Federal Aviation Administration

Memorandum

Date: JAN 12 2012

To: Chas. Frederic Anderson, Director, Aeronautical Products, AJV-3

From: Leslie H. Smith, Manager, Flight Technologies and Procedures Division, AFS-400

Subject: Required Navigation Performance (RNP) 1 Departure Procedure (DP)

The purpose of this memorandum is to provide design guidance for production of Special RNP 1 departure procedure(s) using Global Positioning System (GPS) or DME/DME/IRU (D/D/I) updating for specific locations coordinated between AJV-14 and AFS-400 (*AFS-470*), and AIR-130.

Special RNP 1 departure procedure design guidance is shown in the attachment. Any departure design that uses Radius-to-Fix segments must be designated a Special RNP-1 DP

This memorandum will be incorporated into Order 8260.PBN. If you have any questions, please contact Rick Dunham, Manager, Flight Procedure Standards Branch, AFS-420, at (405) 954-4164.

Attachment:

Cc: Joe McCarthy, Manager, AJV-14
Bruce Decleene, Manager, AIR-130
Jeff Bruce, Airspace Design and Simulation, Jeppesen Sanderson, Inc.
Giovanni Spitale, General Manager, Naverus-GE Aviation, PBN Services

Attachment

1. Design the Special RNP 1 departure procedures using the following referenced documents:

a. Use Order 8260.46D, *Departure Procedures Program*, for documentation requirements see appendix A amended as follows:

Paragraph 2d:

d. DPs designed using conventional, RNAV, or RNP guidance *must be named to correspond with the en route fix/NAVAID name where the DP ends. For example, a conventional DP from Altoona-Blair County Airport that ends at the TATES fix is named the TATES TWO DEPARTURE. If the DP is an RNAV procedure, the "(RNAV)" must be included in the name; for example, TATES TWO DEPARTURE (RNAV). If the DP is an RNP procedure, (RNP 1) must be included in the name; for example, TATES TWO DEPARTURE (RNP 1).*

Paragraph 2e:

e. Chart Annotation.

(1) RNAV-1 will be the default designation for RNAV DPs. Annotate procedures with a standard note: "RNAV-1" on FAA Form 8260-15B (see appendix E).

(2) All RNAV-1 and "(RNP 1)" DPs will contain a note that describes the equipment sensor limitations. Notes, as appropriate, are as follows:

Note 1: *DME/DME/IRU or GPS Required*

Note 2: *GPS Required*

(3) A note may be required to address the need for specific DME facilities to be operational. These are referred to as "critical DME facilities."

Example:

Note: *For Non-GPS Equipped aircraft, ABC, JKL, and XYZ DMEs Must Be Operational.*

(4) Except as required by paragraph 2-1f(3), all "RNAV-1" or "RNP 1" DPs that are annotated "DME/DME/IRU or GPS REQUIRED" must be annotated with the note: "RADAR REQUIRED FOR NON-GPS EQUIPPED AIRCRAFT."

(5) When an "(RNP 1)" DP contains a radius-to-fix (RF) leg or all transitions require an RF leg, annotate the procedure with the standard note "RF REQUIRED" (see Note 1, below). If the RNP DP does not require an RF leg, but at least one transition requires an RF leg, define affected transitions as "RF REQUIRED" (see Note 2, below).

Note 1: *RF Required.*

Note 2: *(Name) Transition, RF Required.*

b. Except as specified in this memorandum, apply the criteria in Order 8260.44A, *Civil Utilization of Area Navigation (RNAV) Departure*, identified as RNAV 1 or RNAV Level 1 to construct RNP 1 departure procedures.

c. Except as specified in this memorandum, manually apply (*vice automation*) Order 8260.54A , *United States Standard for Area Navigation (RNAV),* for:

(1) RF leg construction (*single or consecutive same/opposite direction*)
(2) Primary and secondary width values
(3) Full and changing RNAV segment width constructions.
(4) Indicated airspeed values, true airspeed, tailwind velocity, ground speed, turn radius, leg length and width calculations (*as amended by current memorandums)* using the designer's calculator tool provided with this memorandum.

2. Definitions

ATT	Along-track tolerance
IDL	Initial Departure Leg (*straight ahead, may be composed of one or more leg types; e.g., VA, VI, DF, CF, TF*)
OEA	Obstacle evaluation area
P	Point on the primary area full width boundary abeam the RF termination waypoint
RF	Radius-to-fix leg type
S	Point on secondary area full width boundary abeam the RF termination waypoint
TB	Turn side (inside) boundary connection point
TF	Track-to-fix leg type
TP(P)	Tangent point on primary area full width boundary
TP(S)	Tangent point on secondary area full width boundary

3. RNP 1 engagement is assumed to occur 500 ft above the airport elevation. Climb gradients above 200 ft/NM may be required between the DER and first waypoint to achieve engagement, depending on coding requirements. For obstacle clearance purposes, evaluate the 40:1 surface from departure end of runway (DER) elevation.

