AERONAUTICAL CHARTING FORUM
Instrument Procedures Group
April 23, 2013

HISTORY RECORD

FAA Control # 13-01-311

Subject: Terminal Area Arrivals

Background/Discussion: Terminal Area Arrivals (TAA) have been a part of the US National Airspace System for many years. However, NBAA has number of concerns regarding FAA's most recent published criteria for TAA design and FAA's guidance furnished to pilots for using TAAs on RNAV & RNP instrument approaches.

FAA Order 8260.58, *United States Standard for Performance Based Navigation*, Volume 4, Chapter 1, paragraph 1.1 states:

> **1.1 Initial, Intermediate, Final and Missed Approach Segments.**
>
> The following application guidelines are specific to the TAA and apply to all PBN procedures. The Basic T approach segment configuration, as described below, is the standard configuration for transition from the en route to the terminal environment. Deviations from the Basic T configuration should be made only when absolutely necessary. ***The TAA was conceived as a "free flight" concept; i.e., the pilot can maneuver as necessary within the TAA sector. It is assumed the pilot will maneuver to enter at a given IAF at an airspeed and intercept angle to correctly fly the procedure.***

In addition, paragraph 1.1.1 states, in part:

> The MAXIMUM intercept angle of the initial segment to the intermediate segment is 90 degrees. The MINIMUM intercept angle is 60 degrees (see figure 1-1).
>
> The minimum length of the T initial segments is the larger of the table 1-1 value or the results of the Volume 6, paragraph 1.3.2 "Fly-By Turn" calculation. ***Since the TAA is considered a "Free Flight" concept, assume a 45-degree turn at the IAF.***

The note contained in Table 1-1 re-iterates this assumption, and further states that it is assume that the pilot will maneuver as necessary to make good this maximum intercept angle:

Table 1-1. Minimum Initial Segment Length for TAA Construction

Category	Minimum Length (NM)
A	3
B	4
C	5
D	5
E	6

Note: The TAA is a "free flight" area. Pilots are assumed to maneuver so as to enter the initial segment at approximately a 45-degree angle.

However, no guidance is provided to the pilot regarding a requirement to maneuver within the TAA to limit the intercept angle at the IAF to a maximum of 45 degrees. In fact, the guidance furnished to the pilot in Aeronautical Information Manual (AIM) section 5-4-5, paragraph d 5 (b) ***does not permit*** the pilot to conduct the "free flight" maneuvering assumed by the design criteria:

> **(b)** Pilots entering the TAA and cleared by air traffic control, ***are expected to proceed directly to the IAF associated with that area of the TAA*** at the altitude depicted, unless otherwise cleared by air traffic control.

This guidance is repeated in the FAA's Instrument Flying Handbook (FAA-H-8083-15B, 2012 edition) on page 1-18:

> The standard TAA has three areas: straight-in, left base, and right base. The arc boundaries of the three areas of the TAA are published portions of the approach and allow aircraft to transition from the en route structure direct to the nearest IAF. ***When crossing the boundary of each of these areas or when released by ATC within the area, the pilot is expected to proceed direct to the appropriate waypoint IAF for the approach area being flown***. A pilot has the option in all areas of proceeding directly to the holding pattern.

Similar guidance is also contained in the FAA's Instrument Procedures Handbook (FAA-H-8261-1A, 2007), on page 5-46:

> Procedurally, pilots may be cleared to an IAF associated with the TAA. ***ATC expects the flight to proceed to the IAF and maintain the altitude depicted for that area of the TAA, unless cleared otherwise***. An obstacle clearance of at least 1,000 feet is guaranteed within the boundaries of the TAA.

(Note: This description remains unchanged in the current draft for the 2012 edition of the IPH).

In addition, the AIM does not furnish guidance regarding what constitutes an appropriate airspeed to enter the TAA, which is assumed by the TAA design criteria as described in the 8260.58 paragraph 1.1:

> The TAA was conceived as a "free flight" concept; i.e., the pilot can maneuver as necessary within the TAA sector. ***It is assumed the pilot will maneuver to enter at a given IAF at an airspeed*** and intercept angle ***to correctly fly*** the procedure.

