

**Appendix F      HOUSTON OAPM DESIGN AND IMPLEMENTATION  
TEAM DOCUMENTS**

## Table of Contents

Inventory of Proposed Procedures .....	4
Design Submission Executive Summary .....	7
BAYYY RNAV STAR .....	14
BELLR RNAV STAR .....	28
BOOZZ RNAV STAR .....	41
BRSKT RNAV STAR .....	51
CESAN RNAV STAR .....	64
DOOBI RNAV STAR .....	68
DRLLR RNAV STAR .....	76
GILLL RNAV STAR .....	89
GUSHR RNAV STAR .....	98
HTOWN RNAV STAR .....	107
KIDDZ RNAV STAR .....	116
MSCOT RNAV STAR .....	126
PUCKS RNAV STAR .....	138
SKNRD RNAV STAR .....	152
TEJAS RNAV STAR .....	160
TKNIQ RNAV STAR .....	173
TTORO RNAV STAR .....	183
TWSTD RNAV STAR .....	191
WAPPL RNAV STAR .....	199
WHACK RNAV STAR .....	207
BNDTO RNAV SID .....	215
BORRN RNAV SID .....	229
DOBBY RNAV SID .....	233
DREMR RNAV SID .....	243
ELOCO RNAV SID .....	254
FLYZA RNAV SID .....	263
GUMBY RNAV SID .....	277
INDIE RNAV SID .....	287
KARRR RNAV SID .....	298
LURIC RNAV SID .....	303
MMALT RNAV SID .....	314
MMUGS RNAV SID .....	319
PEECE RNAV SID .....	328
PITZZ RNAV SID .....	339
PTRON RNAV SID .....	353
RITAA RNAV SID .....	365
STRYA RNAV SID .....	377
STYCK RNAV SID .....	388

## Environmental Assessment for Houston Optimization of Airspace and Procedures in the Metroplex

WAFTO RNAV SID .....	399
WYLSN RNAV SID .....	404
HUDZY HOU Conventional STAR .....	415
OHIIO IAH Conventional STAR .....	420
TAKKL Conventional STAR .....	424
TCHDN Conventional STAR .....	428
WHAEL Conventional STAR .....	432
IAH RNP AR East Flow .....	436
IAH RNP AR West Flow .....	446
RNAV Transitions to IAH ILS RWY 08L and 08R .....	452
RNAV Transitions to IAH ILS RWY 26L, 26R, and 27 .....	458
RNAV Transitions to HOU ILS RWY 04 .....	464
BLUBL Conventional STAR .....	468
CARNE IAH Conventional STAR .....	474
GILCO IAH Conventional STAR .....	479
RIICE Conventional STAR .....	483
En Route Airspace changes Proposed Final Design .....	489
Terminal Airspace Proposed Final Design .....	493

## INVENTORY OF PROPOSED PROCEDURES

January 8, 2013

The Houston Design Team took the recommendations of the Study Team and refined their initial designs to increase efficiency in the metroplex. These efficiencies gained include maximizing the use of existing aircraft technologies and aircrew capabilities and optimizing vertical profiles to eliminate or reduce the requirement to level-off. In addition, the team was able to develop flow-specific waypoints to eliminate doglegs on departure, de-conflict arrival and departure procedures to enhance safety, and provide for repeatable/predictable paths to reduce ATC task complexity.

In total, the team proposes the creation of 20 new RNAV STARs, 20 new RNAV SIDs, 5 new non-RNAV STARs, and 4 new RNP-AR approaches. The Design Team also proposes the modification of 4 non-RNAV STARs, 2 RNP-AR approaches, and modification of 6 ILS approaches by adding RNAV transitions. Eleven existing procedures will be retained while 19 procedures will be cancelled. These procedures are as follows:

### New RNAV STARs:

1. BAYYY
2. BELLR
3. BOOZZ
4. BRSKT
5. CESAN
6. DOOBI
7. DRLLR
8. GILLL
9. GUSHR
10. HTOWN
11. KIDDZ
12. MSCOT
13. PUCKS
14. SKNRD
15. TEJAS
16. TKNIQ
17. TTORO
18. TWSTD
19. WAPPL
20. WHACK

### New RNAV SIDs:

1. BNDTO
2. BORRN
3. DOBBY
4. DREMR
5. ELOCO
6. FLYZA
7. GUMBY
8. INDIE
9. KARRR

10. LURIC
11. MMALT
12. MMUGS
13. PEECE
14. PITZZ
15. PTRON
16. RITAA
17. STRYA
18. STYCK
19. WATFO
20. WYLSN

New non-RNAV STARs:

1. HUDZY
2. OHIO
3. TAKKL
4. TCHDN
5. WHAEL

New RNP-AR approaches:

1. IAH RWY 08L
2. IAH RWY 09
3. IAH RWY 26L
4. IAH RWY 26R

Modified ILS Approaches:

1. IAH RWY 08L
2. IAH RWY 08R
3. IAH RWY 26L
4. IAH RWY 26R
5. IAH RWY 27
6. HOU RWY 04.

Modified non-RNAV STARs:

1. BLUBL
2. CARNE
3. GILCO
4. RIICE

Modified RNP-AR approaches:

1. IAH RWY 08R
2. IAH RWY 27

Retained procedures:

1. BOWFN RNAV SID
2. CRIED CONV SID
3. EL DORADO (ELD) CONV SID
4. GIFFA CONV SID
5. INDUSTRY (IDU) CONV SID
6. JUNCTION (JCT) CONV SID
7. LAKE CHARLES (LCH) CONV SID

8. LEONA (LOA) CONV SID
9. LUFKIN (LFK) CONV SID
10. TRUAX (NGP) CONV SID
11. PALACIOS (PSX) CONV SID

Cancelled procedures:

1. AGEEE RNAV STAR
2. ALEXANDRIA (AEX) CONV SID
3. BAZBL RNAV STAR
4. CLMBA RNAV STAR
5. COACH RNAV STAR
6. DAISSETTA (DAS) CONV STAR
7. DYNMO RNAV STAR
8. GUSTI RNAV SID
9. HAMMU RNAV STAR
10. KABOY RNAV STAR
11. ROKIT RNAV STAR
12. ROYOH CONV STAR
13. SABINE (SBI) RNAV SID
14. STROS RNAV STAR
15. TEXXN CONV STAR
16. TXMEX RNAV STAR
17. SCHOLES (VUH) CONV SID
18. WAILN RNAV SID
19. WOLDE RNAV STAR



**Federal Aviation  
Administration**

**Optimization of Airspace and Procedures  
in the Metroplex (OAPM)  
Design Submission Executive Summary  
Houston Metroplex**

Revised January 2013

**Table of Contents**

1.0	Optimization of Airspace and Procedures in the Metroplex	Page 1
2.0	Overview of the Houston OAPM Study and Design Team Process	Page 1
3.0	Scope and Process	Page 2
4.0	Proposed Solutions	Page 4
5.0	Conclusions	Page 5

Attachment A: Proposed Final Design Packages

## 1.0 Optimization of Airspace and Procedures in the Metroplex

In September 2009, the Federal Aviation Administration (FAA) received the RTCA's Task Force 5 Final Report, which recommended the top priorities for the implementation of NextGen initiatives. A key component of the FAA response to the RTCA recommendations was the formation of teams leveraging FAA and Industry Performance Based Navigation (PBN) experience to expedite implementation of optimized airspace and procedures.

Optimization of Airspace and Procedures in the Metroplex (OAPM) was developed in direct response to the RTCA's Task Force 5 Final Report on Mid-Term NextGen Implementation, which addressed the quality, timeliness, and scope of metroplex solutions. OAPM is a systematic, integrated and expedited approach to implementing PBN procedures and associated airspace changes.

OAPM focuses on a geographic area, rather than a single airport in order to consider multiple airports and airspace, all types of operations, and connectivity with other metroplexes. The OAPM initiative is intended to enable accelerated development and implementation of beneficial PBN procedures. The process is made up of five phases: Study, Design, Evaluation, Implementation, and Post Implementation. This Executive Summary describes the Design Phase and Attachment A, Proposed Final Design Submission Packages, provides the detailed designs that are evaluated in the Evaluation Phase.

## 2.0 Overview of the Houston OAPM Study and Design Team Process

The Houston Study Team was the fifth collaborative<sup>1</sup> OAPM team deployed, and it was active from May 2011 to August 2011. The Study Team consisted of participants from the FAA, the National Air Traffic Controllers Association (NATCA), Air Traffic Control (ATC) and Performance-Based Navigation (PBN) subject matter experts (SMEs), industry stakeholders, and the MITRE Corporation's Center for Advanced Aviation System Development (CAASD). These experts were tasked to identify operational and efficiency issues that could be addressed through PBN procedure and airspace design, to develop conceptual solutions that addressed the identified issues, and to make preliminary assessments of associated benefits, costs, and risks. Throughout the process, the Study Team held multiple outreach sessions with local facility and industry stakeholders. Working with those stakeholders, they identified over 100 issues, developed conceptual solutions to many of them, and performed the preliminary benefits assessment. Sixteen underlying issues were identified as outside the scope of OAPM and five issues were

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<sup>1</sup> An FAA manager and a NATCA Article 48 Representative acted as Co-Leads for the project with participants from the FAA Air Traffic Control (ATC) facilities, National Air Traffic Controllers Association (NATCA), ATC subject matter experts (SMEs), Industry stakeholders, representatives from the Central Service Area, other FAA lines of business such as PBN Policy and Support and Flight Procedures, as well as MITRE CAASD, and various support contractors.

deferred to the Design and Implementation process (see Attachment A). The remaining 84 issues were then consolidated into four major areas: *IAH/HOU Arrivals, IAH/HOU Departures, Terminal Airspace and Enroute Airspace*. The Houston OAPM Study Team Final Report, dated 19 August, 2011, served as the foundation for the Design Team's scope of work. The Design Team focused on finalizing the Study Team's conceptual designs in order to address identified operational and efficiency issues through the application of PBN procedures and associated airspace changes within the metroplex, with the ultimate goal of creating designs that support both FAA and Industry needs.

The Study Team identified conceptual PBN solutions that were expected to result in both quantitative and qualitative efficiency gains. The estimated annual fuel savings were between \$9.2 million and \$26.1 million.<sup>2</sup> These estimates were developed by the National Analysis Team (NAT) based on the Study Team's conceptual designs, and do not reflect the refinements made by the Design Team or the results of the FAA's environmental analysis in the Evaluation Phase. The qualitative benefits expected by the Study Team included reduced ATC task complexity, reduced pilot/controller communications, repeatable and predictable flight paths, and a reduction in the need for Traffic Management Initiatives.

The final designs proposed by the Houston Design Team refine the Study Team recommendations to increase efficiency in the metroplex. This includes maximizing the use of existing aircraft technologies and aircrew capabilities, and optimizing vertical profiles to eliminate or reduce the requirements to level-off. In addition, the team was able to develop procedural changes to improve both lateral and vertical paths for Standard Terminal Arrival Routes (STARs) and Standard Instrument Departures (SIDs). This would de-conflict arrival and departure procedures to enhance safety, and provide for repeatable/predictable paths and reduce ATC task complexity.

### **3.0 Scope and Process**

The Houston Metroplex consists of airspace delegated to the Houston Terminal Radar Approach Control (I90) and the Houston Air Route Traffic Control Center (ZHU). The Houston OAPM Design Team focused on aircraft operations at Houston George Bush Intercontinental Airport (IAH) and William P. Hobby Airport (HOU) as well as numerous satellite airports (see Table 1).

---

<sup>2</sup> *The estimated fuel burn savings considered a lower bound based on a conservative European Organization for the Safety of Air Navigation (EUROCONTROL) Base of Aircraft Data (BADA) fuel burn model and an upper bound based on Industry stakeholder flight simulation analysis. This analysis was performed in 2011, and assumed a fuel price of \$3.03 per gallon.*

<b>Airport ID</b>	<b>Airport Name South of J2</b>		<b>Airport ID</b>	<b>Airport Name North of J2</b>
AXH	Houston Southwest		CXO	Lone Star Executive
EFD	Ellington Field		DWH	David Wayne Hooks Memorial
GLS	Scholes International		EYQ	Weiser Air Park
HPY	Baytown			
IWS	West Houston			
LBX	Brazoria County			
LVJ	Pearland Regional			
SGR	Sugar Land Regional			
TME	Houston Executive			
T00	Chambers County			
T41	La Porte Municipal			
54T	RWJ Airpark			

Table 1. Houston OAPM Airports with new/revised PBN procedures

The Houston OAPM Design Team consisted of participants from the FAA ATC facilities, NATCA, ATC SMEs, Industry stakeholders, representatives from the Central Service Area, other FAA lines of business such as PBN Policy and Support and Flight Procedures, MITRE CAASD, and various support contractors.

The Design Team began the process by reviewing the Study Team Final Report to identify all conceptual proposals. The proposals were then prioritized based on their complexity, their interdependencies, and the magnitude of the potential benefit. The remainder of the Design Phase was focused on the refinement of the Study Team conceptual solutions, with the goal of developing Proposed Final Designs that were 90 percent complete before proceeding to the Evaluation Phase, where additional operational validation, environmental review, and safety review would lead to Final Designs that could be carried forward to the Implementation Phase.

The refinement of the Study Team concepts ensured that Proposed Final Designs met the requirements in the Airspace Management Handbook, FAA Order 7100.9D (Standard Terminal Arrival Program and Procedures, Appendix 5 Guidelines for Implementing Terminal RNAV Procedures), and other applicable guidance. While the Study Team Report provided the framework, the Design Team had the flexibility to modify or adjust their proposals if the changes enhanced the expected benefit or if the changes were operationally necessary. Modifications could not significantly reduce the expected benefits, increase the expected costs, or extend the project timeline.

The Design Team evaluated all proposed designs with Industry representatives, and then systematically developed more refined PBN and airspace designs. The preliminary designs were then shared so the FAA, NATCA, SMEs and Industry could provide additional input. Coordination with the North Texas OAPM Team helped facilitate

procedure development between ZHU and Ft. Worth Air Route Traffic Control Center. Numerous factors supported the refinements, including Industry flight simulations, human-in-the-loop validations, and other stakeholder feedback. Finally, the Team documented the designs and obtained signatures from all affected FAA and NATCA stakeholders indicating agreement on Proposed Final Designs (PFDs) (pending environmental and safety review, and further operational validation).

It is important to note that the Design Team considered numerous alternatives in the development of the PFDs. For each individual Study Team concept, the Design Team went through an iterative process that considered alternative lateral and vertical paths, various speed and altitude restrictions, alternative leg types, different deconfliction options, various charting considerations, etc. The Design Team evaluated the efficiency gains associated with each proposal, the potential impact to controller task complexity, and the implementation challenges, among other considerations. The process was supported by a range of tools and analyses (human-in the-loop simulations, simulator flights, flyability assessments, criteria checks, etc.), with a focus on reducing flight times, flying distances, and level-segments. The actual design refinement of each Study Team concept was an iterative process conducted over a nine month period.

At the conclusion of the Design Process, the Design Team had created 56 PFD Submission Packages. These packages describe 20 new RNAV STARs, 20 new RNAV SIDs, 5 new non-RNAV STARs, and 4 new RNP-AR approaches. The Design Team also proposed the modification of 4 non-RNAV STARs, 2 RNP-AR approaches, and modification of 6 ILS approaches by adding RNAV transitions. Eleven existing procedures would be retained while 19 procedures would be cancelled. All four major areas identified in the Study Team recommendations were addressed by the PFDs.

## **4.0 Proposed Solutions**

As stated above, the Design Team considered each of the conceptual solutions proposed by the Study Team and refined them into comprehensive designs. These designs are captured in the PFD Submission Packages, which are included as Attachment A to this document. These Submission Packages describe the issue identified by the Study Team, their conceptual solution, and the refinements made by the Design Team resulting in the PFD. The Submission Packages also identify dependencies among various proposals, include graphical depictions of current conditions and the proposed final designs, identify impacted sectors, provide a broad overview of expected benefits, and identify additional concerns that should be considered.

The Design Team was able to create procedural changes, including the development of Optimized Profile Descents (OPDs) for IAH and HOU. They also improved lateral and/or vertical paths for earlier divergence for departures. Where applicable, arrival and departure procedures were de-conflicted and designed to create repeatable/predictable paths, reduce ATC task complexity, and enhance safety.

The Design Team created or improved STARs and SIDs, and made numerous airspace changes. The environmental effects of the OAPM proposals are being analyzed in the Environmental Assessment and would be implemented in January 2014.

<b>Proposed Publication Date</b>	<b>Number of STARs</b>	<b>Number of SIDs</b>	<b>Number of Airspace Changes</b>	<b>Number of RNP Approaches</b>	<b>Number of RNAV Transitions</b>
October 2013	29	0	0	0	0
December 2013	0	20	28	6	6
<b>Total</b>	<b>29</b>	<b>20</b>	<b>28</b>	<b>6</b>	<b>6</b>

Table 2. Proposed Implementation of Houston Proposals

While no new quantitative benefits have been calculated for the Design phase, it is anticipated they will meet or exceed the estimates included in the Houston Study Team Final Report.

## 5.0 Conclusion

Adopting the Design Team proposals should result in reduced flying miles, minimal level-offs for departures, the implementation of OPDs, as well as reduced controller task complexity. Upon completion of the Evaluation Phase, including all applicable operational, environmental, safety, and business case analyses, a decision will be made whether to proceed with Implementation.

## OAPM Design Package: Houston Metroplex BAYYY RNAV STAR

<b>Name of Change</b>	<b>BAYYY STAR</b>	<b>Date</b>	<b>06-19-12</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E37, T5, I23</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 79, 68, 43, 23, 36, 24, 65, 37, 34	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552</b> <b>Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GILLL BRSKT TKNIQ PUCKS BOOZZ <b>SIDs:</b> FLYZA ELOCO	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase I TARGETS File</b></li> <li><b>2. BAYYY Distribution Package</b></li> <li><b>3. Table of Procedures</b></li> </ol>



## **OAPM Design Package: Houston Metroplex BAYYY RNAV STAR**

### **Study Team Recommendation**

The Study Team recommended replacing the current CLMBA STAR with a redesigned KABOY STAR as proposed below:

1. The proposed KABOY STAR would be the primary HOU southeast arrival route. It would also serve as an offload routing for IAH arrivals.
2. The conceptual KABOY STAR has an OPD with a proposed vertical window at the terminal entry point of 170-FL200 that would reduce level flight segments. Additional lateral spacing was added between the WOLDE and KABOY STARs to optimize their usage. The KABOY and WOLDE STAR proposals are procedurally separated.
3. En route transitions that begin at SJI, LEV, KLAMS and a new waypoint southwest of KLAMS were developed to provide lateral routings that follow current and anticipated aircraft flight paths, as depicted in Figure 2 below.
4. The movement of the HOU arrival traffic north over KABOY would reduce track miles.
5. Runway transitions are proposed, but only developed to Runways 12L/R and 04. The developed runway transitions are laterally positioned for the potential development of RNP AR IAPs.
6. For use as an IAH offload, flow dependent STARs overlaying the KABOY STAR were developed with vertical profiles to accommodate east and west configurations. The OPD with proposed vertical windows at the terminal entry point (East FL190- FL220 and West 140-170) would reduce existing level flight segments.

# OAPM Design Package: Houston Metroplex

## BAYYY RNAV STAR

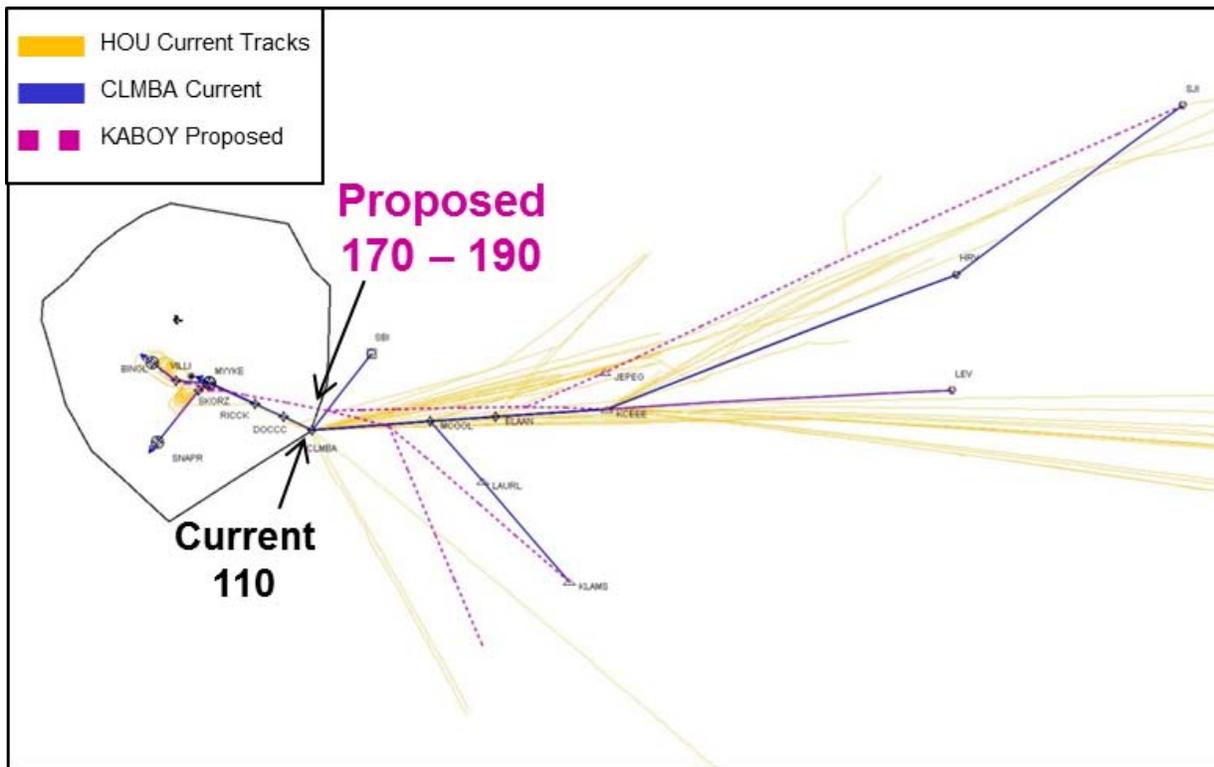


Figure 2. Current Procedure and Study Team Recommendation

# OAPM Design Package: Houston Metroplex

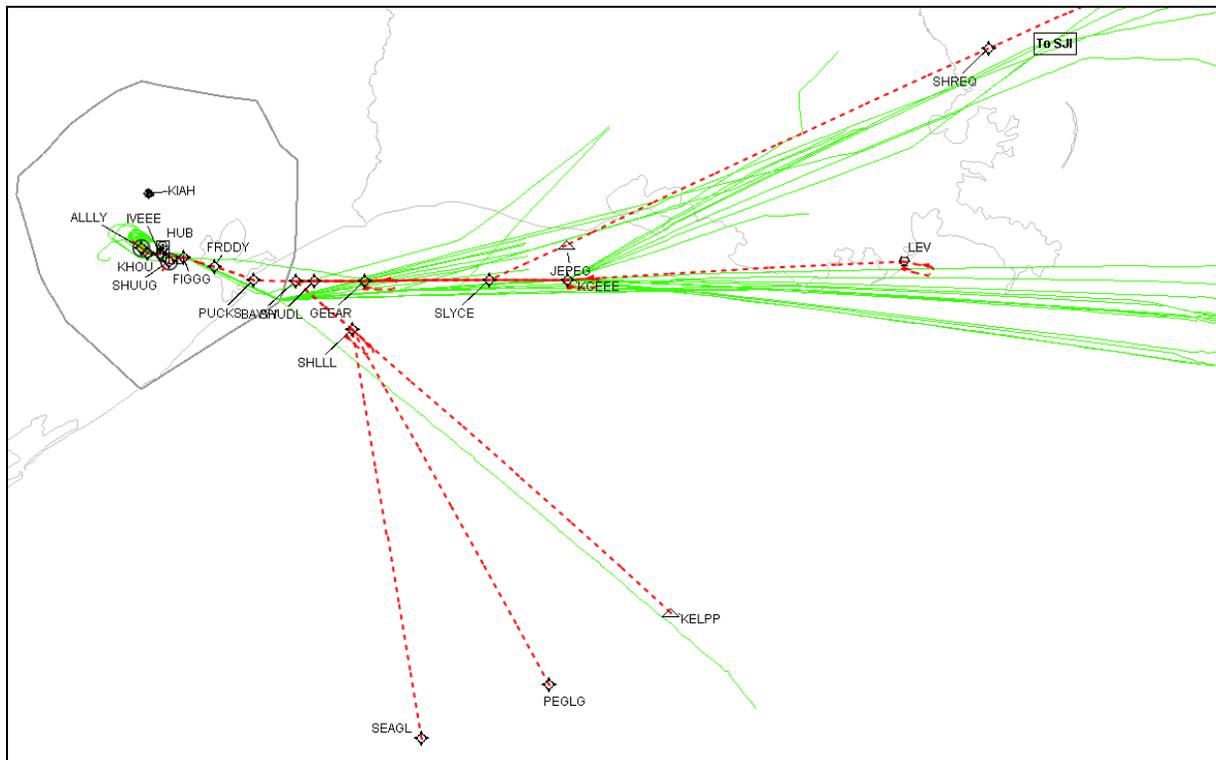
## BAYYY RNAV STAR

### Proposed Final Design

The Design Team began with the Study Team’s proposal to move the primary HOU arrival flow over the path of the current IAH KABOY STAR. The BAYYY STAR closely follows the path of the proposed HOU BAYYY STAR. This STAR would be used for jet aircraft landing HOU when the advertised runway is 04 or 12L/R. As a change to the Study Team’s recommendation, aircraft landing at all other Houston area south satellite airports and turboprop/prop aircraft landing at HOU would be routed via the proposed TQNIK STAR.

En route transitions from the Gulf of Mexico were modified from the Study Team proposal to connect to Required Navigation Performance routes that will be published in the future, as shown below in Figure 3. The Design Team evaluated many options to procedurally separate these transitions on the BAYYY arrival from the IAH GILLL and BRSKT arrivals and determined that tactically separating aircraft on these procedures ensures the maximum industry stakeholder benefit.

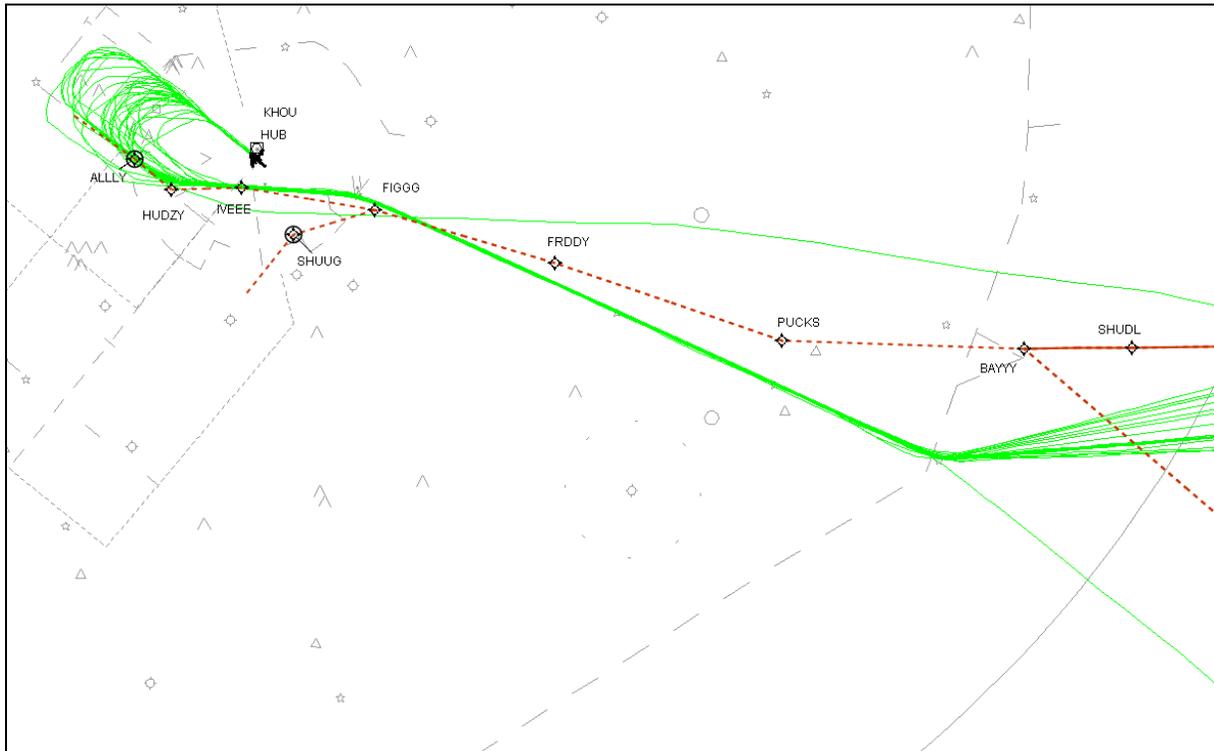
As shown in Figure 4 below, the Design Team proposes the BAYYY STAR be designed as an OPD that crosses BAYYY between 17,000 feet and FL200 at 280 knots.



**Figure 3. Proposed BAYYY STAR (En Route)**

# OAPM Design Package: Houston Metroplex

## BAYYY RNAV STAR



**Figure 4. Proposed BAYYY STAR (Terminal)**

## **OAPM Design Package: Houston Metroplex BAYYY RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

GILLL  
BRSKT  
TKNIQ  
PUCKS  
BOOZZ

#### **SIDs:**

FLYZA  
ELOCO

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. Vertical limits of low altitude sectors were reviewed and may need to be modified to accommodate the new procedures.

The proposed Gulf of Mexico routes were not available during the study team process.

### **Attachments**

1. TARGETS File
2. BAYYY TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex BAYYY RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

6-25-12  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

6/25/12  
Date

  
\_\_\_\_\_  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

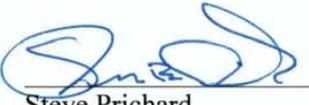
6/26/12  
Date

  
\_\_\_\_\_  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

6/26/12  
Date

  
\_\_\_\_\_  
Mike R. Richardson  
Houston TRACON (I90)  
Facility Lead

6-21-12  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (I90)  
NATCA Lead

6-25-12  
Date

## OAPM Design Package: Houston Metroplex

*HOU BAYYY RNAV STAR*

### RECORD OF CHANGE

Change Number	Date	Document
001	11/15/2012	BAYYY RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

#### Description of Change

Updated Header Section with airport designation.

The design team amended the procedure to enhance functionality with IAH departure flows. The original design proposal is shown in Figures 1 and 2. A transition was added for runway 17. FRDDY waypoint was moved 2.8 NM southeast to resolve airspace and route conflicts with the IAH FLYZA SID. FIGGG waypoint altitude restriction was amended to at or above 6,000 and at or below 7,000 feet to deconflict from the IAH RITTA.SID. EMARR waypoint was added. These changes are shown in Figures 3 and 4. The TARGETS file and TARGETS distribution files were updated.

## OAPM Design Package: Houston Metroplex

*HOU BAYYY RNAV STAR*

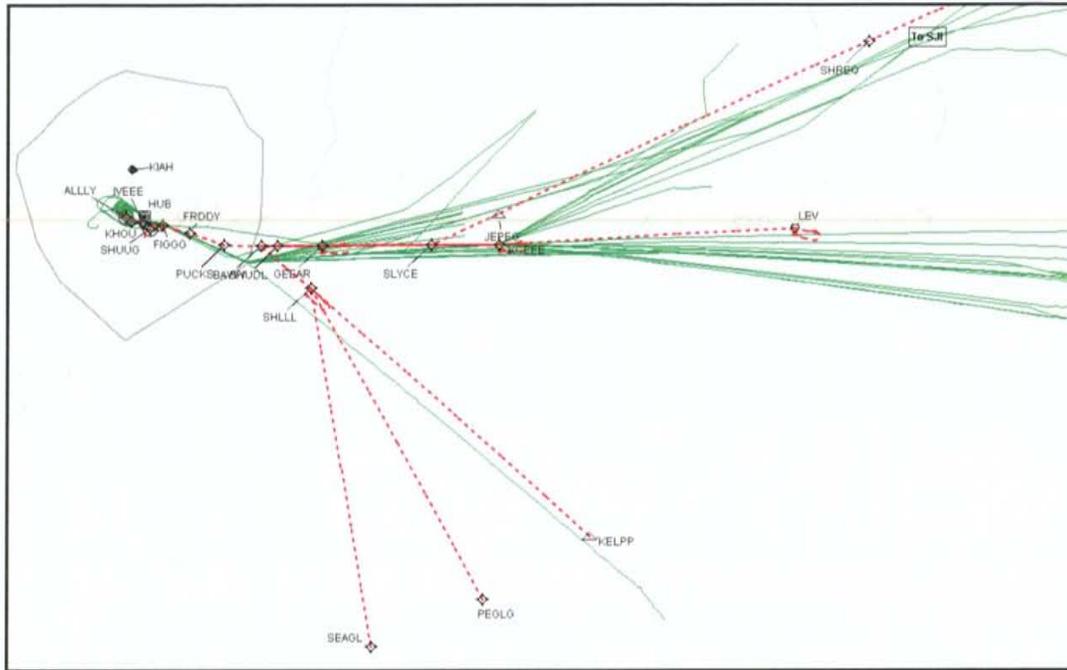


FIGURE 1. BAYYY RNAV STAR PROPOSED DESIGN (EN ROUTE) (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*HOU BAYYY RNAV STAR*

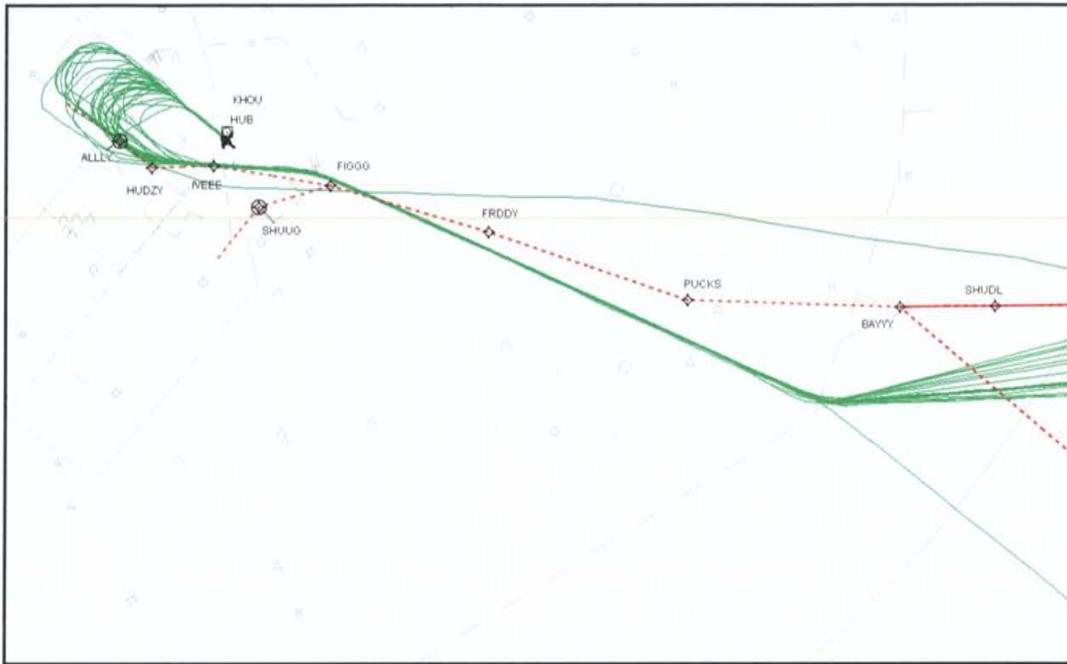


FIGURE 2. BAYYY RNAV STAR PROPOSED DESIGN (TERMINAL) (Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

*HOU BAYYY RNAV STAR*

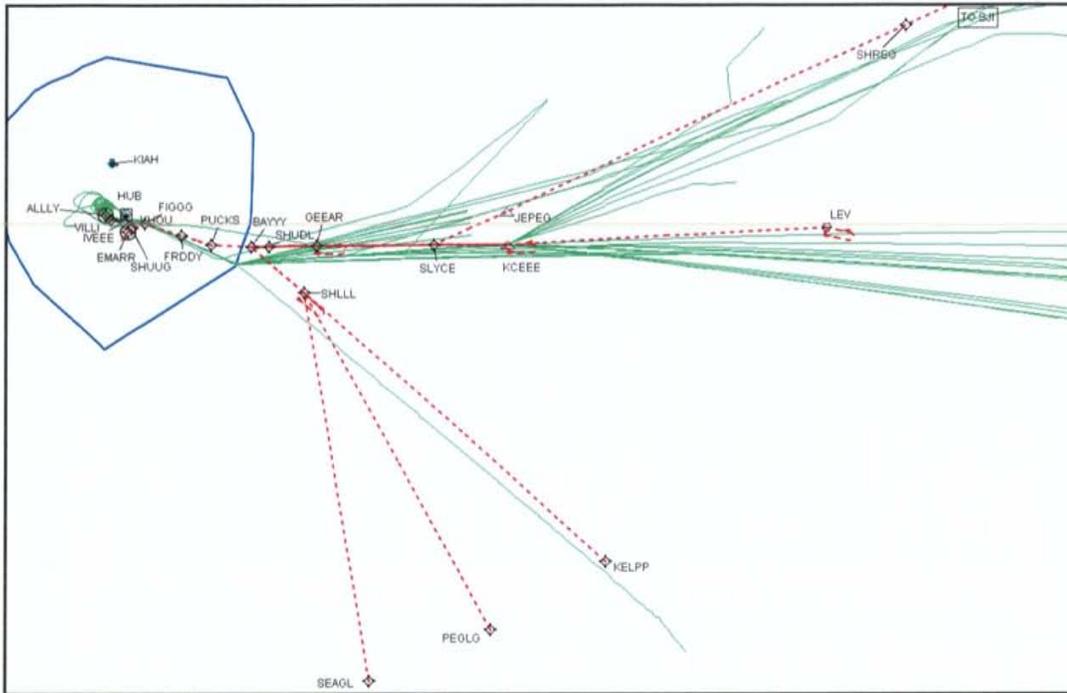
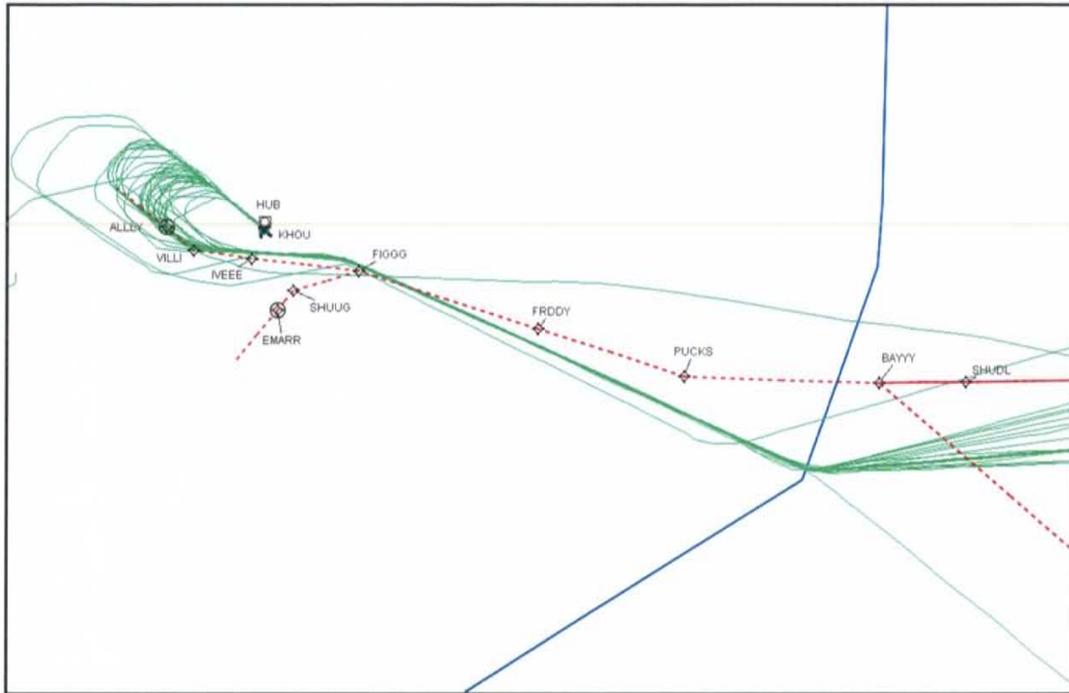


FIGURE 3. BAYYY RNAV STAR PROPOSED DESIGN (EN ROUTE)

(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*HOU BAYYY RNAV STAR*



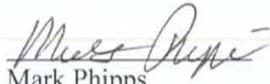
**FIGURE 4. BAYYY RNAV STAR PROPOSED DESIGN (TERMINAL)**

(Will replace Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

*HOU BAYYY RNAV STAR*

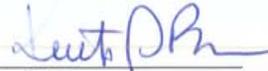
Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.



Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13

Date



Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13

Date

## OAPM Design Package: Houston Metroplex BELLR RNAV STAR

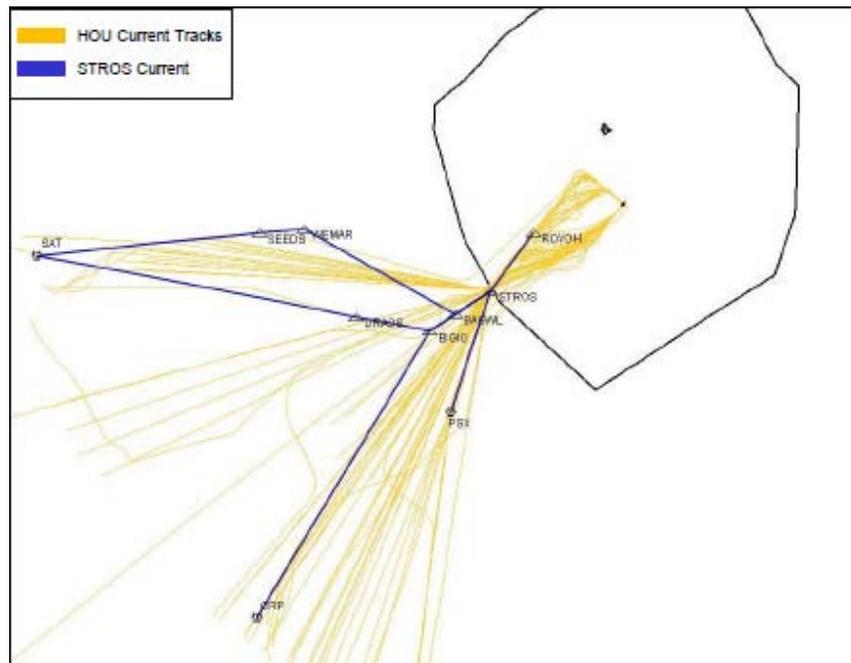
Name of Change	<b>BELLR STAR</b>	Date	<b>06-21-12</b>
Change Classification	<b>Terminal Procedures</b>	Current Phase of Design	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
OAPM Study Team Reference/s	<b>E24, E25, E26, E27, E39, I3, I17, I18</b>	Implementation Date	<b>December 2013</b>
Impacted Facilities and Positions/Areas/Sectors	<b>I90 ZHU Sectors: 58, 59, 76, 87, 95, 92</b>	Facility Points of Contact	<b>Will Hutson 281.230.5556 David Kidd 281.230.5556</b>
Related/Dependent Submissions	<b>STARs: HTOWN TEJAS SIDs: RITAA PTRON</b>	Associated Data Files:	<ol style="list-style-type: none"> <li><b>1. Phase II TARGETS File</b></li> <li><b>2. BELLR TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

# OAPM Design Package: Houston Metroplex BELLR RNAV STAR

## Purpose

This design package addresses issues with the STROS STAR identified by the Houston OAPM Study Team:

1. STROS is the primary arrival for HOU traffic from the southwest (see Figure 1).
2. HOU arrivals have unnecessary flight miles and inefficient routing on both the CRP and SAT transitions. Historical flight tracks do not follow the lateral paths of the CRP transitions. The SAT transition currently takes aircraft south to join the CRP transition or north to WEMAR before turning southeast to intercept the STROS arrival.
3. STROS is not procedurally separated from other STARs and SIDs.
4. STROS is too close in lateral proximity to the DYNMO STAR, which results in limited usage of the current DYNMO.



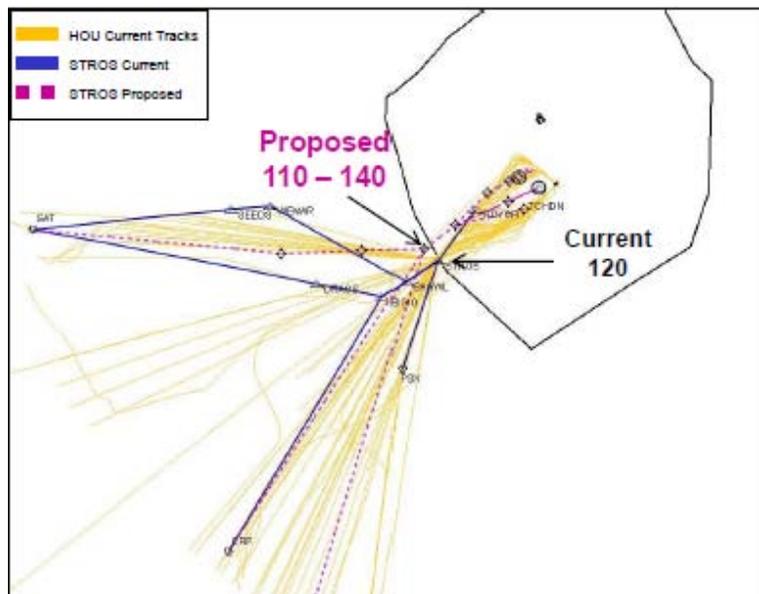
**Figure 1. Current STROS STAR**

# OAPM Design Package: Houston Metroplex

## BELLR RNAV STAR

### Study Team Recommendation

1. The conceptual STROS STAR remains the primary HOU STAR from the southwest, but is realigned to more closely follow historical flight tracks. STROS has been optimized by moving it north to provide a more direct route to HOU. It is now co-located with the DYNMO STAR. STROS traffic may be vertically separated from or sequenced with traffic on the DYNMO STAR in west flow. In east flow, STROS will be sequenced with DYNMO traffic.
2. The OST created a new south transition east of CRP and developed a more direct route to STROS off of the SAT transition, which will reduce flying miles to HOU.
3. OPDs with proposed vertical windows of 110-140 were developed in order to reduce current STROS level-offs.
4. Runway transitions are proposed, but only developed to Runways 12L/R and 04. The developed runway transitions are laterally positioned for the potential development of RNP AR IAPs (see Section 4.3.3).
5. Figure 2 depicts the current and proposed HOU RNAV STROS STAR



**Figure 2. Study Team Recommendation**

# OAPM Design Package: Houston Metroplex

## BELLR RNAV STAR

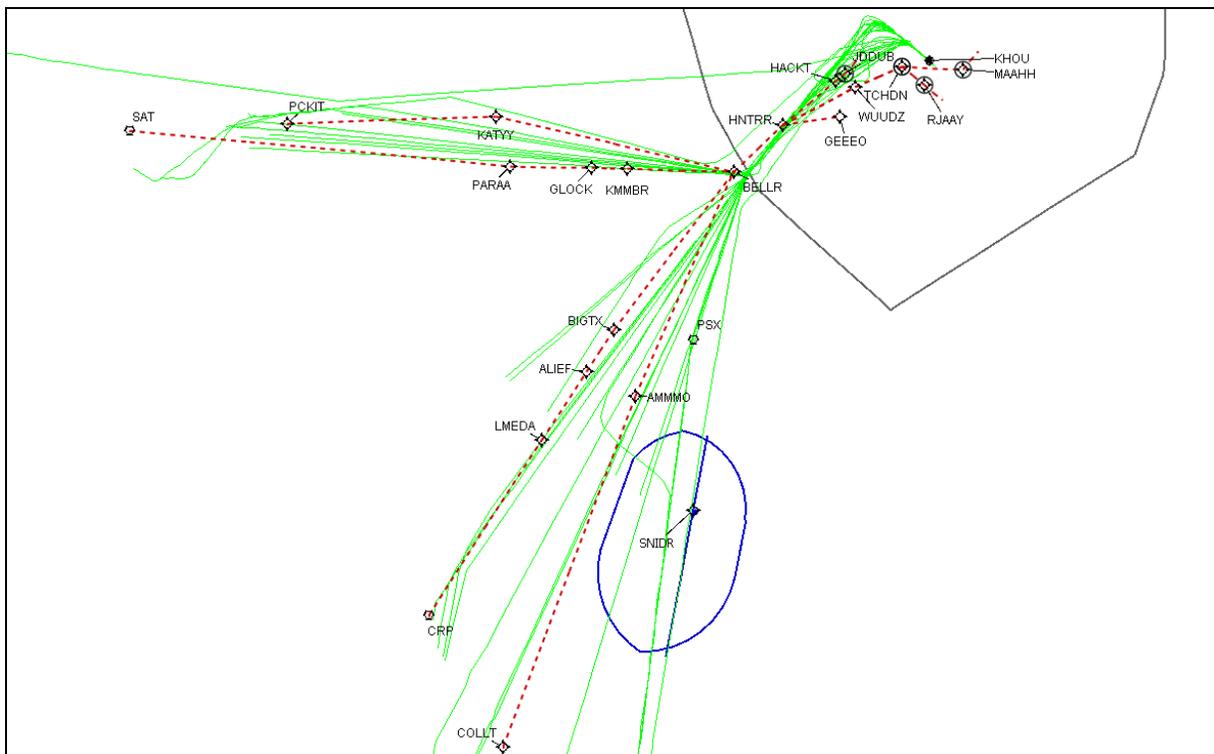
### Proposed Final Design

The BELLR RNAV STAR would be used for jet and turboprop aircraft landing HOU, as depicted in Figure 4. The BELLR STAR is designed with an OPD and an altitude window at BELLR of 11,000 to 13,000 feet at 250 knots.

En route transitions were laterally optimized to reduce track miles. Additional separation was added between the SAT transition of the HTOWN STAR, the TEJAS STAR and the HUBEE SID to provide for an OPD. Some waypoints were added to deconflict from SUAs.

The Design Team evaluated many options to separate en route transitions on the BELLR arrival from the TEJAS and HTOWN arrivals and determined that it would be best to have controllers tactically separate aircraft on these procedures.

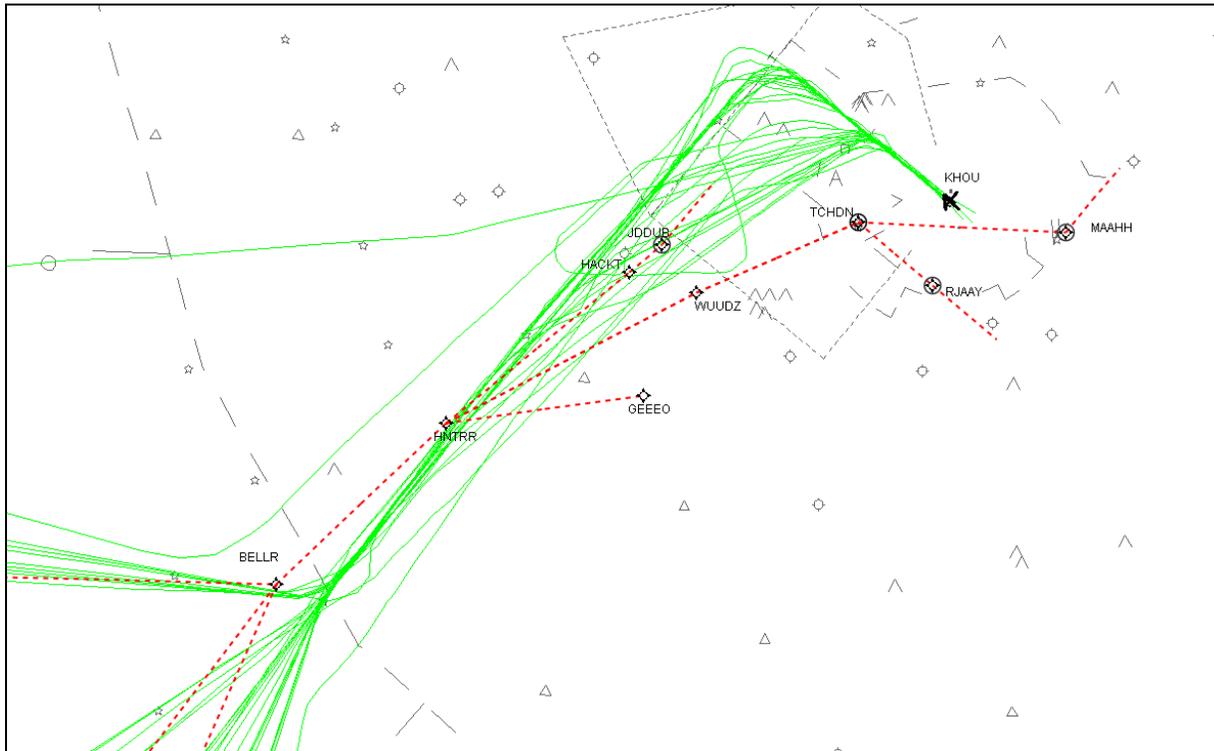
The Design Team determined that it was not beneficial to have an offload STAR to IAH from the southwest corner; therefore the DYNMO STAR recommended by the Study Team was eliminated.



**Figure 3. Proposed BELLR STAR (En Route)**

# OAPM Design Package: Houston Metroplex

## BELLR RNAV STAR



**Figure 4. Proposed BELLR STAR (Terminal)**

## **OAPM Design Package: Houston Metroplex BELLR RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

HTOWN

TEJAS

#### **SIDs:**

RITAA

PTRON

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated. Vertical limits of low altitude sectors were reviewed and may need to be modified to accommodate the new procedures.

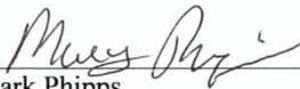
### **Attachments**

1. Phase II TARGETS File
2. BELLR TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex BELLR RNAV STAR

### Review Signatures

The D&I Team has reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

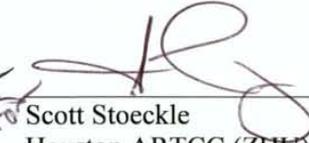
6/25/12  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

6/25/12  
Date

  
\_\_\_\_\_  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

6/25/12  
Date

  
\_\_\_\_\_  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

6/26/12  
Date

  
\_\_\_\_\_  
Mike R. Richardson  
Houston TRACON (I90)  
Facility Lead

6-21-12  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (I90)  
NATCA Lead

6-25-12  
Date

## OAPM Design Package: Houston Metroplex

*HOU BELLR RNAV STAR*

### RECORD OF CHANGE

Change Number	Date	Document
001	11/15/2012	BELLR RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	BELLR TARGETS Distribution Package	N/A

#### Description of Change

Updated Header with airport information.

The design team amended the procedure to enhance functionality with HOU arrival and departure flows. The original design proposal is shown at Figure 1 and 2. Runway transition were added for runways 17 and 35. The altitude restriction at the HNTRR waypoint was modified to between 8,000 and 10,000 feet. WUUDZ waypoint was deleted. AWSTN waypoint was added with an altitude restriction of at or below 7,000 feet. DAYNA waypoint was added. These changes are shown in Figures 3 and 4.

## OAPM Design Package: Houston Metroplex

*HOU BELLR RNAV STAR*

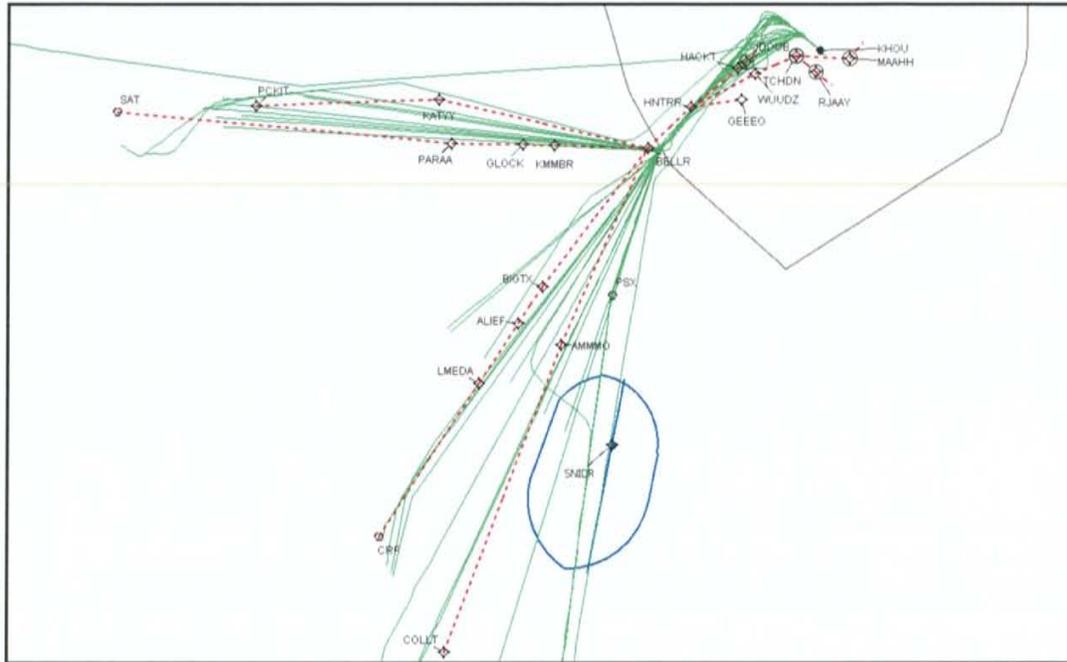
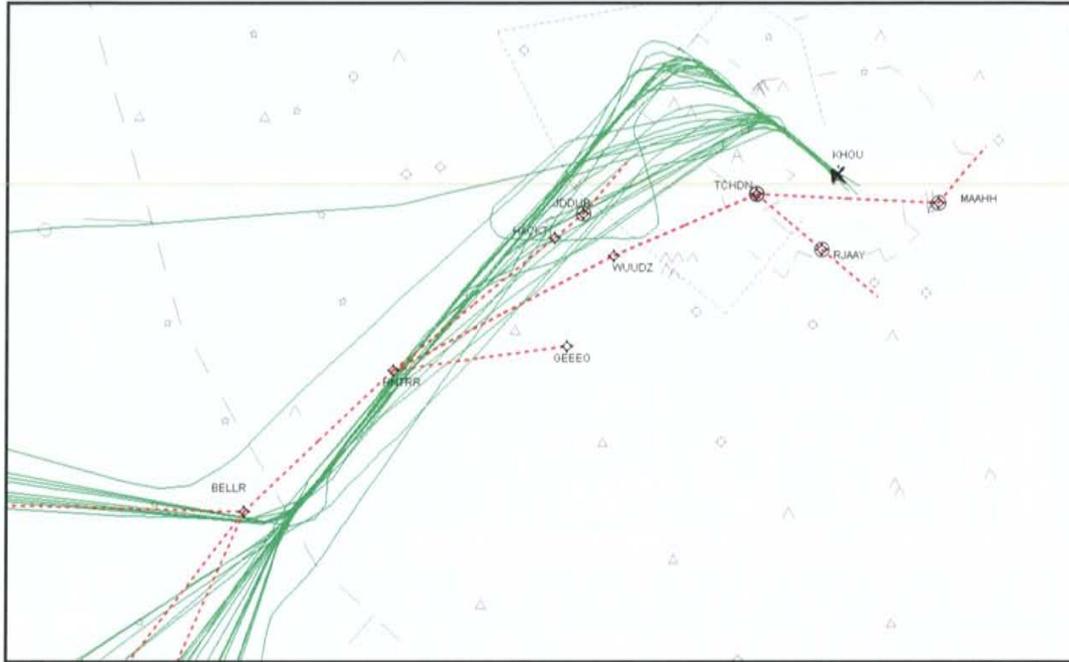


FIGURE 1. BELLR RNAV STAR PROPOSED DESIGN (EN ROUTE) (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

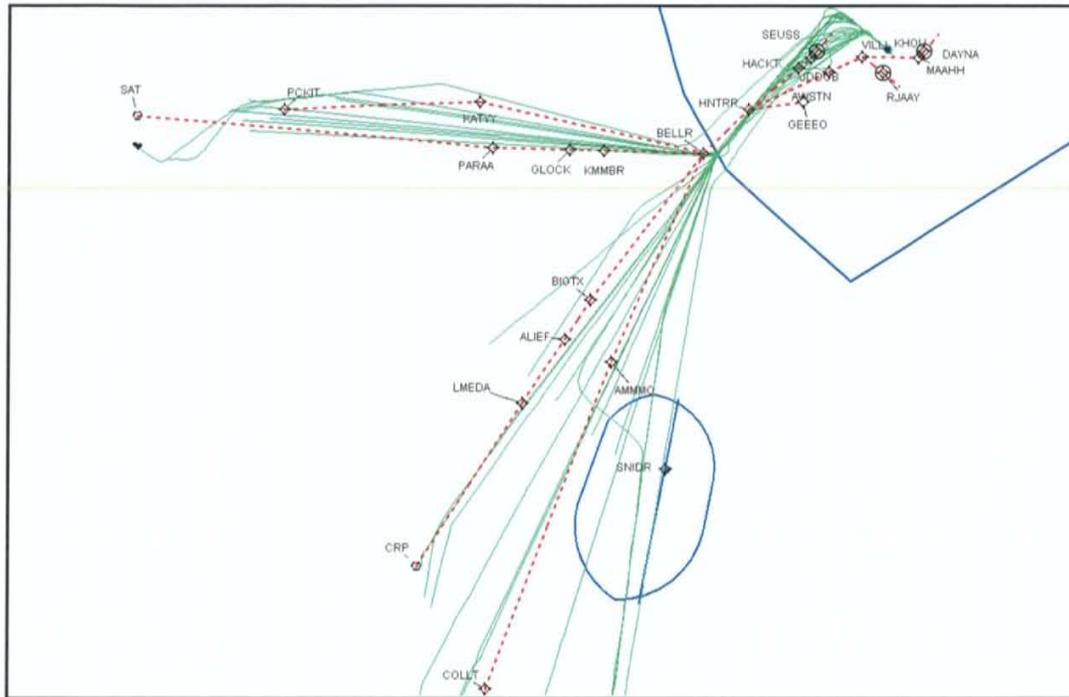
*HOU BELLR RNAV STAR*



**FIGURE 2. BELLR RNAV STAR PROPOSED DESIGN (TERMINAL) (Figure 4 in PFD)**

## OAPM Design Package: Houston Metroplex

*HOU BELLR RNAV STAR*

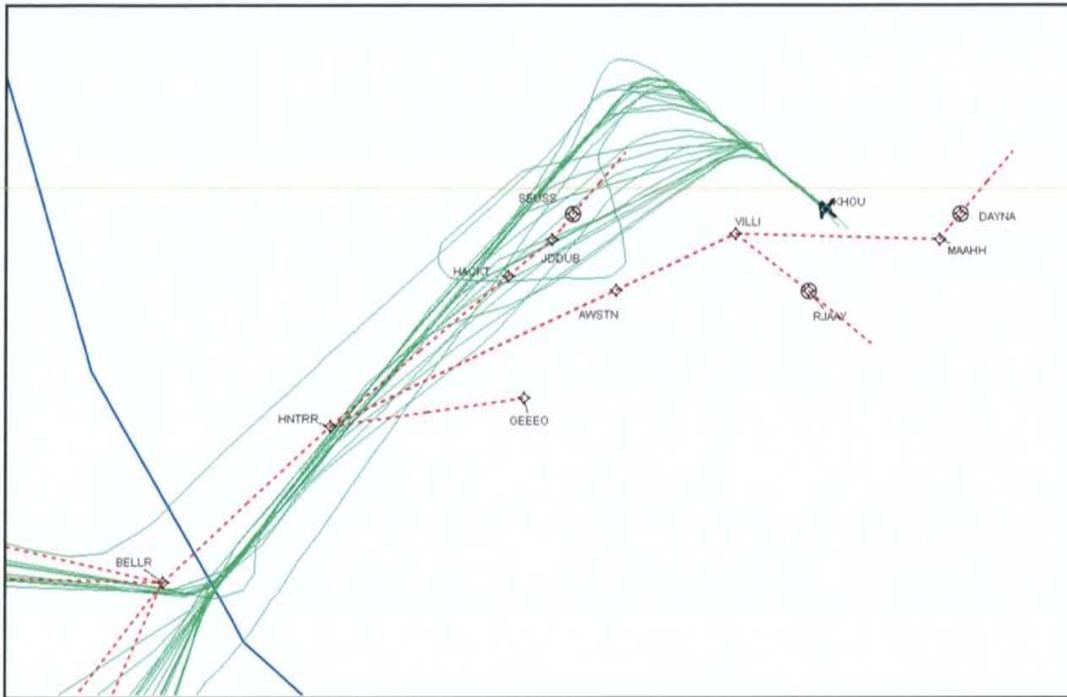


**FIGURE 3. BELLR RNAV STAR PROPOSED DESIGN (EN ROUTE)**

(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*HOU BELLR RNAV STAR*



**FIGURE 4. BELLR RNAV STAR PROPOSED DESIGN (TERMINAL)**

(Will replace Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

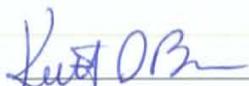
*HOU BELLR RNAV STAR*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.



Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date



Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex BOOZZ RNAV STAR

<b>Name of Change</b>	<b>BOOZZ STAR</b>	<b>Date</b>	<b>06-19-12</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E21, E36, E38, T5, T8, I23</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 79, 68, 43, 23, 36, 24, 65, 37, 34	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552</b> <b>Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> BRSKT GILL BAYYY PUCKS TKNIQ WAPPL <b>SIDs:</b> ELOCO GUMBY MMUGS PEECE FLYZA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase I TARGETS File</b></li> <li><b>2. BOOZZ Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

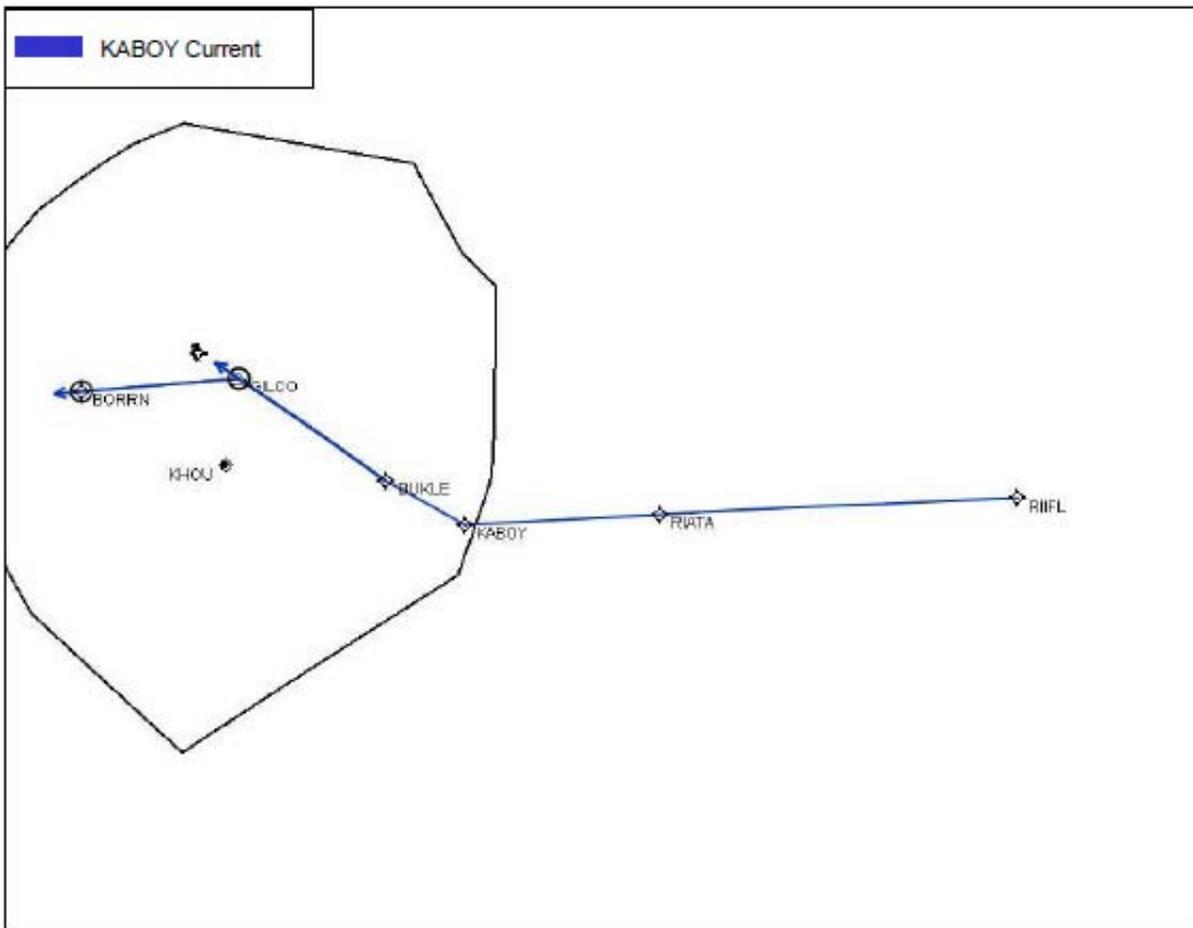
# OAPM Design Package: Houston Metroplex

## BOOZZ RNAV STAR

### Purpose

This design package addresses issues with the KABOY STAR identified by the Design Team:

1. KABOY STAR, as depicted in Figure 1 below, is currently a Severe Weather Avoidance Program (SWAP) route for IAH traffic from the southeast with limited utilization.
2. Additional lateral spacing is requested between the KABOY and WOLDE to optimize their simultaneous usage.
3. The STAR is not vertically optimized resulting in level segments that increase fuel burn and carbon emissions, particularly during east flow.



**Figure 1. Current KABOY STAR**

# OAPM Design Package: Houston Metroplex

## BOOZZ RNAV STAR

### Study Team Recommendation

1. The proposed KABOY STAR would be the primary HOU southeast arrival route. It would also serve as an offload routing for IAH arrivals.
2. For use as an IAH offload, flow dependent STARs overlaying the KABOY STAR were proposed with vertical profiles to accommodate east and west configurations. The OPD with proposed vertical windows at the terminal entry point (East FL190- FL220 and West 140-170) would reduce existing level flight segments.

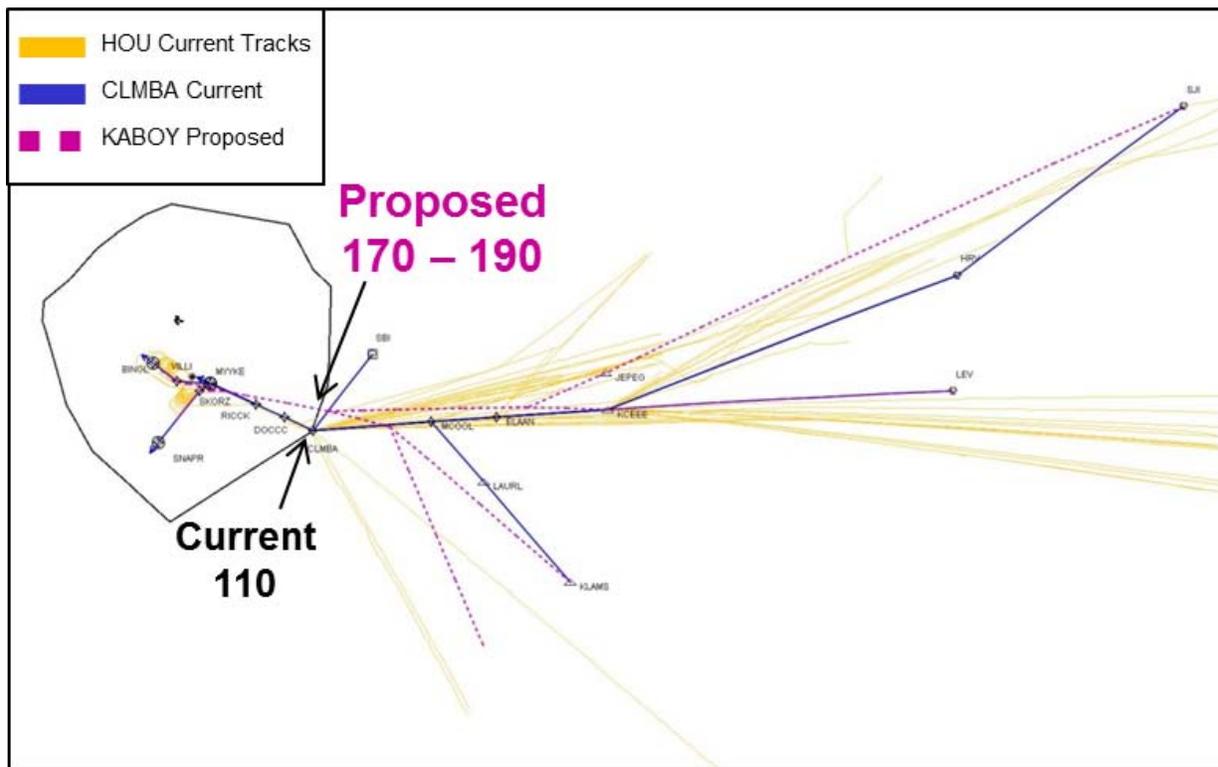


Figure 2. Study Team Recommendation

# OAPM Design Package: Houston Metroplex

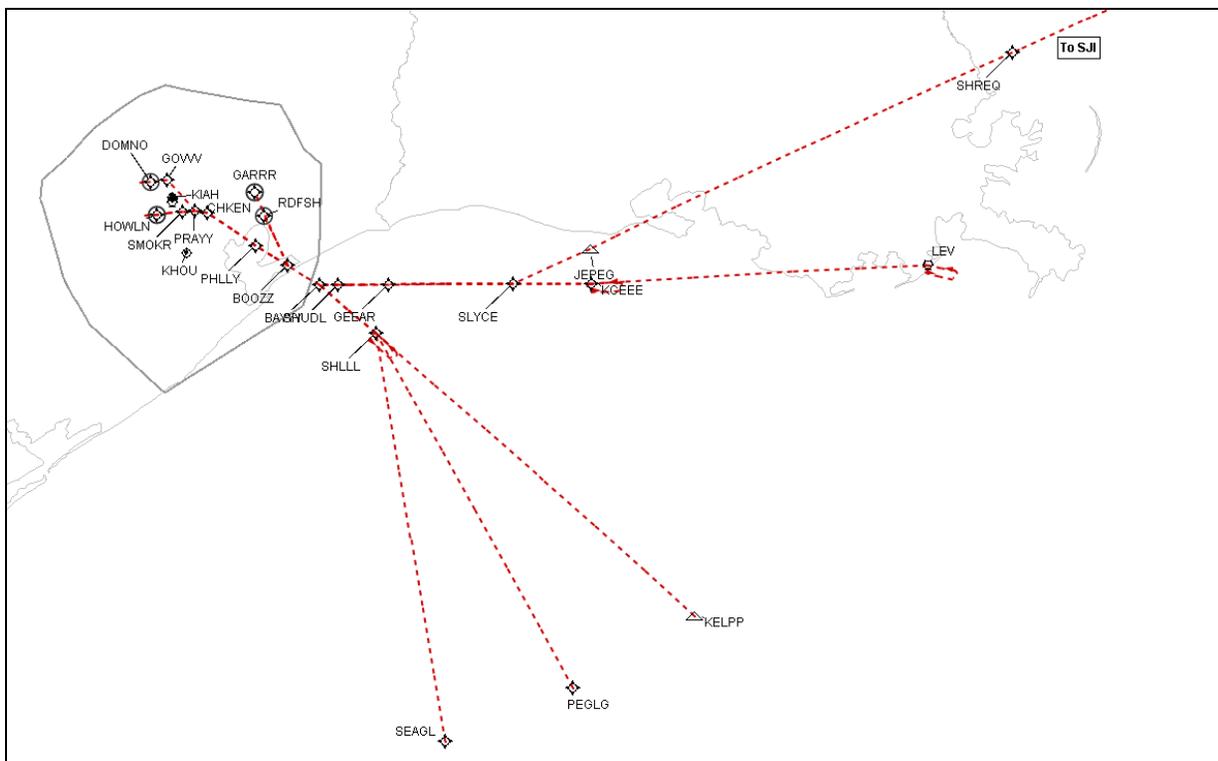
## BOOZZ RNAV STAR

### Proposed Final Design

The current KABOY STAR is proposed to be replaced by the BOOZZ STAR for IAH arrivals. This “ATC assigned only” route would be used as a SWAP route or as a dual feed in conjunction with the GILLL and BRSKT STARS. The BOOZZ STAR would utilize similar tracks to the proposed BAYYY and PUCKS STARS that will be utilized by jets and turboprops landing HOU.

En route transitions from the Gulf of Mexico would be modified from the Study Team proposal to connect to Required Navigation Performance routes that will be published in the future, as shown below in Figure 3 below. The Design Team evaluated many options to deconflict these transitions on the BOOZZ arrival from the HOU BAYYY and PUCKS arrivals and determined that tactically separating aircraft on these procedures ensures the maximum industry stakeholder benefit.

The Design Team proposes the procedure not include an OPD, differing from the Study Team’s recommendation to vertically optimize the procedure. The proposed BOOZZ STAR is designed with a crossing restriction at BAYYY of 13,000 feet and 280 knots.



**Figure 3. Proposed BOOZZ STAR**

# **OAPM Design Package: Houston Metroplex BOOZZ RNAV STAR**

## **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

### **STARs:**

BRSKT  
GILLL  
BAYYY  
PUCKS  
TKNIQ  
WAPPL

### **SIDs:**

ELOCO  
GUMBY  
MMUGS  
PEECE  
FLYZA

## **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. Vertical limits of low altitude sectors were reviewed and may need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

The proposed Gulf of Mexico routes were not available during the study team process.

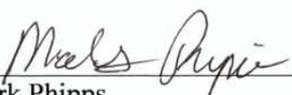
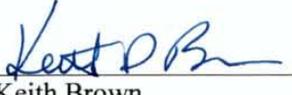
## **Attachments**

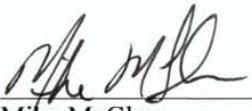
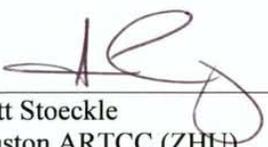
1. Phase I TARGETS File
2. BOOZZ TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex BOOZZ RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 Date
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 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/21/2012 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
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 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	6-21-12 Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	6-25-12 Date
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## OAPM Design Package: Houston Metroplex

IAH BOOZZ RNAV STAR

### RECORD OF CHANGE

Change Number	Date	Document
001	11/15/2012	BOOZZ RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

#### Description of Change

Updated Header Section with airport designation.

This procedure will be used by Jets and Turboprops.

The design team amended the procedure to correct a waypoint name and make minor design enhancements. The original design proposal is shown in Figures 1. SMOKR waypoint was renamed SMOCR. SHIVV waypoint was added for design consistency. GOVVV waypoint was moved to straighten the downwind leg. The altitude restrictions at DOMNO and PRAYY were deleted. These changes are shown in Figures 2.

## OAPM Design Package: Houston Metroplex

IAH BOOZZ RNAV STAR

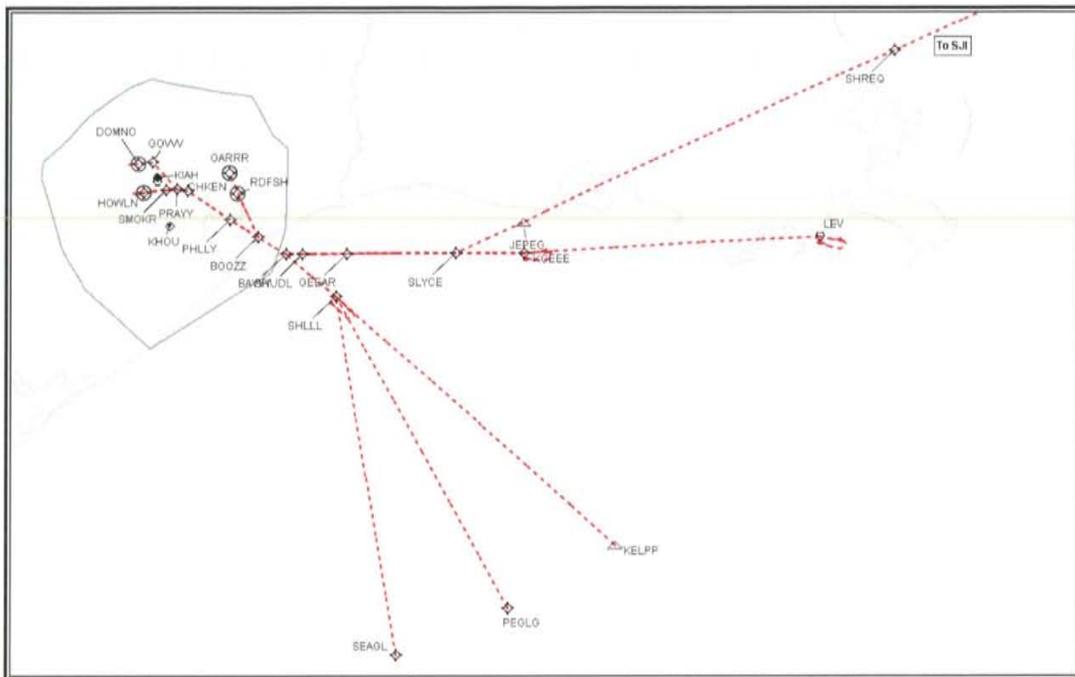


FIGURE 1. BOOZZ RNAV STAR PROPOSED DESIGN (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

IAH BOOZZ RNAV STAR

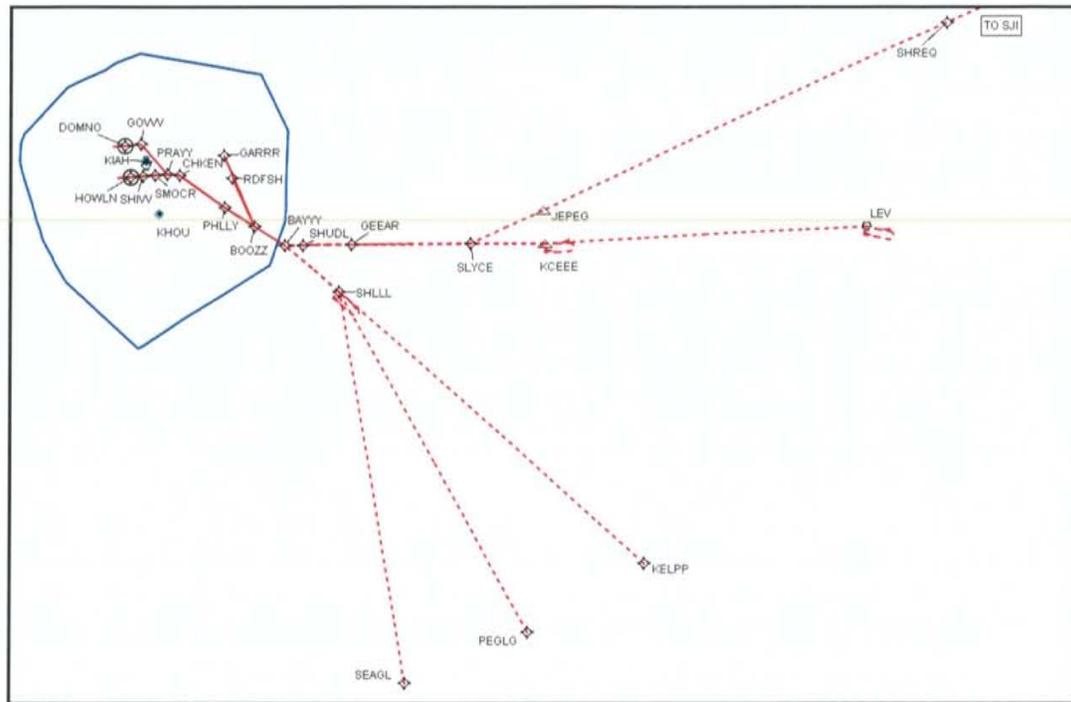


FIGURE 2. BOOZZ RNAV STAR PROPOSED DESIGN (Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

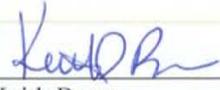
IAH BOOZZ RNAV STAR

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

---

  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex BRSKT RNAV STAR

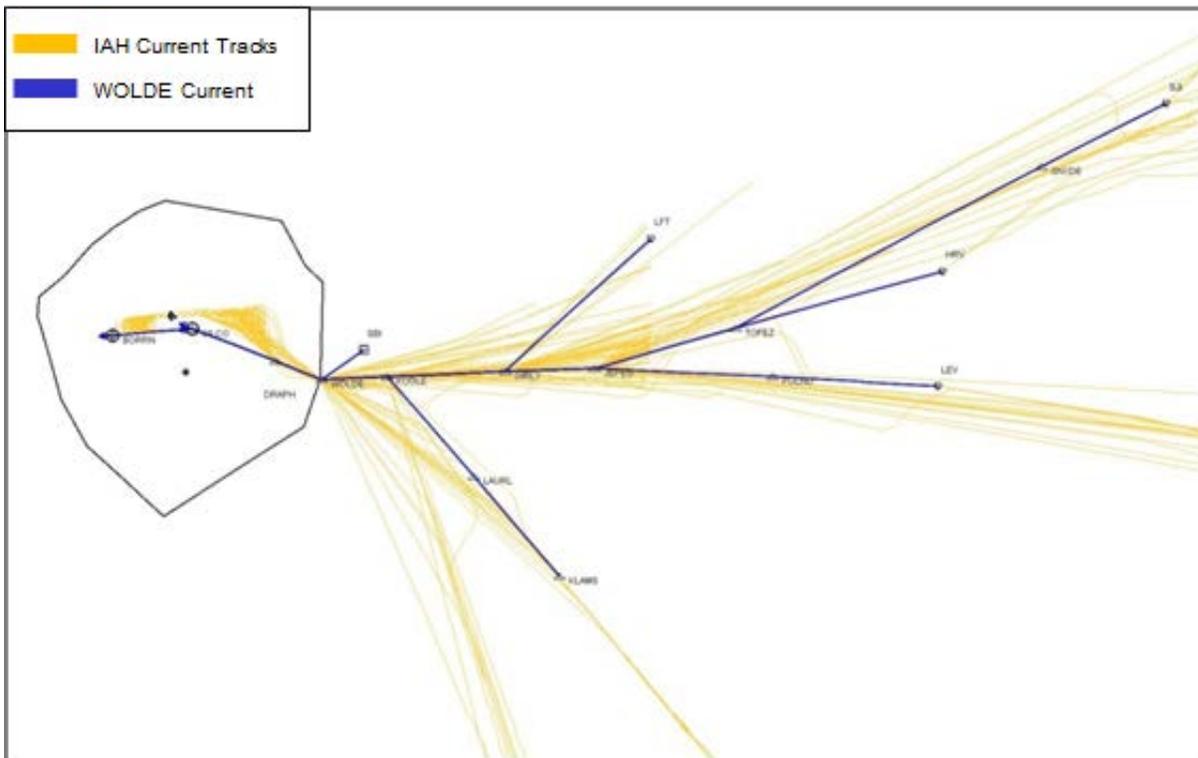
<b>Name of Change</b>	<b>BRSKT STAR</b>	<b>Date</b>	<b>05-08-12</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E20, E36, T4, T5, I19, I20, I21, I23</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 79, 68, 43, 36, 70, 24, 65, 37, 34	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552</b> <b>Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GILLL BAYYY PUCKS BOOZZ TKNIQ WAPPL <b>SIDs:</b> ELOCO GUMBY MMUGS PEECE FLYZA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase I TARGETS File</b></li> <li><b>2. BRSKT TARGETS Distribution Package</b></li> <li><b>3. Table of Procedures</b></li> </ol>

# OAPM Design Package: Houston Metroplex BRSKT RNAV STAR

## Purpose

This design package addresses the following issues with the WOLDE STAR identified by the Houston OAPM Study Team:

1. The WOLDE RNAV STAR is currently the primary arrival for IAH traffic from the southeast.
2. Additional lateral spacing is requested between the IAH STARs to optimize their simultaneous usage.
3. The STAR is not vertically optimized resulting in level segments that increase fuel burn and carbon emissions, particularly during east flow.
4. Aircraft flight tracks do not follow the lateral paths of the KLAMS and SJI transitions, and the SBI and HRV transitions are not utilized, as depicted in Figure 1 below.



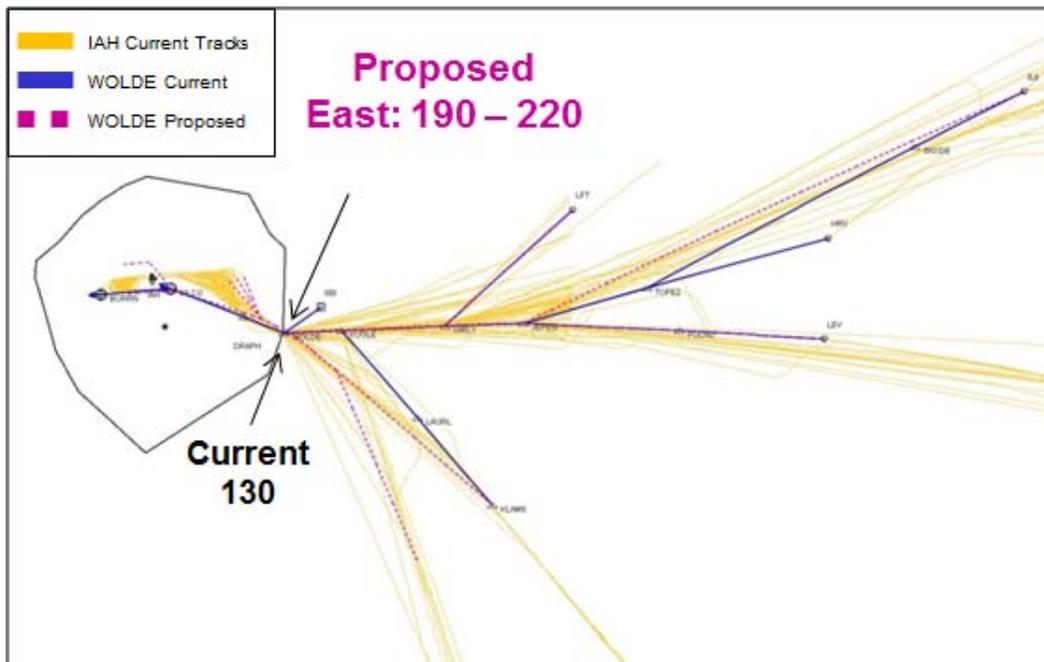
**Figure 1. Current WOLDE STAR**

# OAPM Design Package: Houston Metroplex

## BRSKT RNAV STAR

### Study Team Recommendation

1. The WOLDE STAR would remain as the primary IAH southeast arrival route.
2. The conceptual WOLDE STAR has flow-dependent vertical profiles to accommodate east and west configurations. The OPD with proposed vertical windows at the terminal entry point (East FL190-FL220 and West 120-160) would reduce present day level flight segments. Additional lateral spacing was proposed between the WOLDE and KABOY STARs to optimize their usage.
3. En route transitions that begin at KLAMS and a new waypoint southwest of KLAMS would provide more direct routing inbound. On the SJI transition, TOPEZ would be removed and replaced with a transition at JEPEG to more closely follow historical flight tracks. The SBI and HRV transitions would be removed due to lack of usage.
4. Runway transitions are proposed in each configuration. In west flow, Runway 27 would be the primary transition; however transitions would be available to Runways 26R/L. In east flow, proposed transitions are designed to terminate on a downwind with an FM leg. The Runway 08L transition would cross north of IAH at or above 8,000 feet until midfield to allow IAH and HOU departure traffic to climb more expeditiously and allows for tactical fix balancing. The Runway 08R and Runway 09 transitions track to the south downwind. Both downwinds in the east flow would be laterally positioned for the potential development of RNP AR IAPs. The proposed STAR would be procedurally separated from SBI departures within I90 airspace.
5. Figure 2 below depicts the proposed RNAV WOLDE STAR from the southeast corner-post compared to the current procedure.



