CIVIL AVIATION AUTHORITY, BANGLADESH

ADVISORY CIRCULAR
FOR AIR OPERATORS

Subject: **INFORMATION TO OPERATORS ON RNAV (GNSS) NON PRECISION APPROACH PROCEDURES BASED ON GPS.**

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1. PURPOSE

The purpose of this Advisory Circular is to provide an overview of the GPS/NPA design, and an understanding of the requirements and procedures to conduct a GPS/NPA.

This Advisory Circular addresses the following:

a. the GPS equipment requirements and how to determine if an aircraft installation is suitable for conducting GPS/NPAs, by reference to the flight manual.

b. the GPS/NPA operational requirements including the requirements to provide for an alternate approach procedure based on conventional navigation aids.

c. the pilot qualifications and recency requirements necessary to conduct a GPS/NPA as pilot in command in IMC.

d. the procedures for flying a GPS/NPA and the factors to be considered when conducting an approach, including GPS receiver warnings, messages and mode annunciations.

e. Approach design

f. Airmanship considerations

2. INFORMATION / BACKGROUND

a. The approaches will be supplemental means IFR procedures requiring an approved primary-means navigation system to be available to the pilot. Effectively, this means that an alternate procedure based on a conventional ground-based navigation aid must be available at the

destination or an alternate aerodrome with a ground-based navigation aid must be planned.

b. The approaches are runway-aligned, permitting a lower minimum altitude and providing for a safer approach than the current circling approaches.

c. In most cases three initial approach fixes are provided for each approach, usually permitting a direct entry to the procedure, without the requirement for a Sector entry.

d. The GPS/NPA procedure has been adopted by the International Civil Aviation Organization ICAO) as GNSS/NPA and has been incorporated into PANS/OPS documentation as the international standard.

3. EQUIPMENT REQUIREMENTS

a. The receiver must be installed in accordance with the CAAB Advisory Circular on Global Positioning System (GPS) Installation Guidelines (if one is issued).

b. Automatic barometric aiding as specified, must be installed.

c. The receiver must have a current database. This can be checked during the start-up phase of the receiver.

d. The aircraft's flight manual supplement covering the GPS installation will indicate that the installation is suitable for conducting GPS/NPAs.

e. The GPS equipment operating instructions must be carried onboard the aircraft.

f. It is also advisable to have an appropriate checklist available on board the aircraft for easy reference in the sequential loading and operation of the equipment.

4. OPERATIONAL REQUIREMENTS

a. An alternate approach based on a conventional navigation aid must be planned when intending to conduct a GPS / NPA by day unless not more than 4 octas of cloud is forecast below the final route segment MEA plus 500 feet and forecast visibility at the destination aerodrome is not less than 8 kms.

b. In many cases, a suitable approach with a conventional navigation aid may be available at the destination aerodrome. When this is not the case, sufficient fuel must be carried to fly to an alternate aerodrome which is a suitable destination for the flight.

c. RAIM must be available to conduct a GPS/NPA. The receiver will not transition to approach mode unless RAIM is available prior to passing the final approach fix.

d. The GPS receiver has an approach Receiver Autonomous Integrity Monitoring (RAIM) prediction function which should be used prior to departure, and may be used at any time during the flight. This feature cannot take account of scheduled or unscheduled satellite outages which might affect RAIM availability; therefore, preflight planning should include a review of GPS notams.

5. PILOT REQUIREMENTS

a. A GPS/NPA instrument rating endorsement is required to conduct these approaches as pilot in command in IMC.

b. A flight test is required for an initial rating issue and for regular renewals, as with any other type of instrument approach. The flight test may be conducted in an aircraft or an approved simulator by a CAAB Flight Operations Inspector, an Approved Testing Officer or an Approved Check Pilot employed by a CAAB approved training and checking organisation.

c. Although a pilot need only demonstrate competence on one receiver type to gain a GPS/NPA endorsement, he must have completed at least three receiver specific approaches prior to using a type of receiver as pilot in command in IMC.

d. A pilot employed by a CAAB approved organisation with training and checking approval and who has undergone training in conducting a GPS/NPA using an aircraft's flight management system, may conduct a GPS/NPA using the FMS without holding a GPS/NPA endorsement.

e. Similar recency requirements applicable to other non-precision approaches apply to the GPS/NPA.