From these examples, it can be seen that there exists a fundamental disconnect between the design criteria upon which the TAA concept is based and the guidance furnished to pilots regarding the execution of the required maneuvering necessary to join the initial segments within the TAA.

The statements above extracted from FAAO 8260.58 are not contained in the previous guidance covering TAA's, FAA Order 8260.45A. NBAA was unable to locate other policy or directives affecting TAAs that added the concept that TAA's are free-flight areas and that the pilot would maneuver accordingly to intercept the initial segment at approximately 45-degree angle and at an appropriate speed.

The assumption that the pilot will maneuver the airplane to achieve a 45-degree maximum intercept angle at the IAF when joining the initial segment appears to be sound. Recent test-bed simulator analysis performed on behalf of NBAA illustrates that at adverse groundspeeds (approx. 225 knots), the turn angle reaching the IAF associated with the left/right base leg, especially using the "Y" configuration, results in FMS turn anticipation logic initiating the turn to join the base leg at significant distance from the IAF. For approaches using the TAA "Y" configuration, the result is little or no wings level flight from the IAF to the IF/IAF waypoint (see Fig 1). Since the AIM does not provide a recommended maximum speed for entering the TAA (such as is applied to a procedure turn - ref: AIM 5-4-9, para 3), an excessive indicated airspeed at the left/right base leg IAF only exacerbates the situation.

Finally, it is noted that should the aircraft proceed to the left or right base leg IAF TAA from a point on the sector dividing line at the maximum TAA distance (30 NM), the turn angle at either base leg IAF may exceed the 120-degree turn angle limit for joining the initial segment at the IAF from an airway.

NBAA has noted that some recent instrument procedures have been developed without the use of left and right base leg segments, see attached example of Roundup, MT (KRPX). Without a left and right base leg segments, the pilot must execute the HILPT course reversal if arriving over the IF/IAF from any position within the 180-degree sector opposite of the HILPT. This option eliminates excessive turn angle necessary to join the base legs. It also eliminates the assumption that the pilot will execute a "free flight" maneuver intercept the base leg IAF at a maximum intercept angle of 45 degrees, a requirement that imposes a significant increase on pilot workload during an approach.

(<u>Note</u>: The guidance furnished to pilots in the Instrument Procedures Handbook state that when both base areas are eliminated, TAAs are not depicted in the planview. This is another subject that requires correction in the IPH.)

An added benefit gained by eliminating the left and right base leg from the TAA is the ability to tailor the size of the TAA sectors to meet air traffic requirements. A primary complaint of ATC and an oft-cited reason for not establishing a TAA on an RNAV approach is the amount of airspace that the 30 NM TAA sectors consume. NBAA has been told that in order to clear an aircraft for an approach within the TAA sector, the entire airspace for the altitude assignment down to the TAA sector altitude must be clear and remain clear of other traffic. This is unacceptable at many busy airports or areas with constrained airspace. By removing the left and right base legs, the size of the TAA can be more easily tailored to meet airspace and ATC's requirements. NBAA believes that this will aid the promulgation of

TAAs on RNAV approaches and assist ATC in making use the them. The benefits of doing so include allowing earlier approach clearances, resulting earlier descents to TAA minimum altitudes, and improve the opportunity for safer, stabilized approaches. It will also assist pilots and controllers in using the "direct-to" clearance to the IF for a straight-in approach (ref: FAA Notice 7110.615 Approach Clearances effective 3 June 2013).

Recommendations: Amend FAA Order 8260.58 Volume 4 to state that the preferred configuration for a TAA is without the left and right base legs, with the TAA sector arcs centered on the IF/IAF. The TAA sector size should be coordinated with the controlling ATC facility for optimized usability for the existing airspace. Existing guidance concerning limitations on minimum sector size (arc distance from IF/IAF), number of step-downs within a sector, etc. should remain unchanged. Permit the use of a left or right base leg only when an operational advantage may be gained (e.g. use of a lower initial segment altitude on the base leg resulting from an adverse obstacle within a TAA segment).

