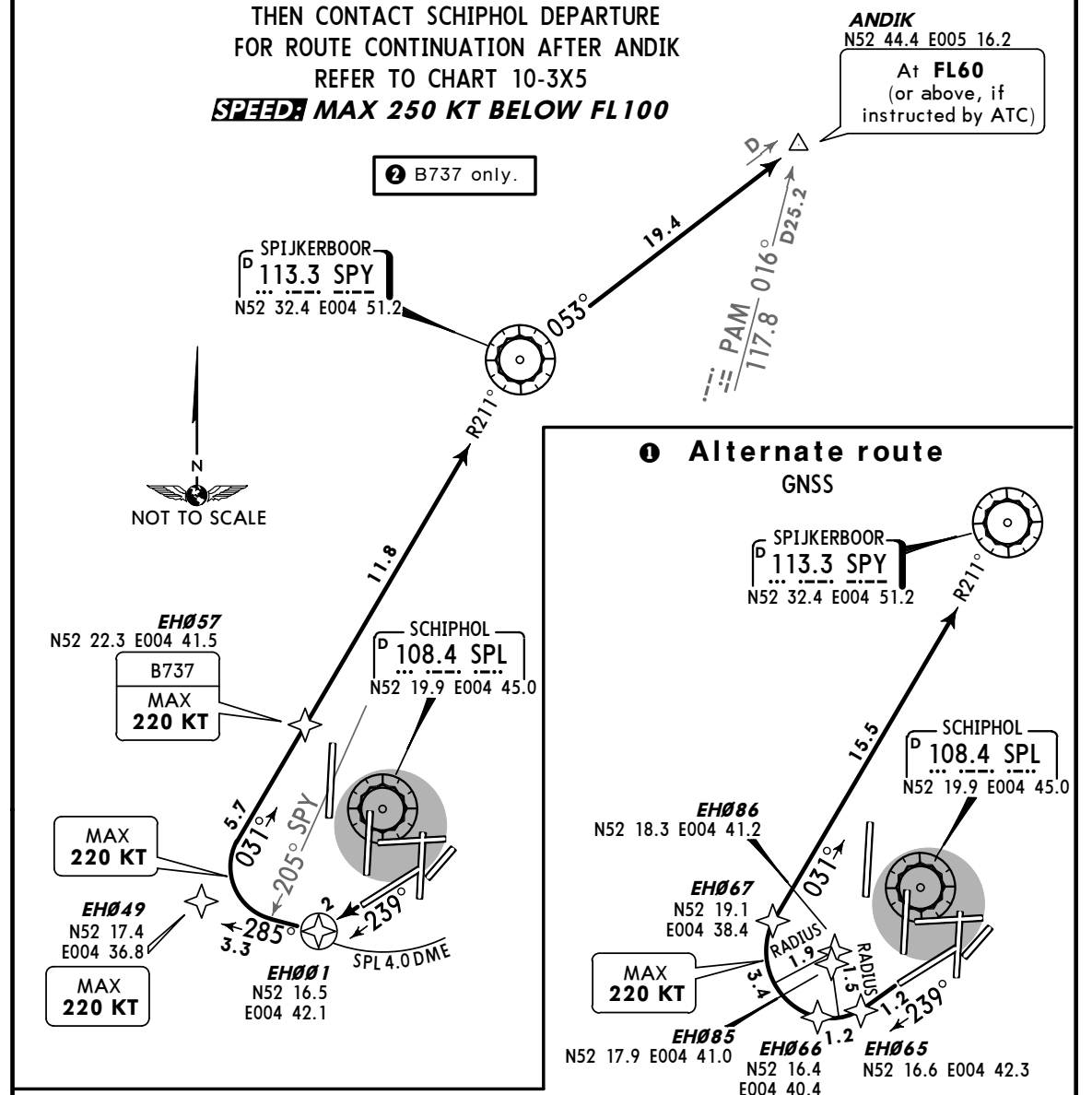


SPIJKERBOOR 2K *[SPY2K], [SPY2KZ]* ❶ *[S2K737]* ❷

RWY 24 DEPARTURE

FOR DEPARTURE INSTRUCTIONS REFER TO 10-3B
REMAIN ON TOWER FREQUENCY UNTIL PASSING 2000′,
THEN CONTACT SCHIPHOL DEPARTURE
FOR ROUTE CONTINUATION AFTER ANDIK
REFER TO CHART 10-3X5

SPEED: MAX 250 KT BELOW FL100



❶ Alternate route

GNSS

SPY2KZ

This SID requires a minimum climb gradient of
492′ per NM (8.1%) up to 500′.

Gnd speed-KT	75	100	150	200	250	300
492′ per NM	615	820	1230	1641	2051	2461

For the use of the alternate route with radius to fix (RF) turn, the following requirements are applicable:
The aircraft FMS must be capable of processing the RF path terminator, P-RNAV or RNAV1 operations approval, TGL-10 or equivalent.