**Figure 2. Current Procedure and Study Team Recommendation**

# OAPM Design Package: Houston Metroplex

## BRSKT RNAV STAR

### Proposed Final Design

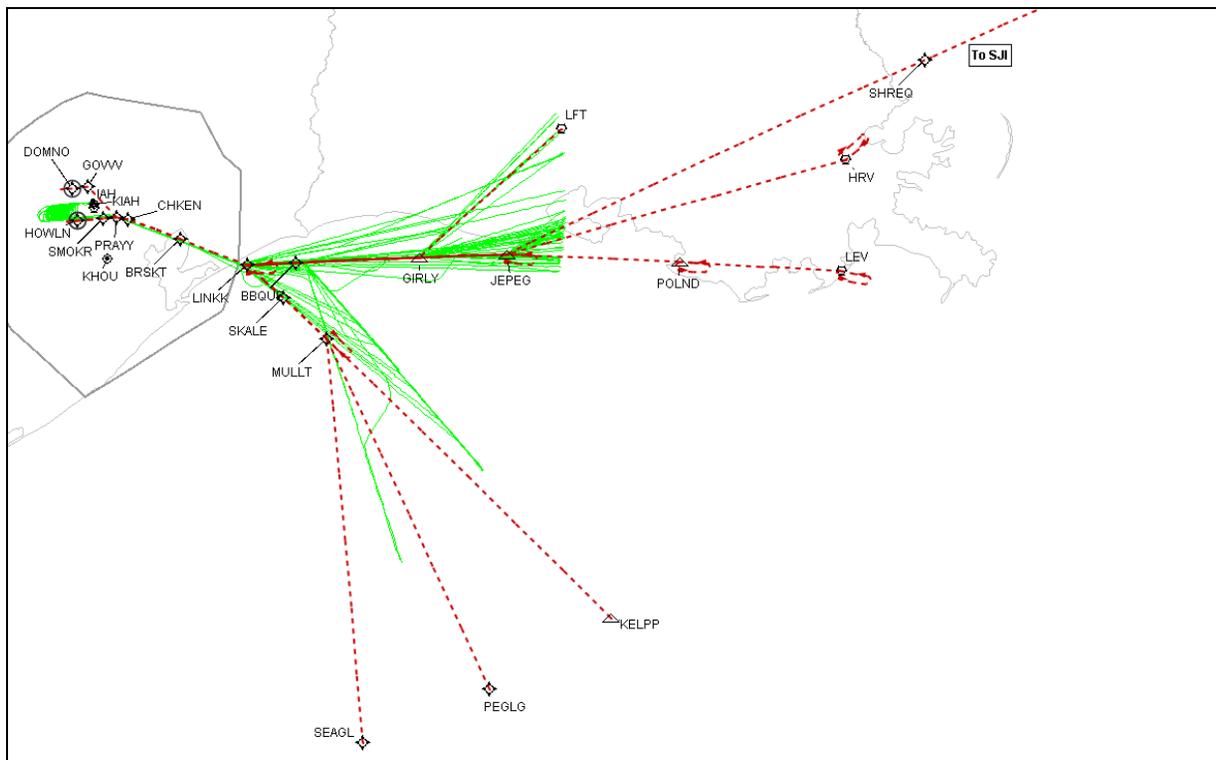
The Design Team has proposed flow dependent RNAV STARs from the southeast to IAH that would replace the current WOLDE STAR. The BRSKT STAR would be used for jet and turboprop aircraft landing IAH when on an east flow.

En route transitions from the Gulf of Mexico were modified from the Study Team proposal to connect to Required Navigation Performance routes that will be published in the future, as shown in Figure 3 below. The Design Team evaluated many options to separate these transitions on the BRSKT arrival from the HOU BAYYYY and PUCKS arrivals and determined that tactically separating aircraft on these procedures ensures the maximum industry stakeholder benefit.

As a change to the Study Team recommendations, the Harvey (HRV) transition was retained to provide routes from Mobile and Gulfport. SHREQ waypoint was added to the SJI transition to deconflict Pensacola departures from WHODAT Military Operating Area (MOA).

Published holding patterns were proposed at LINKK, MULLT, HRV, and LEV.

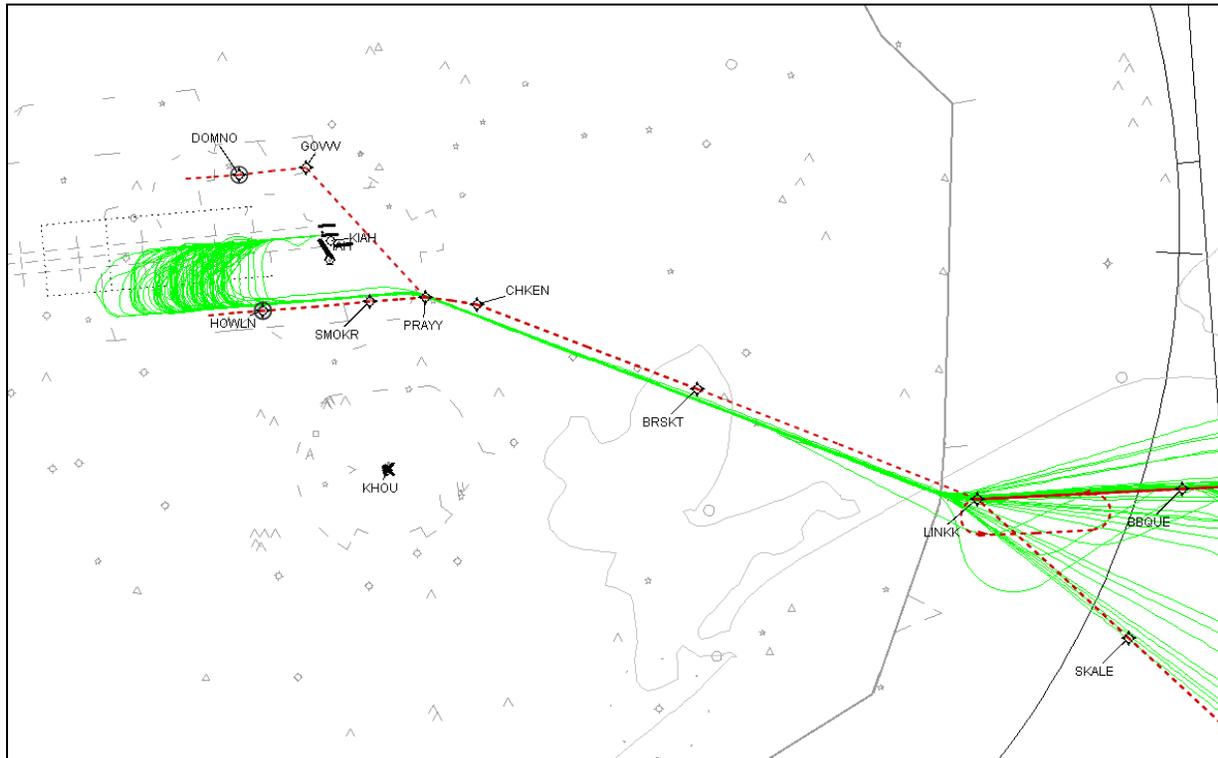
The proposed BRSKT STAR is designed with an OPD and a crossing restriction at LINKK of FL200 to FL230 and 280 knots. Crossing restrictions were added to cross BBQUE and SKALE at or below FL290 at 280 knots to improve ability to sequence aircraft.



**Figure 3. Proposed BRSKT STAR (En Route)**

# OAPM Design Package: Houston Metroplex

## BRSKT RNAV STAR



**Figure 4. Proposed BRSKT STAR (Terminal)**

## **OAPM Design Package: Houston Metroplex BRSKT RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

GILLL  
BAYYY  
PUCKS  
BOOZZ  
TKNIQ  
WAPPL

#### **SIDs:**

ELOCO  
GUMBY  
MMUGS  
PEECE  
FLYZA

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. Vertical limits of low altitude sectors were reviewed and may need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

The proposed Gulf of Mexico routes were not available during the study team process.

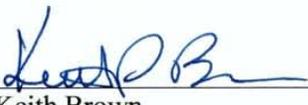
### **Attachments**

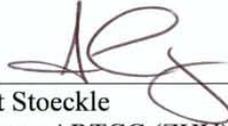
1. Phase I TARGETS File
2. BRSKT TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex BRSKT RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 Date
--	-----------------	---	-----------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/26/12 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
---	-----------------	--	-----------------

 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	6-21-12 Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	6-25-12 Date
---	-----------------	---	-----------------

## OAPM Design Package: Houston Metroplex

IAH BRSKT RNAV STAR

### RECORD OF CHANGE

Change Number	Date	Document
001	10/29/2012	BRSKT RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	BRSKT TARGETS Distribution Package	N/A

#### Description of Change

Updated Header with airport information.

The design team opted to modify the procedure to allow for improved flow eastbound for aircraft departing on the HOU ELOCO RNAV SID and those departing satellite airports south of J2 utilizing the MMALT RNAV SID. The original design proposal is shown in Figures 1 and 2. The location of the BRSKT waypoint was shifted eastward closer to the LINKK waypoint with an altitude restriction of at or below 14,000 feet and speed restriction of 280 knots. An altitude window was modified at the LINKK waypoint to between 17,000 feet and FL200. The waypoints KONNZ and BEDLM were added after LINKK waypoint and before CHKEN, with altitude restrictions of at 12,000 feet and 280 knots, and at or above 10,000 feet and 280 knots, respectively. The CHKEN waypoint altitude restriction was modified to at or below 7,000 feet. SMOKR waypoint was renamed SMOCR. These changes are shown in Figures 3 and 4. The TARGETS file and TARGETS distribution files were updated.

## OAPM Design Package: Houston Metroplex

*IAH BRSKT RNAV STAR*

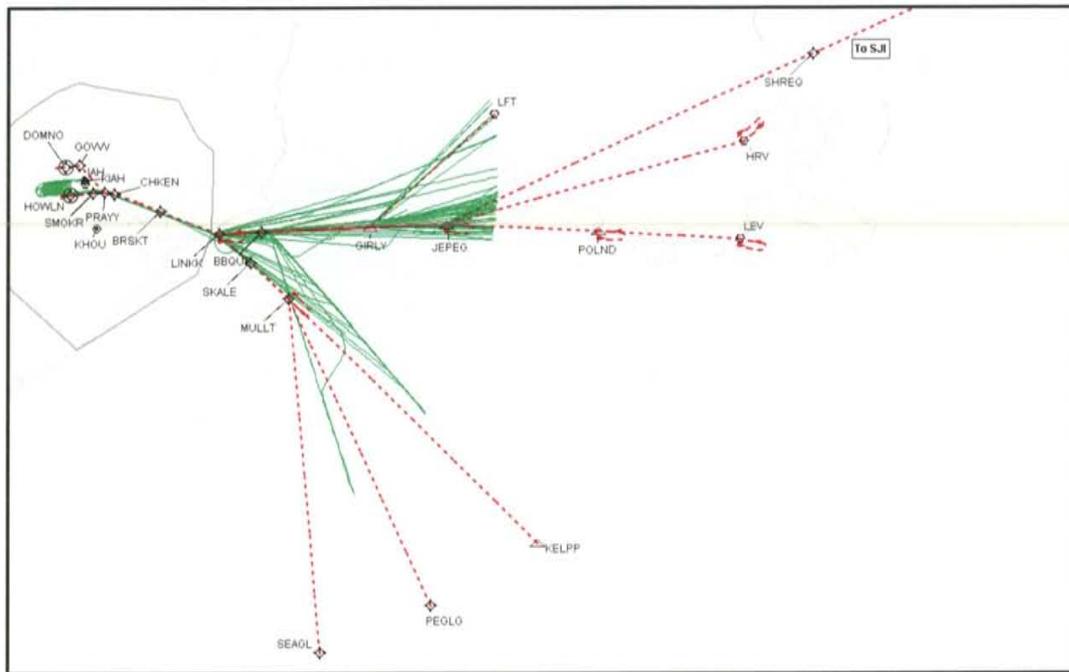


FIGURE 1. BRSKT RNAV STAR PROPOSED DESIGN (EN ROUTE) (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

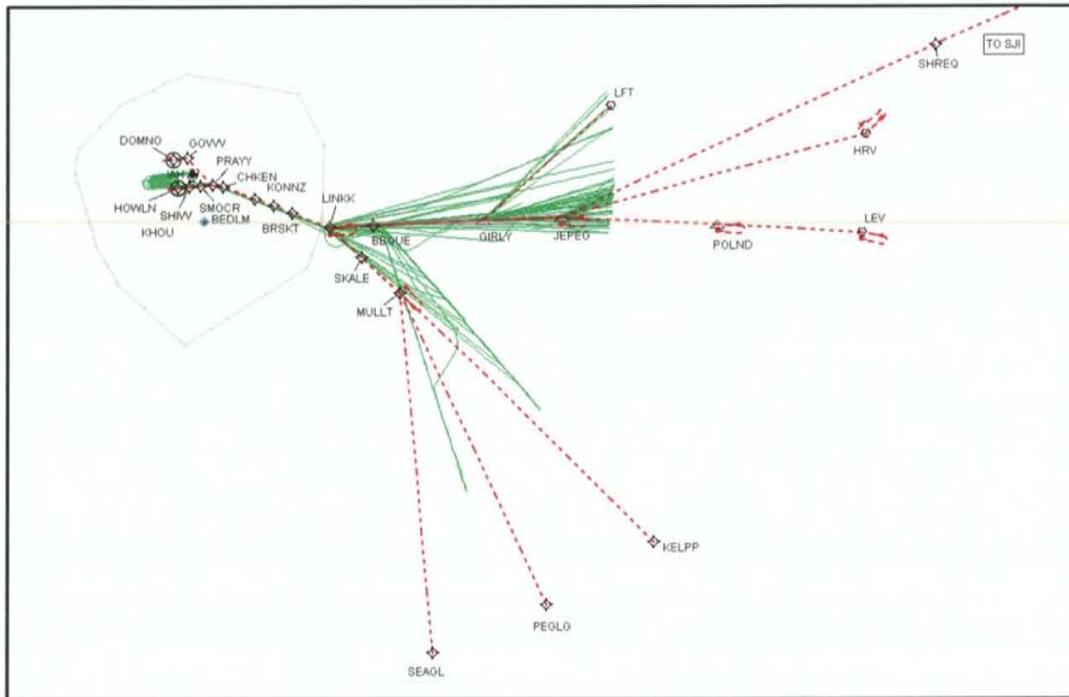
*IAH BRSKT RNAV STAR*



**FIGURE 2. BRSKT RNAV STAR PROPOSED DESIGN (TERMINAL) (Figure 4 in PFD)**

## OAPM Design Package: Houston Metroplex

*IAH BRSKT RNAV STAR*

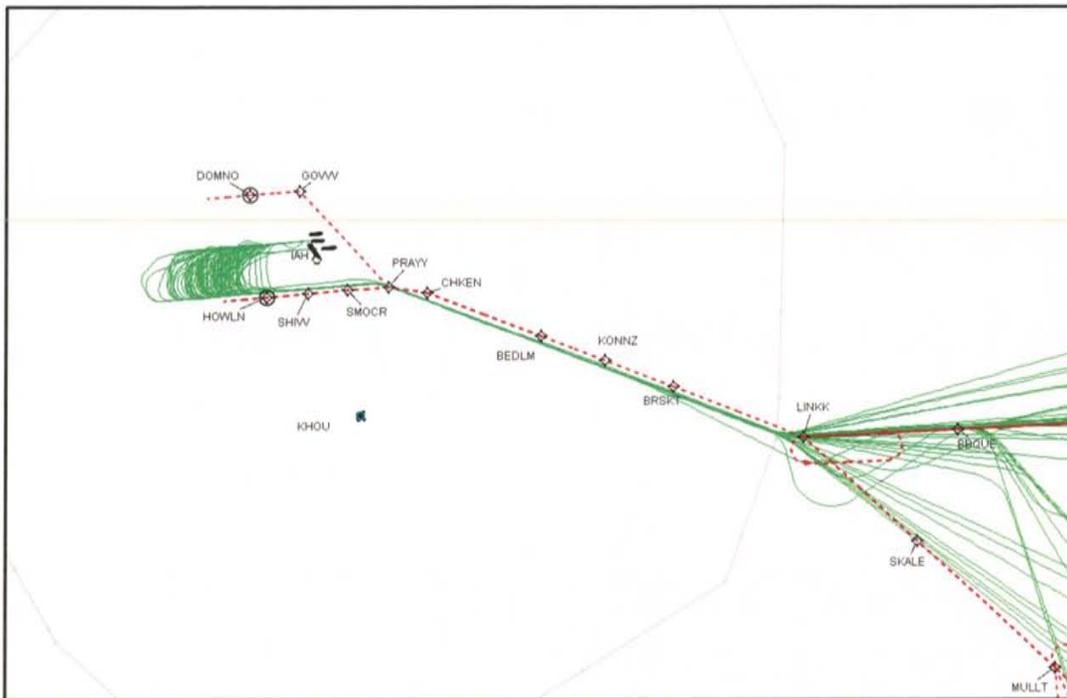


**FIGURE 3. BRSKT RNAV STAR PROPOSED DESIGN (EN ROUTE)**

(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH BRSKT RNAV STAR*



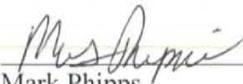
**FIGURE 4. BRSKT RNAV STAR PROPOSED DESIGN (TERMINAL)**

(Will replace Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH BRSKT RNAV STAR*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

  
\_\_\_\_\_  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex CESAN RNAV STAR

<b>Name of Change</b>	<b>CESAN RNAV STAR</b>	<b>Date</b>	<b>10-02-2012</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>N/A</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 ZHU Sectors: 38, 26</b>	<b>Facility Points of Contact</b>	<b>Zeb Snyder 281.230.5553 Ken Wilson 281.230.5553 Frank Hudzinski 281.230.8442</b>
<b>Related/Dependent Submissions</b>	<b>None</b>	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>2. TARGETS Distribution Package</b></li> </ol>

**Purpose**

Specific RNAV procedures for satellite airports were not addressed by the Houston OAPM Study team. The proposed CESAN STAR will provide an RNAV arrival procedure for turboprop aircraft not capable of at least 280 knots and piston powered aircraft destined south satellite airports as shown in Table 1.

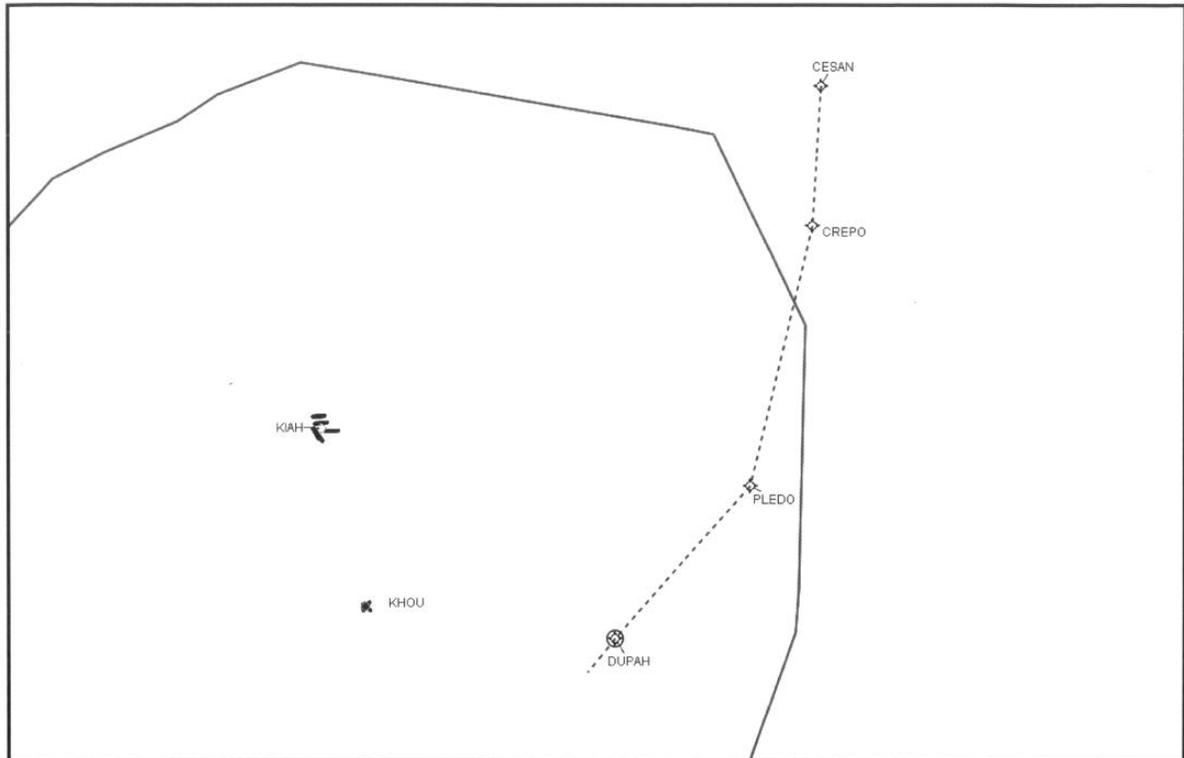
**Study Team Recommendation**

The Houston OAPM Study Team did not propose satellite airport arrival procedures.

**Proposed Final Design**

RNAV equipped aircraft not capable of at least 280 knots and destined HOU and south satellite airports, annotated at Table 1, will utilize the proposed CESAN RNAV STAR. Turboprop arrivals will cross CESAN at 11,000 feet and piston powered arrivals will cross CESAN at 6,000 feet. Arrivals will depart DUPAH heading 220. The proposed CESAN RNAV STAR is shown in Figure 1 below. The CESAN RNAV STAR is not flow dependent.

## OAPM Design Package: Houston Metroplex CESAN RNAV STAR



**FIGURE 1. PROPOSED CESAN RNAV STAR**

<b>Airport ID</b>	<b>Airport Name South of J2</b>		<b>Airport ID</b>	<b>Airport Name North of J2</b>
AXH	Houston Southwest		CXO	Lone Star Executive
EFD	Ellington Field		DWH	David Wayne Hooks Memorial
GLS	Scholes International		EYQ	Weiser Air Park
HPY	Baytown			
IWS	West Houston			
LBX	Brazoria County			
LVJ	Pearland Regional			
SGR	Sugar Land Regional			
TME	Houston Executive			
T00	Chambers County			
T41	La Porte Municipal			
54T	RWJ Airpark			

**Table 1. HOUSTON OAPM SATELLITE AIRPORTS**

## **OAPM Design Package: Houston Metroplex CESAN RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

**None**

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

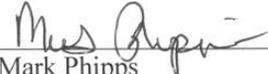
### **Attachments**

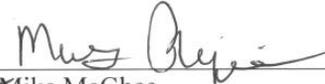
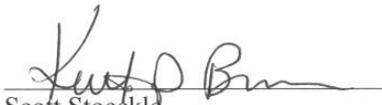
1. Houston OAPM D&I Master TARGETS File
2. TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)

## OAPM Design Package: Houston Metroplex CESAN RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	1-9-13 _____ Date	 _____ Keith Brown Houston Metroplex NATCA Lead	1/9/13 _____ Date
--	-------------------------	---	-------------------------

 _____ for Mike McGhee Houston ARTCC (ZHU) Facility Lead	1-9-13 _____ Date	 _____ for Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	1/9/13 _____ Date
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 _____ for Mike R. Richardson Houston TRACON (I90) Facility Lead	1-9-13 _____ Date	 _____ for Steve Prichard Houston TRACON (I90) NATCA Lead	1/9/13 _____ Date
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## OAPM Design Package: Houston Metroplex DOOBI RNAV STAR

<b>Name of Change</b>	<b>DOOBI STAR</b>	<b>Date</b>	<b>06-19-12</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E6, E7, E30, E32, E34, T2, I2, I5, I7</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 26, 38, 40, 42, 81 <b>ZFW Sectors:</b> 30, 86 <b>Ft. Polk Approach</b>	<b>Facility Points of Contact</b>	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> WHACK TWSTD SKNRD WAPPL <b>SIDs:</b> STRYA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase III TARGETS File</b></li> <li><b>2. DOOBI TARGETS Distribution Package</b></li> <li><b>3. Table of Procedures</b></li> </ol>

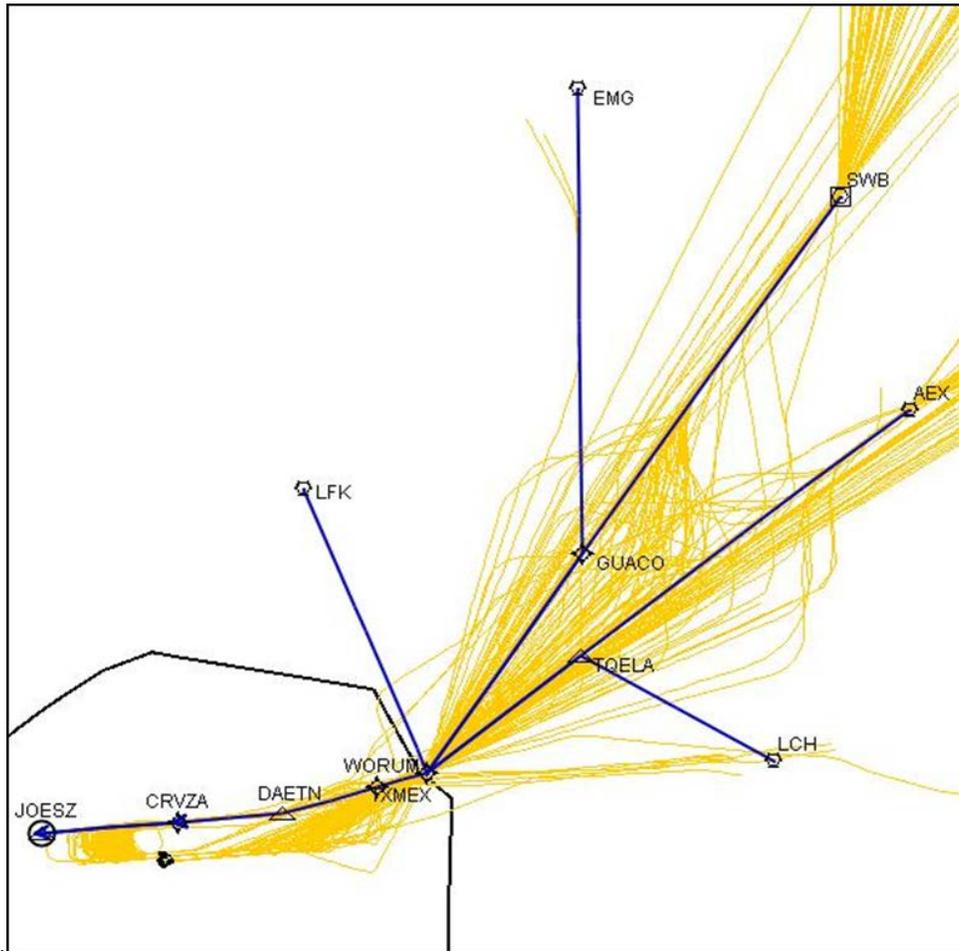
## **OAPM Design Package: Houston Metroplex DOOBI RNAV STAR**

### **Purpose**

This design package addresses the following issues with the TXMEX STAR identified by the Houston OAPM Study Team:

1. The current TXMEX STAR is the primary arrival for IAH traffic from the northeast (see Figure 1).
2. Additional lateral spacing is requested between the IAH STARs to optimize their simultaneous usage.
3. Due to the current lack of consistent dual STAR utilization, excessive vectoring occurs for sequencing as aircraft approach TXMEX.
4. The STAR is not vertically optimized resulting in level segments that result in increased fuel burn and excessive carbon emissions, particularly during east flow.
5. Aircraft flight tracks do not follow the lateral paths of the LCH and EMG transitions.

## OAPM Design Package: Houston Metroplex DOOBI RNAV STAR



**Figure 1. Current TXMEX STAR**

### **Study Team Recommendation**

1. The proposed TXMEX STAR would become a preferred HOU arrival with the IAH traffic routed via the DAS and ROKIT STARs.
2. The conceptual DAS STAR has flow-dependent vertical profiles to accommodate east and west configurations. The OPD with proposed vertical windows at COMBS (East FL190-FL220 and West 100-140), would reduce present day level flight segments on the TXMEX STAR.
3. The DAS STAR, in conjunction with the ROKIT STAR, is designed to provide a dual feed to IAH. Additional lateral spacing is added between the dual STARs to optimize their usage. The DAS STAR has en route transitions beginning at SWB and AEX to facilitate the use of the dual feeds and reduce complexity as crossover transitions are eliminated. The EMG and LCH transitions were removed due to lack of usage and to

## OAPM Design Package: Houston Metroplex DOOBI RNAV STAR

avoid unnecessary crossing traffic. The LFK transition is still available for weather re-routing, but only in west flow.

- Runway transitions are proposed in each configuration. In west flow, Runway 26L is designed as the primary transition; however, transitions are available to Runways 26R and 27. In east flow, transitions would terminate on a downwind leg. The Runway 08L transition passes north of IAH at or above 8,000 ft until midfield to allow IAH and HOU departure traffic to climb more expeditiously. The Runway 09 transition crosses to the south downwind and allows for tactical runway and fix balancing. The Runway 08R transition will be determined during D&I. Both downwind legs in east flow are laterally positioned for the potential development of RNP AR IAPs.

Figure 2 depicts the proposed RNAV DAS STAR from the northeast corner-post compared to the current TXMEX STAR.

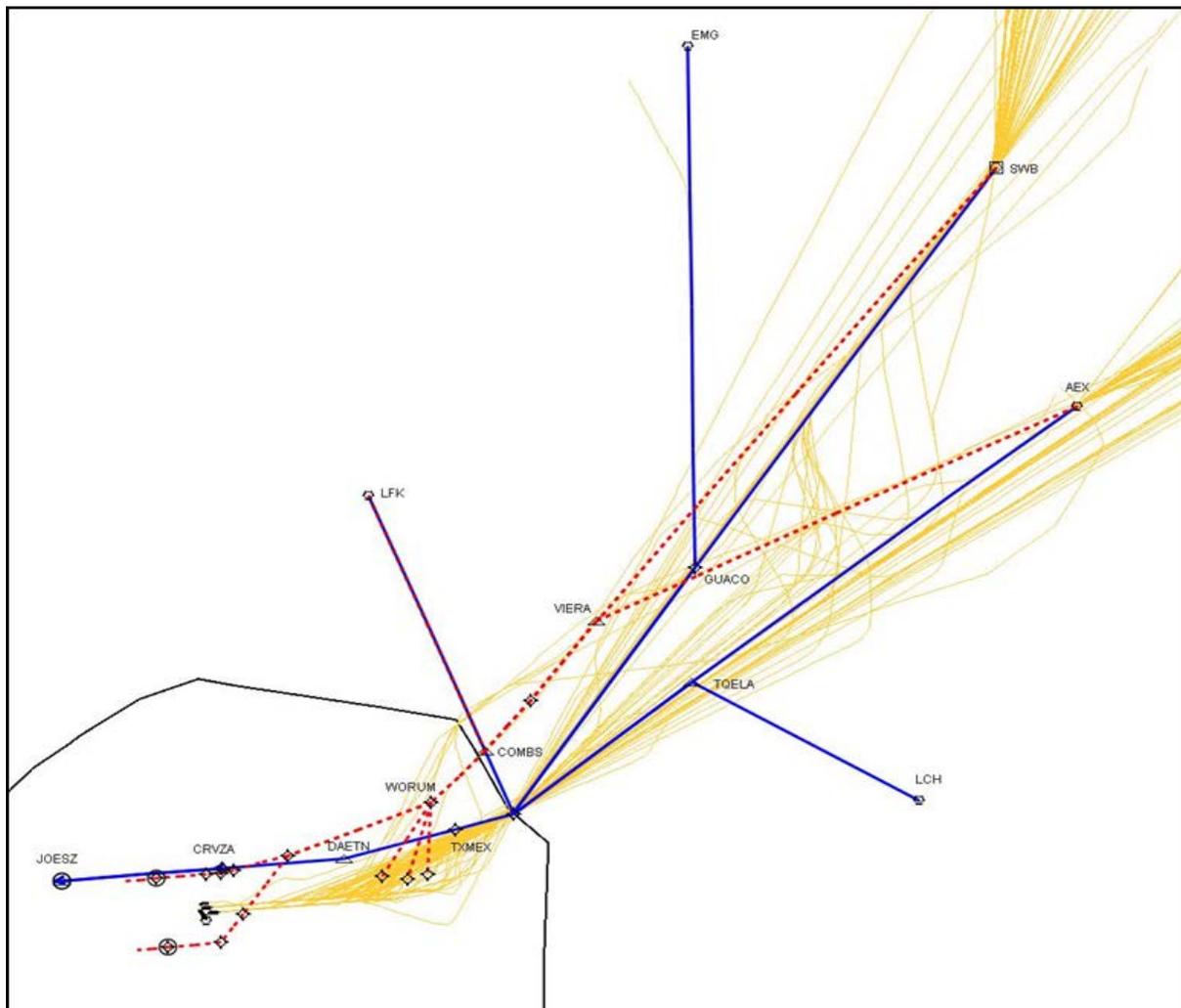


Figure 2. Current Procedure and Study Team Recommendation

## **OAPM Design Package: Houston Metroplex DOOBI RNAV STAR**

### **Proposed Final Design**

The DOOBI STAR would be one of two STARs designed to provide a dual feed to IAH on a west flow (Figure 3). The DOOBI STAR would be used for RNAV jet and high performance turboprop aircraft landing IAH. The primary arrival runway would be 26L (Figure 4).

En route transitions from the northeast were modified from the Study Team proposal. The PLANB transition was added to allow SHV departures access to the DOOBI STAR and provide an ATC assigned, weather contingent route for ZFW. The AEX transition was straightened to remove unnecessary track miles.

The Design Team evaluated many options to separate the en route transitions on the DOOBI arrival from the HOU WAPPL and IAH WHACK arrivals and determined that it would be better to have controllers tactically separate aircraft on these procedures.

The EGULZ waypoint was added to the SWB transition and JERNY waypoint was added to the AEX transition. These waypoints would be used to separate from WARRIOR Special Use Airspace (SUA) and have crossing restrictions at or above FL240.

An outer fix holding pattern was created at EGULZ and an inner fix holding pattern was created at DOOBI.

The DOOBI STAR utilizes an OPD with an altitude window at DOOBI from 15,000 to 17,000 feet at 250 knots. An altitude window was added at TURNR and BEATL from 17,000 feet to FL230 at 280 knots to facilitate predictable descent profiles. EGULZ and JERNY would be restricted to 280 knots and serve as initial sequencing fixes.

# OAPM Design Package: Houston Metroplex

## DOOBI RNAV STAR

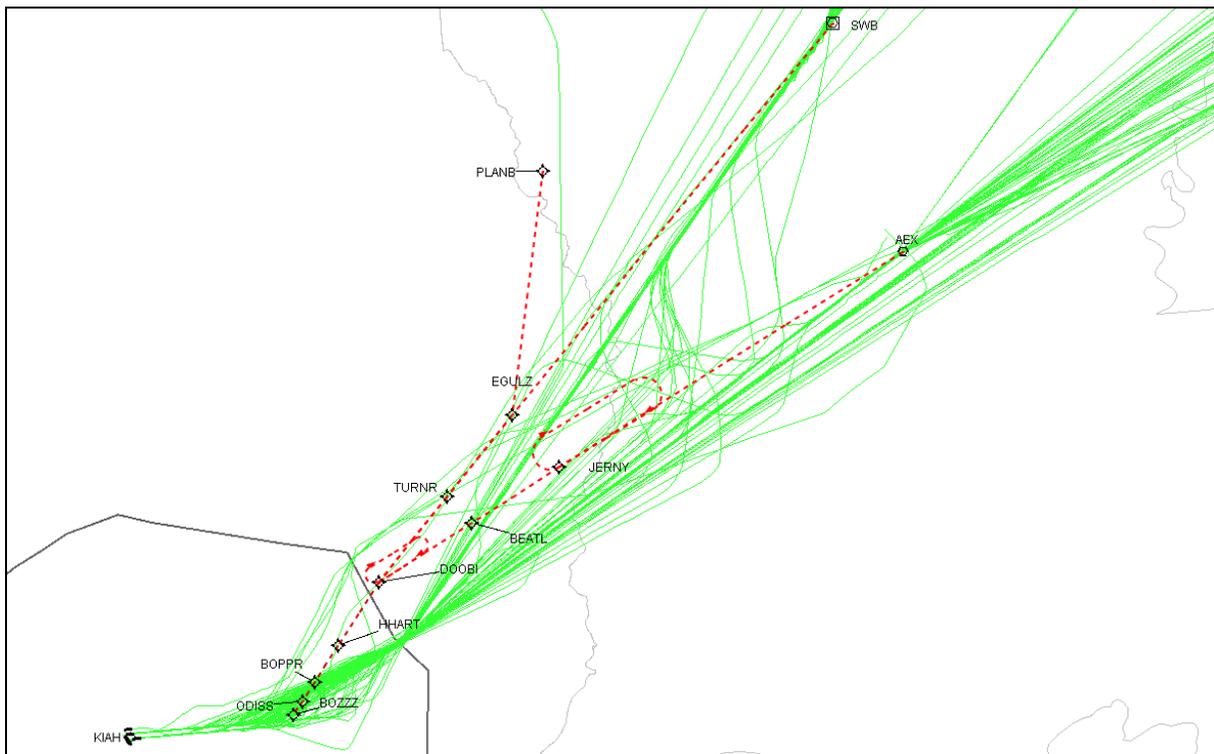


Figure 3. Proposed DOOBI STAR (En Route)

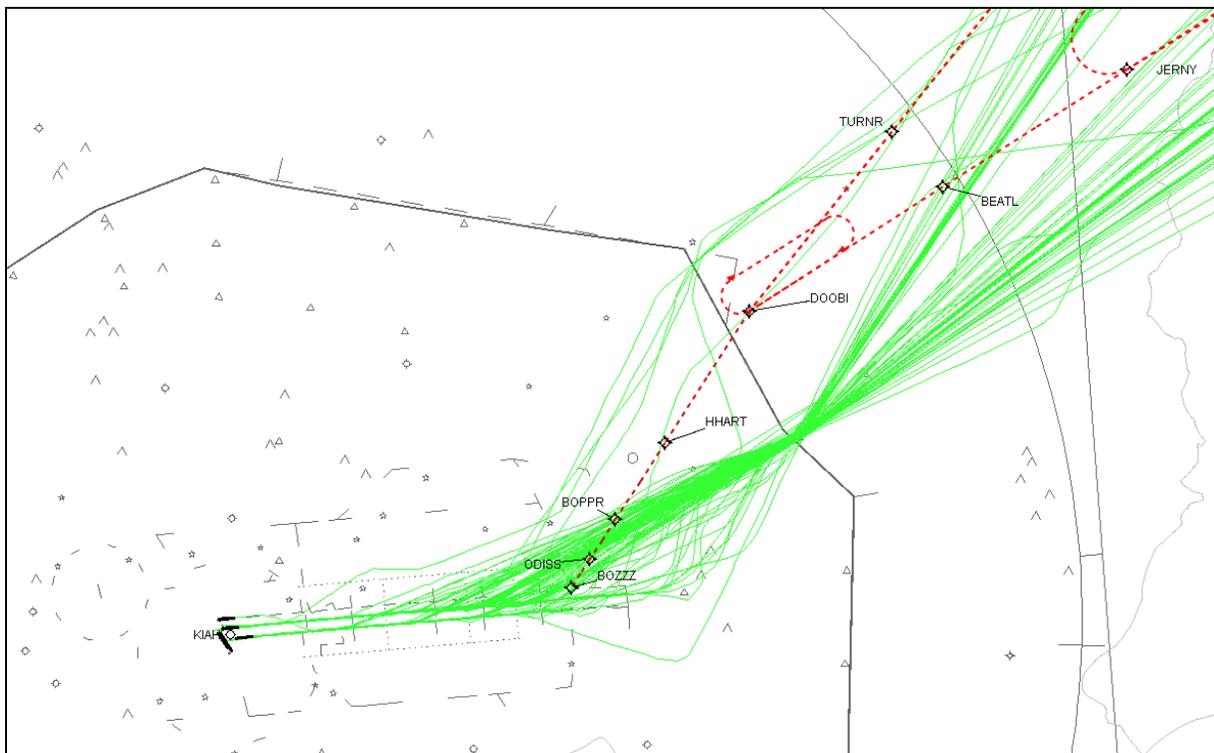


Figure 4. Proposed DOOBI STAR (Terminal)

## **OAPM Design Package: Houston Metroplex DOOBI RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

WHACK  
TWSTD  
SKNRD  
WAPPL

#### **SIDs:**

STRYA

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated. Vertical limits of low altitude sectors were reviewed and will not need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

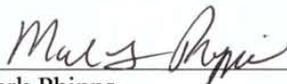
### **Attachments**

1. Phase III TARGETS File
2. DOOBI TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

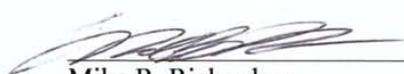
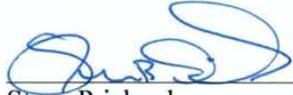
## OAPM Design Package: Houston Metroplex DOOBI RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 Date
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 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/25/12 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
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 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	6-20-12 Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	6-25-12 Date
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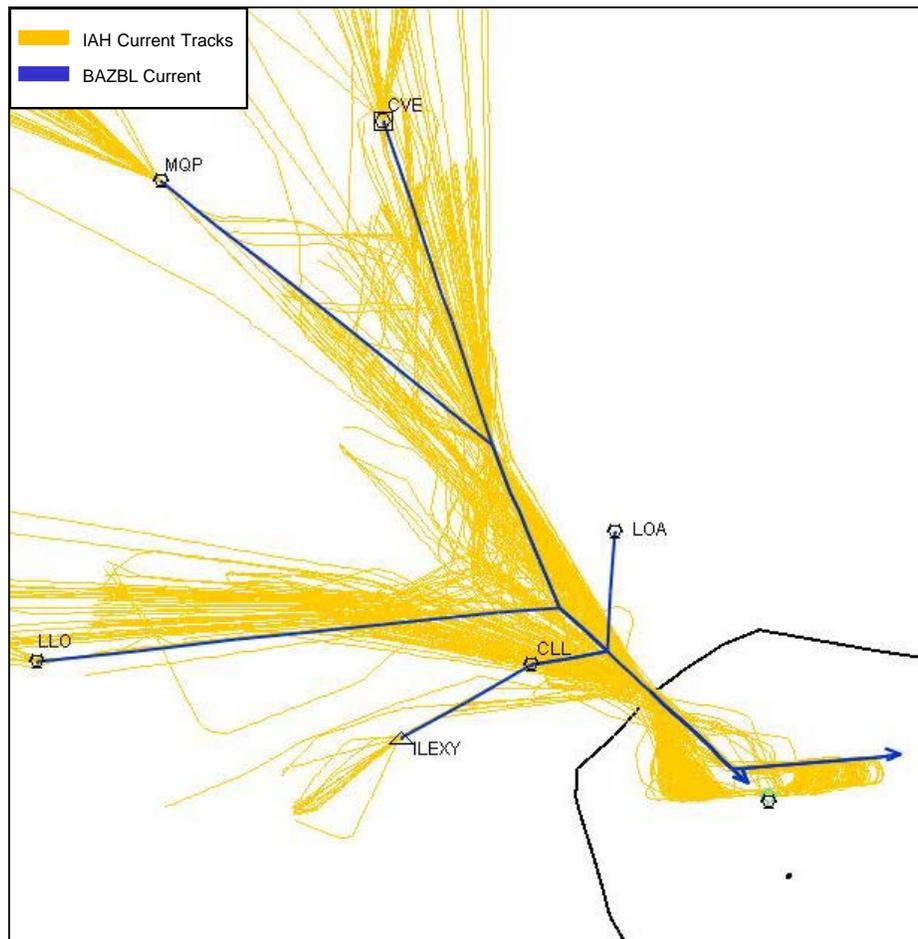
## OAPM Design Package: Houston DRLLR RNAV STAR

<b>Name of Change</b>	<b>DRLLR STAR</b>	<b>Date</b>	<b>06-20-12</b>
<b>Change Classification</b>	Terminal Procedures	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E10, E11, E17, E29, I7</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 74, 78, 80, 82, 83, 96 <b>ZFW Sectors:</b> 46, 96	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GUSHR TTORO MSCOT KIDDZ <b>SIDs:</b> BNDTO DOBBY PITZZ	<b>Associated Data Files:</b>	<b>1. Phase IV TARGETS File</b> <b>2. DRLLR TARGETS Distribution Package</b> <b>3. Table of Procedures</b>

### Purpose

1. The BAZBL STAR is the primary arrival for IAH traffic from the northwest.
2. The historical flight tracks do not follow the published arrival procedures, as depicted in Figure 1.
3. The vertical and lateral paths are not optimized.
4. The limited volume of ZHU airspace in the northwest corner in conjunction with the absence of applied ACM prevents efficient metering.

## OAPM Design Package: Houston DRLLR RNAV STAR



**Figure 1. Current IAH Northwest BAZBL STAR**

### **Study Team Recommendation**

1. The conceptual BAZBL STAR more closely follows historical flight tracks. The OST developed the STAR to be flow-specific, providing configuration-dependent vertical profile benefits. The proposed altitude window for west flow is 170-FL200. The proposed altitude window for east flow is 100-130. The OPD will reduce current level segments on the BAZBL STAR.
2. Runway transitions are proposed in each configuration. In east flow, Runway 08L was designed as the primary transition; however, transitions are available to Runways 08R and 09. In west flow, transitions are designed to terminate on a downwind leg. The Runway 26L/R transitions pass north of IAH at or above 8,000 feet until midfield to allow IAH and HOU departure traffic to climb more expeditiously. The Runway 27 transition crosses to join the south downwind at 6,000 feet and allows for tactical runway and fix balancing. Both downwind legs in the west flow are laterally positioned for the potential development of RNP AR IAPs.

## OAPM Design Package: Houston DRLLR RNAV STAR

3. Figure 2 below depicts the recommended RNAV BAZBL STAR and the current procedure.

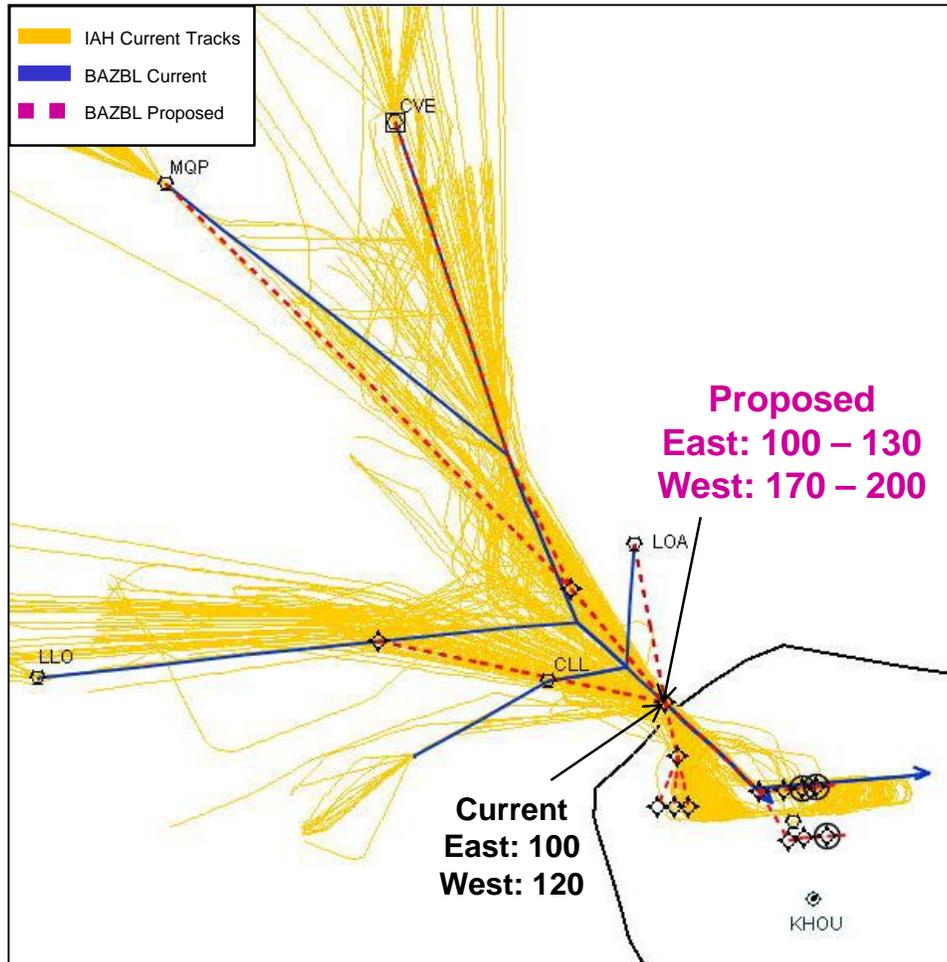


Figure 2. Proposed IAH Northwest BAZBL STAR

# OAPM Design Package: Houston

## DRLLR RNAV STAR

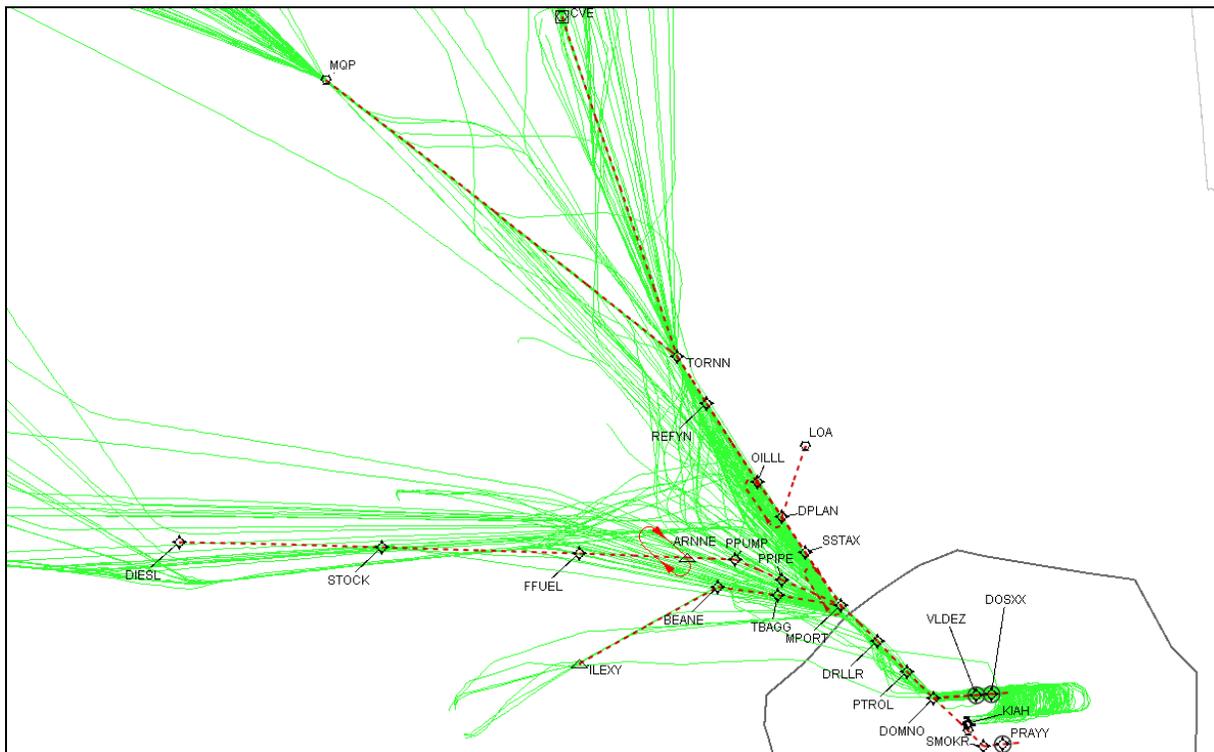
### Proposed Final Design

The Design Team has proposed flow dependent dual RNAV STARs from the northwest to IAH that would replace the current BAZBL STAR. The DRLLR STAR would be one of two STARs designed to provide a dual feed to IAH on a west flow (Figure 3). The DRLLR STAR would be used for jet and high performance turboprop aircraft landing IAH when on a west flow.

The en route transitions were modified from the Study Team proposal to reduce track miles and more closely align the procedure with historical track data. The en route transition from DIESL has been developed to be used during times when dual arrival flows to IAH are not available. The Design Team evaluated many options to deconflict the transitions on the DRLLR arrival from the HOU KIDDZ arrival and determined that it would be better to tactically separate aircraft on these procedures.

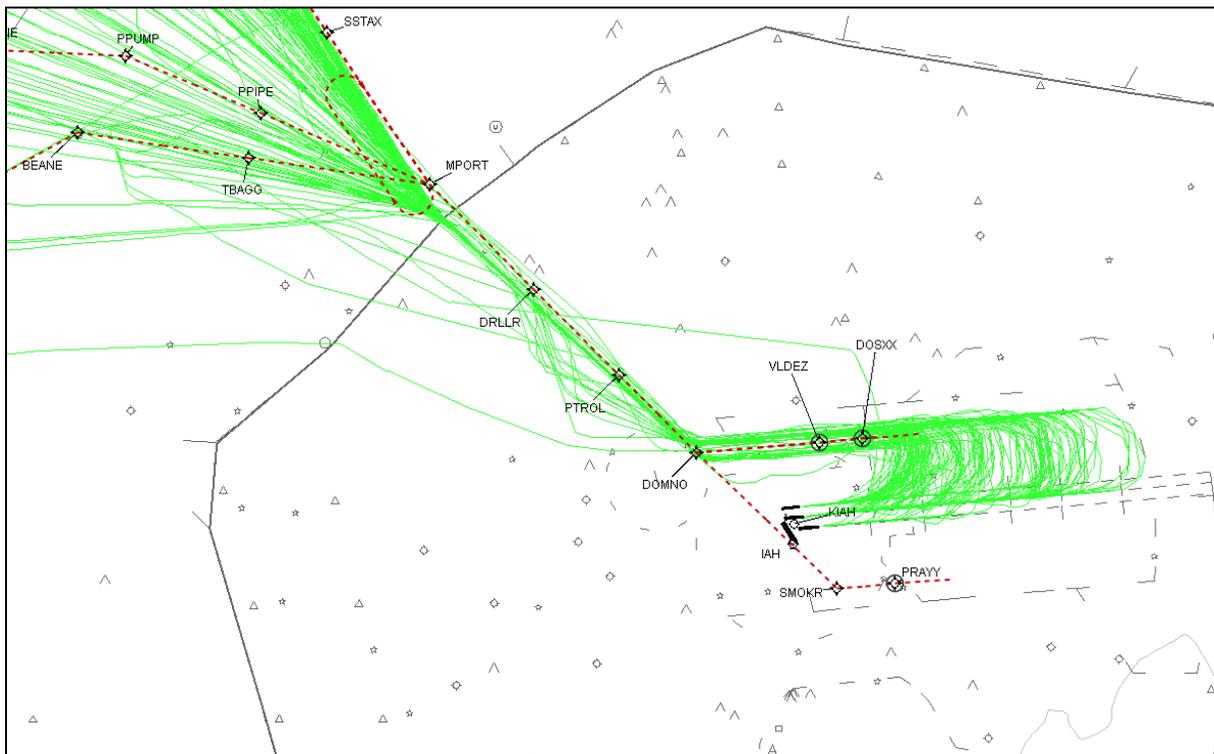
Published holding patterns have been proposed at DRLLR, OILLL, and ARNNE.

The proposed DRLLR STAR was designed with an OPD and an altitude window at DRLLR from 16,000 feet to FL190 at 280 knots.



**Figure 3. Proposed DRLLR STAR (En Route)**

# OAPM Design Package: Houston DRLLR RNAV STAR



**Figure 4. Proposed DRLLR STAR (Terminal)**

## **OAPM Design Package: Houston DRLLR RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

GUSHR  
MSCOT  
TTORO  
KIDDZ

#### **SIDs:**

BNDTO  
DOBBY  
PITZZ

### **Additional Design Considerations**

This proposal requires modifications to ZHU, ZFW and I90 internal Standard Operating Procedures and Letters of Agreement.

Validation through a Human-in-the-Loop simulation (HITLs) is anticipated to evaluate the increase in complexity of sequencing the DRLLR arrival with aircraft on the MSCOT arrival to KIAH.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

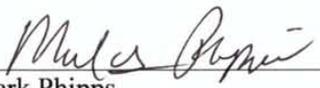
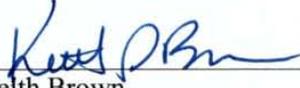
### **Attachments**

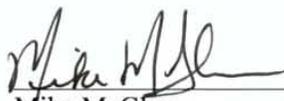
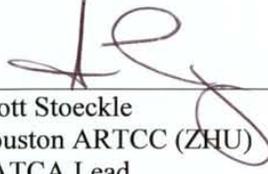
1. Phase IV TARGETS File
2. DRLLR TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

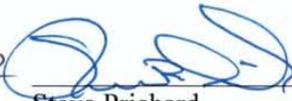
## OAPM Design Package: Houston DRLLR RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
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 Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/21/2012</u> Date	 Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
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 Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>6-21-12</u> Date	 Steve Prichard Houston TRACON (I90) NATCA Lead	<u>6-25-12</u> Date
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## OAPM Design Package: Houston Metroplex

IAH DRLLR RNAV STAR

### RECORD OF CHANGE

Change Number	Date	Document
001	11/15/2012	DRLLR RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	DRLLR TARGETS Distribution Package	N/A

#### Description of Change

Updated Header with airport information.

The design team amended the procedure to ensure criteria compliance, airspace sector integrity, and procedure connectivity. The original design proposal is shown in Figures 1 and 2. Due to criteria requirements, the LOA transition was removed and replaced by an OILLL transition. Additionally, TBAGG waypoint was moved. A TTORN transition was added to ensure connectivity with the North Texas OAPM procedures.

Changes made for airspace are:

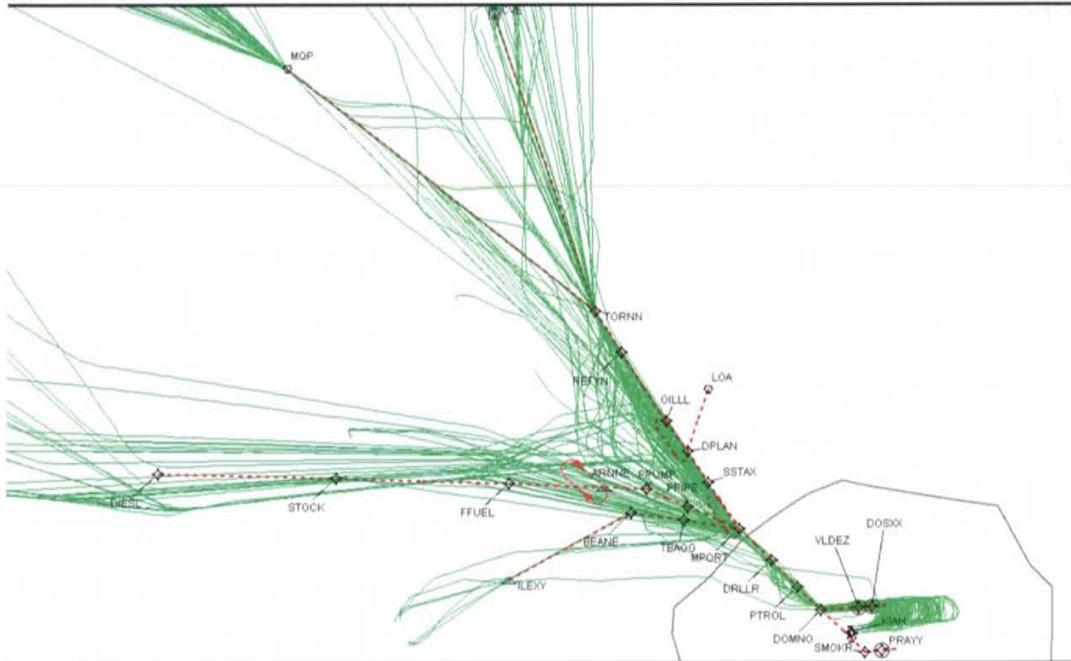
PTROL and DRLLR waypoints were moved 1.5 NM.

An additional waypoint, named BOING, was added to the DRLLR STAR between DOMNO and SMOKR waypoints with an altitude restriction of 6,000 feet.

The DOSXX and SMOKR waypoints were renamed DOOOM and SMOCR, respectively. VLDEZ waypoint was added on the Runway 26R transition. These changes are shown in Figures 3 and 4. The TARGETS file and TARGETS distribution files were updated.

## OAPM Design Package: Houston Metroplex

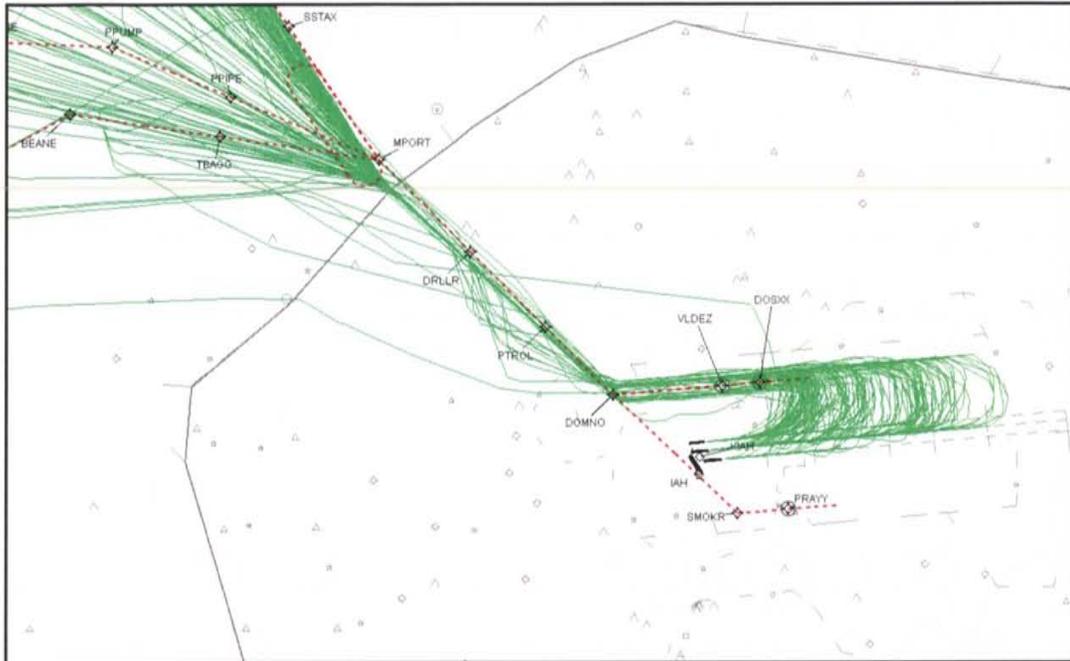
*IAH DRLLR RNAV STAR*



**FIGURE 1. DRLLR RNAV STAR PROPOSED DESIGN (EN ROUTE) (Figure 3 in PFD)**

## OAPM Design Package: Houston Metroplex

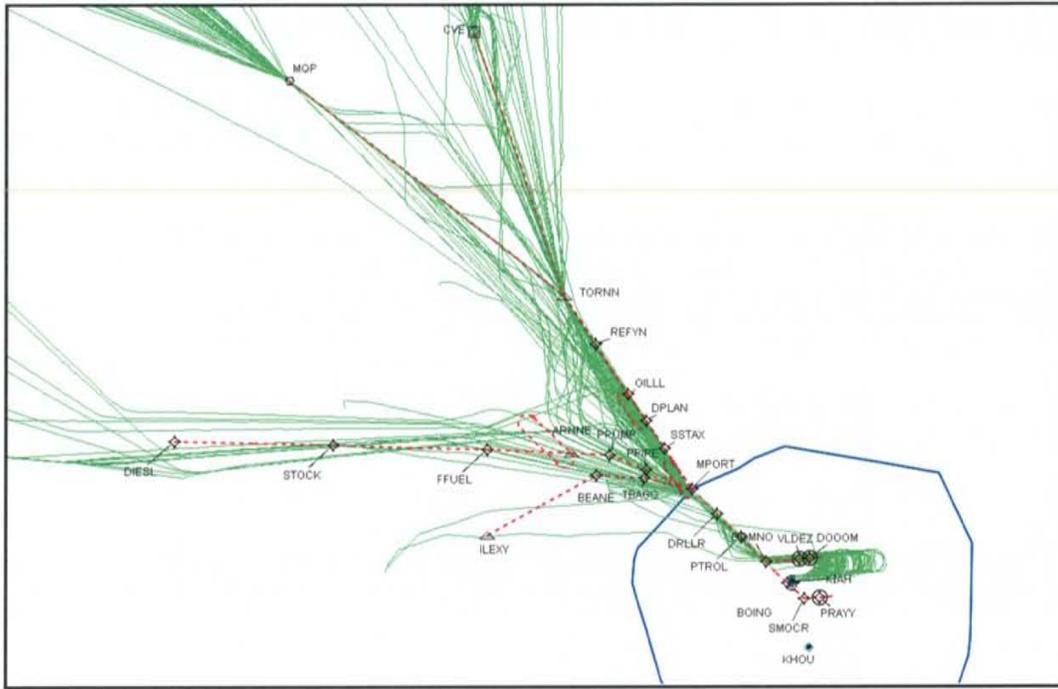
*IAH DRLLR RNAV STAR*



**FIGURE 2. DRLLR RNAV STAR PROPOSED DESIGN (TERMINAL) (Figure 4 in PFD)**

## OAPM Design Package: Houston Metroplex

*IAH DRLLR RNAV STAR*

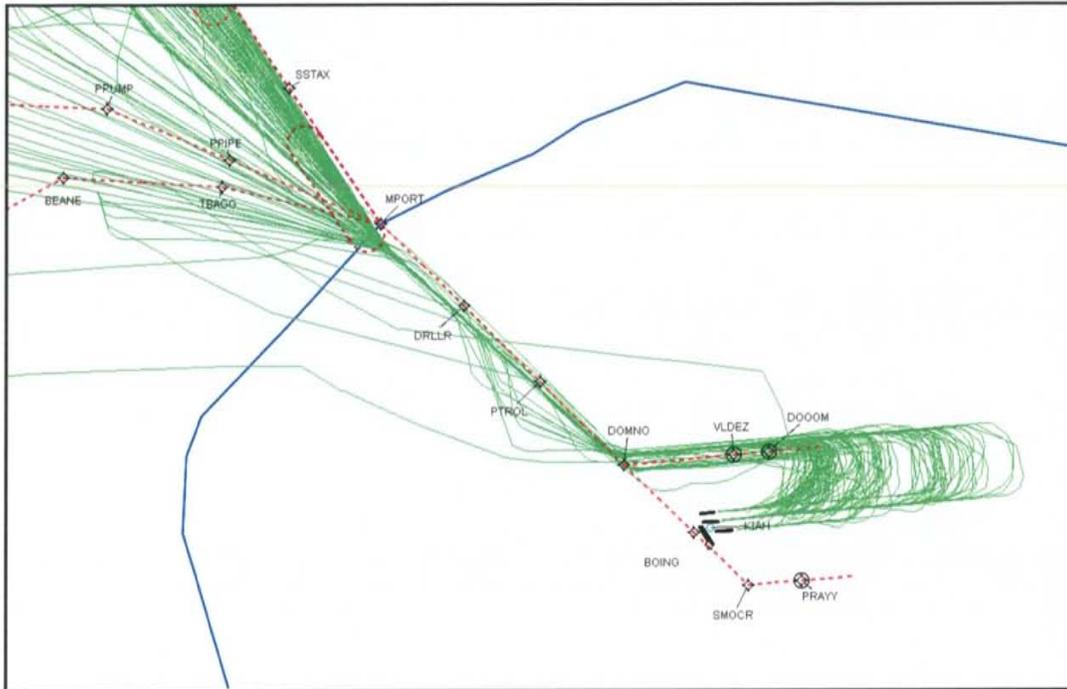


**FIGURE 3. DRLLR RNAV STAR PROPOSED DESIGN (EN ROUTE)**

(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH DRLLR RNAV STAR*



**FIGURE 4. DRLLR RNAV STAR PROPOSED DESIGN (TERMINAL)**

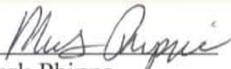
(Will replace Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH DRLLR RNAV STAR*

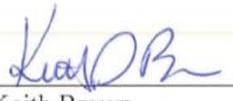
Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

---

  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

---

  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex GILL RNAV STAR

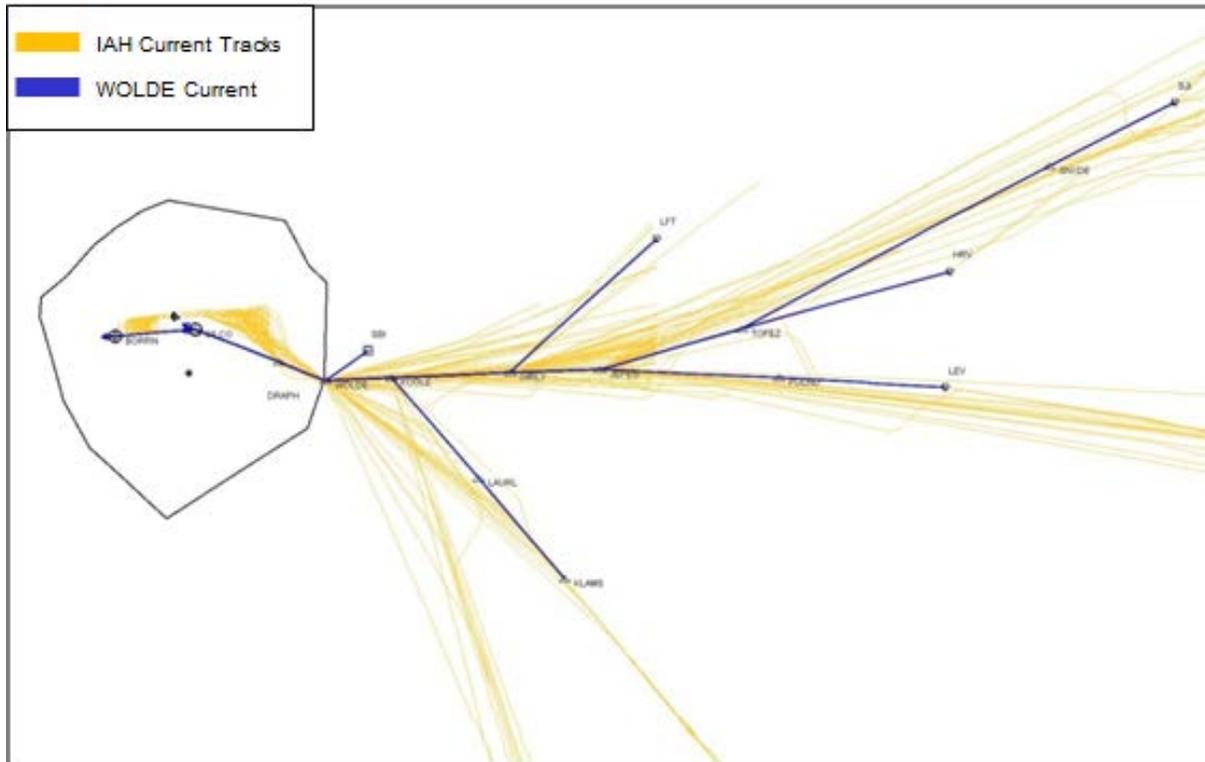
<b>Name of Change</b>	<b>GILL STAR</b>	<b>Date</b>	<b>05-17-2012</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E20, E36, T4, T5, I19, I20, I21, I23</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 79, 68, 43, 36, 70, 24, 65, 37, 34	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552</b> <b>Bruce Hinote 281.230.5552</b>
<b>Dependent Submissions</b>	<b>STARs:</b> BRSKT BAYYY PUCKS BOOZZ TKNIQ WAPPL <b>SIDs:</b> ELOCO GUMBY MMUGS PEECE FLYZA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li>1. Phase I TARGETS File</li> <li>2. GILL TARGETS Distribution Package</li> <li>3. Procedure Change Table</li> </ol>

# OAPM Design Package: Houston Metroplex GILL RNAV STAR

## Purpose

This design package addresses the following issues with the WOLDE STAR identified by the Study Team:

1. The WOLDE RNAV STAR is currently the primary arrival for IAH traffic from the southeast.
2. Additional lateral spacing is requested between the IAH STARs to optimize their simultaneous usage.
3. The STAR is not vertically optimized resulting in level segments that increase fuel burn and carbon emissions, particularly during east flow.
4. Aircraft flight tracks do not follow the lateral paths of the KLAMS and SJI transitions, and the SBI and HRV transitions are not utilized, as depicted in Figure 1 below.



**Figure 1. Current WOLDE STAR**

# OAPM Design Package: Houston Metroplex

## GILL RNAV STAR

### Study Team Recommendations

1. The WOLDE STAR would remain the primary IAH southeast arrival route.
2. The conceptual WOLDE STAR would have flow-dependent vertical profiles to accommodate east and west configurations. The OPD with proposed vertical windows at the terminal entry point (East FL190-FL220 and West 120-160) would reduce present day level flight segments. Additional lateral spacing would be added between the WOLDE and KABOY STARS to optimize their usage.
3. En route transitions that begin at KLAMS and a new waypoint southwest of KLAMS would provide more direct routing inbound. On the SJI transition, TOPEZ would be removed and replaced with a transition at JEPEG to more closely follow historical flight tracks. The SBI and HRV transitions would be removed due to lack of usage.
4. Runway transitions are proposed in each configuration. In west flow, Runway 27 would be the primary transition; however transitions are available to Runways 26L/R. In east flow, transitions are designed to terminate on a downwind with an FM leg. The Runway 08L transition would cross north of IAH at or above 8,000 feet until midfield to allow IAH and HOU departure traffic to climb more expeditiously and allows for tactical fix balancing. The Runway 08R and Runway 09 transitions track to the south downwind. Both downwinds in the east flow would be laterally positioned for the potential development of RNP AR IAPs. The STAR would be procedurally separated from SBI departures within I90 airspace.
5. Figure 2 below depicts the proposed RNAV WOLDE STAR from the southeast corner-post compared to the current procedure.

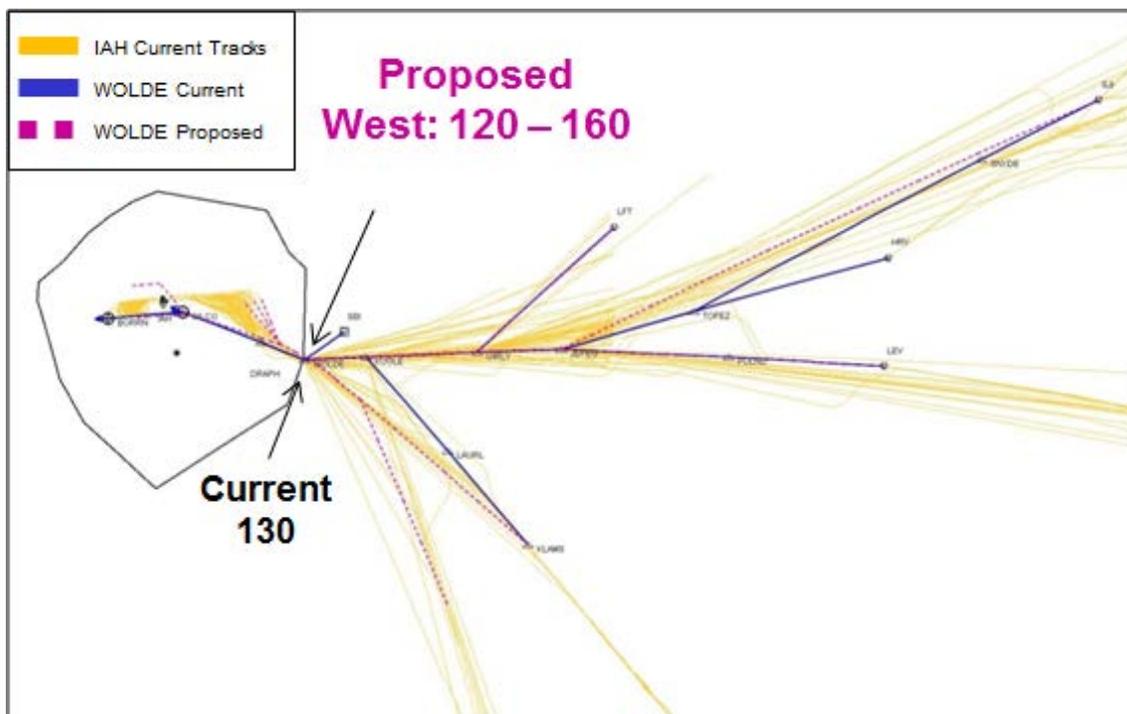


Figure 2. Current Procedure and Study Team Recommendation

# OAPM Design Package: Houston Metroplex

## GILL RNAV STAR

### Proposed Final Design

The Design Team proposes flow dependent RNAV STARs from the southeast to IAH that would replace the current WOLDE STAR. The GILL STAR would be used for jet and turboprop aircraft when landing on a west flow.

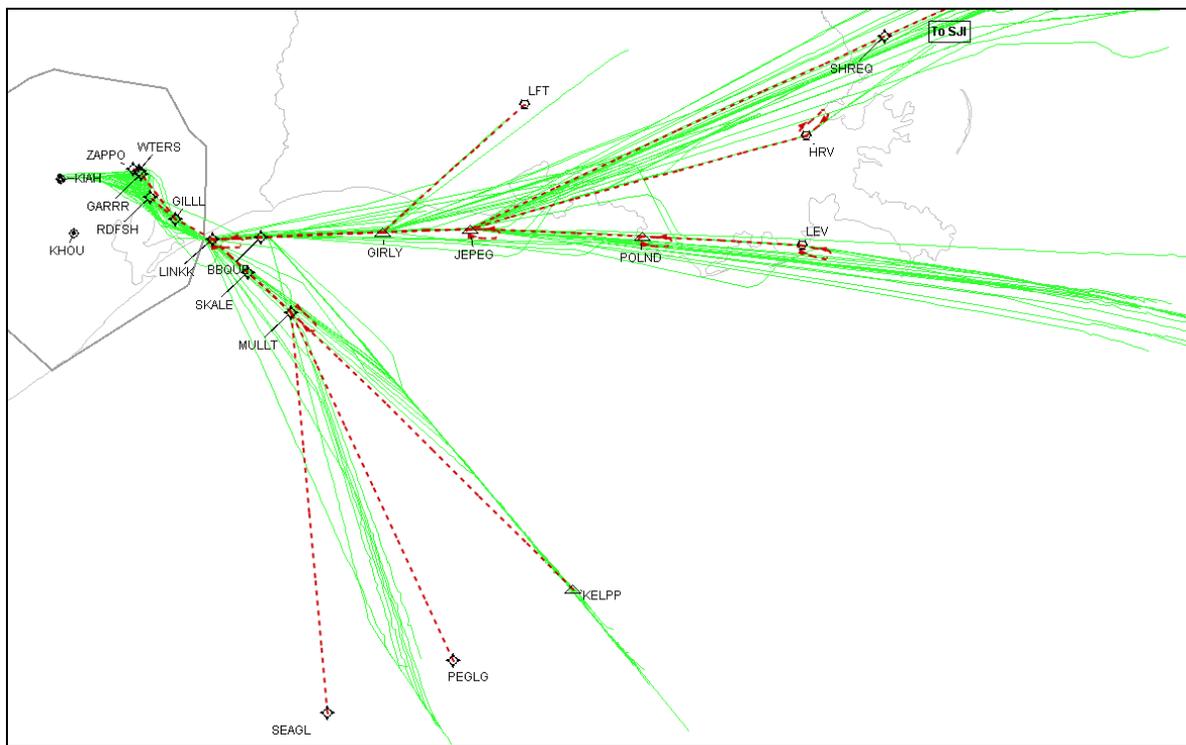
En route transitions from the Gulf of Mexico were modified from the Study Team proposal to connect to Required Navigation Performance routes that will be published in the future, as shown below in Figure 3. The Design Team evaluated many options to separate these transitions on the GILL arrival from the HOU BAYYYY and PUCKS arrivals and determined that tactically separating aircraft on these procedures ensures the maximum industry stakeholder benefit.

As a change to the Study Team recommendations, the Harvey (HRV) transition was retained to provide routes from Mobile and Gulfport. SHREQ waypoint was added to the SJI transition to deconflict Pensacola departures from WHODAT Military Operating Area (MOA).

Published holding patterns are proposed at LINKK, MULLT, HRV, and LEV.

The proposed GILL STAR is designed with an OPD and an altitude window at LINKK of 12,000 to 15,000 feet and 250 knots. Crossing restrictions were added to cross BBQUE and SKALE at or below FL210 at 280 knots to improve ability to sequence aircraft.

Runway transitions were modified as depicted in Figure 4 below to connect with ILS approach transitions that the Design Team will propose in Design Phase IV.



**Figure 3. Proposed GILL STAR (En Route)**

# OAPM Design Package: Houston Metroplex

## GILL RNAV STAR

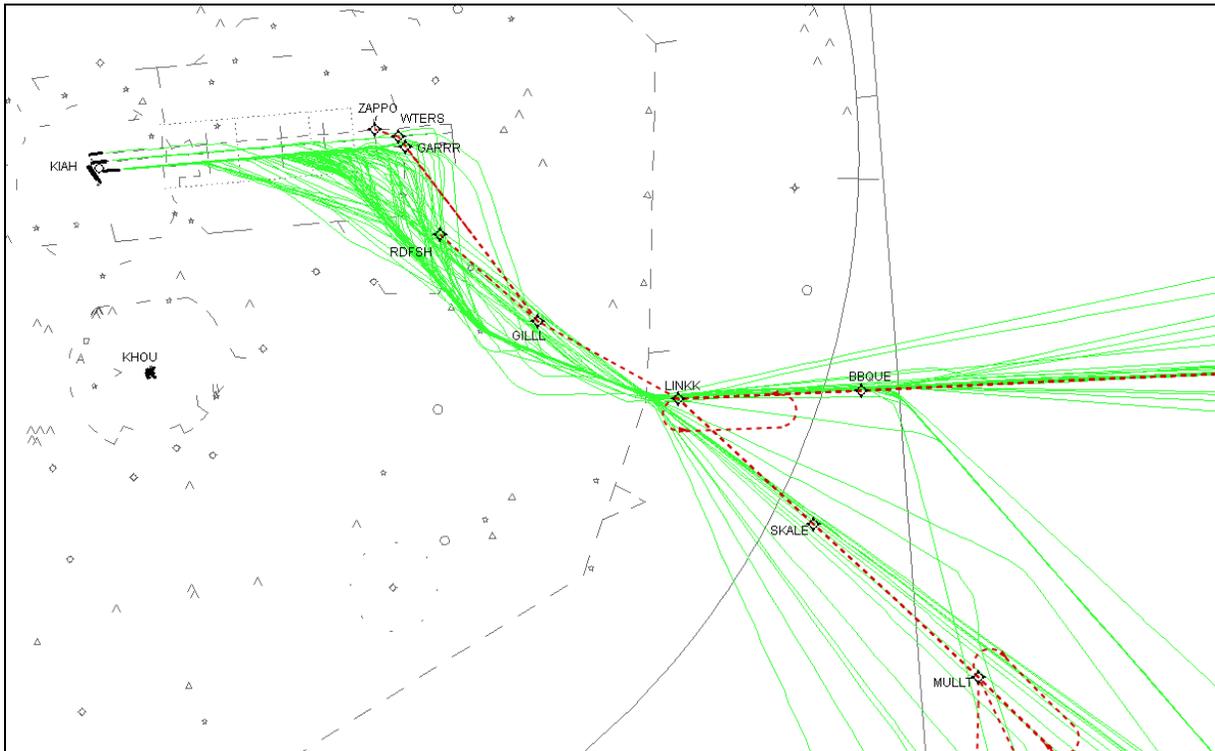


Figure 4. Proposed GILL STAR (Terminal)

# **OAPM Design Package: Houston Metroplex GILL RNAV STAR**

## **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

### **STARs:**

BRSKT  
BAYYY  
PUCKS  
BOOZZ  
TKNIQ  
WAPPL

### **SIDs:**

ELOCO  
GUMBY  
MMUGS  
PEECE  
FLYZA

## **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. Vertical limits of low altitude sectors were reviewed and may need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

The proposed Gulf of Mexico routes were not available during the study team process.

## **Attachments**

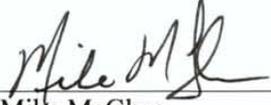
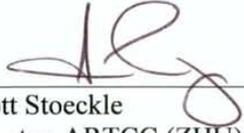
1. Phase I TARGETS File
2. GILL TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

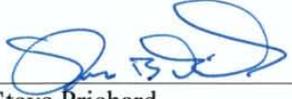
## OAPM Design Package: Houston Metroplex GILL RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
--	------------------------	---	------------------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/21/12</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/24/12</u> Date
---	------------------------	--	------------------------

 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>6-21-12</u> Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	<u>6-25-12</u> Date
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## OAPM Design Package: Houston Metroplex

*IAH GILL RNAV STAR*

### RECORD OF CHANGE

Change Number	Date	Document
001	10/01/2012	GILL RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

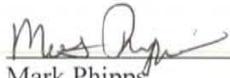
### Description of Change

Updated Header with airport information.

## OAPM Design Package: Houston Metroplex

*IAH GILL RNAV STAR*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.



Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13

Date



Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13

Date

## OAPM Design Package: Houston GUSHR RNAV STAR

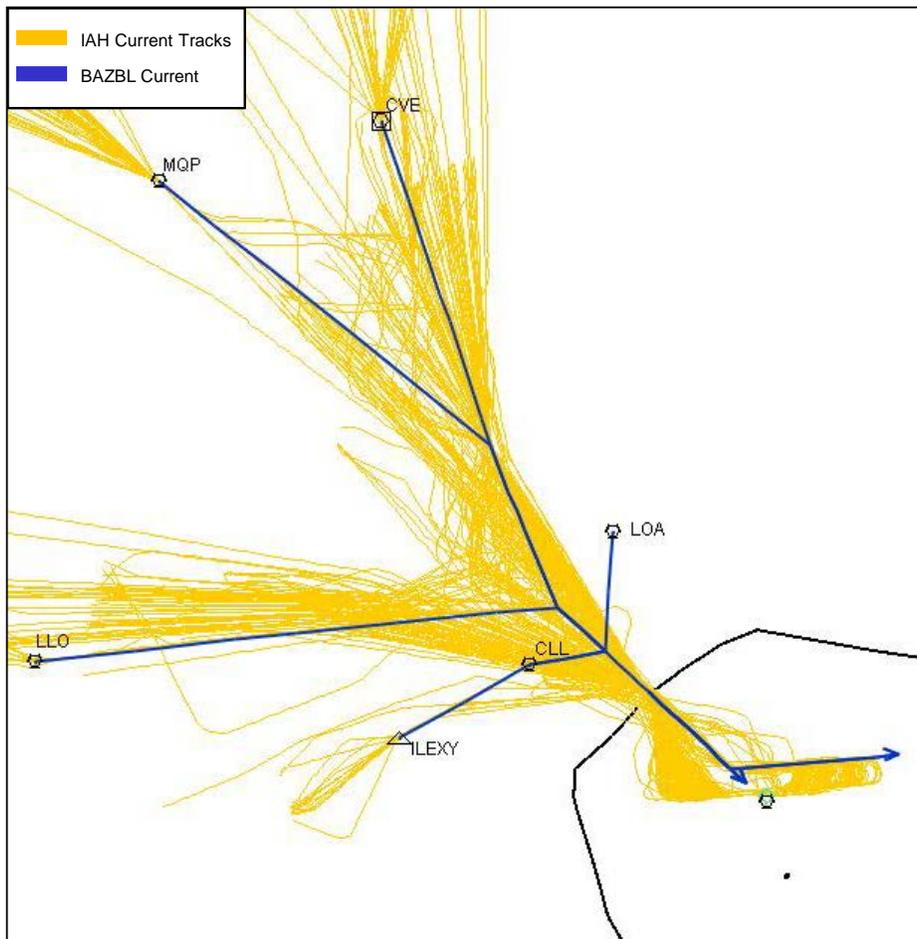
<b>Name of Change</b>	<b>GUSHR STAR</b>	<b>Date</b>	<b>06-20-12</b>
<b>Change Classification</b>	Terminal Procedures	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E10, E11, E17, E29, I7</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 74, 78, 80, 82, 83, 96 <b>ZFW Sectors:</b> 46, 96	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs:</b> DRLLR TTORO MSCOT KIDDZ <b>SIDs:</b> BNDTO DOBBY PITZZ	<b>Associated Data Files:</b>	<b>1. Phase IV TARGETS File</b> <b>2. GUSHR TARGETS Distribution Package</b> <b>3. Table of Procedures</b>

### Purpose

1. The BAZBL STAR is the primary arrival for IAH traffic from the northwest
2. The historical flight tracks do not follow the published arrival procedures, as depicted in Figure 1
3. The vertical and lateral paths are not optimized
4. The limited volume of ZHU airspace in the northwest corner in conjunction with the absence of applied ACM prevents efficient metering

# OAPM Design Package: Houston

## GUSHR RNAV STAR



**Figure 1. Current IAH Northwest BAZBL STAR**

### Study Team Recommendation

1. The conceptual BAZBL STAR more closely follows historical flight tracks. The OST developed the STAR to be flow-specific, providing configuration-dependent vertical profile benefits. The proposed altitude window for west flow is 170-FL200. The proposed altitude window for east flow is 100-130. The OPD will reduce current level segments on the BAZBL STAR.
2. Runway transitions are proposed in each configuration. In east flow, Runway 08L was designed as the primary transition; however, transitions are available to Runways 08R and 09. In west flow, transitions are designed to terminate on a downwind leg. The Runway 26L/R transitions pass north of IAH at or above 8,000 feet until midfield to allow IAH and HOU departure traffic to climb more expeditiously. The Runway 27 transition crosses to join the south downwind at 6,000 feet and allows for tactical runway and fix balancing. Both downwind legs in the west flow are laterally positioned for the potential development of RNP AR IAPs.