Amend AIM paragraph section 5-4-5, paragraph "d" concerning TAAs. The recommended changes are based on adoption of the first NBAA recommendation:

A. If the recommendation is adopted:

    a. Revise AIM guidance emphasizing the requirement to execute the HILPT when approaching the IF/IAF from the 180-degree sector opposite of the HILPT

    b. NoPT arrivals are permitted when approaching within the 180-degree sector located on the same side of the HILPT or when issued a direct-to clearance to the IF fix.

    c. Except as required for holding at the HILPT, recommend that the airspeed crossing the No PT IAF or NoPT IF/IAF not exceed 200 KIAS.

B. If the recommendation is not adopted and the existing guidance contained in the 8260.58 remains unchanged, amend the AIM as follows:

    a. Remove statement that the pilot is expected to proceed direct to the IAF associated with that area of the TAA; i.e., proceed direct to the IAF for the left or right base leg.

    b. Instruct the pilot that once cleared for the approach, they are required to maneuver within the TAA to achieve a maximum 45-degree intercept angle with the base leg upon crossing the applicable left or right base leg IAF prior to joining the initial segment.

    c. Except as required for holding at the HILPT, recommended that the airspeed crossing a NoPT IAF or the NoPT IF/IAF not exceed 200 KIAS.

NBAA requests that FAA's Instrument Procedures Handbook be revised to explain in detail the expectations for pilots flying an RNAV approach and arriving over an IAF or the IF/IAF using a TAA. This discussion should reflect the option selected above.

Comments: This recommendation affects:

- FAA Order 8260.58, United States Standard for Performance Based Navigation (PBN) Instrument Procedure Design and FAA Aeronautical Information Manual.
- FAA Aeronautical Information Manual
- FAA Handbook FAA-H-8261-1, Instrument Procedures Handbook, Current Edition

Submitted by: Richard J. Boll II
Organization: NBAA
Phone: 316-655-8856
FAX:
E-mail: richard.boll@sbcglobal.net
Date: March 25, 2013

Added Comments: In support of this ACF-IPG Recommendation Document, NBAA conducted a test bed simulation of the Cleveland Regional Airport (KRZR) RNAV (GPS) RWY 3 approach that is posted on the FAA Coordination web site (see attached flight inspection graphic). This test simulator used manual entry of waypoint data and did not include a programed vertical path. Key points resulting from this simulation are:

- Page 4 shows that the initial roll-up begins 5.9 miles from YODUL.
- Pages 9-10 show that even though the leg distance from YODUL to MMARS is 8 NM, the airplane does not achieve wings level until less than 2.5 NM from MMARs.
- There was no tailwind component throughout the simulation. Imagine the difficulty if the winds at 4000 MSL were say, 320/60.

A copy of the simulation is provided here: ( )