(i) A pilot intending to fly a GPS/NPA in IMC as pilot in command must have carried out at least one GPS/NPA within the previous 90 days.

(ii) Due to the variety of procedures applicable to different GPS receiver types an equipment specific recency requirement of one approach using the particular receiver type in the previous 6 months also applies.

f. Pilots should carefully review the receiver's operating procedures prior to every flight. A useful way of ensuring a pilot is familiar with the equipment is to enter the proposed flight plan, including the approach, into the receiver prior to departure. This will also allow a pilot to conduct a confidence check of each of the planned tracks and distances.

6. GPS/NPA RECEIVER DATABASE

a. The approaches are coded as a series of waypoints which the receiver can retrieve and automatically sequence during the approach.

b. Included with the waypoint coordinates in the database is information about the waypoint type. This information includes whether the waypoint is a fly over point, or a fly-by point and whether it is an initial, intermediate, final or missed approach point.

c. The receiver will permit an approach to be flown with an out of date database, however this should only be used in an emergency, or after verification of the approach waypoints, tracks and distances against the current published approach chart.

7. RAIM AND GPS NAVIGATIONAL MODES

a. Integrity of a navigation system is the ability of the system to provide a timely warning to users when the system is no longer suitable for navigation. Integrity monitoring provides a guarantee that a warning will be provided should the system be unable to remain within specified limits.

b. For the particular phase of flight being undertaken ie. enroute, approach etc, there is an allowable positional tolerance. This is called the Horizontal Integrity Limit (HIL). When the calculated positions from the various combinations of satellites are compared by the RAIM algorithm, the differences between each calculated position should not exceed that tolerance. If the horizontal integrity limit is exceeded a RAIM Warning indication is given by the receiver.

c. Situations may arise when the receiver will indicate that RAIM has been lost (display of this message is receiver dependent). This occurs when not enough satellites are in view, or the geometry of the satellites is poor.

d. Multi-sensor navigation systems such as some flight management systems, can use position information from other navigation sensors such as INS, DME/DME or DME/VOR for integrity monitoring.

e. The mode determines the CDI sensitivity and the RAIM horizontal integrity limit.

(i) Enroute Mode - CDI full scale deflection is selectable by the pilot with most receivers defaulting to the recommended 5nm full scale deflection. This should be checked before flight using the setup mode. In enroute mode, the RAIM horizontal integrity limit is 2nm.

NOTE: Some manufacturers choose not to implement the enroute RAIM HIL of 2nm, in which case the HIL remains at 1nm enroute.

(ii) Terminal Mode - CDI full scale deflection is +/- 1nm and the RAIM HIL is 1nm. Terminal mode operates within 30nm of the departure and destination aerodrome.

(iii) Approach Mode - CDI full scale deflection is +/- 0.3nm and the RAIM HIL is 0.3nm. Approach mode is used between the final approach waypoint and the missed approach point.

NOTE: A linear scale of 0.3nm full scale deflection is implemented by most manufacturers. The alternative allows the CDI sensitivity to emulate a VOR, becoming more sensitive as you approach the missed approach point. Consult the receiver's operating instructions for more information.

8. RAIM WARNINGS AND MESSAGES

a. For most phases of flight, the GPS receiver will provide an immediate annunciation of a loss of RAIM capability. The exception to this is the five minutes following passage over the final approach waypoint of a non-precision approach during which time, a loss of RAIM

annunciation will be inhibited. GPS navigation may still be possible during this RAIM outage.

