August 28, 2014

Ms. Margaret Gilligan
Associate Administrator for Aviation Safety
Federal Aviation Administration
800 Independence Avenue
Washington, DC 20591

Dear Peggy:

The Performance-based operations Aviation Rulemaking Committee (PARC) is pleased to submit the following recommendations which address an issue that was requested by FAA and Industry. The issue is developing appropriate design criteria for using an RNAV / RNP intermediate segment to join an ILS, GLS, or LPV final approach that will allow the broadest range of aircraft participation in the procedures.

The PARC Navigation Working Group was assigned these tasks, which they completed in July 2014. The WG recommendation was approved by the PARC SG at the August 21, 2014 meeting, and I have attached the recommendation to this letter.

PARC has retained a history of meetings and backup substantiation of conclusions on the PARC website. The PARC appreciates your continued support of its activities and invites you to discuss any aspects of these recommendations at your earliest convenience. The PARC respectfully requests the FAA to provide the PARC with a formal response.

Sincerely,

Mark Bradley
Chairman, PARC

Cc: R. Dunham
M. Steinbicker
B. DeCleene
M. Cramer

RNP TO XLS RECOMMENDATIONS

The PARC SG asked the Navigation WG to recommend procedure design criteria updates / changes that would enable the widest possible range of current generation of aircraft to participate in approach procedures using an RNAV/RNP initial and intermediate segment to reach an xLS final. The criteria were to account for lateral navigation accuracy effect on the lateral capture and provide for automatic captures of the glideslope over a wide range of ISA deviations from a constantly descending path.

At the start of this activity, the WG compiled a complete survey of ILS / GLS capture criteria across aircraft and avionics models, classifying them into three basic types, and MITRE developed a MATLAB tool to investigate the relationships between all variables further. The MITRE FMS study this year (2014) tested the limits of many systems in engineering labs at both OEMs and manufacturers to further refine ideas and validate the tool. The Boeing Company supplied data they have generated while studying different designs for new procedures of this type into Oslo, Norway as well. The most significant findings from the testing across manufacturers during the MITRE study were 1) Two manufacturers systems automatically insert a shallower segment into the vertical path prior to the PFAF resulting in GS captures under all the tested temperature conditions and 2) Some systems require longer times over which capture criteria are satisfied before they will actually capture the GS, resulting in missed captures in some of the high delta ISA conditions. Research into some on-going Eurocontrol studies found they were beginning to use the shallower segments as part of their design, with good results. That idea allows, with a suitable length shallower segment, GS captures from below across the range of temperatures as well, and enables LOC before GS capture (the preferred operational method) on all the procedures. This is illustrated in the figure below.

Testing has also shown that a level segment prior to the PFAF that is 1 NM long will allow captures from below over a wide temperature range, so the initial team recommendation will be to use 1 NM for a level segment unless temperatures exceed a ΔISA of +60C. For segments less than 3 deg but greater than 0, the distance will have to be increased for the same temperature range, but will not need to exceed 5 NM, and a calculator has been developed to compute the optimal length based on the temperature range desired.

The following guidelines and parameters are recommended for implementation by FAA:

1. The standard design will use an RF to intercept the final approach course (up to 180^{o})
2. The PFAF location will be determined by:
    a. Using the current standards for ILS, GLS or LPV
    b. Typically it will be closer to the runway than traditional designs, therefore:
        i. This is not be precluded by criteria and
        ii. No special exception should be necessary to move it closer than traditional designs.
3. Between the RF and PFAF the design will incorporate a shallower segment (approximately 2^{o} down to a level segment) to allow GS capture from below at high ΔISA

a. The standard design will have this segment coincident with the final approach course, but the criteria should not preclude having it along the final part of the RF turn before it joins the approach final segment course
b. The end of the RF (start of shallow segment) will be a hard altitude
c. Per current criteria, the PFAF is still an "at or above" altitude
d. The length of the shallow segment can be computed two ways:
    i. It will be 1 NM or greater, the minimum of 1 NM is based on approach speed and 20-25 seconds to engage approach mode, or,
    ii. It can be computed based on the highest temperature for which the procedure is intended to be used (see Figure 1 below)
    iii. 1 NM will allow glideslope capture from below for temperatures up to +50 ΔISA at sea level