4. Construction when RF turn radius is ≥ 3×RNP.

a. If RF leg entry occurs after the initial departure leg reaches full width, construct the rest of the route's OEA under 8260.54A guidance. See figures 1 and 2

Figure 1. RF Leg entry at full segment width before turn, radius ≥ 3.0

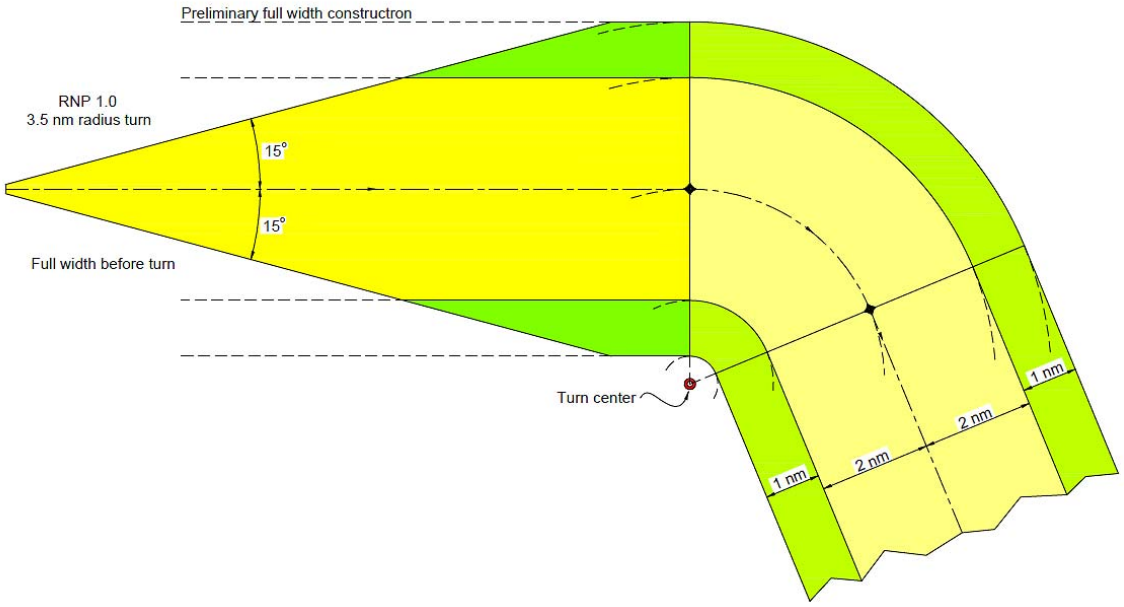
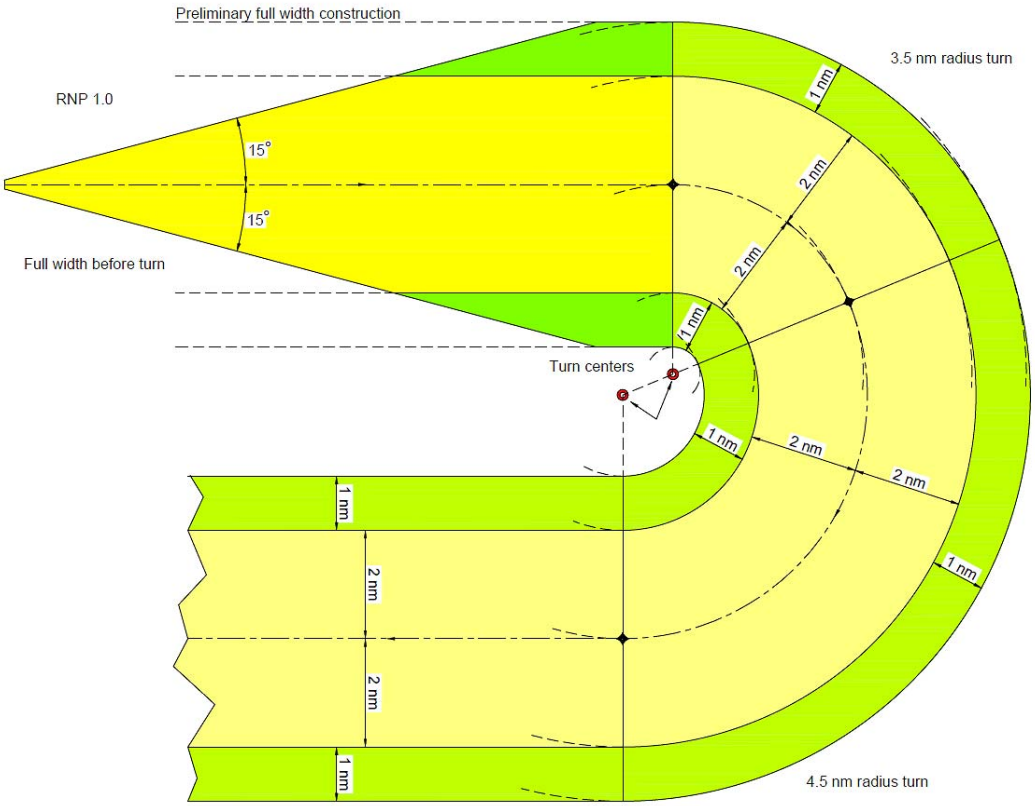


Figure 2. Back-to-back RF legs of differing radius, radius ≥ 3.0



b. If RF Leg entry occurs <u>prior</u> to achieving full segment width:

(1) Locate the RF initial waypoint at least 1 NM from the DER. If the RF leg is entered from a TF leg, locate the TF initial waypoint at least 0.5 NM prior to the RF initial waypoint. Do not apply ATT to locate waypoints between the DER and (*inclusive of*) the initial waypoint of the first RF leg.