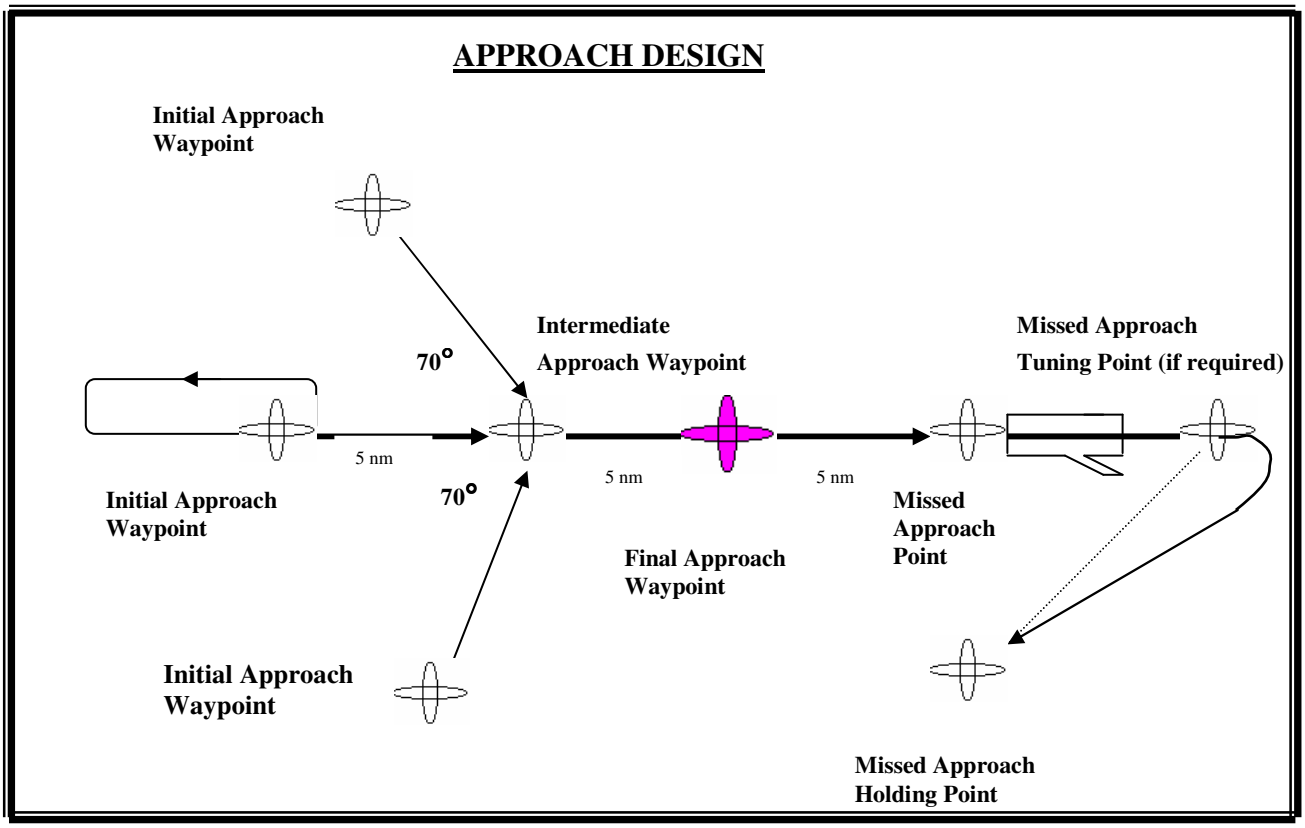
b. The GPS receiver automatically performs an approach RAIM prediction just prior to passing the final approach waypoint and will only enter approach mode if RAIM at the 0.3nm horizontal integrity limit is predicted to be available from the final approach waypoint to the missed approach waypoint.

c. **RAIM Loss** - A RAIM loss will be indicated when the system is unable to provide integrity at the required horizontal integrity limit. This is usually due to insufficient satellites in view or poor satellite geometry. Navigation may still be possible.

d. **RAIM Warning** - An immediate RAIM warning will be provided whenever the RAIM function detects an anomolous condition causing position uncertainty to exceed the relevant horizontal integrity limit.

e. Whenever a RAIM warning is provided, the system must be assumed to be unreliable and an alternative means of navigation must be used. If this occurs during a non-precision approach, then a missed approach is required.

9. APPROACH DESIGN



a. **Initial Approach Waypoint** - GPS Non-Precision Approaches are designed as straight-in runway approaches. The approaches usually offer a choice of three initial approach

waypoints allowing direct entry to the approach from any direction. Sector 1 and 2 entries are not normally required.