## OAPM Design Package: Houston GUSHR RNAV STAR

3. Figure 2 below depicts the recommended RNAV BAZBL STAR and the current procedure.

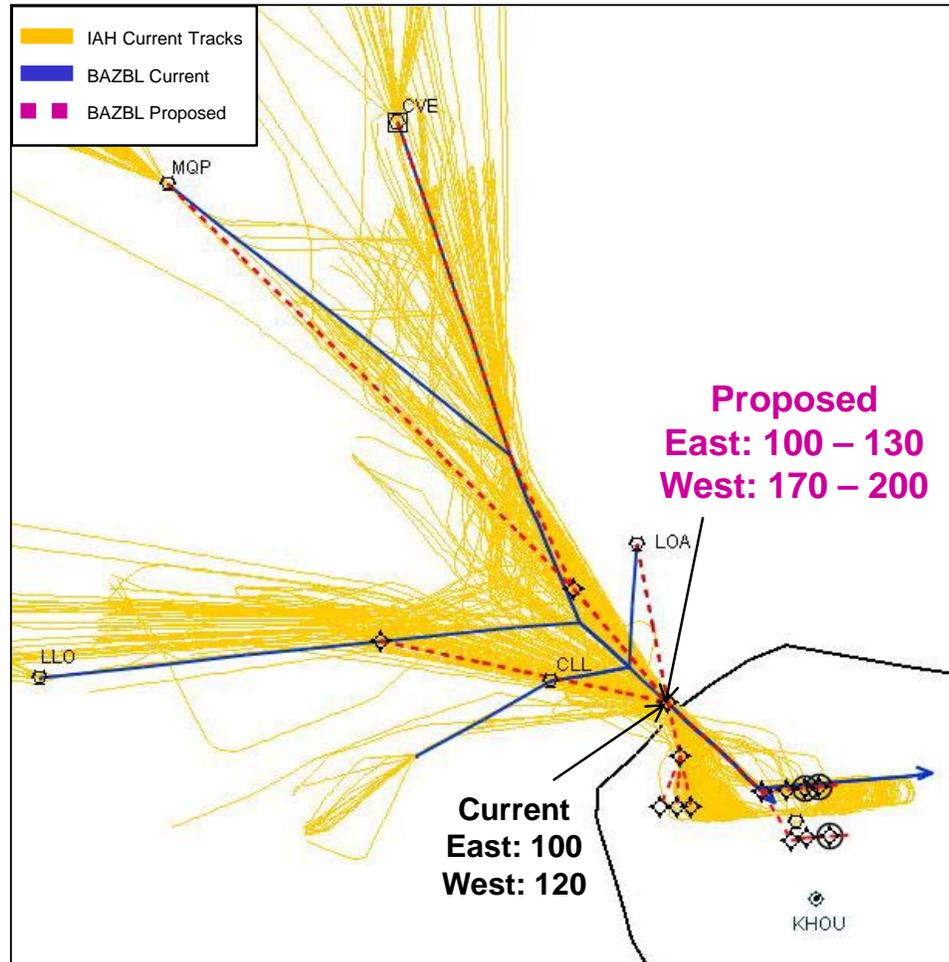


Figure 2. Proposed IAH Northwest BAZBL STAR

# OAPM Design Package: Houston GUSHR RNAV STAR

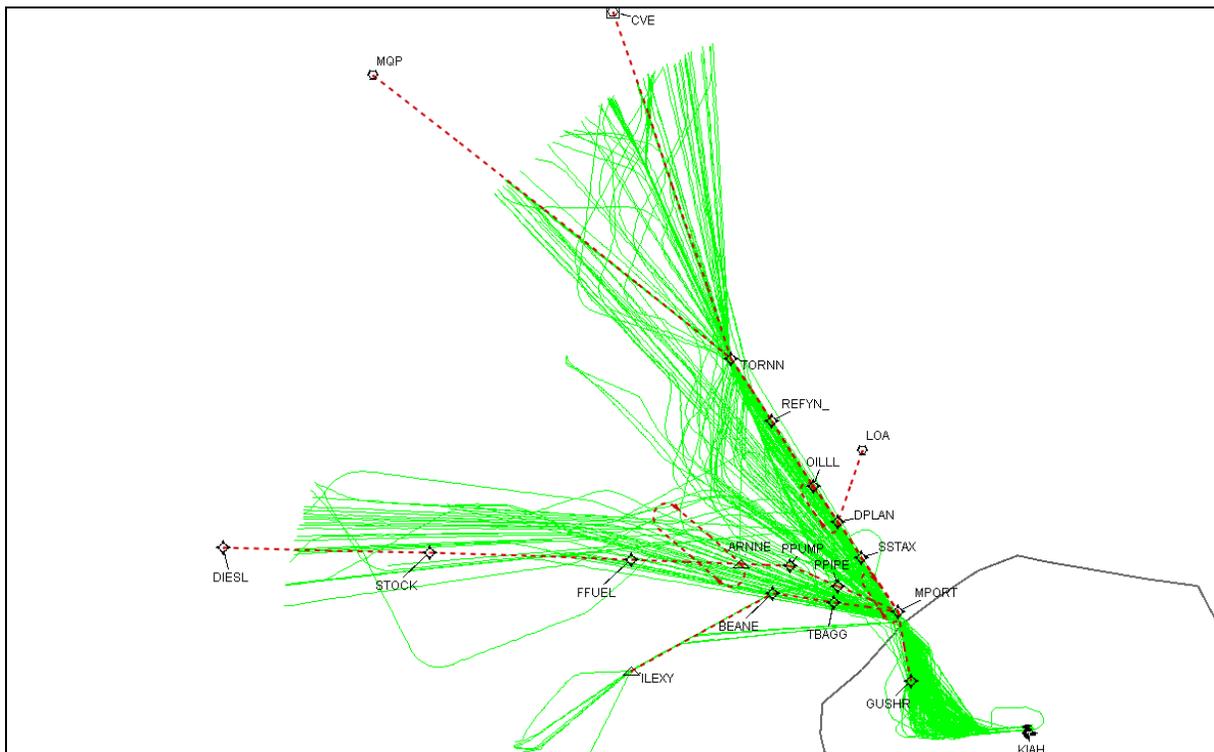
## Proposed Final Design

The Design Team has proposed flow dependent dual RNAV STARs from the northwest to IAH that would replace the current BAZBL STAR. The GUSHR STAR would be one of two STARs designed to provide a dual feed to IAH on an east flow (Figure 3). The GUSHR STAR would be used for jet and turboprop aircraft landing IAH when on an east flow.

The en route transitions were modified from the Study Team proposal to reduce track miles and more closely align the procedure with historical track data. The en route transition from DIESL has been developed to be used during those times when dual arrival flows to IAH are not available. The Design Team evaluated many options to deconflict the transitions on the GUSHR arrival from the HOU KIDDZ arrival and determined that it would be better to tactically separate aircraft on these procedures.

Published holding patterns have been proposed at DRLLR, OILLL, and ARNNE.

The proposed GUSHR STAR was designed with an OPD and an altitude window at DRLLR from 9,000 to 12,000 feet at 250 knots.



**Figure 3. Final GUSHR STAR Design**

## **OAPM Design Package: Houston GUSHR RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

DRLLR  
MSCOT  
TTORO  
KIDDZ

#### **SIDs:**

BNDTO  
DOBBY  
PITZZ

### **Additional Design Considerations**

This proposal requires modifications to ZHU, ZFW and I90 internal Standard Operating Procedures and Letters of Agreement.

Validation through a Human-in-the-Loop simulation (HITLs) is anticipated to evaluate the increase in complexity of sequencing the GUSHR arrival with aircraft on the TTORO arrival to KIAH.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

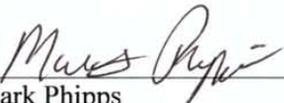
### **Attachments**

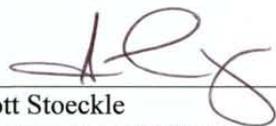
1. Phase IV TARGETS File
2. GUSHR TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

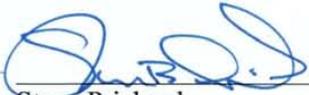
## OAPM Design Package: Houston GUSHR RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 Date
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 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/26/12 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
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 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	6-21-12 Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	6-25-12 Date
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## OAPM Design Package: Houston Metroplex

*IAH GUSHR RNAV STAR*

### RECORD OF CHANGE

Change Number	Date	Document
001	11/01/2012	GUSHR RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

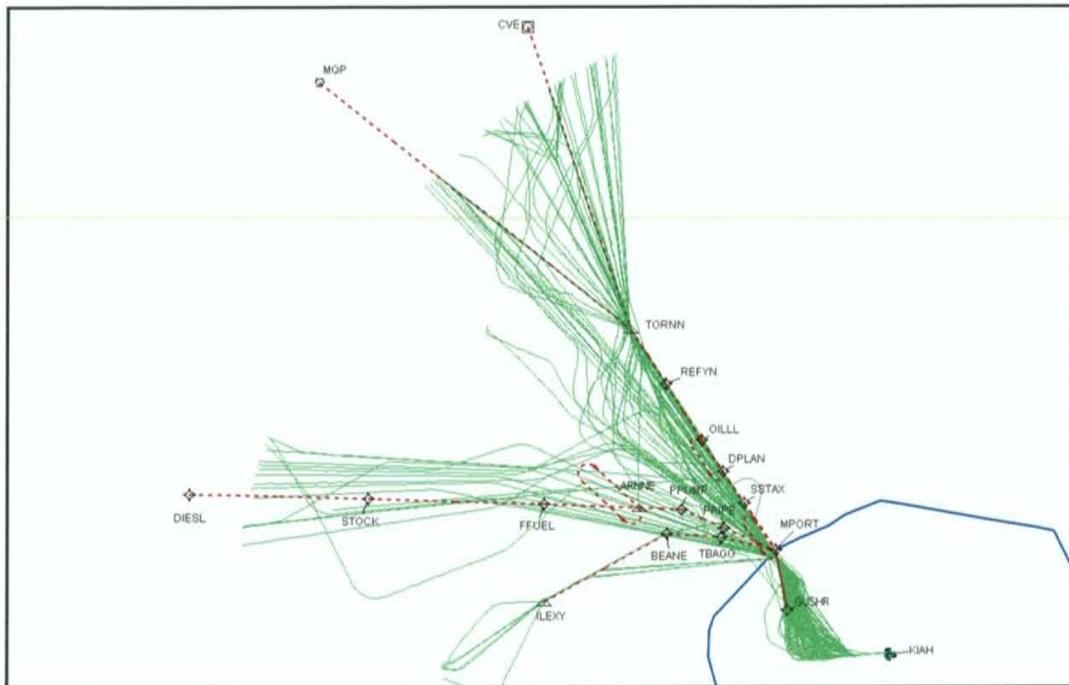
#### Description of Change

Updated Header with airport information.

The design team amended the procedure to ensure criteria compliance and procedure connectivity. The original design proposal is shown in Figure 1. Due to criteria requirements, the LOA transition was removed and replaced by an OILLL transition. Additionally, TBAGG waypoint was moved. A TTORN transition was added to ensure connectivity with the North Texas OAPM procedures. These changes are shown in Figure 3.

## OAPM Design Package: Houston Metroplex

*IAH GUSHR RNAV STAR*



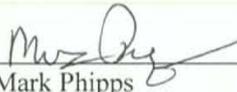
**FIGURE 2. GUSHR RNAV STAR PROPOSED DESIGN**

(Will replace Figure 3 in PFD)

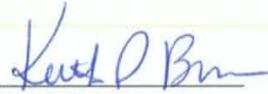
## OAPM Design Package: Houston Metroplex

*IAH GUSHR RNAV STAR*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

  
\_\_\_\_\_  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex HTOWN RNAV STAR

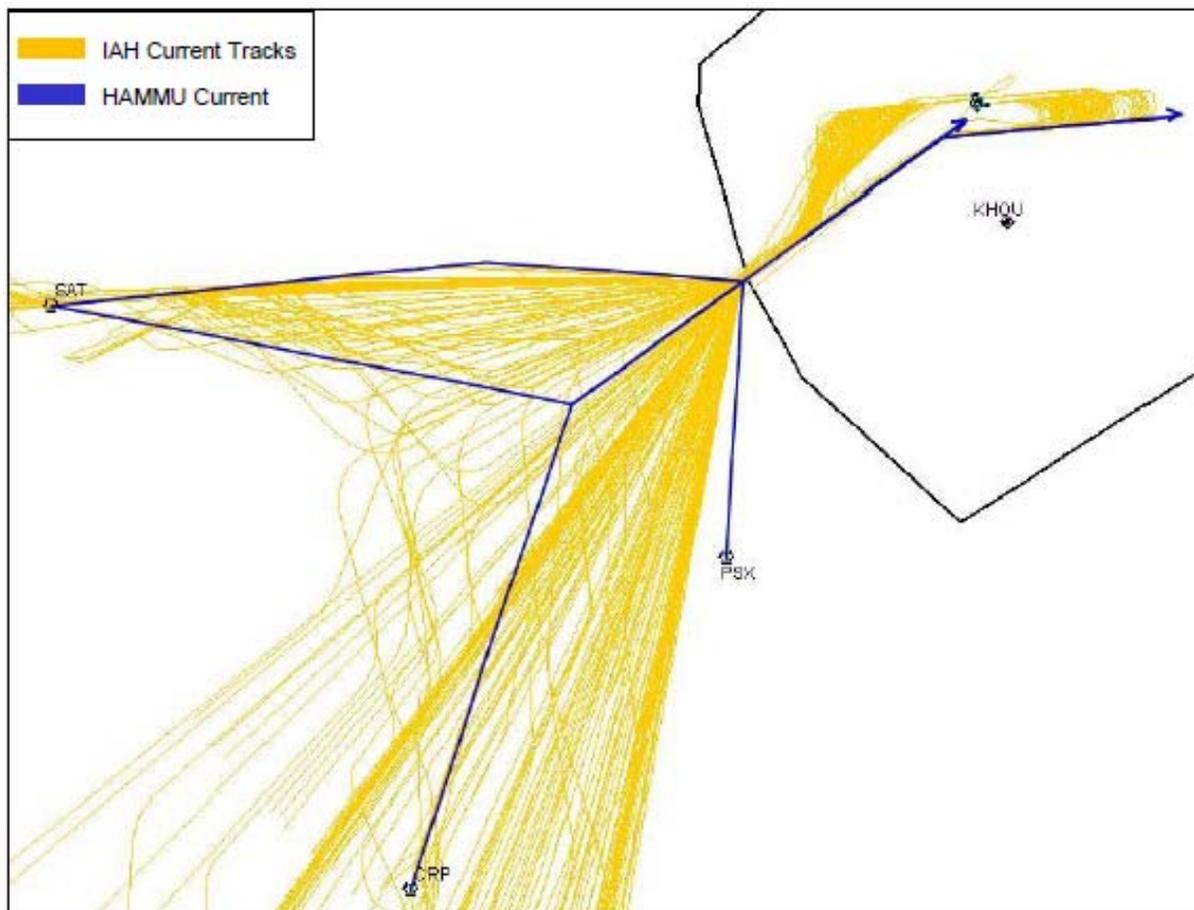
Name of Change	<b>HTOWN STAR</b>	Date	<b>06-21-12</b>
Change Classification	<b>Terminal Procedures</b>	Current Phase of Design	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
OAPM Study Team Reference/s	<b>E24, E25, E26, E27, E39, I3, I17, I18</b>	Implementation Date	<b>December 2013</b>
Impacted Facilities and Positions/Areas/Sectors	<b>I90</b> <b>ZHU Sectors:</b> 58, 59, 76, 87, 95, 92	Facility Points of Contact	<b>David Kidd 281.230.5556</b> <b>Will Hutson 281.230.5556</b>
Related/Dependent Submissions	<b>STARs:</b> TEJAS BELLR KIDDZ <b>SIDs:</b> HUBEE DOBBY PITZZ BNDTO	Associated Data Files:	<ol style="list-style-type: none"> <li>1. Phase II TARGETS File</li> <li>2. HTOWN TARGETS Distribution Package</li> <li>3. Procedure Change Table</li> </ol>

## OAPM Design Package: Houston Metroplex HTOWN RNAV STAR

### Purpose

This design package addresses issues with the Southwest/South IAH STARs identified by the Houston OAPM Study Team:

1. The HAMMU STAR is currently the primary arrival for IAH traffic from the southwest.
2. The historical flight tracks do not follow current arrival procedures.
3. There are inefficient vertical profiles and lateral paths.
4. Two distinct arrival streams from the south do not transition over CRP and the PSX transition is not used.
5. HAMMU is not procedurally separated from other STARs and SIDs and conflicts with SAT departures. Specifically, SAT HUBEE departures interact with HAMMU arrivals. Significant vectoring is routinely required to separate aircraft departing SAT from aircraft inbound on HAMMU, resulting in additional complexity.



**Figure 1. Current HAMMU STAR**

# OAPM Design Package: Houston Metroplex HTOWN RNAV STAR

## Study Team Recommendation

1. The conceptual HAMMU STAR is optimized to more closely follow current flight tracks. The OST developed the HAMMU RNAV STAR with OPDs, which provide configuration-dependent vertical profile improvements. The OST developed proposed altitude windows that are flow-dependent (East 120-140 and West 170-FL200). The OPD with proposed vertical windows will reduce current level segments on the HAMMU STAR.
2. To address the SAT HUBEE interactions, the Houston OST also proposed routing SAT HUBEE departures north to avoid the new HAMMU arrival. This provides lateral spacing in the vicinity of WEMAR to allow for climb and descent.
3. Runway transitions are proposed in each configuration. In east flow, Runway 08R was designed as the primary transition, however transitions are available to Runway 08L and Runway 09. In west flow, transitions are designed to terminate on a downwind with an FM leg. The Runway 26R transition passes north of IAH at or above 8,000 ft until midfield to allow IAH and HOU departure traffic to climb more expeditiously and allow for tactical runway and fix balancing. The Runway 27 transition joins the south downwind at 6,000 ft. The Runway 26L transition routing will be determined during D&I. Both downwinds in the west flow are laterally positioned for the potential development of RNP AR IAPs.

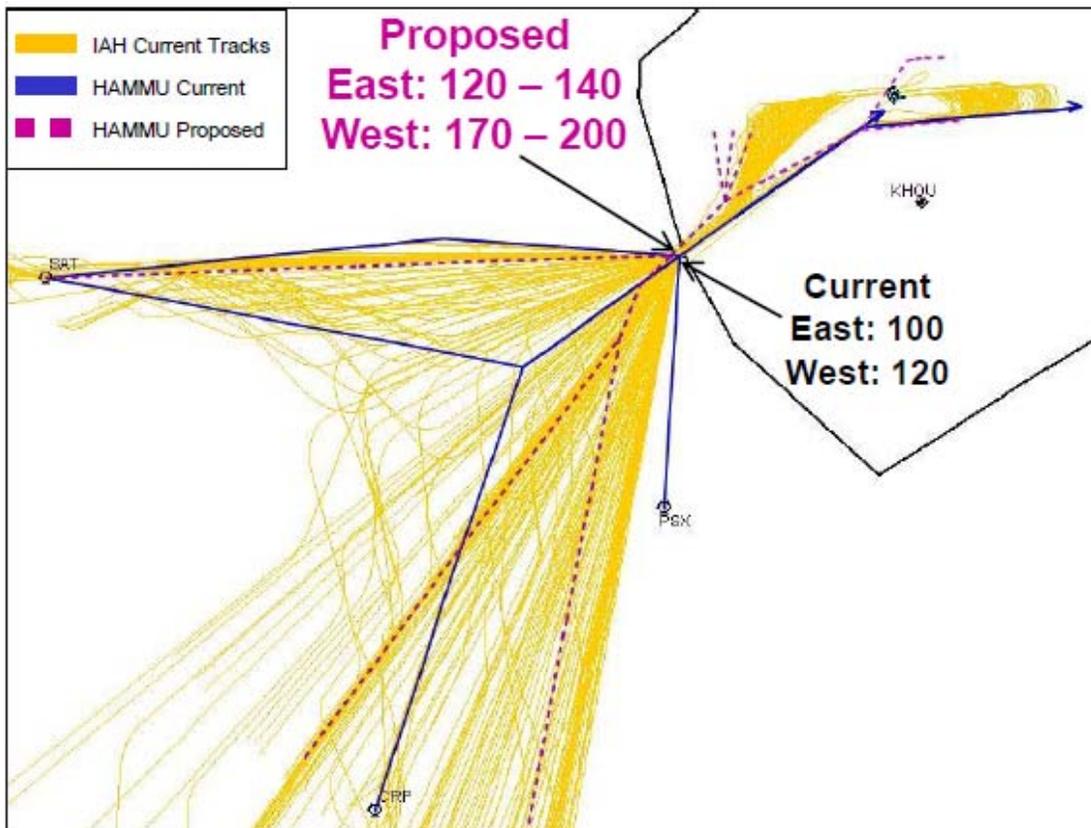


Figure 2. Study Team Recommendation

## **OAPM Design Package: Houston Metroplex HTOWN RNAV STAR**

### **Proposed Final Design**

The Design Team is proposing flow dependent RNAV STARs from the southwest to IAH that replace the current HAMMU STAR. The HTOWN will be used for jet and turboprop aircraft landing IAH when on an east flow, as depicted in Figure 4. The HTOWN STAR is designed with an OPD and an altitude window at DEFIX of 13,000 to 16,000 feet at 250 knots. The HTOWN STAR was deconflicted from the KIDDZ STAR.

Runway transitions were not included in the HTOWN STAR as the STAR will terminate at the end of the common route. Approach transitions were designed to connect the STAR with the approaches prior to the 'duals bar'.

En route transitions from south Texas and Mexico were laterally optimized based on analysis performed by United Airlines to determine beneficial routings based on proposed route changes with Mexico air traffic control. A key benefit from these changes is separate arrival and departure corridors enabling uninterrupted climbs and descents.

En route transitions were laterally optimized to reduce track miles. Additional separation was added between the SAT transition of the HTOWN STAR and the HUBEE SID to provide for an OPD. Some waypoints were added to deconflict from SUAs.

The Design Team evaluated many options to separate the en route transitions on the HTOWN arrival from the HOU BELLR arrival and determined that it would be best to have controllers tactically separate aircraft on these procedures.

# OAPM Design Package: Houston Metroplex

## HTOWN RNAV STAR

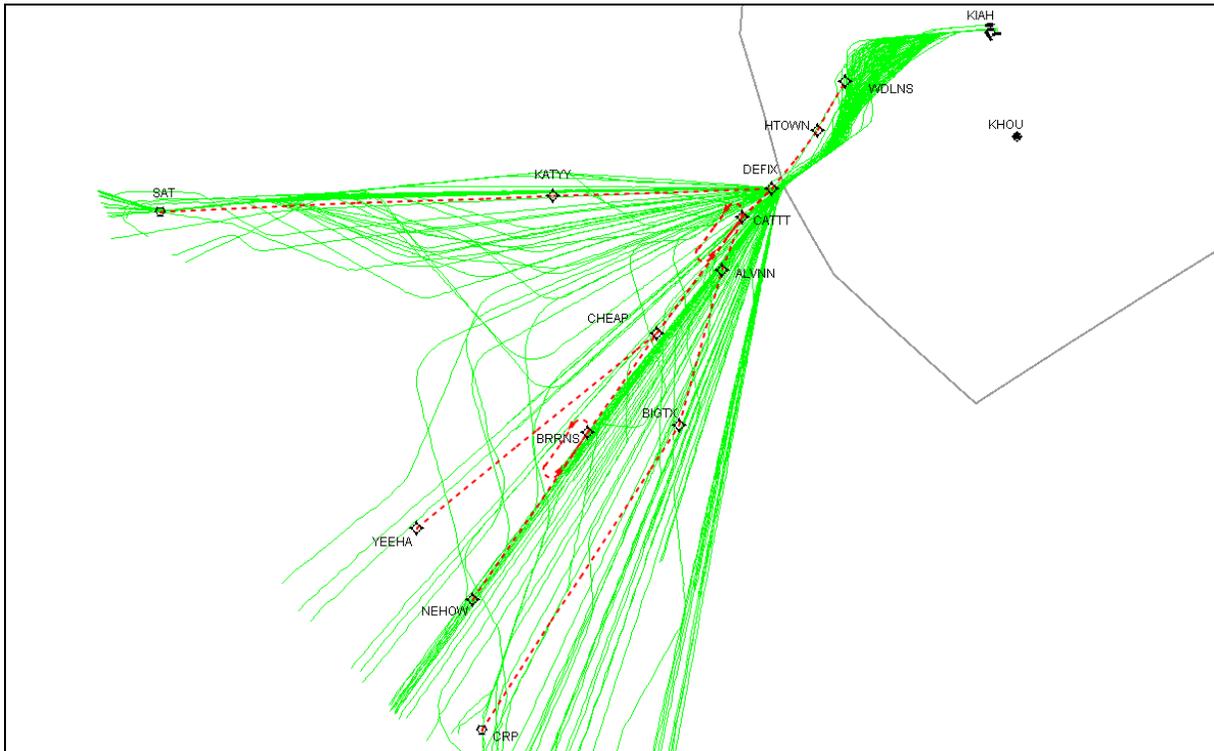


Figure 3. Proposed HTOWN STAR (En Route)

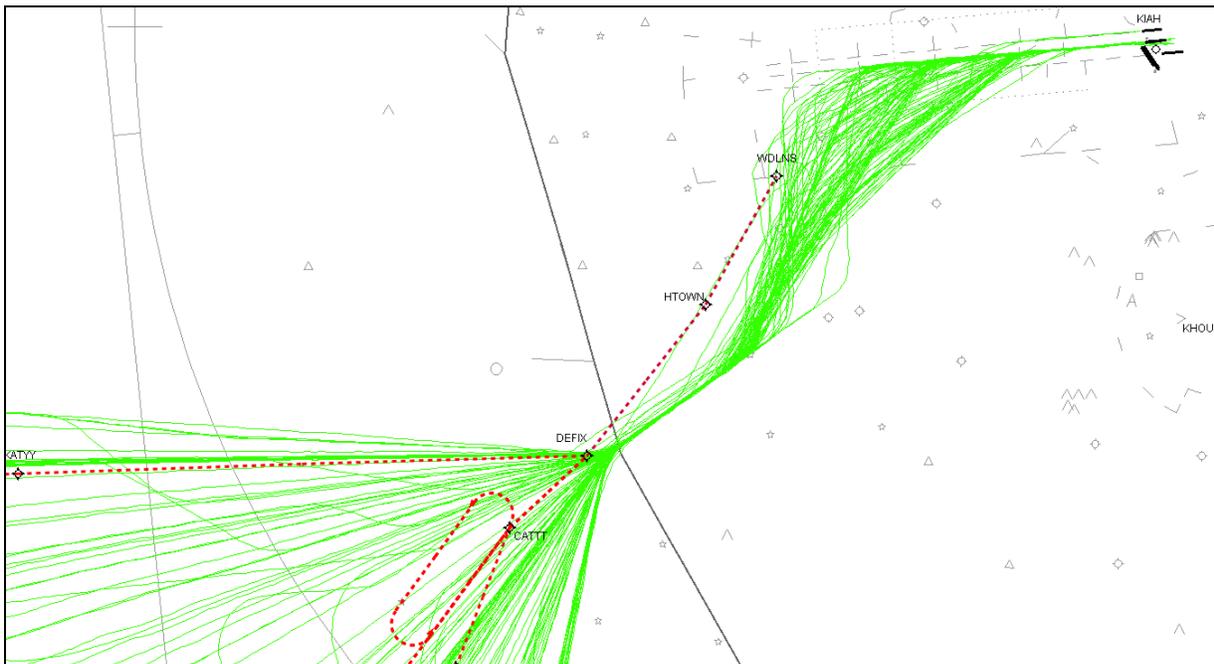


Figure 4. Proposed HTOWN STAR (Terminal)

## **OAPM Design Package: Houston Metroplex HTOWN RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

TEJAS  
BELLR  
KIDDZ

#### **SIDs:**

HUBEE  
DOBBY  
PITZZ  
BNDTO

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated. Vertical limits of low altitude sectors were reviewed and may need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

### **Attachments**

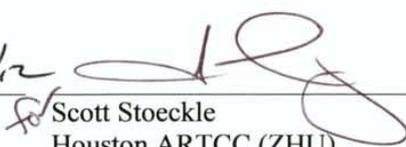
1. Phase II TARGETS File
2. HTOWN TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

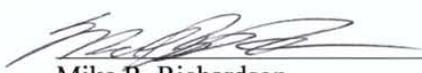
## OAPM Design Package: Houston Metroplex HTOWN RNAV STAR

### Review Signatures

The D&I Team has reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
---	------------------------	--	------------------------

 Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6-26-12</u> Date	 Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
--	------------------------	---	------------------------

 Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>6-21-12</u> Date	 Steve Prichard Houston TRACON (I90) NATCA Lead	<u>6-25-12</u> Date
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## OAPM Design Package: Houston Metroplex

IAH HTOWN RNAV STAR

### RECORD OF CHANGE

Change Number	Date	Document
001	10/01/2012	HTOWN RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

#### Description of Change

Updated Header with airport information.

## OAPM Design Package: Houston Metroplex

*IAH HTOWN RNAV STAR*

Design Team Lead's Signatures indicates the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.



Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date



Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston KIDDZ RNAV STAR

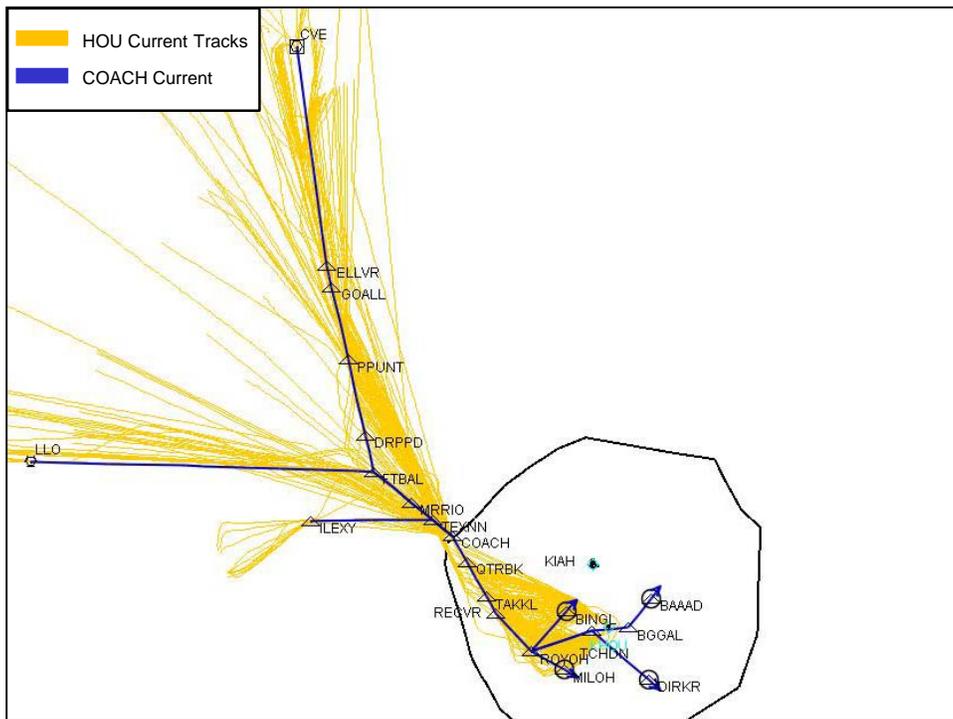
<b>Name of Change</b>	<b>KIDDZ STAR</b>	<b>Date</b>	<b>06-20-12</b>
<b>Change Classification</b>	Terminal Procedures	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E29, I2, I3, I10, I14</b>	<b>Implementation Date</b>	December 2013
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 74, 78, 80, 82, 83, 96 <b>ZFW Sectors:</b> 46, 96	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GUSHR TTORO MSCOT DRLLR <b>SIDs:</b> BNDTO DOBBY PITZZ	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li>1. Phase IV TARGETS File</li> <li>2. KIDDZ TARGETS Distribution Package</li> <li>3. Table of Procedures</li> </ol>

### Purpose

1. COACH is the primary arrival for HOU traffic from the northwest.
2. Historical flight tracks for current HOU arrivals do not follow the published arrival procedures, as depicted in figure 1.
3. Vertical and lateral paths are not optimized.

# OAPM Design Package: Houston

## KIDDZ RNAV STAR



**Figure 1. Current HOU Northwest COACH STAR**

### **Study Team Recommendation**

1. The proposed COACH STAR has been optimized to more closely follow historical flight tracks. The OST developed the COACH STAR with an OPD and modified en route and runway transitions to allow more direct routing. The proposed altitude window at the terminal entry point is 110-140. Although improved, the COACH STAR is not as vertically optimized as many of the other STAR proposals due to the location of the departure and arrival traffic to IAH.
2. Runway transitions are proposed, but only developed to Runways 12L/R and 04. The runway transitions are laterally positioned for the potential development of RNP AR IAPs (see Section 4.3.3).
3. Figure 2 depicts the current and proposed RNAV COACH STARs

# OAPM Design Package: Houston

## KIDDZ RNAV STAR

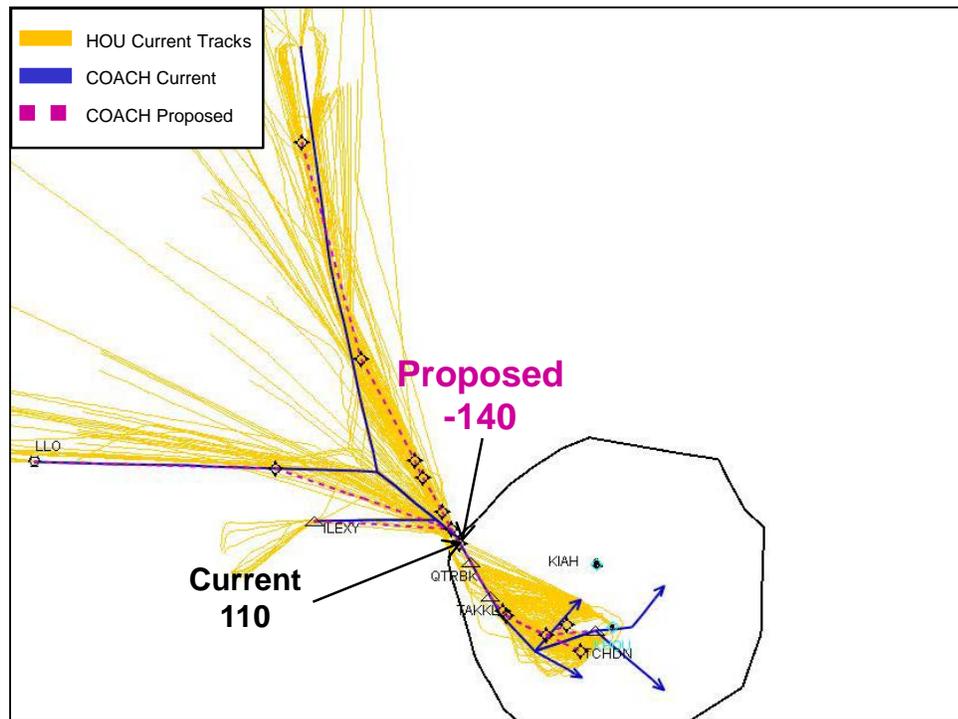


Figure 2. Study Team Proposed HOU Northwest COACH STAR

# OAPM Design Package: Houston

## KIDDZ RNAV STAR

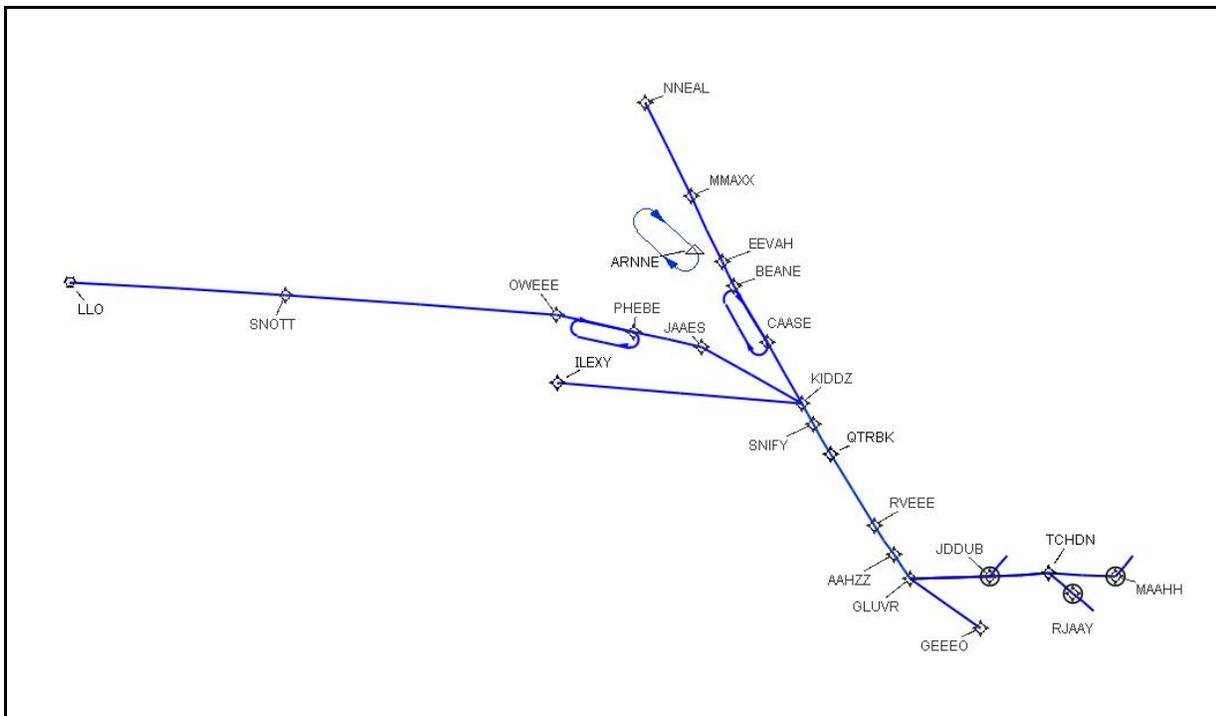
### Proposed Final Design

The Design Team has proposed an RNAV STAR from the northwest to HOU that would replace the current COACH STAR. The KIDDZ STAR would be used for jet aircraft landing HOU.

The en route transitions were modified from the Study Team proposal to reduce track miles and more closely align the procedure with historical track data. The Design Team evaluated many options to deconflict the transitions on the KIDDZ arrival from the IAH MSCOT/TTORO and DRLLR/GUSHR arrivals and determined that it would be better to tactically separate aircraft on these procedures.

Published holding patterns are proposed at JAAES, ARNNE, and CAASE.

The proposed KIDDZ STAR was designed with an OPD and an altitude window at KIDDZ from 12,000 to 14,000 feet at 280 knots.



**Figure 3. Proposed KIDDZ STAR**

## **OAPM Design Package: Houston KIDDZ RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

DRLLR  
GUSHR  
MSCOT  
TTORO

#### **SIDs:**

BNDTO  
DOBBY  
PITZZ

### **Additional Design Considerations**

This proposal requires modifications to ZHU, ZFW and I90 internal Standard Operating Procedures and Letters of Agreement.

Validation through a Human-in-the-Loop simulation (HITLs) is anticipated to evaluate the increase in complexity of tactically separating the KIDDZ arrival from the KIAH TTORO/MSCOT and DRLLR/GUSHR arrivals as well as the KAUS ILEXY transition of the CWK4 SID.

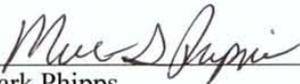
### **Attachments**

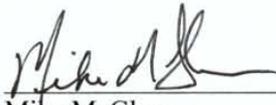
1. Phase IV TARGETS File
2. KIDDZ TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

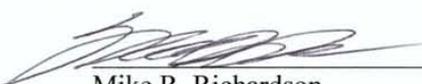
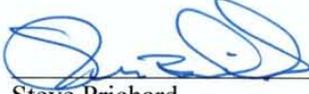
## OAPM Design Package: Houston KIDDZ RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
--	------------------------	---	------------------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/26/12</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
---	------------------------	--	------------------------

 _____ Mike R. Richardson Houston TRACON (190) Facility Lead	<u>6-21-12</u> Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	<u>6-25-12</u> Date
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## OAPM Design Package: Houston Metroplex

*HOU KIDDZ RNAV STAR*

### RECORD OF CHANGE

Change Number	Date	Document
001	11/15/2012	KIDDZ RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

#### Description of Change

Updated Header with airport information.

The design team amended the procedure for criteria compliance and procedure enhancement. The original design proposal is shown in Figure 1. Transitions were added for runway 17 and 35. DAYNA and SEUSS waypoints were added. JDDUB waypoint was moved to straighten a route segment. The altitude restriction at VILLI was deleted. SNOTT waypoint was renamed CHUKY. TCHDN waypoint was removed and replaced with VILLI as VILLI is an existing fix within 0.3 NM. These changes are shown in Figure 2.

## OAPM Design Package: Houston Metroplex

*HOU KIDDZ RNAV STAR*

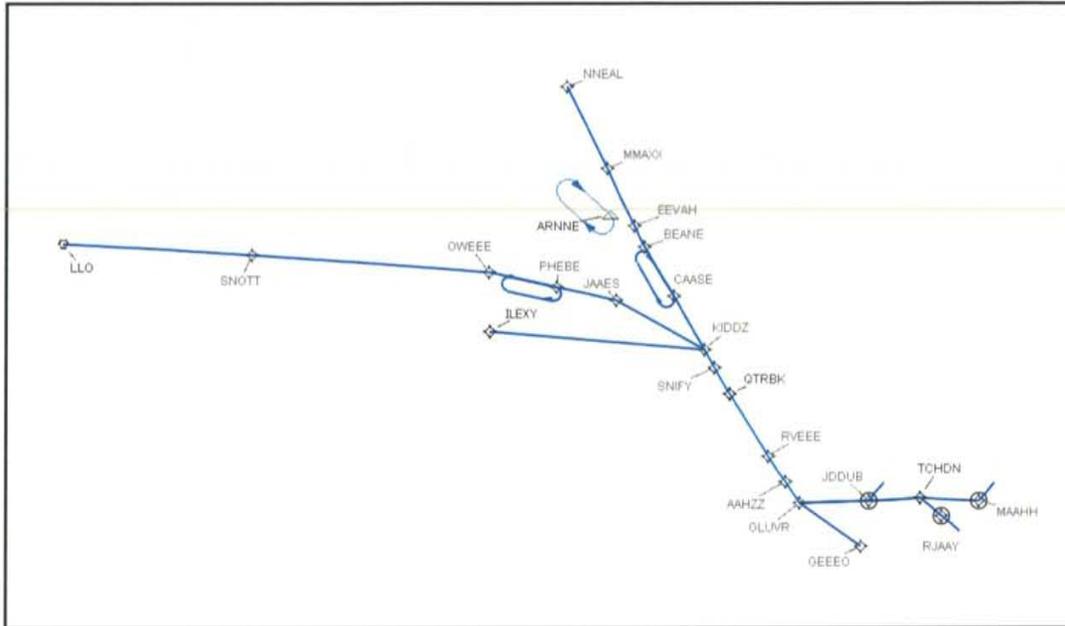
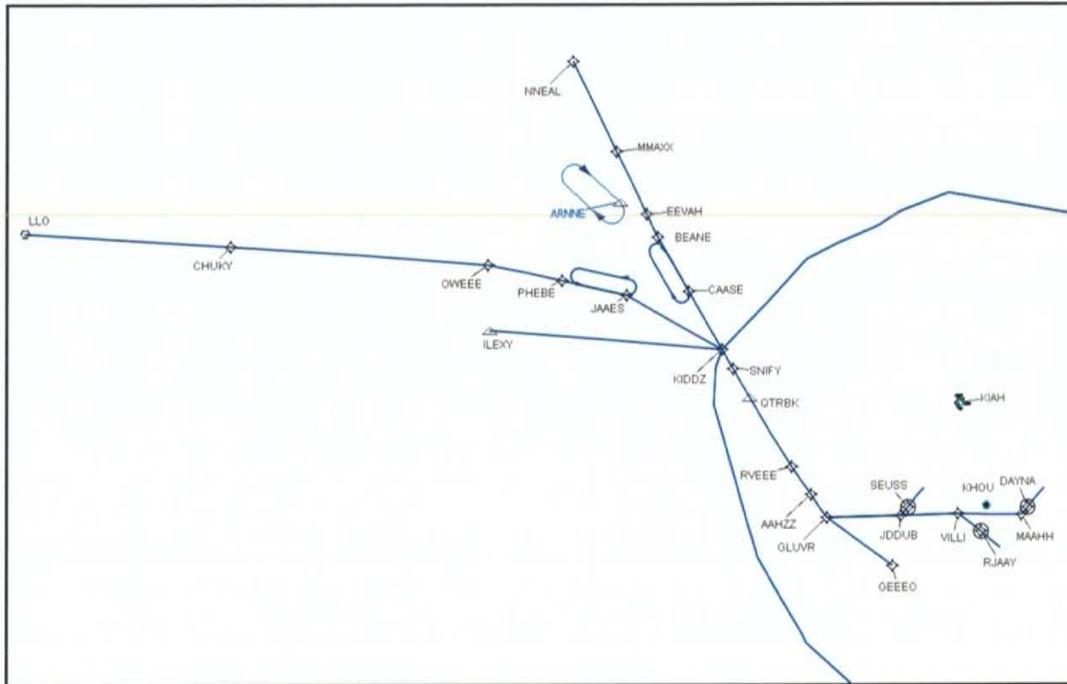


FIGURE 1. KIDDZ RNAV STAR PROPOSED DESIGN (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*HOU KIDDZ RNAV STAR*



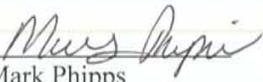
**FIGURE 2. KIDDZ RNAV STAR PROPOSED DESIGN**

**(Will replace Figure 3 in PFD)**

## OAPM Design Package: Houston Metroplex

*HOU KIDDZ RNAV STAR*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.



Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date



Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston MSCOT RNAV STAR

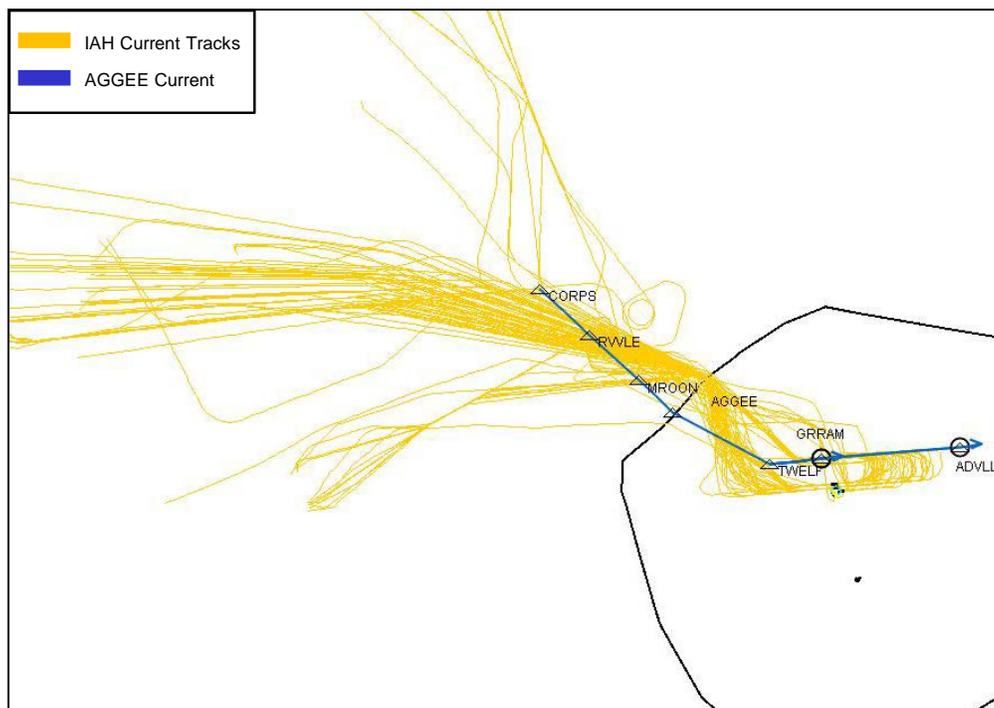
<b>Name of Change</b>	<b>MSCOT STAR</b>	<b>Date</b>	<b>06-20-12</b>
<b>Change Classification</b>	Terminal Procedures	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E10, E11, E17, E29, I7</b>	<b>Implementation Date</b>	December 2013
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 74, 78, 80, 82, 83, 96 <b>ZFW Sectors:</b> 46, 96	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GUSHR DRLLR TTORO KIDDZ <b>SIDs:</b> BNDTO DOBBY PITZZ	<b>Associated Data Files:</b>	<b>1. Phase IV TARGETS File</b> <b>2. MSCOT TARGETS Distribution Package</b> <b>3. Table of Procedures</b>

### Purpose

This design package addresses the following issues with the AGGEE STAR identified by the Houston OAPM Study Team:

1. AGGEE is the current IAH offload for arrival traffic from the northwest.
2. There is minimal use of AGGEE as a dual feed to IAH due to limited airspace and high traffic volume, as depicted in Figure 1.
3. The vertical and lateral paths are not optimized.
4. The limited size of ZHU airspace in the northwest corner in conjunction with the absence of applied ACM prevents efficient metering.

## OAPM Design Package: Houston MSCOT RNAV STAR



**Figure 1. Current AGGEE STAR**

### **Study Team Recommendation**

1. The OST developed the AGGEE RNAV STAR to be flow-specific, providing configuration-dependent vertical profile benefits. The proposed altitude window for east flow is 100-130. The proposed altitude window for west flow is 170-FL200. The OPD with proposed vertical windows would reduce current level-offs on the AGGEE STAR.
2. The OST developed CORPS and ILEXY transitions dedicated to AGGEE that closely mirror current arrival tracks.
3. Runway transitions are proposed in each configuration that are procedurally separated from other STARs and SIDs where practical. In east flow, Runway 08R was designed as the primary transition; however, transitions are available to Runways 08L and 09. In west flow, transitions are designed to terminate on a downwind leg. The Runway 26L/R transitions pass north of IAH at or above 8,000 feet until midfield to allow IAH and HOU departure traffic to climb more expeditiously. The Runway 27 transition crosses to join the south downwind at 6,000 feet and allows for tactical runway and fix balancing. Both downwind legs in the west flow are laterally positioned for the potential development of RNP AR IAPs.
4. Figure 2 depicts the current and recommended AGGEE RNAV STARs.

# OAPM Design Package: Houston MSCOT RNAV STAR

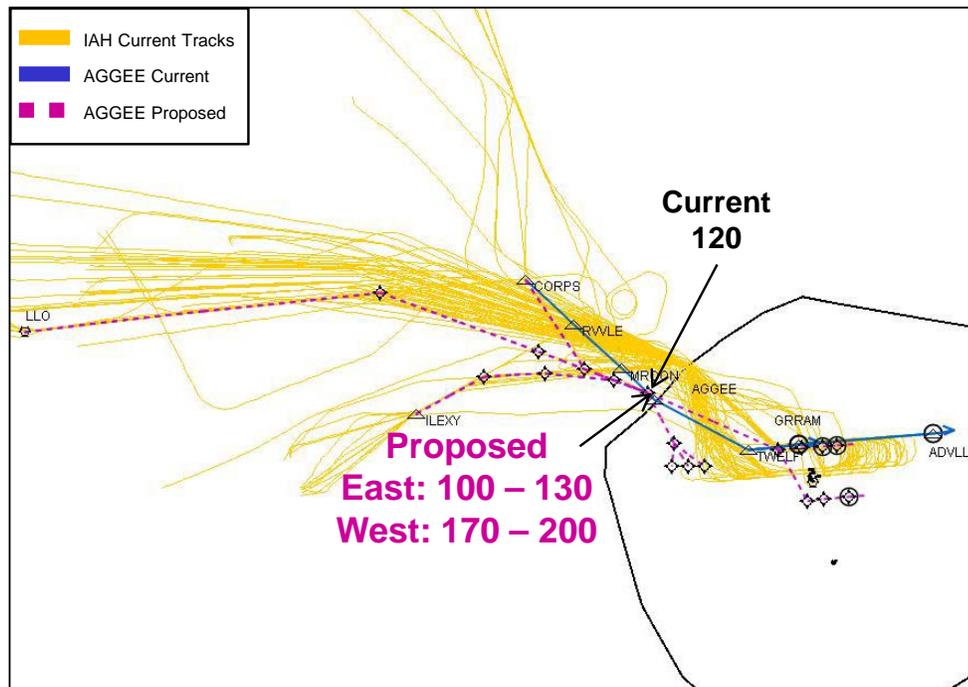


Figure 2. Proposed IAH Northwest AGGEE STAR and Current Procedure

# OAPM Design Package: Houston

## MSCOT RNAV STAR

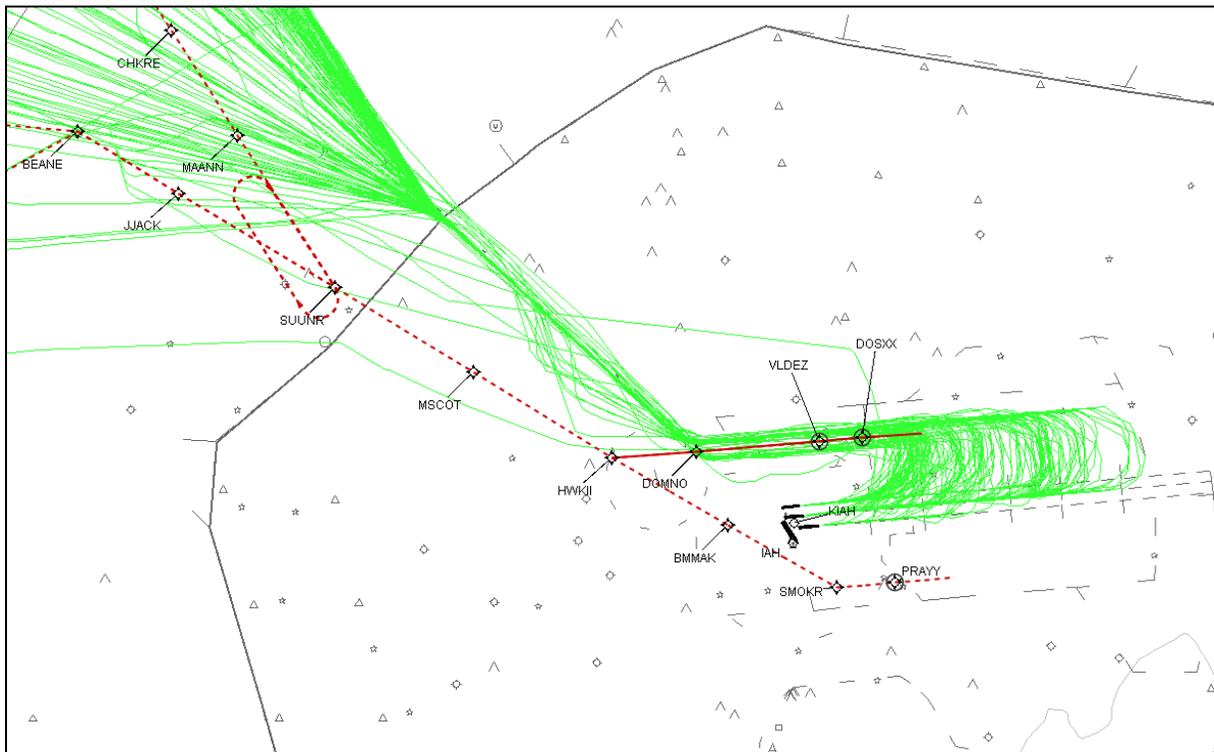
### Proposed Final Design

The Design Team has proposed flow dependent dual RNAV STARs from the northwest to IAH that would replace the current AGGEE STAR. The MSCOT STAR would be one of two STARs designed to provide a dual feed to IAH on a west flow, as depicted in Figure 3. The MSCOT STAR would be used for jet and high performance turboprop aircraft landing IAH when on a west flow.

The en route transitions were modified from the Study Team proposal to reduce track miles and more closely align the procedure with historical track data. The Design Team evaluated many options to deconflict the DIESL and ILEXY transitions on the MSCOT arrival from the HOU KIDDZ arrival and determined that it would be better to tactically separate aircraft on these procedures.

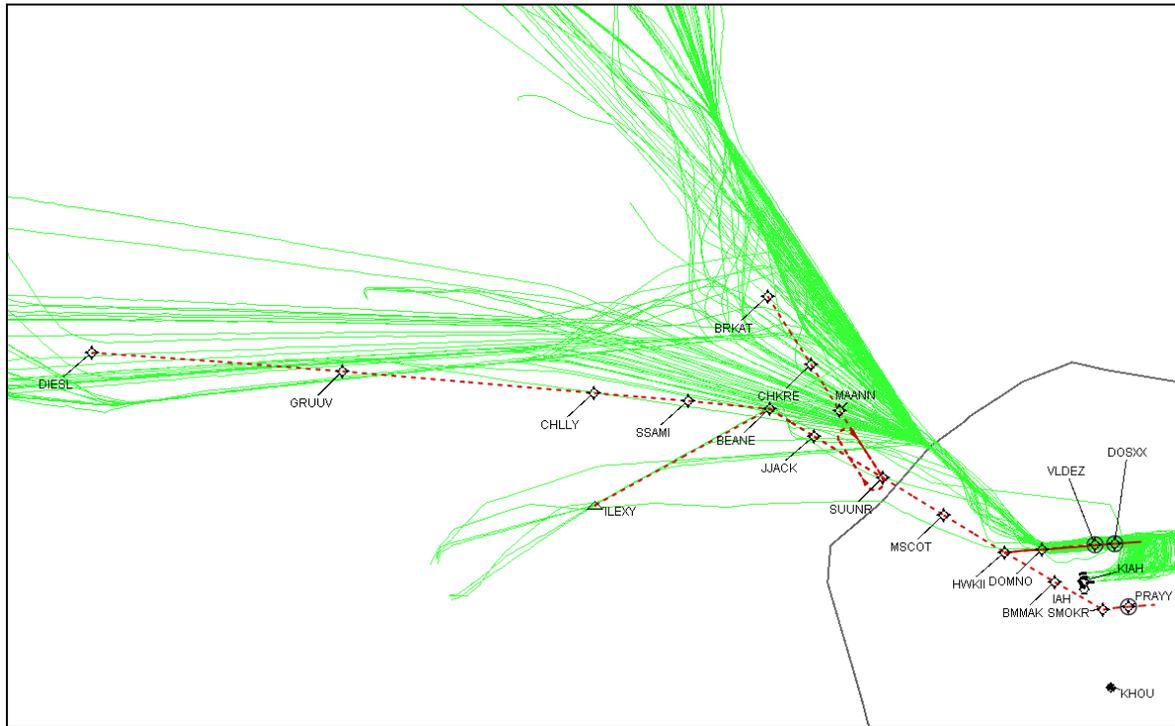
A published holding pattern is proposed at MSCOT and ARNNE.

The proposed MSCOT STAR is designed with an OPD and an altitude window at SUUNR from 12,000 and 15,000 feet at 280 knots.



**Figure 3. Proposed MSCOT STAR (Terminal)**

# OAPM Design Package: Houston MSCOT RNAV STAR



**Figure 4. Proposed MSCOT STAR (En Route)**

## **OAPM Design Package: Houston MSCOT RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

DRLLR  
GUSHR  
TTORO  
KIDDZ

#### **SIDs:**

BNDTO  
DOBBY  
PITZZ

### **Additional Design Considerations**

This proposal requires modifications to ZHU, ZFW and I90 internal Standard Operating Procedures and Letters of Agreement.

Validation through a Human-in-the-Loop simulation (HITLs) is anticipated to evaluate the increase in complexity of sequencing the DRLLR arrival with aircraft on the MSCOT arrival to KIAH.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

### **Attachments**

1. Phase IV TARGETS File
2. MSCOT TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

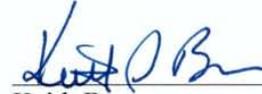
## OAPM Design Package: Houston MSCOT RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
Mark Phipps  
Houston Metroplex  
FAA Lead

6-25-12  
Date

  
Keith Brown  
Houston Metroplex  
NATCA Lead

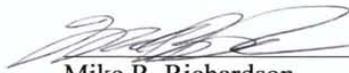
6/25/12  
Date

  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

6/26/12  
Date

  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

6/26/12  
Date

  
Mike R. Richardson  
Houston TRACON (I90)  
Facility Lead

6-21-12  
Date

  
Steve Prichard  
Houston TRACON (I90)  
NATCA Lead

6-25-12  
Date

## OAPM Design Package: Houston Metroplex

IAH MSCOT RNAV STAR

### RECORD OF CHANGE

Change Number	Date	Document
001	11/15/2012	MSCOT RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	MSCOT TARGETS Distribution Package	N/A

### Description of Change

Updated Header with airport information.

The design team amended the procedure for airspace sector integrity. The original design proposal is shown in Figures 1 and 2. An additional waypoint, named BOING, was added to the MSCOT STAR between DOMNO and SMOKR waypoints with an altitude restriction of 6,000 feet. The DOSXX and SMOKR waypoints were renamed DOOOM and SMOCR, respectively. VLDEZ waypoint was added on the Runway 26R transition. These changes are shown in Figures 3 and 4.

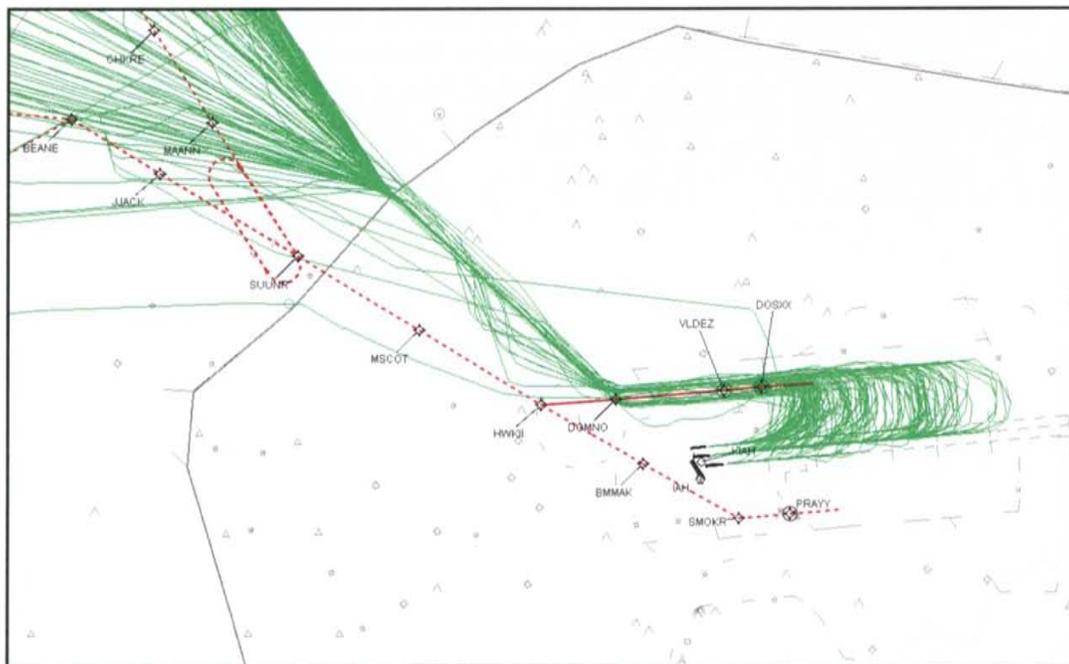
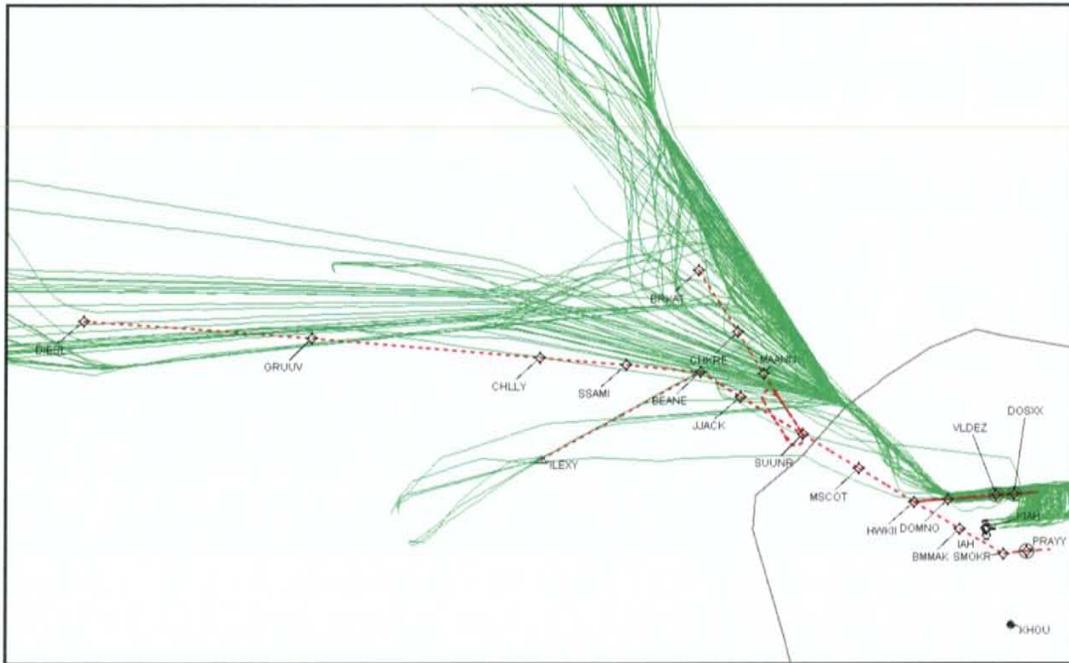


FIGURE 1. MSCOT RNAV STAR PROPOSED DESIGN (TERMINAL) (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

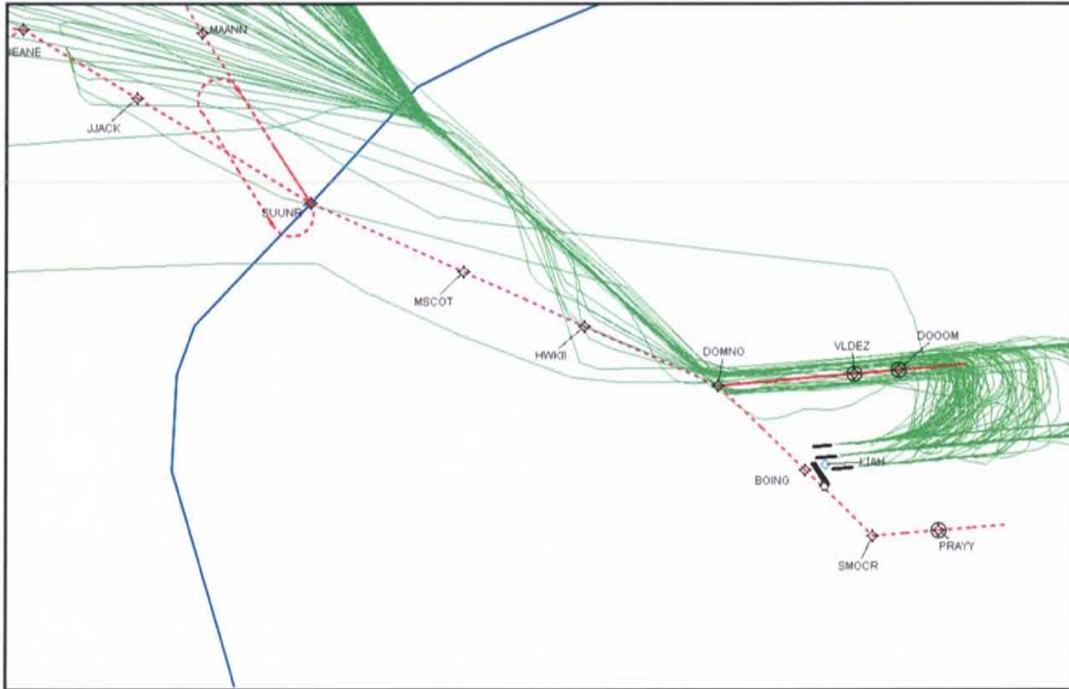
*IAH MSCOT RNAV STAR*



**FIGURE 2. MSCOT RNAV STAR PROPOSED DESIGN (EN ROUTE) (Figure 4 in PFD)**

## OAPM Design Package: Houston Metroplex

*IAH MSCOT RNAV STAR*

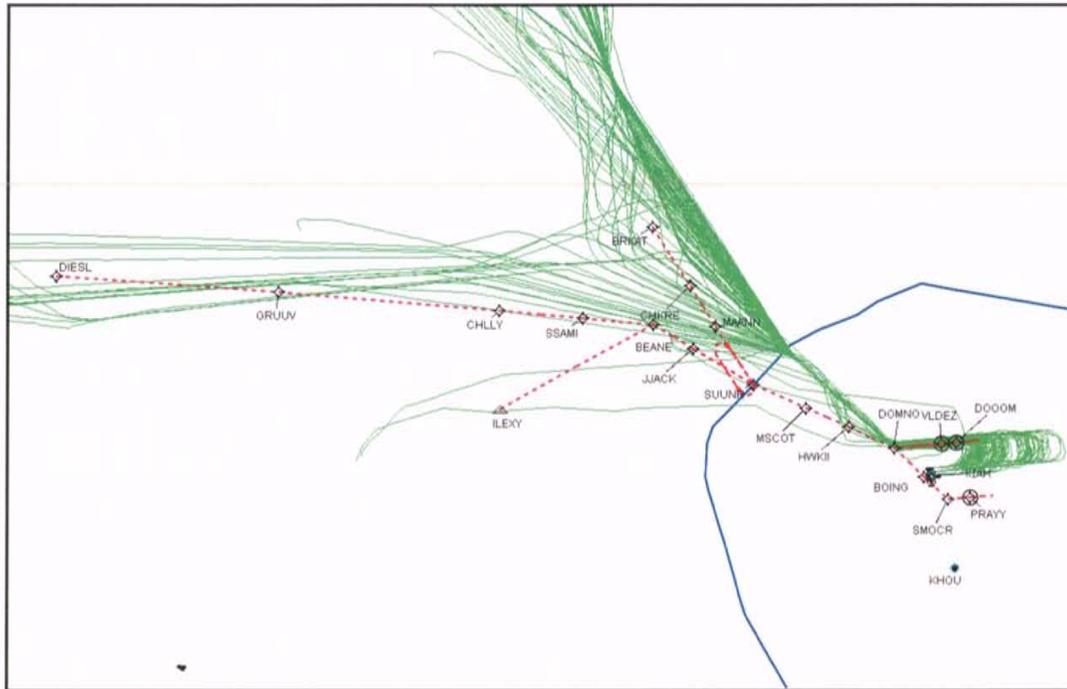


**FIGURE 3. MSCOT RNAV STAR PROPOSED DESIGN (TERMINAL)**

(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH MSCOT RNAV STAR*



**FIGURE 4. MSCOT RNAV STAR PROPOSED DESIGN (EN ROUTE)**

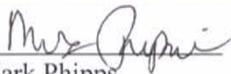
**(Will replace Figure 4 in PFD)**

## OAPM Design Package: Houston Metroplex

*IAH MSCOT RNAV STAR*

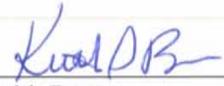
Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

---

  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

---

  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex PUCKS RNAV STAR

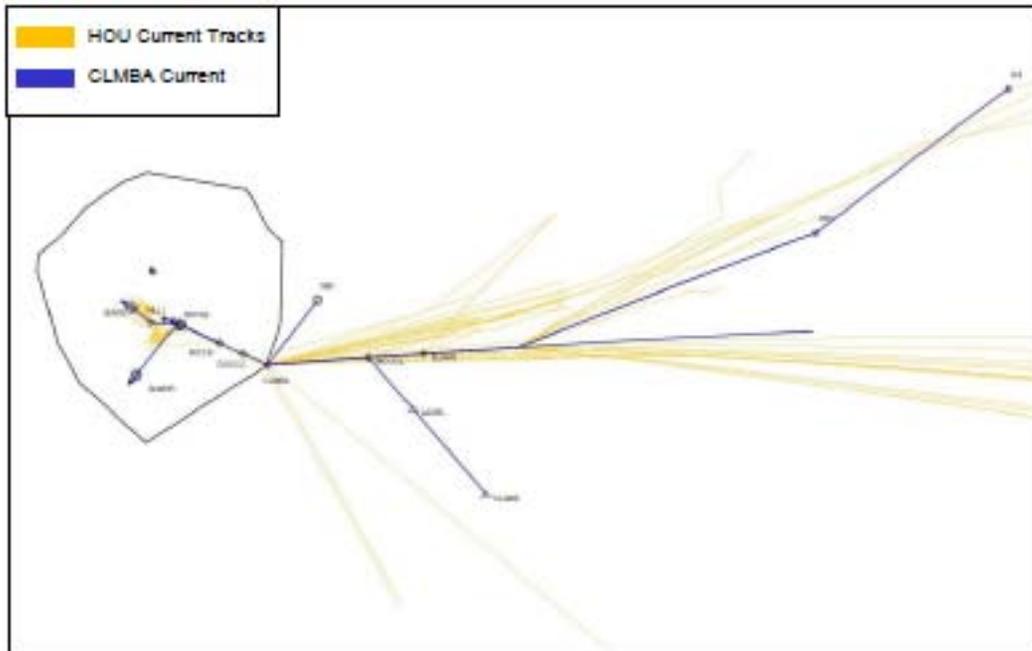
<b>Name of Change</b>	<b>PUCKS STAR</b>	<b>Date</b>	<b>06-19-12</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E37, T5, I23</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 79, 68, 43, 23, 36, 24, 65, 37, 34	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552</b> <b>Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GILLL BRSKT TKNIQ BAYYY BOOZZ <b>SIDs:</b> FLYZA ELOCO	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase I TARGETS File</b></li> <li><b>2. PUCKS TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

# OAPM Design Package: Houston Metroplex PUCKS RNAV STAR

## Purpose

This design package addresses issues with the CLMBA STAR identified by the Design Team:

1. The CLMBA RNAV STAR is currently the primary arrival for HOU traffic from the southeast.
2. The STAR is not vertically optimized, resulting in level segments that increase fuel burn and carbon emissions.
3. Aircraft flight tracks do not follow the lateral paths of the procedure, as shown below in Figure 1.
4. The SBI and KLAMS transitions are not utilized.



**Figure 1. Current CLMBA STAR**

## **OAPM Design Package: Houston Metroplex PUCKS RNAV STAR**

### **Study Team Recommendation**

The Study Team recommended replacing the current CLMBA STAR with a redesigned KABOY STAR as proposed below:

1. The proposed KABOY STAR would be the primary HOU southeast arrival route. It would also serve as an offload routing for IAH arrivals.
2. The conceptual KABOY STAR has an OPD with a proposed vertical window at the terminal entry point of 170-FL200 that would reduce level flight segments. Additional lateral spacing would be added between the WOLDE and KABOY STARs to optimize their usage. The KABOY and WOLDE STARs would be procedurally separated.
3. En route transitions that begin at SJI, LEV, KLAMS and a new waypoint southwest of KLAMS were proposed to provide lateral routings that follow current and anticipated aircraft flight paths, as depicted in Figure 2 below.
4. The movement of the HOU arrival traffic north over KABOY would reduce track miles.
5. Runway transitions are proposed, but only developed to Runways 12L/R and 04. The developed runway transitions would be laterally positioned for the potential development of RNP AR IAPs.
6. For use as an IAH offload, flow dependent STARs overlaying the KABOY STAR were proposed with vertical profiles to accommodate east and west configurations. The OPD with proposed vertical windows at the terminal entry point (East FL190- FL220 and West 140-170) would reduce existing level flight segments.

# OAPM Design Package: Houston Metroplex PUCKS RNAV STAR

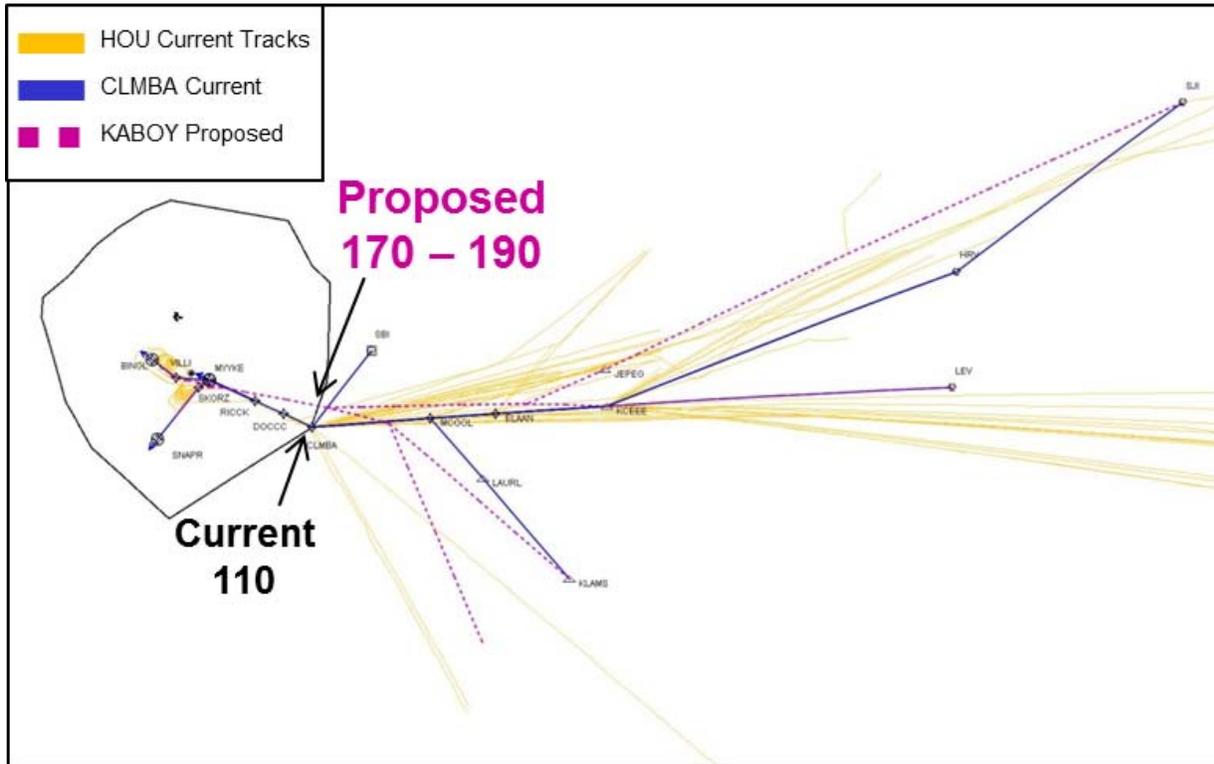


Figure 2. Current Procedure and Study Team Recommendation

# OAPM Design Package: Houston Metroplex

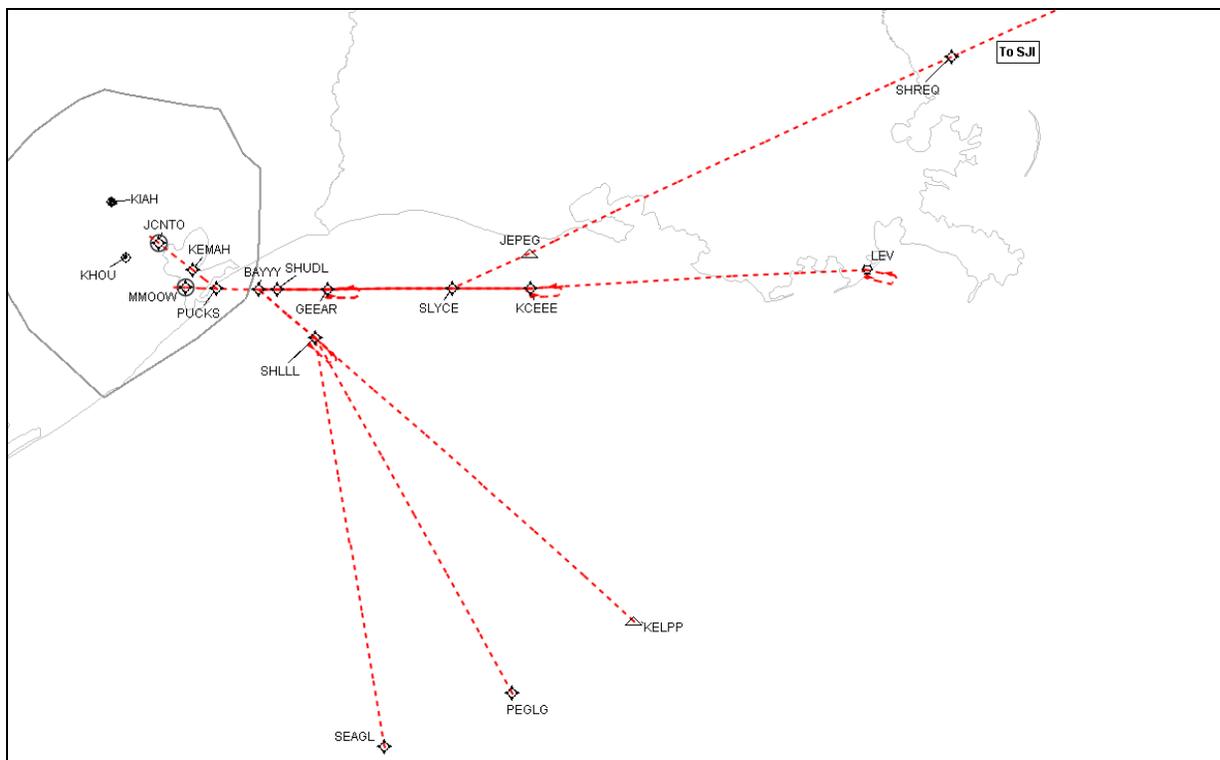
## PUCKS RNAV STAR

### Proposed Final Design

The Design Team began with the Study Team’s proposal to move the primary HOU arrival flow over the path of the current IAH KABOY STAR. The PUCKS STAR closely follows the path of the proposed HOU KABOY STAR. This STAR would be used for jet aircraft landing HOU when the advertised runway is 22 or 30L/R. As a change to the Study Team’s recommendation, aircraft landing at all other Houston area south satellite airports and turboprop/prop aircraft landing at HOU would be routed via the proposed TQNIK STAR.

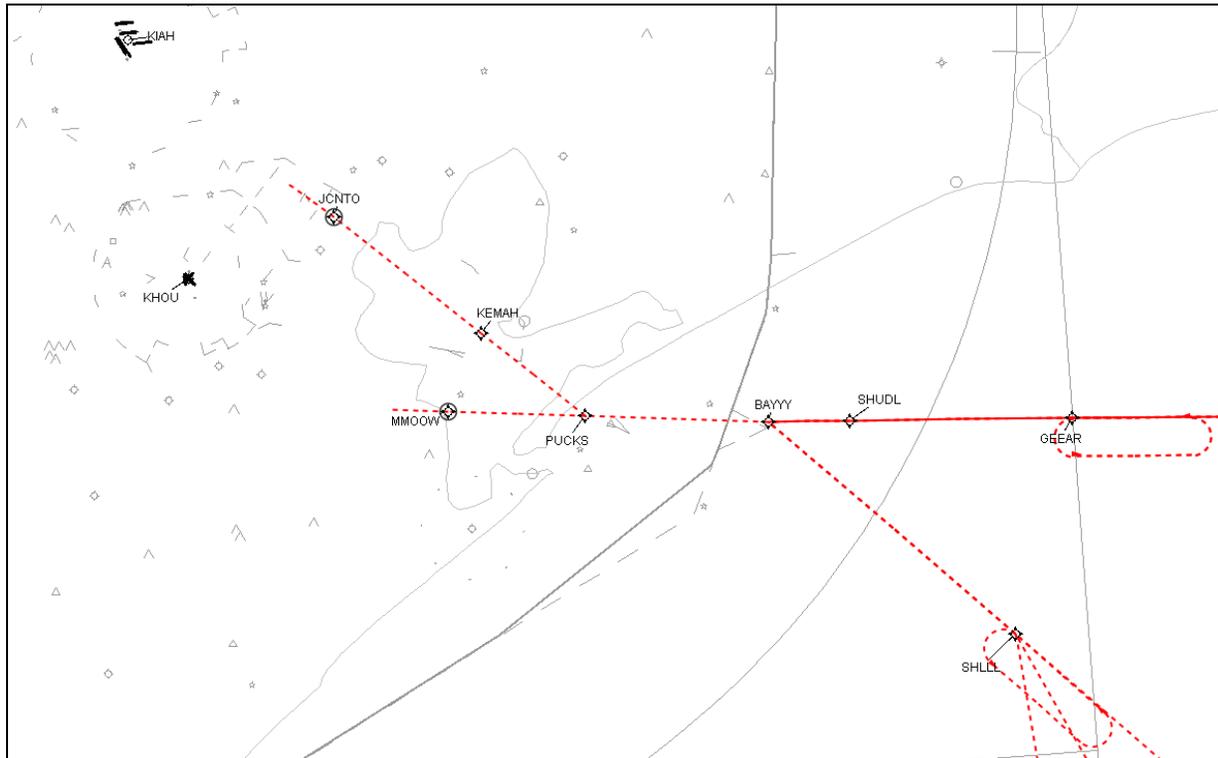
En route transitions from the Gulf of Mexico were modified from the Study Team proposal to connect to Required Navigation Performance routes that will be published in the future, as shown below in Figure 3. The Design Team evaluated many options to separate these transitions on the PUCKS arrival from the IAH GILLL and BRSKT arrivals and determined that tactically separating aircraft on these procedures ensures the maximum industry stakeholder benefit.

As shown in Figure 4 below, the Design Team proposes the PUCKS STAR be designed as an OPD that crosses BAYYYY between 13,000 feet and 16,000 feet at 250 knots.



**Figure 3. Proposed PUCKS STAR (En Route)**

# OAPM Design Package: Houston Metroplex PUCKS RNAV STAR



**Figure 4. Proposed PUCKS STAR (Terminal)**

## **OAPM Design Package: Houston Metroplex PUCKS RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

GILLL  
BRSKT  
TKNIQ  
BAYYY  
BOOZZ

#### **SIDs:**

FLYZA  
ELOCO

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. Vertical limits of low altitude sectors were reviewed and may need to be modified to accommodate the new procedures.

The proposed Gulf of Mexico routes were not available during the study team process.

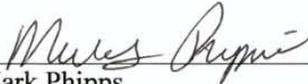
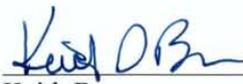
### **Attachments**

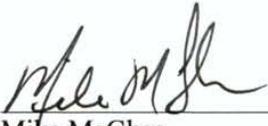
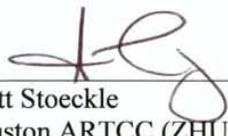
1. Phase I TARGETS File
2. PUCKS TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

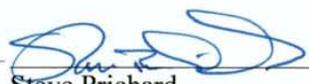
## OAPM Design Package: Houston Metroplex PUCKS RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
---	------------------------	--	------------------------

 Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/26/12</u> Date	 Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
--	------------------------	---	------------------------

 Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>6-21-12</u> Date	 Steve Prichard Houston TRACON (I90) NATCA Lead	<u>6-25-12</u> Date
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## OAPM Design Package: Houston Metroplex

*HOU PUCKS RNAV STAR*

### RECORD OF CHANGE

Change Number	Date	Document
001	11/15/2012	PUCKS RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	PUCKS TARGETS Distribution Package	N/A

#### Description of Change

Updated Header with airport information.

The design team amended the procedure to ensure airspace sector integrity. The original design proposal is shown at Figure 1 and 2. A transition was added for runway 35. The altitude restriction at BAYYY waypoint was modified to between 12,000 and 15,000 feet. The altitude restriction at PUCKS waypoint was modified to between 8,000 and 11,000 feet. The altitude restriction at KEMAH waypoint was modified to 6,000 feet. Three additional waypoints were added in TRACON airspace. The first between PUCKS and MMOOW waypoints, named WEENY, with an altitude restriction of at or above 8,000 feet; the second between PUCKS and KEMAH waypoints named FREAK, with an altitude restriction of at or above 8,000 feet; and the third between KEMAH and JCNT0 waypoints, named OUTLW, with an altitude of 6,000 feet and a speed of 210 knots. These changes are shown in Figures 3 and 4.