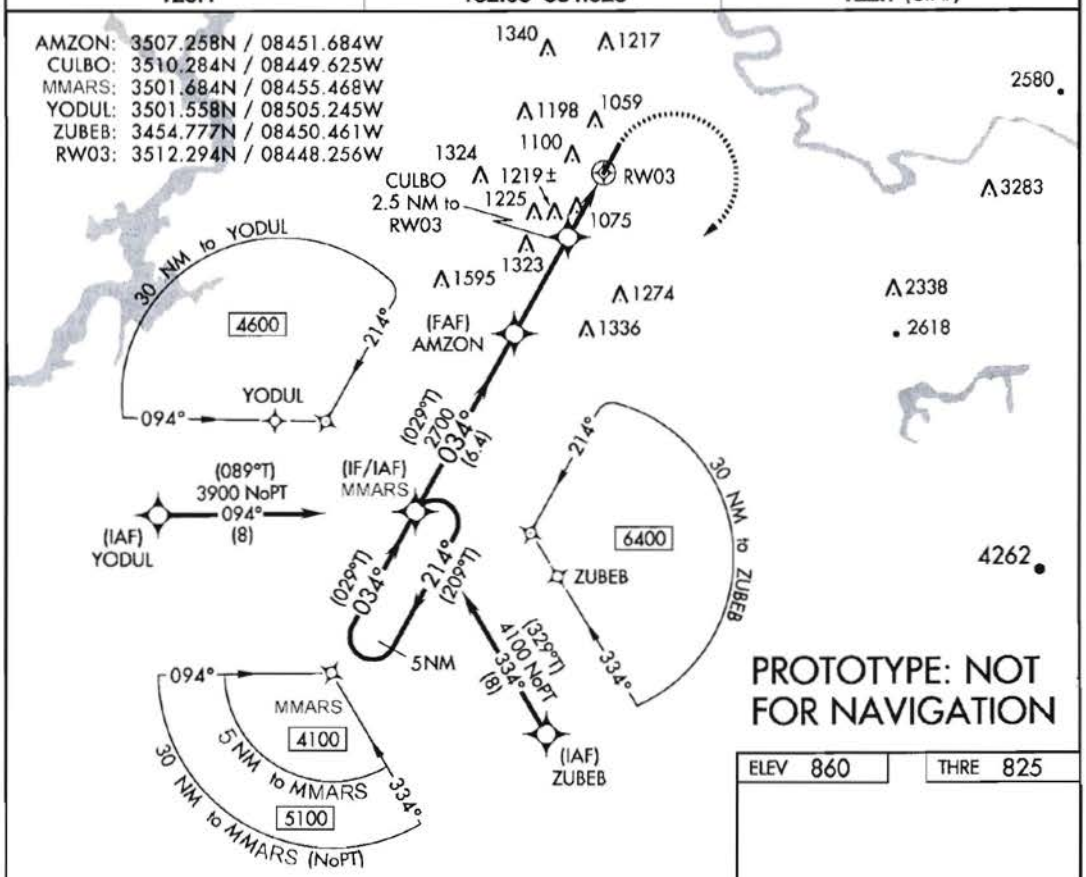
WAAS CH 99632 W03A	APP CRS 034°	Rwy ldg 5500 THRE 825 Apt Elev 860

RNAV (GPS) RWY 3
CLEVELAND REGIONAL JETPORT (RZR)

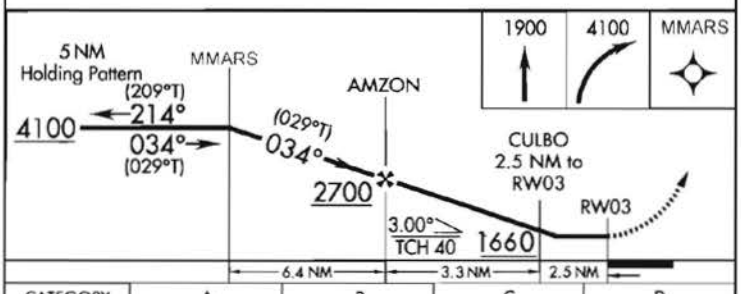
DME/DME RNP-0.3 NA. Procedure NA at night. When local altimeter setting not received, use Chattanooga altimeter setting and increase all MDA 80 feet and increase LP Cat C and D visibility 1/8 mile and LNAV Cat C and D and Circling Cat C visibility ¼ mile. Helicopter visibility reduction below 1 SM NA.