(i) When terrain or environmental considerations preclude entry from a particular direction, this initial waypoint will not be published.

(ii) The initial approach waypoints are all fly-by points and the receiver can be set to provide turn anticipation onto the initial leg. Turn anticipation takes account of the aircraft's groundspeed and the magnitude of the turn required.

b. **Intermediate Approach waypoint** - The GPS/NPA incorporates an intermediate segment into the approach which allows the aircraft to be aligned with the final approach segment before passing the final approach waypoint.

(i) The intermediate brings the aircraft into the capture zone required for the transition to approach mode.

(ii) The intermediate approach waypoint is a fly-by waypoint.

c. **Final Approach Waypoint -** The final approach waypoint is a fly-over waypoint. The aircraft must track over the waypoint within a defined capture zone to allow the receiver to transition to approach mode and commence the next segment of the approach.

d. **Missed Approach Waypoint -** The missed approach point is always a fly over waypoint at the runway threshold. At the missed approach waypoint, the GPS receiver will enter HOLD mode and automatic waypoint sequencing will be suspended. *(GPS continues to provide tracking information to the runway end waypoint, but does not sequence to the missed approach turning waypoint unless selected by a pilot.)*

e. **Missed Approach Turning Waypoint -** When the missed approach comprises a straight segment, followed by a turn to the missed approach holding waypoint, a missed approach turning waypoint is established. This waypoint is either a fly-by or fly over waypoint.

f. **Missed Approach Holding Waypoint** - The final waypoint in the GPS/NPA sequence is the missed approach holding waypoint. The GPS receiver will provide tracking guidance to this waypoint if the missed approach mode is selected, after passing the missed approach waypoint.

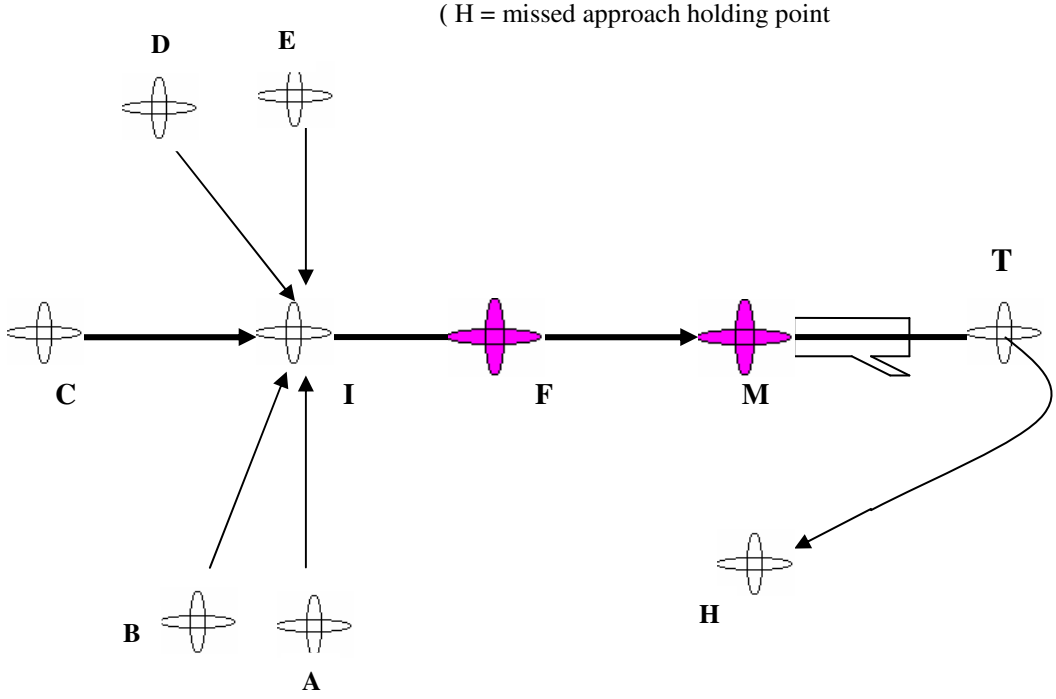
(i) The chart will indicate a bearing and distance from the missed approach waypoint or the missed approach turning waypoint (if used) to the missed approach holding waypoint. This bearing and distance represents the direct track to the missed approach holding waypoint.