## OAPM Design Package: Houston Metroplex

### HOU PUCKS RNAV STAR

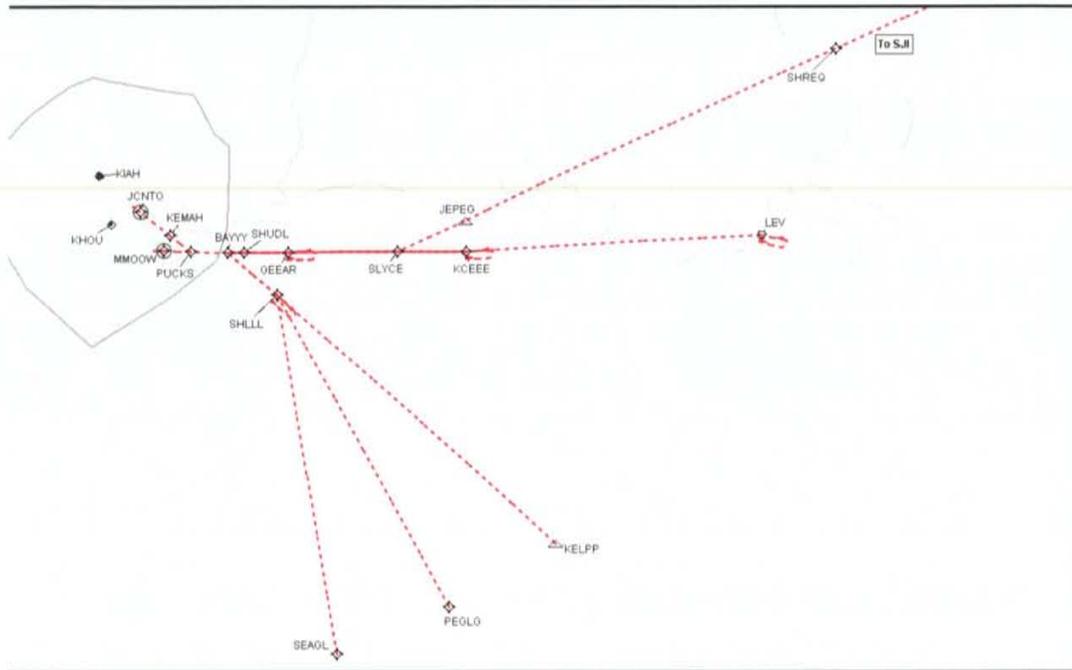
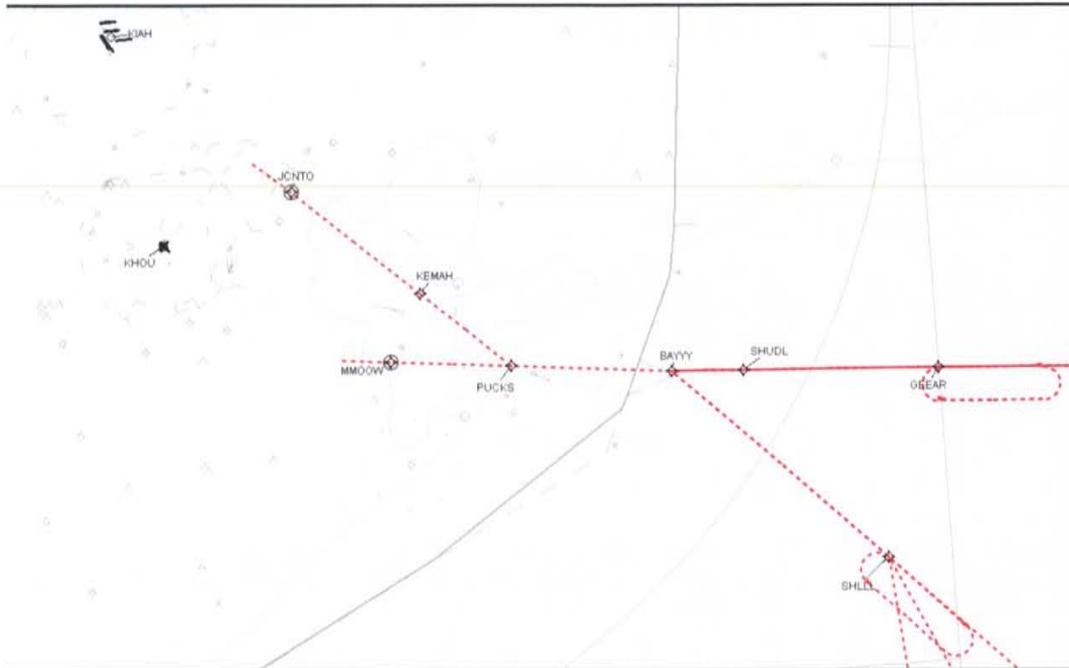


FIGURE 1. PUCKS RNAV STAR PROPOSED DESIGN (EN ROUTE) (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

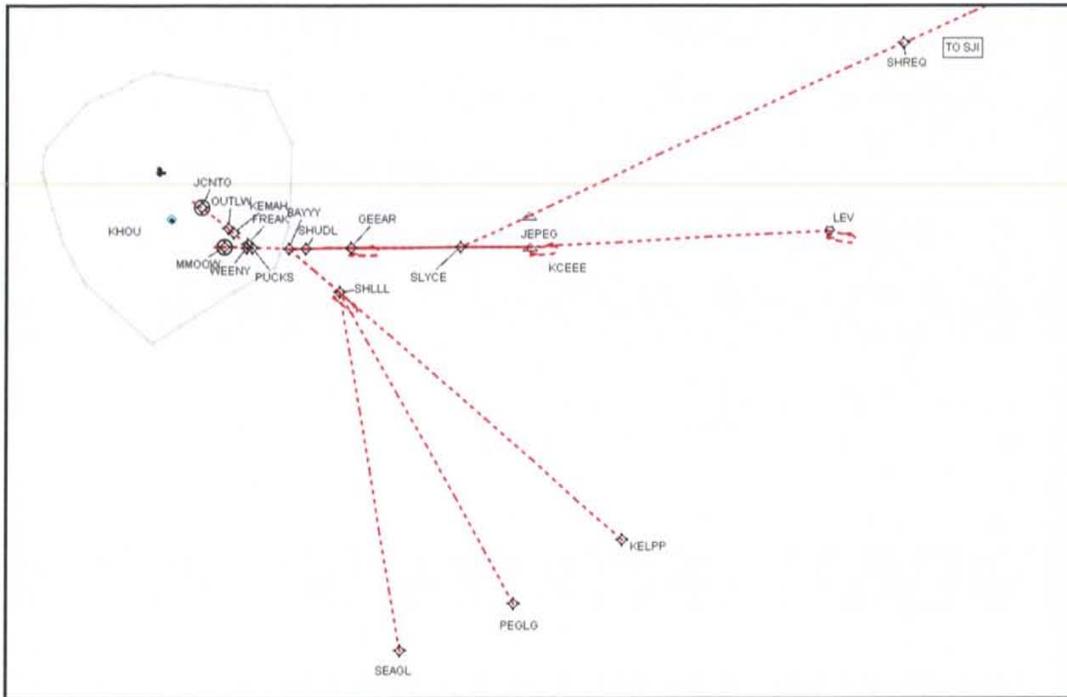
*HOU PUCKS RNAV STAR*



**FIGURE 2. PUCKS RNAV STAR PROPOSED DESIGN (TERMINAL) (Figure 4 in PFD)**

## OAPM Design Package: Houston Metroplex

*HOU PUCKS RNAV STAR*

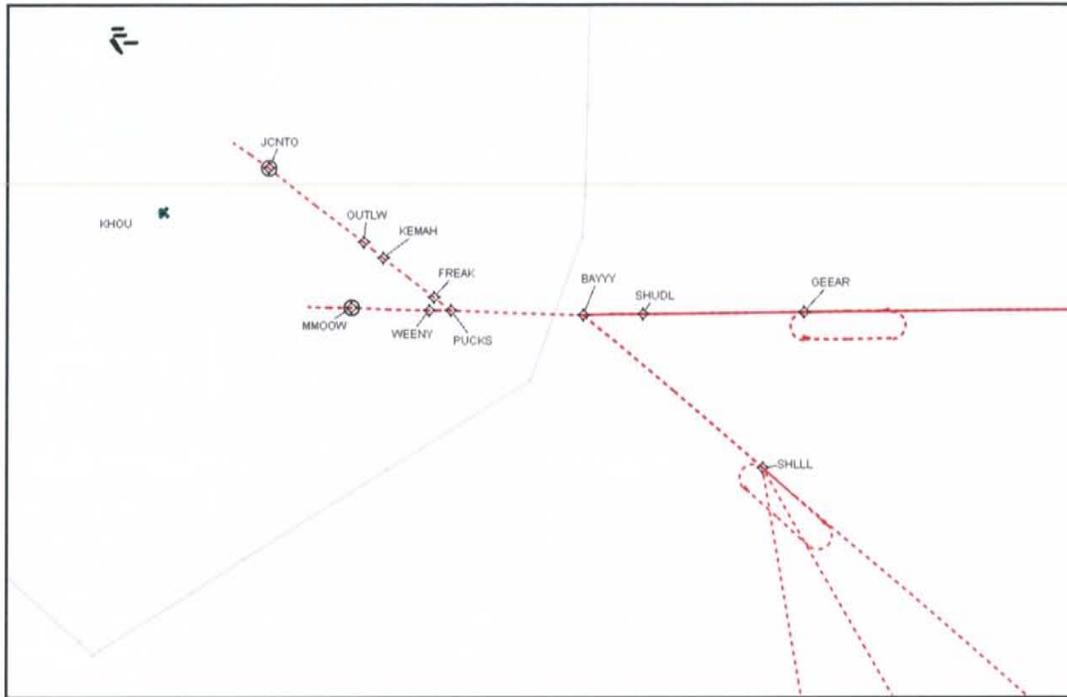


**FIGURE 3. PUCKS RNAV STAR PROPOSED DESIGN (EN ROUTE)**

(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*HOU PUCKS RNAV STAR*



**FIGURE 4. PUCKS RNAV STAR PROPOSED DESIGN (TERMINAL)**

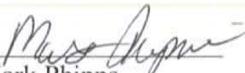
(Will replace Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

*HOU PUCKS RNAV STAR*

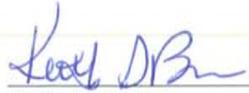
Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

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\_\_\_\_\_  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
\_\_\_\_\_  
Date

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\_\_\_\_\_  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
\_\_\_\_\_  
Date

## OAPM Design Package: Houston Metroplex SKNRD RNAV STAR

Name of Change	<b>SKNRD STAR</b>	Date	<b>06-19-12</b>
Change Classification	<b>Terminal Procedure</b>	Current Phase of Design	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
OAPM Study Team Reference/s	<b>E6, E7, E30, E32, E34, T2, I2, I5, I7</b>	Implementation Date	<b>December 2013</b>
Impacted Facilities and Positions/Areas/Sectors	<b>I90</b> <b>ZHU Sectors:</b> 26, 38, 40, 42, 81 <b>ZFW Sectors:</b> 30, 86 <b>Ft. Polk Approach</b>	Facility Points of Contact	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
Related/Dependent Submissions	<b>STARs:</b> WHACK TWSTD DOOBI WAPPL <b>SIDs:</b> STRYA	Associated Data Files:	<ol style="list-style-type: none"> <li><b>1. Phase III TARGETS File</b></li> <li><b>2. SKNRD TARGETS Distribution Package</b></li> <li><b>3. Table of Procedures</b></li> </ol>

# OAPM Design Package: Houston Metroplex SKNRD RNAV STAR

## Purpose

This design package addresses the following issues with the TXMEX STAR identified by the Houston OAPM Study Team:

1. The current TXMEX STAR is the primary arrival for IAH traffic from the northeast (see Figure 1).
2. Additional lateral spacing is requested between the IAH STARs to optimize their simultaneous usage.
3. Due to the current lack of consistent dual STAR utilization, excessive vectoring occurs for sequencing as aircraft approach TXMEX.
4. The STAR is not vertically optimized resulting in level segments that result in increased fuel burn and excessive carbon emissions, particularly during east flow.
5. Aircraft flight tracks do not follow the lateral paths of the LCH and EMG transitions.

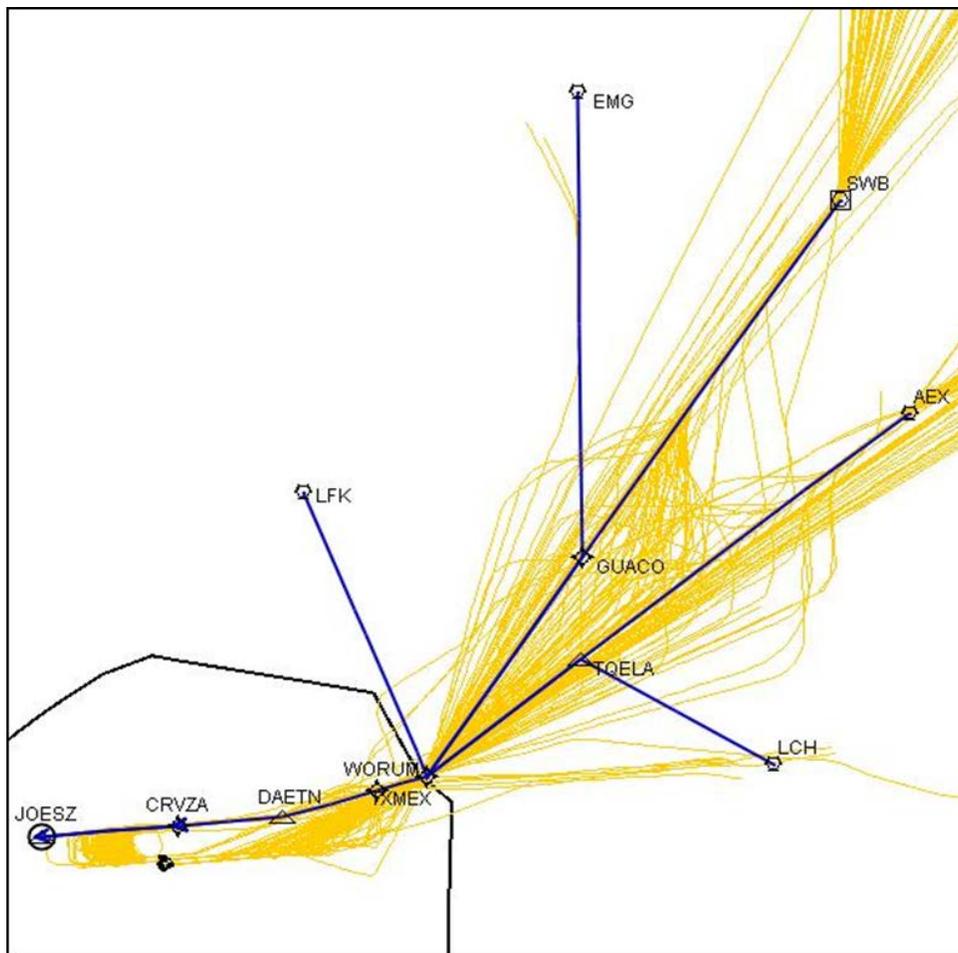


Figure 1. Current TXMEX STAR

## **OAPM Design Package: Houston Metroplex SKNRD RNAV STAR**

### **Study Team Recommendation**

1. The proposed TXMEX STAR would become a preferred HOU arrival with the IAH traffic routed via the DAS and ROKIT STARs.
2. The conceptual DAS STAR has flow-dependent vertical profiles to accommodate east and west configurations. The OPD with proposed vertical windows at COMBS (East FL190-FL220 and West 100-140), would reduce present day level flight segments on the TXMEX STAR.
3. The DAS STAR, in conjunction with the ROKIT STAR, is designed to provide a dual feed to IAH. Additional lateral spacing is added between the dual STARs to optimize their usage. The DAS STAR has en route transitions beginning at SWB and AEX to facilitate the use of the dual feeds and reduce complexity as crossover transitions are eliminated. The EMG and LCH transitions were removed due to lack of usage and to avoid unnecessary crossing traffic. The LFK transition is still available for weather re-routing, but only in west flow.
4. Runway transitions are proposed in each configuration. In west flow, Runway 26L is designed as the primary transition; however, transitions are available to Runways 26R and 27. In east flow, transitions would terminate on a downwind leg. The Runway 08L transition passes north of IAH at or above 8,000 ft until midfield to allow IAH and HOU departure traffic to climb more expeditiously. The Runway 09 transition crosses to the south downwind and allows for tactical runway and fix balancing. The Runway 08R transition will be determined during D&I. Both downwind legs in east flow are laterally positioned for the potential development of RNP AR IAPs.

Figure 2 depicts the proposed RNAV DAS STAR from the northeast corner-post as compared to the current TXMEX STAR.

# OAPM Design Package: Houston Metroplex SKNRD RNAV STAR

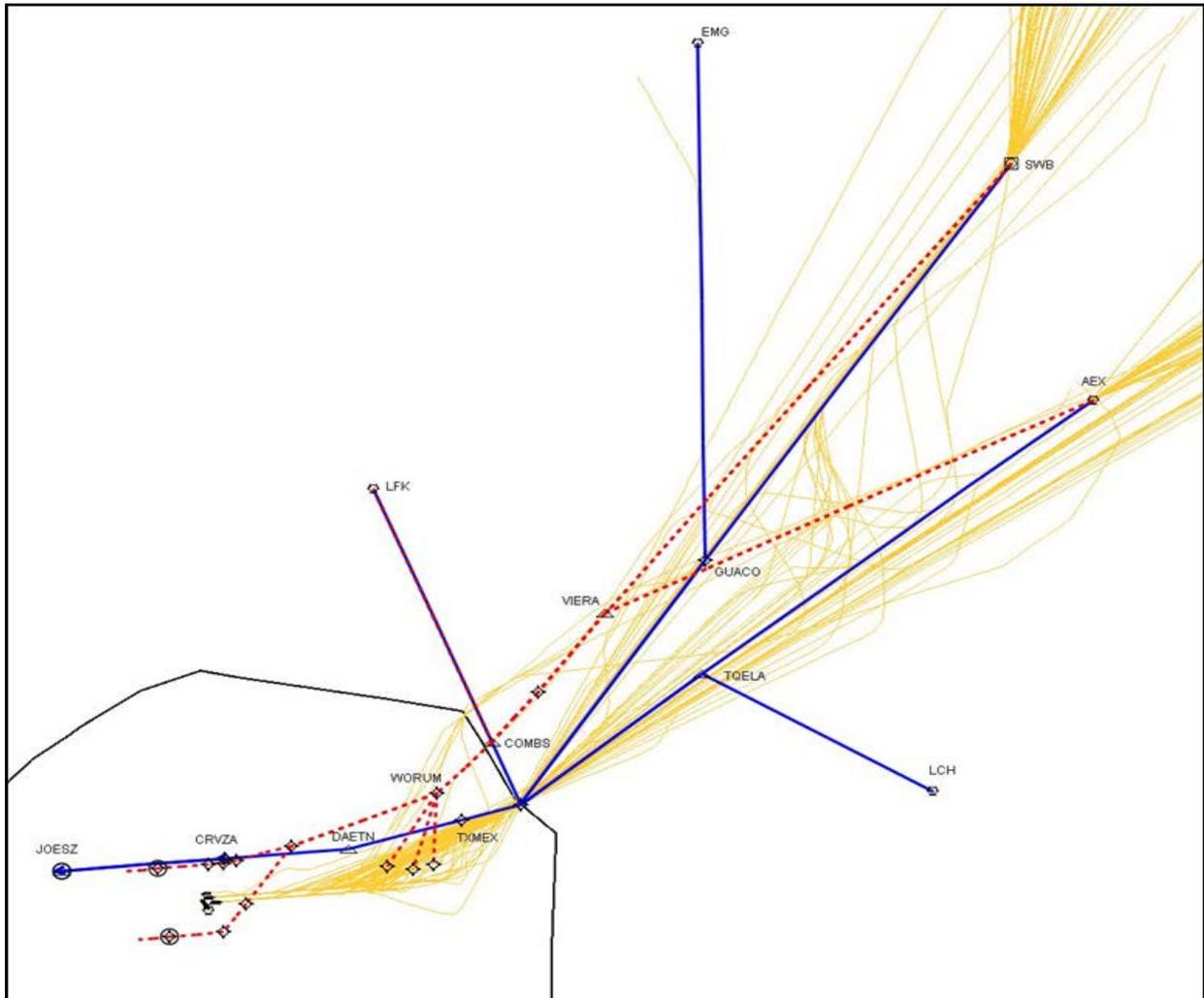


Figure 2. Current Procedure and Study Team Recommendation

## **OAPM Design Package: Houston Metroplex SKNRD RNAV STAR**

### **Proposed Final Design**

The SKNRD STAR would be one of two STARs designed to provide a dual feed to IAH on an east flow (Figure 3). The SKNRD STAR would be used for RNAV jet and high performance turboprop aircraft landing IAH. The primary arrival runway would be 8L (Figure 4).

En route transitions from the northeast were modified from the Study Team proposal. The PLANB transition was added to allow SHV departures access to the SKNRD STAR and provide an ATC assigned, weather contingent route for ZFW. The AEX transition was straightened to eliminate unnecessary track miles.

The Design Team evaluated many options to separate the en route transitions on the SKNRD arrival from the HOU WAPPL and IAH TWSTD arrivals and determined that it would be better to have controllers tactically separate aircraft on these procedures.

The EGULZ waypoint was added to the SWB transition and JERNY waypoint was added to the AEX transition. EGULZ and JERNY would serve as initial sequencing fixes.

An outer fix holding pattern was created at JERNY and an inner fix holding pattern was created at DOOBI.

The SKNRD STAR utilizes an OPD with an altitude window at DOOBI from FL190 to FL220 at 280 knots. An altitude window was added at TURNR and BEATL from FL240 to FL280 at 280 knots to facilitate predictable descent profiles. TURNR and BEATL also protect from the WARRIOR SUA.

The at or below 16,000 foot altitude restriction at SKNRD and the 12,000 to 14,000 foot window at BFFET would facilitate airspace boundary design while still allowing unrestricted OPD procedures.

# OAPM Design Package: Houston Metroplex

## SKNRD RNAV STAR

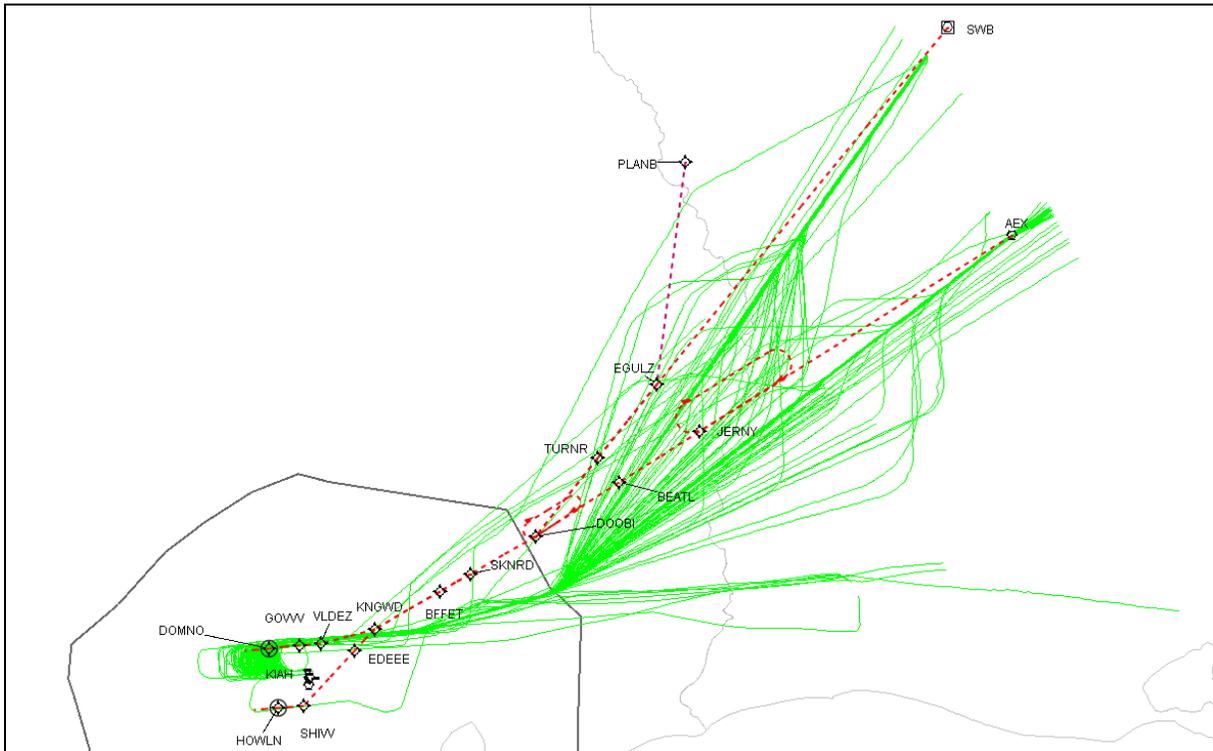


Figure 3. Proposed SKNRD STAR (En Route)

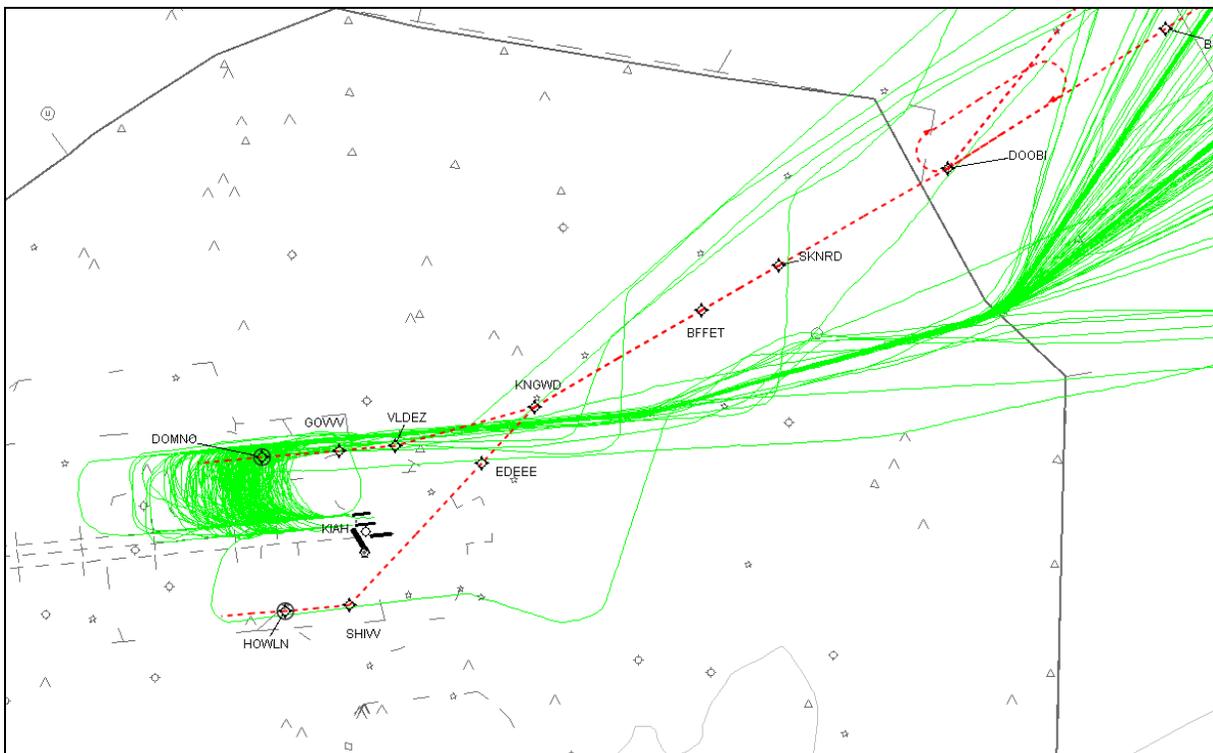


Figure 4. Proposed SKNRD STAR (Terminal)

## **OAPM Design Package: Houston Metroplex SKNRD RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

WHACK  
TWSTD  
DOOBI  
WAPPL

#### **SIDs:**

STRYA

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated. Vertical limits of low altitude sectors were reviewed and will not need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

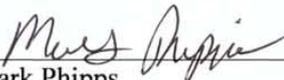
### **Attachments**

1. Phase III TARGETS File
2. SKNRD TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

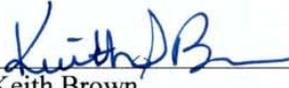
## OAPM Design Package: Houston Metroplex SKNRD RNAV STAR

### Review Signatures

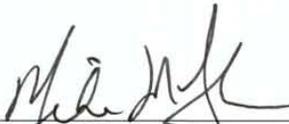
The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
Mark Phipps  
Houston Metroplex  
FAA Lead

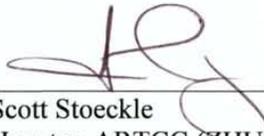
6-25-12  
Date

  
Keith Brown  
Houston Metroplex  
NATCA Lead

6/25/12  
Date

  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

6/25/12  
Date

  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

6/26/12  
Date

  
Mike R. Richardson  
Houston TRACON (190)  
Facility Lead

6-20-12  
Date

  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

6-25-12  
Date

## OAPM Design Package: Houston Metroplex TEJAS RNAV STAR

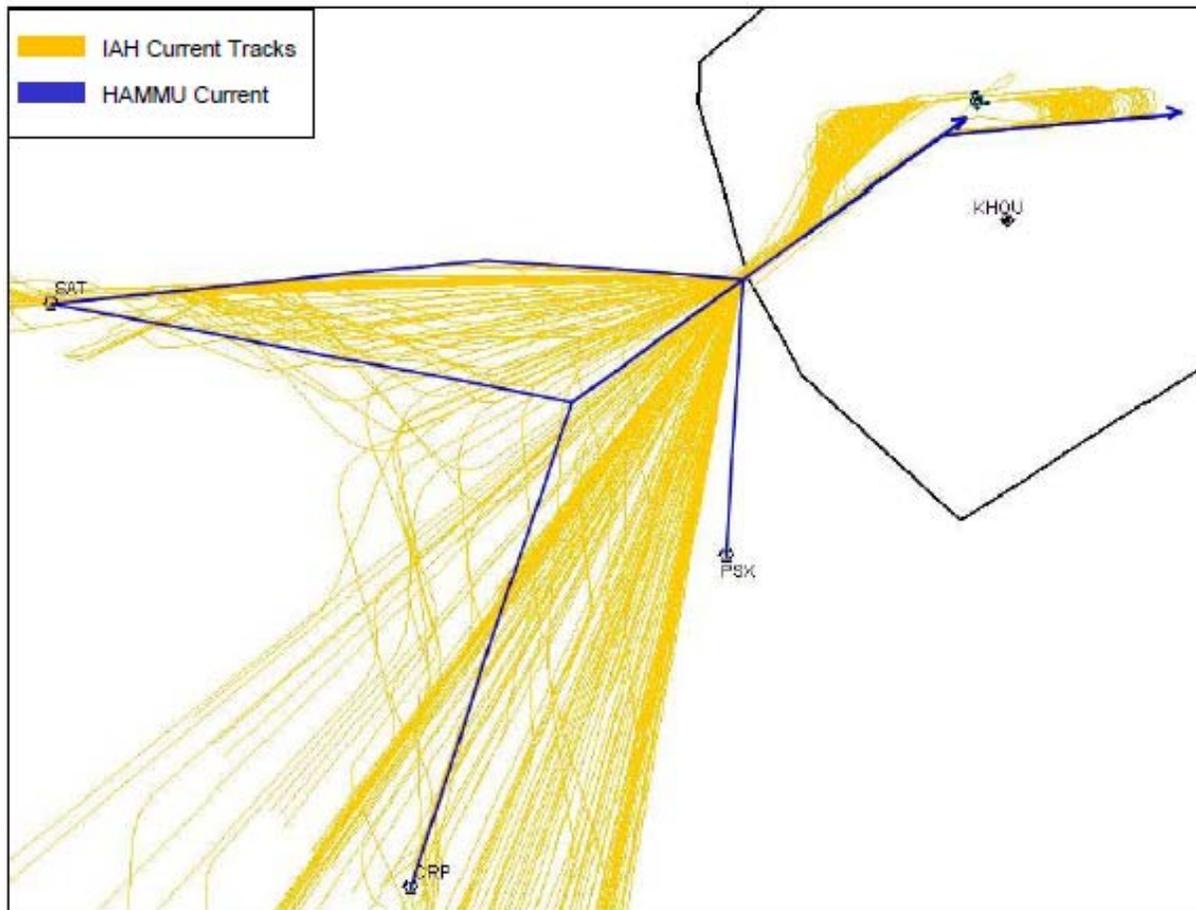
Name of Change	<b>TEJAS STAR</b>	Date	<b>06-21-12</b>
Change Classification	<b>Terminal Procedures</b>	Current Phase of Design	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
OAPM Study Team Reference/s	<b>E24, E25, E26, E27, E39, I3, I17, I18</b>	Implementation Date	<b>December 2013</b>
Impacted Facilities and Positions/Areas/Sectors	<b>I90 ZHU Sectors: 58, 59, 76, 87, 95, 92</b>	Facility Points of Contact	<b>Will Hutson 281.230.5556 David Kidd 281.230.5556</b>
Related/Dependent Submissions	<b>STARs: HTOWN BELLR KIDDZ SIDs: DOBBY RITAA PTRON HUBEE</b>	Associated Data Files:	<ol style="list-style-type: none"> <li><b>1. Phase II TARGETS File</b></li> <li><b>2. TEJAS TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

# OAPM Design Package: Houston Metroplex TEJAS RNAV STAR

## Purpose

This design package addresses issues with the Southwest/South IAH STARs identified by the Houston OAPM Study Team:

1. The HAMMU STAR is currently the primary arrival for IAH traffic from the southwest.
2. The historical flight tracks do not follow current arrival procedures.
3. There are inefficient vertical profiles and lateral paths.
4. Two distinct arrival streams from the south do not transition over CRP and the PSX transition is not used.
5. HAMMU is not procedurally separated from other STARs and SIDs and conflicts with SAT departures. Specifically, SAT HUBEE departures interact with HAMMU arrivals. Significant vectoring is routinely required to separate aircraft departing SAT from aircraft inbound on HAMMU, resulting in additional complexity.



**Figure 1. Current HAMMU STAR**

# OAPM Design Package: Houston Metroplex TEJAS RNAV STAR

## Study Team Recommendation

1. The conceptual HAMMU STAR is optimized to more closely follow current flight tracks. The OST developed the HAMMU RNAV STAR with OPDs, which provide configuration-dependent vertical profile improvements. The OST developed proposed altitude windows that are flow-dependent (East 120-140 and West 170-FL200). The OPD with proposed vertical windows will reduce current level segments on the HAMMU STAR.
2. To address the SAT HUBEE interactions, the Houston OST also proposed routing SAT HUBEE departures north to avoid the new HAMMU arrival. This provides lateral spacing in the vicinity of WEMAR to allow for climb and descent.
3. Runway transitions are proposed in each configuration. In east flow, Runway 08R was designed as the primary transition, however transitions are available to Runway 08L and Runway 09. In west flow, transitions are designed to terminate on a downwind with an FM leg. The Runway 26R transition passes north of IAH at or above 8,000 ft until midfield to allow IAH and HOU departure traffic to climb more expeditiously and allow for tactical runway and fix balancing. The Runway 27 transition joins the south downwind at 6,000 ft. The Runway 26L transition routing will be determined during D&I. Both downwinds in the west flow are laterally positioned for the potential development of RNP AR IAPs.

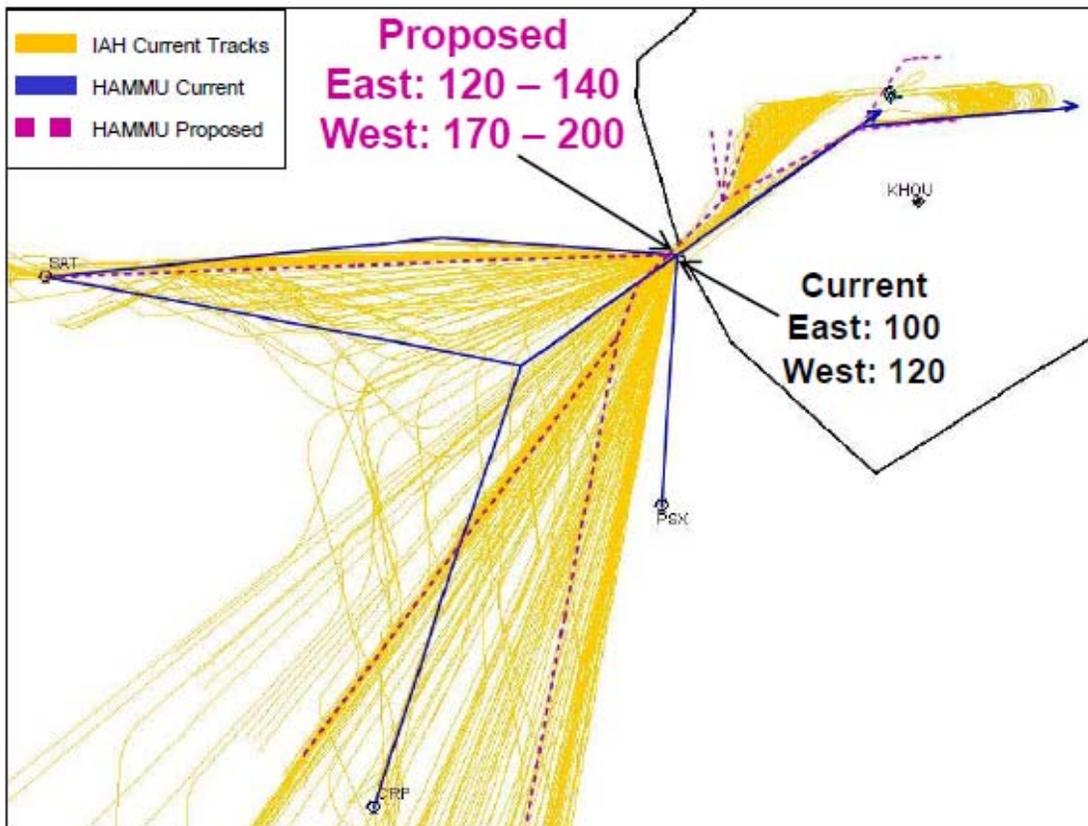


Figure 2. Study Team Recommendation

# OAPM Design Package: Houston Metroplex

## TEJAS RNAV STAR

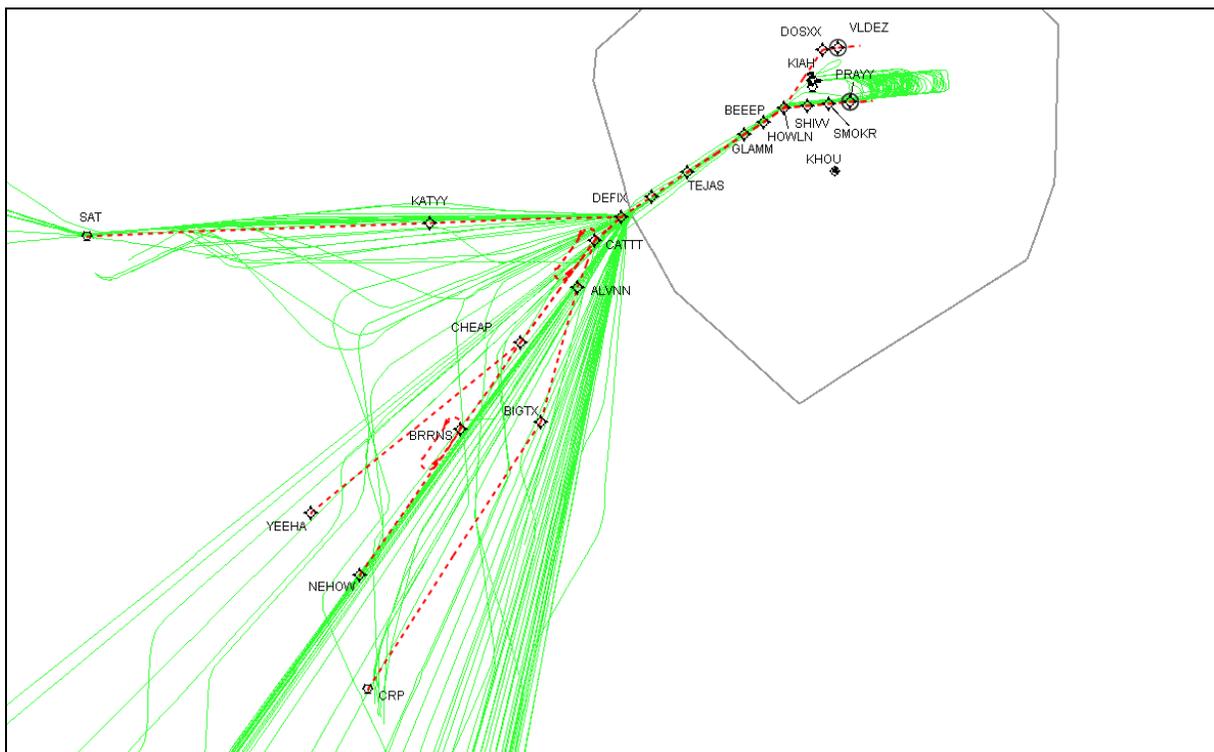
### Proposed Final Design

The Design Team is proposing flow dependent RNAV STARS from the southwest to IAH that replace the current HAMMU STAR. The TEJAS would be used for jet and turboprop aircraft landing IAH when on a west flow, as depicted in Figure 4. The TEJAS STAR is designed with an OPD and an altitude window at DEFIX of 16,000 feet to FL190 at 280 knots. The TEJAS STAR was deconflicted from the KIDDZ STAR.

En route transitions from south Texas and Mexico were laterally optimized based on analysis performed by United Airlines to determine beneficial routings based on proposed route changes with Mexico air traffic control. A key benefit from these changes is separate arrival and departure corridors enabling uninterrupted climbs and descents.

En route transitions were laterally optimized to reduce track miles flown. Additional separation was added between the SAT transition of the BELLR STAR and the HUBEE SID to provide for an OPD. Some waypoints were added to deconflict from SUA.

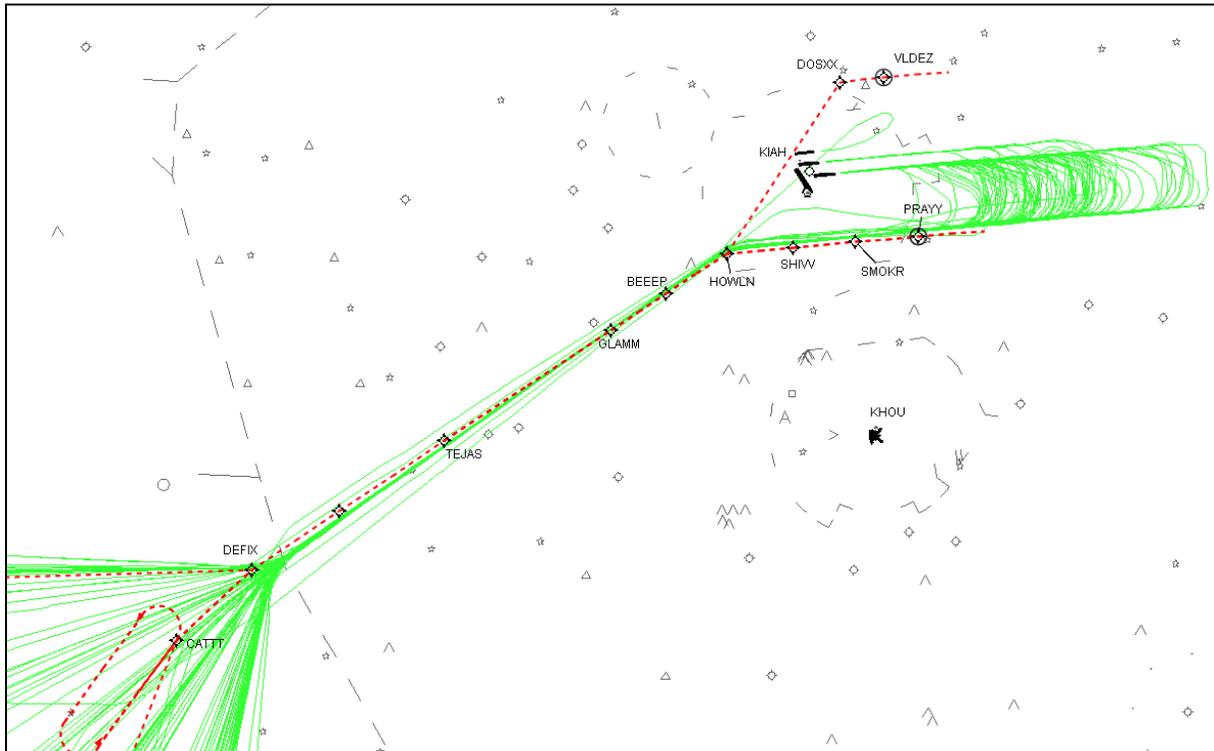
The Design Team evaluated many options to separate en route transitions on the TEJAS arrival from the HOU BELLR arrival and determined that it would be best to have controllers tactically separate aircraft on these procedures.



**Figure 3. Proposed TEJAS STAR (En Route)**

# OAPM Design Package: Houston Metroplex

## TEJAS RNAV STAR



**Figure 4. Proposed TEJAS STAR (Terminal)**

## **OAPM Design Package: Houston Metroplex TEJAS RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

HTOWN

BELLR

KIDDZ

#### **SIDs:**

DOBBY

RITAA

PTRON

HUBEE

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated. Vertical limits of low altitude sectors were reviewed and may need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

### **Attachments**

1. Phase II TARGETS File
2. TEJAS TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

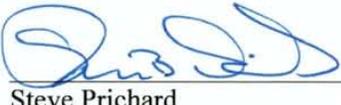
## OAPM Design Package: Houston Metroplex TEJAS RNAV STAR

### Review Signatures

The D&I Team has reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 _____ Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 _____ Date
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 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/25/12 _____ Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 _____ Date
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 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	6-21-12 _____ Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	6-25-12 _____ Date
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## OAPM Design Package: Houston Metroplex

IAH TEJAS RNAV STAR

### RECORD OF CHANGE

Change Number	Date	Document
001	11/15/2012	TEJAS RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	TEJAS TARGETS Distribution Package	N/A

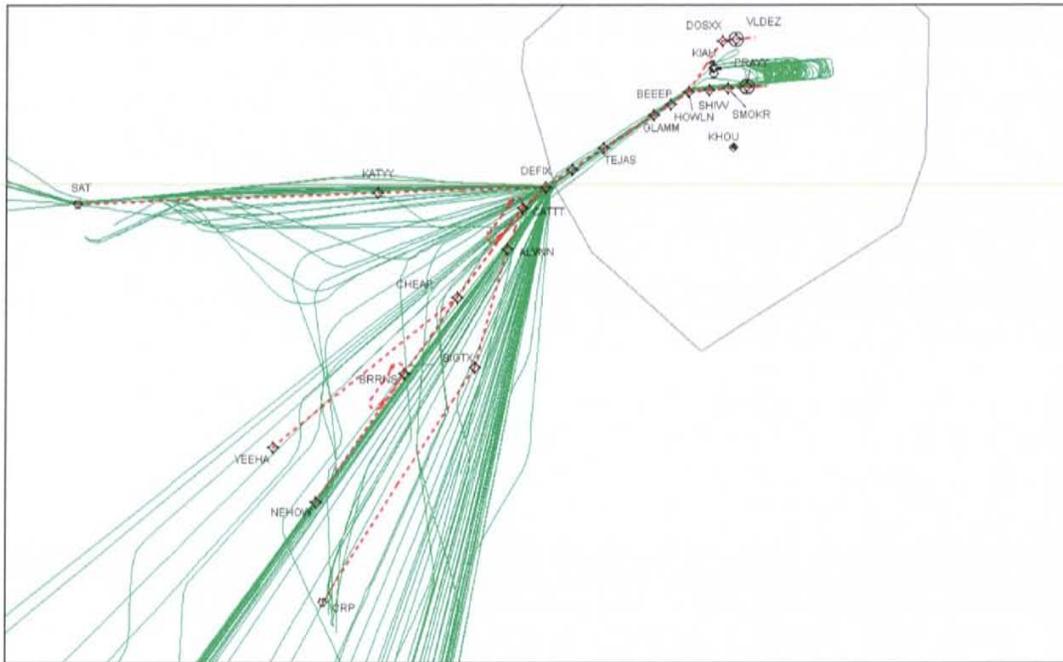
#### Description of Change

Updated Header with airport information.

The design team amended the procedure to ensure airspace sector integrity. The original design proposal is shown in Figures 1 and 2. The altitude restriction at the GLAMM waypoint was relocated and modified to at or below 10,000 feet. The altitude restriction at TEJAS waypoint was modified to at or above 12,000 and at or below 14,000 feet. DOSXX and SMOKR waypoints were renamed DOOOM and SMOCR, respectively. SHIVV waypoint was deleted. These changes are shown in Figures 3 and 4.

## OAPM Design Package: Houston Metroplex

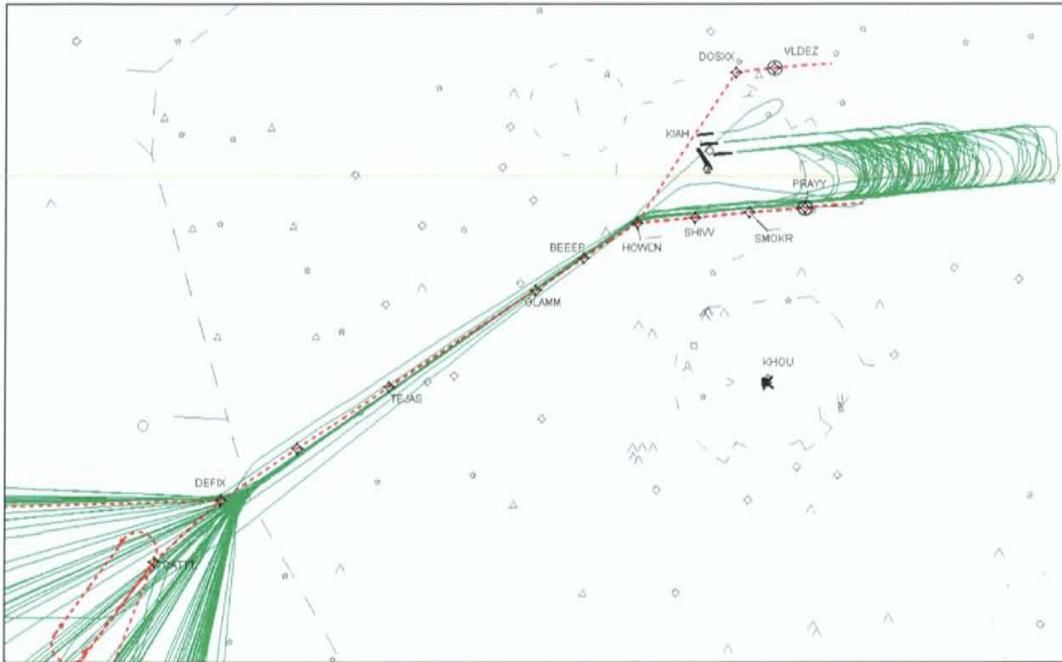
*IAH TEJAS RNAV STAR*



**FIGURE 1. TEJAS RNAV STAR PROPOSED DESIGN (EN ROUTE) (Figure 3 in PFD)**

## OAPM Design Package: Houston Metroplex

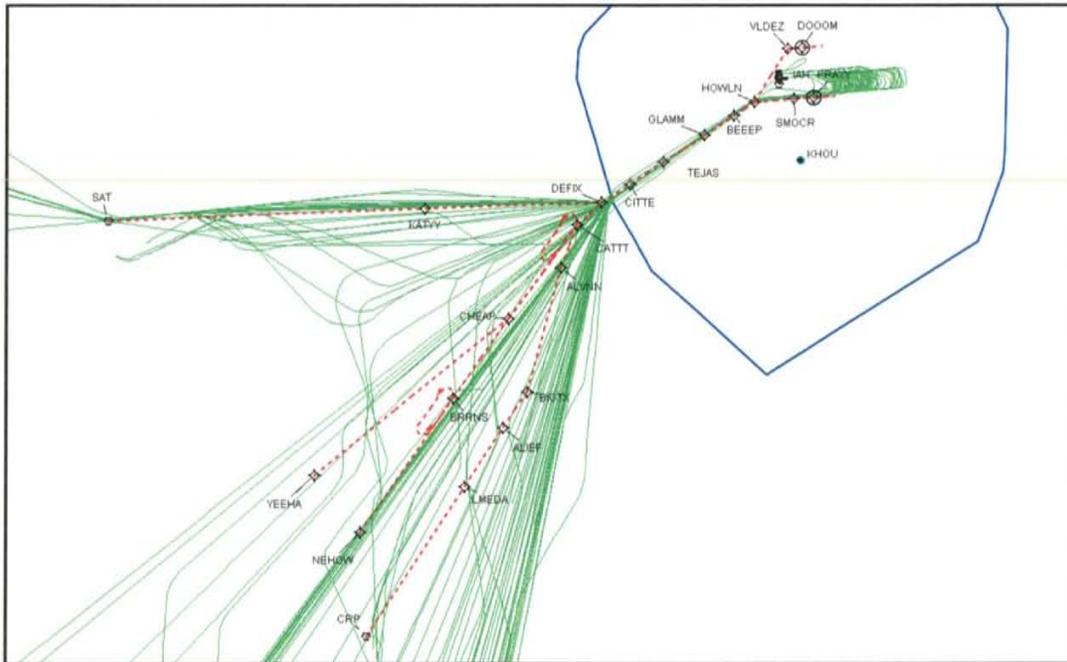
*IAH TEJAS RNAV STAR*



**FIGURE 2. TEJAS RNAV STAR PROPOSED DESIGN (TERMINAL) (Figure 4 in PFD)**

## OAPM Design Package: Houston Metroplex

*IAH TEJAS RNAV STAR*



**FIGURE 3. TEJAS RNAV STAR PROPOSED DESIGN (EN ROUTE)**

(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

IAH TEJAS RNAV STAR

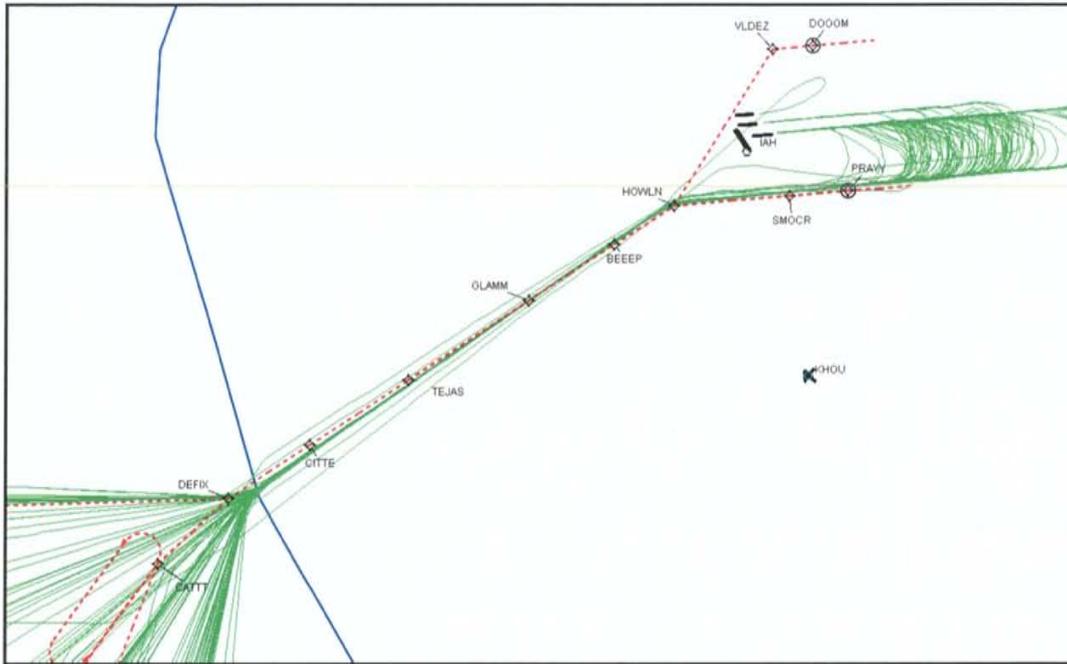


FIGURE 4. TEJAS RNAV STAR PROPOSED DESIGN (TERMINAL)

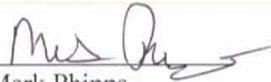
(Will replace Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

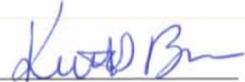
*IAH TEJAS RNAV STAR*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

---

  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex TKNIQ RNAV STAR

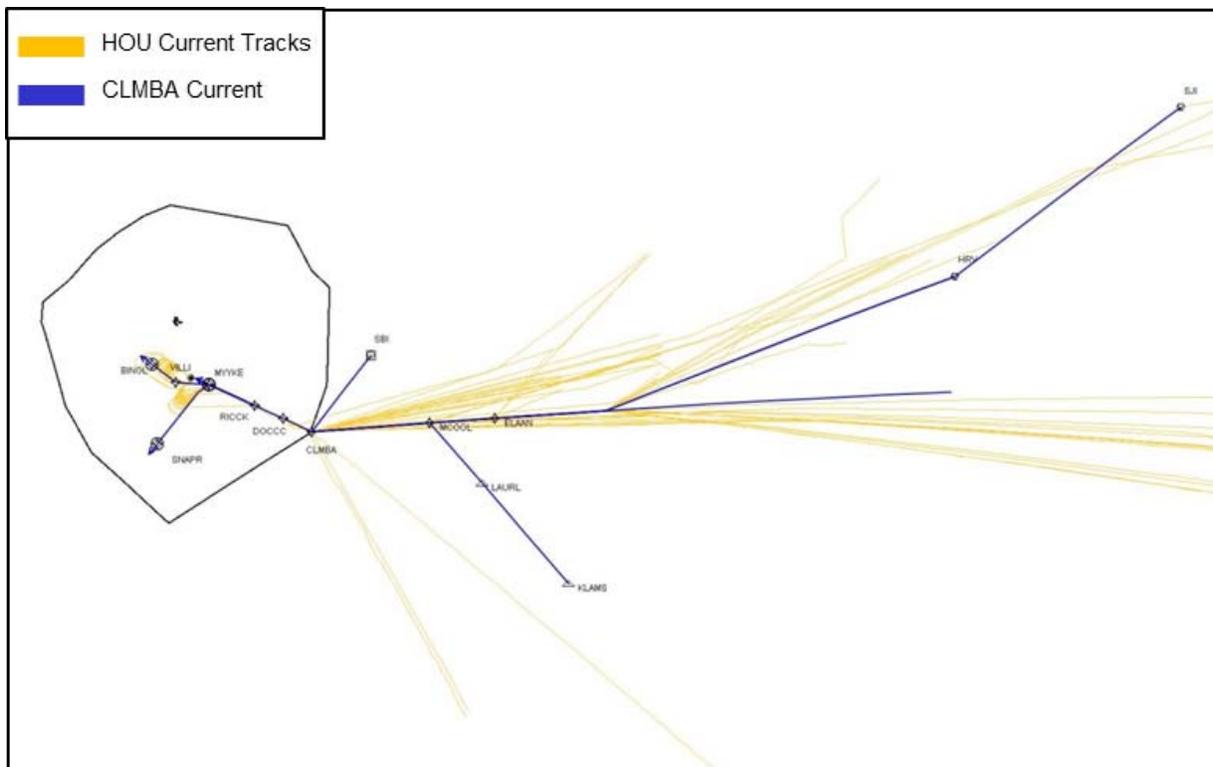
<b>Name of Change</b>	<b>TKNIQ STAR</b>	<b>Date</b>	<b>05-10-2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E21, E36, E38, T5, T8, I23</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 79, 68, 43, 23, 36, 24, 65, 37, 34	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552</b> <b>Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GILLL BRSKT BAYYY PUCKS BOOZZ <b>SIDs:</b> FLYZA ELOCO RITAA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li>1. Phase I TARGETS File</li> <li>2. TKNIQ TARGETS Distribution Package</li> <li>3. Procedure Change Table</li> </ol>

# OAPM Design Package: Houston Metroplex TKNIQ RNAV STAR

## Purpose

This design package addresses issues with the CLMBA STAR identified by the Design Team:

1. The CLMBA RNAV STAR is currently the primary arrival for HOU traffic from the southeast.
2. The STAR is not vertically optimized, resulting in level segments that increase fuel burn and carbon emissions.
3. Aircraft flight tracks do not follow the lateral paths of the procedure.
4. The SBI and KLAMS transitions are not utilized, as shown below in Figure 1.

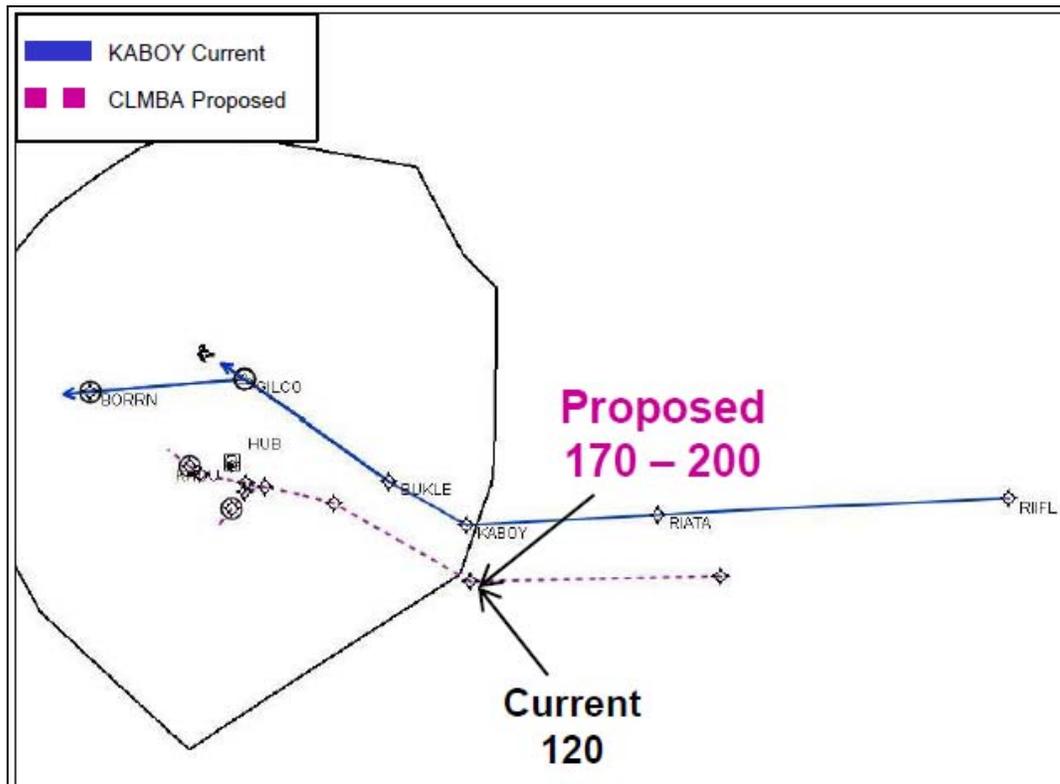


**Figure 1. Current CLMBA STAR**

# OAPM Design Package: Houston Metroplex TKNIQ RNAV STAR

## Study Team Recommendation

1. The proposed CLMBA STAR would be a HOU SWAP routing when the KABOY STAR is utilized for IAH arrivals, either due to weather or as a dual feed in conjunction with the WOLDE STAR.
2. The conceptual CLMBA STAR would be an OPD with a proposed vertical window at the terminal entry point (170-FL200) that would reduce level-offs. Additional lateral spacing is proposed between the CLMBA and KABOY STARs to optimize their usage.
3. Runway transitions are proposed, but only developed to Runways 12L/R and 04. The developed runway transitions are laterally positioned for the potential development of RNP AR IAPs.
4. Figure 2 below depicts the proposed RNAV CLMBA STAR from the southeast corner-post compared to the lateral path of the current KABOY STAR.



**Figure 2. Current Procedure and Study Team Recommendation**

# OAPM Design Package: Houston Metroplex

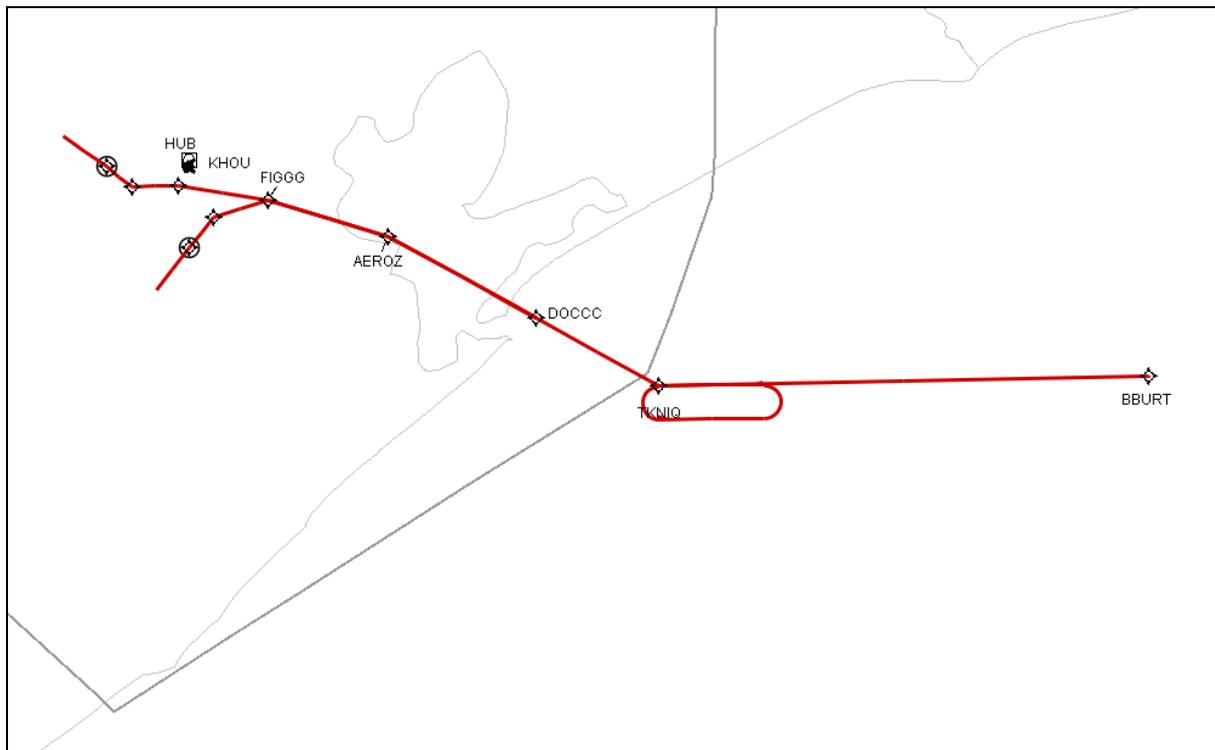
## TKNIQ RNAV STAR

### Proposed Final Design

The TKNIQ STAR would be used as a primary route for aircraft landing at all Houston area south satellite airports (AXH, EFD, GLS, SGR, TME, HPY, 54T, T41, LBX, IWS, LVJ, and T00), and for turboprop/prop aircraft landing at HOU. The TKNIQ STAR would also be utilized as a SWAP route for jets landing HOU when the BOOZZ STAR is being utilized for IAH arrivals.

As shown in Figure 3 below, the Design Team proposes the TKNIQ STAR be established without an OPD. Jets would be expected to cross TKNIQ at 12,000 feet and 280 knots and props would be expected to cross TKNIQ at 11,000 feet.

Runway transitions to runways 04 and 12L/R were designed to connect with proposed RNP approaches. Aircraft landing HOU runway 22 or runway 30L/R would be radar vectored after DOCCC.



**Figure 3. Proposed TKNIQ STAR**

# **OAPM Design Package: Houston Metroplex TKNIQ RNAV STAR**

## **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

### **STARs:**

GILLL  
BRSKT  
BAYYY  
PUCKS  
BOOZZ

### **SIDs:**

FLYZA  
ELOCO  
RITAA

## **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. Vertical limits of low altitude sectors were reviewed and may need to be modified to accommodate the new procedures.

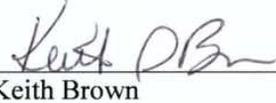
## **Attachments**

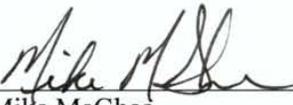
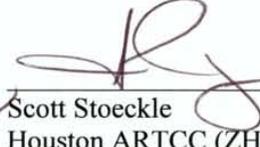
1. Phase I TARGETS File
2. TKNIQ TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

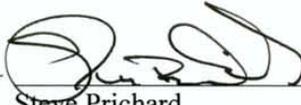
## OAPM Design Package: Houston Metroplex TKNIQ RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>5-17-12</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>5/17/12</u> Date
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 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/12/12</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
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 _____ Mike R. Richardson Houston TRACON (190) Facility Lead	<u>5-17-12</u> Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	<u>6-12-12</u> Date
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## OAPM Design Package: Houston Metroplex

*TKNIQ RNAV STAR*

### RECORD OF CHANGE

Change Number	Date	Document
001	11/15/2012	TKNIQ RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

### Description of Change

Under the **Proposed Final Design** section, the following was added:

This STAR will serve RNAV equipped turboprop arrivals to HOU and all RNAV equipped arrivals to the following satellite airports:

Ellington Field Airport  
 Scholes International Airport at Galveston  
 Sugar Land Regional Airport  
 Houston Executive Airport  
 Baytown Airport  
 RWJ Airpark Baytown  
 LA Porte Municipal  
 Texas Gulf Coast Regional  
 West Houston Airport  
 Pearland Regional Airport  
 Chambers County General Airport

Under the **Proposed Final Design** section, the following was deleted:

Runway transitions to runways 04 and 12L/R were designed to connect with proposed RNP approaches.

The design team amended the procedure to enhance functionality with IAH departure flows. The original design proposal is shown in Figure 1. Runway transitions were added for runways 17 and 35 at HOU. AEROZ waypoint name was changed to FRDDY. FRDDY waypoint was moved 2.8 NM southeast to resolve airspace and route conflicts with the IAH FLYZA SID. EMARR waypoint was moved. Altitude restrictions at ALLY and EMARR waypoints were deleted. These changes are shown in Figure 2.

## OAPM Design Package: Houston Metroplex

*TKNIQ RNAV STAR*

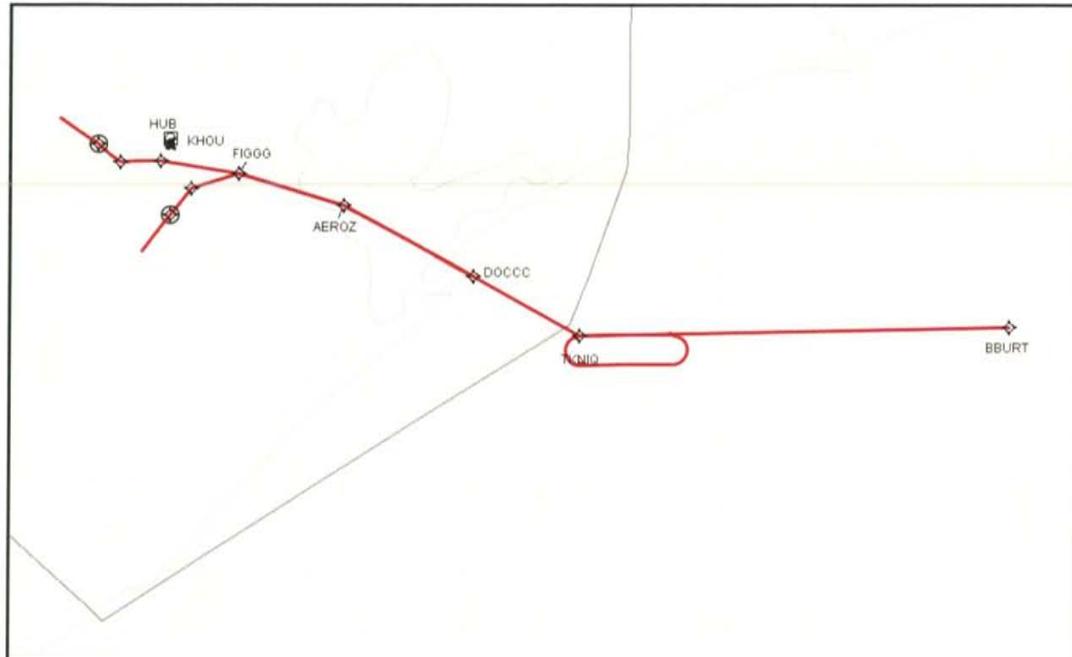


FIGURE 1. TKNIQ RNAV STAR PROPOSED DESIGN (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*TKNIQ RNAV STAR*

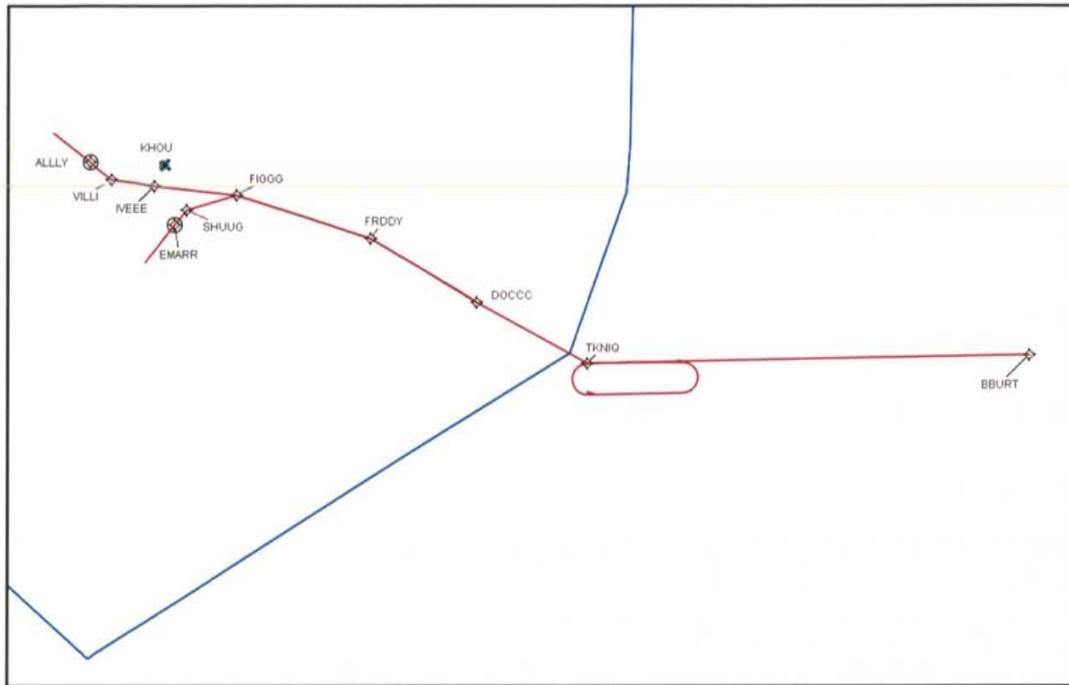


FIGURE 2. TKNIQ RNAV STAR PROPOSED DESIGN

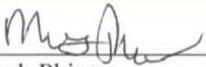
(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*TKNIQ RNAV STAR*

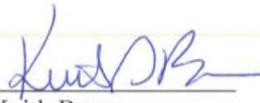
Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

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\_\_\_\_\_  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

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\_\_\_\_\_  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston TTORO RNAV STAR

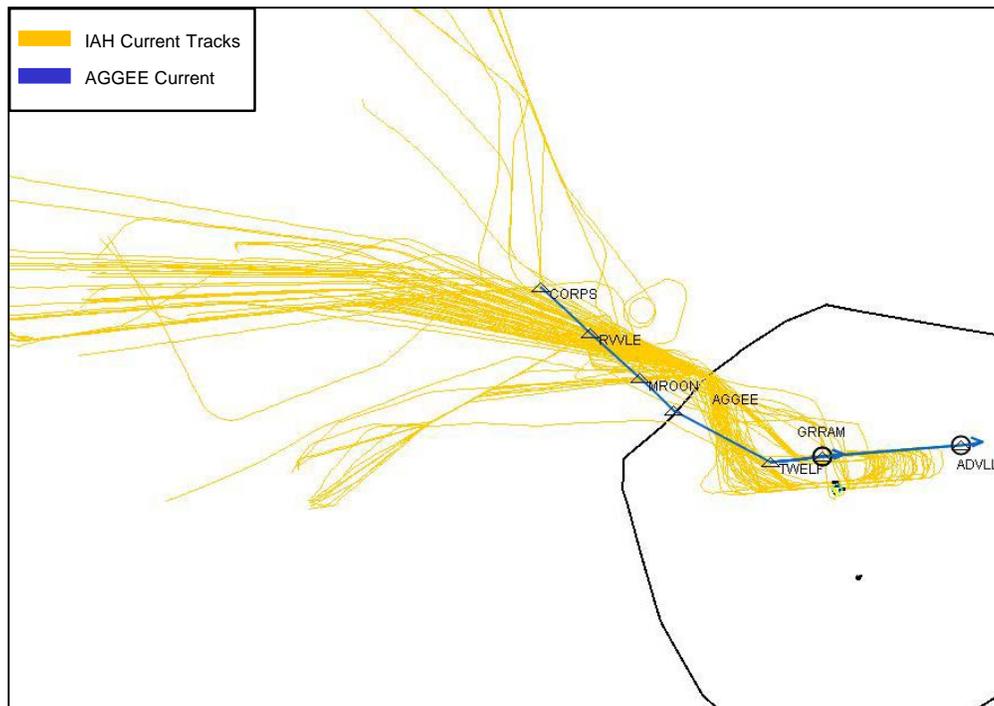
<b>Name of Change</b>	<b>TTORO STAR</b>	<b>Date</b>	<b>06-20-12</b>
<b>Change Classification</b>	Terminal Procedures	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E10, E11, E17, E29, I7</b>	<b>Implementation Date</b>	December 2013
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 74, 78, 80, 82, 83, 96 <b>ZFW Sectors:</b> 46, 96	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GUSHR DRLLR MSCOT KIDDZ <b>SIDs:</b> BNDTO DOBBY PITZZ	<b>Associated Data Files:</b>	<b>1. Phase IV TARGETS File</b> <b>2. TTORO TARGETS Distribution Package</b> <b>3. Table of Procedures</b>

### Purpose

This design package addresses the following issues with the AGGEE STAR identified by the Houston OAPM Study Team:

1. AGGEE is the current IAH offload for arrival traffic from the northwest.
2. There is minimal use of AGGEE as a dual feed to IAH due to limited airspace and high traffic volume, as depicted in Figure 1.
3. The vertical and lateral paths are not optimized.
4. The limited size of ZHU airspace in the northwest corner in conjunction with the absence of applied ACM prevents efficient metering.

## OAPM Design Package: Houston TTORO RNAV STAR



**Figure 1. Current AGGEE STAR**

### **Study Team Recommendation**

1. The OST developed the AGGEE RNAV STAR to be flow-specific, providing configuration-dependent vertical profile benefits. The proposed altitude window for east flow is 100-130. The proposed altitude window for west flow is 170-FL200. The OPD with proposed vertical windows would reduce current level-offs on the AGGEE STAR.
2. The OST developed CORPS and ILEXY transitions dedicated to AGGEE that closely mirror current arrival tracks.
3. Runway transitions are proposed in each configuration that are procedurally separated from other STARs and SIDs where practical. In east flow, Runway 08R was designed as the primary transition; however, transitions are available to Runways 08L and 09. In west flow, transitions are designed to terminate on a downwind leg. The Runway 26L/R transitions pass north of IAH at or above 8,000 feet until midfield to allow IAH and HOU departure traffic to climb more expeditiously. The Runway 27 transition crosses to join the south downwind at 6,000 feet and allows for tactical runway and fix balancing. Both downwind legs in the west flow are laterally positioned for the potential development of RNP AR IAPs.
4. Figure 2 depicts the current and recommended AGGEE RNAV STARs.

# OAPM Design Package: Houston

## TTORO RNAV STAR

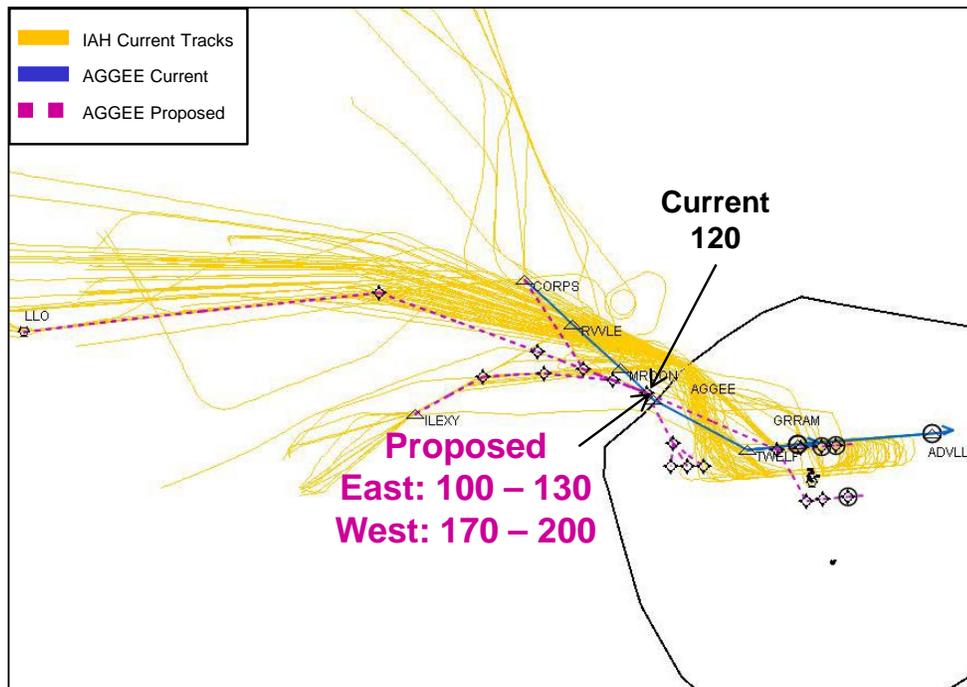


Figure 2. Proposed IAH Northwest AGGEE STAR and Current Procedure

# OAPM Design Package: Houston

## TTORO RNAV STAR

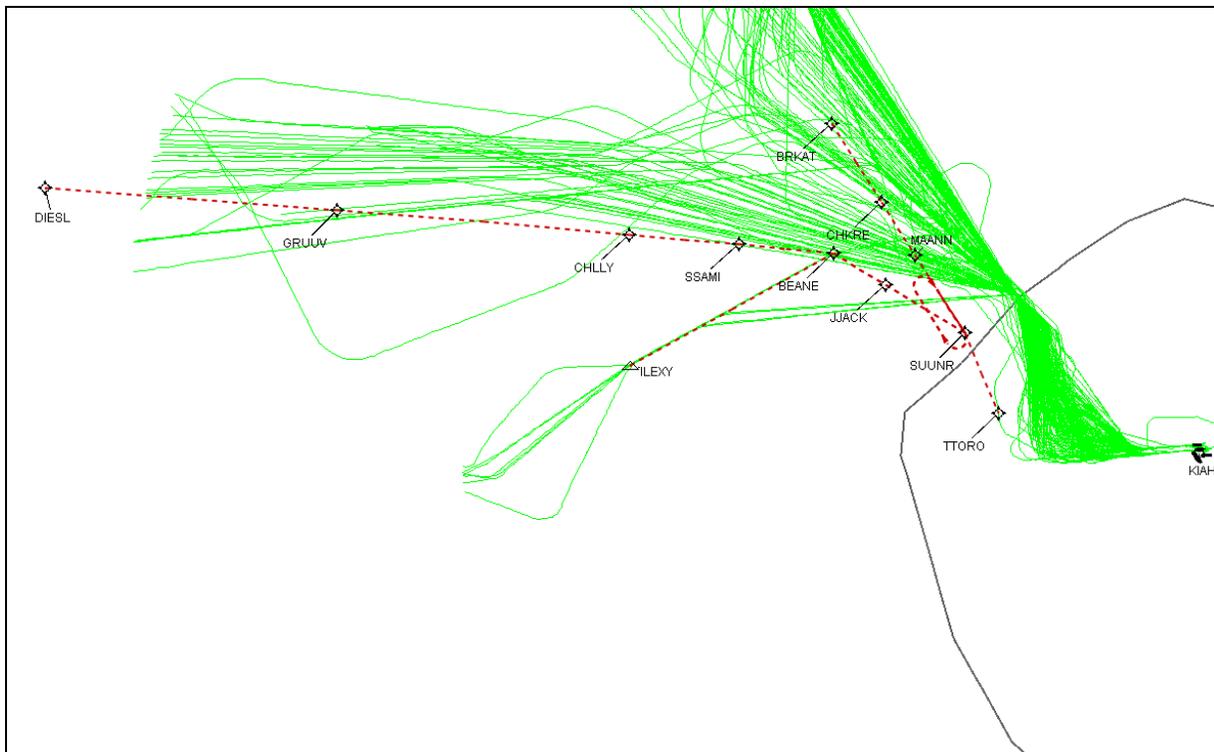
### Proposed Final Design

The Design Team has proposed flow dependent dual RNAV STARs from the northwest to IAH that would replace the current AGGEE STAR. The TTORO STAR would be one of two STARs designed to provide a dual feed to IAH on an east flow, as depicted in Figure 3. The TTORO STAR would be used for jet and high performance turboprop aircraft landing IAH when on an east flow.

The en route transitions were modified from the Study Team proposal to reduce track miles and more closely align the procedure with historical track data. The Design Team evaluated many options to deconflict the DIESL and ILEXY transitions on the TTORO arrival from the HOU KIDDZ arrival and determined that it would be better to tactically separate aircraft on these procedures.

A published holding pattern is proposed at SUUNR and ARNNE.

The proposed TTORO STAR is designed with an OPD and an altitude window at SUUNR from 10,000 to 13,000 feet at 250 knots.



**Figure 3. Final TTORO STAR Design**

## **OAPM Design Package: Houston TTORO RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

GUSHR  
DRLLR  
MSCOT  
KIDDZ

#### **SIDs:**

BNDTO  
DOBBY  
PITZZ

### **Additional Design Considerations**

This proposal requires modifications to ZHU, ZFW and I90 internal Standard Operating Procedures and Letters of Agreement.

Validation through a Human-in-the-Loop simulation (HITLs) is anticipated to evaluate the increase in complexity of sequencing the GUSHR arrival with aircraft on the TTORO arrival to KIAH.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

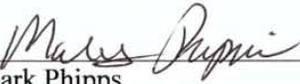
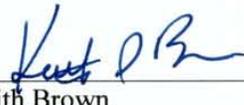
### **Attachments**

1. Phase IV TARGETS File
2. TTORO TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

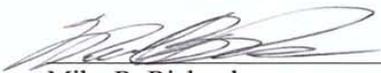
## OAPM Design Package: Houston TTORO RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
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 Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/21/2012</u> Date	 Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
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 Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>6-21-12</u> Date	 Steve Prichard Houston TRACON (I90) NATCA Lead	<u>6-25-12</u> Date
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## OAPM Design Package: Houston Metroplex

*IAH TTORO RNAV STAR*

### RECORD OF CHANGE

Change Number	Date	Document
001	10/01/2012	TTORO RNAV STAR
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

#### Description of Change

Updated Header with airport information.

## OAPM Design Package: Houston Metroplex

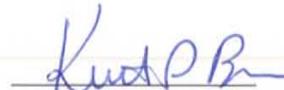
*IAH TTORO RNAV STAR*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.



Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date



Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex TWSTD RNAV STAR

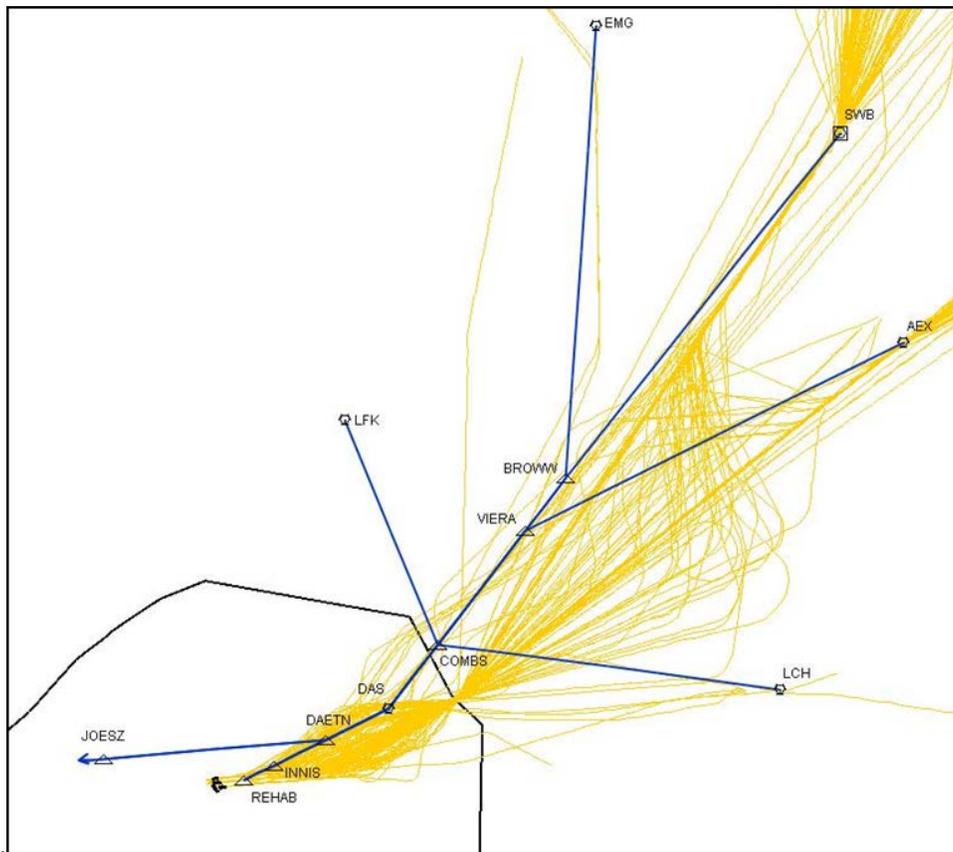
<b>Name of Change</b>	<b>TWSTD STAR</b>	<b>Date</b>	<b>06-19-12</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E2, E4, E5, T2, I2, I5</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 26, 38, 40, 42, 81 <b>ZFW Sectors:</b> 30, 86 <b>Ft. Polk Approach</b>	<b>Facility Points of Contact</b>	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> DOOBI WHACK SKNRD WAPPL <b>SIDs:</b> STRYA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase III TARGETS File</b></li> <li><b>2. TWSTD TARGETS Distribution Package</b></li> <li><b>3. Table of Procedures</b></li> </ol>

# OAPM Design Package: Houston Metroplex TWSTD RNAV STAR

## Purpose

This design package addresses the following issues with the DAS STAR identified by the Houston OAPM Study Team:

1. The DAS STAR is the offload/conventional arrival for IAH traffic from the northeast (see Figure 1), it currently experiences minimal use.
2. Additional lateral spacing is requested between the IAH STARs to optimize simultaneous usage.
3. The STAR is not vertically optimized, resulting in level segments that increase fuel burn and carbon emissions, particularly during east flow.
4. Aircraft flight tracks do not follow the lateral paths of the LCH and EMG transitions



**Figure 1. Current DAS STAR**

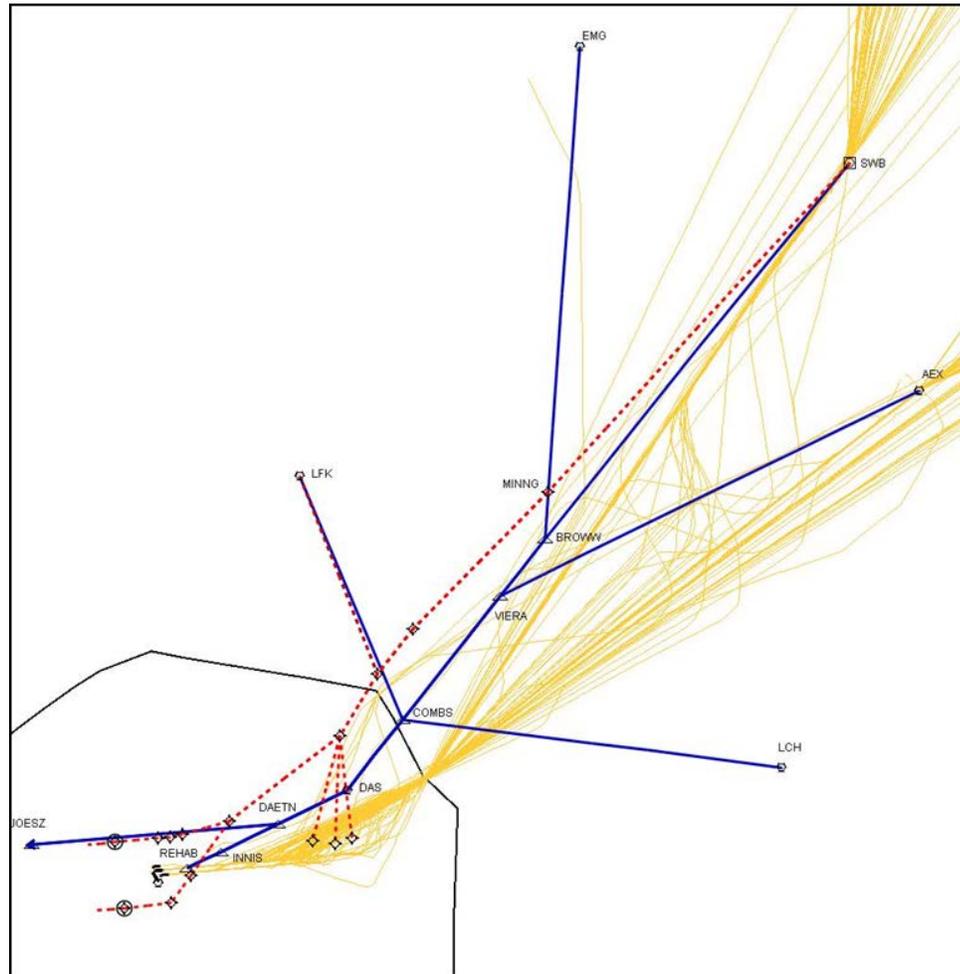
## **OAPM Design Package: Houston Metroplex TWSTD RNAV STAR**

### **Study Team Recommendation**

1. The Houston OST has proposed that IAH traffic will be routed via the DAS and ROKIT STARS, while the TXMEX STAR will become the preferred HOU arrival.
2. The conceptual ROKIT STAR has flow-dependent vertical profiles to accommodate east and west configurations. The OPD with proposed vertical windows at the terminal entry point (East FL190-FL220 and West 110-150) will reduce present day level flight segments on the DAS STAR.
3. The ROKIT and DAS STARS are designed to provide a dual feed to IAH. Additional lateral spacing was added between the arrivals to optimize their usage. The ROKIT STAR has en route transitions beginning at SWB, MINNG, and LFK (west flow only) to facilitate the use of the dual feeds and reduce complexity as crossover transitions are eliminated. The AEX, EMG and LCH transitions were removed due to lack of usage and to avoid unnecessary crossing traffic. The LFK transition is still available for weather re-routing, but only in west flow.
4. Runway transitions are proposed in each configuration. In west flow, Runway 26R was designed as the primary transition, however transitions are available to Runways 26L and 27. In east flow, transitions terminate on a downwind with an FM leg. The Runway 08L transition passes north of IAH at or above 8,000 ft until midfield to allow IAH and HOU departure traffic to climb more expeditiously. The Runway 09 transition crosses to the south downwind and allows for tactical runway and fix balancing. The Runway 08R transition routing will be determined during D&I. Both downwind legs in east flow are laterally positioned for the potential development of RNP AR IAPs.

Figure 2 depicts the proposed RNAV ROKIT STAR from the northeast corner-post as compared to the current DAS STAR.

# OAPM Design Package: Houston Metroplex TWSTD RNAV STAR



**Figure 2. Current Procedure and Study Team Recommendation**

## **OAPM Design Package: Houston Metroplex TWSTD RNAV STAR**

### **Proposed Final Design**

The TWSTD STAR would be one of two STARs designed to provide a dual feed to IAH on an East flow (Figure 3). The TWSTD STAR would be used for RNAV jet and high performance turboprop aircraft landing IAH. The primary arrival runway would be 8L (Figure 4).

En route transitions from the northeast were modified from the Study Team proposal. The PLANB transition was added to allow SHV departures access to the TWSTD STAR and provide an ATC assigned, weather contingent route for ZFW. The design team added the AEX and CARPR transitions for weather contingent routes.

The Design Team evaluated many options to separate the en route transitions on the TWSTD arrival from the HOU WAPPL and IAH SKNRD arrivals and determined that it would be better to have controllers tactically separate aircraft on these procedures while still allowing for OPD utilization.

The MENTL waypoint was added to the SWB transition and CRNKY waypoint was added to the AEX transition. These waypoints would be used to separate from WARRIOR Special Use Airspace (SUA) and have crossing restrictions of at or above FL240.

An outer fix holding pattern was created at MENTL and an inner fix holding pattern was created at WHACK.

The TWSTD STAR utilizes an OPD with an altitude window at WHACK from 17,000 feet to FL200 at 280 knots. An altitude window was added at NUTZZ, FRAGL and PROZC from FL220 to FL270 at 280 knots to facilitate predictable descent profiles. MENTL and CRNKY would serve as initial sequencing fixes.

The 13,000 to 16,000 foot altitude window at TWSTD would facilitate airspace boundary design while still allowing unrestricted OPD procedures.

# OAPM Design Package: Houston Metroplex TWSTD RNAV STAR

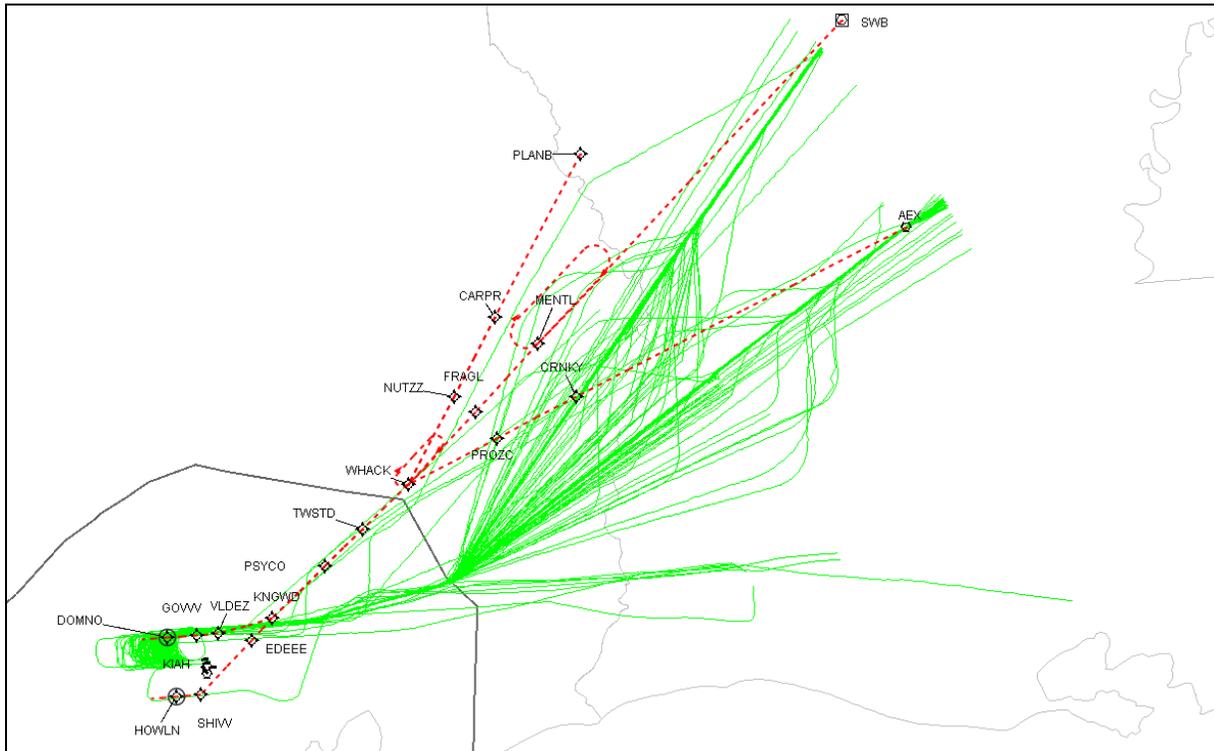


Figure 3. Proposed TWSTD STAR (En Route)

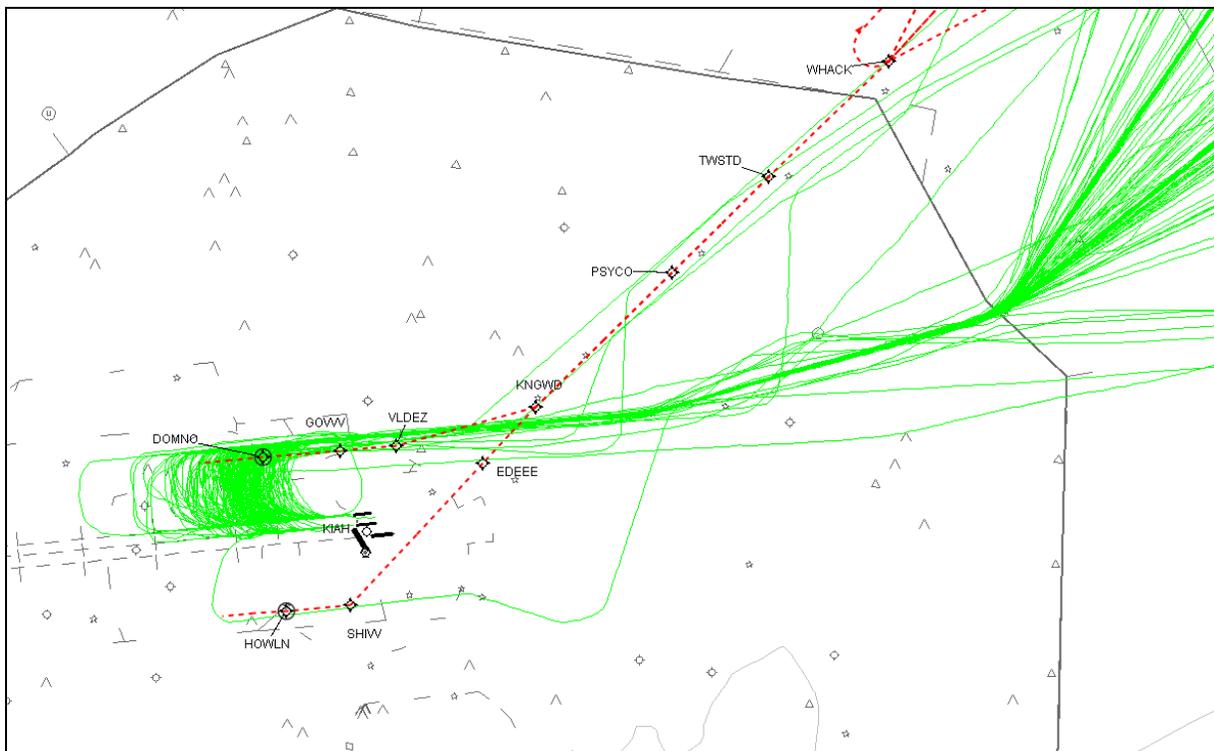


Figure 4. Proposed TWSTD STAR (Terminal)

## **OAPM Design Package: Houston Metroplex TWSTD RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

DOOBI  
WHACK  
SKNRD  
WAPPL

#### **SIDs:**

STRYA

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated. Vertical limits of low altitude sectors were reviewed and will not need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

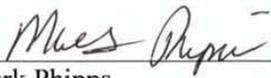
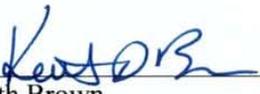
### **Attachments**

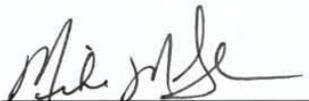
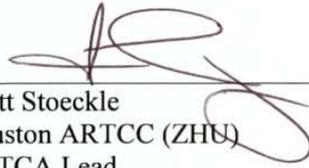
1. Phase III TARGETS File
2. TWSTD TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex TWSTD RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 Date
--	-----------------	---	-----------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/25/12 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
---	-----------------	--	-----------------

 _____ Mike R. Richardson Houston TRACON (190) Facility Lead	6-20-12 Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	6-25-12 Date
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## OAPM Design Package: Houston Metroplex WAPPL RNAV STAR

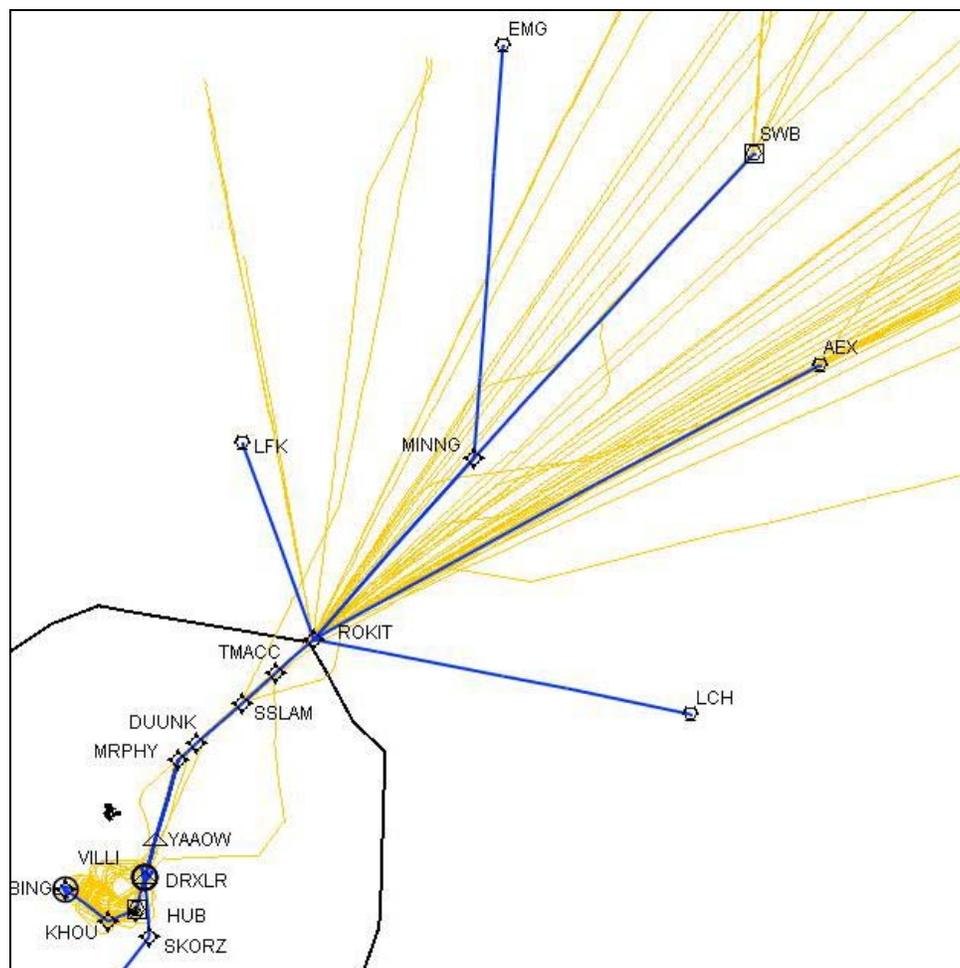
Name of Change	<b>WAPPL STAR</b>	Date	<b>06-19-12</b>
Change Classification	<b>Terminal Procedure</b>	Current Phase of Design	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
OAPM Study Team Reference/s	<b>E2, E4, E5, E7, E8, T1, T2, I2, I3, I5, I7</b>	Implementation Date	<b>December 2013</b>
Impacted Facilities and Positions/Areas/Sectors	<b>I90</b> <b>ZHU Sectors:</b> 23, 26, 36, 38, 40, 42, 81 <b>ZFW Sectors:</b> 30, 86 <b>Ft. Polk Approach</b>	Facility Points of Contact	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
Related/Dependent Submissions	<b>STARs:</b> WHACK TWSTD SKNRD DOOBI BOOZZ BRSKT <b>SIDs:</b> FLYZA MMUGS GUMBY	Associated Data Files:	<ol style="list-style-type: none"> <li><b>1. Phase III TARGETS File</b></li> <li><b>2. WAPPL TARGETS Distribution Package</b></li> <li><b>3. Table of Procedures</b></li> </ol>

## OAPM Design Package: Houston Metroplex WAPPL RNAV STAR

### Purpose

This design package addresses the following issues with the ROKIT STAR identified by the Houston OAPM Study Team:

1. The ROKIT STAR is currently the preferred northeast routing to HOU (see Figure 1).
2. The STAR is not vertically optimized, resulting in level segments that increase fuel burn and carbon emissions.
3. In addition, aircraft flight tracks do not follow the lateral paths of the LFK, LCH and EMG transitions.



**Figure 1. Current ROKIT STAR**

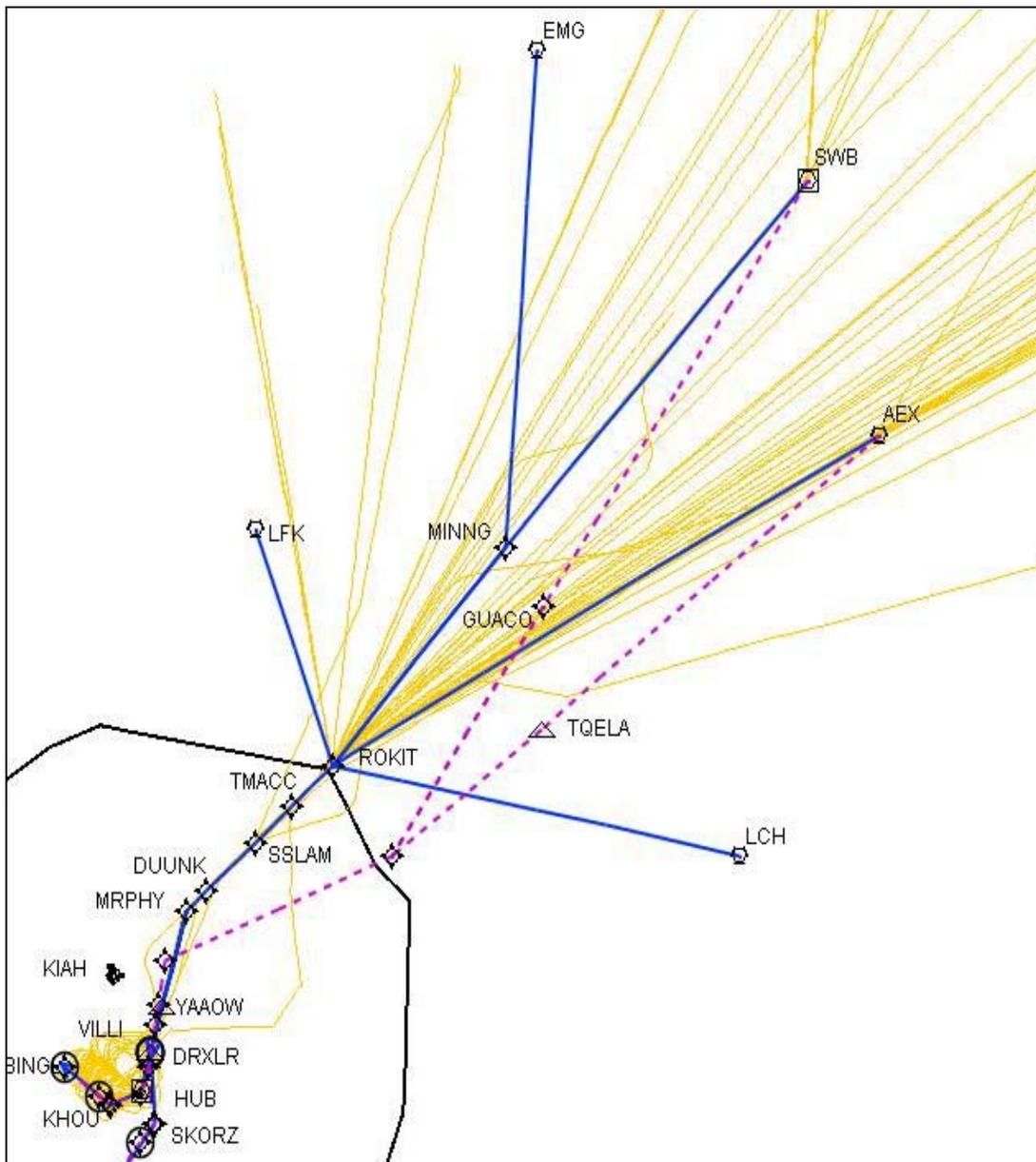
## **OAPM Design Package: Houston Metroplex WAPPL RNAV STAR**

### **Study Team Recommendation**

1. The TXMEX STAR would become the preferred HOU arrival with the IAH traffic routed via the DAS and ROKIT STARS.
2. The conceptual TXMEX STAR has an OPD with a proposed vertical window at the terminal entry fix (FL190-FL220) to eliminate the level flight segments on the present day ROKIT STAR.
3. The proposed TXMEX STAR has en route transitions beginning at SWB, AEX, and GUACO to provide a laterally efficient route structure for the projected HOU arrival flow. The EMG, LFK and LCH transitions were removed due to lack of usage.
4. Runway transitions are proposed, but only developed to Runways 12L/R and 04. The developed runway transitions are laterally positioned for the potential development of RNP AR IAPs.

Figure 2 depicts the proposed RNAV TXMEX STAR from the northeast corner-post as compared to the current ROKIT STAR.

# OAPM Design Package: Houston Metroplex WAPPL RNAV STAR



**Figure 2. Current Procedure and Study Team Recommendation**

## **OAPM Design Package: Houston Metroplex WAPPL RNAV STAR**

### **Proposed Final Design**

The WAPPL STAR would be used for RNAV jet and high performance turboprop aircraft landing HOU (Figures 3 and 4).

En route transitions from the northeast were modified from the Study Team proposal. The PLANB and CARPR transitions were added to allow SHV departures access to provide an ATC assigned, weather contingent route.

The Design Team evaluated many options to separate the en route transitions on the WAPPL arrival from the IAH DOOBI/SKNRD and IAH WHACK/TWSTD arrivals and determined that it would be better to have controllers tactically separate aircraft on these procedures.

The JMIKE waypoint was added to the SWB transition and BRWCK waypoint was added to the AEX transition. These waypoints would be used to separate from WARRIOR Special Use Airspace (SUA) and have crossing restrictions at or above FL240

An outer fix holding pattern was created at BRWCK and an inner fix holding pattern was created at WAPPL.

The WAPPL STAR utilizes an OPD with an altitude window at WAPPL from FL220 to FL270 at 280 knots.

The at or below FL230 at WLMOR and the 14,000 to 16,000 foot window at HUDZY would facilitate airspace boundary design while still allowing unrestricted OPD procedures.

# OAPM Design Package: Houston Metroplex

## WAPPL RNAV STAR

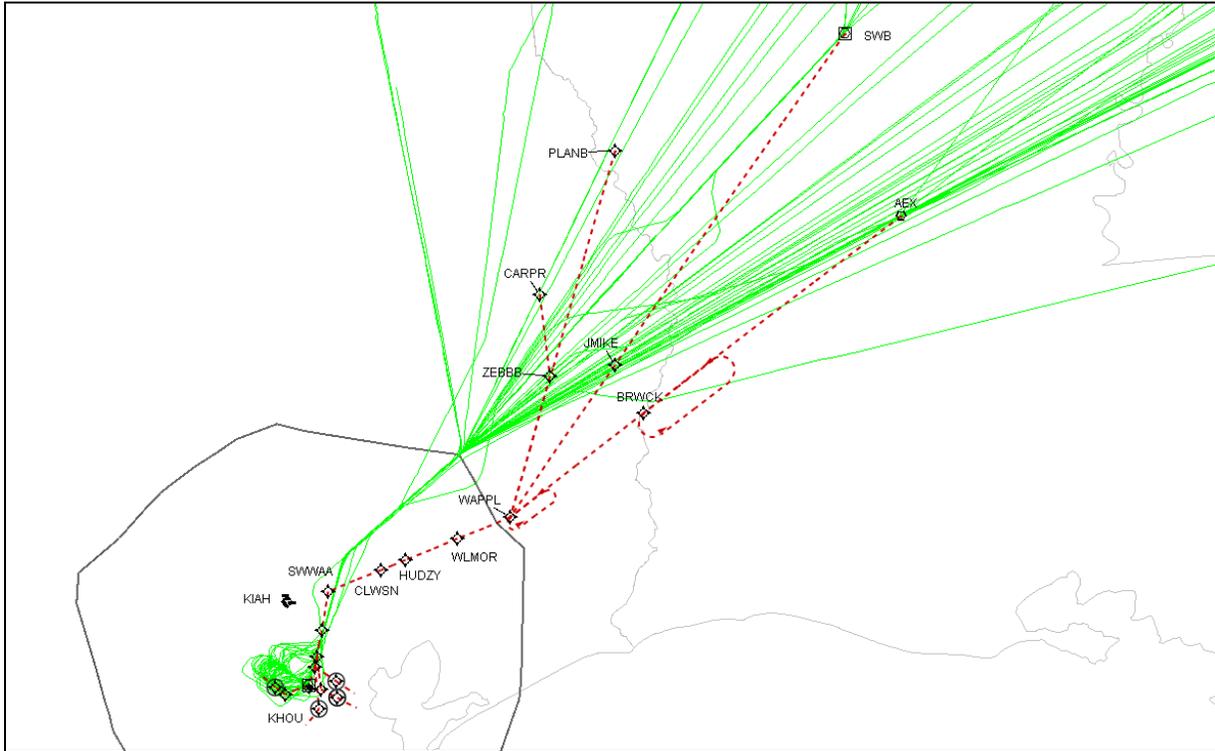


Figure 3. Proposed WAPPL STAR (En Route)

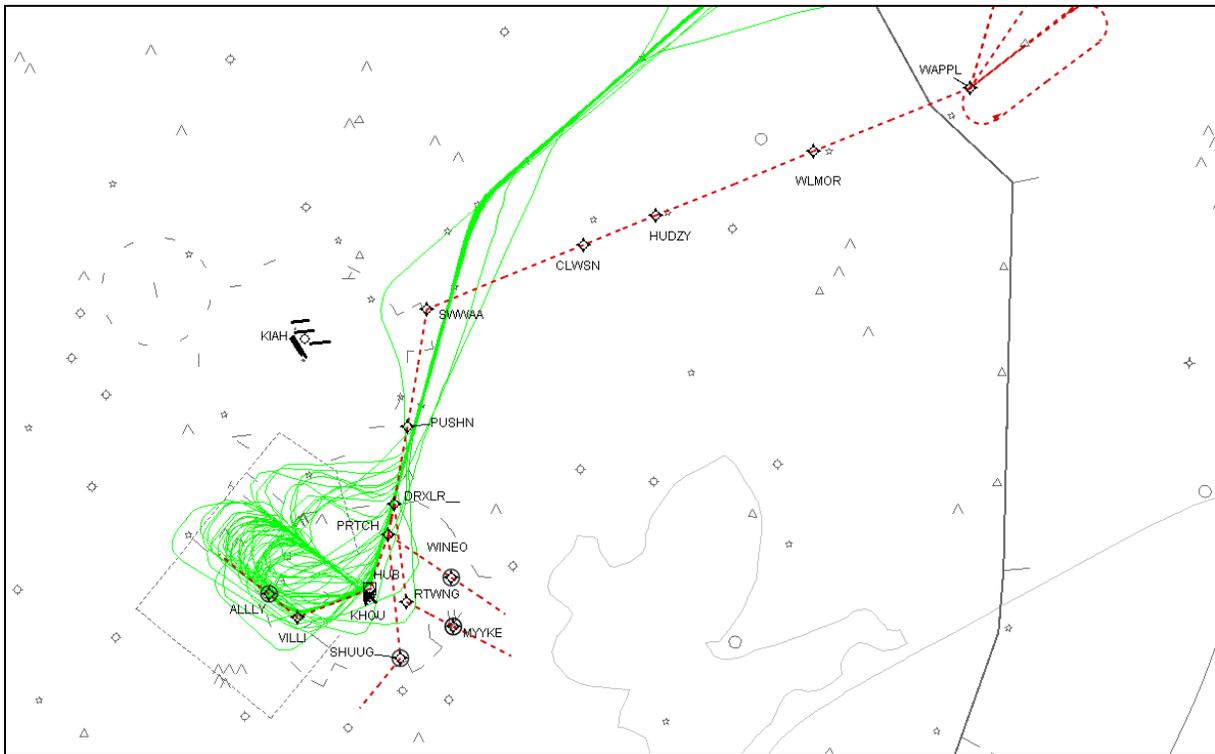


Figure 4. Proposed WAPPL STAR (Terminal)

## **OAPM Design Package: Houston Metroplex WAPPL RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

WHACK  
TWSTD  
SKNRD  
DOOBI  
BOOZZ  
BRSKT

#### **SIDs:**

MMUGS  
GUMBY  
FLYZA

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated. Lateral boundaries of low altitude sectors were reviewed and need to be modified to accommodate the new procedures.

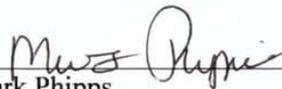
### **Attachments**

1. Phase III TARGETS File
2. WAPPL TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex WAPPL RNAV STAR

### Review Signatures

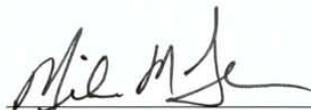
The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

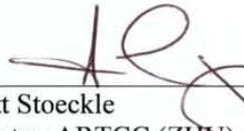
6-25-12  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

6/25/12  
Date

  
\_\_\_\_\_  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

6/25/12  
Date

  
\_\_\_\_\_  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

6/26/12  
Date

  
\_\_\_\_\_  
Mike R. Richardson  
Houston TRACON (I90)  
Facility Lead

6-20-12  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (I90)  
NATCA Lead

6-25-12  
Date

## OAPM Design Package: Houston Metroplex WHACK RNAV STAR

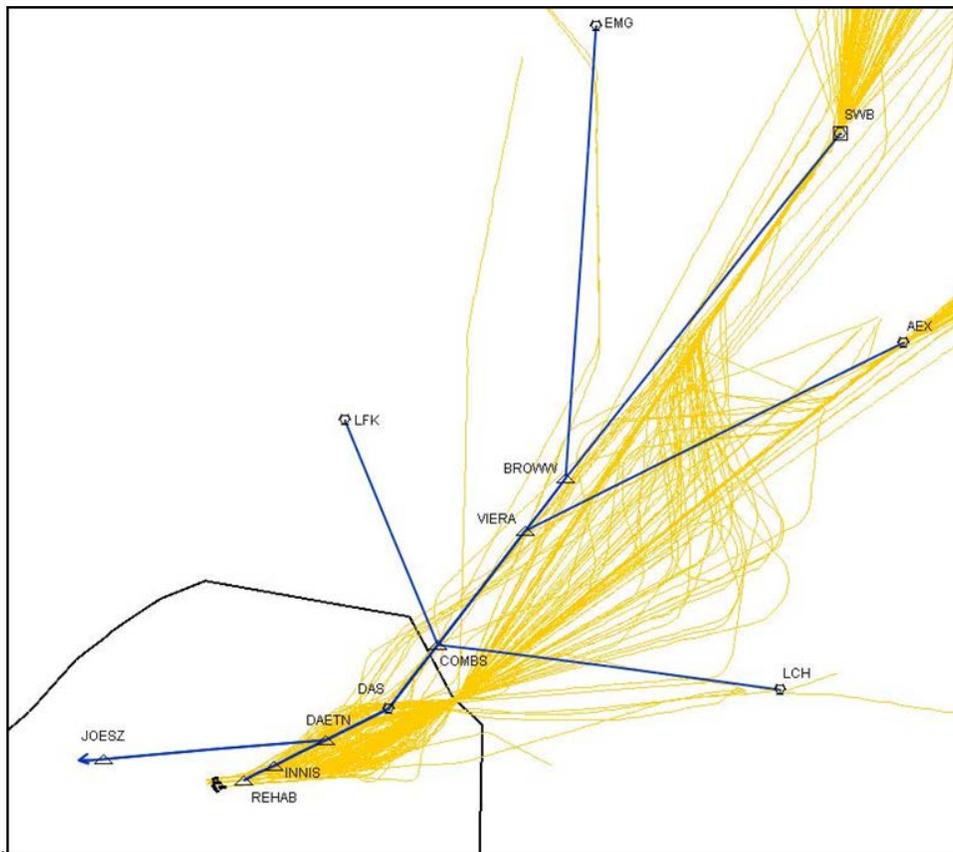
<b>Name of Change</b>	<b>WHACK STAR</b>	<b>Date</b>	<b>06-19-12</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E2, E4, E5, T2, I2, I5</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 26, 38, 40, 42, 81 <b>ZFW Sectors:</b> 30, 86 <b>Ft. Polk Approach</b>	<b>Facility Points of Contact</b>	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> DOOBI TWSTD SKNRD WAPPL <b>SIDs:</b> STRYA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase III TARGETS File</b></li> <li><b>2. WHACK TARGETS Distribution Package</b></li> <li><b>3. Table of Procedures</b></li> </ol>

# OAPM Design Package: Houston Metroplex WHACK RNAV STAR

## Purpose

This design package addresses the following issues with the DAS STAR identified by the Houston OAPM Study Team:

1. The DAS STAR is the offload/conventional arrival for IAH traffic from the northeast (see Figure 1), it currently experiences minimal use.
2. Additional lateral spacing is requested between the IAH STARS to optimize simultaneous usage.
3. The STAR is not vertically optimized, resulting in level segments that increase fuel burn and carbon emissions, particularly during east flow.
4. Aircraft flight tracks do not follow the lateral paths of the LCH and EMG transitions



**Figure 1. Current DAS STAR**

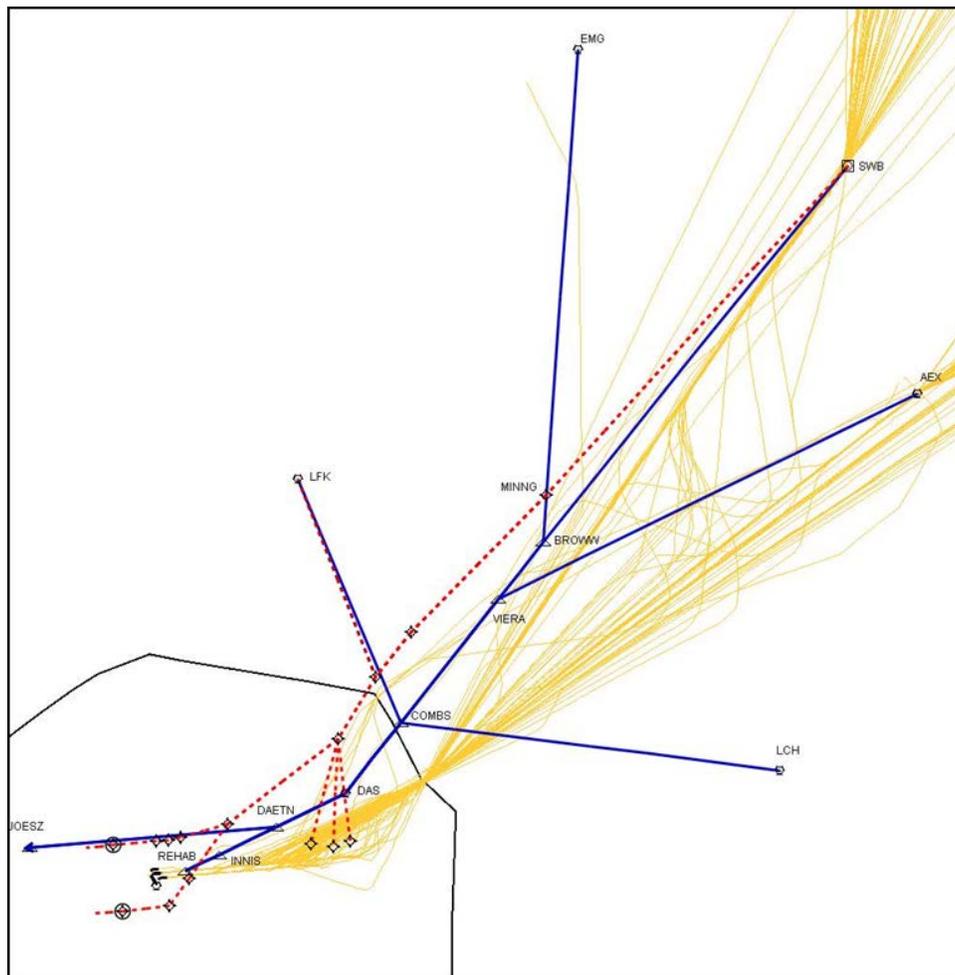
## **OAPM Design Package: Houston Metroplex WHACK RNAV STAR**

### **Study Team Recommendation**

1. The Houston OST has proposed that IAH traffic will be routed via the DAS and ROKIT STARS, while the TXMEX STAR will become the preferred HOU arrival.
2. The conceptual ROKIT STAR has flow-dependent vertical profiles to accommodate east and west configurations. The OPD with proposed vertical windows at the terminal entry point (East FL190-FL220 and West 110-150) will reduce present day level flight segments on the DAS STAR.
3. The ROKIT and DAS STARS are designed to provide a dual feed to IAH. Additional lateral spacing was added between the arrivals to optimize their usage. The ROKIT STAR has en route transitions beginning at SWB, MINNG, and LFK (west flow only) to facilitate the use of the dual feeds and reduce complexity as crossover transitions are eliminated. The AEX, EMG and LCH transitions were removed due to lack of usage and to avoid unnecessary crossing traffic. The LFK transition is still available for weather re-routing, but only in west flow.
4. Runway transitions are proposed in each configuration. In west flow, Runway 26R was designed as the primary transition, however transitions are available to Runways 26L and 27. In east flow, transitions terminate on a downwind with an FM leg. The Runway 08L transition passes north of IAH at or above 8,000 ft until midfield to allow IAH and HOU departure traffic to climb more expeditiously. The Runway 09 transition crosses to the south downwind and allows for tactical runway and fix balancing. The Runway 08R transition routing will be determined during D&I. Both downwind legs in east flow are laterally positioned for the potential development of RNP AR IAPs.

Figure 2 depicts the proposed RNAV ROKIT STAR from the northeast corner-post as compared to the current DAS STAR.

# OAPM Design Package: Houston Metroplex WHACK RNAV STAR



**Figure 2. Current Procedure and Study Team Recommendation**

## **OAPM Design Package: Houston Metroplex WHACK RNAV STAR**

### **Proposed Final Design**

The WHACK STAR would be one of two STARs designed to provide a dual feed to IAH on a West flow (Figure 3). The WHACK STAR would be used for RNAV jet and high performance turboprop aircraft landing IAH. The primary arrival runway would be 26R, with an option to 26L and 27 (Figure 4).

En route transitions from the northeast were modified from the Study Team proposal. The PLANB transition was added to allow SHV departures access to the WHACK STAR and provide an ATC assigned, weather contingent route for ZFW. The AEX and CARPR transitions were added for weather contingent routes.

The Design Team evaluated many options to separate the en route transitions on the WHACK arrival from the HOU WAPPL and IAH DOOBI arrivals and determined that it would be better to have controllers tactically separate aircraft on these procedures while still allowing for OPD utilization.

The MENTL waypoint was added to the SWB transition and CRNKY waypoint was added to the AEX transition. These waypoints would be used to separate from WARRIOR Special Use Airspace (SUA) and have crossing restrictions at or above FL240.

An outer fix holding pattern was created at MENTL and an inner fix holding pattern was created at WHACK.

The WHACK STAR utilizes an OPD with an altitude window at WHACK from 12,000 to 14,000 feet at 250 knots. An altitude window was added at NUTZZ, FRAGL and PROZC from 17,000 feet to FL200 at 280 knots to facilitate predictable descent profiles. MENTL and CRNKY would be restricted to 280 knots and serve as initial sequencing fixes.

# OAPM Design Package: Houston Metroplex WHACK RNAV STAR

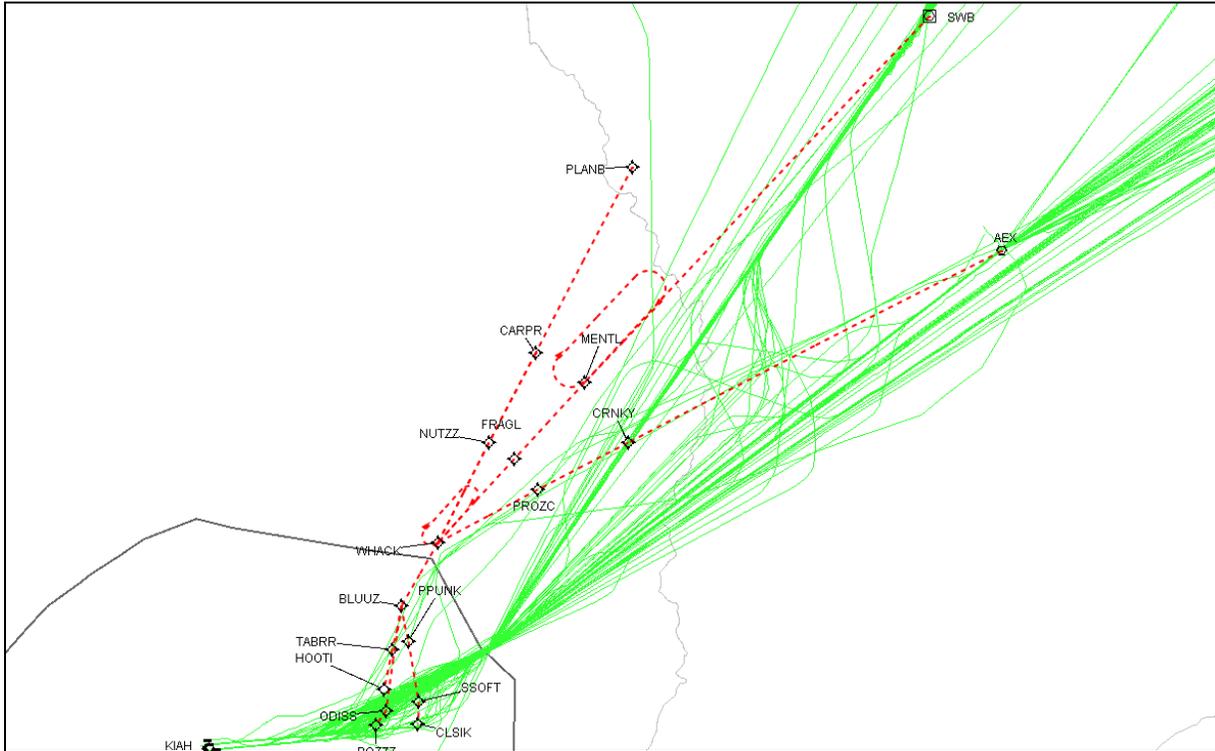


Figure 3. Proposed WHACK STAR (En Route)

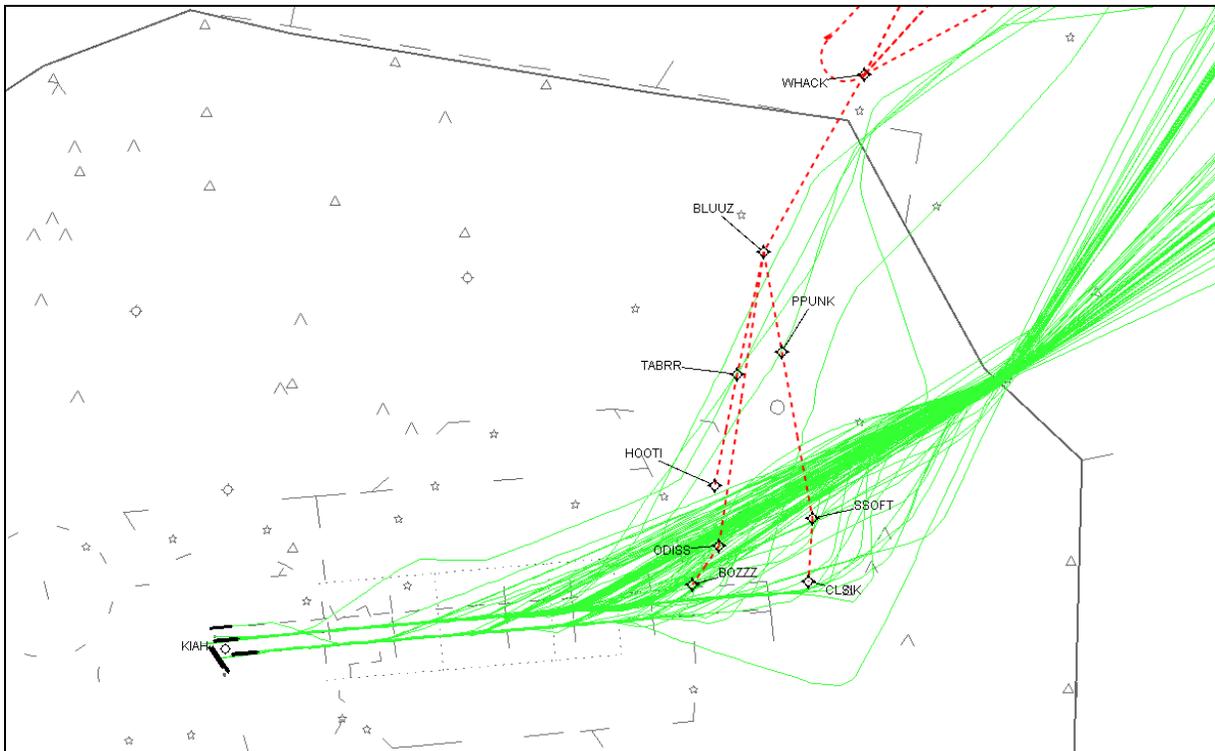


Figure 4. Proposed WHACK STAR (Terminal)

## **OAPM Design Package: Houston Metroplex WHACK RNAV STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

DOOBI  
TWSTD  
SKNRD  
WAPPL

#### **SIDs:**

STRYA

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated. Vertical limits of low altitude sectors were reviewed and will not need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

### **Attachments**

1. Phase III TARGETS File
2. WHACK TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

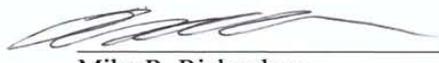
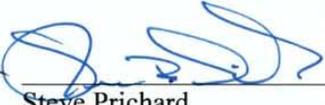
## OAPM Design Package: Houston Metroplex WHACK RNAV STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 Date
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 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/25/12 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
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 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	6-19-12 Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	6-25-12 Date
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## OAPM Design Package: Houston BNDTO RNAV SID

<b>Name of Change</b>	<b>BNDTO SID</b>	<b>Date</b>	<b>06-20-12</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, E53</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>IAH ATCT I90 ZHU Sectors: 74, 78, 80</b>	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs: GUSHR DRLLR TTORO MSCOT KIDDZ SIDs: PITZZ DOBBY</b>	<b>Associated Data Files:</b>	<b>1. Phase IV TARGETS File</b> <b>2. BNDTO TARGETS Distribution Package</b> <b>3. Procedure Change Table</b>

### Purpose

The BNDTO SID addresses the following issues identified by the Houston OAPM Study Team for the IAH westbound departures as depicted in Figure 1:

1. Figure 1 depicts the current IAH departures to the west.
2. SIDs extend too far into the en route structure and some transitions are rarely used.

## OAPM Design Package: Houston BNDTO RNAV SID

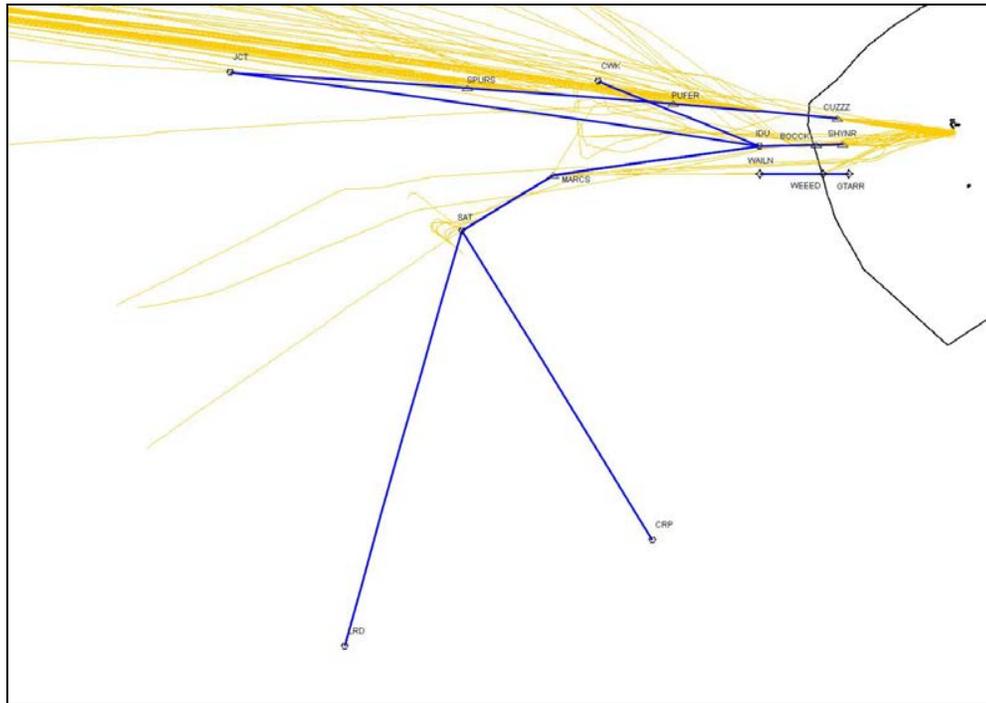


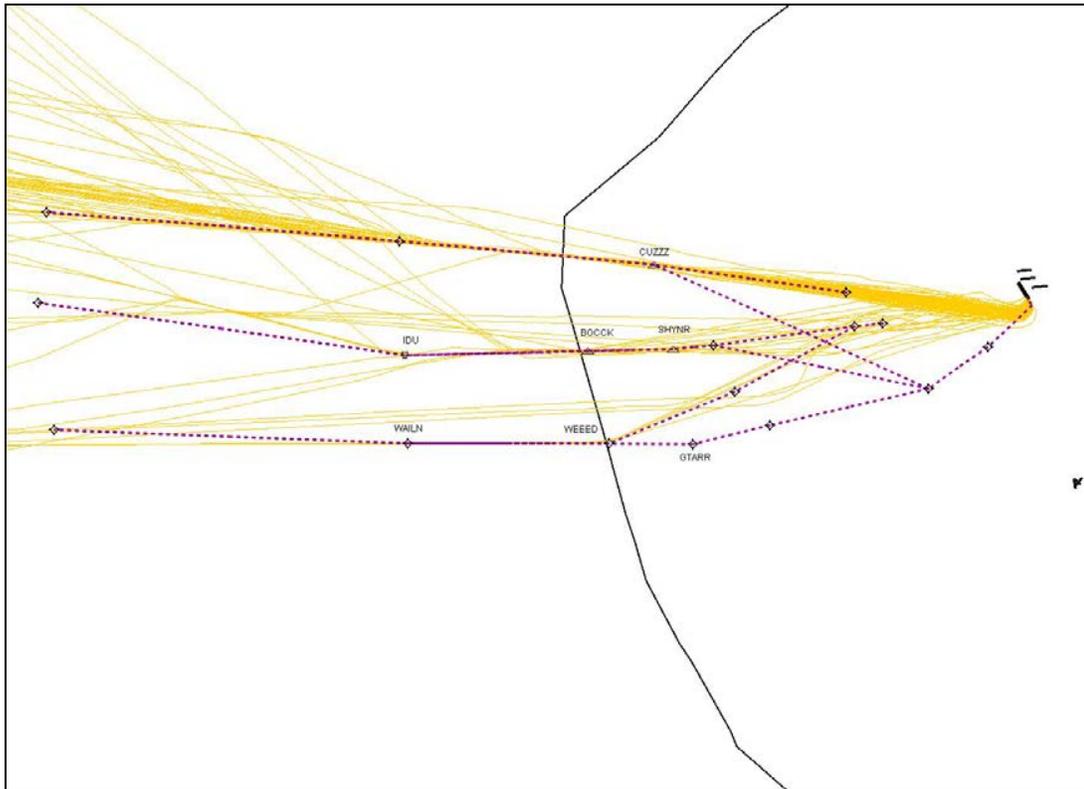
Figure 1. Current JCT, IDU, and WAILN SIDs

### Study Team Recommendation

1. Three RNAV SIDs for IAH west departures provide additional routes and repeatable paths that are separated from other STARs and SIDs where practical.
2. When IAH is in west flow, radar vector departures are utilized in order to retain the shortest path to join the RNAV routes. When IAH is in east flow, an RNAV off-the-ground SID is proposed that is separated from Runway 8L and 8R arrivals.
3. The proposed en route transitions laterally follow existing flight tracks and terminate approximately 100 NM from IAH where most aircraft are expected to reach the cruise stratum (FL290). This provides shorter paths, provides greater route flexibility, and negates the need to plan and carry fuel for a longer transition that might not be flown.
4. Figure 2 depicts the proposed IAH westbound SIDs.

# OAPM Design Package: Houston

## BNDTO RNAV SID



**Figure 2. Study Team IAH West SIDs**

# OAPM Design Package: Houston

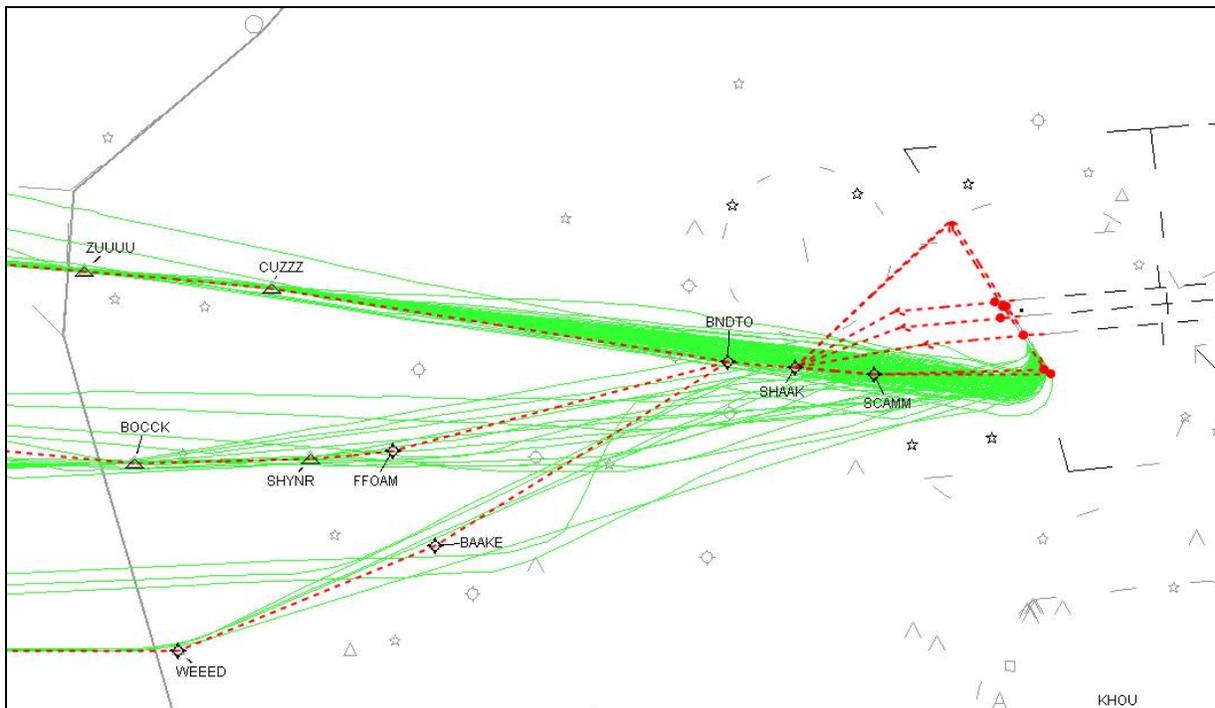
## BNDTO RNAV SID

### Proposed Final Design

The Design Team proposed two flow dependent RNAV SIDs to replace today's three SIDs for IAH westbound departures: JCT, IDU, and WAILN SIDs. These SIDs would be replaced by the BNDTO SID when IAH is landing west.

The BNDTO SID was designed as an RNAV-off-the-Ground procedure for Runways 15L and 15R. The Design Team determined that radar vectors would be more efficient for all other runways due to current RNAV SID criteria.

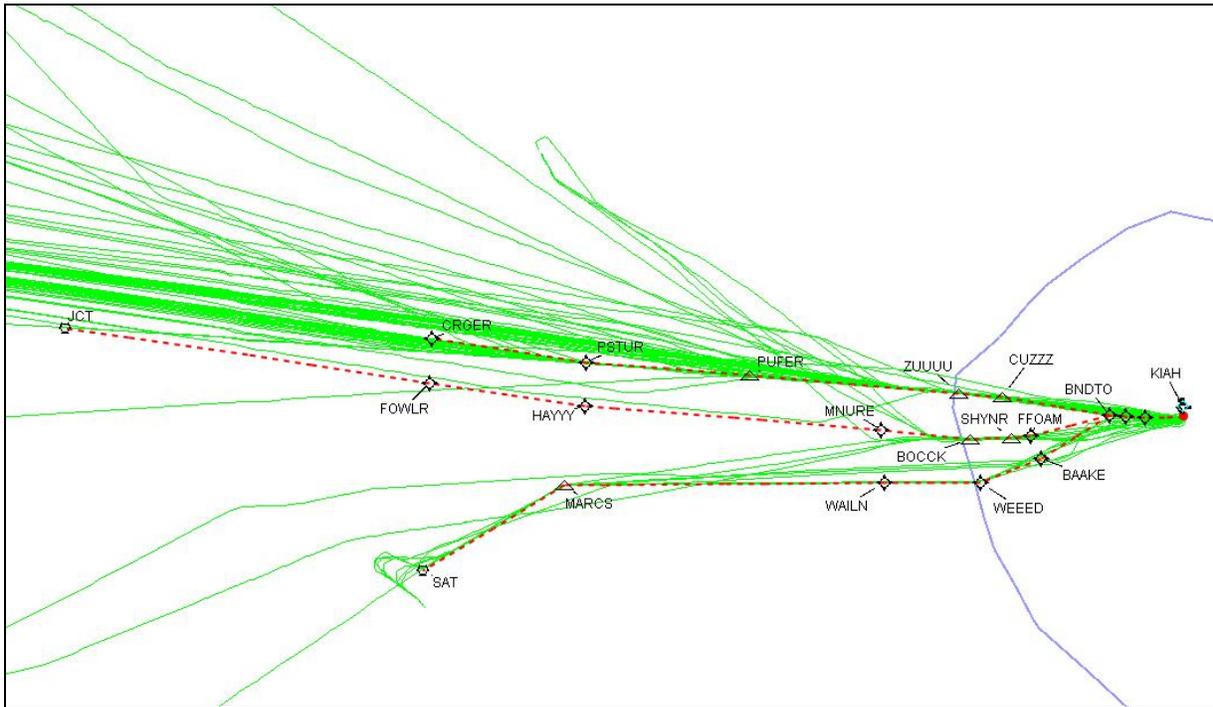
The en route transitions were modified from the Study Team proposal to reduce track miles and to procedurally deconflict aircraft on parallel transitions.



**Figure 3. Proposed BNDTO SID (Terminal)**

# OAPM Design Package: Houston

## BNDTO RNAV SID



**Figure 4. Proposed BNDTO SID (En Route)**

## **OAPM Design Package: Houston BNDTO RNAV SID**

### **Proposed Design and Implementation Dependencies**

This procedure is dependent on the following procedures:

**STARs:**

GUSHR

DRLLR

TTORO

MSCOT

KIDDZ

**SIDs:**

PITZZ

DOBBY

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

### **Attachments**

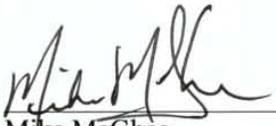
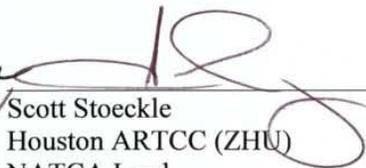
1. Phase IV TARGETS File
2. BNDTO TARGETS Distribution File
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston BNDTO RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
--	------------------------	---	------------------------

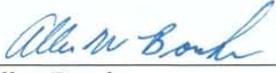
 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/21/2012</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
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 _____ Mike R. Richardson Houston TRACON (190) Facility Lead	<u>6-21-12</u> Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	<u>6-25-12</u> Date
---	------------------------	---	------------------------

## OAPM Design Package: Houston BNDTO RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Allen Borchers  
George Bush Intercontinental  
Tower (IAH ATCT)  
FAA Lead

*6/26/12*  
Date  
  
\_\_\_\_\_  
John Olinger  
George Bush Intercontinental Tower  
(IAH ATCT)  
NATCA Lead

*6/26/12*  
Date

## OAPM Design Package: Houston Metroplex

*IAH BNDTO RNAV SID*

### RECORD OF CHANGE

Change Number	Date	Document
001	11/01/2012	BNDTO RNAV SID
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

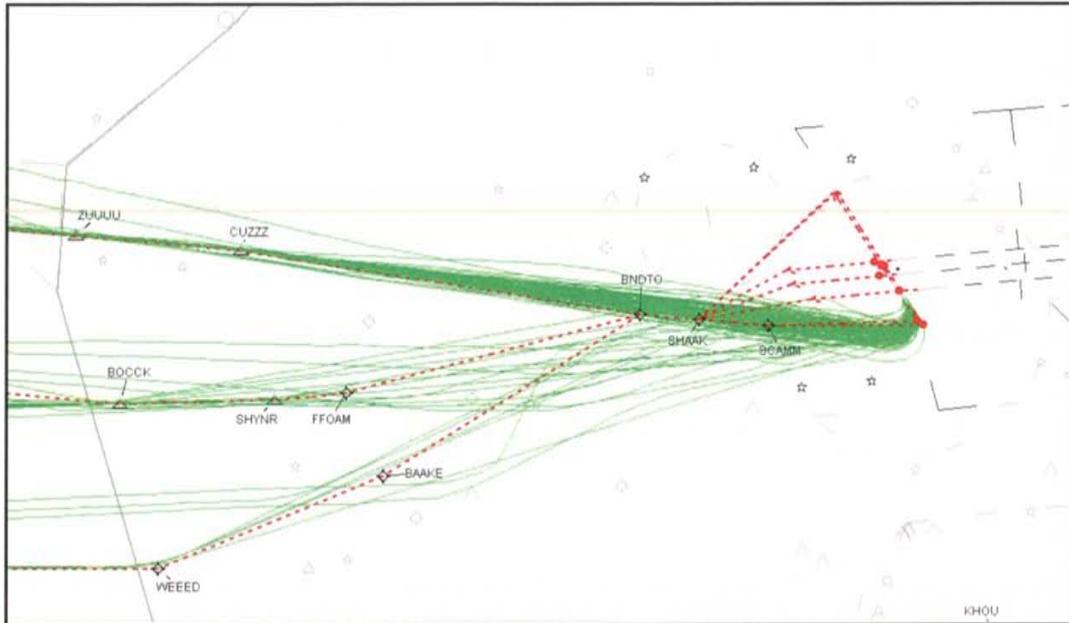
### Description of Change

Updated Header with airport information.

This procedure will be used by all RNAV capable aircraft. The design team amended the procedure to correct the design intent of the SAT transition. The original design proposal is shown at Figure 1 and 2. The routing to SAT was changed to depart I90 airspace over BOCKK waypoint, then via MNURE and MARCS waypoints. These changes are shown in Figures 3 and 4.

## OAPM Design Package: Houston Metroplex

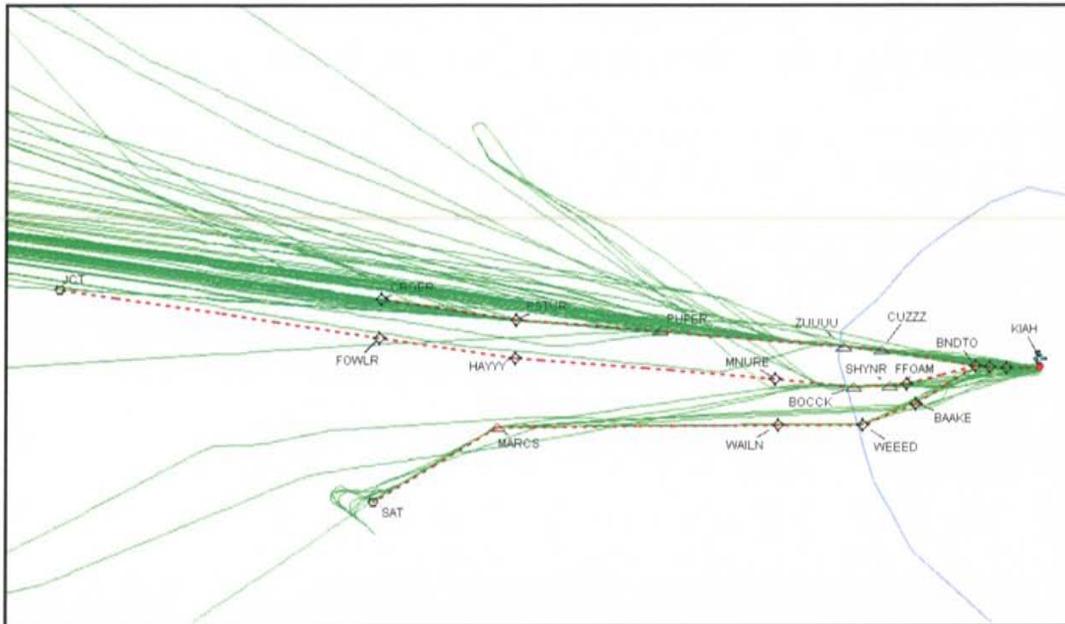
*IAH BNDTO RNAV SID*



**FIGURE 1. BNDTO RNAV SID PROPOSED DESIGN (TERMINAL) (Figure 3 in PFD)**

## OAPM Design Package: Houston Metroplex

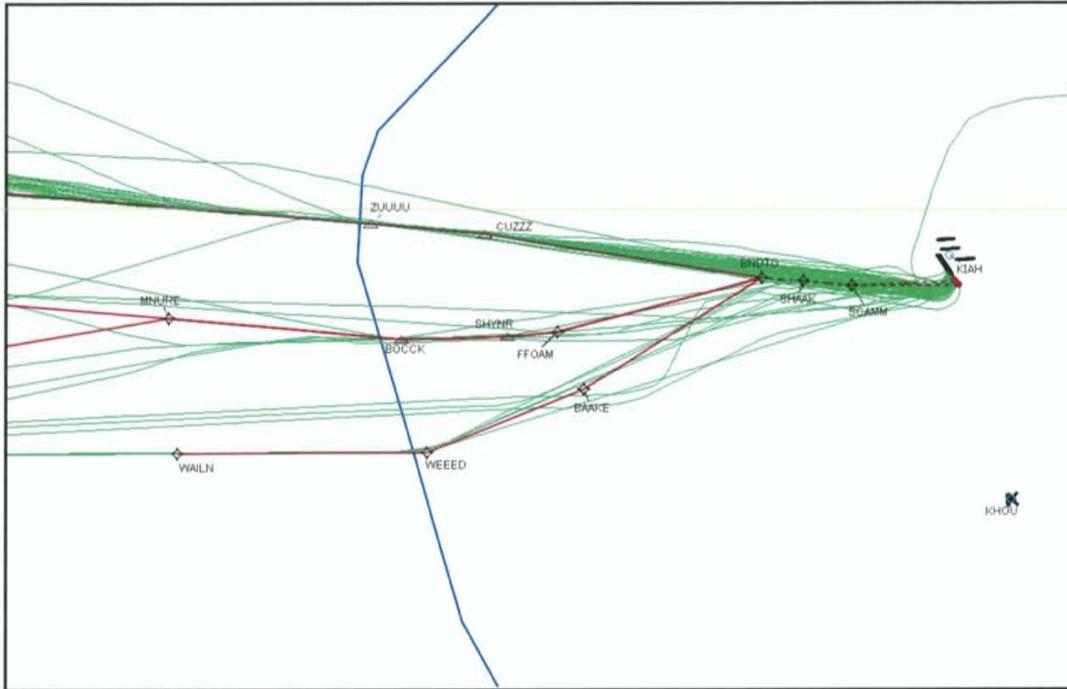
*IAH BNDTO RNAV SID*



**FIGURE 2. BNDTO RNAV SID PROPOSED DESIGN (EN ROUTE) (Figure 4 in PFD)**

## OAPM Design Package: Houston Metroplex

*IAH BNDTO RNAV SID*

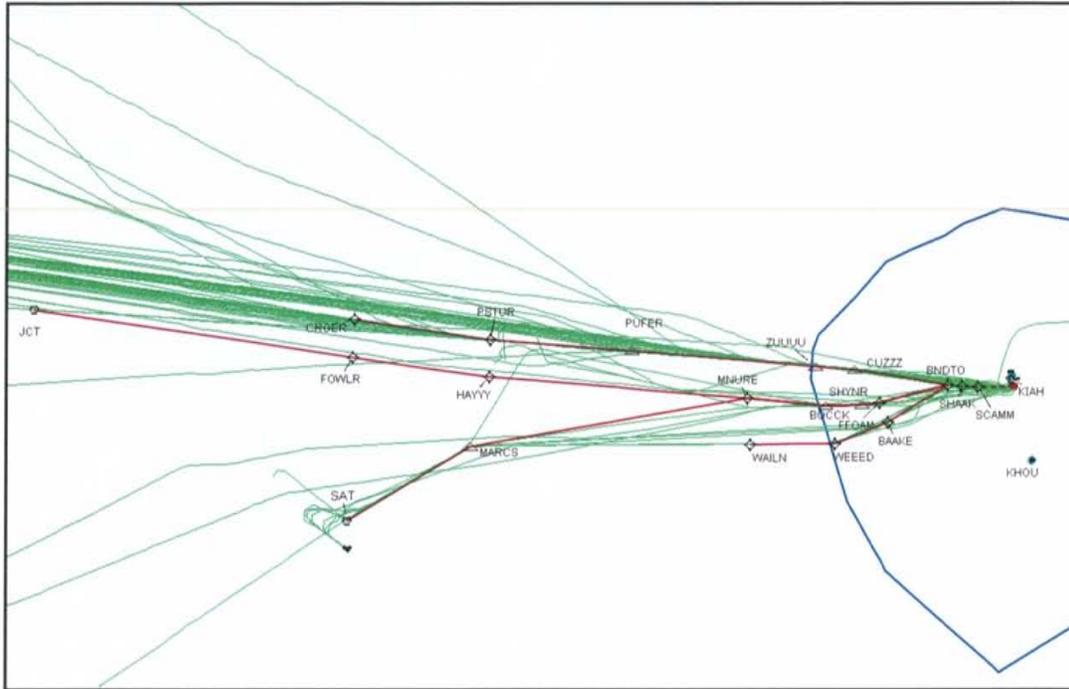


**FIGURE 3. BNDTO RNAV SID PROPOSED DESIGN (TERMINAL)**

(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH BNDTO RNAV SID*



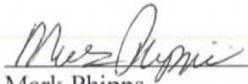
**FIGURE 4. BNDTO RNAV SID PROPOSED DESIGN (EN ROUTE)**

(Will replace Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH BNDTO RNAV SID*

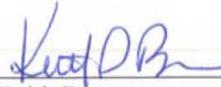
Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.



Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13

Date



Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13

Date

## OAPM Design Package: Houston BORRN Satellite RNAV SID

<b>Name of Change</b>	<b>BORRN SID</b>	<b>Date</b>	<b>09-19-2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, E53</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 ZHU Sectors: 74, 78, 80</b>	<b>Facility Points of Contact</b>	<b>Jason Park 281-230-5555 Rock Brown 281-230-5555</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GUSHR DRLLR TTORO MSCOT KIDDZ <b>SIDs:</b> PITZZ DOBBY	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li>1. Houston OAPM D&amp;I Master TARGETS File</li> <li>2. BORRN TARGETS Distribution Package</li> <li>3. Procedure Change Table</li> </ol>

### Purpose

Specific RNAV procedures were not addressed by the Houston OAPM Study team. The proposed BORRN SID will provide an RNAV departure procedure similar to RNAV SIDs for IAH and HOU.

### Study Team Recommendation

The Houston OAPM Study Team did not propose satellite airport departure procedures.

### Proposed Final Design

West bound departures from satellite airports exit terminal airspace utilizing existing departure procedures serving IAH and HOU. The WAILN, IDU, and JCT SIDs would be replaced by the proposed BORRN RNAV SID as depicted in Figure 1. The BORRN RNAV SID transitions will emulate the en route transitions used for proposed IAH and HOU west bound RNAV SIDs. All turbojet/turboprop departures from these airports will be radar vectored as they are today to join the BORRN RNAV SID prior to entering ZHU's airspace. I90 satellite airports utilizing these procedures are shown in Table 1 below.

## OAPM Design Package: Houston BORN Satellite RNAV SID

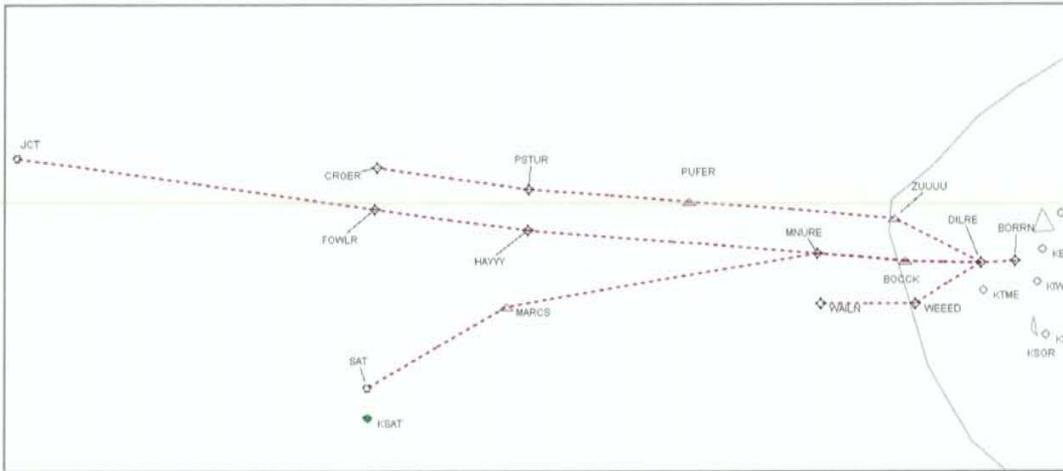


Figure 1. Proposed BORN SID

Airport ID	Airport Name South of J2	Airport ID	Airport Name North of J2
AXH	Houston Southwest	CXO	Lone Star Executive
EFD	Ellington Field	DWH	David Wayne Hooks Memorial
GLS	Scholes International	EYQ	Weiser Air Park
HPY	Baytown		
IWS	West Houston		
LBX	Brazoria County		
LVJ	Pearland Regional		
SGR	Sugar Land Regional		
TME	Houston Executive		
T00	Chambers County		
T41	La Porte Municipal		
54T	RWJ Airpark		

Table 1. Houston OAPM Satellite Airports

### Proposed Design and Implementation Dependencies

This procedure is dependent on the following procedures:

- STARs:**  
 GUSHR  
 DRLLR  
 TTORO  
 MSCOT  
 KIDDZ

## **OAPM Design Package: Houston BORRN Satellite RNAV SID**

### **SIDs:**

PITZZ

DOBBY

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

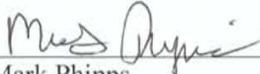
### **Attachments**

1. Houston OAPM D&I Master TARGETS File
2. BORNN TARGETS Distribution File
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

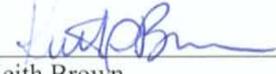
## OAPM Design Package: Houston BORRN Satellite RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

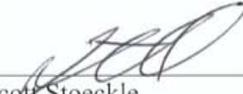
1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

12/27/12  
Date

  
\_\_\_\_\_  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

1/2/13  
Date

  
\_\_\_\_\_  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

12/28/12  
Date

  
\_\_\_\_\_  
Mike Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/7/13  
Date

## OAPM Design Package: Houston DOBBY RNAV SID

<b>Name of Change</b>	<b>DOBBY SID</b>	<b>Date</b>	<b>06-20-12</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, E53</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>HOU ATCT I90 ZHU Sectors 74, 78, 80</b>	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GUSHR DRLLR TTORO MSCOT KIDDZ <b>SIDs:</b> BNDTO PITZZ	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase IV TARGETS File</b></li> <li><b>2. DOBBY TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

### Purpose

The DOBBY SID addresses the following issues identified by the Houston OAPM Study Team.

1. Figure 1 depicts the current HOU departures to the west.
2. SIDs extend too far into the en route structure, and some transitions are rarely used.

## OAPM Design Package: Houston DOBBY RNAV SID

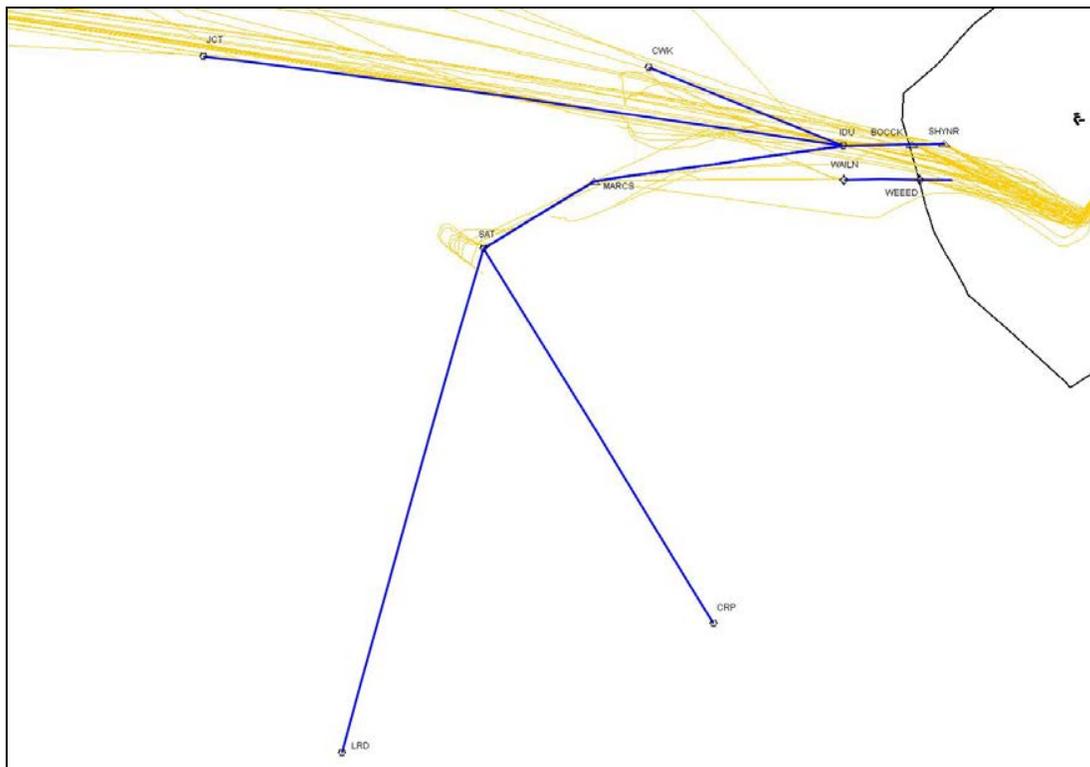


Figure 1. Current IDU and WAILN SIDs

### Study Team Recommendation

1. Two RNAV SIDs with runway transitions for west HOU departures provide repeatable paths that are separated from other STARS and SIDs where practical.
2. One SID departs Runway 12R and 22 to the south/southwest separating it from Runway 12R arrivals and associated STARS. The other SID departs Runway 12R in a left turn to allow separation from Runway 04 arrivals and associated STARS.
3. The proposed en route transitions laterally follow existing flight tracks and terminate approximately 100 NM from HOU where most aircraft are expected to reach the cruise stratum (FL290). This provides shorter paths, provides greater route flexibility, and negates the need to plan and carry fuel for a longer transition that might not be flown.
4. Figure 2 depicts the proposed HOU westbound SIDs.

# OAPM Design Package: Houston

## DOBBY RNAV SID

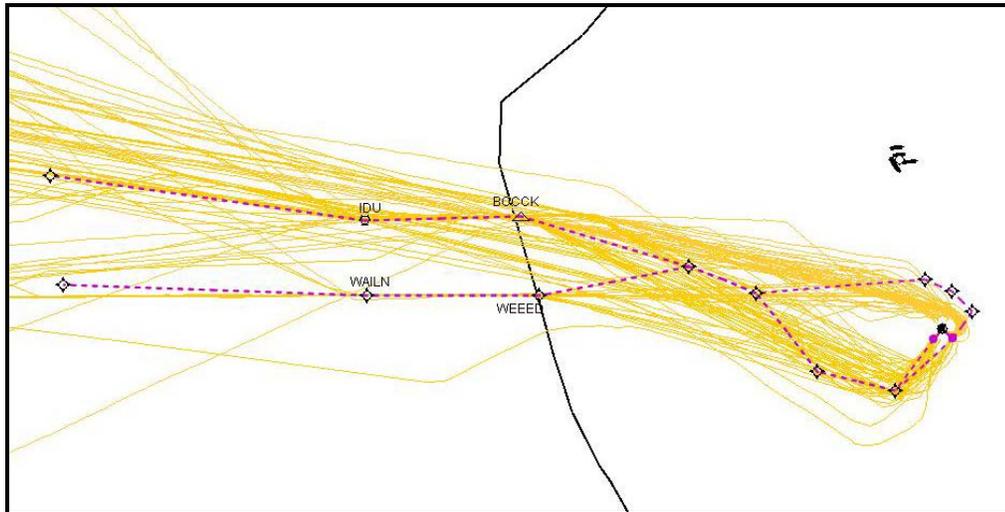


Figure 2. Study Team Proposed HOU West SIDs

# OAPM Design Package: Houston

## DOBBY RNAV SID

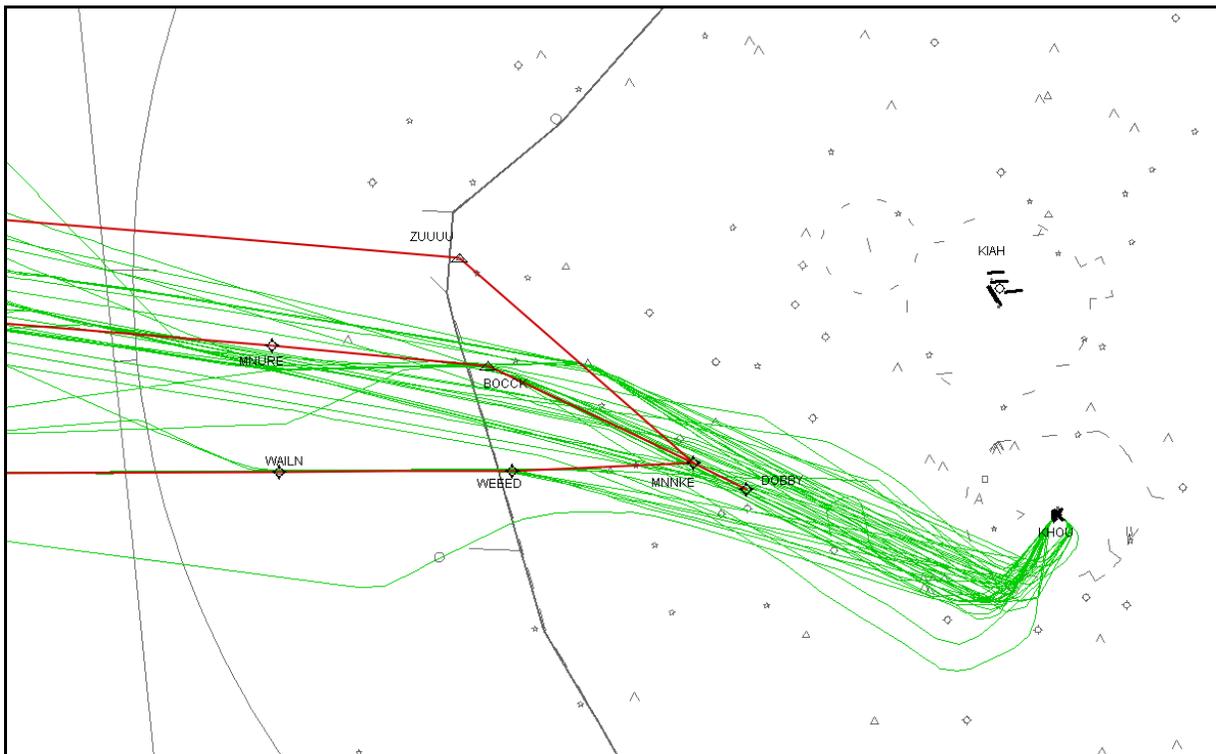
### Proposed Final Design

The Design Team proposed an RNAV SID to replace today's two SIDs for the HOU westbound departures: IDU and WAILN. This SID would be called the DOBBY SID.

The Design Team determined that it would be more efficient to begin the DOBBY SID with radar vectors due to current RNAV SID criteria.

The en route transitions were modified from the Study Team proposal to reduce track miles and to procedurally deconflict aircraft on parallel transitions.

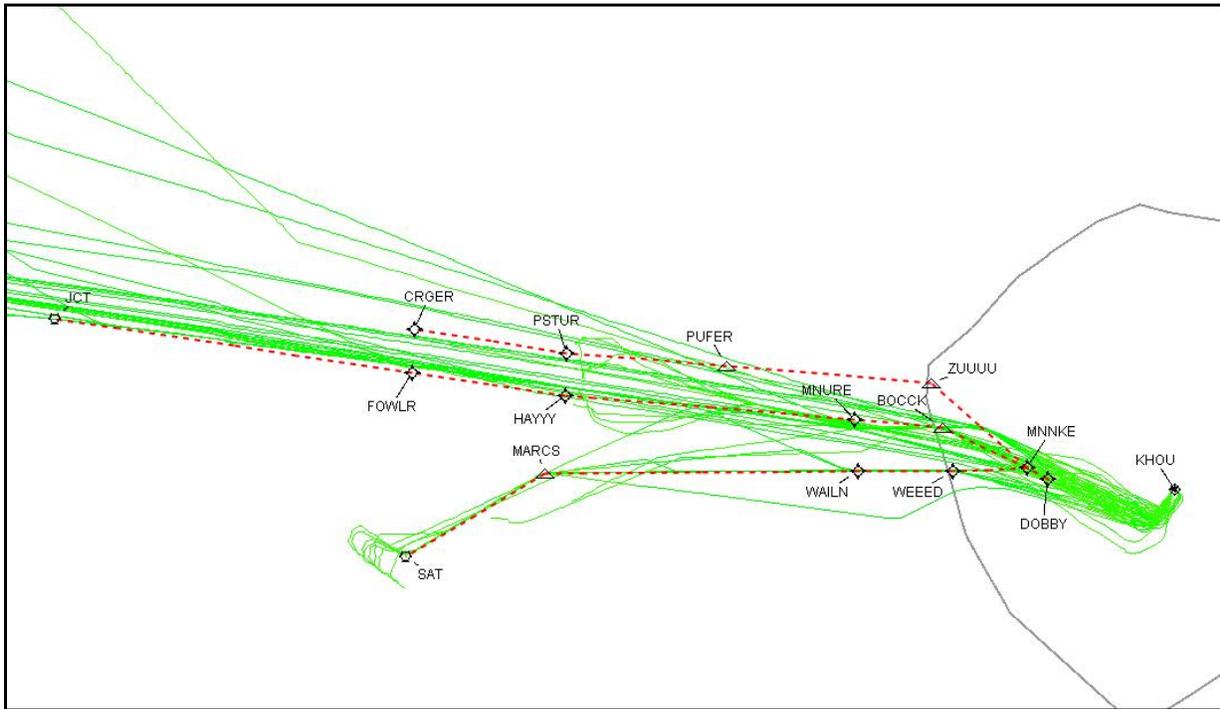
The ZUUUU transition was designed to be used as a weather SWAP route and would be published as ATC assigned only.



**Figure 3. Proposed DOBBY SID (Terminal)**

# OAPM Design Package: Houston

## DOBBY RNAV SID



**Figure 4. Proposed DOBBY SID (En Route)**

## **OAPM Design Package: Houston DOBBY RNAV SID**

### **Proposed Design and Implementation Dependencies**

This procedure is dependent on the following procedures:

#### **STARs:**

GUSHR

DRLLR

TTORO

MSCOT

KIDDZ

#### **SIDs:**

BNDTO

PITZZ

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

### **Attachments**

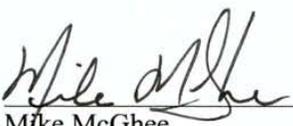
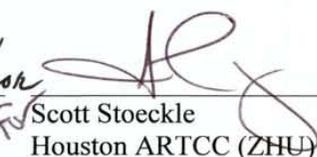
1. Phase IV TARGETS File
2. DOBBY TARGETS Distribution File
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston DOBBY RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
--	------------------------	---	------------------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/26/12</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
---	------------------------	--	------------------------

 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>6-21-12</u> Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	<u>6-25-12</u> Date
---	------------------------	---	------------------------

## OAPM Design Package: Houston DOBBY RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mike Sapp  
William P. Hobby Tower (HOU  
ATCT)  
FAA Lead

Date *for*   
\_\_\_\_\_  
Kevin Butler  
William P. Hobby Tower (HOU  
ATCT)  
NATCA Lead

*6/28/17*  
\_\_\_\_\_  
Date

## OAPM Design Package: Houston Metroplex

*HOU DOBBY RNAV SID*

### RECORD OF CHANGE

Change Number	Date	Document
001	10/01/2012	DOBBY RNAV SID
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	DOBBY TARGETS Distribution Package	N/A

### Description of Change

Updated Header with airport information.