(2) Preliminarily, construct the IDL from the DER and the RF leg at full width (1-2-2-1).

(3) On the <u>non-turning side</u> (*outside*), construct a line starting 500 feet from runway centerline abeam DER splaying at 15° relative to the departure track until intersecting the RF leg outer border (*primary and secondary*) to form the IDL outside boundary. See figures 3, 4, 5.

(4) On the turning side (*inside*) of the IDL OEA, the TB is abeam the leg termination fix.

(5) Construct a line from TB to TP(P) and TP(S) to establish the OEA inner boundary connection from the IDL to the RF leg. If the RF leg terminates prior to inner boundaries reaching tangent points, construct a line from TB to S and P points. See Figures 3, 4, 5.

Figure 3. Connections radius ≥ 3.0

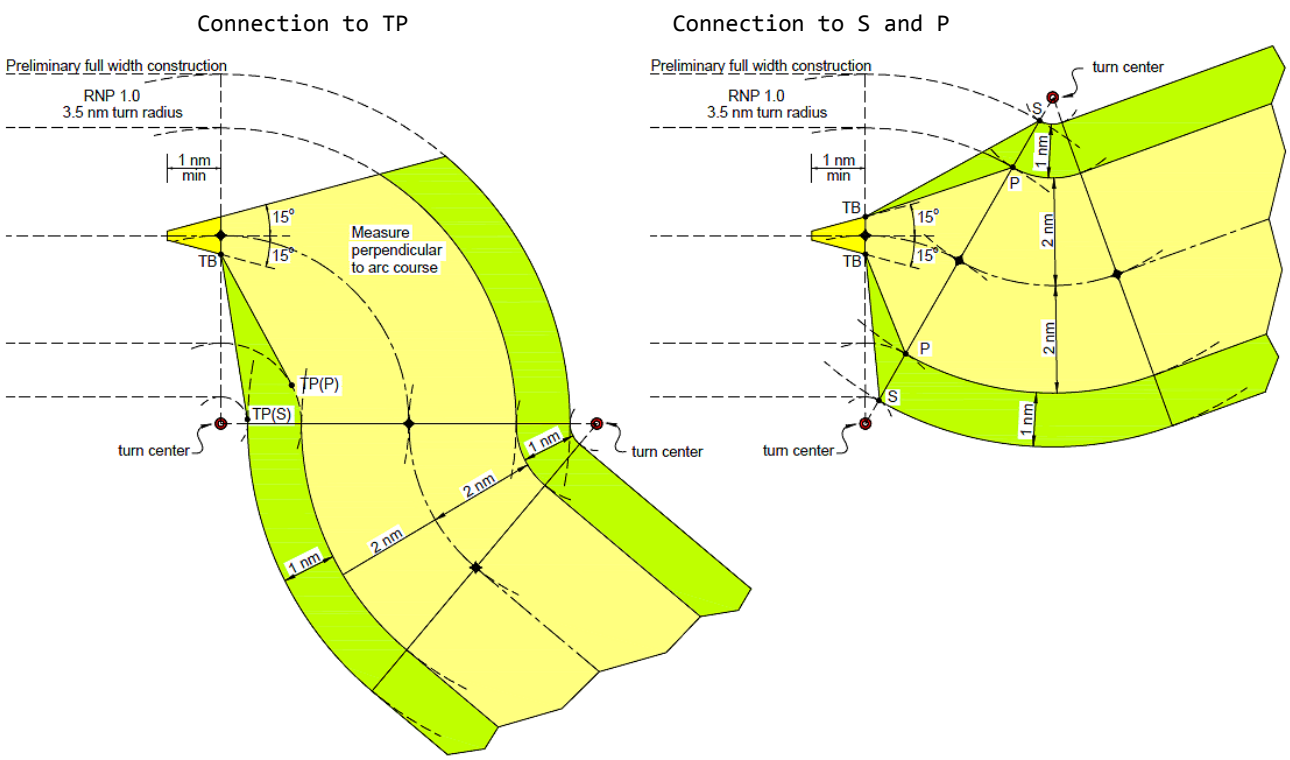


Figure 4. Connection to TP and S, radius ≥ 3.0

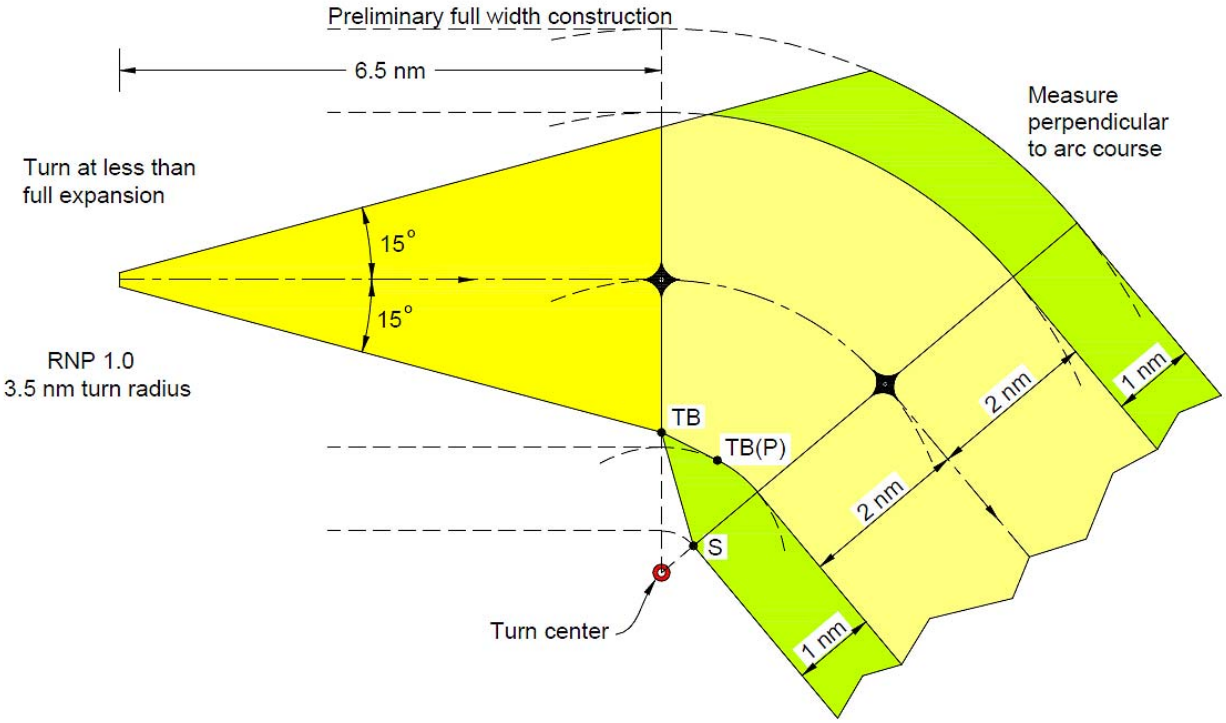
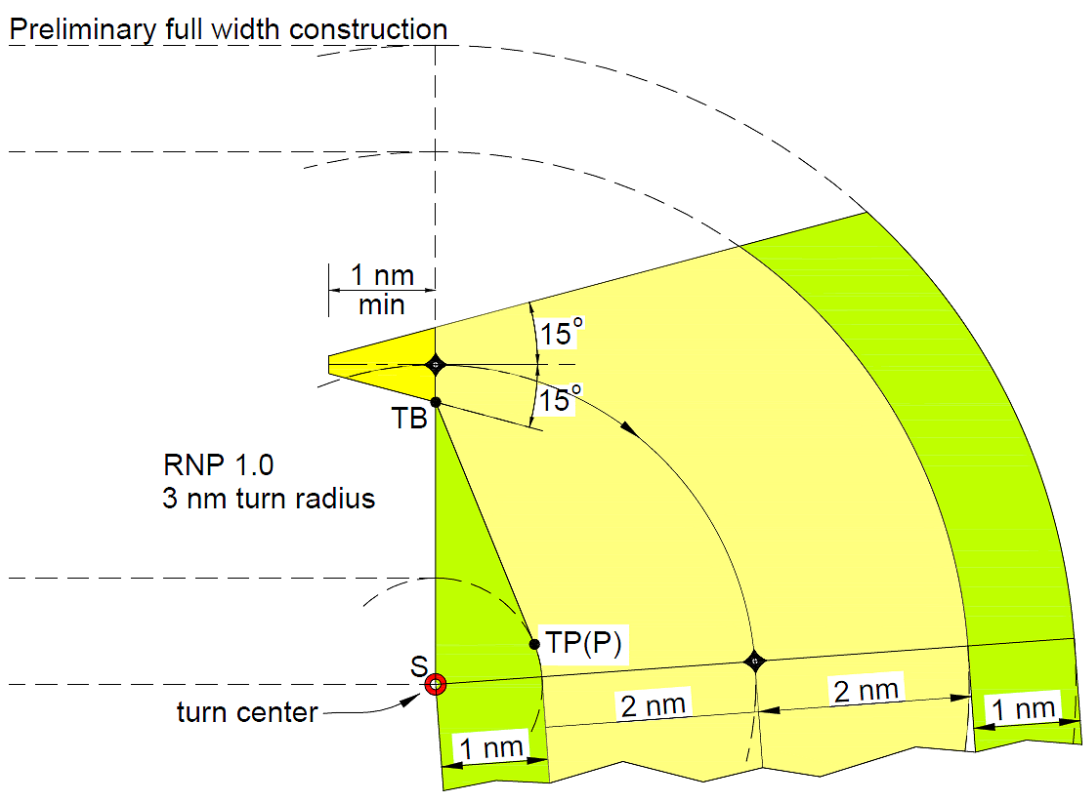
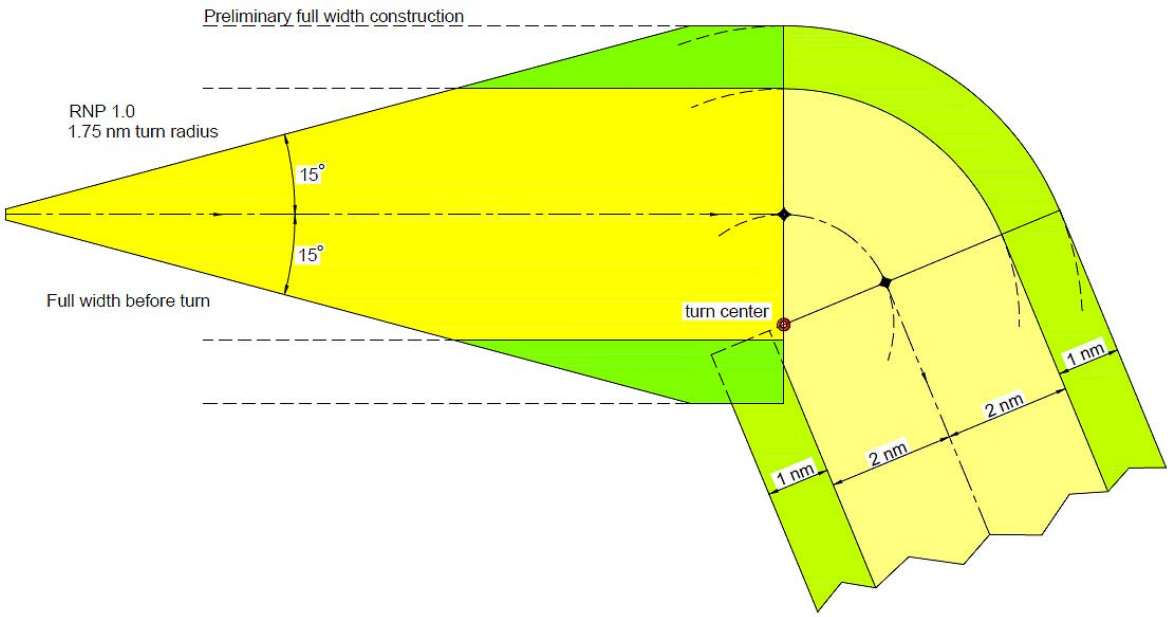