10. WAYPOINT NAMING CONVENTION

WAYPOINT NAMING CONVENTION

- **Waypoint names comprise**
  (the 3 letter aerodrome designator
  (the compass quadrant from which
  the approach is flown eg. N = north

the type of waypoint
(A/B/C/D/E for Initial approach
(I = intermediate approach waypoint
(F = final approach waypoint
(M = missed approach point
(T = missed approach turning point
(H = missed approach holding point



NOTE: Besides the straight-in initial waypoint there could be either "Y" *or* "T" *positioned waypoints as depicted in the above graph.*

a. A standard waypoint naming convention has been used for approaches to aid situational awareness. The waypoint names all consist of five letters. The first three letters are the last three letters of the aerodrome designator (ie. the Y is omitted). For example, the Goulburn (YGLB) NPA uses GLB as the first three letters for each of the GPS/NPA waypoints.

(i) The next letter in the waypoint name is the compass quadrant from which the approach is flown. ie. N, S, W, or E.

(ii) The last letter describes the position of the waypoint in the approach sequence. The initial approach waypoints use A, B, C, D etc, depending upon how many approaches and initial approach waypoints are established at the aerodrome.

NOTE: The combination "NB" is not used since this is the Jeppesen designator for an aerodrome's NDB. The remaining waypoint designators are as follows:

I = intermediate approach waypoint
F = final approach waypoint
M = missed approach waypoint
T = missed approach turning waypoint
H = missed approach holding waypoint.

(iii) When using waypoint names in position reports it is usual to say:
the name of the location
the last two letters spoken in phonetics -

eg. the final approach waypoint of an approach from the south of Goulburn would be called GLBSF and would be pronounced, "Goulburn Sierra Foxtrot".

11. FLYING THE APPROACH

a. Selecting the Approach

(i) To select a GPS/NPA the final waypoint in the receiver's flight plan must be an aerodrome. To ensure proper aircraft tracking, the flight plan should be to the destination navigation aid and then to the aerodrome. When a GPS/NPA is selected, it will replace the aerodrome in the flight plan.

(ii) Select the desired approach from the receiver's database and the desired initial approach waypoint. Check waypoint sequence, tracks and distances against the approach chart.

b. Enabling the Approach

(i) When within 30nm of the destination, the receiver will prompt you to enable APPROACH mode. You may also be prompted to enter the aerodrome QNH.

(ii) The CDI full-scale deflection and the RAIM horizontal integrity limit will transition to terminal mode (1.0nm). If you wish the CDI to remain at the enroute sensitivity, (5.0nm) you may choose not to enable the approach at this stage. You will be prompted again prior to passing the final approach waypoint.

(iii) When ready, track direct to the selected initial approach waypoint. Be aware of the MSA prior to deviating from the planned track. The approach chart shows the 25nm MSA. Remember, ATS requirements (ie. controlled airspace clearance) must also be satisfied before tracking direct to the initial approach waypoint.

(iv) Three initial approach waypoints mean that direct entry to the approach is usually possible from any direction.

c. Approach Sequencing

(i) Once the approach has been selected and the APPROACH mode enabled, the GPS receiver will automatically sequence through the approach. Pilot inputs to the receiver are not required unless holding or a missed approach needs to be flown. Refer to your receiver's operating instructions for more details.

(ii) The initial and intermediate waypoints are fly-by waypoints and the receiver will provide turn anticipation to guide you onto the next segment.

(iii) The receiver displays track and distance to the next approach waypoint. Standard leg lengths of 5nm and the waypoint naming convention will assist situational awareness. The approach chart provides an altitude and distance scale for the final approach segment.

d. The Final Approach Segment

(i) At 3nm from the final approach waypoint, the receiver will predict RAIM availability at the 0.3nm horizontal integrity limit. At 2.0nm from the final approach waypoint, provided RAIM is available and the aircraft flies through the capture area of the final approach waypoint, the receiver will transition to approach mode.