This procedure will be used by all RNAV capable aircraft.

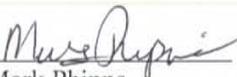
The altitude restriction at the MNNKE waypoint was removed. CRGER transition will be ATC assigned only.

## OAPM Design Package: Houston Metroplex

*HOU DOBBY RNAV SID*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

---

  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

---

  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex DREMR RNAV SID

<b>Name of Change</b>	<b>DREMR SID</b>	<b>Date</b>	<b>06-19-12</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, T11, T14, I23</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 49, 86, 46, <b>ZFW Sectors:</b> 29, 89	<b>Facility Points of Contact</b>	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
<b>Related/Dependent Submissions</b>	<b>None</b>	<b>Associated Data Files:</b>	<b>1. Phase III TARGETS File</b> <b>2. DREMR TARGETS Distribution Package</b> <b>3. Procedure Change Table</b>

## **OAPM Design Package: Houston Metroplex DREMR RNAV SID**

### **Purpose**

This design package addresses issues with the Houston Terminal northbound SIDs identified by the Houston OAPM Study Team:

#### **IAH:**

1. IAH northbound departures currently spend approximately 45 to 60 seconds in level flight at 4,000 ft. The main reasons for this are the downwind arrival traffic descending to 6,000 ft, and the HOU departures climbing to 5,000 ft.
2. The SIDs extend too far into en route airspace and limit user flexibility. A request was made for earlier “jumping off” points to give aircraft an earlier capability for a more direct routing. ZHU also stated that automation problems do not let the aircraft come off of the assigned SID earlier due to too many T-fixes on the routes.

#### **HOU:**

1. IAH departures are stopped at 4,000 ft for HOU departures as well as their own downwind traffic, even though HOU traffic currently shows no significant level-offs.
2. Users were again concerned with the length of SIDs since they tie in with IAH SIDs in the en route environment.

Figure 1 depicts the current IAH northbound SIDs.

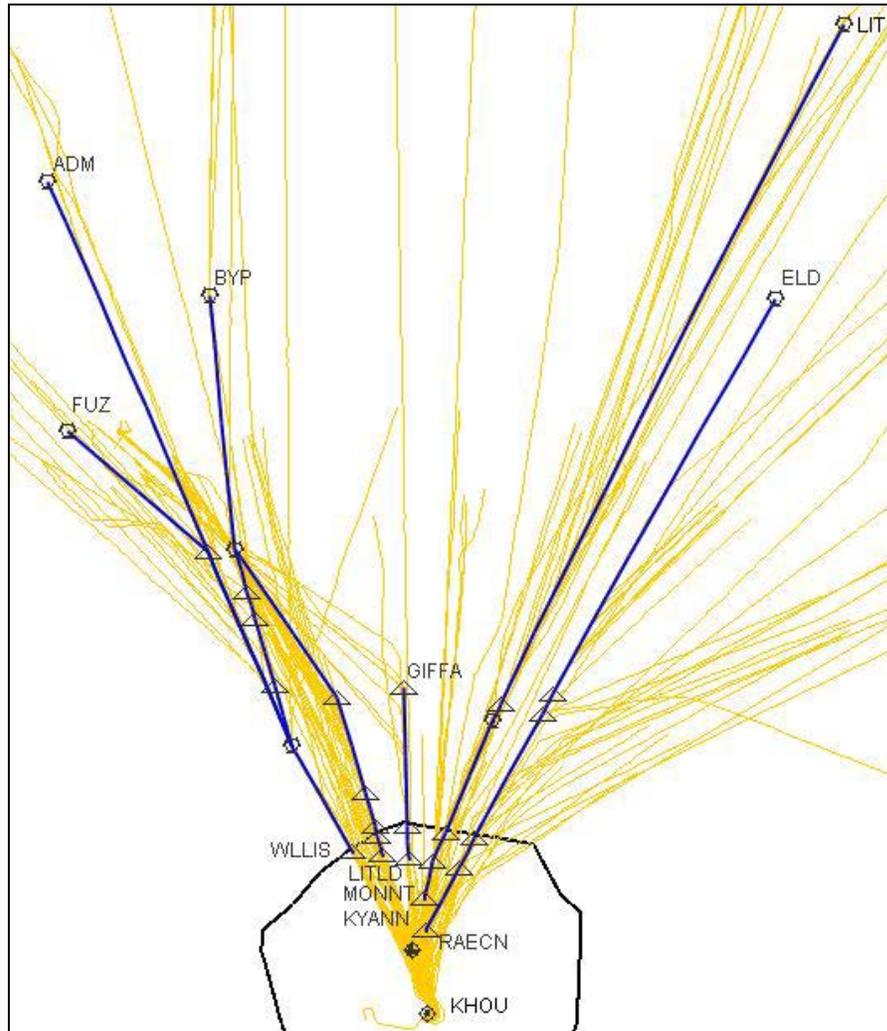
Figure 2 depicts the current HOU northbound SIDs.

## OAPM Design Package: Houston Metroplex DREMR RNAV SID



**Figure 1. Current IAH Northbound SIDs**

## OAPM Design Package: Houston Metroplex DREMR RNAV SID



**Figure 2. Current HOU Northbound SIDs**

## **OAPM Design Package: Houston Metroplex DREMR RNAV SID**

### **Study Team Recommendation**

#### **IAH:**

1. Six conceptual RNAV SIDs, three for each configuration, were created for IAH northbound departures. Runway transitions were included in the design for more repeatable and predictable paths, but because of the proficient vectoring by departure controllers, the procedures designed off Runways 15L/R were kept as radar vector RNAV procedures. Aircraft will be initially vectored on departure to one of three waypoints that are located approximately 7 NM north of IAH.
2. The north downwind was raised from 6,000 ft to 10,000 ft to allow for a higher initial climb, eliminating the 4,000 ft level-off. Upon reaching the waypoints north of IAH and clear of the north downwind, the aircraft join the lateral and vertical path of the designed procedure which is separated from the STARs. Using this concept, complexity and workload issues are reduced for controllers and pilots alike.
3. Once the aircraft exit I90 airspace, they are on a modified shorter route that terminates approximately 100 miles from the airport.

Figure 3 depicts the proposed IAH northbound SIDs.

#### **HOU:**

1. The conceptual HOU SIDs were designed to tie into the IAH SIDs. The dynamic of raising the IAH downwinds changed the initial concept of HOU departures. Through multiple analyses and simulator runs, it was determined that the IAH south downwind could not be raised due to the climb capability of aircraft departing HOU northbound. With the IAH south downwind remaining at 6,000 ft, it was possible to climb HOU northbound traffic above both the IAH downwinds. The first restriction will be at or above 7,000 ft and the second will be at or above 11,000 ft (north IAH downwind is 10,000 ft descending to 7,000 ft).
2. Another issue for HOU northbound departures was traffic departing from Runways 30 and 04. An RNAV off-the ground procedure could not be designed to effectively “top” the south downwind. The OST decided that the current radar vectoring operation would be the most efficient for departures from these runways. Runway transitions were, however, designed for Runways 12L, 12R, and 22. There is an “at or below 5,000 ft” restriction to provide separation from the TXMEX arrival. All HOU departures are restricted to 5,000 ft or below in today’s environment.

Figure 4 depicts the proposed HOU northbound SIDs.

# OAPM Design Package: Houston Metroplex DREMR RNAV SID

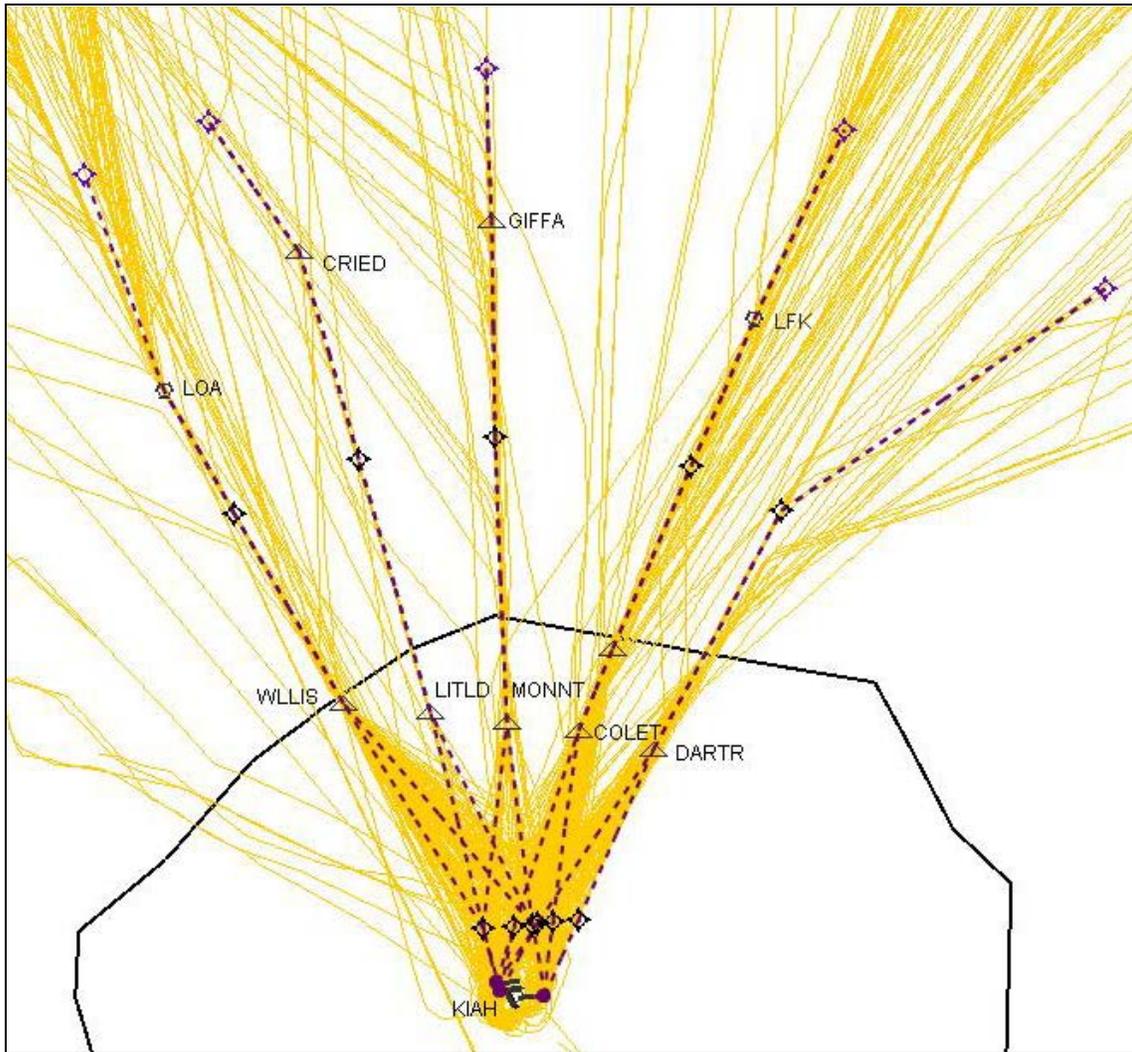
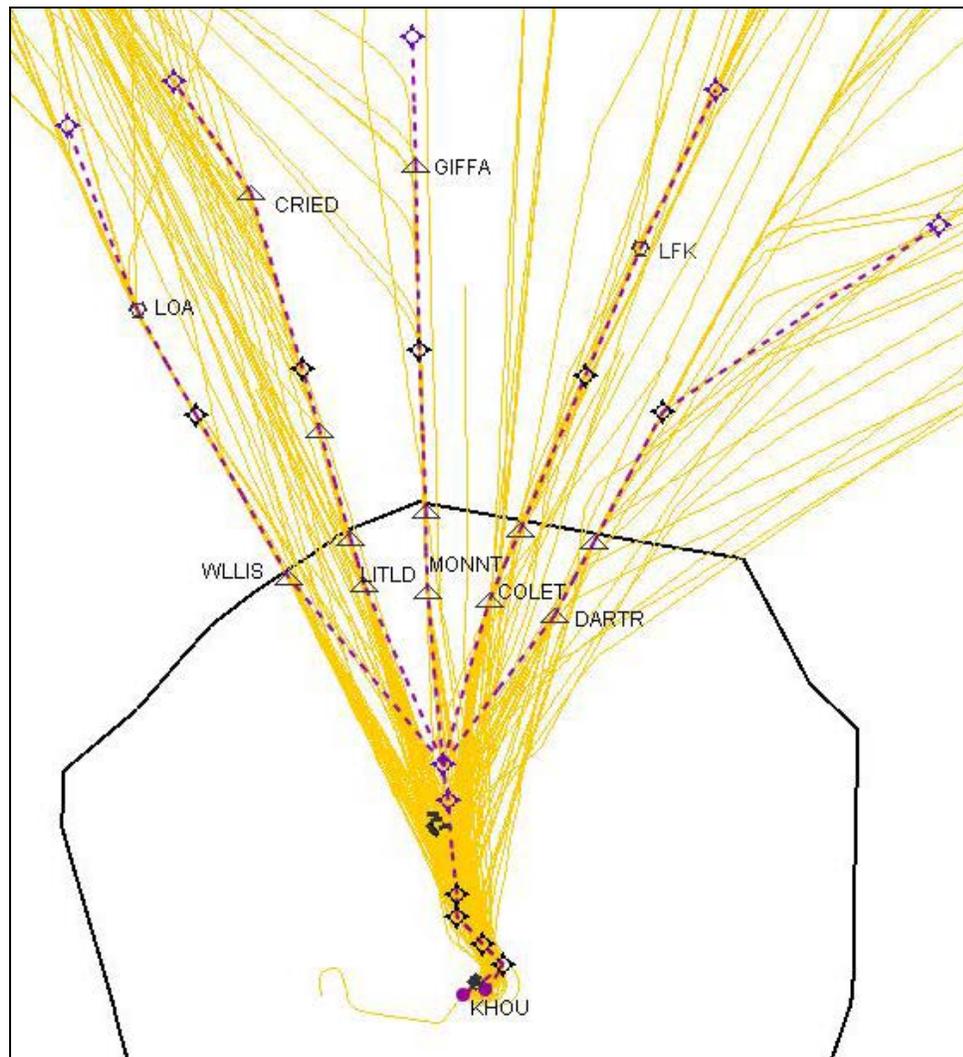


Figure 3. Study Team Proposed IAH Northbound SIDs

# OAPM Design Package: Houston Metroplex DREMR RNAV SID



**Figure 4. Study Team Proposed HOU Northbound SIDs**

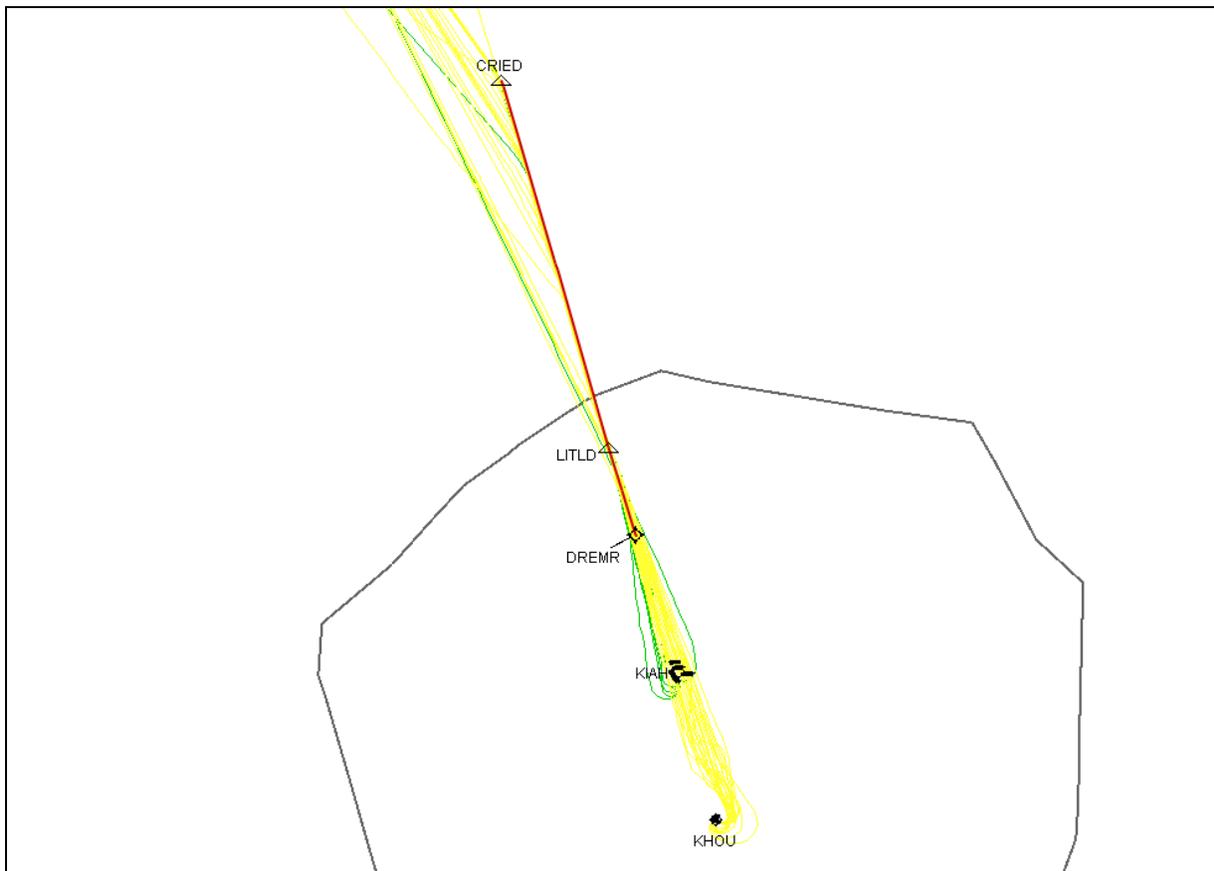
## OAPM Design Package: Houston Metroplex DREMR RNAV SID

### Proposed Final Design

The Design Team proposed six RNAV SIDs to replace today's six northbound SIDs: LOA, CRIED, GIFFA, LFK, ELD and AEX. These SIDs would be replaced by the STYCK, DREMR, WYLSN, INDIE, LURIC and STRYA SIDs. The DREMR SID would begin with a radar vector because a more efficient departure could not be built using current RNAV SID criteria.

The proposed DREMR SID would replace the current CRIED SID.

The Design Team moved the SID termination point to CRIED after coordination with the North Texas OAPM Team to coincide with their designs to be implemented in December 2014. Prior to North Texas OAPM implementation, aircraft will fly the DREMR SID to DAL. After North Texas OAPM implementation, aircraft will fly the DREMR SID to DFW.



**Figure 5. Proposed DREMR SID**

## **OAPM Design Package: Houston Metroplex DREMR RNAV SID**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

**None**

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZFW, ZHU, and I90 internal Standard Operating Procedures and Letters of Agreement.

### **Attachments**

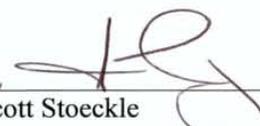
1. Phase III TARGETS File
2. DREMR TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

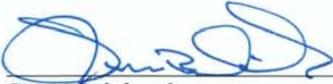
## OAPM Design Package: Houston Metroplex DREMR RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
--	------------------------	---	------------------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/25/12</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/25/12</u> Date
---	------------------------	--	------------------------

 _____ Mike R. Richardson Houston TRACON (190) Facility Lead	<u>6-20-12</u> Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	<u>6-25-12</u> Date
---	------------------------	---	------------------------

## OAPM Design Package: Houston Metroplex DREMR RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Allen Borchers  
George Bush Intercontinental  
Tower (IAH ATCT)  
FAA Lead

6/26/12  
Date

  
\_\_\_\_\_  
John Olinger  
George Bush Intercontinental Tower  
(IAH ATCT)  
NATCA Lead

6/26/12  
Date

  
\_\_\_\_\_  
Mike Sapp  
William P. Hobby Tower (HOU  
ATCT)  
FAA Lead

Date

for

  
\_\_\_\_\_  
Kevin Butler  
William P. Hobby Tower (HOU  
ATCT)  
NATCA Lead

Date

6/28/12

## OAPM Design Package: Houston ELOCO RNAV SID

<b>Name of Change</b>	<b>ELOCO SID</b>	<b>Date</b>	<b>05-17-12</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, E48, I4, I22, I29</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 Houston ARTCC Sectors 23, 36, 70</b>	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552 Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> BAYYY PUCKS BOOZZ GILLL BRSKT TQNIK <b>SIDs:</b> FLYZA GUMBY MMUGS	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase I TARGETS File</b></li> <li><b>2. ELOCO TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

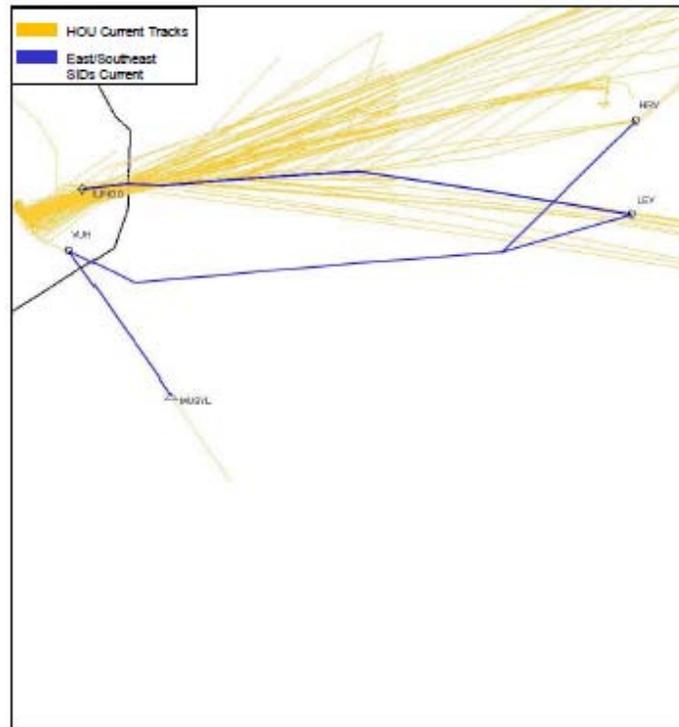
# OAPM Design Package: Houston

## ELOCO RNAV SID

### Purpose

The ELOCO SID addresses the following issues identified by the Houston OAPM Study Team:

1. East and southeast HOU departures will sometimes conflict with the Class D airspace around Ellington Field (EFD). This requires either vectors or point-outs by ATC.
2. All HOU departures to the east are currently routed over SBI as shown in Figure 1, limiting flexibility and adding flying miles for certain destinations. While ZHU would prefer to route HOU traffic over LCH and GUSTI as well as SBI, I90 has limited airspace due to conflicts with the CLMBA and WOLDE arrivals and eastbound departures from IAH.
3. There are currently no RNAV-off-the-ground procedures in use.



**Figure 1. Current HOU VUH and SBI SIDs**

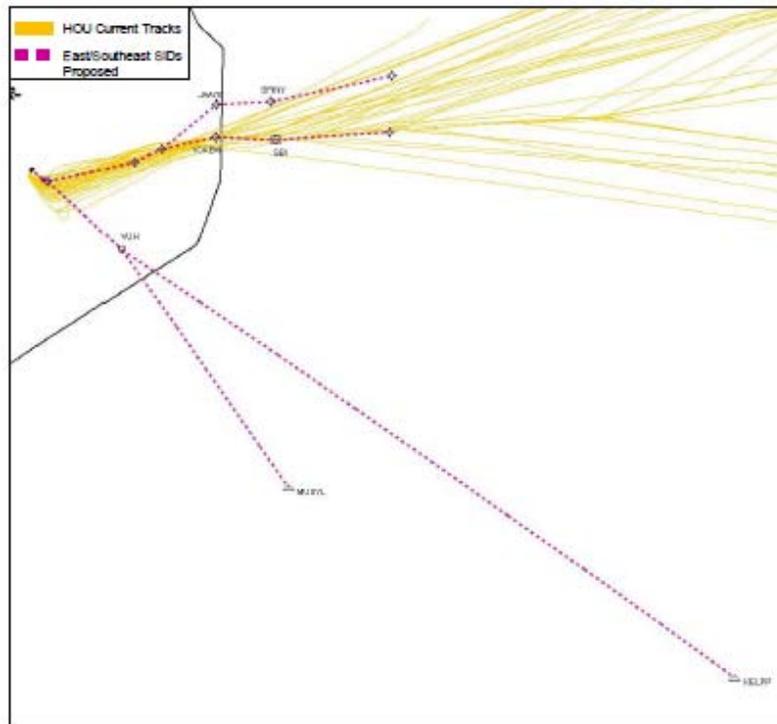
# OAPM Design Package: Houston

## ELOCO RNAV SID

### Study Team Recommendation

1. HOU departures to the east and southeast were specifically designed to tie in with the IAH departure procedures. This concept gives HOU an additional option to the east on the GUSTI transition, where they only have one option (SBI) today.
2. The procedures would be procedurally separated from other SIDs and STARs where practical. Traffic departing to the east would be restricted below southeast corner arrivals during east flow, and would top that same southeast corner traffic during west flow.
3. The issue with the Ellington (EFD) Class D airspace would be resolved through development of a VI leg to an altitude window that would route aircraft above the ceiling of the Class D airspace.
4. The Houston OAPM Study Team evaluated an additional Florida route, but discarded the procedure due to traffic conflicts, and at the request of Houston ARTCC.
5. The lengths of the proposed en route transitions were modified to 100 miles and all procedures were procedurally separated where practical.

Figure 2 depicts the Study Team’s proposed HOU east and southeast departures.



**Figure 2. Study Team HOU East and Southeast SIDs**

## OAPM Design Package: Houston ELOCO RNAV SID

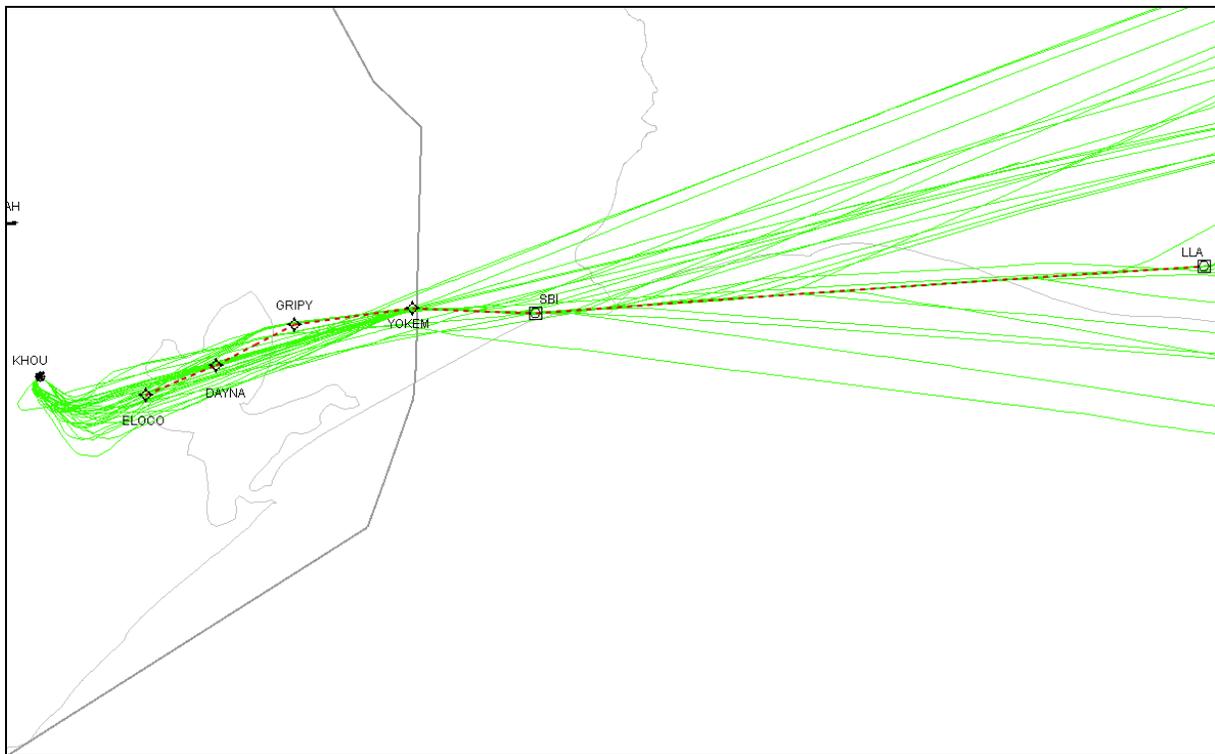
### Proposed Final Design

The current HOU Sabine Pass (SBI) SID would be replaced by the ELOCO RNAV SID. Aircraft on the procedure would be issued radar vectors to ELOCO. Conventional aircraft would fly a Preferential Departure Route or airway as they do today, based upon cruise altitude stratum and destination.

The Study Team proposal reduced the SID to approximately 100 miles from the airport. The Design Team extended the SID to LLA to better connect with the en route environment and ensure deconfliction until the cruise stratum.

The GUSTI transition recommended by the Study Team was removed from the proposed procedure, leaving only the LLA transition.

This proposed SID was procedurally deconflicted from STARs where practical.



**Figure 3. Proposed ELOCO SID**

## **OAPM Design Package: Houston ELOCO RNAV SID**

### **Proposed Design and Implementation Dependencies**

This procedure is dependent on the following procedures:

#### **STARs:**

BAYYY  
PUCKS  
BOOZZ  
GILLL  
BRSKT  
TQNIK

#### **SIDs:**

FLYZA  
GUMBY  
MMUGS

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

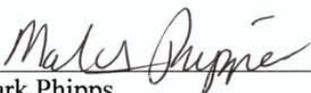
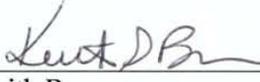
### **Attachments**

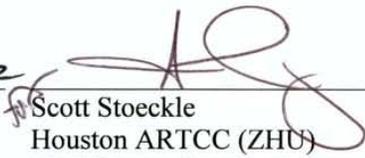
1. Phase I TARGETS File
2. ELOCO TARGETS Distribution File
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

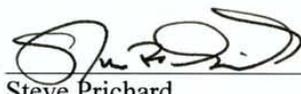
## OAPM Design Package: Houston ELOCO RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>5-17-12</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>5/17/12</u> Date
--	------------------------	---	------------------------

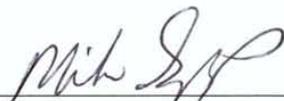
 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/12/12</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
---	------------------------	--	------------------------

 _____ Mike R. Richardson Houston TRACON (190) Facility Lead	<u>5-17-12</u> Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	<u>6-12-12</u> Date
---	------------------------	---	------------------------

## OAPM Design Package: Houston ELOCO RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mike Sapp  
William P. Hobby Tower (HOU  
ATCT)  
FAA Lead

Date *for*   
\_\_\_\_\_  
Kevin Butler  
William P. Hobby Tower (HOU  
ATCT)  
NATCA Lead

6/28/12  
Date

## OAPM Design Package: Houston Metroplex

*HOU ELOCO RNAV SID*

### RECORD OF CHANGE

Change Number	Date	Document
001	10/0/20112	ELOCO RNAV SID
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	ELOCO TARGETS Distribution Package	N/A

#### Description of Change

Updated Header with airport information.

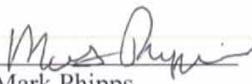
This procedure will be used by all RNAV capable aircraft.

The altitude restrictions at waypoints ELOCO and GRIPY were removed.

## OAPM Design Package: Houston Metroplex

*HOU ELOCO RNAV SID*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

  
Mark Phipps  
Houston  
OAPM FAA Lead

1-18-13  
Date

  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston FLYZA RNAV SID

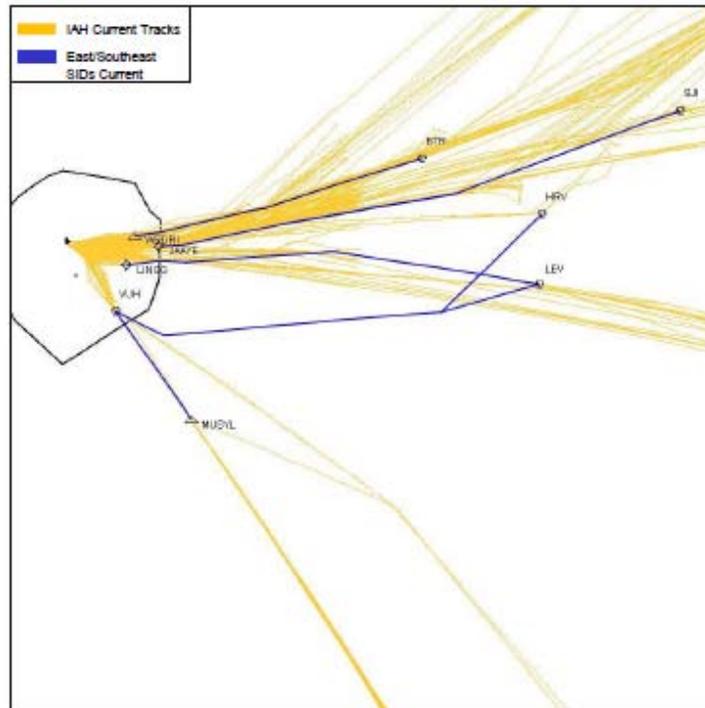
Name of Change	<b>FLYZA SID</b>	Date	<b>06-13-12</b>
Change Classification	<b>Terminal Procedure</b>	Current Phase of Design	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
OAPM Study Team Reference/s	<b>E44, T13, I29</b>	Implementation Date	<b>December 2013</b>
Impacted Facilities and Positions/Areas/Sectors	<b>I90 Houston ARTCC Sectors 79, 68, 43</b>	Facility Points of Contact	<b>Robert Nelson 281.230.5552 Bruce Hinote 281.230.5552</b>
Related/Dependent Submissions	<b>STARs:</b> WAPPL PUCKS BAYYY GILL BRSKT BOOZZ TKNIQ <b>SIDs:</b> MMUGS GUMBY ELOCO PEECE	Associated Data Files:	<ol style="list-style-type: none"> <li><b>1. Phase I TARGETS File</b></li> <li><b>2. FLYZA TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

# OAPM Design Package: Houston FLYZA RNAV SID

## Purpose

This FLYZA SID addresses the following issues identified by the Houston OAPM Study Team:

1. IAH southeast departures currently level off at 4,000 feet for 18 to 42 seconds.
2. Requests were made for additional headings and a possible additional route to the southeast for Florida departure traffic. This could be similar to the current ATC-assigned BOWFN SID, which would eliminate the need for aircraft to head east on initial departure, potentially reducing flying miles.

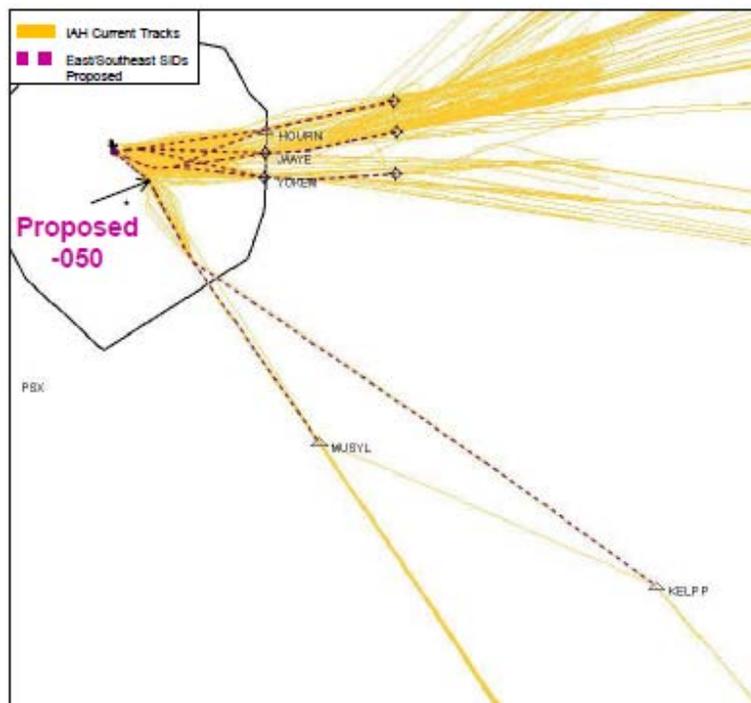


**Figure 1. Current IAH East and Southeast SIDs**

## OAPM Design Package: Houston FLYZA RNAV SID

### Study Team Recommendation

1. The Houston Study Team proposed three RNAV SIDs to the east and one to the southeast with runway transitions from Runways 09, 15L, and 15R.
2. The 15L/R departures would use a 115 degree heading for eastbound destinations and a 130 degree heading for southeast and southwest destinations. These diverging departure headings potentially increase departure throughput. Environmental analysis is required to ensure there are no significant noise impacts since these changes occur at low altitudes.
3. The Houston OAPM Study Team proposed an additional routing toward Florida, but ZHU raised concerns about conflicting traffic in the southeast area, so the design was discarded.
4. The study team proposal reduced the length of the SIDs to 100 miles.
5. All SIDs would be procedurally separated from STARs where practical.
6. Figure 2 depicts the study team’s proposed IAH east and southeast departures.



**Figure 2. Study Team proposed IAH Southeast SID**

# OAPM Design Package: Houston

## FLYZA RNAV SID

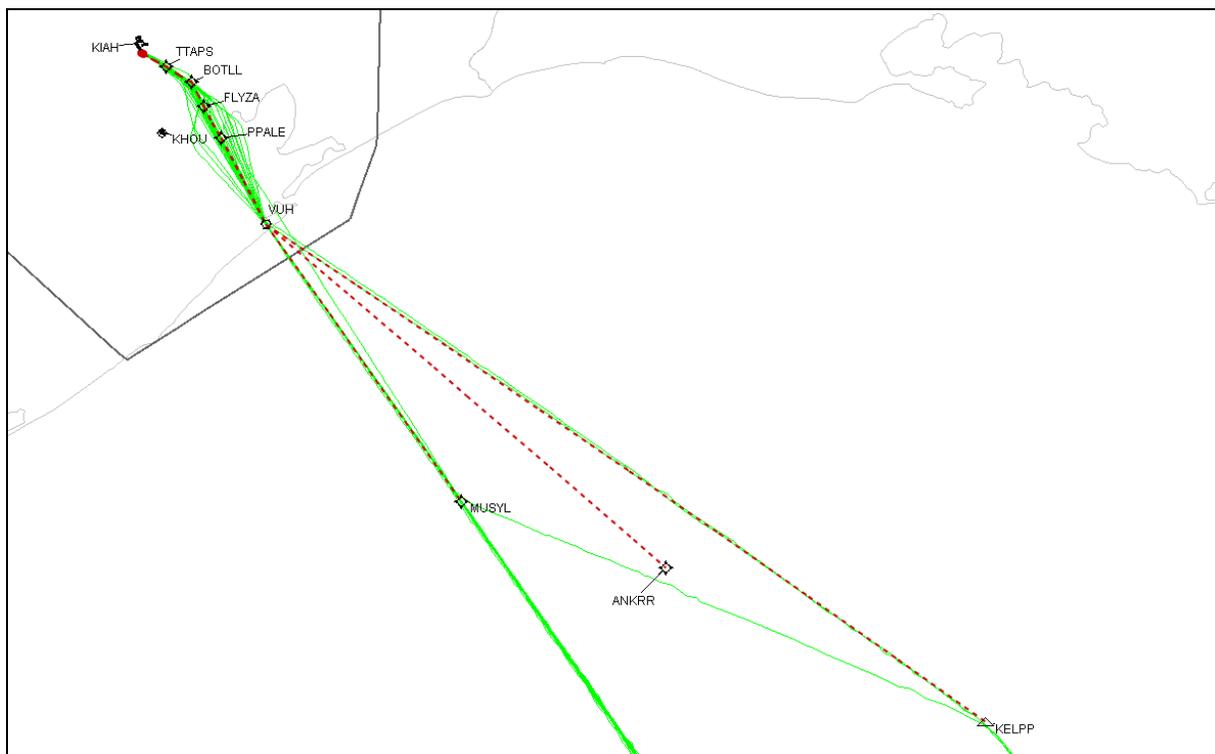
### Proposed Final Design

The current IAH VUH SID would be replaced by the FLYZA RNAV SID. This procedure would be RNAV off-the-ground for flights departing Runways 15L or 15R. Flights departing other runways would be issued a departure heading to fly. Conventional aircraft would fly a Preferential Departure Route or airway as they do today based on cruise altitude stratum and destination.

The proposed FLYZA SID is designed to avoid HOU ATCT airspace.

The Design Team revised en route transitions to align with the proposed Gulf of Mexico Required Navigation Performance (RNP) routes, as shown in Figure 3.

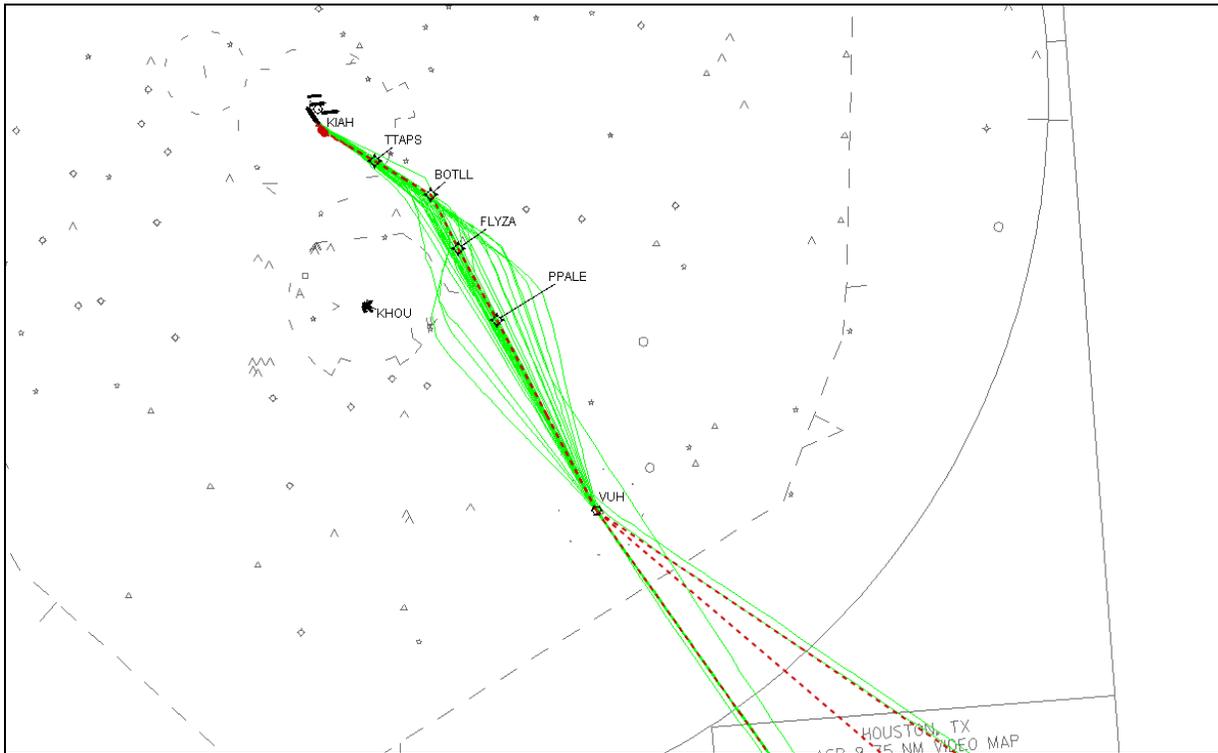
This proposed SID was procedurally deconflicted from STARs where practical.



**Figure 3. Proposed FLYZA SID (En Route)**

# OAPM Design Package: Houston

## FLYZA RNAV SID



**Figure 4. Proposed FLYZA SID (Terminal)**

## **OAPM Design Package: Houston FLYZA RNAV SID**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

WAPPL  
PUCKS  
BAYYY  
GILL  
BRSKT  
BOOZZ  
TKNIQ

#### **SIDs:**

GUMBY  
MMUGS  
ELOCO  
PEECE

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

The proposed Gulf of Mexico routes were not available during the study team process.

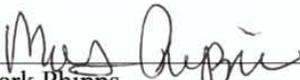
### **Attachments**

1. Phase I TARGETS File
2. FLYZA TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston FLYZA RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

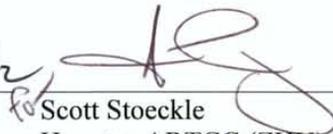
6-25-12  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

6/25/12  
Date

  
\_\_\_\_\_  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

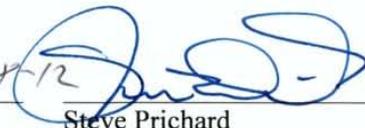
6/25/12  
Date

  
\_\_\_\_\_  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

6/26/12  
Date

  
\_\_\_\_\_  
Mike R. Richardson  
Houston TRACON (I90)  
Facility Lead

6-26-12  
Date

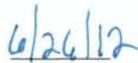
  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (I90)  
NATCA Lead

6-26-12  
Date

## OAPM Design Package: Houston FLYZA RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

	
Allen Borchers	John Olinger
George Bush Intercontinental Tower (IAH ATCT) FAA Lead	George Bush Intercontinental Tower (IAH ATCT) NATCA Lead
	
Date	Date

## OAPM Design Package: Houston Metroplex

*IAH FLYZA RNAV SID*

### RECORD OF CHANGE

Change Number	Date	Document
001	11/01/2012	FLYZA RNAV SID
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

#### Description of Change

Updated Header with airport information.

In the Proposed Final Design section, the font of the last paragraph needs to be changed.

The design team amended the procedure to deconflict from HOU arrival flows and for connectivity. The original design proposal is shown in Figures 1 and 2. ANKRR waypoint was relocated to ensure connectivity with proposed Gulf of Mexico RNAV ATS routes. FLYZA and PPALE waypoints were moved to provide additional spacing from HOU Runway 30R/L arrival traffic. These changes are shown in Figures 3 and 4.

## OAPM Design Package: Houston Metroplex

*IAH FLYZA RNAV SID*

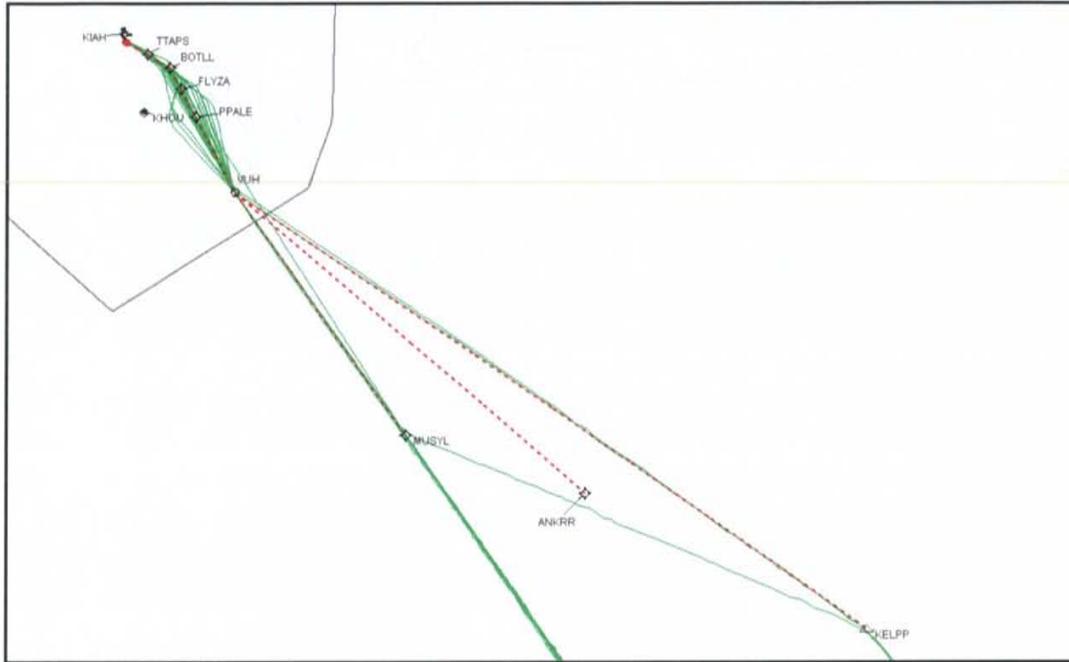


FIGURE 1. FLYZA RNAV SID PROPOSED DESIGN (EN ROUTE) (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH FLYZA RNAV SID*

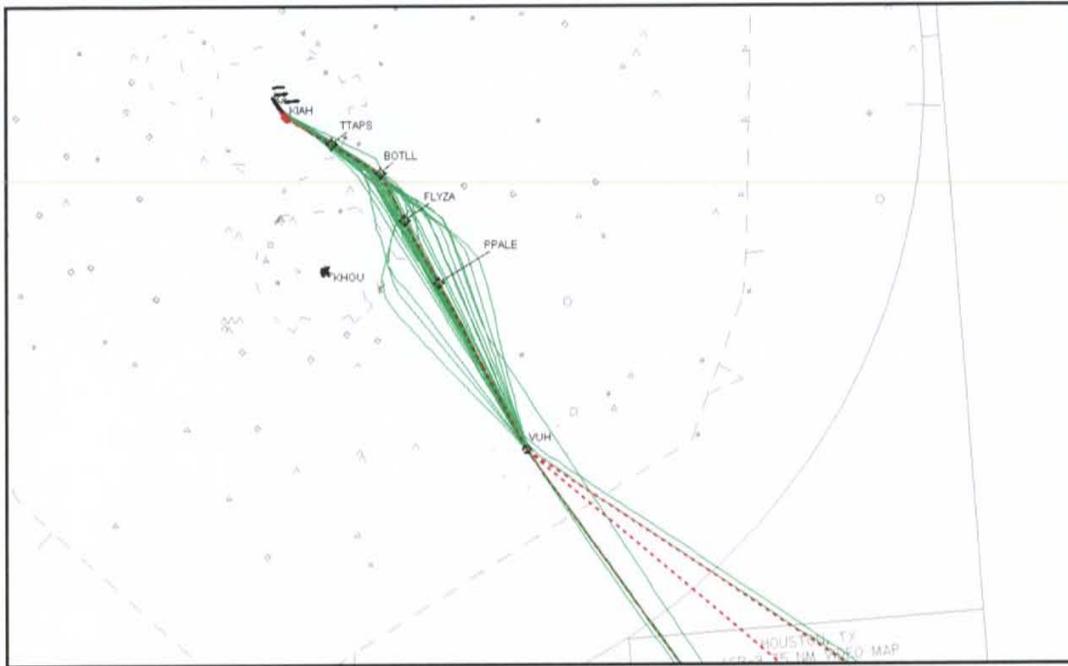
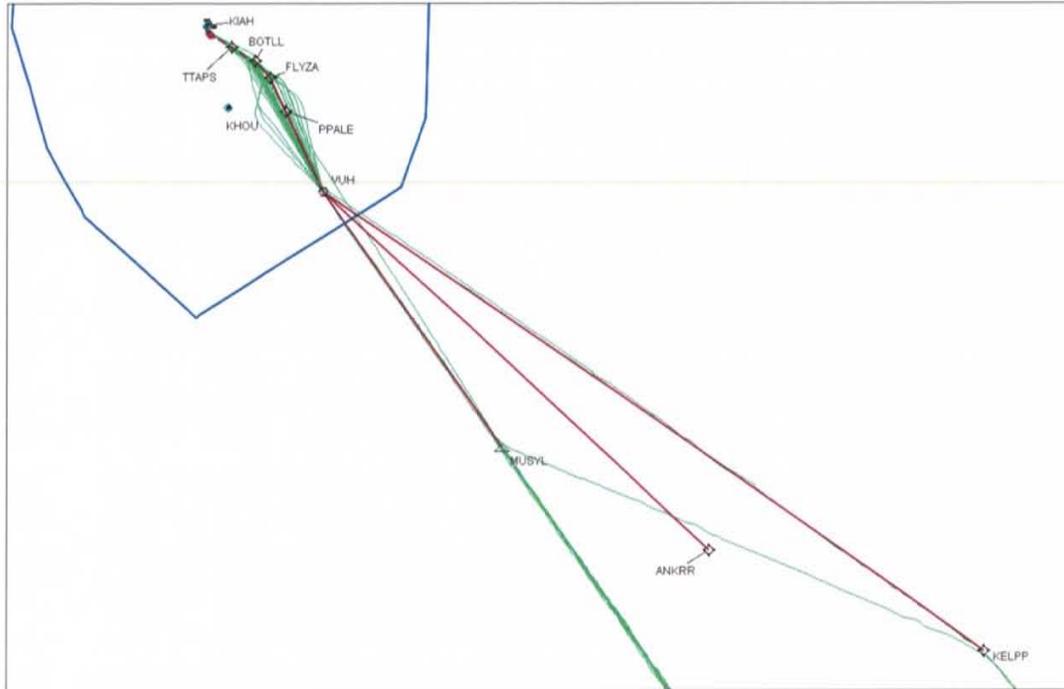


FIGURE 2. FLYZA RNAV SID PROPOSED DESIGN (TERMINAL) (Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH FLYZA RNAV SID*

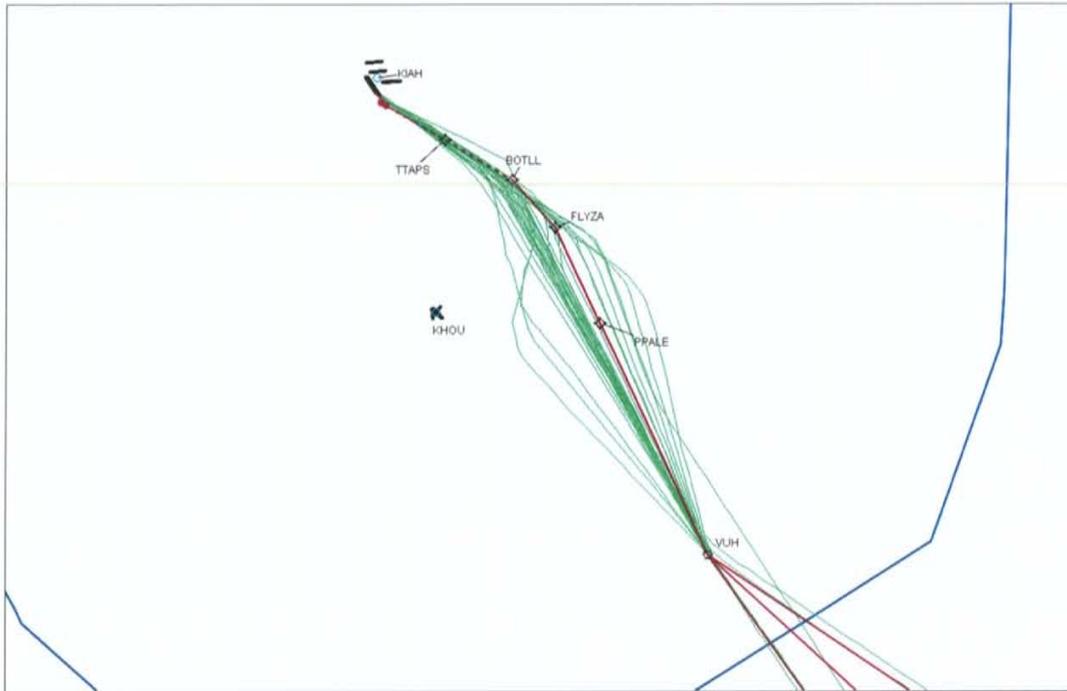


**FIGURE 3. FLYZA RNAV SID PROPOSED DESIGN (EN ROUTE)**

(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH FLYZA RNAV SID*



**FIGURE 4. FLYZA RNAV SID PROPOSED DESIGN (TERMINAL)**

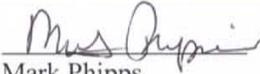
(Will replace Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

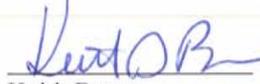
*IAH FLYZA RNAV SID*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

---

  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex GUMBY RNAV SID

<b>Name of Change</b>	<b>GUMBY SID</b>	<b>Date</b>	<b>05-09-12</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, T13, I29</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 ZHU Sectors: 23, 36, 70</b>	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552 Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GILLL BOOZZ WAPPL <b>SIDs:</b> MMUGS ELOCO FLYZA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase I TARGETS File</b></li> <li><b>2. GUMBY TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

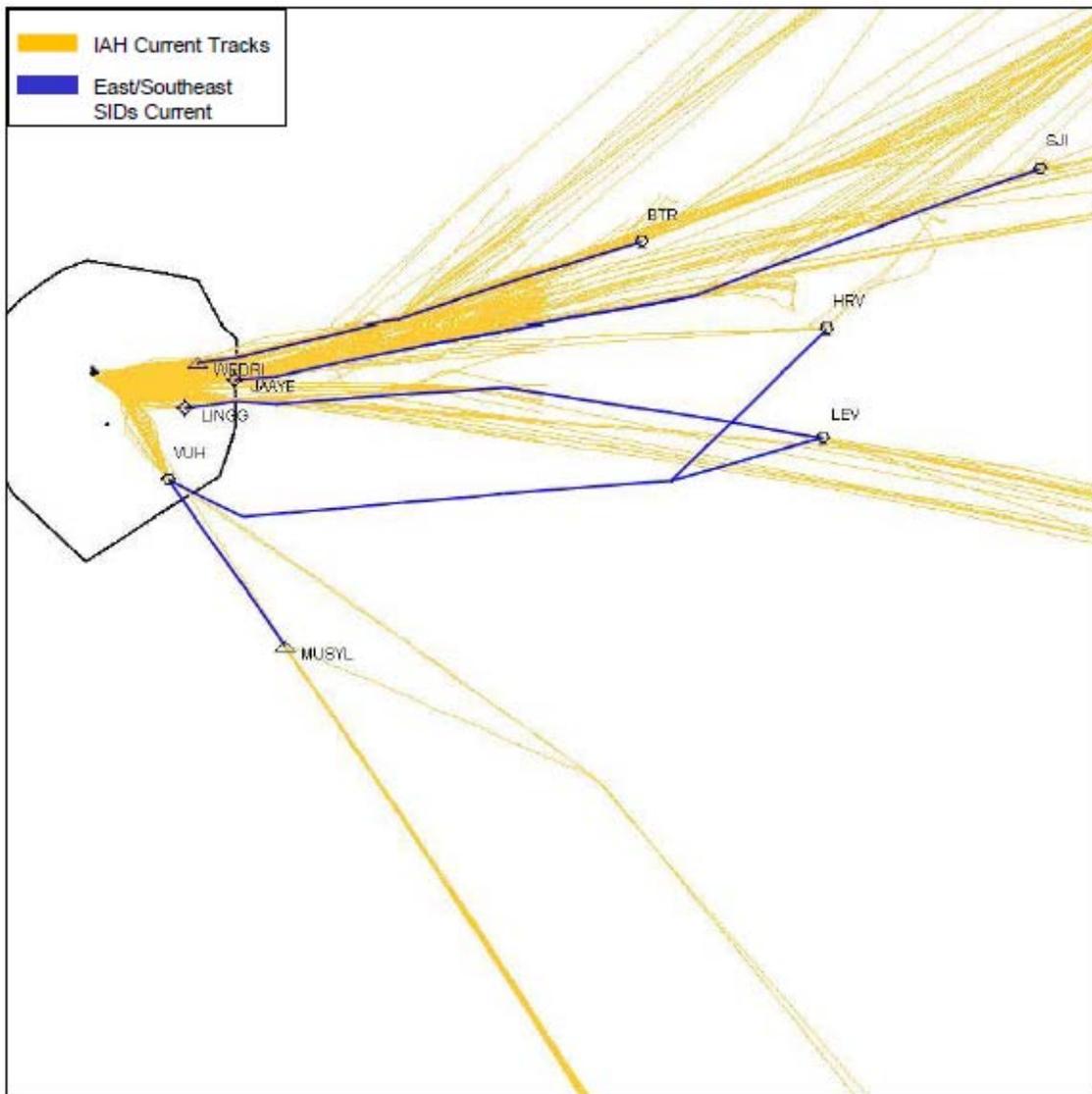
# OAPM Design Package: Houston Metroplex

## GUMBY RNAV SID

### Purpose

This design package addresses issues with the East/Southeast IAH SIDs identified by the Houston OAPM Study Team:

1. IAH southeast departures currently level off at 4,000 feet for 18 to 42 seconds.
2. Requests were made for additional headings and a possible additional route to the southeast for Florida departure traffic. This could be similar to the current ATC-assigned BOWFN SID, which would eliminate the need for aircraft to head east on initial departure, potentially reducing flying miles.



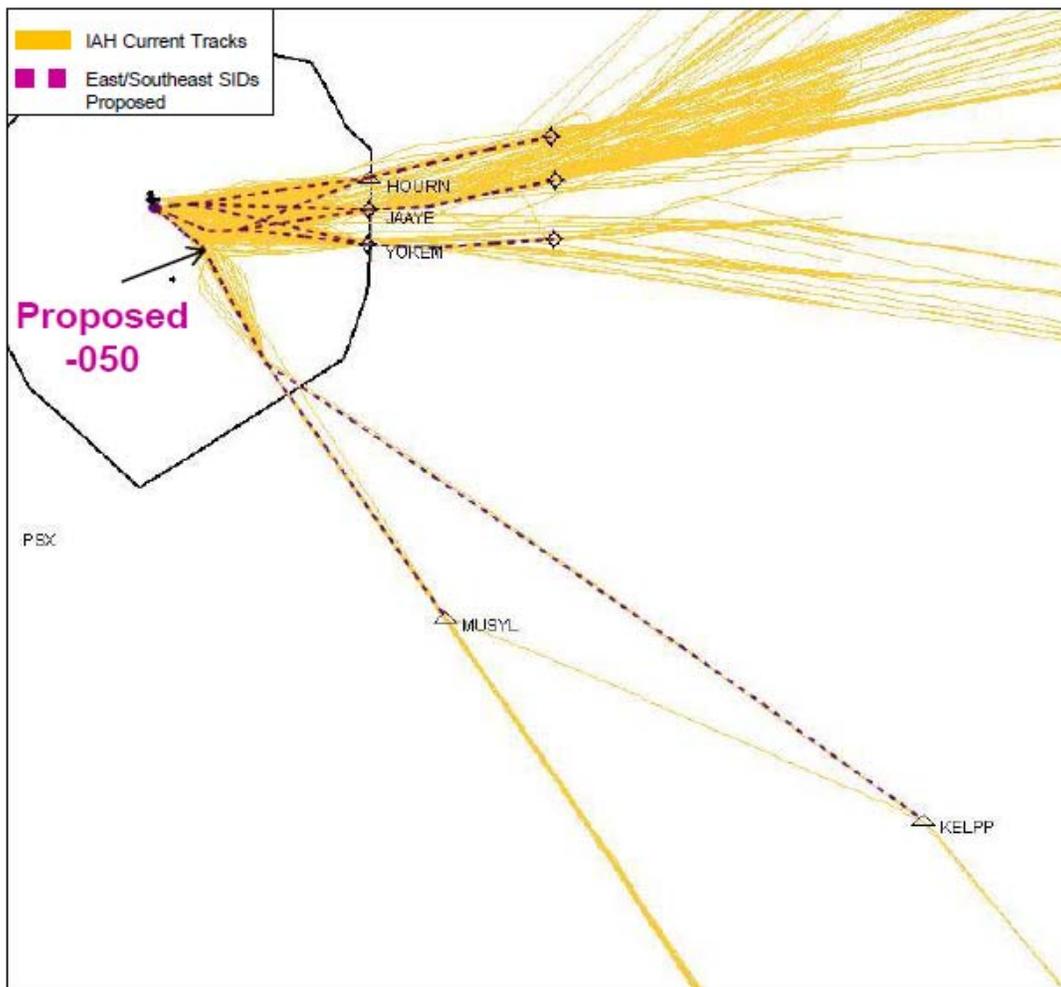
**Figure 1. Current East and Southeast SIDs**

# OAPM Design Package: Houston Metroplex

## GUMBY RNAV SID

### Study Team Recommendation

1. The Study Team proposed three RNAV SIDs to the east and southeast with runway transitions from Runways 09, 15L, and 15R.
2. The 15L/R departures would use a 115 degree heading for eastbound destinations and a 130 degree heading for southeast and southwest destinations. These diverging departure headings potentially increase departure throughput. Environmental analysis is required to ensure there are no significant noise impacts since these changes occur at low altitudes.
3. The OST proposed an additional routing toward Florida, but ZHU raised concerns about conflicting traffic in the southeast area, so the design was discarded.
4. Again, the OST proposal reduced the length of the SIDs to 100 miles, as shown in Figure 2.
5. All SIDs would be procedurally separated from STARs where practical.



**Figure 2. Study Team Recommendation**

## **OAPM Design Package: Houston Metroplex GUMBY RNAV SID**

### **Proposed Final Design**

The Design Team proposed flow dependent RNAV SIDs to replace the three east IAH SIDs; Lake Charles, GUSTI, and Sabine Pass SIDs. These three SIDs would be replaced by the GUMBY and the MMUGS SIDs, each with LCH, GUSTI, and SBI transitions. The GUMBY SID would be used when IAH is on an east flow. These procedures would be RNAV off-the-ground for flights departing Runways 15L or 15R. Flights departing other runways would be issued a departure heading to fly. Conventional aircraft would fly a Preferential Departure Route or airway as they do today, based upon cruise altitude stratum and destination.

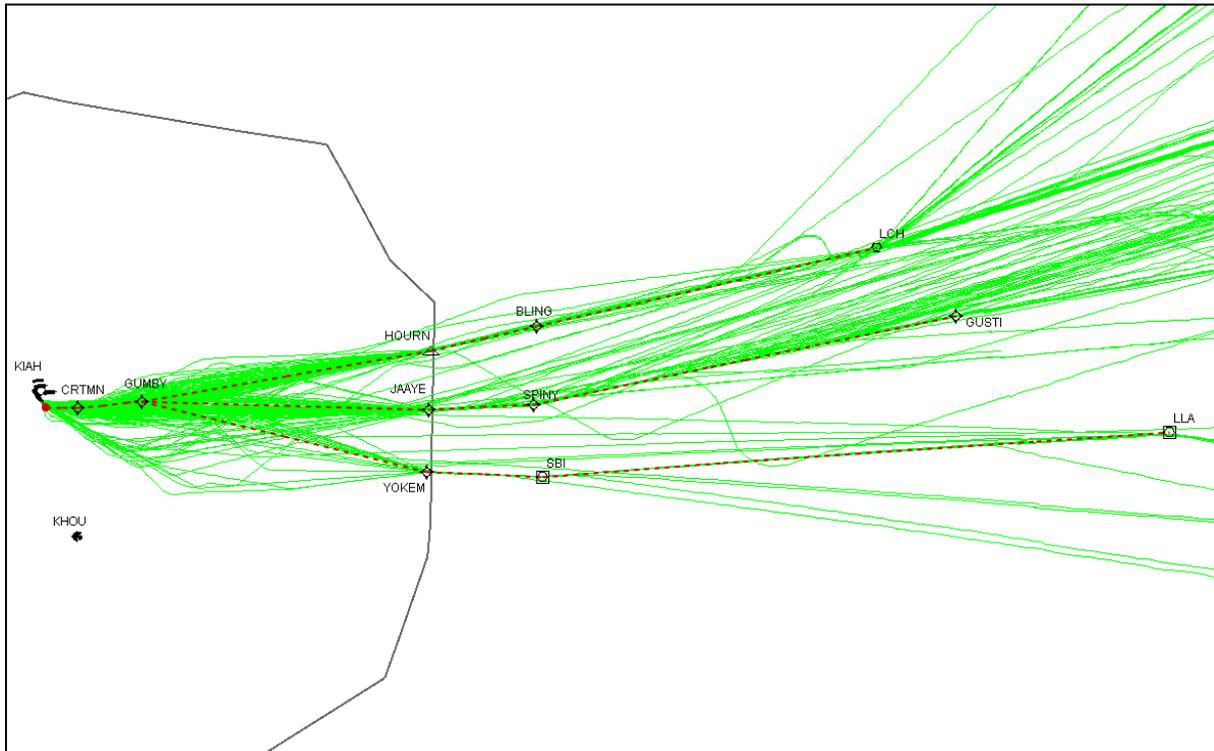
The RNAV off-the-ground SID for Runway 9 that was proposed by the Study Team was discarded due to concerns from IAH ATCT in regards to the complexity of having to reissue clearances when issuing a runway change.

The 15L/R RNAV transitions will utilize a 115 degree track to CRTMN, while the southeast and south SIDS will utilize a divergent 130 degree track, potentially increasing departure throughput.

The Study Team proposal reduced the SID to approximately 100 miles from the airport. The Design Team extended the en route transitions to LCH, GUSTI, and LLA to connect better with the en route environment and ensure separation until cruise stratum. The LCH and GUSTI transitions connect to Q22 and Q24 respectively.

These proposed SIDs were procedurally deconflicted from STARs where practical.

# OAPM Design Package: Houston Metroplex GUMBY RNAV SID



**Figure 3. Proposed GUMBY SID**

## **OAPM Design Package: Houston Metroplex GUMBY RNAV SID**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

GILLL  
BOOZZ  
WAPPL

#### **SIDs:**

MMUGS  
ELOCO  
FLYZA

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

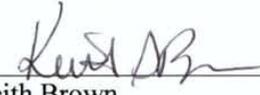
### **Attachments**

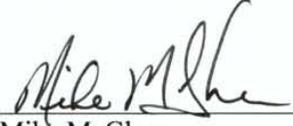
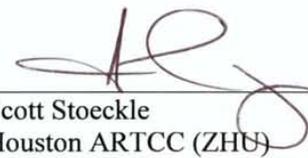
1. Phase I TARGETS File
2. GUMBY TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex GUMBY RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	5-10-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	5/10/12 Date
--	-----------------	---	-----------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/12/12 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
---	-----------------	--	-----------------

 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	5-17-12 Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	6-12-12 Date
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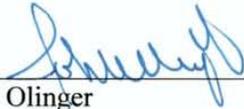
## OAPM Design Package: Houston Metroplex GUMBY RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Allen Borchers  
George Bush Intercontinental  
Tower (IAH ATCT)  
FAA Lead

6/26/12  
Date

  
\_\_\_\_\_  
John Olinger  
George Bush Intercontinental Tower  
(IAH ATCT)  
NATCA Lead

6/26/12  
Date

## OAPM Design Package: Houston Metroplex

*IAH GUMPY RNAV SID*

### RECORD OF CHANGE

<b>Change Number</b>	<b>Date</b>	<b>Document</b>
001	10/01/2012	GUMPY RNAV SID
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

### Description of Change

Updated Header with airport information.

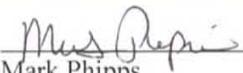
This procedure will be used by all RNAV capable aircraft.

## OAPM Design Package: Houston Metroplex

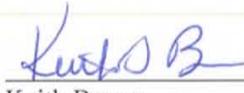
IAH GUMBY RNAV SID

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

---

  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex INDIE RNAV SID

Name of Change	<b>INDIE SID</b>	Date	<b>06-19-12</b>
Change Classification	<b>Terminal Procedures</b>	Current Phase of Design	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
OAPM Study Team Reference/s	<b>E44, T11, T14, I23</b>	Implementation Date	<b>December 2013</b>
Impacted Facilities and Positions/Areas/Sectors	<b>I90</b> <b>ZHU Sectors:</b> 86, 46 <b>ZFW Sectors:</b> 30, 86, 52, 28	Facility Points of Contact	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
Related/Dependent Submissions	<b>None</b>	Associated Data Files:	<ol style="list-style-type: none"> <li><b>1. Phase III TARGETS File</b></li> <li><b>2. INDIE TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

## **OAPM Design Package: Houston Metroplex INDIE RNAV SID**

### **Purpose**

This design package addresses issues with the Houston Terminal northbound SIDs identified by the Houston OAPM Study Team:

#### **IAH:**

1. IAH northbound departures currently spend approximately 45 to 60 seconds in level flight at 4,000 ft. The main reasons for this are the downwind arrival traffic descending to 6,000 ft, and the HOU departures climbing to 5,000 ft.
2. The SIDs extend too far into en route airspace and limit user flexibility. A request was made for earlier “jumping off” points to give aircraft an earlier capability for a more direct routing. ZHU also stated that automation problems do not let the aircraft come off of the assigned SID earlier due to too many T-fixes on the routes.

#### **HOU:**

1. IAH departures are stopped at 4,000 ft for HOU departures as well as their own downwind traffic, even though HOU traffic currently shows no significant level-offs.
2. Users were again concerned with the length of SIDs since they tie in with IAH SIDs in the en route environment.

Figure 1 depicts the current IAH northbound SIDs.

Figure 2 depicts the current HOU northbound SIDs.

## OAPM Design Package: Houston Metroplex INDIE RNAV SID

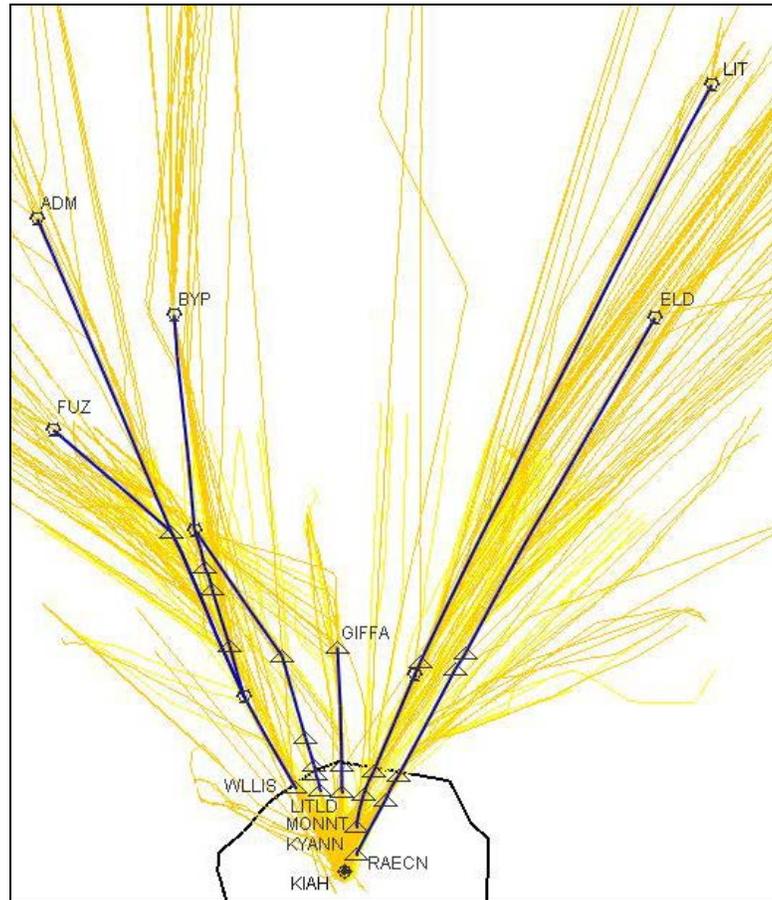


Figure 1. Current IAH Northbound SIDs

## OAPM Design Package: Houston Metroplex INDIE RNAV SID

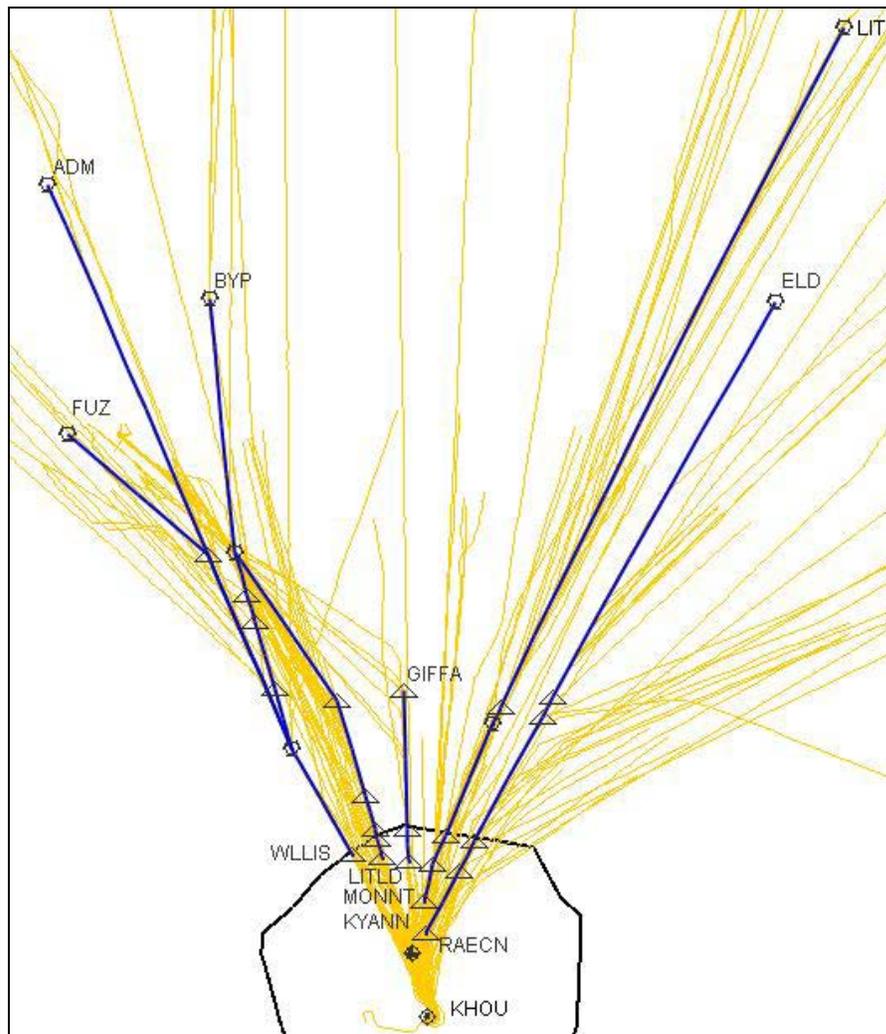


Figure 2. Current HOU Northbound SIDs

## **OAPM Design Package: Houston Metroplex INDIE RNAV SID**

### **Study Team Recommendation**

#### **IAH:**

1. Six conceptual RNAV SIDs, three for each configuration, were created for IAH northbound departures. Runway transitions were included in the design for more repeatable and predictable paths, but because of the proficient vectoring by departure controllers, the procedures designed off Runways 15L/R were kept as radar vector RNAV procedures. Aircraft will be initially vectored on departure to one of three waypoints that are located approximately 7 NM north of IAH.
2. The north downwind was raised from 6,000 ft to 10,000 ft to allow for a higher initial climb, eliminating the 4,000 ft level-off. Upon reaching the waypoints north of IAH and clear of the north downwind, the aircraft join the lateral and vertical path of the designed procedure which is separated from the STARs. Using this concept, complexity and workload issues are reduced for controllers and pilots alike.
3. Once the aircraft exit I90 airspace, they are on a modified shorter route that terminates approximately 100 miles from the airport.

Figure 3 depicts the proposed IAH northbound SIDs.

#### **HOU:**

1. The conceptual HOU SIDs were designed to tie into the IAH SIDs. The dynamic of raising the IAH downwinds changed the initial concept of HOU departures. Through multiple analyses and simulator runs, it was determined that the IAH south downwind could not be raised due to the climb capability of aircraft departing HOU northbound. With the IAH south downwind remaining at 6,000 ft, it was possible to climb HOU northbound traffic above both the IAH downwinds. The first restriction will be at or above 7,000 ft and the second will be at or above 11,000 ft (north IAH downwind is 10,000 ft descending to 7,000 ft).
2. Another issue for HOU northbound departures was traffic departing from Runways 30 and 04. An RNAV off-the-ground procedure could not be designed to effectively “top” the south downwind. The OST decided that the current radar vectoring operation would be the most efficient for departures from these runways. Runway transitions were, however, designed for Runways 12L, 12R, and 22. There is an “at or below 5,000 ft” restriction to provide separation from the TXMEX arrival. All HOU departures are restricted to 5,000 ft or below in today’s environment.

Figure 4 depicts the proposed HOU northbound SIDs.

# OAPM Design Package: Houston Metroplex INDIE RNAV SID

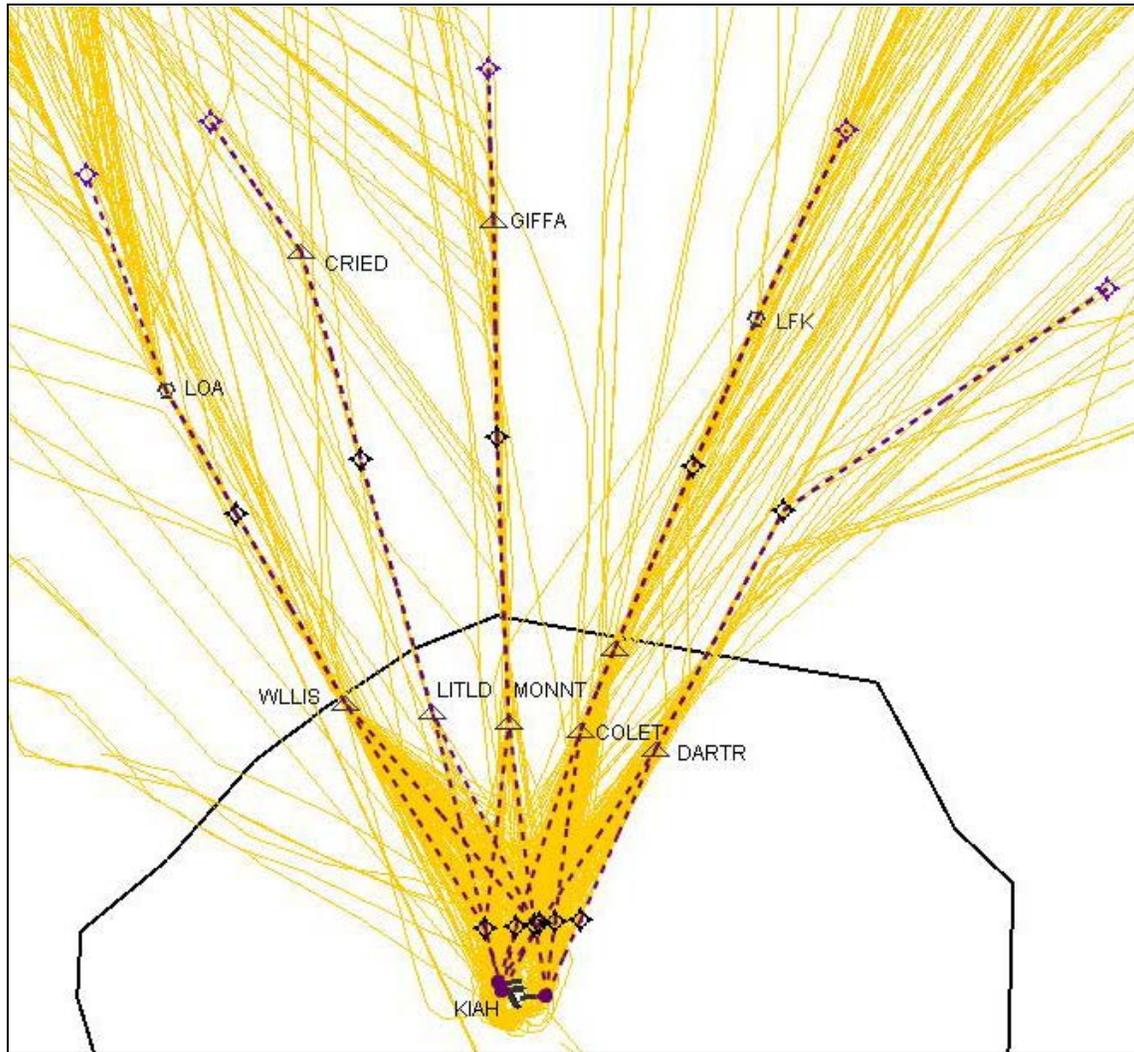


Figure 3. Study Team Proposed IAH Northbound SIDs



## OAPM Design Package: Houston Metroplex INDIE RNAV SID

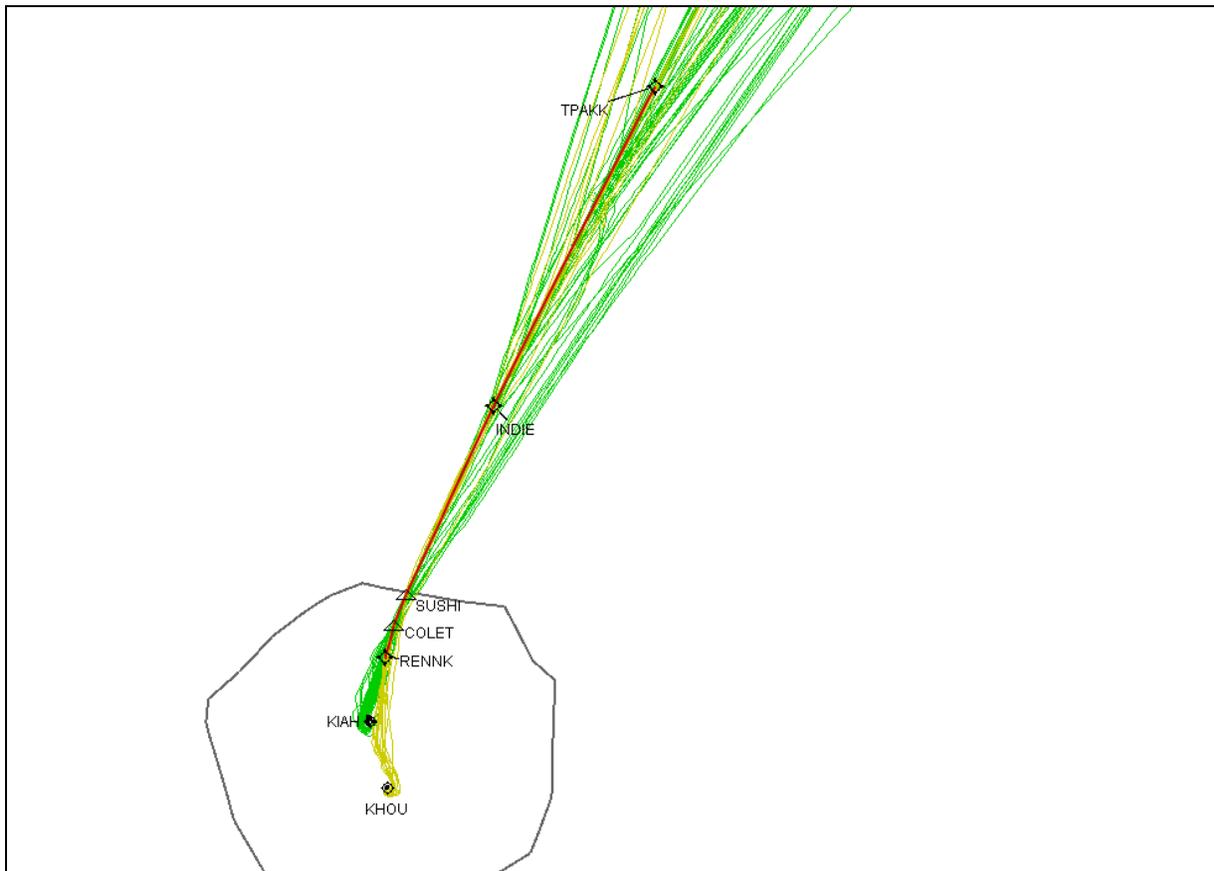
### Proposed Final Design

The Design Team proposed six RNAV SIDs to replace today's six northbound SIDs: LOA, CRIED, GIFFA, LFK, ELD and AEX. These SIDs would be replaced by the STYCK, DREMR, WYLSN, INDIE, LURIC and STRYA SIDs. The INDIE SID would begin with a radar vector because a more efficient departure could not be built using current RNAV SID criteria.

The INDIE SID would replace the current LFK SID and would have an en route transition to TPAKK.

Aircraft destined to KXNA will exit the SID at the end of the common route at INDIE.

The North Texas OAPM D&I team recommended the TPAKK transition extend beyond D10 arrival traffic inbound from the southeast and D10 eastbound departures to allow deconfliction from these routes.



**Figure 5. Proposed INDIE SID**

## **OAPM Design Package: Houston Metroplex INDIE RNAV SID**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

**None**

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZFW, ZHU, and I90 internal Standard Operating Procedures and Letters of Agreement.

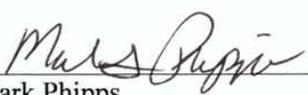
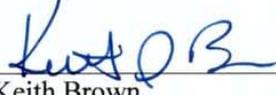
### **Attachments**

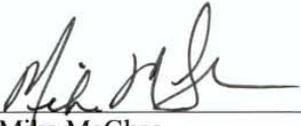
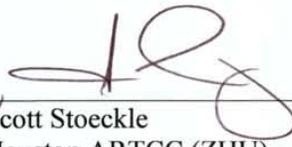
1. Phase III TARGETS File
2. INDIE TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex INDIE RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 Date
--	-----------------	---	-----------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/25/12 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
---	-----------------	--	-----------------

 _____ Mike R. Richardson Houston TRACON (190) Facility Lead	6-20-12 Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	6-25-12 Date
---	-----------------	---	-----------------

## OAPM Design Package: Houston Metroplex INDIE RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
Allen Borchers  
George Bush Intercontinental  
Tower (IAH ATCT)  
FAA Lead

6/26/12  
Date

  
John Olinger  
George Bush Intercontinental Tower  
(IAH ATCT)  
NATCA Lead

6/26/12  
Date

  
Mike Sapp  
William P. Hobby Tower (HOU  
ATCT)  
FAA Lead

Date

for

  
Kevin Butler  
William P. Hobby Tower (HOU  
ATCT)  
NATCA Lead

6/28/12  
Date

## OAPM Design Package: Houston KARRR RNAV SID

<b>Name of Change</b>	<b>KARRR SID</b>	<b>Date</b>	<b>09-19-2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E24, E25, E26, E27, E39, I3, I17, I18</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 ZHU Sectors: 58, 59, 76, 87, 95, 92</b>	<b>Facility Points of Contact</b>	<b>Will Hutson 281.230.5556 David Kidd 281.230.5556</b>
<b>Related/Dependent Submissions</b>	<b>STARs: HTOWN TEJAS SIDs: RITAA PTRON</b>	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li>1. Houston OAPM D&amp;I Master TARGETS File</li> <li>2. KARRR TARGETS Distribution Package</li> <li>3. Procedure Change Table</li> </ol>

### Purpose

Specific RNAV procedures were not addressed by the Houston OAPM D and I Study team. The proposed KARRR SID will provide an RNAV departure procedure similar to RNAV SIDs for IAH and HOU.