Initial climb clearance **FL60** higher level only when cleared by ATC

ROUTING

239° track, at SPL 4.0 DME turn RIGHT, 285° track, at SPY R-205 turn RIGHT, intercept SPY R-211 inbound to SPY, SPY R-053 to ANDIK.
RNAV [SPY2K]: THR 24 - EH001 - EH049 (K220-) - SPY - ANDIK (FL60).
RNAV [SPY2KZ] ❶: THR 24 - EH065 - EH066 - EH067 (K220-) - SPY - ANDIK (FL60).
B737: THR 24 - EH001 - EH057 (K220-) - SPY - ANDIK (FL60).

CHANGES: Alternate route established (SIDs transferred).

APP CRS	Rwy Idg	11236
284°	TDZE	13
	Apt Elev	13

RF

RNAV (GPS) RF RWY 28R

SAN FRANCISCO INTL (SFO)

TBD

ALSF-2

MISSED APPROACH: Climb to 3000 on track 284° to VIKYU and hold.
*Missed Approach requires minimum climb of 250 feet per NM to 2000.
#Missed Approach requires minimum climb of 325 feet per NM to 2500.

ATIS	NORCAL APP CON	SAN FRANCISCO TOWER	GND CON	CLNC DEL	CPDLC
113.7 115.8 118.85	134.5 338.2	120.5 269.1	121.8	118.2	

RADAR REQUIRED

MISSED APCH FIX

VIKYU 104° 284° 4 NM

WP09 (6.0) 104° (IF) WP07 Max 210 KIAS 5400 (2.0) 104° WP06 WP05

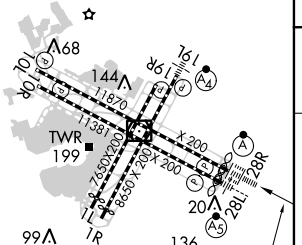
284° (12.8) RW28R 284° (5.1) PFAF (2.0) 284° WP02 WP11 WP03

810 1569 1123 283 709 621 154 46 136 628 177 1425 701 768 1993 2026 715 1120 895 940

MSA RW28R 25 NM 5100

PROTOTYPE - NOT FOR NAVIGATION

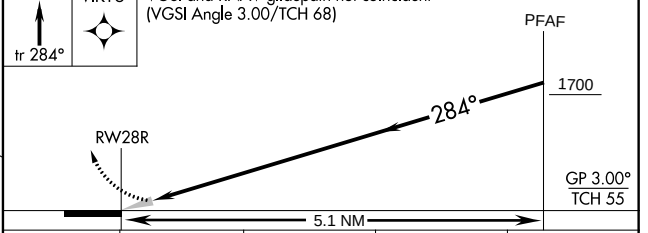
ELEV 13 D TDZE 13



TDZ/CL Rwys 19L and 28R
REIL Rwys 1L, 1R and 10L
HIRL all Rwys

3000 tr 284° VIKYU

VGSI and RNAV glidepath not coincident (VGSI Angle 3.00/TCH 68)



CATEGORY		A	B	C	D
TBD	DA*	361/30	348 (400-5/8)		
TBD	DA#	415/45	402 (500-7/8)		

APP CRS	Rwy Idg	11236
284°	TDZE	13
	Apt Elev	13

TF

RNAV (GPS) TF RWY 28R

SAN FRANCISCO INTL (SFO)

TBD

ALSF-2

MISSED APPROACH: Climb to 3000 on track 284° to VIKYU and hold.
*Missed Approach requires minimum climb of 250 feet per NM to 2000.
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ATIS	NORCAL APP CON	SAN FRANCISCO TOWER	GND CON	CLNC DEL	CPDLC
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RADAR REQUIRED

MISSED APCH FIX

VIKYU 104° 284° 4 NM

WP09 (6.0) 104° (IF) WP07 Max 210 KIAS 5400 (2.0) 104° WP06 (1.6) 104° WP05 (3.6) 160° WP11 (3.6) 228° WP03 (1.6) 284° WP02 (2.0) 284° PFAF 284° (5.1) RW28R 284° (12.8)

MSA RW28R 25 NM 5100

PROTOTYPE - NOT FOR NAVIGATION

ELEV 13 D TDZE 13

TWR 199

284° to RW28R

TDZ/CL Rwys 19L and 28R
REIL Rwys 1L, 1R and 10L
HIRL all Rwys

3000 tr 284° VIKYU

VGSI and RNAV glidepath not coincident
(VGSI Angle 3.00/TCH 68)

PFAF 1700 284° RW28R GP 3.00° TCH 55 5.1 NM

CATEGORY	A	B	C	D
RNP 0.11 DA*	361/30 348 (400-⅝)			
RNP 0.30 DA#	415/45 402 (500-⅞)			