MISSED APPROACH: Climb to 1900 then climbing right turn to 4100 direct MMARS and hold

CHATTANOOGA APP CON*	ATLANTA CENTER	UNICOM
125.1	132.05 354.025	122.7 (CTAF)



ELEV 860	THRE 825



CATEGORY	A	B	C	D
LP MDA	1380-1	555 (600-1)	1380-1⅝	555 (600-1⅝)
LNAV MDA	1440-1	615 (600-1)	1440-1¾	615 (600-1¾)
C CIRCLING	1460-1 600 (600-1)	1480-1 620 (700-1)	1580-2 720 (800-2)	1780-3 920 (1000-3)

034° to RW03

MIRL Rwy 3-21
REIL Rwys 3 and 21

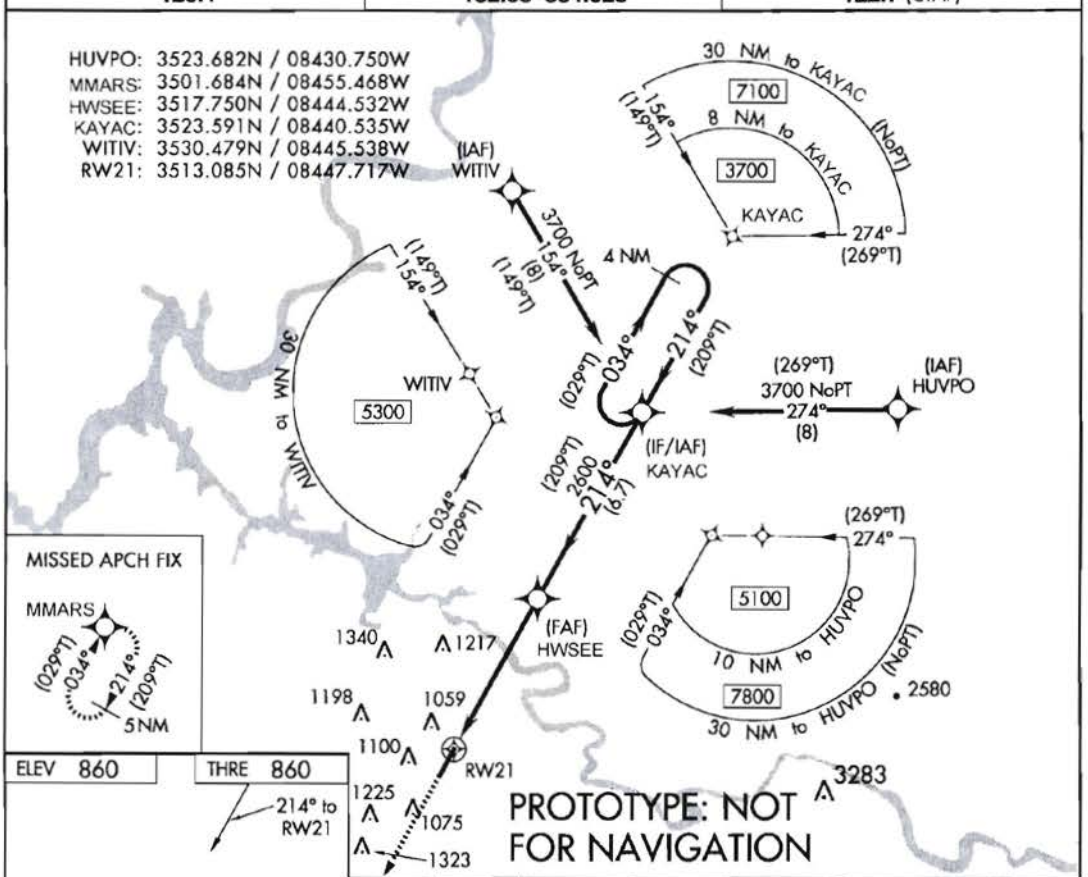
WAAS CH 45731 W21A	APP CRS 214°	Rwy ldg 5500 THRE 860 Apt Elev 860

RNAV (GPS) RWY 21
CLEVELAND REGIONAL JETPORT (RZR)