Figure 5. Shortest RF Leg entry prior to full segment width before turn, radius ≥ 3.0



5. Construction when RF turn radius is <u>< 3×RNP</u>. When the turn radius is less than 3 NM, the RF leg OEA on the inside of the turn folds back over itself; therefore, a new construction technique is required. (*Note: the turn radius of subsequent legs cannot be less than the radius of the previous turn.*) For turns at full width each segment is evaluated individually in the overlapping areas. See figure 6.

Figure 6. Turn At Full Width



When the RF initial fix is encountered prior to reaching full width:

a. The outside boundary is established as in paragraph 4b(2) and 4b(3) above.

b. For the inside boundary, construct a line from TB to the turn center, TP(P), TP(S), or if tangency cannot be achieved, points P and/or S.

(1) <u>The connection point is the turn center</u> when the leg following the RF termination point is a TF leg. If IDL half-width at its termination fix is greater than the turn radius, truncate the half-width of the IDL on the turn side to the value of the RF leg turn radius. The turn side boundary of the TF leg expands at angle of 15 degrees relative to the segment track. If the segment is not long enough for the splay to complete, connect to full width points abeam the leg termination waypoint. See figures 7, 8, and 9.

Figure 7. Turn Center Connection Point (*Shortest IDL*)

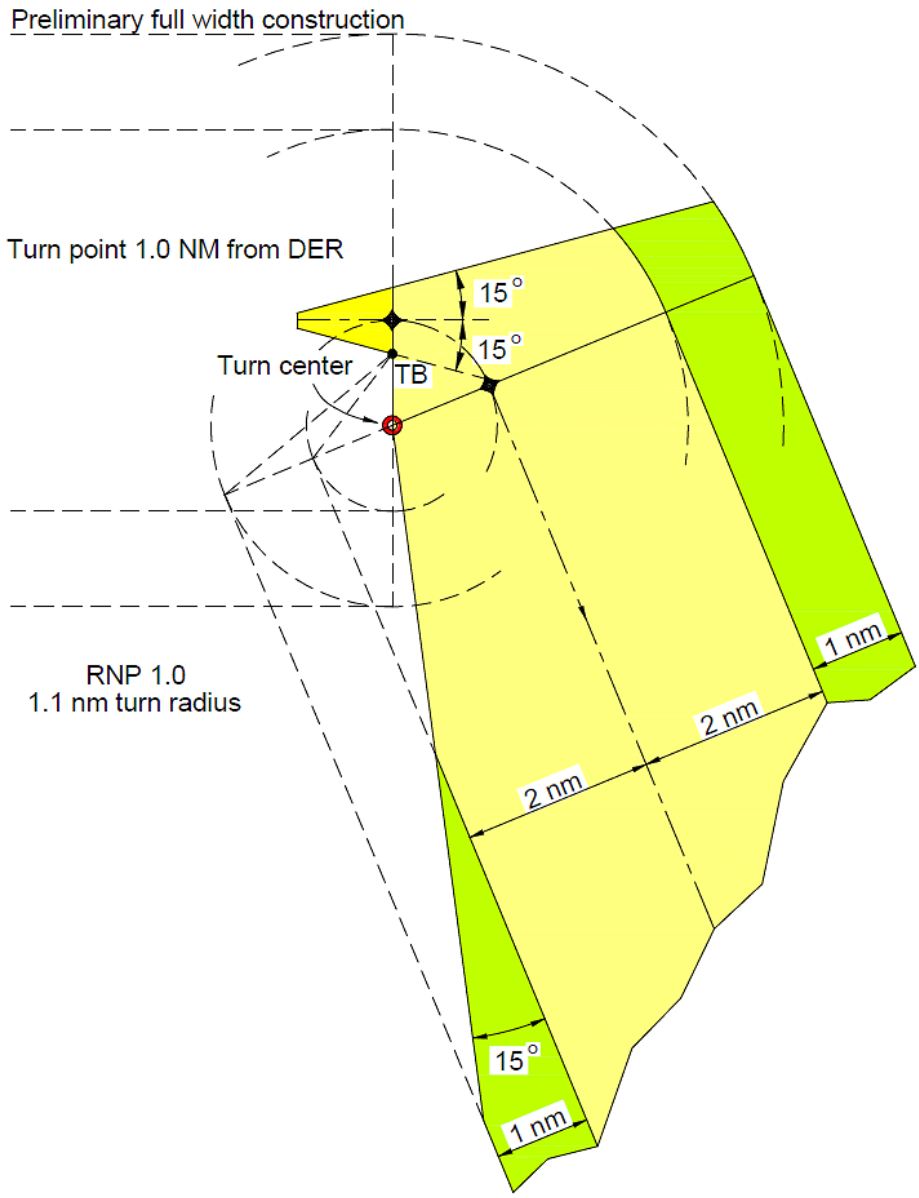


Figure 8. Turn Center Connection Point (*IDL not full width*)

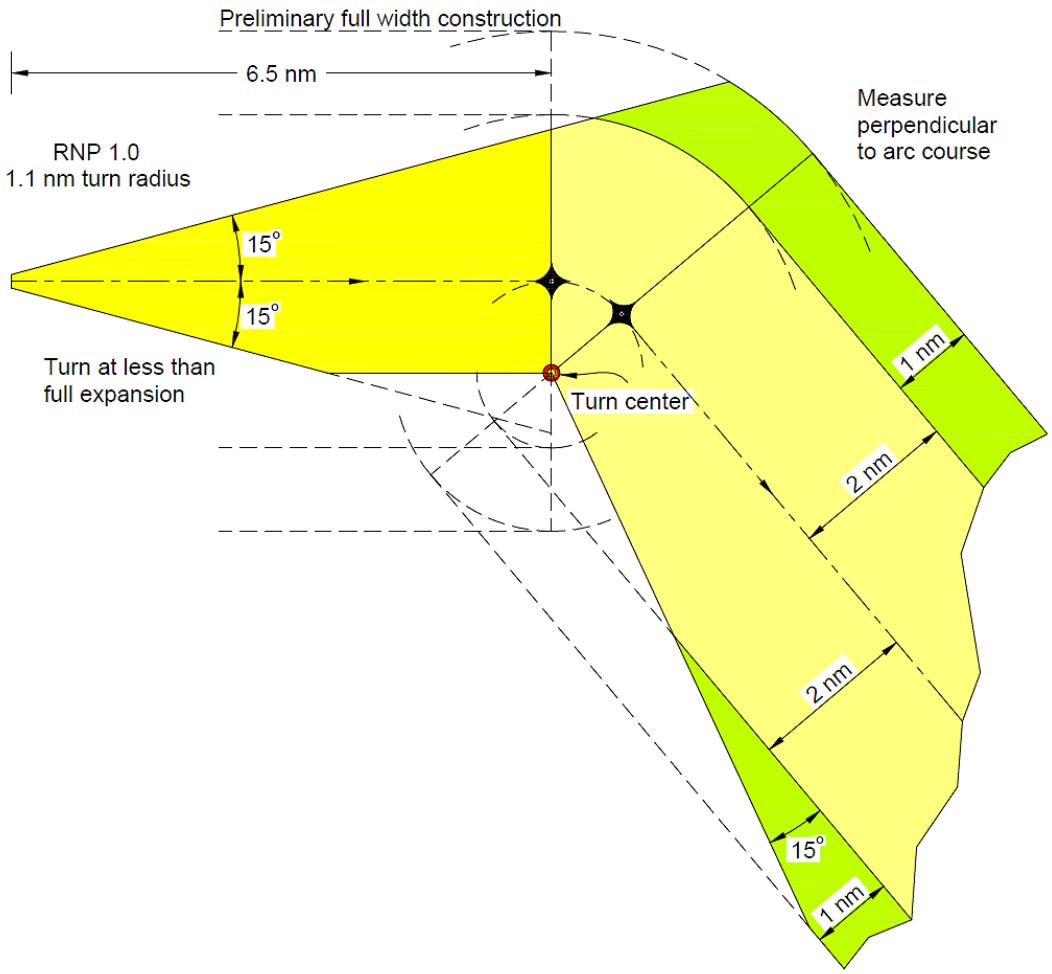
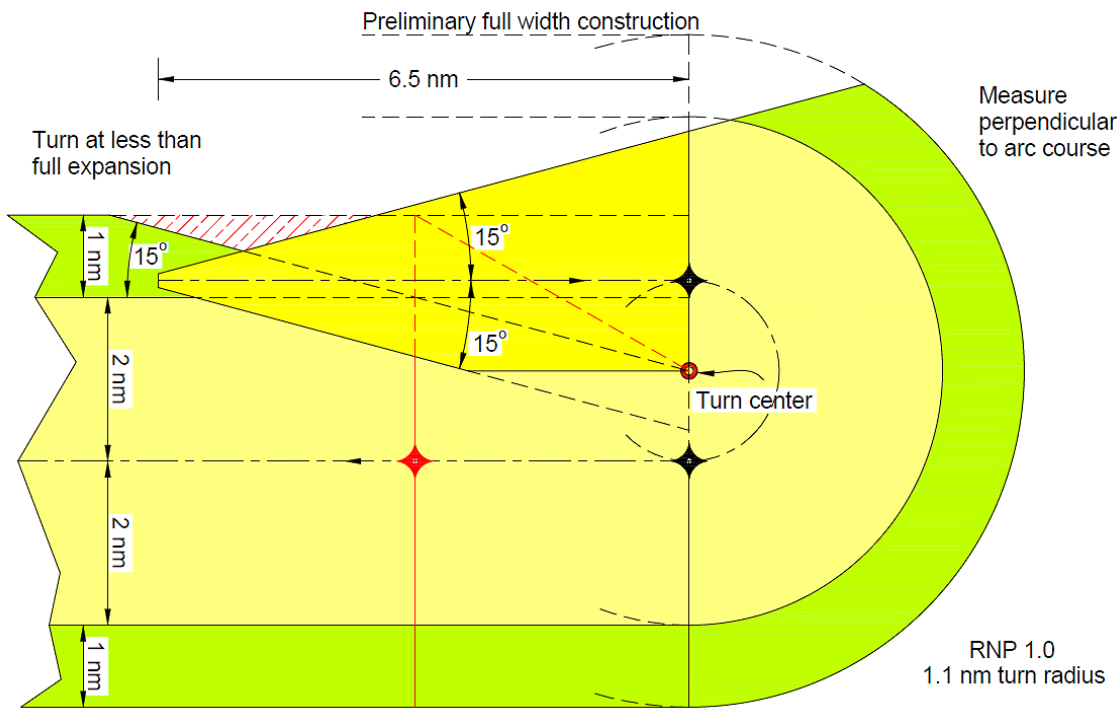


