

March 4, 2019

Mr. Ali Bahrami
Associate Administrator for Aviation Safety
Federal Aviation Administration
800 Independence Avenue, 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 Working Group (Nav WG) recently completed an analysis of issues that arise when a Standard Terminal Arrival Route (STAR) procedure is connected to an instrument approach procedure (IAP) when programming the flight management computer (FMC). There were occasions in which the terminating (or last) altitude on a STAR was lower than the initial altitude of an IAP. When this happened, the FMC could not reconcile the difference. This resulted in a pilot executing labor intensive modifications. The Nav WG identified possible solutions that would properly sequence the waypoints and correctly compute the descent profile. This would result in a smoother and more efficient transition from STAR to IAP.

Further details are delineated in the recommendation on the following pages.

I personally commend the Nav WG for their continued diligence relative to issues such as the one noted in this report. These efforts lead to a more efficient NAS and pave the way for the next evolution of NextGen performance based operations.

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. The PARC also respectfully requests the FAA to provide us with a formal response to these recommendations. Please call me if you have any questions or would like to set up a discussion.

Sincerely,



Mark Bradley
Chairman, PARC
404-915-2144

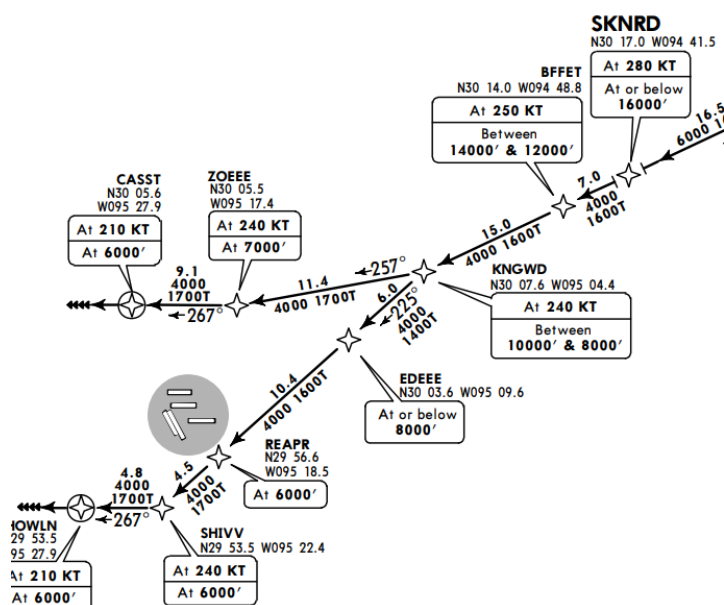
Cc: Mark Steinbicker
Chris Hope
Mike Cramer
Merrill Armstrong
TJ Nichols
Donna Creasap

STAR Bottom Altitudes versus IAP IAF/IF Altitudes– Problem Statement

As Performance Based Navigation (PBN) procedures started to make their way through the National Airspace System (NAS) an issue surfaced when the Standard Terminal Arrival Route (STAR) bottom altitude was lower than the altitude at the initial approach fix (IAF) of an instrument approach procedure (IAP). In this case, most modern Flight Management Computers (FMC) will not allow the entry of a descent to the bottom altitude of the STAR, followed by a climb to go back up to the IAF altitude coded on the approach. While common not to allow such an operation by the FMC, there are variations on how FMC OEMs handle this exception which can cause further pilot confusion. One example is the GE FMC which will not allow the execution of a route that has this descent, followed by climb operation. In the GE handling, if the pilot misses an obscure scratch pad message when loading the STAR and approach, later they will not get an execute light on the MCDU and must discover why they have a MOD route with no EXEC light.

We mainly see this issue at locations where the STAR ends on a downwind but the approach is built to handle both the downwind and straight in traffic. The primary cause of this problem with PBN routing is that an effort was made to improve aircraft energy management while flying PBN routes. On the older conventional STARs, bottom altitudes on the downwind were often higher but created unstable approaches with high energy if ATC turned the aircraft early on VMC days (and it's simply a fact we have more VMC days than IMC at most locations). On the newer PBN procedures industry asked to use existing ground tracks on VMC days to figure a STAR bottom altitude that would remove the high energy, unstable approach problems we saw with the conventional procedures. Let's look at a practical example of this problem, then look at some potential solutions:

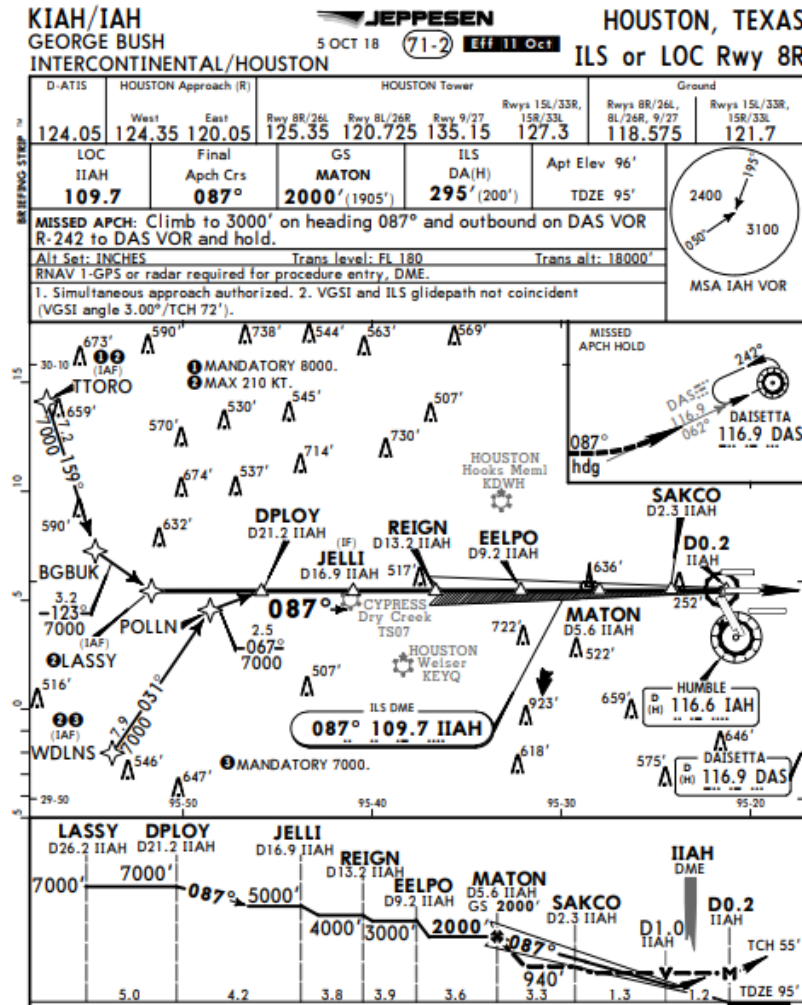
KIAH in East configuration using the SKNRD RNAV Arrival with the ILS Rwy 08R. Using the North downwind, the SKNRD RNAV Arrival ends at CASST at 6,000 ft.



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When the pilot attempts to load the ILS RWY 08R, the only relevant options from CASST are either to load the FMC from EELPO (no transition) or LASSY transition. Most pilots would know they will likely not get turned in by EELPO and therefore would want to load the LASSY transition to be prepared to be turned onto final further out. The only problem is that the LASSY transition starts at 7,000 feet which is higher than the STAR bottom altitude of 6,000 feet. In this case, the pilot will not be able to EXEC this routing into the FMC without some modification. Since most operators train pilots not to modify approach attributes in the FMC and we of course cannot modify the bottom altitude of the STAR, this leaves few options for the pilots.



Possible Solutions

There are multiple ways to handle procedure design that would correct this issue, two examples are below:

- 1) Add an IAF on all IAPs that starts at or below the STAR bottom altitude. In our example, JELLI could be made into an IAF as pilots could load the JELLI transition with the 5,000-foot altitude.
- 2) Require the STAR bottom altitude to always be at or above the highest IAF for approaches that the STAR can feed. Consideration should be maintained for the energy management state of the

aircraft flying these procedures so that may restrict the location (laterally) of where the STAR terminus may be located. In our example, CASST could be raised to 7,000 feet but by raising the altitude 1,000 feet, the location may need to be moved back 3 miles to keep the energy management state consistent with current operations.

Recommendation

To prevent this problem in the future, the PARC NAV WG recommends that the FAA add notes to **both** STAR and SIAP criteria. The note in the STAR criteria should encourage the procedure designer to assure that the bottom altitude of the STAR is not lower than the desired connecting point on any IAP it will serve. Conversely, the note in the SIAP criteria would encourage the designer to verify that the IAF for the approach is not higher than the bottom altitude on the planned connecting STAR. Using this method will ensure if a STAR is built or modified without opening SIAPs that the STAR construction complies with this need. Conversely if a SIAP is built or modified without opening the arrivals, having this note in SIAP criteria will also ensure this need is met.