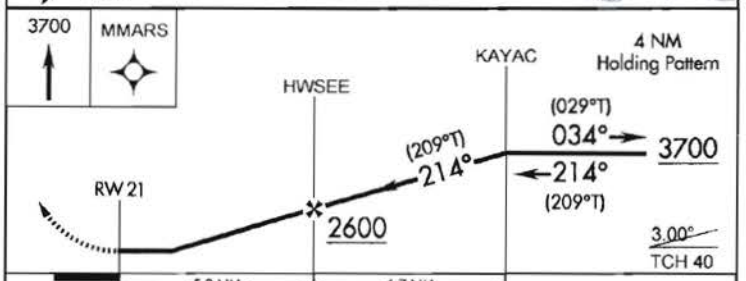
DME/DME RNP-0.3 NA. Procedure NA at night. When local altimeter setting not received, use Chattanooga altimeter setting and increase all MDA 80 feet and LP and LNAV Cat C and D visibility and circling Cat C visibility ¼ mile. HELICOPTER VISIBILITY REDUCTION BELOW 1SM NOT AUTHORIZED.

MISSED APPROACH: Climb to 4100 direct MMARS and hold, continue climb-in-hold to 4100.

CHATTANOOGA APP CON*	ATLANTA CENTER	UNICOM
125.1	132.05 354.025	122.7 (CTAF)



ELEV 860 THRE 860



CATEGORY	A	B	C	D
LP MDA	1340-1 480 (500-1)		1340 - 1⅜ 480 (500 - 1⅜)	
LNAV MDA	1360-1 500 (500-1)		1360-1⅜ 500 (500-1⅜)	
C CIRCLING	1460-1 600(600-1)	1480- 1 620 (700-1)	1580-2 720 (800-2)	1780-3 920 (1000-3)

MIRL Rwy 3-21
REIL Rwys 3 and 21

Initial Discussion - MEETING 13-01: New issue presented by Bob Lamond on behalf of NBAA. NBAA has conducted extensive research on TAA design criteria (FAA Order 8260.58, *United States Standard for Performance Based Navigation*) vs. pilot guidance for flying within a TAA (AIM, IPH, IFH, etc.). Order 8260.58, which incorporated TAA guidance from FAA Order 8260.45, *Terminal Arrival Area,* states that "*The TAA was conceived as a "free flight" concept; i.e., the pilot can maneuver as necessary within the TAA sector. It is assumed the pilot will maneuver to enter at a given IAF at an airspeed and intercept angle to correctly fly the procedure.*" The "free flight" verbiage is new to TAA design and has not been incorporated in any pilot educational material. The NBAA Recommendation Document (RD) provides explicit examples where guidance in the AIM, IPH and IFH effectively negates the "free flight" concept. From these examples, it can be seen that there exists a fundamental disconnect between the design criteria upon which the TAA concept is based and the guidance furnished to pilots regarding the execution of the required maneuvering necessary to join the initial segments within the TAA. NBAA has noted that some recent instrument procedures have been developed without the use of left and right base leg segments, providing an example at Roundup, MT (KRPX). NBAA supports this simplified design noting that without left and right base leg segments, the pilot must execute the hold-in-lieu of procedure turn (HILPT) course reversal if arriving over the IF/IAF from any position within the 180-degree sector opposite of the HILPT. This option eliminates excessive turn angles necessary to join the base legs. It also eliminates the assumption that the pilot will execute a "free flight" maneuver to intercept the base leg IAF at a maximum intercept angle of 45 degrees, a requirement that imposes a significant increase on pilot workload during an approach. Paul Eure, AJE-31, stated that the FAA has not done the best job in training controllers on TAA use and the ATO is currently working with Flight Standards specialists to help develop a training package for controllers. Paul stated that most controllers are under the assumption that once the aircraft is within the TAA, they can clear it for the approach and the pilots will fly it as charted. Gary McMullin, Southwest Airlines, stated that the TAA criteria were looked at extensively during the development of Order 8260.58 and the only thing that works effectively is the basic "T" design. Design criteria should be re-worked to do away with the "Y" design and retain the "T" design with shorter legs. Gary further recommended that future studies consider a 25 degree bank angle, historical winds, and published speed restrictions to enhance design and use. In summary, the discussion acknowledged that there are several "disconnects" related to the design and operational use of TAAs as well as controller training issues. Tom Schneider commented that certain elements of Order 8260.58 need to be addressed and he will take this to the US-IFPP. Paul Eure remarked that there's also a need to educate controllers about the characteristics and use of TAAs and this should take place sooner than later. Two IOUs were assigned:
1) AFS-420 will pursue a review of FAA Order 8260.58 through the US-IFPP and forward the results to AFS-470 for updating of the AIM, IPH and IFH.; and, 2) AJE-31 and AJT-2A3 will continue developing controller training material.
ACTION: AFS-420, AJE-31, and AJT-2A3.