Figure 9. Turn Center Connection Point (*180 degree turn*)



(2) When the leg following the RF termination point is another RF leg, construct a line from TB to the TP(P) and TP(S) or to points P and/or S as appropriate. See Figures 10 and 11.

Figure 10. Shortest Initial Departure Leg To Consecutive RF Legs Of Differing Radii

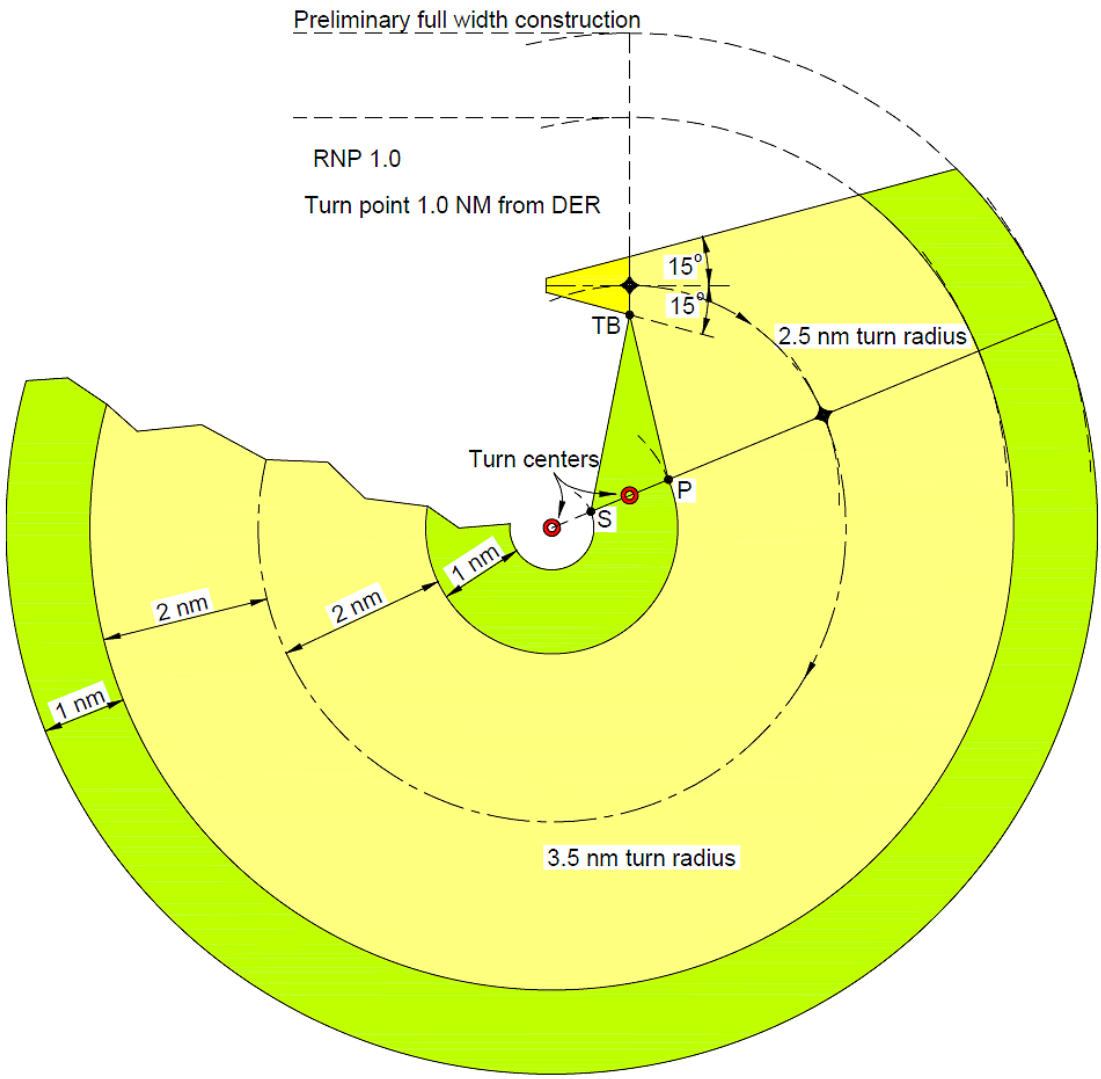
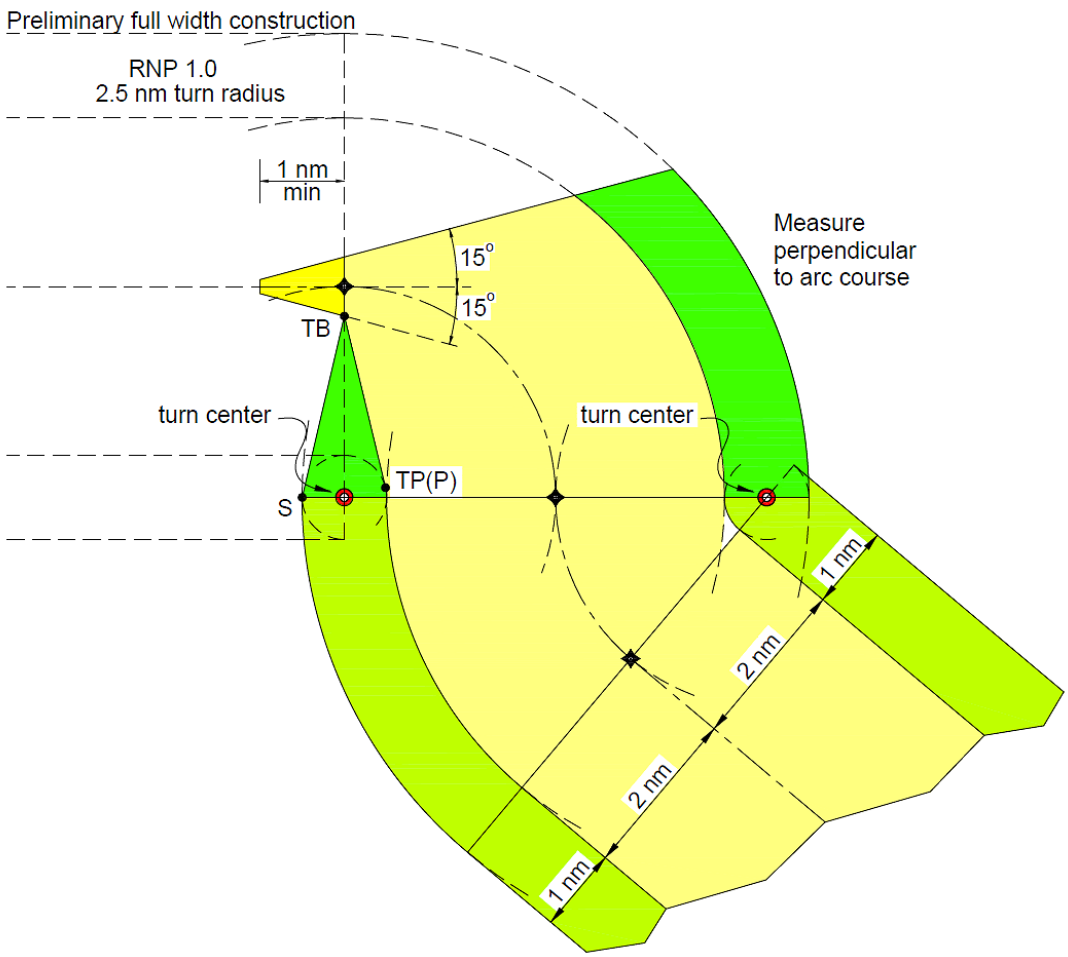


Figure 11. Opposite Direction Consecutive RF Turns



5. **<u>Obstacle Evaluation.</u>** The elevation of the 40:1 obstacle clearance surface (OCS) at any given point in primary area is equal to the elevation of the centerline track abeam (*perpendicular to*) it. Even though the departure consists of multiple legs, the OCS is evaluated as a single continuous surface. Obstacles within the OEA boundaries are evaluated against the elevation of the track centerline perpendicular to the obstacle. The inside boundary of an RF leg creates a small "pie" shaped area. For simplicity sake, where one legs OEA overlaps another, the obstacle is evaluated in each leg. Along-track distance is measured fix-to-fix.

6. **Procedure naming**. Title RNP 1 Departures as follows:

   Example: **KMORE FOUR DEPARTURE (RNP 1)**