### Study Team Recommendation

The Houston OAPM Study Team did not propose satellite airport departure procedures.

### Proposed Final Design

Southwest bound turbojet/turboprop departures from satellite airports exit terminal airspace utilizing existing departure procedures serving IAH and HOU. The NGP and PSX SIDs would be replaced by the proposed KARRR RNAV SID as depicted in Figure 1. The KARRR RNAV SID transitions will emulate the en route transitions used for proposed IAH and HOU southwest bound RNAV SIDs. Departures from these airports will be radar vectored as they are today to join the KARRR RNAV SID prior to entering ZHU's airspace. I90 satellite airports utilizing these procedures are shown in Table 1 below.

## OAPM Design Package: Houston KARRR RNAV SID

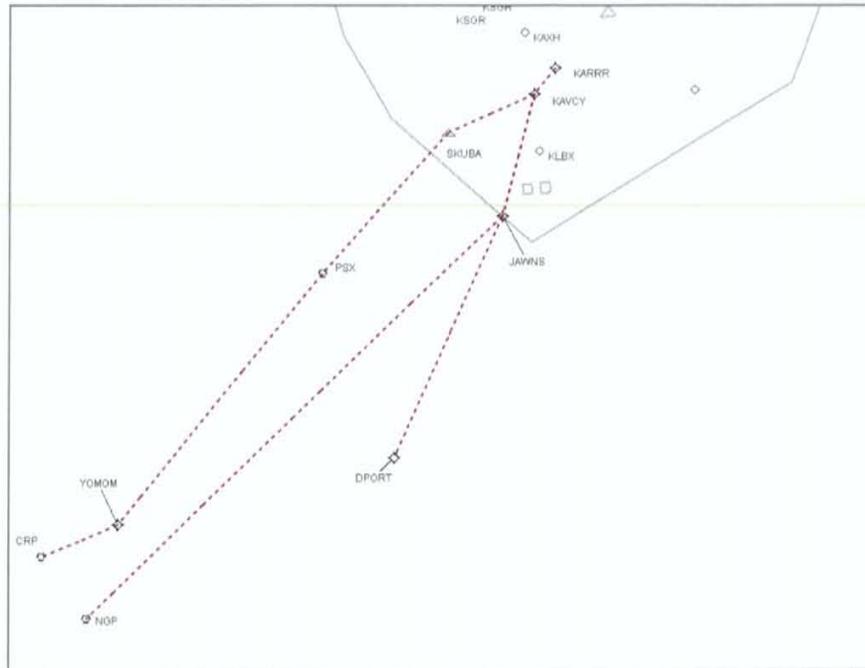


Figure 1. Proposed KARRR SID

## OAPM Design Package: Houston KARRR RNAV SID

Airport ID	Airport Name South of J2		Airport ID	Airport Name North of J2
AXH	Houston Southwest		CXO	Lone Star Executive
EFD	Ellington Field		DWH	David Wayne Hooks Memorial
GLS	Scholes International		EYQ	Weiser Air Park
HPY	Baytown			
IWS	West Houston			
LBX	Brazoria County			
LVJ	Pearland Regional			
SGR	Sugar Land Regional			
TME	Houston Executive			
T00	Chambers County			
T41	La Porte Municipal			
54T	RWJ Airpark			

**Table 1. Houston OAPM Satellite Airports**

### Proposed Design and Implementation Dependencies

This procedure is dependent on the following procedures:

**STARs:**

HTOWN  
TEJAS

**SIDs:**

RITAA  
PTRON

### Additional Design Considerations

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

## **OAPM Design Package: Houston KARRR RNAV SID**

### **Attachments**

1. Houston OAPM D&I Master TARGETS File
2. KARRR TARGETS Distribution File

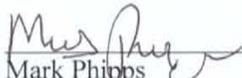
---

3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston KARRR RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
Mark Phipps  
Houston Metroplex  
FAA Lead

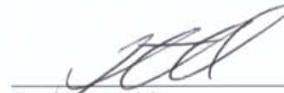
1-8-13  
Date

  
Keith Brown  
Houston Metroplex  
NATCA Lead

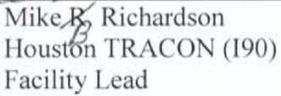
12/27/12  
Date

  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

1/2/13  
Date

  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

12/28/12  
Date

  
Mike B. Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
Date

  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/4/13  
Date

## OAPM Design Package: Houston Metroplex LURIC RNAV SID

<b>Name of Change</b>	<b>LURIC SID</b>	<b>Date</b>	<b>06-19-12</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, T11, T14, I23</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 49, 46 <b>ZFW Sectors:</b> 30, 86, 52, 28	<b>Facility Points of Contact</b>	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
<b>Related/Dependent Submissions</b>	<b>SIDs:</b> STRYA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase III TARGETS File</b></li> <li><b>2. LURIC TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

## **OAPM Design Package: Houston Metroplex LURIC RNAV SID**

### **Purpose**

This design package addresses issues with the Houston Terminal northbound SIDs identified by the Houston OAPM Study Team:

#### **IAH:**

1. IAH northbound departures currently spend approximately 45 to 60 seconds in level flight at 4,000 ft. The main reasons for this are the downwind arrival traffic descending to 6,000 ft, and the HOU departures climbing to 5,000 ft.
2. The SIDs extend too far into en route airspace and limit user flexibility. A request was made for earlier “jumping off” points to give aircraft an earlier capability for a more direct routing. ZHU also stated that automation problems do not let the aircraft come off of the assigned SID earlier due to too many T-fixes on the routes.

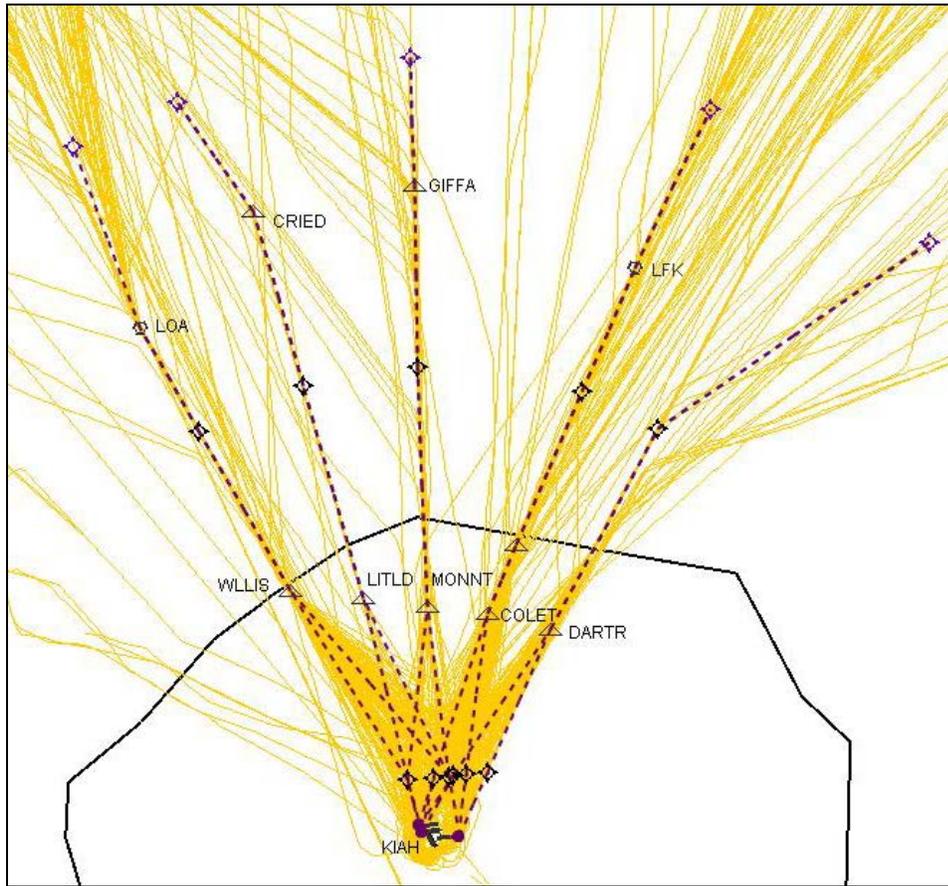
#### **HOU:**

1. IAH departures are stopped at 4,000 ft for HOU departures as well as their own downwind traffic, even though HOU traffic currently shows no significant level-offs.
2. Users were again concerned with the length of SIDs since they tie in with IAH SIDs in the en route environment.

Figure 1 depicts the current IAH northbound SIDs.

Figure 2 depicts the current HOU northbound SIDs.

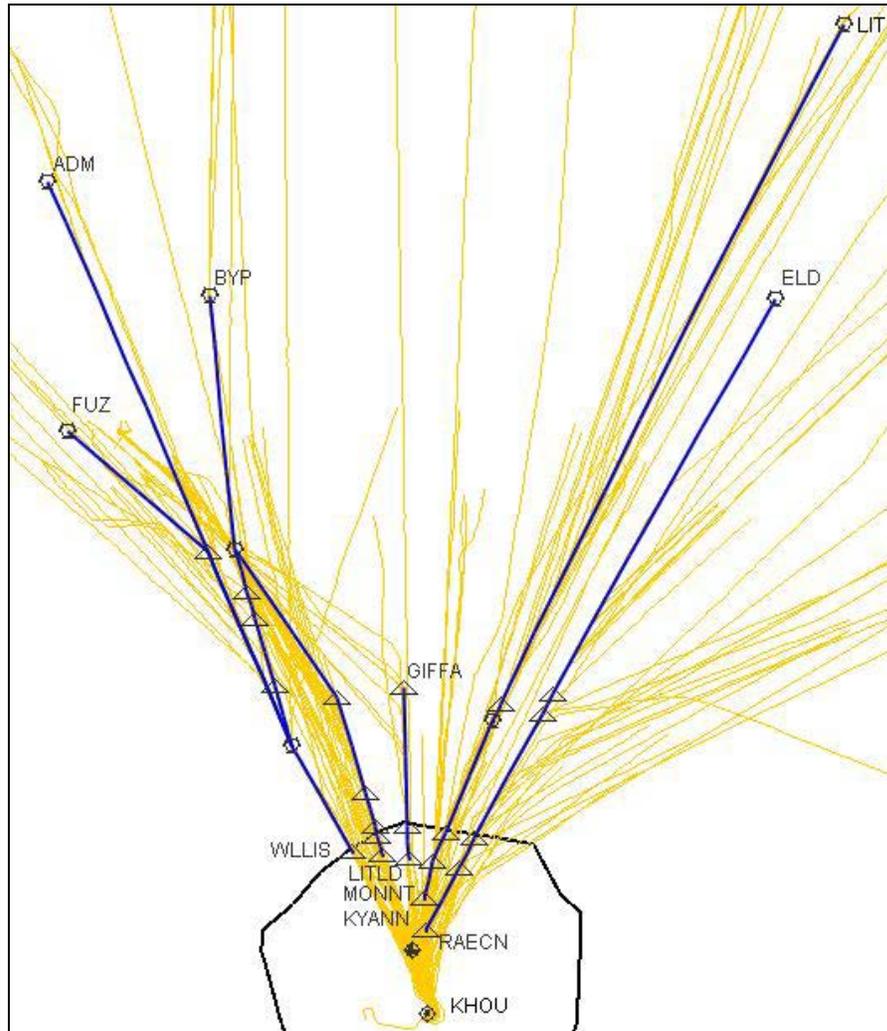
# OAPM Design Package: Houston Metroplex LURIC RNAV SID



**Figure 1. Current IAH Northbound SIDs**

# OAPM Design Package: Houston Metroplex

## LURIC RNAV SID



**Figure 2. Current HOU Northbound SIDs**

## **OAPM Design Package: Houston Metroplex LURIC RNAV SID**

### **Study Team Recommendation**

#### **IAH:**

1. Six conceptual RNAV SIDs, three for each configuration, were created for IAH northbound departures. Runway transitions were included in the design for more repeatable and predictable paths, but because of the proficient vectoring by departure controllers, the procedures designed off Runways 15L/R were kept as radar vector RNAV procedures. Aircraft will be initially vectored on departure to one of three waypoints that are located approximately 7 NM north of IAH.
2. The north downwind was raised from 6,000 ft to 10,000 ft to allow for a higher initial climb, eliminating the 4,000 ft level-off. Upon reaching the waypoints north of IAH and clear of the north downwind, the aircraft join the lateral and vertical path of the designed procedure which is separated from the STARs. Using this concept, complexity and workload issues are reduced for controllers and pilots alike.
3. Once the aircraft exit I90 airspace, they are on a modified shorter route that terminates approximately 100 miles from the airport.

Figure 3 depicts the proposed IAH northbound SIDs.

#### **HOU:**

1. The conceptual HOU SIDs were designed to tie into the IAH SIDs. The dynamic of raising the IAH downwinds changed the initial concept of HOU departures. Through multiple analyses and simulator runs, it was determined that the IAH south downwind could not be raised due to the climb capability of aircraft departing HOU northbound. With the IAH south downwind remaining at 6,000 ft, it was possible to climb HOU northbound traffic above both the IAH downwinds. The first restriction will be at or above 7,000 ft and the second will be at or above 11,000 ft (north IAH downwind is 10,000 ft descending to 7,000 ft).
2. Another issue for HOU northbound departures was traffic departing from Runways 30 and 04. An RNAV off-the ground procedure could not be designed to effectively “top” the south downwind. The OST decided that the current radar vectoring operation would be the most efficient for departures from these runways. Runway transitions were, however, designed for Runways 12L, 12R, and 22. There is an “at or below 5,000 ft” restriction to provide separation from the TXMEX arrival. All HOU departures are restricted to 5,000 ft or below in today’s environment.

Figure 4 depicts the proposed HOU northbound SIDs.

# OAPM Design Package: Houston Metroplex

## LURIC RNAV SID

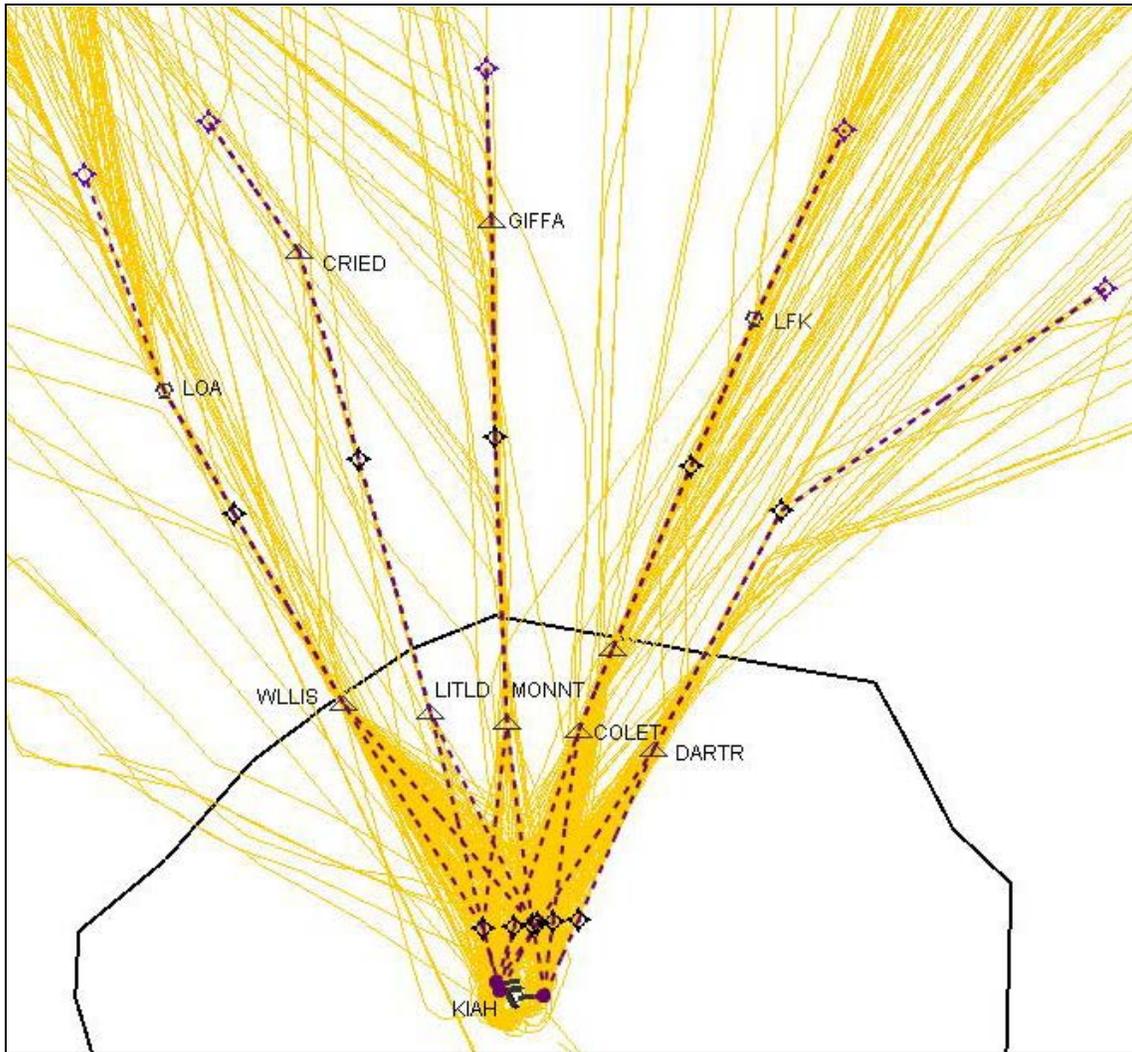
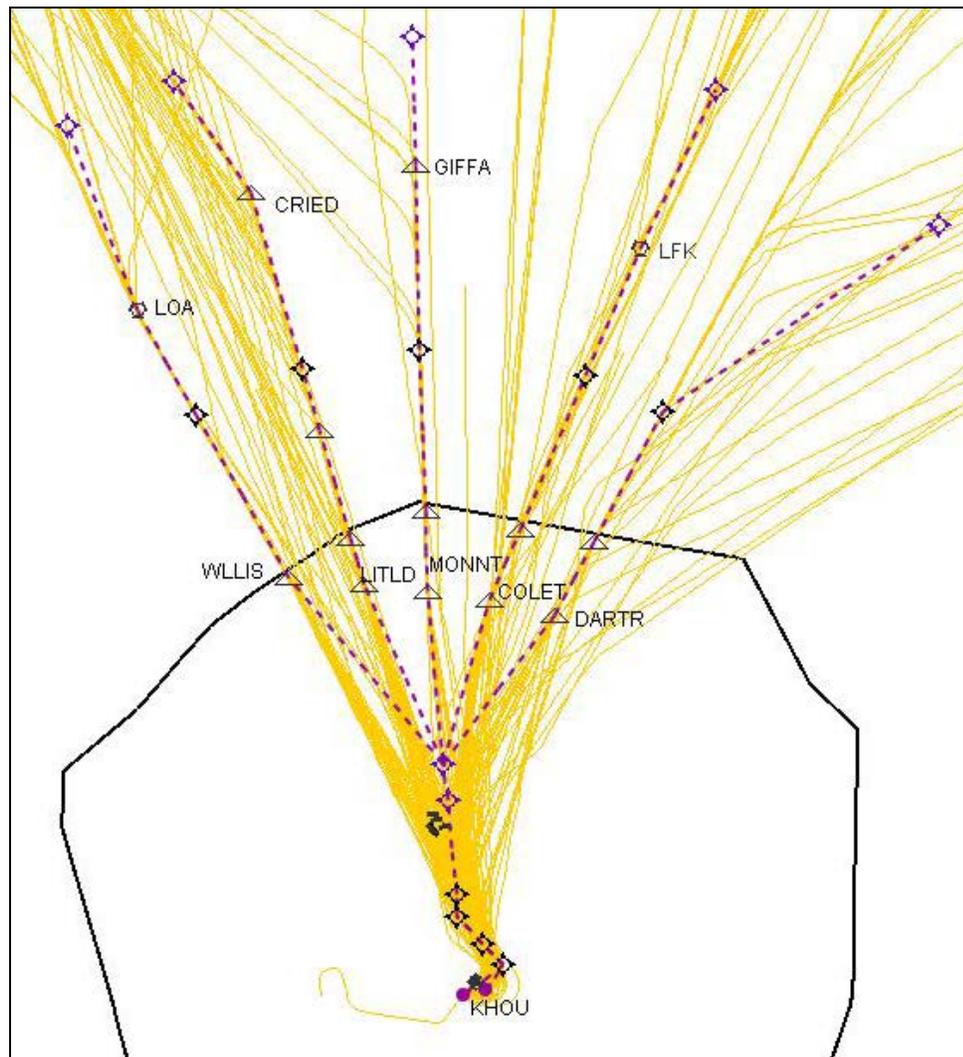


Figure 3. Study Team Proposed IAH Northbound SIDs

# OAPM Design Package: Houston Metroplex

## LURIC RNAV SID



**Figure 4. Study Team Proposed HOU Northbound SIDs**

# OAPM Design Package: Houston Metroplex

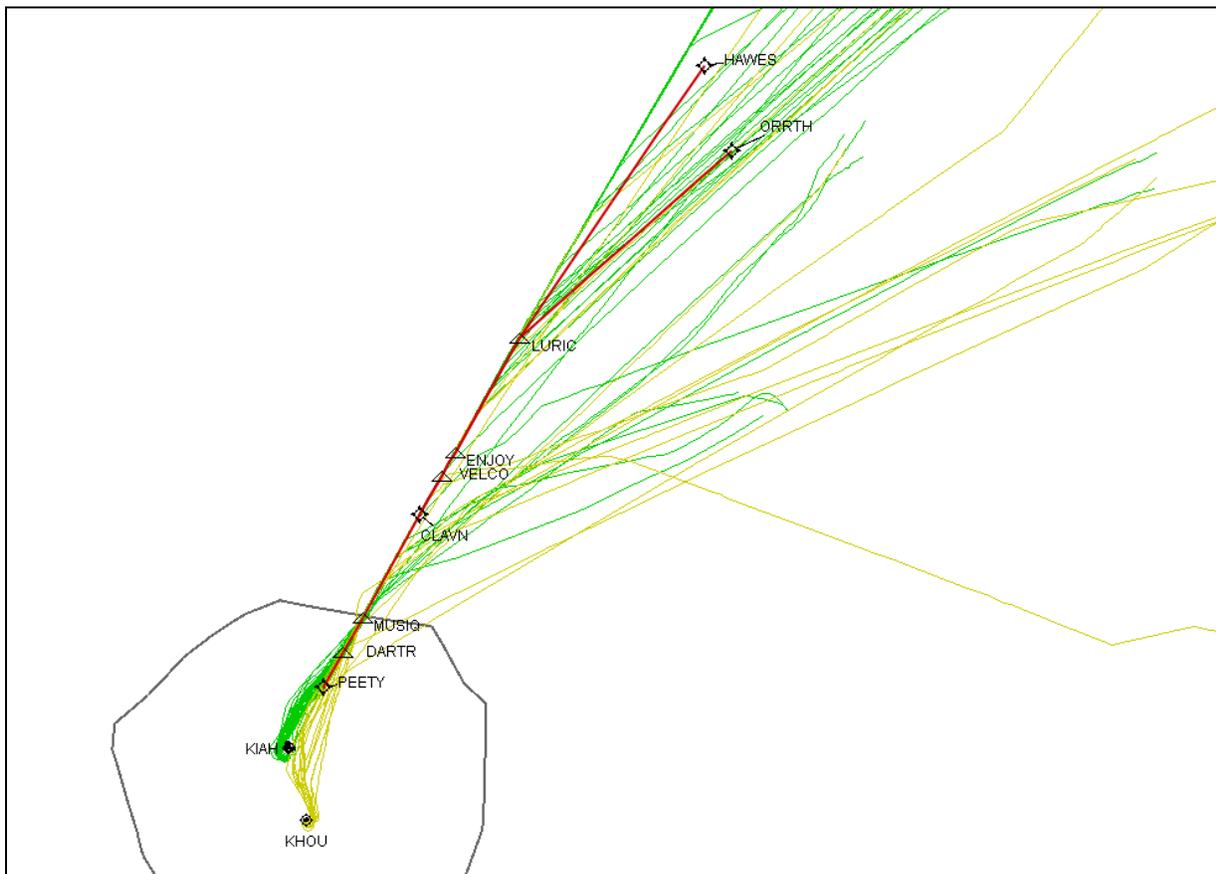
## LURIC RNAV SID

### Proposed Final Design

The Design Team proposed six RNAV SIDs to replace today's six northbound SIDs: LOA, CRIED, GIFFA, LFK, ELD and AEX. These SIDs would be replaced by the STYCK, DREMR, WYLSN, INDIE, LURIC and STRYA SIDs. The LURIC SID would begin with a radar vector because a more efficient departure could not be built using current RNAV SID criteria.

The LURIC SID would replace the current ELD SID and would have ORRTH and HAWES en route transitions.

The North Texas OAPM D&I team recommended the ORRTH and HAWES transitions extend beyond D10 arrival traffic inbound from the southeast and D10 eastbound departures to allow deconfliction from these routes.



**Figure 5. Proposed LURIC SID**

## **OAPM Design Package: Houston Metroplex LURIC RNAV SID**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **SIDs:**

STRYA

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZFW, ZHU, and I90 internal Standard Operating Procedures and Letters of Agreement.

### **Attachments**

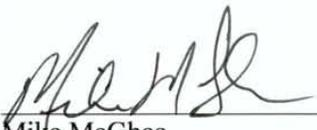
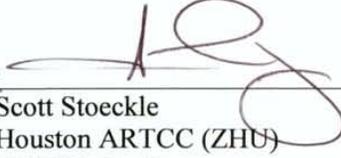
1. Phase III TARGETS File
2. LURIC TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex LURIC RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 _____ Kerth Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
--	------------------------	---	------------------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/25/12</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
---	------------------------	--	------------------------

 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>6-20-12</u> Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	<u>6-25-12</u> Date
---	------------------------	---	------------------------

## OAPM Design Package: Houston Metroplex LURIC RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 Allen Borchers George Bush Intercontinental Tower (IAH ATCT) FAA Lead	<u>4/26/12</u> Date	 John Olinger George Bush Intercontinental Tower (IAH ATCT) NATCA Lead	<u>6/26/12</u> Date
 Mike Sapp William P. Hobby Tower (HOU ATCT) FAA Lead	<u>6/28/12</u> Date	 Kevin Butler William P. Hobby Tower (HOU ATCT) NATCA Lead	<u>6/28/12</u> Date

## OAPM Design Package: Houston MMALT RNAV SID

<b>Name of Change</b>	<b>MMALT SID</b>	<b>Date</b>	<b>05-17-2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, E48, I4, I22, I29</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 Houston ARTCC Sectors 23, 36, 70</b>	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552 Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> BAYYY PUCKS BOOZZ GILLL BRSKT TQNIK <b>SIDs:</b> FLYZA GUMBY MMUGS	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li>1. Phase I TARGETS File</li> <li>2. MMALT TARGETS Distribution Package</li> <li>3. Procedure Change Table</li> </ol>

## OAPM Design Package: Houston MMALT RNAV SID

### Purpose

Specific RNAV procedures were not addressed by the Houston OAPM D and I Study team. The proposed MMALT SID will provide an RNAV departure procedure similar to RNAV SIDs for IAH and HOU.

---

### Study Team Recommendation

The Houston OAPM Study Team did not propose satellite airport departure procedures.

### Proposed Final Design

Eastbound departures from satellite airports exit terminal airspace utilizing existing departure procedures serving IAH and HOU. The LCH, GUSTI and SBI SIDs would be replaced by the proposed MMALT RNAV SID as depicted in Figure 1. The MMALT RNAV SID transitions will emulate the en route transitions used for proposed IAH and HOU eastbound RNAV SIDs. All turbojet/turboprop departures from these airports will be radar vectored as they are today to join the MMALT RNAV SID prior to entering ZHU's airspace. 190 satellite airports utilizing these procedures are shown in Table 1 below.

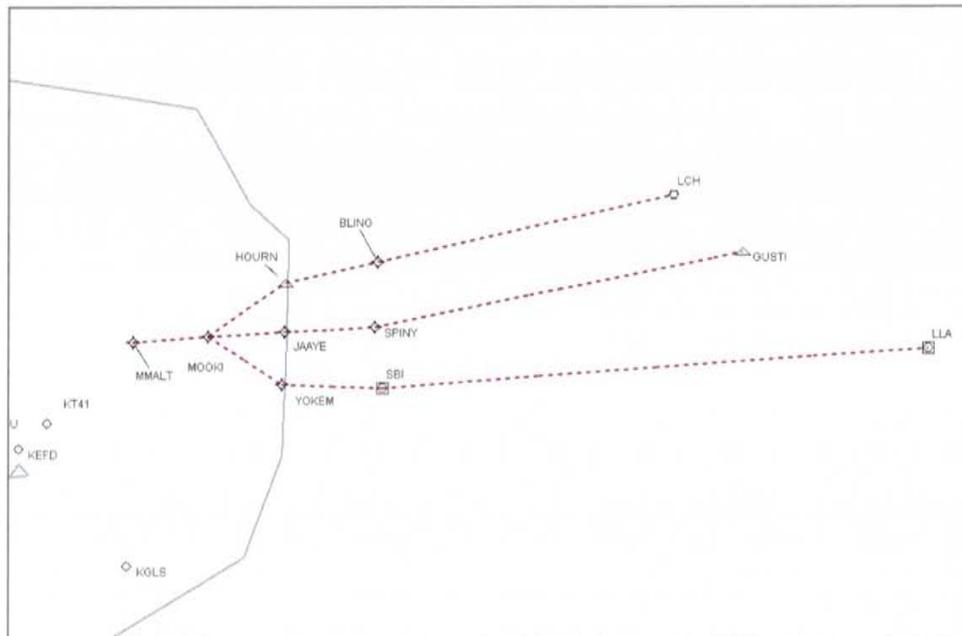


Figure 1. Proposed MMALT SID

## OAPM Design Package: Houston MMALT RNAV SID

Airport ID	Airport Name South of J2		Airport ID	Airport Name North of J2
AXH	Houston Southwest		CXO	Lone Star Executive
EFD	Ellington Field		DWH	David Wayne Hooks Memorial
GLS	Scholes International		EYQ	Weiser Air Park
HPY	Baytown			
IWS	West Houston			
LBX	Brazoria County			
LVJ	Pearland Regional			
SGR	Sugar Land Regional			
TME	Houston Executive			
T00	Chambers County			
T41	La Porte Municipal			
54T	RWJ Airpark			

**Table 1. Houston OAPM Satellite Airports**

### Proposed Design and Implementation Dependencies

This procedure is dependent on the following procedures:

#### **STARs:**

BAYYY  
PUCKS  
BOOZZ  
GILLL  
BRSKT  
TQNIK

#### **SIDs:**

FLYZA  
GUMBY  
MMUGS

### Additional Design Considerations

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

## **OAPM Design Package: Houston MMALT RNAV SID**

### **Attachments**

1. Houston OAPM D&I Master TARGETS File
2. MMALT TARGETS Distribution File

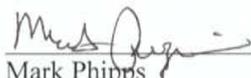
---

3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston MMALT RNAV SID

### Review Signatures

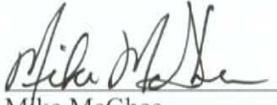
The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

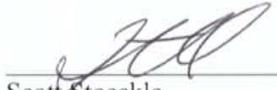
1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

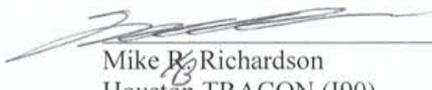
12/27/12  
Date

  
\_\_\_\_\_  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

1/2/13  
Date

  
\_\_\_\_\_  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

12/29/12  
Date

  
\_\_\_\_\_  
Mike Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/4/13  
Date

## OAPM Design Package: Houston Metroplex MMUGS RNAV SID

<b>Name of Change</b>	<b>MMUGS SID</b>	<b>Date</b>	<b>05-08-12</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, T13, I29</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 23, 36, 70	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552</b> <b>Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> WAPPL GILL BRSKT BOOZZ <b>SIDs:</b> FLYZA GUMBY ELOCO	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase I TARGETS File</b></li> <li><b>2. MMUGS TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

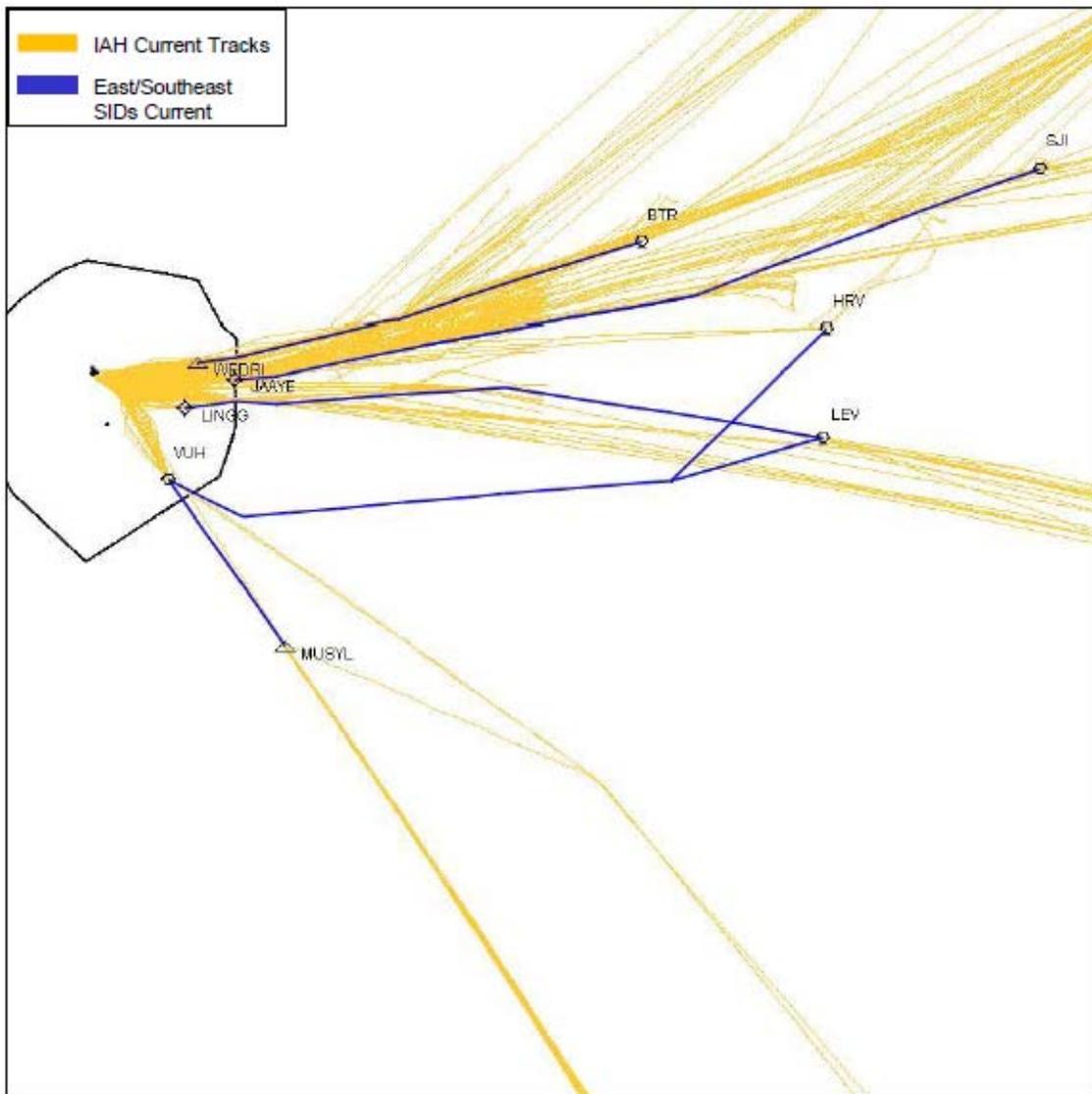
# OAPM Design Package: Houston Metroplex

## MMUGS RNAV SID

### Purpose

This design package addresses issues with the East/Southeast IAH STARs, depicted in Figure 1, identified by the Houston OAPM Study Team:

1. IAH southeast departures currently level off at 4,000 feet for 18 to 42 seconds.
2. Requests were made for additional headings and a possible additional route to the southeast for Florida departure traffic. This could be similar to the current ATC-assigned BOWFN SID, which would eliminate the need for aircraft to head east on initial departure, potentially reducing flying miles.



**Figure 1. Current East and Southeast SIDs**

# OAPM Design Package: Houston Metroplex MMUGS RNAV SID

## Study Team Recommendation

1. The Study Team developed three RNAV SIDs to the east and southeast with runway transitions from Runways 09, 15L, and 15R.
2. The 15L/R departures would use a 115 degree heading for eastbound destinations and a 130 degree heading for southeast and southwest destinations. These diverging departure headings potentially increase departure throughput. Environmental analysis is required to ensure there are no significant noise impacts since these changes occur at low altitudes.
3. The OST proposed an additional routing toward Florida, but ZHU raised concerns about conflicting traffic in the southeast area, so the design was discarded.
4. Again, the OST shortened the length of the SIDs to 100 miles, as shown in Figure 2.
5. All SIDs were procedurally separated from STARs where practical.

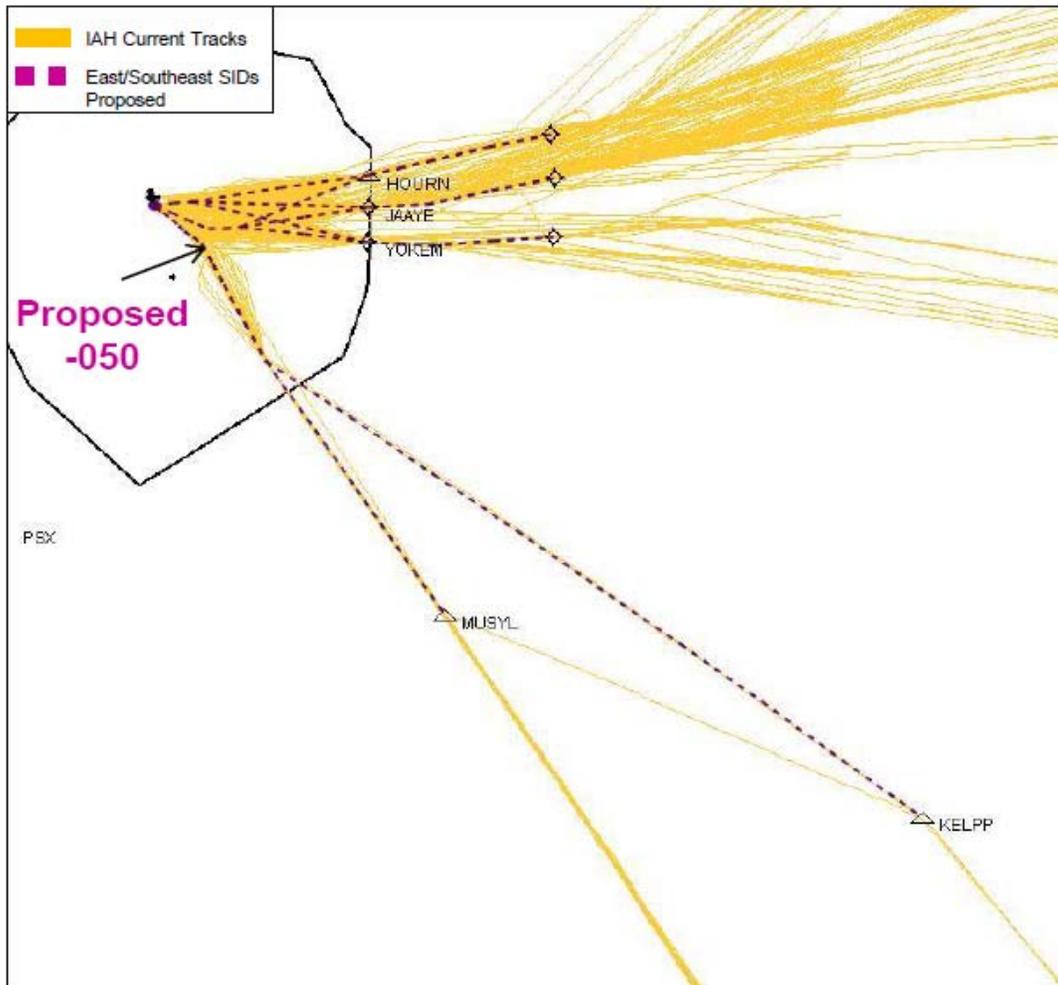


Figure 2. Study Team Recommendation

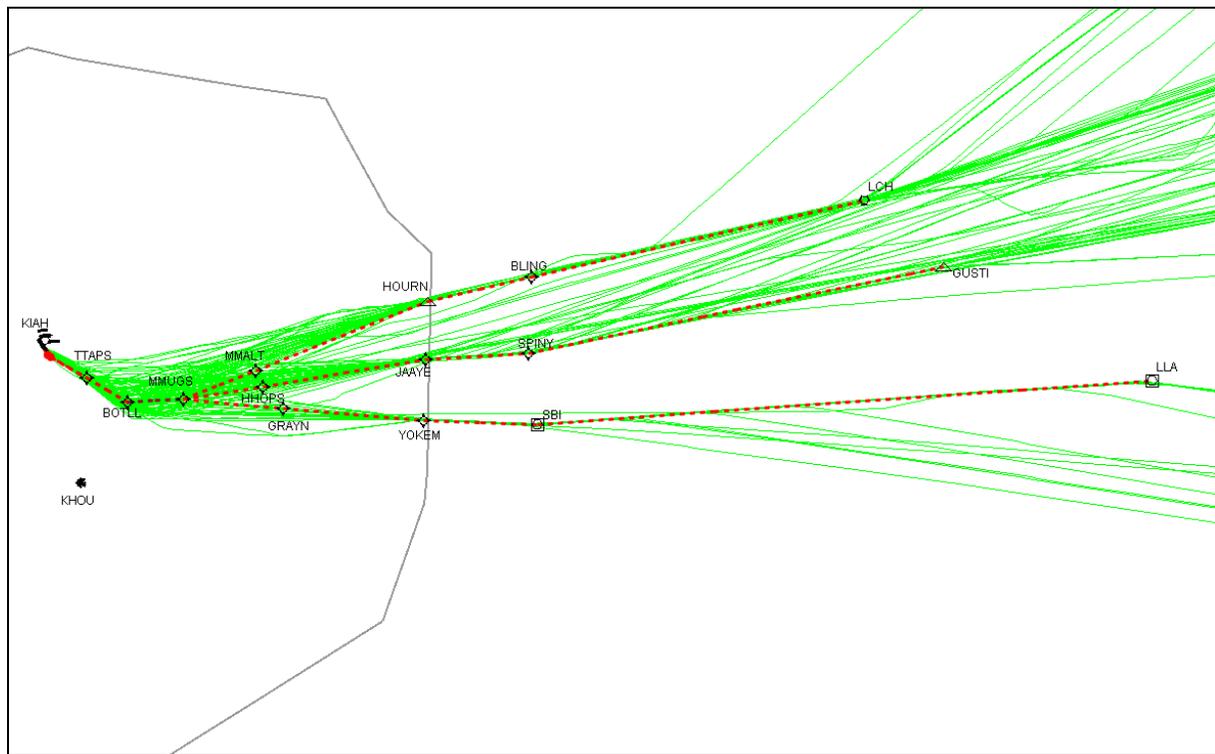
# OAPM Design Package: Houston Metroplex MMUGS RNAV SID

## Proposed Final Design

The Design Team proposes flow dependent RNAV SIDs to replace the three east IAH SIDs; Lake Charles, GUSTI, and Sabine Pass SIDs. These three SIDs would be replaced by the MMUGS and GUMBY SIDs, each with LCH, GUSTI, and SBI transitions. The MMUGS SID would be used when IAH is on a west flow. These procedures would be RNAV off-the-ground for flights departing Runways 15L or 15R. Flights departing other runways will be issued a departure heading to fly. Conventional aircraft would fly a Preferential Departure Route or airway as they do today, based upon cruise altitude stratum and destination.

The Study Team reduced SID length to approximately 100 miles from the airport. The Design Team extended the en route transitions to LCH, GUSTI, and LLA, as shown in Figure 3, to connect better with the en route environment and provide lateral separation from Houston terminal STARs until in the cruise stratum. The LCH and GUSTI transitions connect to Q22 and Q24 respectively.

These proposed SIDs were procedurally deconflicted from STARs where practical.



**Figure 3. Proposed MMUGS SID**

## **OAPM Design Package: Houston Metroplex MMUGS RNAV SID**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

WAPPL  
GILL  
BRSKT  
BOOZZ

#### **SIDs:**

FLYZA  
GUMBY  
ELOCO

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

### **Attachments**

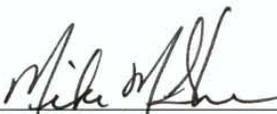
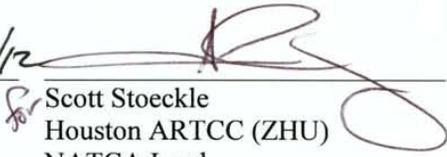
1. Phase I TARGETS File
2. MMUGS TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

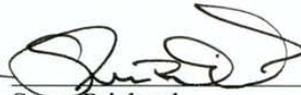
## OAPM Design Package: Houston Metroplex MMUGS RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>5-10-12</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>5/10/12</u> Date
--	------------------------	---	------------------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/12/12</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
---	------------------------	--	------------------------

 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>5-17-12</u> Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	<u>6-12-12</u> Date
---	------------------------	---	------------------------

## **OAPM Design Package: Houston Metroplex MMUGS RNAV SID**

### **Review Signatures**

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Allen Borchers  
George Bush Intercontinental  
Tower (IAH ATCT)  
FAA Lead

6/26/12  
Date

  
\_\_\_\_\_  
John Olinger  
George Bush Intercontinental Tower  
(IAH ATCT)  
NATCA Lead

6/26/12  
Date

## OAPM Design Package: Houston Metroplex

*IAH MMUGS RNAV SID*

### RECORD OF CHANGE

Change Number	Date	Document
001	10/01/2012	MMUGS RNAV SID
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

#### Description of Change

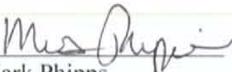
Updated Header with airport information.

This procedure will be used by all RNAV capable aircraft.

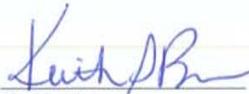
## OAPM Design Package: Houston Metroplex

*IAH MMUGS RNAV SID*

Design Team Lead's Signatures indicates the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

  
\_\_\_\_\_  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston PEECE RNAV SID

<b>Name of Change</b>	<b>PEECE SID</b>	<b>Date</b>	<b>05-17-12</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, T13, I29</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 Houston ARTCC: Sectors 79, 68, 43</b>	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552 Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GILLL BRSKT BOOZZ BAYYY PUCKS TKNIQ <b>SID:</b> FLYZA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase I TARGETS File</b></li> <li><b>2. PEECE TARGETS Distribution File</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

# OAPM Design Package: Houston

## PEECE RNAV SID

### Purpose

The PEECE SID addresses following issues identified by the Houston OAPM Study Team:

1. East and southeast HOU departures will sometimes conflict with the Class D airspace around Ellington Field (EFD). This requires either vectors or point-outs by ATC.
2. All HOU departures to the east are currently routed over SBI as depicted in Figure 1, limiting flexibility and adding flying miles for certain destinations. While ZHU would prefer to route HOU traffic over LCH and GUSTI as well as SBI, I90 has limited airspace due to conflicts with the CLMBA and WOLDE arrivals and eastbound departures from IAH.
3. There are currently no RNAV-off-the-ground procedures in use.

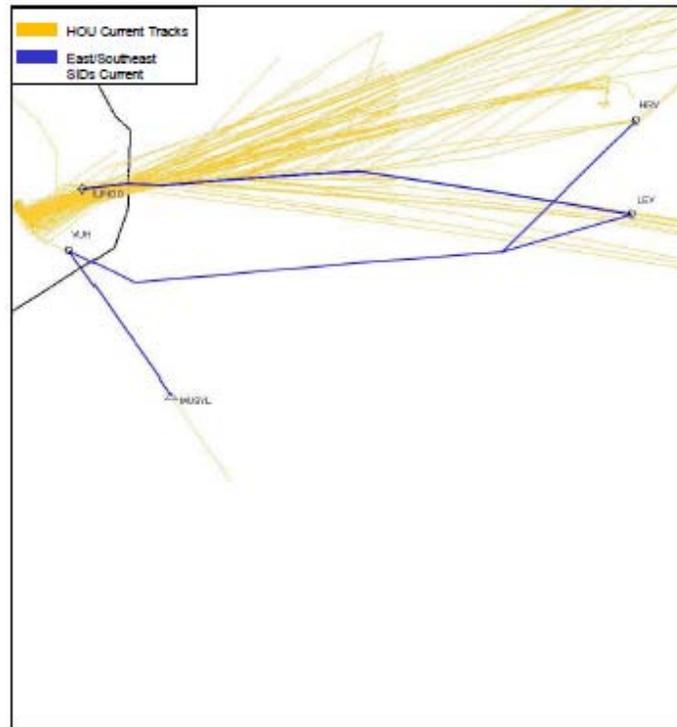


Figure 1. Current VUH and SBI SIDs

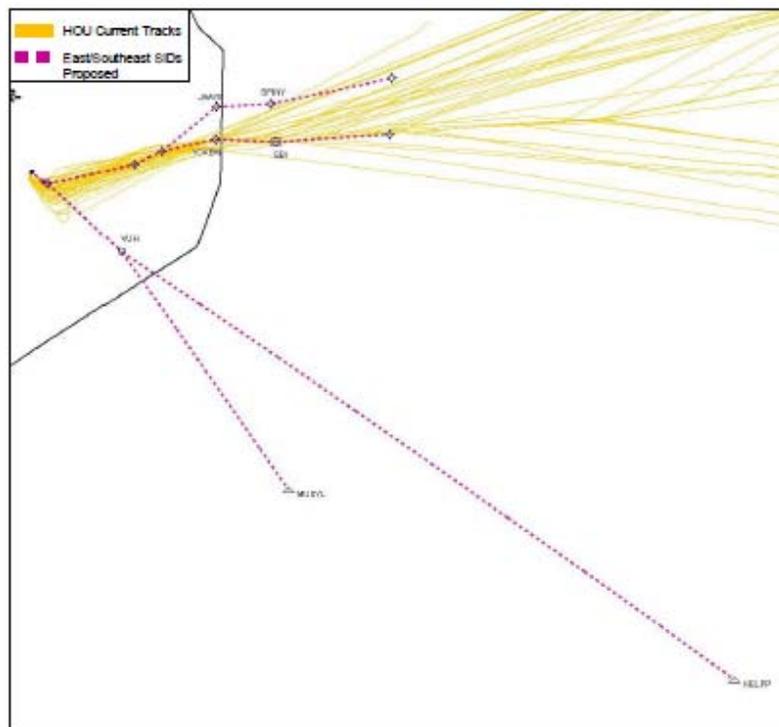
# OAPM Design Package: Houston

## PEECE RNAV SID

### Study Team Recommendation

1. HOU departures to the east and southeast were specifically proposed to tie in with the IAH departure procedures. This would provide HOU an additional option to the east on the GUSTI transition, where they only have one option (SBI) today.
2. The proposed procedures are procedurally separated from other SIDs and STARs where practical. Traffic departing to the east would be restricted below southeast corner arrivals during east flow, and would top that same southeast corner traffic during west flow.
3. The issue with the Ellington (EFD) Class D airspace would be resolved through development of a VI leg to an altitude window that will route aircraft above the ceiling of the Class D airspace.
4. The Houston OAPM Study Team evaluated an additional Florida route, but discarded the procedure due to traffic conflicts, and at the request of Houston ARTCC.
5. The lengths of the proposed en route transitions were modified to 100 miles and all procedures were procedurally separated where practical.

Figure 2 depicts the Study Team’s proposed HOU east and southeast departures.



**Figure 2. Study Team Recommendation**

# OAPM Design Package: Houston

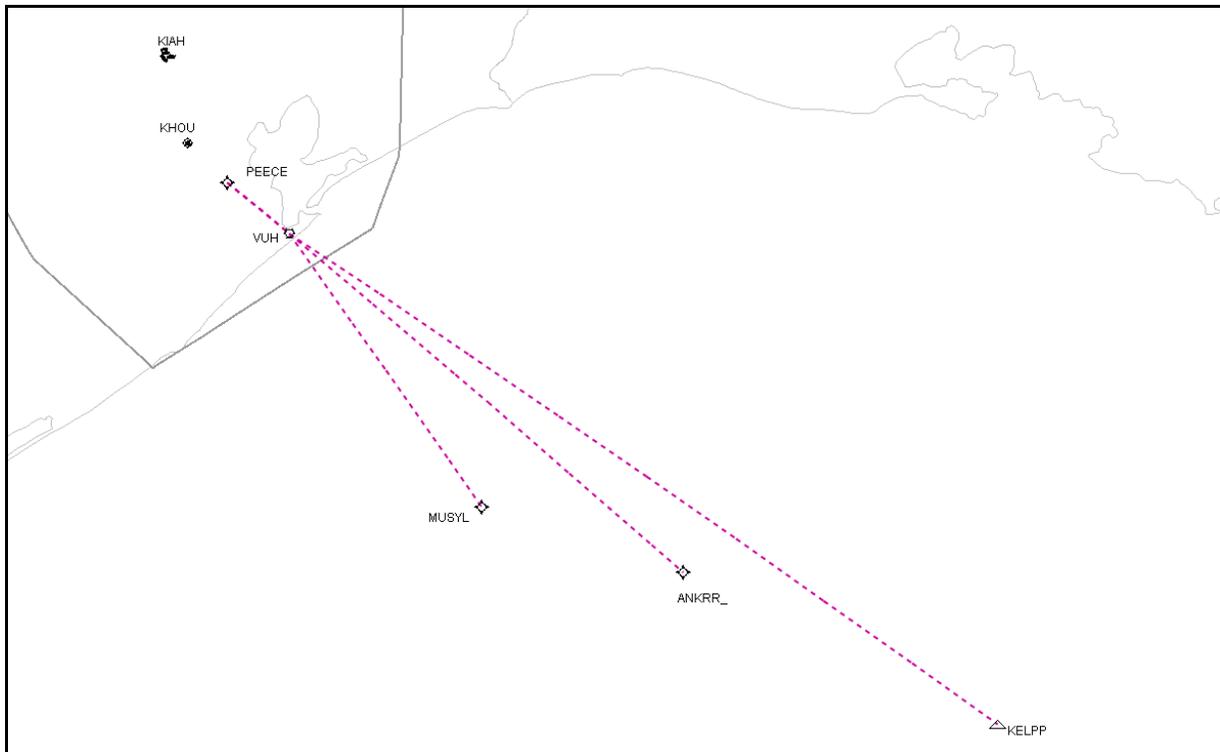
## PEECE RNAV SID

### Proposed Final Design

The current HOU VUH SID would be replaced by the PEECE RNAV SID. Aircraft on this procedure would be issued radar vectors to PEECE. Conventional aircraft would fly a Preferential Departure Route or airway as they do today based on cruise altitude stratum and destination.

The Design Team revised en route transitions to align with the proposed Gulf of Mexico Required Navigation Performance (RNP) routes, as shown in Figure 3.

This proposed SID was procedurally deconflicted from STARs where practical.



**Figure 3. Proposed PEECE SID**

## **OAPM Design Package: Houston PEECE RNAV SID**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

GILLL  
BRSKT  
BOOZZ  
BAYYY  
PUCKS  
TKNIQ

#### **SID:**

FLYZA

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

The proposed Gulf of Mexico routes were not available during the study team process.

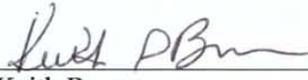
### **Attachments**

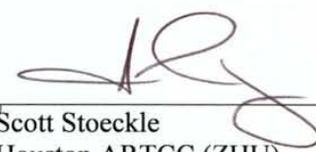
1. Phase I TARGETS File
2. PEECE TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

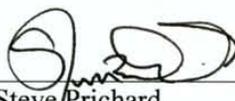
## OAPM Design Package: Houston PEECE RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	5-17-12 _____ Date	 _____ Keith Brown Houston Metroplex NATCA Lead	5/17/12 _____ Date
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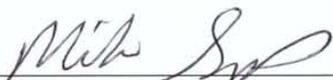
 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/12/12 _____ Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 _____ Date
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 _____ Mike R. Richardson Houston TRACON (190) Facility Lead	5-17-12 _____ Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	6-12-12 _____ Date
---	--------------------------	---	--------------------------

## OAPM Design Package: Houston PEECE RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mike Sapp  
William P. Hobby Tower (HOU  
ATCT)  
FAA Lead

Date *for*  6/28/12  
\_\_\_\_\_  
Date  
Kevin Butler  
William P. Hobby Tower (HOU  
ATCT)  
NATCA Lead

**OAPM Design Package: Houston Metroplex**  
*HOU PEECE RNAV SID*

**RECORD OF CHANGE**

<b>Change Number</b>	<b>Date</b>	<b>Document</b>
001	11/01/2012	PEECE RNAV SID
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

**Description of Change**

Updated Header with airport information.

This procedure will be used by all RNAV capable aircraft.

The design team amended the procedure to provide connectivity with proposed Gulf of Mexico RNAV ATS routes. The original design proposal is shown in Figure 1. ANKRR waypoint was moved 11.06 NM as shown in Figure 2. The TARGETS file and TARGETS distribution files were updated.

## OAPM Design Package: Houston Metroplex

*HOU PEECE RNAV SID*

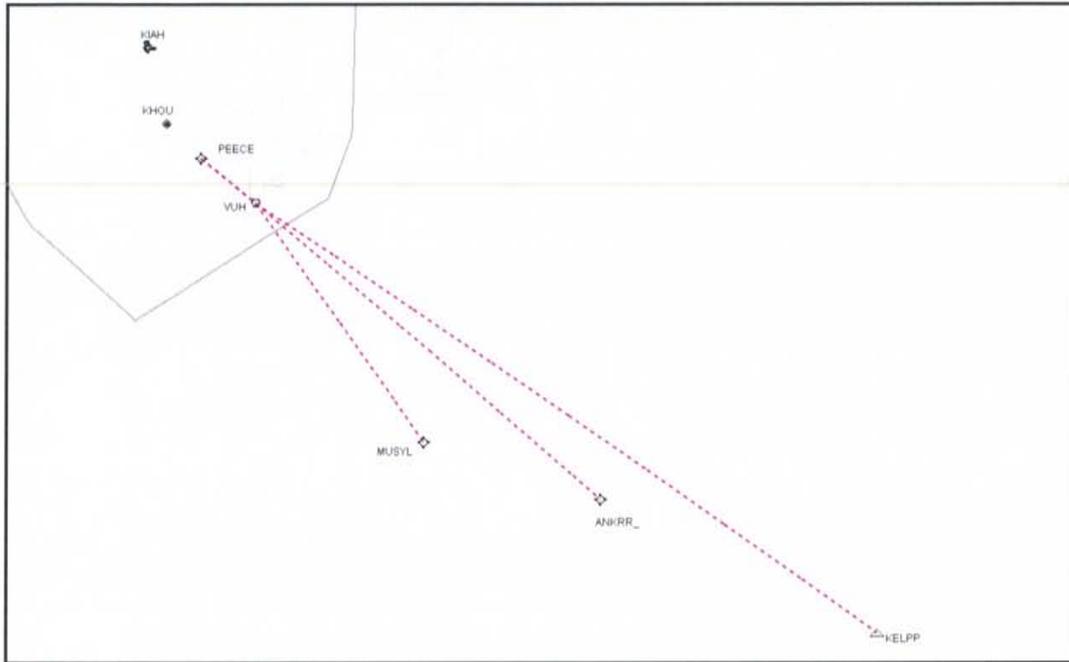
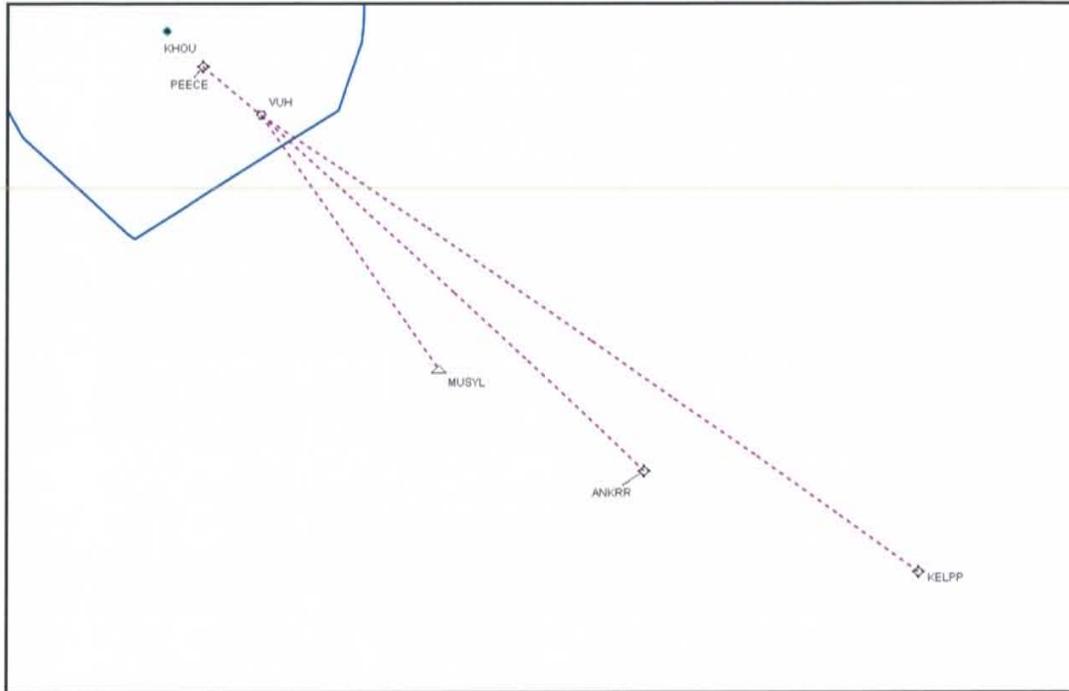


FIGURE 1. PEECE RNAV SID PROPOSED DESIGN (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*HOU PEECE RNAV SID*

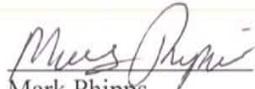


**FIGURE 2. PEECE RNAV SID PROPOSED DESIGN (Will replace Figure 3 in PFD)**

## OAPM Design Package: Houston Metroplex

*HOU PEECE RNAV SID*

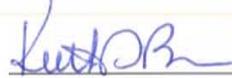
Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.



Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13

Date



Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13

Date

## OAPM Design Package: Houston PITZZ RNAV SID

<b>Name of Change</b>	<b>PITZZ SID</b>	<b>Date</b>	<b>06-20-12</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, E53</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>IAH ATCT</b> <b>I90</b> <b>ZHU Sectors:</b> 74, 78, 80	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs:</b> GUSHR DRLLR TTORO MSCOT KIDDZ <b>SIDs:</b> BNDTO DOBBY	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase IV TARGETS File</b></li> <li><b>2. PITZZ TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

### Purpose

The PITZZ SID addresses the following issues identified by the Houston OAPM Study Team for the IAH westbound departures as depicted in Figure 1:

1. Figure 1 depicts the current IAH departures to the west.
2. SIDs extend too far into the en route structure and some transitions are rarely used.

## OAPM Design Package: Houston PITZZ RNAV SID

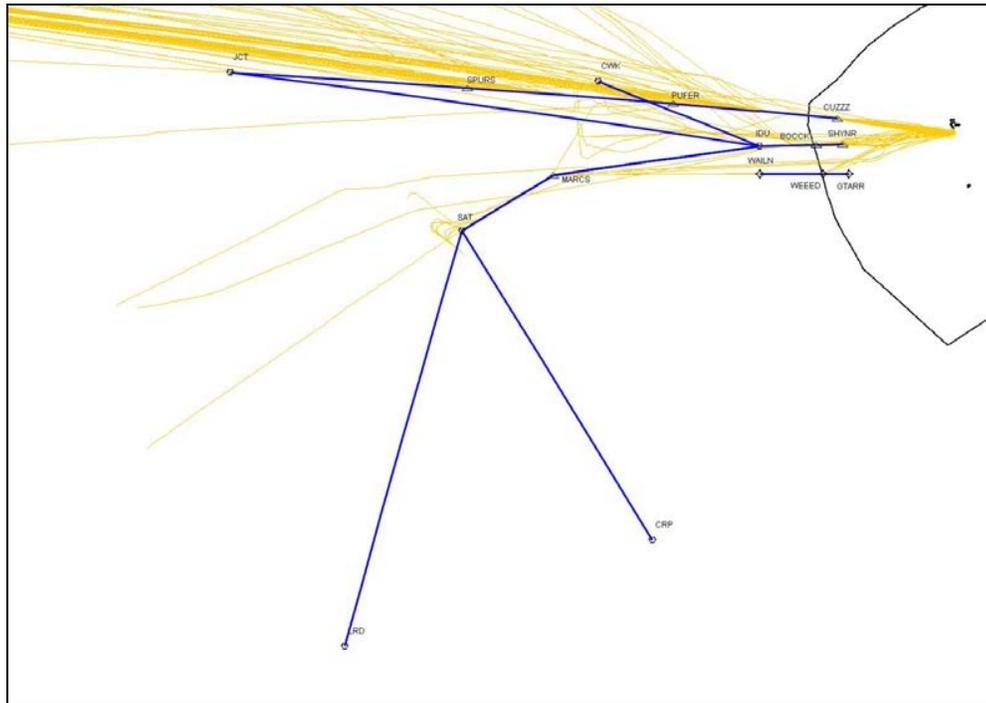


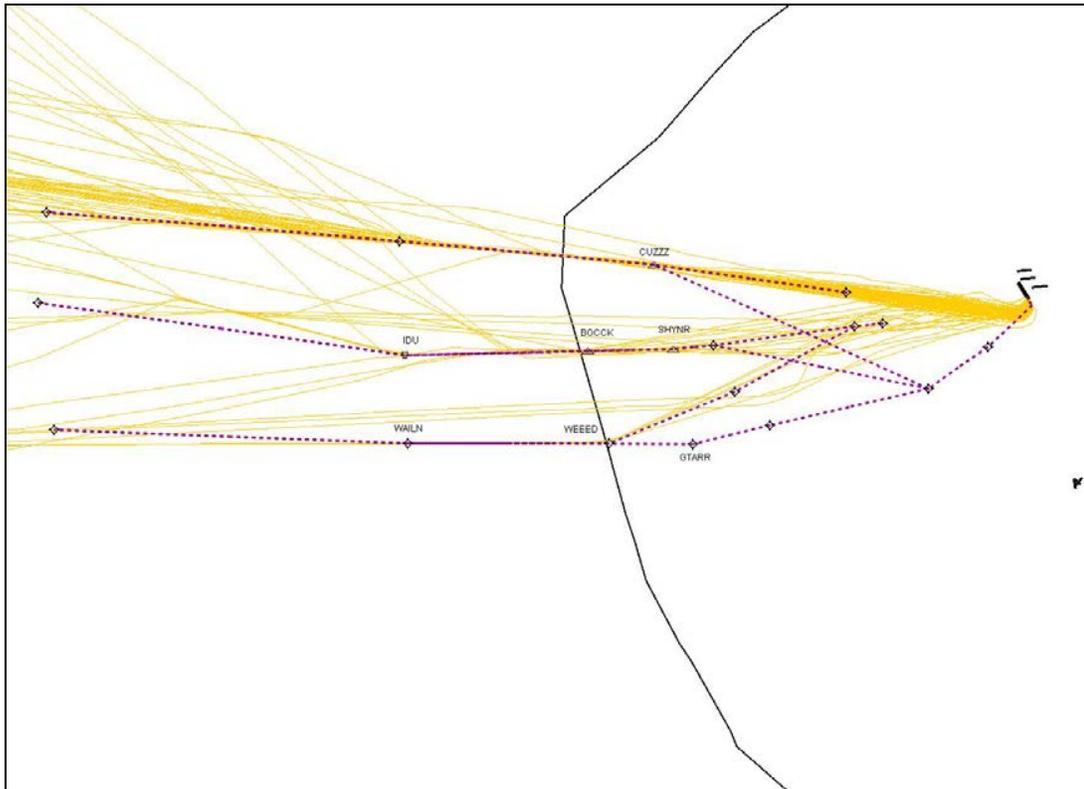
Figure 1. Current JCT, IDU, and WAILN SIDs

### Study Team Recommendation

1. Three RNAV SIDs for IAH west departures provide additional routes and repeatable paths that are separated from other STARs and SIDs where practical.
2. When IAH is in west flow, radar vector departures are utilized in order to retain the shortest path to join the RNAV routes. When IAH is in east flow, an RNAV off-the-ground SID is proposed that is separated from Runway 8L and 8R arrivals.
3. The proposed en route transitions laterally follow existing flight tracks and terminate approximately 100 NM from IAH where most aircraft are expected to reach the cruise stratum (FL290). This provides shorter paths, provides greater route flexibility, and negates the need to plan and carry fuel for a longer transition that might not be flown.
4. Figure 2 depicts the proposed IAH westbound SIDs.

# OAPM Design Package: Houston

## PITZZ RNAV SID



**Figure 2. Study Team IAH West SIDs**

# OAPM Design Package: Houston

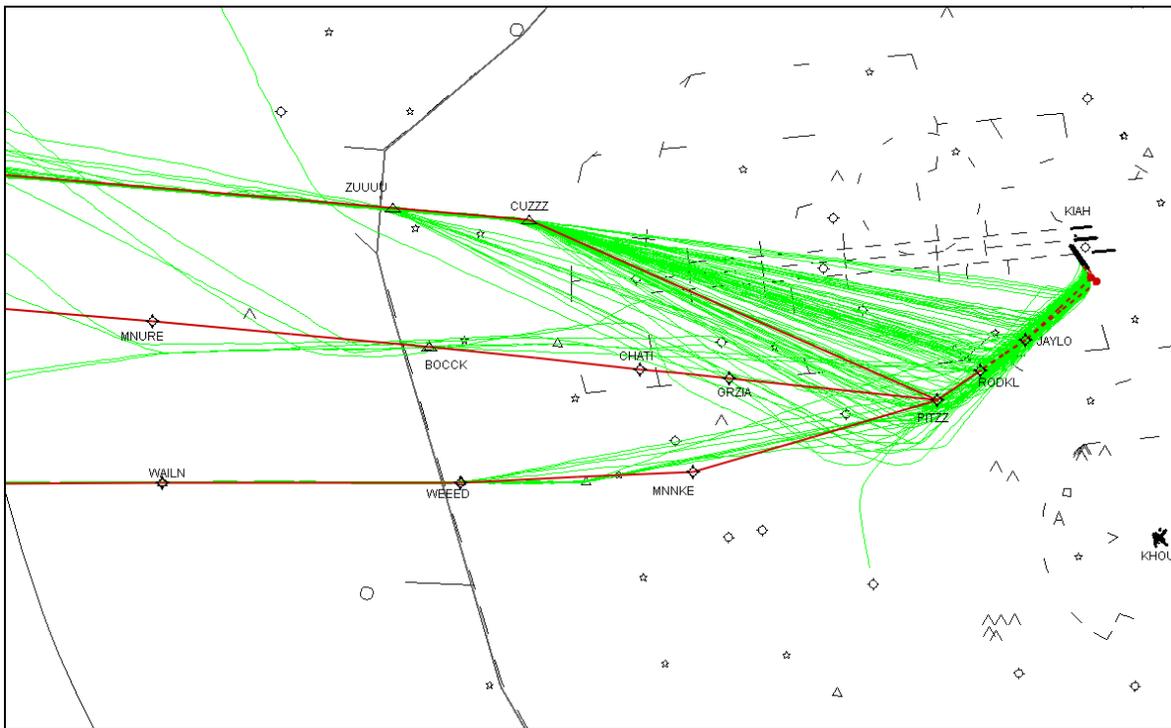
## PITZZ RNAV SID

### Proposed Final Design

The Design Team proposed two flow dependent RNAV SIDs to replace today's three SIDs for IAH westbound departures: JCT, IDU, and WAILN SIDs. These SIDs would be replaced by the PITZZ SID when IAH is landing east.

The PITZZ SID was designed as an RNAV-off-the-Ground procedure for Runways 15L and 15R. The Design Team determined that radar vectors would be more efficient for all other runways due to current RNAV SID criteria.

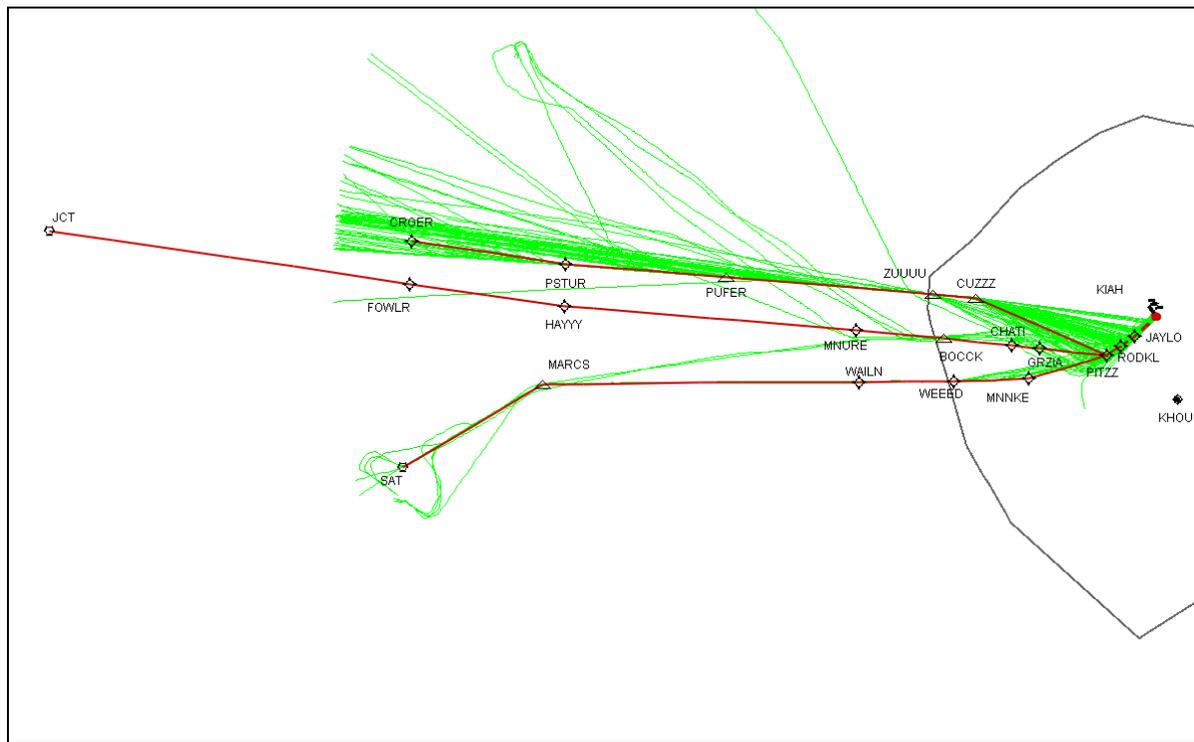
The en route transitions were modified from the Study Team proposal to reduce track miles and to procedurally deconflict aircraft on parallel transitions.



**Figure 3. Proposed PITZZ SID (Terminal)**

# OAPM Design Package: Houston

## PITZZ RNAV SID



**Figure 4. Proposed PITZZ SID (En Route)**

## **OAPM Design Package: Houston PITZZ RNAV SID**

### **Proposed Design and Implementation Dependencies**

This procedure is dependent on the following procedures:

**STARs:**

GUSHR

DRLLR

TTORO

MSCOT

KIDDZ

**SIDs:**

BNDTO

DOBBY

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

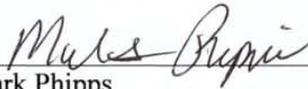
### **Attachments**

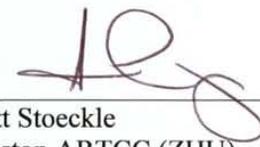
1. Phase IV TARGETS File
2. PITZZ TARGETS Distribution File
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston PITZZ RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 Date
--	-----------------	---	-----------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/26/12 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
---	-----------------	--	-----------------

 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	6-21-12 Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	6-25-12 Date
---	-----------------	---	-----------------

## OAPM Design Package: Houston PITZZ RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

	<u>6/26/12</u>		<u>6/26/12</u>
Allen Borchers	Date	John Olinger	Date
George Bush Intercontinental Tower (IAH ATCT) FAA Lead		George Bush Intercontinental Tower (IAH ATCT) NATCA Lead	

## OAPM Design Package: Houston Metroplex

*IAH PITZZ RNAV SID*

### RECORD OF CHANGE

Change Number	Date	Document
001	11/01/2012	PITZZ RNAV SID
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

#### Description of Change

Updated Header with airport information.

This procedure will be used by all RNAV capable aircraft.

The design team amended the procedure to correct the design intent of the SAT transition. The original design proposal is shown in Figures 1 and 2. The routing to SAT was changed to depart I90 airspace over BOCK waypoint, then via MNURE and MARCS waypoints. PITZZ waypoint was relocated for a criteria issue. These changes are shown in Figures 3 and 4. The TARGETS file and TARGETS distribution files were updated.

## OAPM Design Package: Houston Metroplex

*IAH PITZZ RNAV SID*

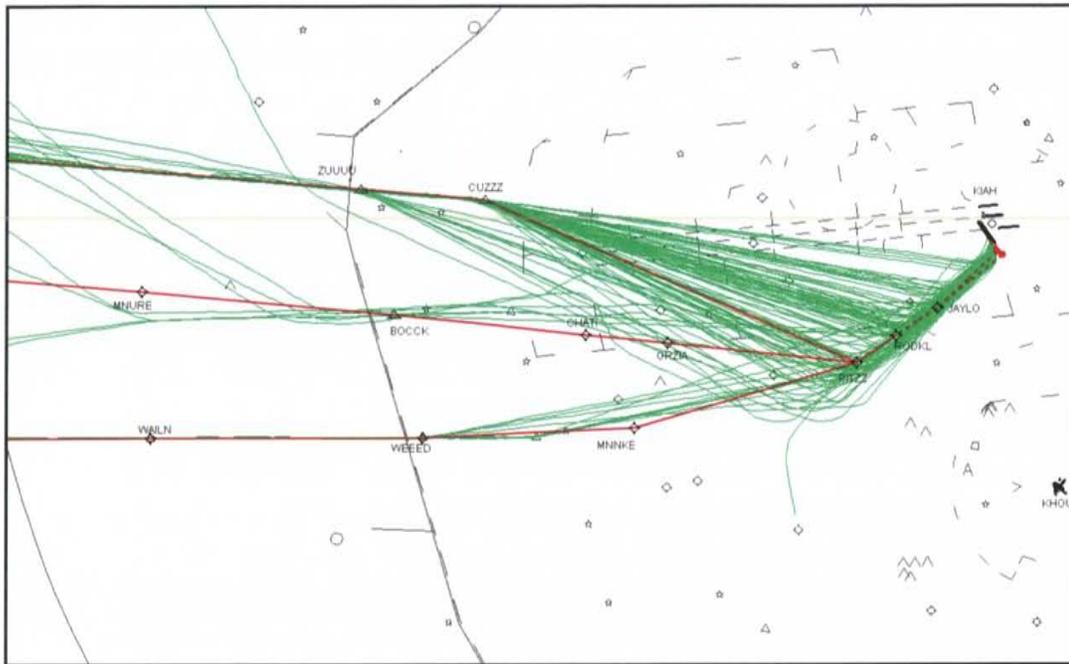


FIGURE 1. PITZZ RNAV SID PROPOSED DESIGN (TERMINAL) (Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

IAH PITZZ RNAV SID

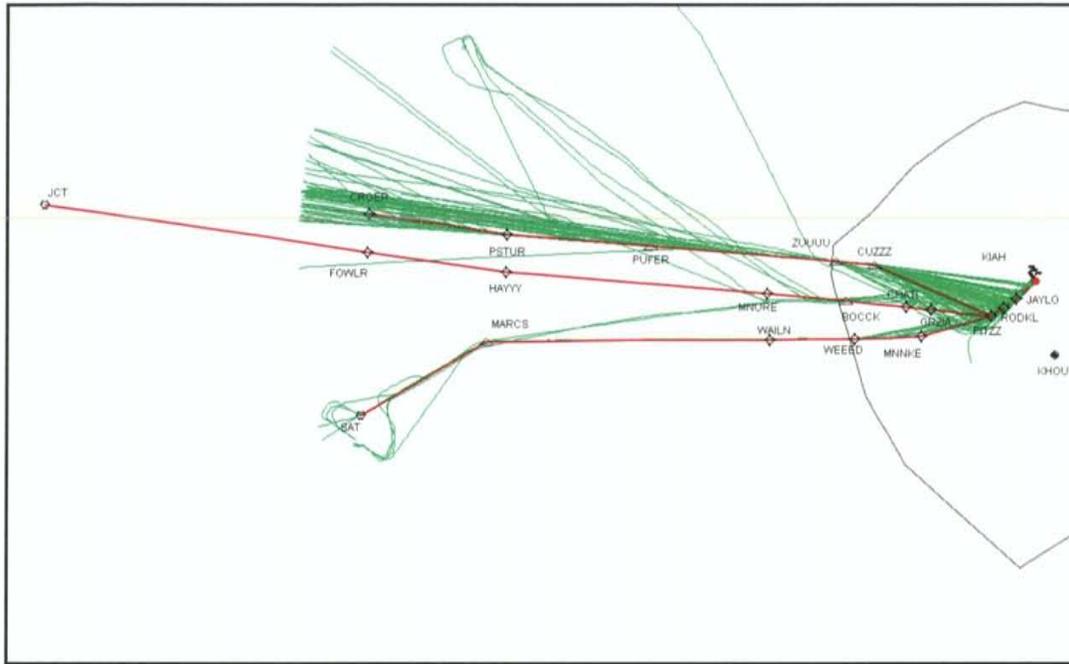


FIGURE 2. PITZZ RNAV SID PROPOSED DESIGN (EN ROUTE) (Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

IAH PITZZ RNAV SID

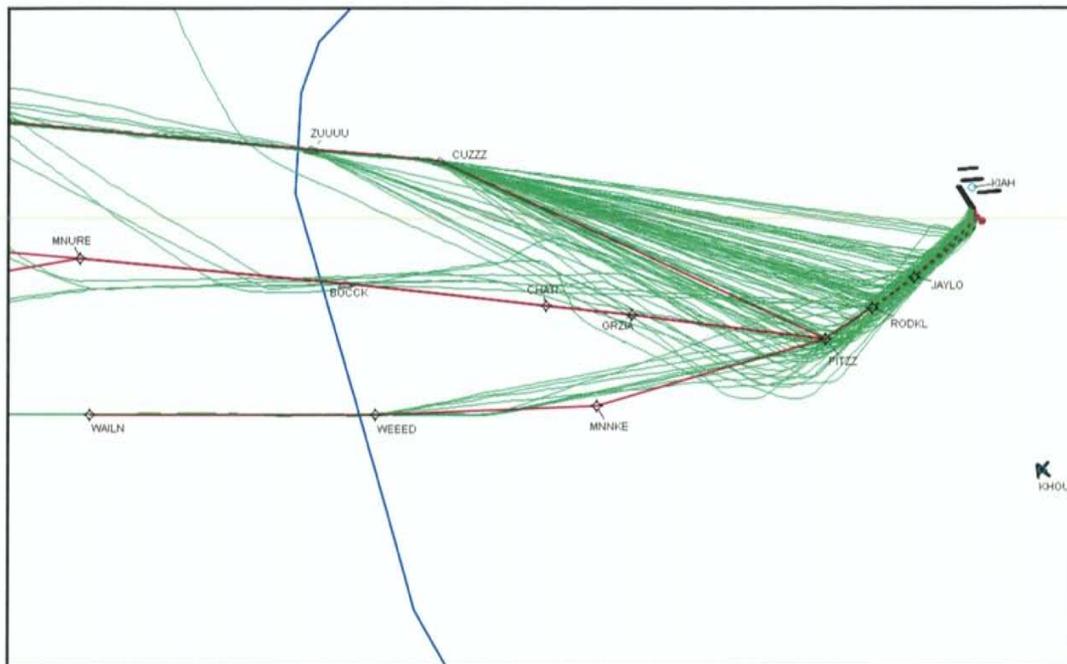
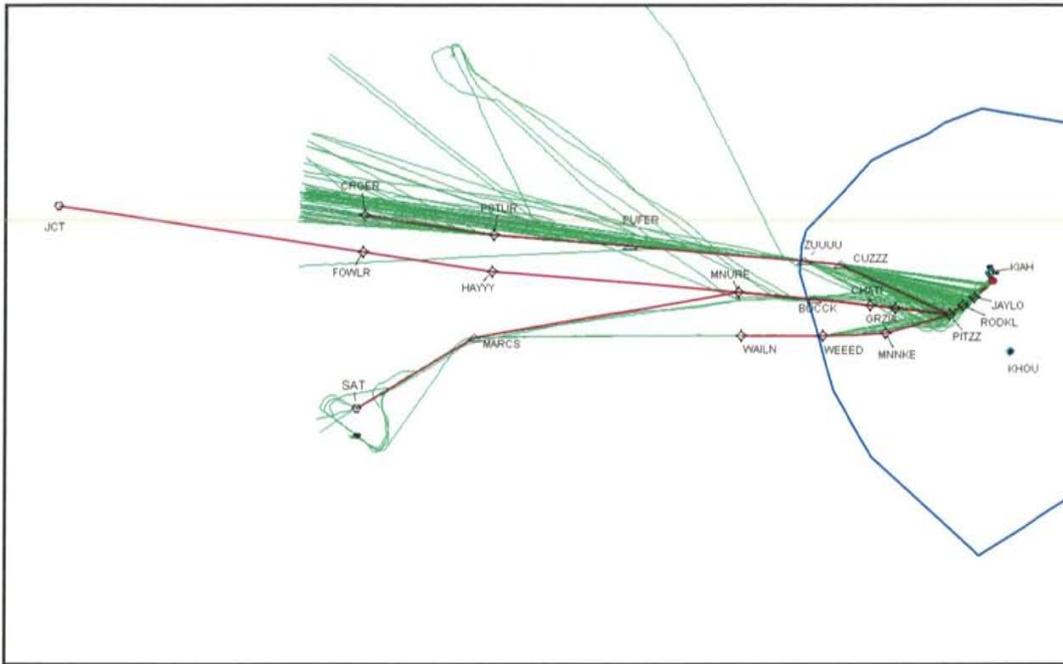


FIGURE 3. PITZZ RNAV SID PROPOSED DESIGN (TERMINAL)

(Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*IAH PITZZ RNAV SID*



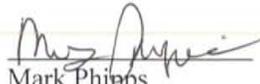
**FIGURE 4. PITZZ RNAV SID PROPOSED DESIGN (EN ROUTE)**

(Will replace Figure 4 in PFD)

## OAPM Design Package: Houston Metroplex

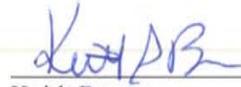
*IAH PITZZ RNAV SID*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.



Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date



Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston PTRON SID

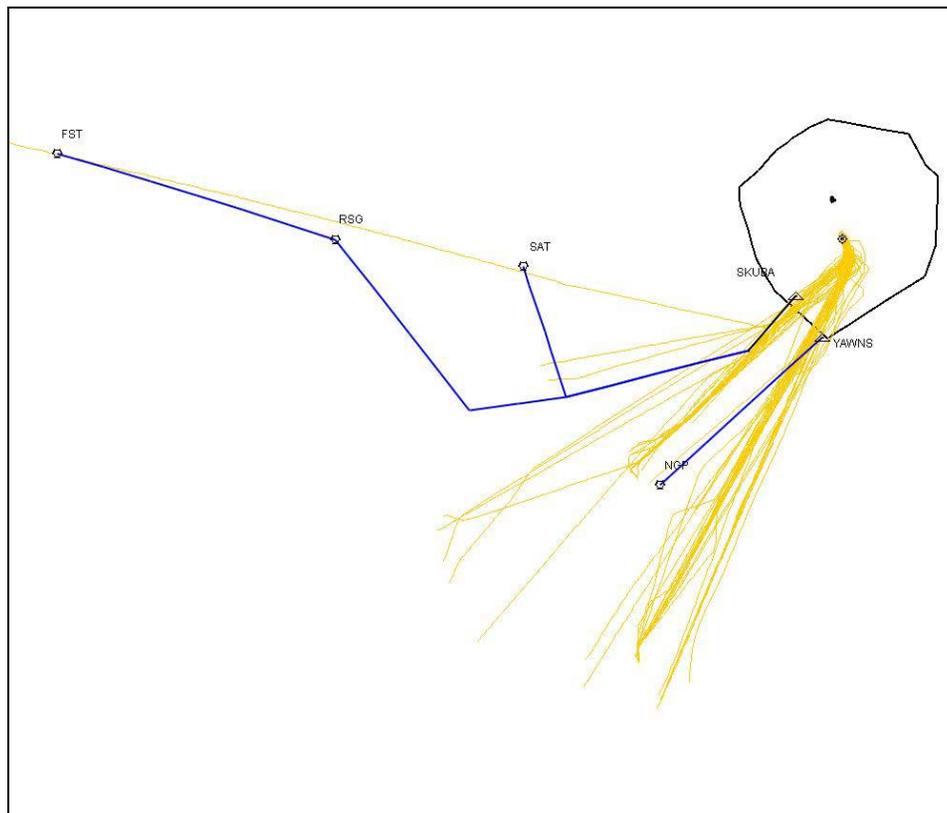
<b>Name of Change</b>	<b>PTRON SID</b>	<b>Date</b>	<b>06-21-12</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>ZHU Sectors</b> 58, 59, 87, 95 <b>I90</b>	<b>Facility Points of Contact</b>	<b>David Kidd 281.230.5556</b> <b>Will Hutson 281.230.5556</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> TEJAS HTOWN BELLR  <b>SID:</b> RITAA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Phase II TARGETS File</b></li> <li><b>2. PTRON TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

### Purpose

The PTRON SID addresses the following issues identified by the Houston OAPM Study Team:

1. Figure 1 depicts the current HOU departures to the southwest.
2. The HOU southwest SIDs extend too far into the en route structure, and some transitions are rarely used.