MEETING 13-02: Tom Schneider, AFS-420, briefed the following update from the US-IFPP as received from TJ Nichols, the AFS-420 TERPS RNAV criteria specialist: "This subject was extensively discussed at the June US-IFPP meeting and led to a collaborative effort between AFS-420 and AFS-470 to review TAA use and a review of Order 8260.58. Both offices agreed to make changes in the next revision of the Order to remove all references to "free flight" from Volume 4, paragraphs 1.1.1, 1.2.1, 1.2.2, 1.2.3, and table 1-1. It was also

noted that there is a discontinuity between the minimum leg length or the ideal leg length and the assumed intercept angle. There was some language implying pilots were supposed to, or were obligated to, maneuver themselves to make the angle, in order to make the leg length good and there are issues with that. There is no obligation nor any pilot training that requires this, and AFS is going to re-consider the leg length criteria instead of trying to put this on the pilot.

It was also discussed that there is contradiction between TERPS design, ATC procedures, and AIM material for pilots that must be resolved. For example, the AIM says that once a pilot crosses the TAA boundary he/she may proceed direct to the applicable fix, whereas TERPS implies the pilot must maneuver to be at a 45º intercept or fail to make the intercept with the appropriate leg length.

AFS-420 and AFS-470 agreed to jointly lead a US-IFPP working group to develop recommended revisions to FAA Order 8260.58, AIM, IPH, and IFH."

A lengthy group discussion followed on TAA concepts and actions, including pilot actions and controller responsibilities. Kel Christianson, AFS-470, advised action is underway to revise the entire TAA portion of the AIM. John Collins, GA Pilot, stated the original TAA concept was to apply to RNAV approaches, but it is becoming more and more common to see them on conventional IAPs. He supports increased use of TAAs and asked that if a TAA is published in lieu of a MSA, should the IAP be annotated “GPS Required”. The consensus was yes. Brad Rush, AJV-3B, stated that they are seeing increasing TAA application on conventional IAPs. John stated he supports this concept. Tom advised the TAA concept was to replace MSA and a short discussion ensued regarding the future value of MSAs. Any changes will be discussed in US-IFPP, including all references to free flight. Bill Hammett, AFS-420 (ISI/Pragmatics Contract Support), asked Gary Fiske, AJV-8, if TAA controller training had been developed. Gary said that AT had not been good at training controllers on the benefits of TAAs. He also added that use of TAAs is most beneficial in remote areas where the ARTCC serves as the approach control. The IOUs are the same as from the previous meeting: 1) AFS-420 will pursue a review of FAA Order 8260.58 through the US-IFPP and forward the results to AFS-470 for updating of the AIM, IPH and IFH; and, 2) AJE-31 and AJV-8 will continue developing controller training material. ACTION: AFS-420, AJE-31, and AJV-8.

MEETING 14-01: Kel Christianson, AFS-470, briefed that he worked closely with Rich Boll, NBAA, and they recreated AIM section 5-4-5 (text and figures), which will be published in July, 2014. This info will be provided to AFS-420 for the IPH. ( ) John Collins, GA Pilot, inquired if any thought was given to relocating the section within the AIM so as to not be associated only with RNAV. Kel responded not yet. The AFS-420 part (Order 8260.58) is still being reworked by TJ Nichols, AFS-420, and remains open.

Status: AFS-420 will continue to work the Order 8260.58 and IPH revisions. Item Open (AFS-420)