4. RF descending (intermediate segment) cannot be steeper than the final segment
    a. "At or below" speed at start of RF
5. Minimum radius of RF per current criteria
6. End point of RF will be the FACF

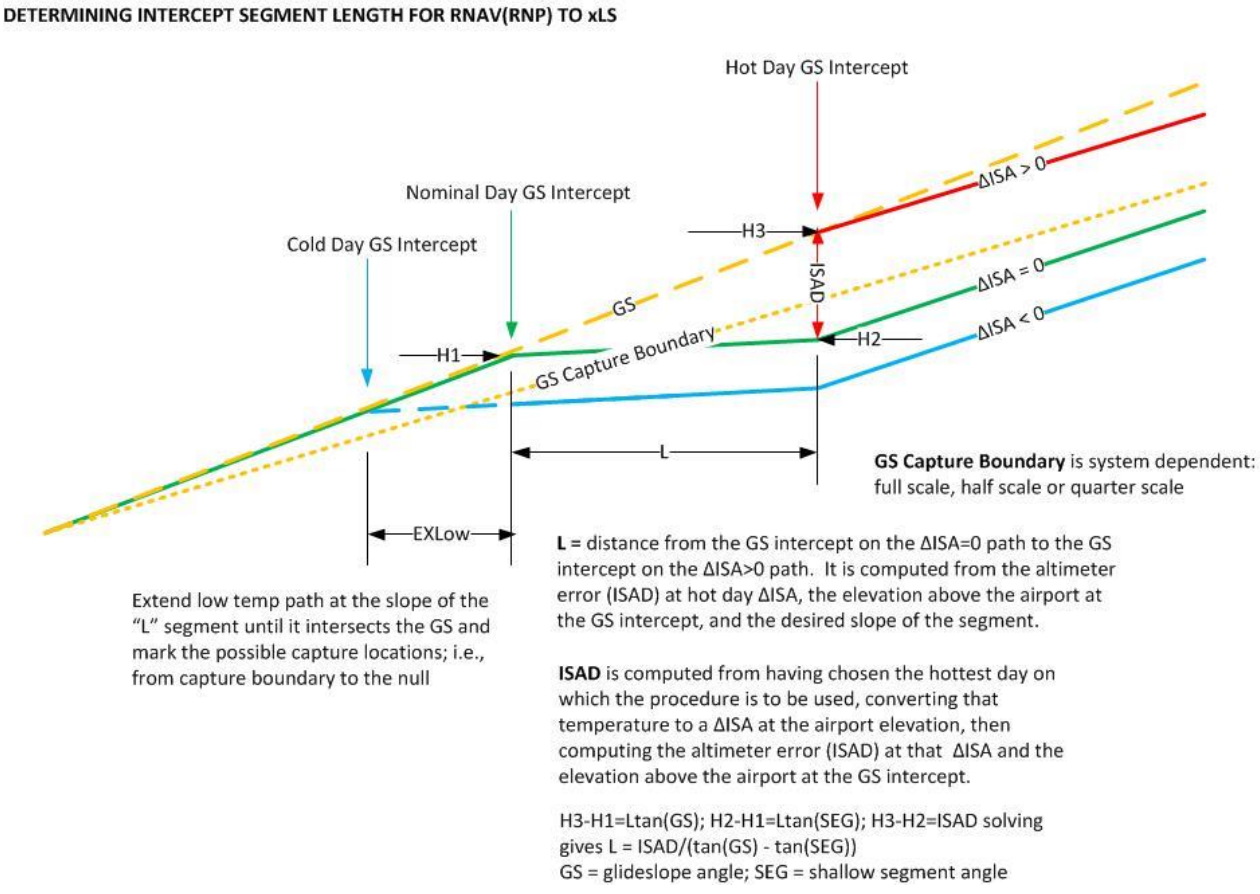

Figure 1 Method for computing shallow segment length