(1) The APPROACH annunciator will illuminate.
(2) A RAIM loss annunciation will be inhibited for five minutes after passing the final approach waypoint.
(3) RAIM warnings will continue to be immediately displayed.
(4) CDI full-scale deflection and the RAIM horizontal integrity limit is 0.3nm.
(5) The pilot tracking tolerance is within a half-scale deflection of the CDI.

Note : A loss of RAIM means that the system is unable to monitor integrity (navigation may still be possible). A RAIM Warning means that RAIM is currently available and an anomaly has been detected. *[The Air Operator SOPs must address the Human Factor problems that the crew may be confronted with from the final approach segment down through the missed approach. If there is a system integrity warning, or other confusing indications, do not continue to use the system. The industry is plagued with problems during missed approach /go-around maneuvers because of so many ways to conduct them. The Air Operator procedures should require the crew to use an alternate means of navigation immediately after getting any indication of failure in RAIM warning /loss or annunciation. Go-around, sort it out and try again, but do not try to fix it on the way down to the ground.]*

e. The Missed Approach

(i) If you are not visual at the minimum altitude, initiate an immediate climb to the missed approach altitude, continue to the missed approach waypoint, before selecting MISSED APPROACH mode on the receiver.

(ii) If you lose approach annunciation or you receive a RAIM loss or warning annunciation and/or message, initiate the missed approach on the receiver straight away.

(1) The receiver will immediately return to terminal mode and navigation with RAIM (1.0nm HIL) may be restored, allowing you to use the GPS for missed approach guidance.

(2) Further missed approach selection will be required at the missed approach waypoint. *[Typically a crew would select TOGA and two selections of missed approach. This is a very demanding phase of flight and procedures should be kept simple.]*

(3) Should navigation not be restored, an alternate means of navigation, (including DR) will be required. *[The crew should be cautioned against typing their way out of trouble by restoring navigation. This is exactly what happened to American Airlines at Cali. The Air Operator procedures must address all Human Factor issues.]*

(ii) The waypoint coding for the missed approach waypoint tells the receiver to enter HOLD mode, therefore for further guidance after passing the missed approach waypoint, the missed approach mode will need to be selected. This applies even if you have selected MISSED APPROACH mode prior to arrival at the missed approach waypoint.

Note:. The missed approach turning point may well be the MAP with a climbing turn called out in the text description. A Missed Approach initiated before the MAP should be conducted in the vertical, but no turns initiated toward the missed approach holding point until the MAP is reached in order to ensure obstacle clearance.

f. Holding

(i) If holding is required, select HOLD mode prior to arrival at the desired holding waypoint. Automatic waypoint sequencing will be suspended.

(ii) Enter the required inbound track for the holding pattern - depending on the receiver, this may be selected on the receiver's control panel or on the external omni-bearing selector. In HOLD mode, the GPS receiver provides similar guidance to a VOR established at the holding waypoint.

(iii) Fly the required sector entry into the holding pattern.

(iv) When ready to continue the approach, cancel HOLD mode to resume automatic waypoint sequencing.

(v) Always remember to check displayed information before accepting the receiver's default settings or instructions.

12. Airmanship

a. A lack of mode awareness is a well-recognized hazard associated with computerized flight systems. You must be able to recognize the correct mode of operation for each phase of flight, particularly during instrument approach. Ensure you are familiar with the operating procedures before using the GPS in IMC.

b. Check the receiver operation, the database validity and your approach chart before flight. Make sure the receiver is setup with the required navigation settings. ie. distances in nautical miles, QNH in hectopascals, etc. The CDI scaling for enroute operation should also be checked.

c. When first learning GPS, there is a tendency to become so engrossed in the operation of the receiver that situational awareness is lost. Remember, your first priority is always to fly the aircraft. Ensure GPS is included in your instrument scan but avoid fixating on the receiver.

d. Differences in the operation of GPS receiver types can be confusing. Review the functions of the GPS receiver before each flight by entering the complete flight plan, including the instrument approach procedure, to your destination. Finally, do a confidence check of all tracks and distances.

e. As familiarity is gained, complacency must be guarded against. Always use all navigation information available to crosscheck GPS information.

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