Additional Examples

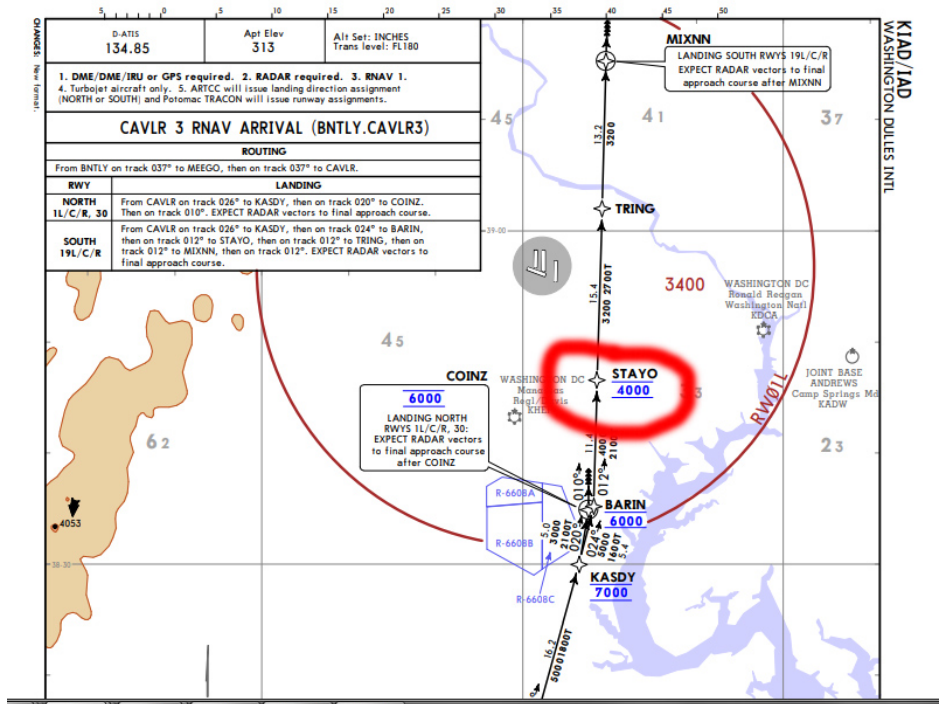
This last section will provide some additional examples of this problem in current operations to help highlight this need.

IAD

KIAD CAVLR3 arrival -> ILS 19C, ILS 19L

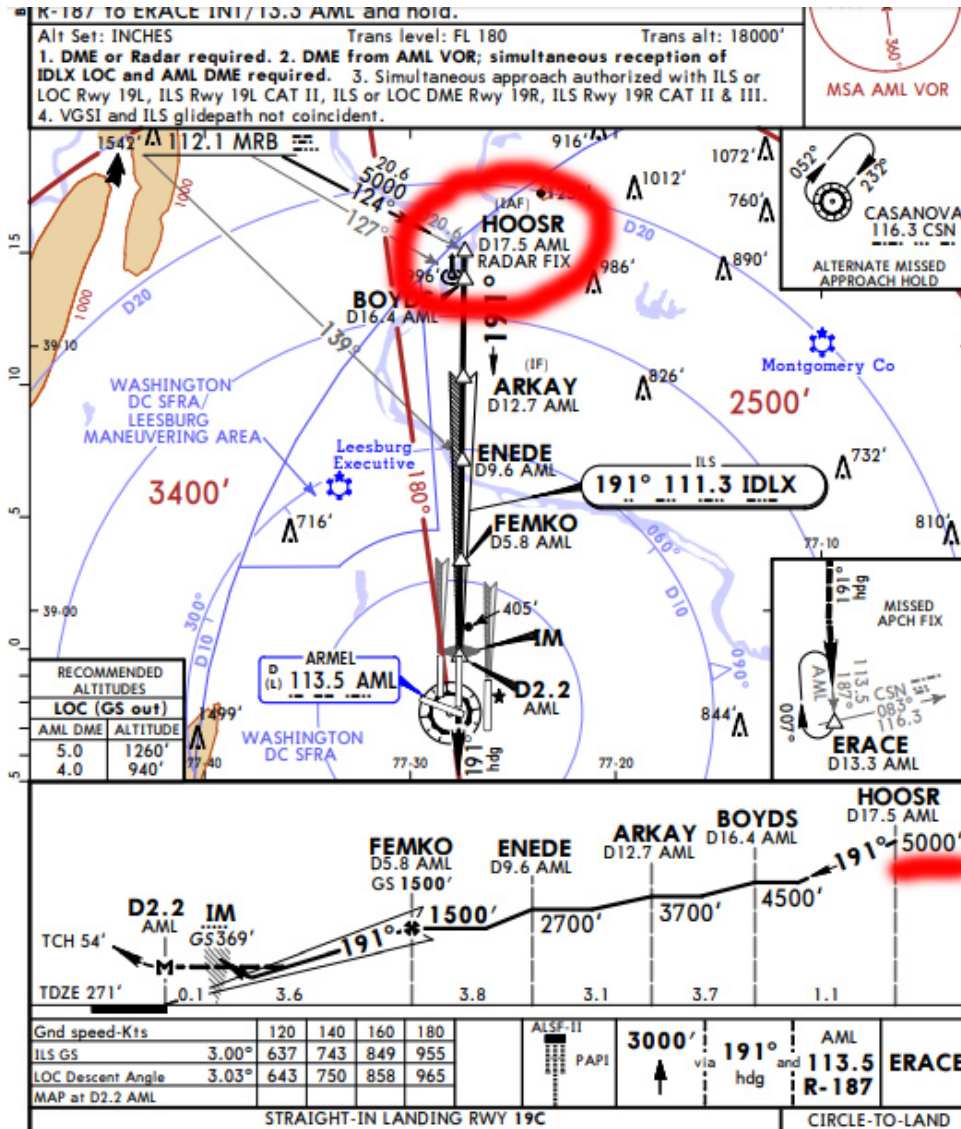
- STAR bottom altitude = 4,000 ft, SIAP IAF = 5,000 ft

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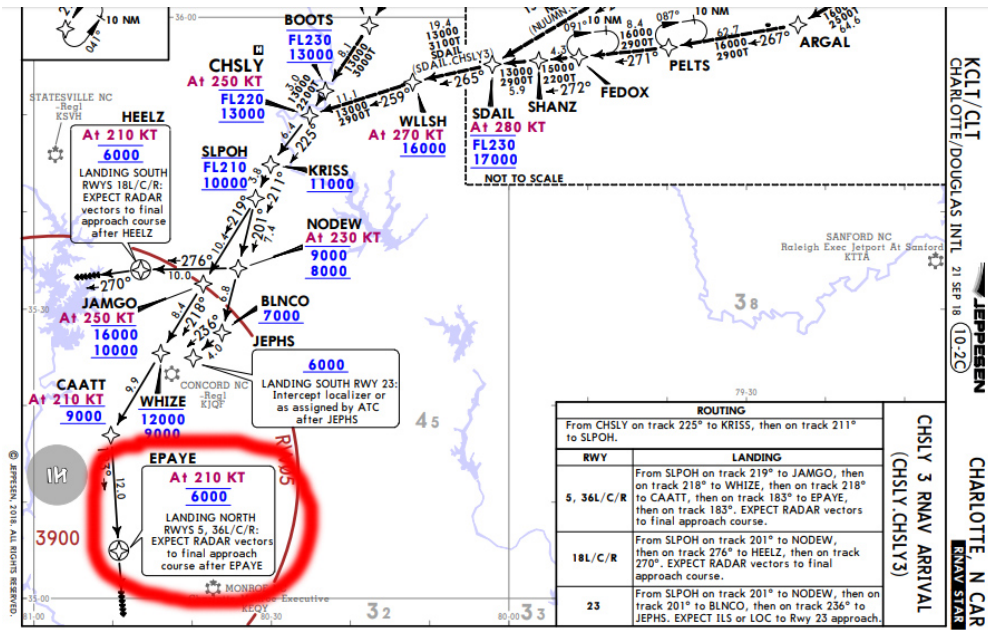
CLT

KCLT CHSLY3 arrival -> ILS 36C

- STAR bottom altitude = 6,000 ft, SIAP IAF = 8,000 ft

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LAX

KLAX IRNMN2 arrival -> ILS 24R

- STAR bottom altitude = 6,000 ft, SIAP IAFs = 12,000 ft