## OAPM Design Package: Houston PTRON SID

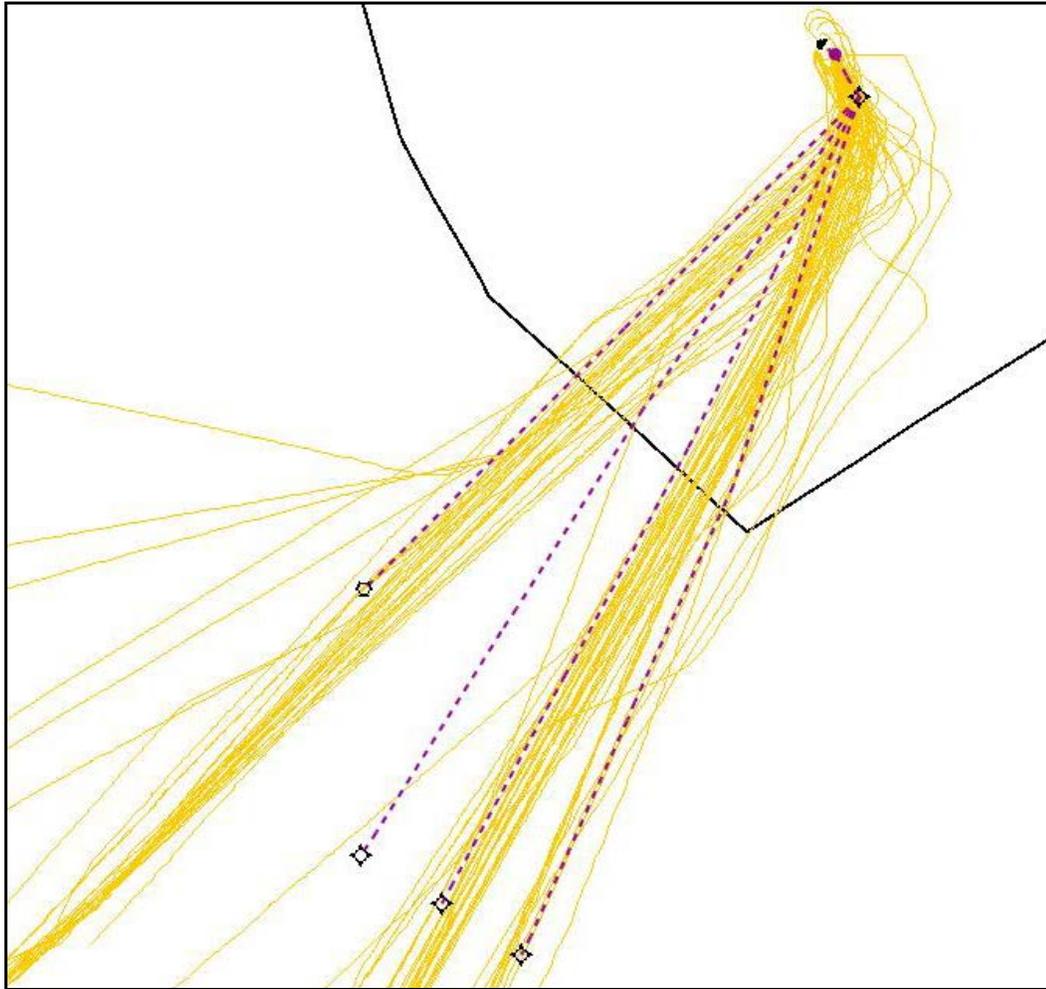


**Figure 1. Current HOU SW SIDs**

### **Study Team Recommendation**

1. The proposed conceptual RNAV SID for southwest HOU departures provides defined runway transitions for repeatable, predictable paths that are procedurally separated from other SIDs and STARs where practical.
2. The proposed en route transitions laterally follow existing flight tracks and terminate approximately 100 NM from HOU where most aircraft are expected to reach the cruise stratum (FL290). This provides shorter paths, provides greater route flexibility, and negates the need to plan and carry fuel for a longer transition that might not be flown.
3. Figure 2 depicts the proposed HOU Southwest SIDs.

## OAPM Design Package: Houston PTRON SID



**Figure 2. Study Team HOU Southwest SID**

## **OAPM Design Package: Houston PTRON SID**

### **Proposed Final Design**

The Houston Design Team made modifications to the study team's proposal for the PTRON SID. The PTRON SID would replace the PSX and NGP SIDs.

En Route transition changes were designed based on a proposed procedural change with Mexico regarding where Northbound and Southbound traffic cross. The proposed change would have Mexico to U.S. traffic crossing the border at REX/MFE, and U.S. to Mexico traffic crossing at Brownsville. These changes are still in the proposal stage.

The DPORT transition was designed for eastern Mexico traffic that would be able to operate above Special Use Airspace (SUA) over the Gulf of Mexico or when SUA is not active.

Contrary to the Study Team recommendations, the Design Team has two transitions near Corpus Christi. One connects to CRP to allow for better connectivity to J22, and one terminates at a point just prior to CRP to allow traffic destined to northern Mexico to be released off the procedure.

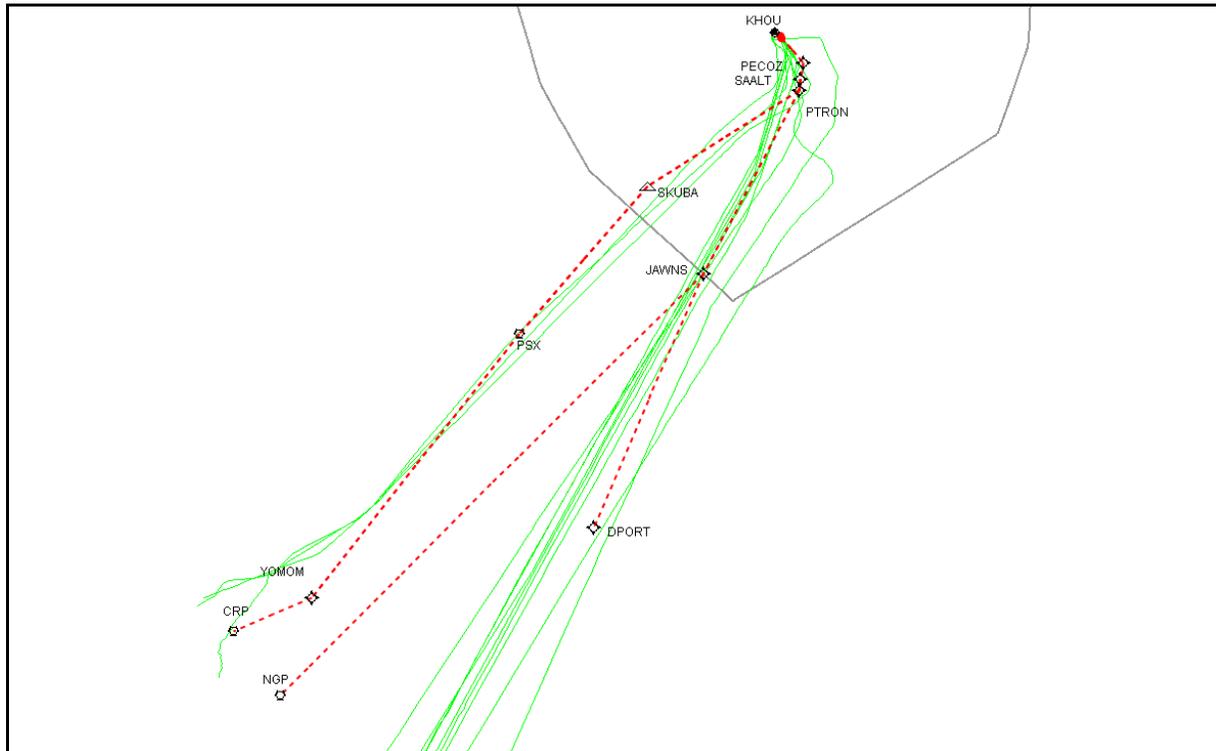
The NGP transition was created to provide low altitude or lower performance aircraft a route to circumnavigate the SUAs. It would also be the preferred transition for south Texas valley arrivals (HRL, BRO, MFE, etc.).

The Design Team decided to remove the two middle en route transitions that were recommended by the Study Team in order to segregate lower performance climbing aircraft. The Design Team felt this was not necessary and designed en route transitions based on reducing track miles to the south Texas valley and Mexico.

The PTRON SID would now exit I90 airspace at JAWNS instead of YAWNS in order to reduce track miles flown.

# OAPM Design Package: Houston

## PTRON SID



**Figure 3. Proposed Final Design**

## **OAPM Design Package: Houston PTRON SID**

### **Proposed Design and Implementation Dependencies**

This procedure is dependent on the following procedures:

#### **STARs:**

TEJAS  
HTOWN  
BELLR

#### **SID:**

RITAA

### **Additional Design Considerations**

The PTRON SID would begin with radar vectors for all runways.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated.

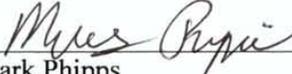
### **Attachments**

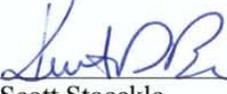
1. Phase II TARGETS File
2. PTRON TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

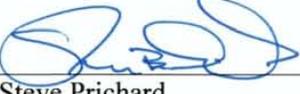
## OAPM Design Package: Houston PTRON SID

### Review Signatures

The D&I Team has reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 Date
--	-----------------	---	-----------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/25/12 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
---	-----------------	--	-----------------

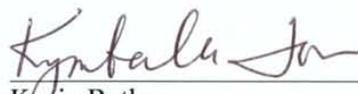
 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	6-21-12 Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	6-25-12 Date
---	-----------------	---	-----------------

## OAPM Design Package: Houston PTRON SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mike Sapp  
William P. Hobby Tower (HOU  
ATCT)  
FAA Lead

  
\_\_\_\_\_  
Date *for* Kevin Butler  
William P. Hobby Tower (HOU  
ATCT)  
NATCA Lead

6/28/12  
Date

**OAPM Design Package: Houston Metroplex**  
*HOU PTRON RNAV SID*

**RECORD OF CHANGE**

<b>Change Number</b>	<b>Date</b>	<b>Document</b>
001	11/01/2012	PTRON RNAV SID
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

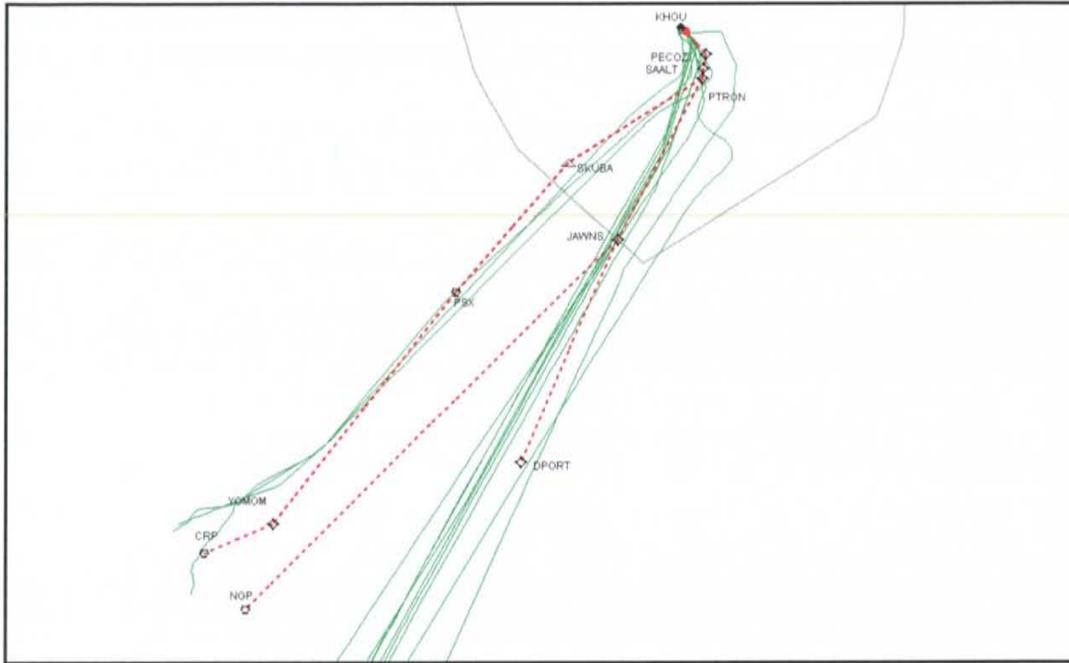
**Description of Change**

Updated Header with airport information.

This procedure will be used by all RNAV capable aircraft. The design team amended the procedure to ensure compliance with applicable FAA criteria. The original design proposal is shown in Figure 1. SAALT and PTRON waypoints were relocated as shown in Figure 2 to achieve required minimum leg segment length. The TARGETS file and TARGETS distribution files were updated.

## OAPM Design Package: Houston Metroplex

*HOU PTRON RNAV SID*



**FIGURE 1. PTRON RNAV SID PROPOSED DESIGN (Figure 3 in PFD)**

## OAPM Design Package: Houston Metroplex

### HOU PTRON RNAV SID

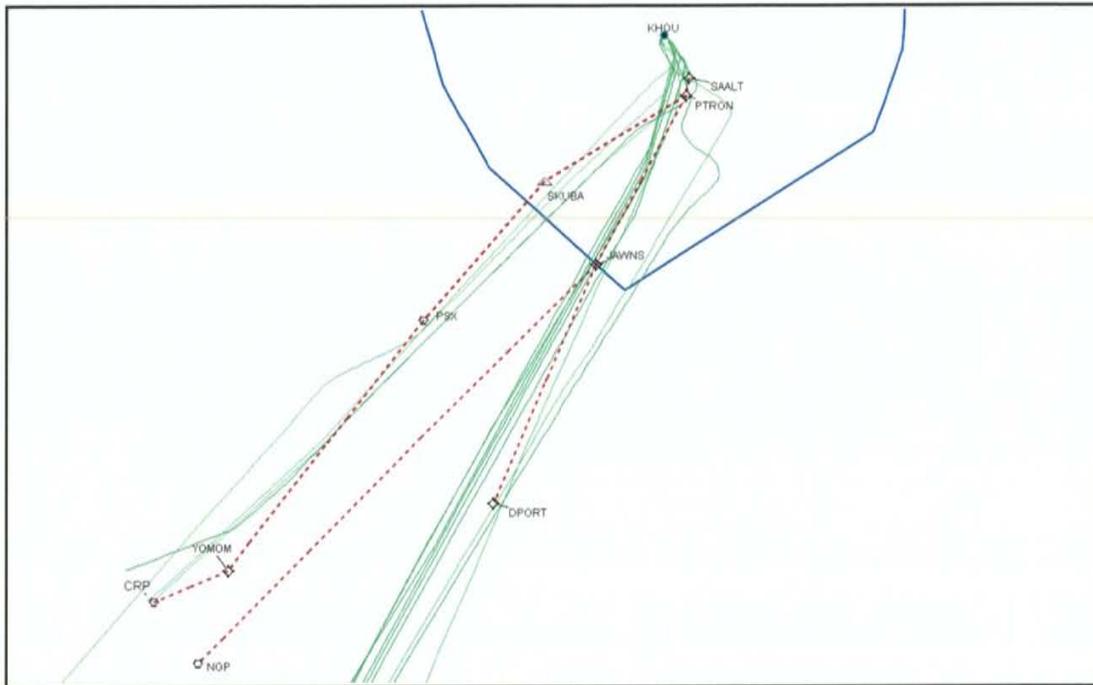


FIGURE 2. PTRON RNAV SID PROPOSED DESIGN (Will replace Figure 3 in PFD)

## OAPM Design Package: Houston Metroplex

*HOU PTRON RNAV SID*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.



Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date



Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston RITAA SID

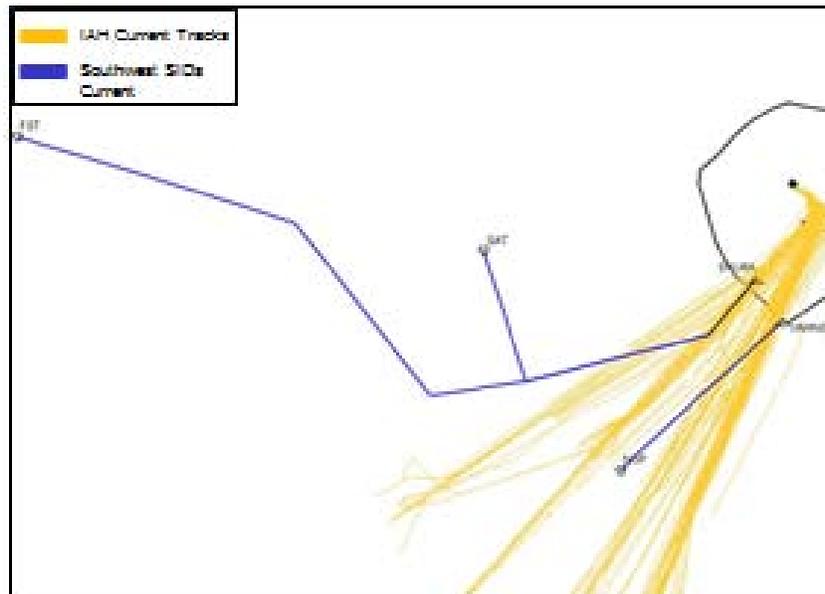
<b>Name of Change</b>	<b>RITAA SID</b>	<b>Date</b>	<b>06-21-12</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, E51, T13</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>ZHU 58, 59, 87, 95 I90</b>	<b>Facility Points of Contact</b>	<b>David Kidd 281.230.5556 Will Hutson 281.230.5556</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> WAPPL BRSKT BELLR  <b>SIDs:</b> MMUGS FLYZA PTRON	<b>Associated Data Files:</b>	<b>1. Phase II TARGETS File</b> <b>2. RITAA TARGETS Distribution Package</b> <b>3. Procedure Change Table</b>

### Purpose

The RITAA SID addresses the following issues identified by the Houston OAPM Study Team:

1. Figure 1 depicts the current IAH departures to the southwest.
2. Limited headings available off IAH Runways 15L/R result in constraints on capacity and throughput.
3. Reliance on radar vectors contributes to a lack of predictability and vertical profile inefficiencies.
4. Wide turns after departure may require ATC point-outs to adjacent sector controllers which further limits capacity/throughput and contributes to aircraft level-offs.
5. SID transitions extend too far into the en route structure and are often unused.

## OAPM Design Package: Houston RITAA SID

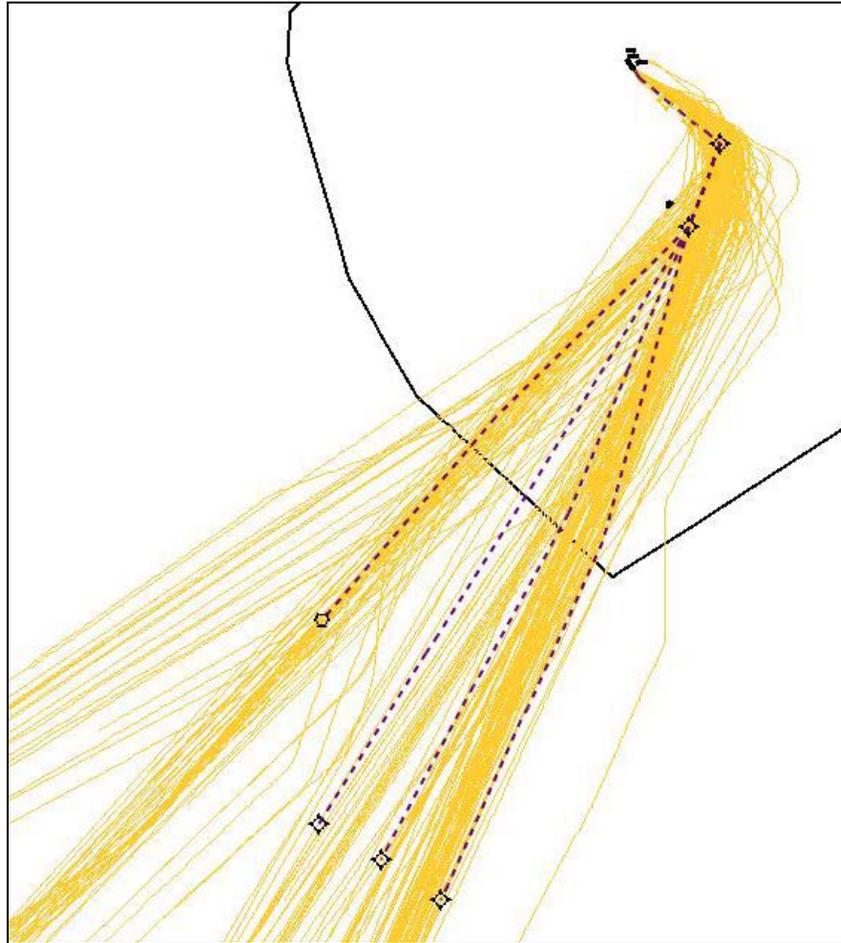


**Figure 1. Current PSX SID**

### **Study Team Recommendation**

1. The proposed RNAV SID for southwest IAH departures provides a divergent flight path from east and southeast traffic, potentially increasing departure capacity and throughput.
2. It also reduces ATC task complexity by providing repeatable, predictable paths that reduce point-outs to ZHU36, ZHU43, and ZHU80 (BPT, SBI, and IDU) that can occur today when departures fly further to the east before turning southwest. It is also procedurally separated from other STARs and SIDs.
3. The proposed en route transitions laterally follow existing flight tracks and terminate approximately 100 NM from IAH where most aircraft are expected to reach cruise altitudes. This provides shorter paths, provides greater route flexibility, and negates the need to plan and carry fuel for a longer transition that might not be flown.
4. Figure 2 depicts the proposed IAH southwest SIDs.

## OAPM Design Package: Houston RITAA SID



**Figure 2. Study Team IAH Southwest SID**

## **OAPM Design Package: Houston RITAA SID**

### **Proposed Final Design**

The Houston Design Team made modifications to the study team's proposal for the RITAA SID. The RITAA SID will replace the PSX and NGP SIDs.

En Route transition changes were made based on a proposed procedural change with Mexico regarding where Northbound and Southbound traffic cross. The proposed change would have Mexico to U.S. traffic crossing the border at REX/MFE, and U.S. to Mexico traffic crossing at Brownsville. These changes are still in the proposal stage.

The DPORT transition was designed for eastern Mexico traffic that would be able to operate above Special Use Airspace (SUA) over the Gulf of Mexico or when SUA is not active.

Contrary to the Study Team recommendations, the Design Team has two transitions that pass near Corpus Christi. One connects to CRP to allow for better connectivity to J22, and one terminates at a point just prior to CRP to allow traffic destined to northern Mexico to be released off the procedure.

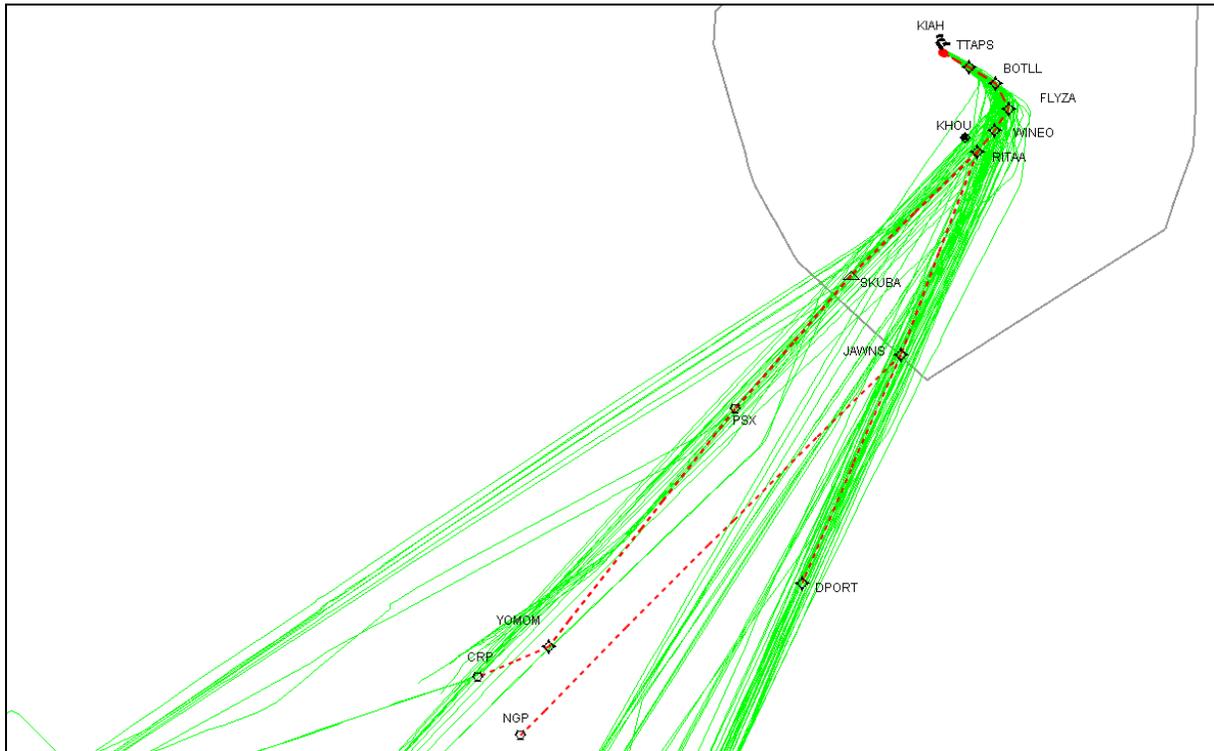
The NGP transition was created to provide low altitude or lower performance aircraft a route to circumnavigate the SUAs. It would also be the preferred transition for south Texas valley arrivals (HRL, BRO, MFE, etc.).

The Design Team decided to remove the two middle en route transitions that were recommended by the Study Team in order to segregate lower performance climbing aircraft. The Design Team felt this was not necessary and designed en route transitions to reduce track miles to the south Texas valley and Mexico.

The RITAA SID will now exit I90 at JAWNS instead of YAWNS in order to reduce track miles flown.

# OAPM Design Package: Houston

## RITAA SID



**Figure 3. Proposed RITAA RNAV SID**

## **OAPM Design Package: Houston RITAA SID**

### **Proposed Design and Implementation Dependencies**

This procedure is dependent on the following procedures:

#### **STARs:**

WAPPL

BRSKT

BELLR

#### **SIDs:**

MMUGS

FLYZA

PTRON

### **Additional Design Considerations**

The RITAA SID will be RNAV off-the-Ground for Runways 15L/R, and vectors to a point for all other runways (VA/VM/DF).

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated.

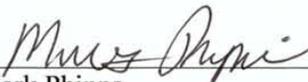
### **Attachments**

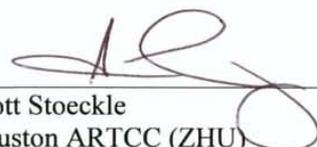
1. Phase II TARGETS File
2. RITAA TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

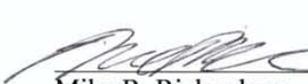
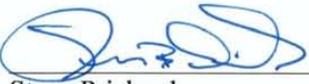
## OAPM Design Package: Houston RITAA SID

### Review Signatures

The D&I Team has reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
--	------------------------	---	------------------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/25/12</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/26/12</u> Date
---	------------------------	--	------------------------

 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>6-21-12</u> Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	<u>6-25-12</u> Date
---	------------------------	---	------------------------

## OAPM Design Package: Houston RITAA SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

	
Allen Borchers	John Olinger
George Bush Intercontinental Tower (IAH ATCT)	George Bush Intercontinental Tower (IAH ATCT)
FAA Lead	NATCA Lead
	
Date	Date

## OAPM Design Package: Houston Metroplex

*IAH RITAA RNAV SID*

### RECORD OF CHANGE

Change Number	Date	Document
001	11/01/2012	RITAA RNAV SID
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
Houston OAPM D&I Master TARGETS File	N/A	N/A

#### Description of Change

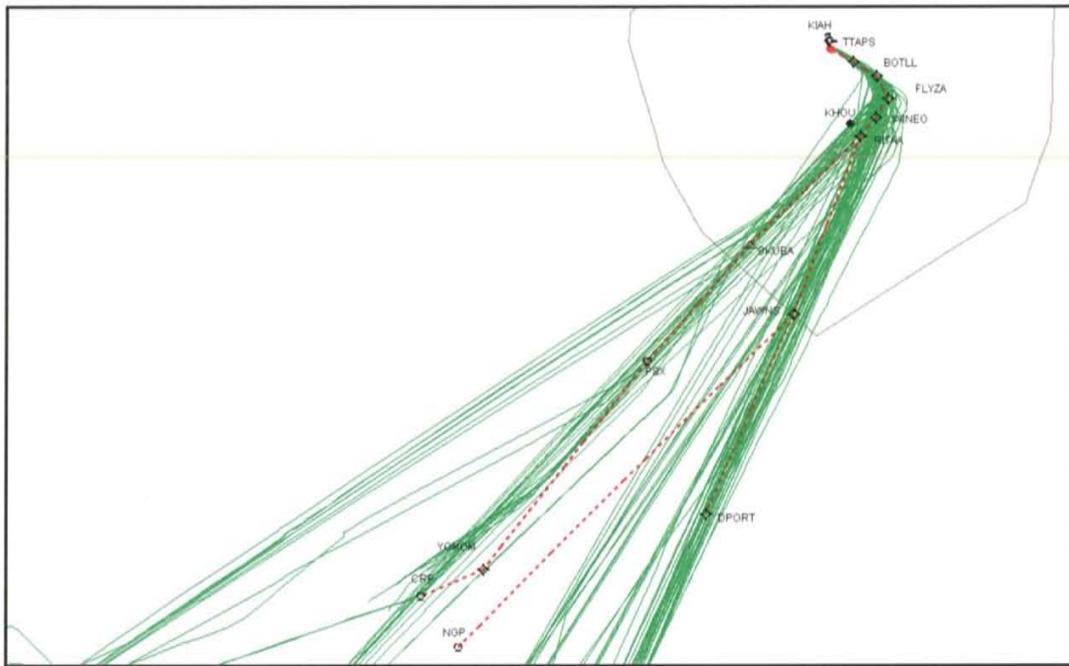
Updated Header with airport information.

This procedure will be used by all RNAV capable aircraft.

The design team amended the procedure to procedurally deconflict from the HOU Runways 30L/R and 22 arrival flows. The original design proposal is shown in Figure 1. FLYZA waypoint was moved and the altitude restriction at WINEO was amended to at or above 9,000 feet as shown in Figure 2.

## OAPM Design Package: Houston Metroplex

*IAH RITAA RNAV SID*



**FIGURE 1. RITAA RNAV SID PROPOSED DESIGN (Figure 3 in PFD)**

## OAPM Design Package: Houston Metroplex

*IAH RITAA RNAV SID*

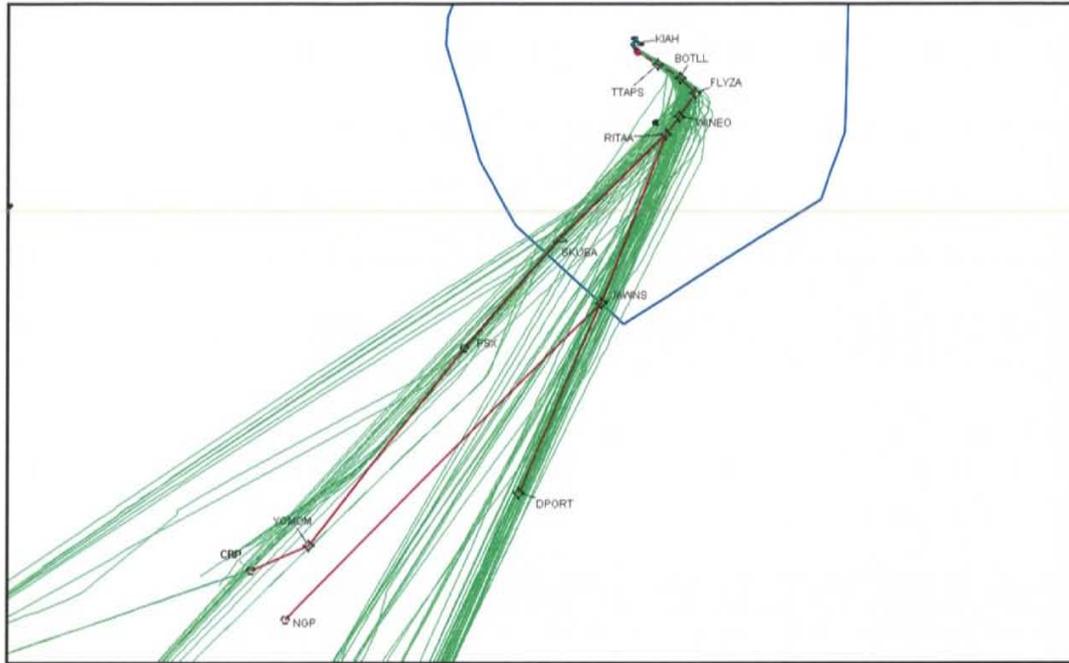
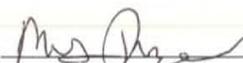


FIGURE 2. RITAA RNAV SID PROPOSED DESIGN (Will replace Figure 3 in PFD)

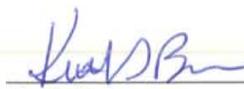
## OAPM Design Package: Houston Metroplex

*IAH RITAA RNAV SID*

Design Team Lead's signatures indicate the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

  
Mark Phipps  
Houston  
OAPM FAA Lead

1-8-13  
Date

  
Keith Brown  
Houston  
OAPM NATCA Lead

1/2/13  
Date

## OAPM Design Package: Houston Metroplex STRYA RNAV SID

Name of Change	<b>STRYA SID</b>	Date	<b>06-19-12</b>
Change Classification	<b>Terminal Procedures</b>	Current Phase of Design	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
OAPM Study Team Reference/s	<b>E44, T11, T14, I23</b>	Implementation Date	<b>December 2013</b>
Impacted Facilities and Positions/Areas/Sectors	<b>I90</b> <b>ZHU Sectors:</b> 49, 46, 38, 26, 40, 42, 81	Facility Points of Contact	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
Related/Dependent Submissions	<b>STARs:</b> WAPPL WHACK TWSTD SKNRD DOOBI <b>SIDs:</b> LURIC	Associated Data Files:	<ol style="list-style-type: none"> <li><b>1. Phase III TARGETS File</b></li> <li><b>2. STRYA TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

## **OAPM Design Package: Houston Metroplex STRYA RNAV SID**

### **Purpose**

This design package addresses issues with the Houston Terminal northbound SIDs identified by the Houston OAPM Study Team:

#### **IAH:**

1. IAH northbound departures currently spend approximately 45 to 60 seconds in level flight at 4,000 ft. The main reasons for this are the downwind arrival traffic descending to 6,000 ft, and the HOU departures climbing to 5,000 ft.
2. The SIDs extend too far into en route airspace and limit user flexibility. A request was made for earlier “jumping off” points to give aircraft an earlier capability for a more direct routing. ZHU also stated that automation problems do not let the aircraft come off of the assigned SID earlier due to too many T-fixes on the routes.

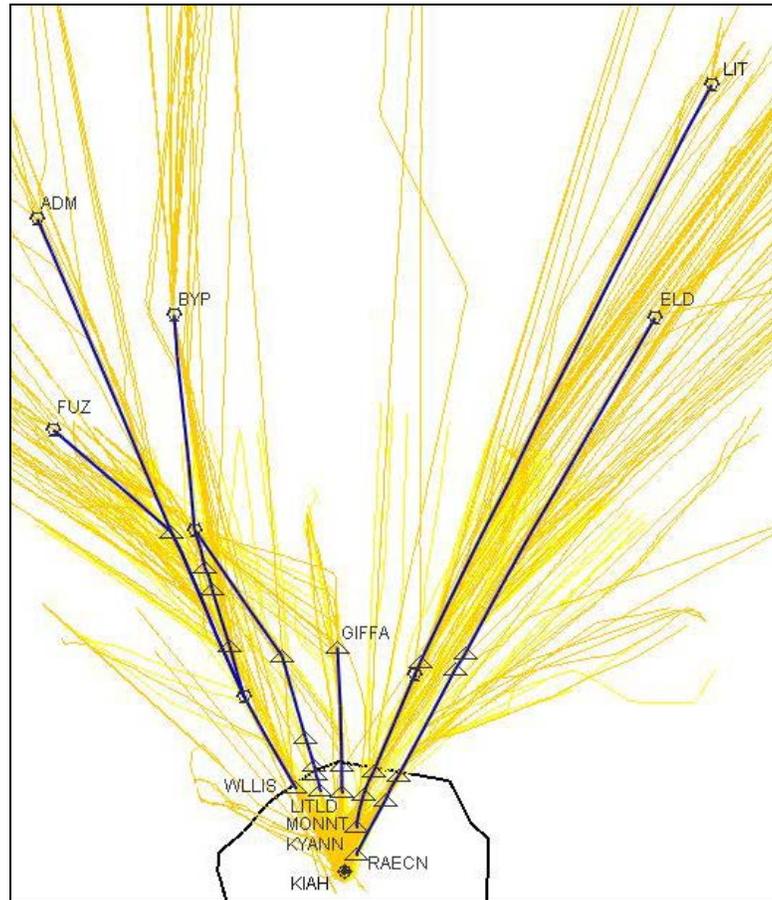
#### **HOU:**

1. IAH departures are stopped at 4,000 ft for HOU departures as well as their own downwind traffic, even though HOU traffic currently shows no significant level-offs.
2. Users were again concerned with the length of SIDs since they tie in with IAH SIDs in the en route environment.

Figure 1 depicts the current IAH northbound SIDs.

Figure 2 depicts the current HOU northbound SIDs.

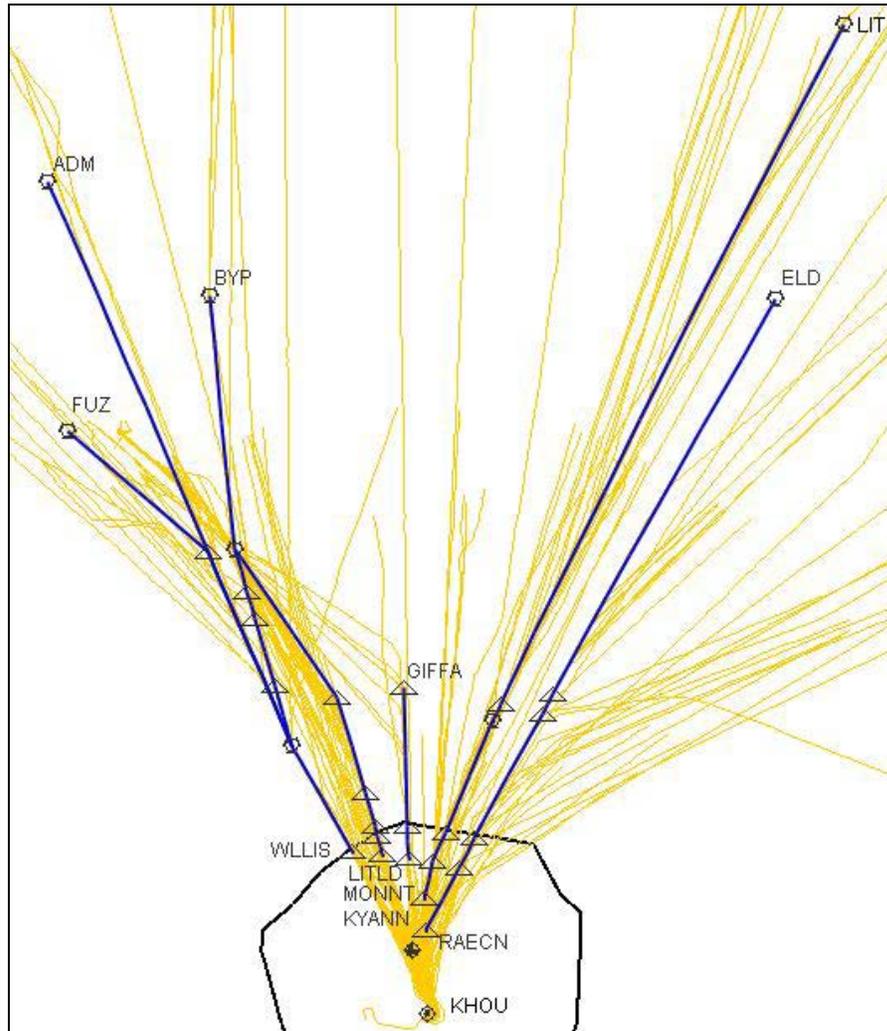
## OAPM Design Package: Houston Metroplex STRYA RNAV SID



**Figure 1. Current IAH Northbound SIDs**

# OAPM Design Package: Houston Metroplex

## STRYA RNAV SID



**Figure 2. Current HOU Northbound SIDs**

## **OAPM Design Package: Houston Metroplex STRYA RNAV SID**

### **Study Team Recommendation**

#### **IAH:**

1. Six conceptual RNAV SIDs, three for each configuration, were created for IAH northbound departures. Runway transitions were included in the design for more repeatable and predictable paths, but because of the proficient vectoring by departure controllers, the procedures designed off Runways 15L/R were kept as radar vector RNAV procedures. Aircraft will be initially vectored on departure to one of three waypoints that are located approximately 7 NM north of IAH.
2. The north downwind was raised from 6,000 ft to 10,000 ft to allow for a higher initial climb, eliminating the 4,000 ft level-off. Upon reaching the waypoints north of IAH and clear of the north downwind, the aircraft join the lateral and vertical path of the designed procedure which is separated from the STARs. Using this concept, complexity and workload issues are reduced for controllers and pilots alike.
3. Once the aircraft exit I90 airspace, they are on a modified shorter route that terminates approximately 100 miles from the airport.

Figure 3 depicts the proposed IAH northbound SIDs.

#### **HOU:**

1. The conceptual HOU SIDs were designed to tie into the IAH SIDs. The dynamic of raising the IAH downwinds changed the initial concept of HOU departures. Through multiple analyses and simulator runs, it was determined that the IAH south downwind could not be raised due to the climb capability of aircraft departing HOU northbound. With the IAH south downwind remaining at 6,000 ft, it was possible to climb HOU northbound traffic above both the IAH downwinds. The first restriction will be at or above 7,000 ft and the second will be at or above 11,000 ft (north IAH downwind is 10,000 ft descending to 7,000 ft).
2. Another issue for HOU northbound departures was traffic departing from Runways 30 and 04. An RNAV off-the ground procedure could not be designed to effectively “top” the south downwind. The OST decided that the current radar vectoring operation would be the most efficient for departures from these runways. Runway transitions were, however, designed for Runways 12L, 12R, and 22. There is an “at or below 5,000 ft” restriction to provide separation from the TXMEX arrival. All HOU departures are restricted to 5,000 ft or below in today’s environment.

Figure 4 depicts the proposed HOU northbound SIDs.

# OAPM Design Package: Houston Metroplex

## STRYA RNAV SID

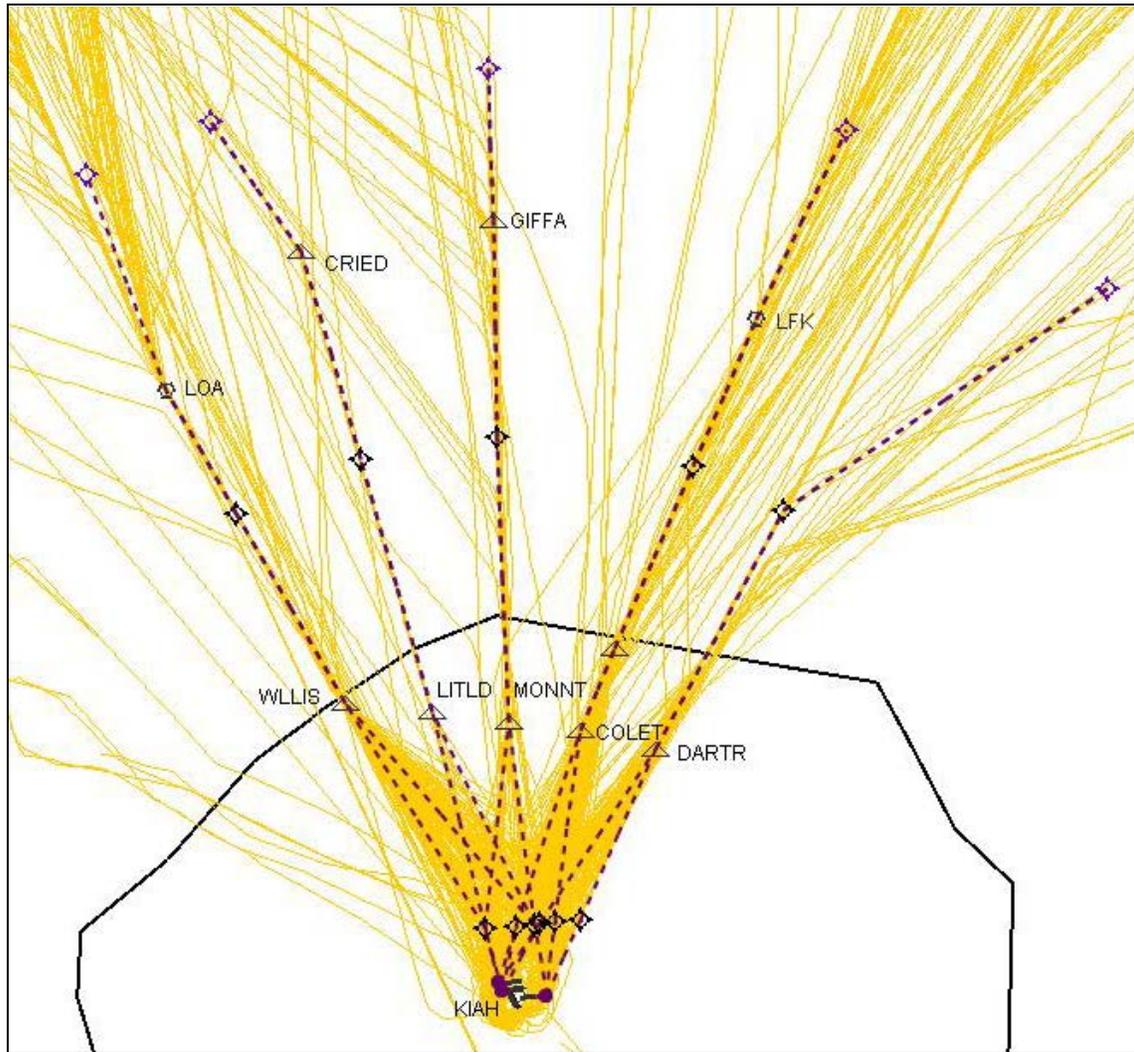


Figure 3. Study Team Proposed IAH Northbound SIDs

# OAPM Design Package: Houston Metroplex STRYA RNAV SID

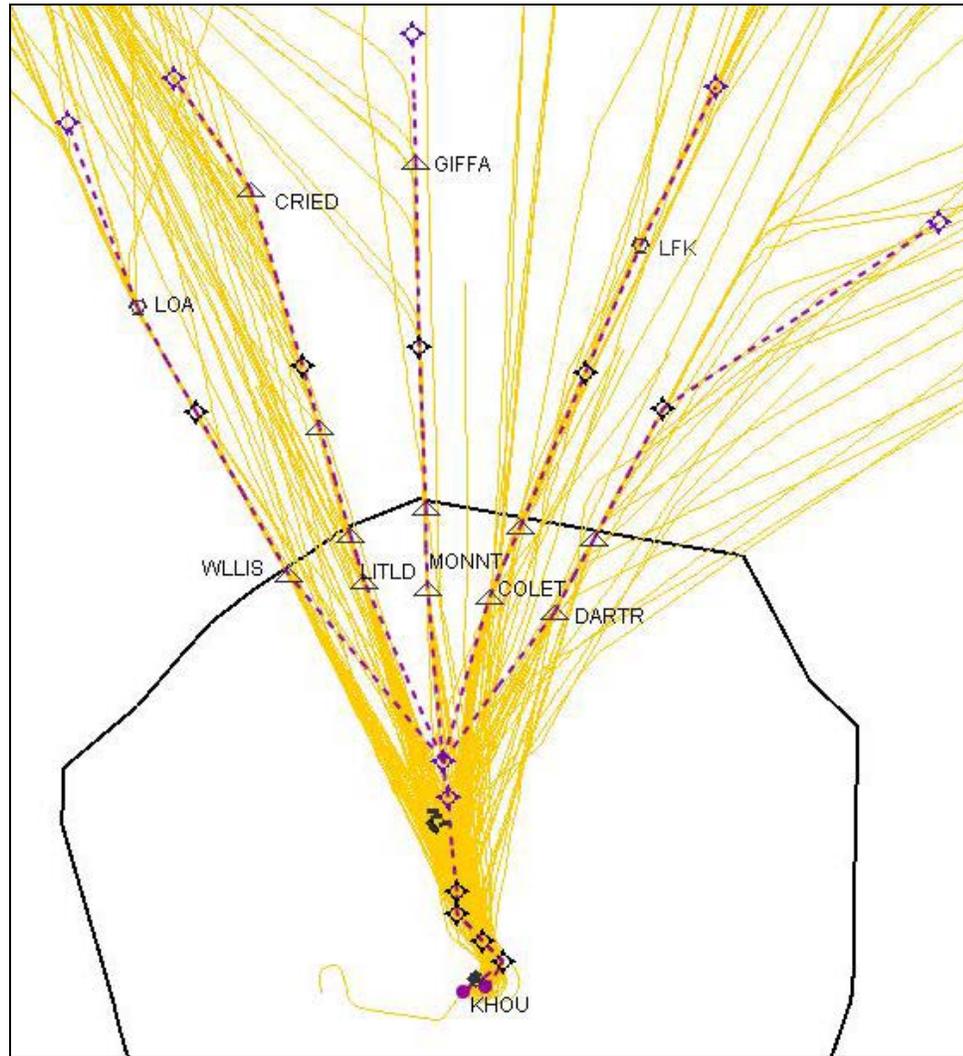


Figure 4. Study Team Proposed HOU Northbound SIDs

# OAPM Design Package: Houston Metroplex

## STRYA RNAV SID

### Proposed Final Design

The Design Team proposed six RNAV SIDs to replace today's six northbound SIDs: LOA, CRIED, GIFFA, LFK, ELD and AEX. These SIDs would be replaced by the STYCK, DREMR, WYLSN, INDIE, LURIC and STRYA SIDs. The STRYA SID would begin with a radar vector because a more efficient departure could not be built using current RNAV SID criteria.

The STRYA SID would replace the current AEX SID and would include DPATY and JBULL en route transitions.

The CLAVN waypoint was moved north and the STRYA waypoint was created to deconflict the lateral route from the proposed WHACK/TWSTD IAH STARs.

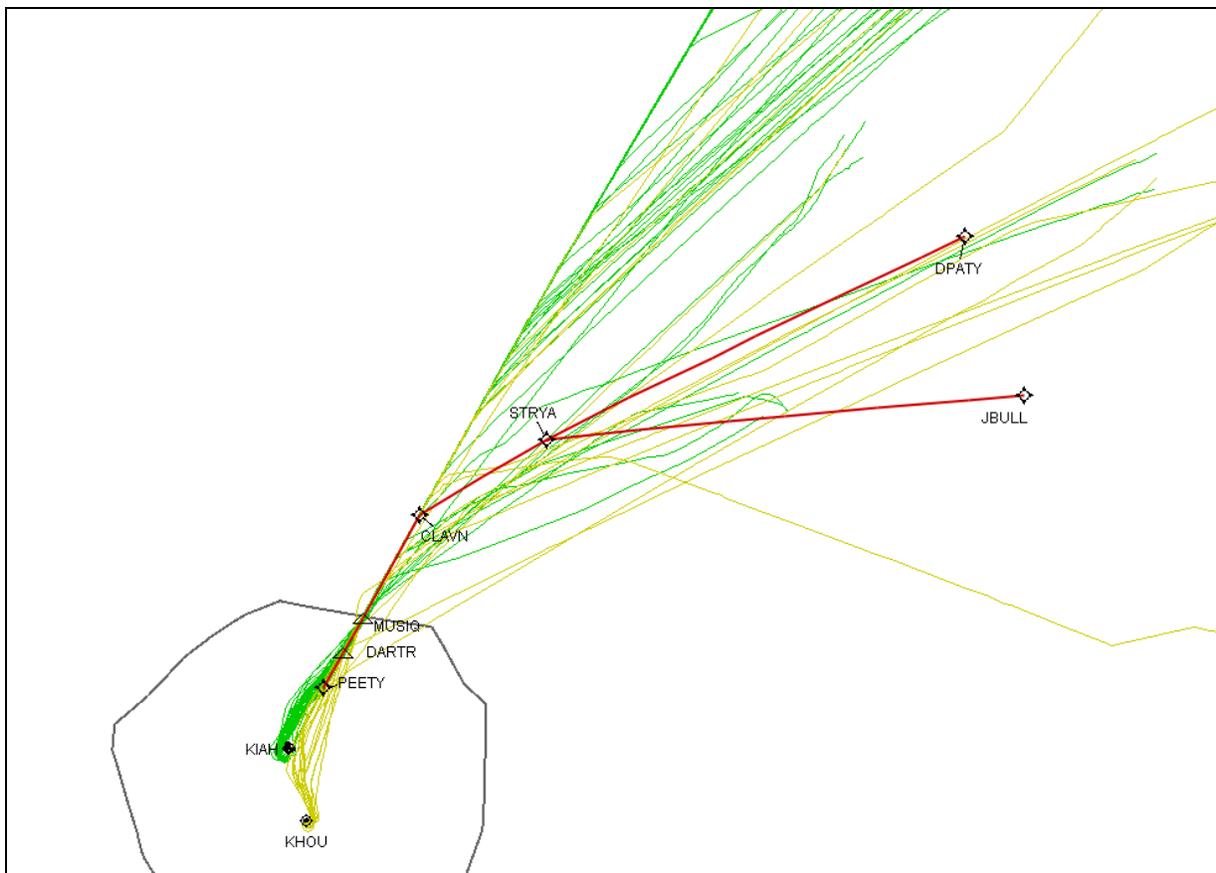


Figure 5. Proposed STRYA SID

## **OAPM Design Package: Houston Metroplex STRYA RNAV SID**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

WAPPL  
WHACK  
TWSTD  
SKNRD  
DOOBI

#### **SIDs:**

LURIC

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

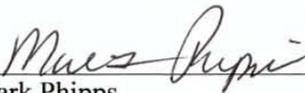
### **Attachments**

1. Phase III TARGETS File
2. STRYA TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex STRYA RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
Mark Phipps  
Houston Metroplex  
FAA Lead

6-25-12  
Date

  
Keith Brown  
Houston Metroplex  
NATCA Lead

6/25/12  
Date

  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

6/25/12  
Date

  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

6/26/12  
Date

  
Mike R. Richardson  
Houston TRACON (I90)  
Facility Lead

6-20-12  
Date

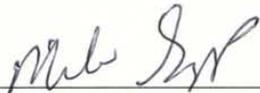
  
Steve Prichard  
Houston TRACON (I90)  
NATCA Lead

6-25-12  
Date

## OAPM Design Package: Houston Metroplex STRYA RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 Allen Borchers George Bush Intercontinental Tower (IAH ATCT) FAA Lead	<u>4/26/12</u> Date	 John Olinger George Bush Intercontinental Tower (IAH ATCT) NATCA Lead	<u>6/26/12</u> Date
 Mike Sapp William P. Hobby Tower (HOU ATCT) FAA Lead	<u>        </u> Date	 Kevin Butler William P. Hobby Tower (HOU ATCT) NATCA Lead	<u>6/28/12</u> Date

## OAPM Design Package: Houston Metroplex STYCK RNAV SID

<b>Name of Change</b>	<b>STYCK SID</b>	<b>Date</b>	<b>06-19-2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, T11, T14, I23</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 86, 46 <b>ZFW Sectors:</b> 29, 89	<b>Facility Points of Contact</b>	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
<b>Related/Dependent Submissions</b>	<b>None</b>	<b>Associated Data Files:</b>	<b>1. Phase III TARGETS File</b> <b>2. STYCK TARGETS Distribution Package</b> <b>3. Procedure Change Table</b>

## **OAPM Design Package: Houston Metroplex STYCK RNAV SID**

### **Purpose**

This design package addresses issues with the Houston Terminal northbound SIDs identified by the Houston OAPM Study Team:

#### **IAH:**

1. IAH northbound departures currently spend approximately 45 to 60 seconds in level flight at 4,000 ft. The main reasons for this are the downwind arrival traffic descending to 6,000 ft, and the HOU departures climbing to 5,000 ft.
2. The SIDs extend too far into en route airspace and limit user flexibility. A request was made for earlier “jumping off” points to give aircraft an earlier capability for a more direct routing. ZHU also stated that automation problems do not let the aircraft come off of the assigned SID earlier due to too many T-fixes on the routes.

#### **HOU:**

1. IAH departures are stopped at 4,000 ft for HOU departures as well as their own downwind traffic, even though HOU traffic currently shows no significant level-offs.
2. Users were again concerned with the length of SIDs since they tie in with IAH SIDs in the en route environment.

Figure 1 depicts the current IAH northbound SIDs.

Figure 2 depicts the current HOU northbound SIDs.

# OAPM Design Package: Houston Metroplex STYCK RNAV SID



Figure 1. Current IAH Northbound SIDs

## OAPM Design Package: Houston Metroplex STYCK RNAV SID

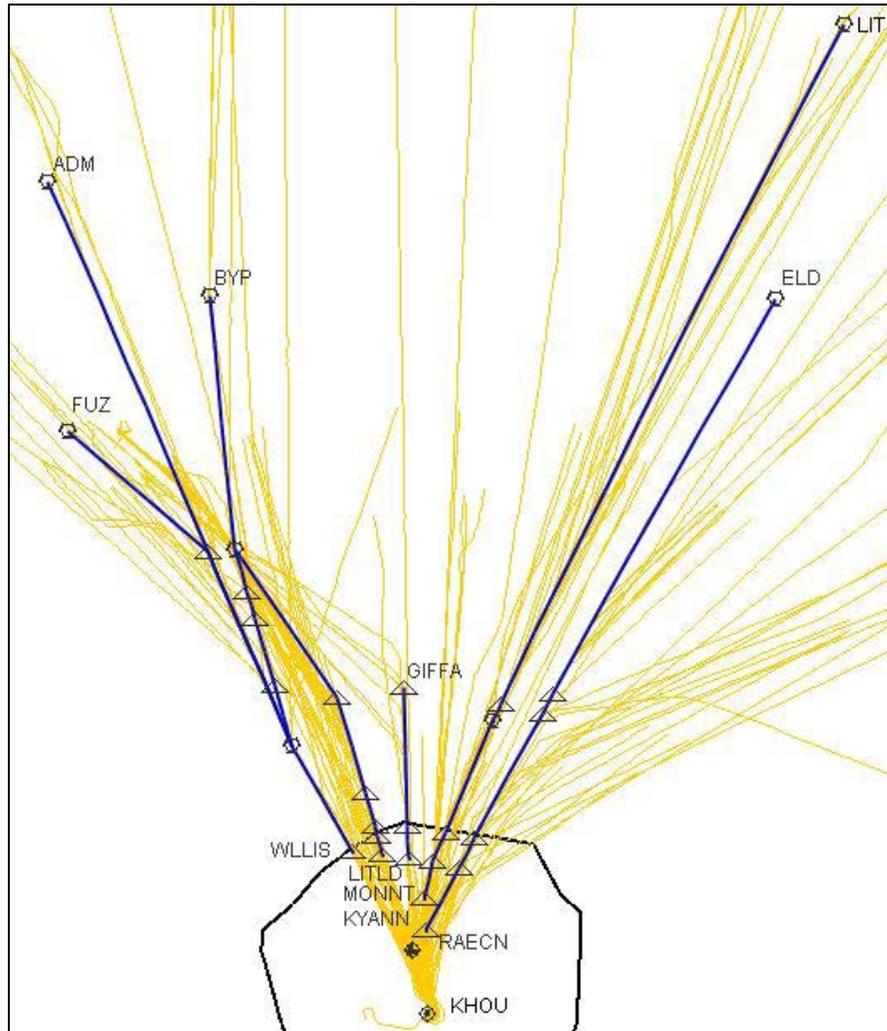


Figure 2. Current HOU Northbound SIDs

## **OAPM Design Package: Houston Metroplex STYCK RNAV SID**

### **Study Team Recommendation**

#### **IAH:**

1. Six conceptual RNAV SIDs, three for each configuration, were created for IAH northbound departures. Runway transitions were included in the design for more repeatable and predictable paths, but because of the proficient vectoring by departure controllers, the procedures designed off Runways 15L/R were kept as radar vector RNAV procedures. Aircraft will be initially vectored on departure to one of three waypoints that are located approximately 7 NM north of IAH.
2. The north downwind was raised from 6,000 ft to 10,000 ft to allow for a higher initial climb, eliminating the 4,000 ft level-off. Upon reaching the waypoints north of IAH and clear of the north downwind, the aircraft join the lateral and vertical path of the designed procedure which is separated from the STARs. Using this concept, complexity and workload issues are reduced for controllers and pilots alike.
3. Once the aircraft exit I90 airspace, they are on a modified shorter route that terminates approximately 100 miles from the airport.

Figure 3 depicts the proposed IAH northbound SIDs.

#### **HOU:**

1. The conceptual HOU SIDs were designed to tie into the IAH SIDs. The dynamic of raising the IAH downwinds changed the initial concept of HOU departures. Through multiple analyses and simulator runs, it was determined that the IAH south downwind could not be raised due to the climb capability of aircraft departing HOU northbound. With the IAH south downwind remaining at 6,000 ft, it was possible to climb HOU northbound traffic above both the IAH downwinds. The first restriction will be at or above 7,000 ft and the second will be at or above 11,000 ft (north IAH downwind is 10,000 ft descending to 7,000 ft).
2. Another issue for HOU northbound departures was traffic departing from Runways 30 and 04. An RNAV off-the-ground procedure could not be designed to effectively “top” the south downwind. The OST decided that the current radar vectoring operation would be the most efficient for departures from these runways. Runway transitions were, however, designed for Runways 12L, 12R, and 22. There is an “at or below 5,000 ft” restriction to provide separation from the TXMEX arrival. All HOU departures are restricted to 5,000 ft or below in today’s environment.

Figure 4 depicts the proposed HOU northbound SIDs.

# OAPM Design Package: Houston Metroplex STYCK RNAV SID

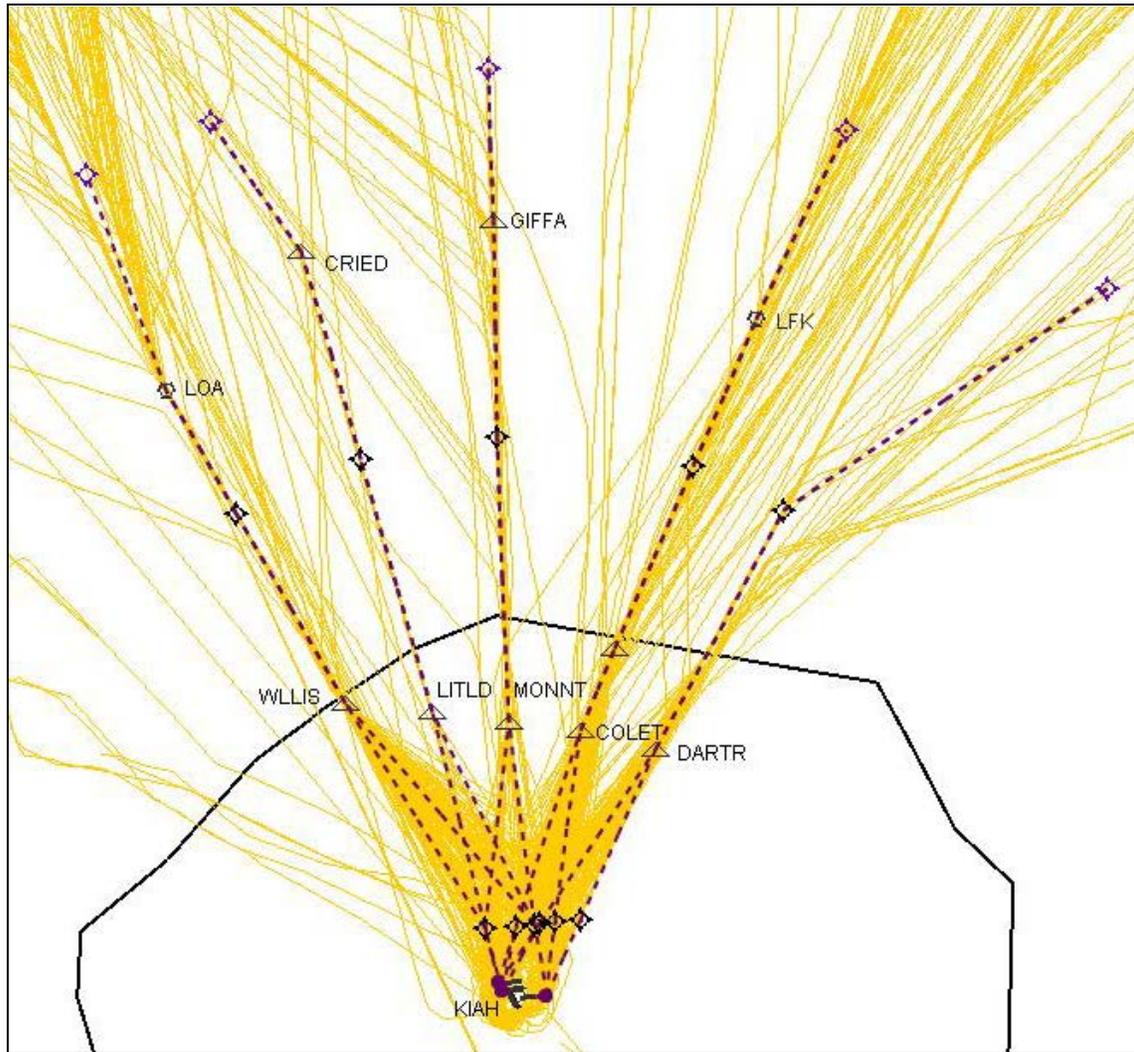


Figure 3. Study Team Proposed IAH Northbound SIDs

# OAPM Design Package: Houston Metroplex STYCK RNAV SID

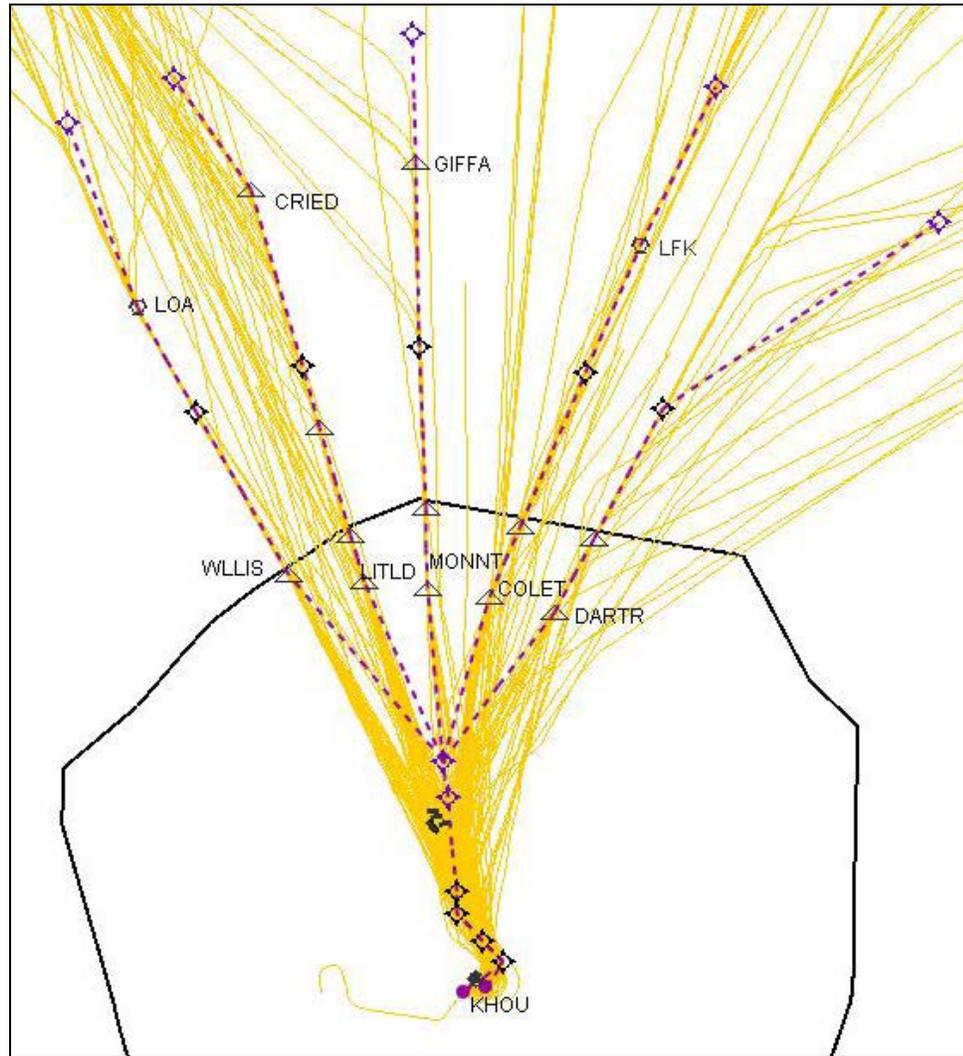


Figure 4. Study Team Proposed HOU Northbound SIDs

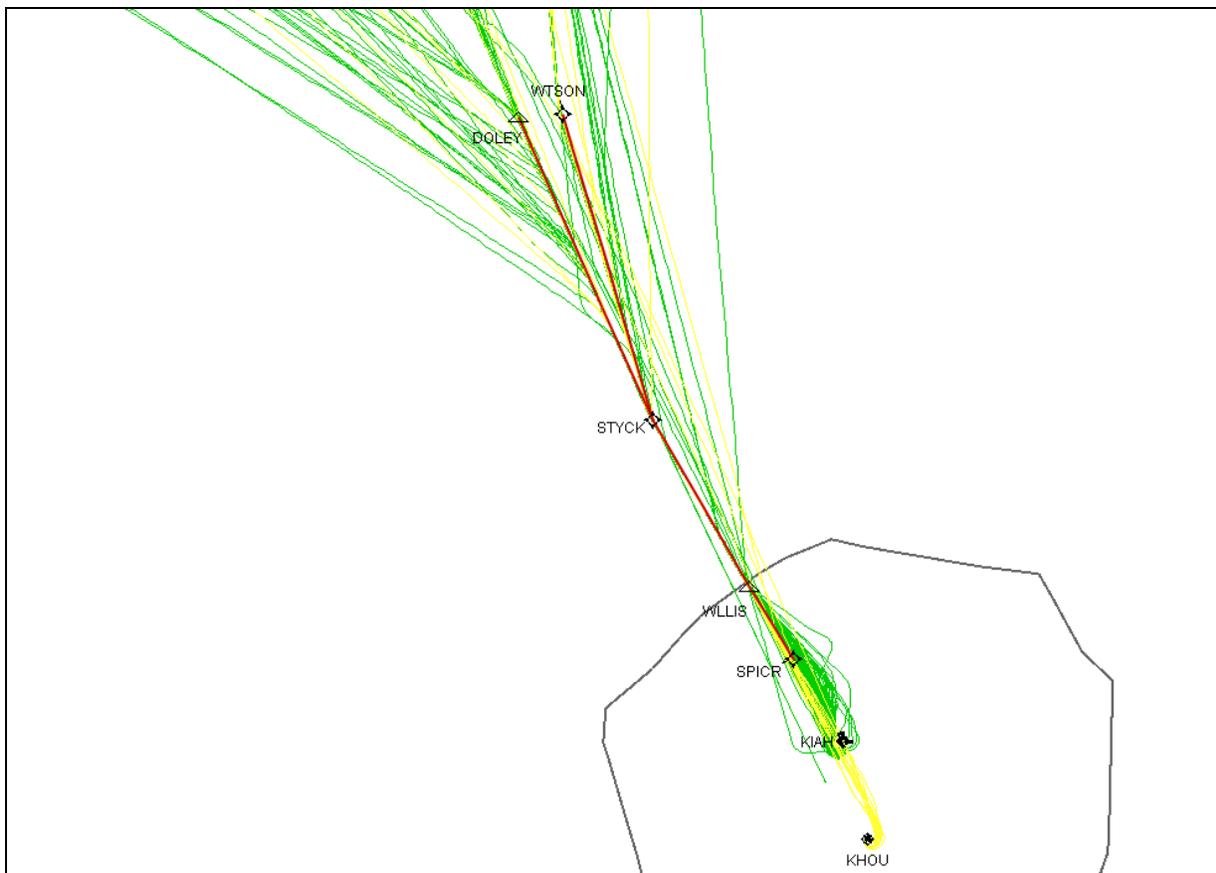
## OAPM Design Package: Houston Metroplex STYCK RNAV SID

### Proposed Final Design

The Design Team proposed six RNAV SIDs to replace today's six northbound SIDs: LOA, CRIED, GIFFA, LFK, ELD and AEX. These SIDs would be replaced by the STYCK, DREMR, WYLSN, INDIE, LURIC and STRYA SIDs. The STYCK SID would begin with a radar vector because a more efficient departure could not be built using current RNAV SID criteria.

The proposed STYCK SID would replace the current LOA SID and would have DOLEY and WTSON en route transitions.

The Design Team removed CQY as a SID termination point and replaced it with WTSON after coordination with the North Texas OAPM Team.



**Figure 5. Proposed STYCK SID**

## **OAPM Design Package: Houston Metroplex STYCK RNAV SID**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

**None**

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZFW, ZHU, and I90 internal Standard Operating Procedures and Letters of Agreement.

### **Attachments**

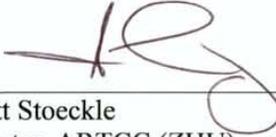
1. Phase III TARGETS File
2. STYCK TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

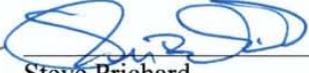
## OAPM Design Package: Houston Metroplex STYCK RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	6-25-12 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	6/25/12 Date
--	-----------------	---	-----------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	6/25/12 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	6/26/12 Date
---	-----------------	--	-----------------

 _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	6-20-12 Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	6-25-12 Date
---	-----------------	---	-----------------

## OAPM Design Package: Houston Metroplex STYCK RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 Allen Borchers George Bush Intercontinental Tower (IAH ATCT) FAA Lead	<u>6/26/12</u> Date	 John Olinger George Bush Intercontinental Tower (IAH ATCT) NATCA Lead	<u>6/26/12</u> Date
 Mike Sapp William P. Hobby Tower (HOU ATCT) FAA Lead	<u>        </u> Date	 Kevin Butler William P. Hobby Tower (HOU ATCT) NATCA Lead	<u>6/28/12</u> Date

## OAPM Design Package: Houston WATFO RNAV SID

<b>Name of Change</b>	<b>WATFO SID</b>	<b>Date</b>	<b>09-19-2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E44, E48, I4, I22, I29</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 Houston ARTCC Sectors 23, 36, 70</b>	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552 Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> BAYYY PUCKS BOOZZ GILLL BRSKT TQNIK <b>SIDs:</b> FLYZA GUMBY MMUGS	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>WATFO TARGETS Distribution Package</b></li> <li><b>Procedure Change Table</b></li> </ol>

### Purpose

Specific RNAV procedures were not addressed by the Houston OAPM D and I Study team. The proposed WATFO SID will provide an RNAV departure procedure similar to RNAV SIDs for IAH and HOU.

### Study Team Recommendation

The Houston OAPM Study Team did not propose satellite airport departure procedures.

### Proposed Final Design

Southeast bound departures from satellite airports exit terminal airspace utilizing existing departure procedures serving IAH and HOU. The BOWFN and VUH SIDs would be replaced by the proposed WATFO RNAV SID as depicted in Figure 1. The WATFO RNAV SID transitions will emulate the en route transitions used for proposed IAH and HOU southeast bound RNAV SIDs. All turbojet/turboprop departures from these airports will be radar vectored as they are today to join the WATFO RNAV SID prior to entering ZHU's airspace. I90 satellite airports utilizing these procedures are shown in Table 1 below.

## OAPM Design Package: Houston WATFO RNAV SID

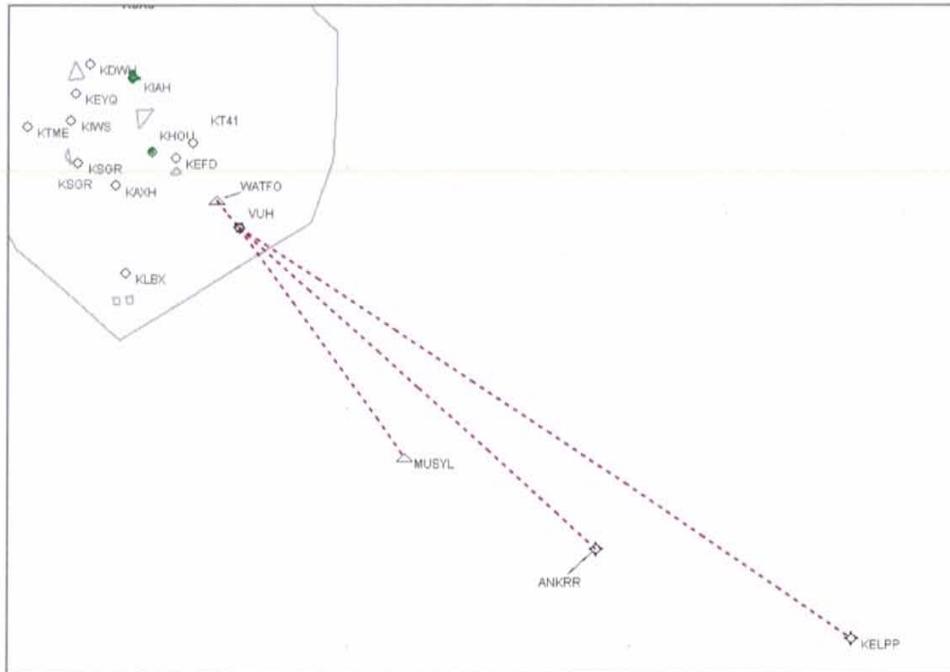


Figure 1. Proposed WATFO SID

## OAPM Design Package: Houston WATFO RNAV SID

Airport ID	Airport Name South of J2		Airport ID	Airport Name North of J2
AXH	Houston Southwest		CXO	Lone Star Executive
EFD	Ellington Field		DWH	David Wayne Hooks Memorial
GLS	Scholes International		EYQ	Weiser Air Park
HPY	Baytown			
IWS	West Houston			
LBX	Brazoria County			
LVJ	Pearland Regional			
SGR	Sugar Land Regional			
TME	Houston Executive			
T00	Chambers County			
T41	La Porte Municipal			
54T	RWJ Airpark			

**Table 1. Houston OAPM Satellite Airports**

### Proposed Design and Implementation Dependencies

This procedure is dependent on the following procedures:

#### **STARs:**

BAYYY  
PUCKS  
BOOZZ  
GILLL  
BRSKT  
TQNIK

#### **SIDs:**

FLYZA  
GUMBY  
MMUGS

### Additional Design Considerations

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

## **OAPM Design Package: Houston WATFO RNAV SID**

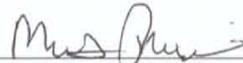
### **Attachments**

1. Houston OAPM D&I Master TARGETS File
2. WATFO TARGETS Distribution File
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston WATFO RNAV SID

### Review Signatures

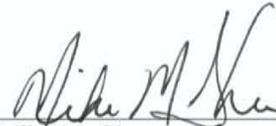
The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

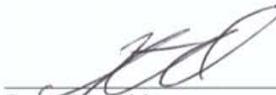
1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

12/27/12  
Date

  
\_\_\_\_\_  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

1/2/13  
Date

  
\_\_\_\_\_  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

12/28/12  
Date

  
\_\_\_\_\_  
Mike R. Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/4/13  
Date

## OAPM Design Package: Houston Metroplex WYLSN RNAV SID

Name of Change	<b>WYLSN SID</b>	Date	<b>06-19-12</b>
Change Classification	<b>Terminal Procedures</b>	Current Phase of Design	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
OAPM Study Team Reference/s	<b>E44, T11, T14, I23</b>	Implementation Date	<b>December 2013</b>
Impacted Facilities and Positions/Areas/Sectors	<b>I90</b> <b>ZHU Sectors:</b> 49, 86, 46 <b>ZFW Sectors:</b> 29, 89	Facility Points of Contact	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
Related/Dependent Submissions	<b>None</b>	Associated Data Files:	<ol style="list-style-type: none"> <li><b>1. Phase III TARGETS File</b></li> <li><b>2. WYLSN TARGETS Distribution Package</b></li> <li><b>3. Procedure Change Table</b></li> </ol>

## **OAPM Design Package: Houston Metroplex WYLSN RNAV SID**

### **Purpose**

This design package addresses issues with the Houston Terminal northbound SIDs identified by the Houston OAPM Study Team:

#### **IAH:**

1. IAH northbound departures currently spend approximately 45 to 60 seconds in level flight at 4,000 ft. The main reasons for this are the downwind arrival traffic descending to 6,000 ft, and the HOU departures climbing to 5,000 ft.
2. The SIDs extend too far into en route airspace and limit user flexibility. A request was made for earlier “jumping off” points to give aircraft an earlier capability for a more direct routing. ZHU also stated that automation problems do not let the aircraft come off of the assigned SID earlier due to too many T-fixes on the routes.

#### **HOU:**

1. IAH departures are stopped at 4,000 ft for HOU departures as well as their own downwind traffic, even though HOU traffic currently shows no significant level-offs.
2. Users were again concerned with the length of SIDs since they tie in with IAH SIDs in the en route environment.

Figure 1 depicts the current IAH northbound SIDs.

Figure 2 depicts the current HOU northbound SIDs.

## OAPM Design Package: Houston Metroplex WYLSN RNAV SID



**Figure 1. Current IAH Northbound SIDs**

## OAPM Design Package: Houston Metroplex WYLSN RNAV SID

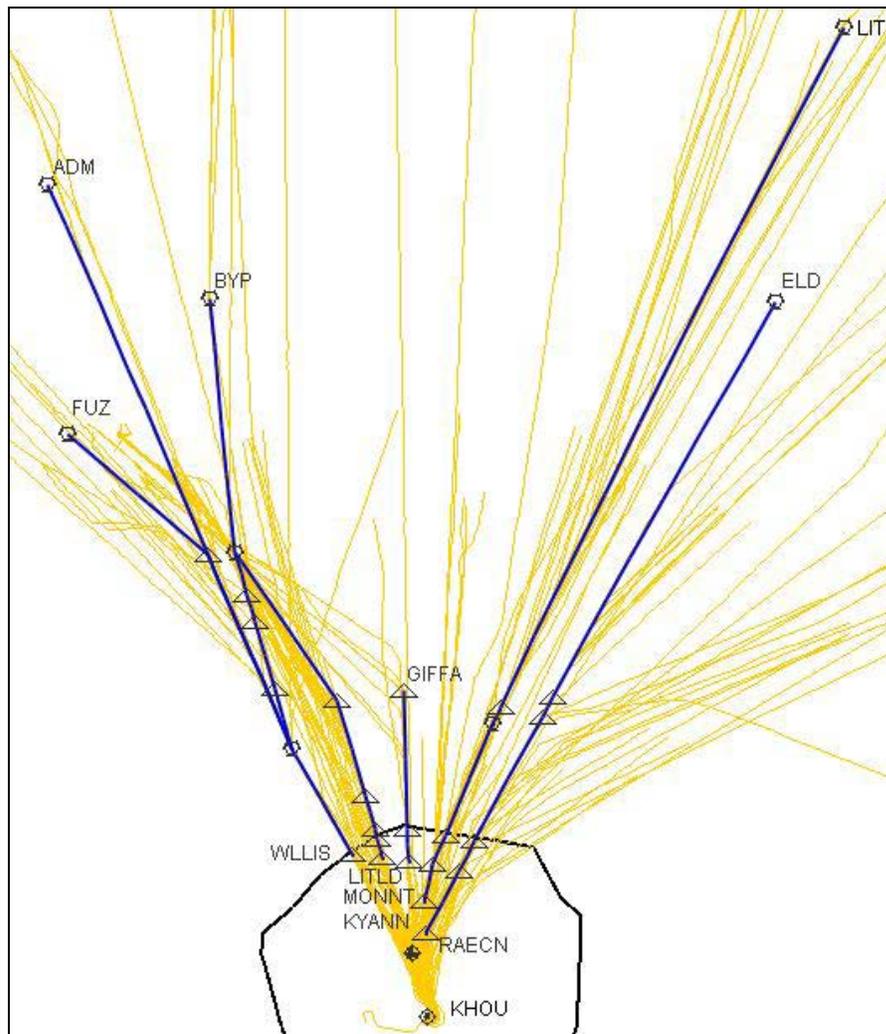


Figure 2. Current HOU Northbound SIDs

## **OAPM Design Package: Houston Metroplex WYLSN RNAV SID**

### **Study Team Recommendation**

#### **IAH:**

1. Six conceptual RNAV SIDs, three for each configuration, were created for IAH northbound departures. Runway transitions were included in the design for more repeatable and predictable paths, but because of the proficient vectoring by departure controllers, the procedures designed off Runways 15L/R were kept as radar vector RNAV procedures. Aircraft will be initially vectored on departure to one of three waypoints that are located approximately 7 NM north of IAH.
2. The north downwind was raised from 6,000 ft to 10,000 ft to allow for a higher initial climb, eliminating the 4,000 ft level-off. Upon reaching the waypoints north of IAH and clear of the north downwind, the aircraft join the lateral and vertical path of the designed procedure which is separated from the STARs. Using this concept, complexity and workload issues are reduced for controllers and pilots alike.
3. Once the aircraft exit I90 airspace, they are on a modified shorter route that terminates approximately 100 miles from the airport.

Figure 3 depicts the proposed IAH northbound SIDs.

#### **HOU:**

1. The conceptual HOU SIDs were designed to tie into the IAH SIDs. The dynamic of raising the IAH downwinds changed the initial concept of HOU departures. Through multiple analyses and simulator runs, it was determined that the IAH south downwind could not be raised due to the climb capability of aircraft departing HOU northbound. With the IAH south downwind remaining at 6,000 ft, it was possible to climb HOU northbound traffic above both the IAH downwinds. The first restriction will be at or above 7,000 ft and the second will be at or above 11,000 ft (north IAH downwind is 10,000 ft descending to 7,000 ft).
2. Another issue for HOU northbound departures was traffic departing from Runways 30 and 04. An RNAV off-the ground procedure could not be designed to effectively “top” the south downwind. The OST decided that the current radar vectoring operation would be the most efficient for departures from these runways. Runway transitions were, however, designed for Runways 12L, 12R, and 22. There is an “at or below 5,000 ft” restriction to provide separation from the TXMEX arrival. All HOU departures are restricted to 5,000 ft or below in today’s environment.

Figure 4 depicts the proposed HOU northbound SIDs.

# OAPM Design Package: Houston Metroplex WYLSN RNAV SID

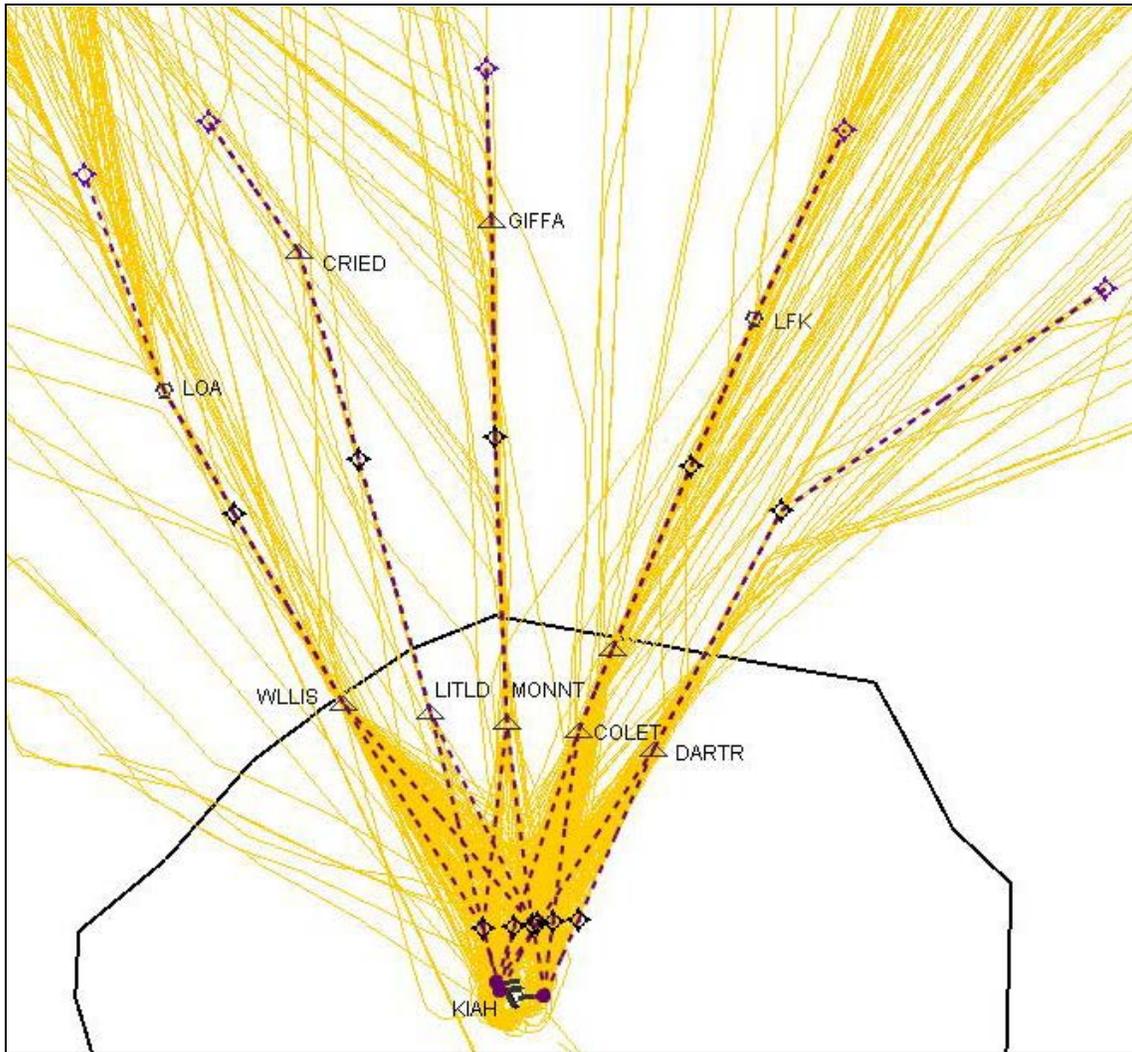


Figure 3. Study Team Proposed IAH Northbound SIDs

# OAPM Design Package: Houston Metroplex

## WYLSN RNAV SID

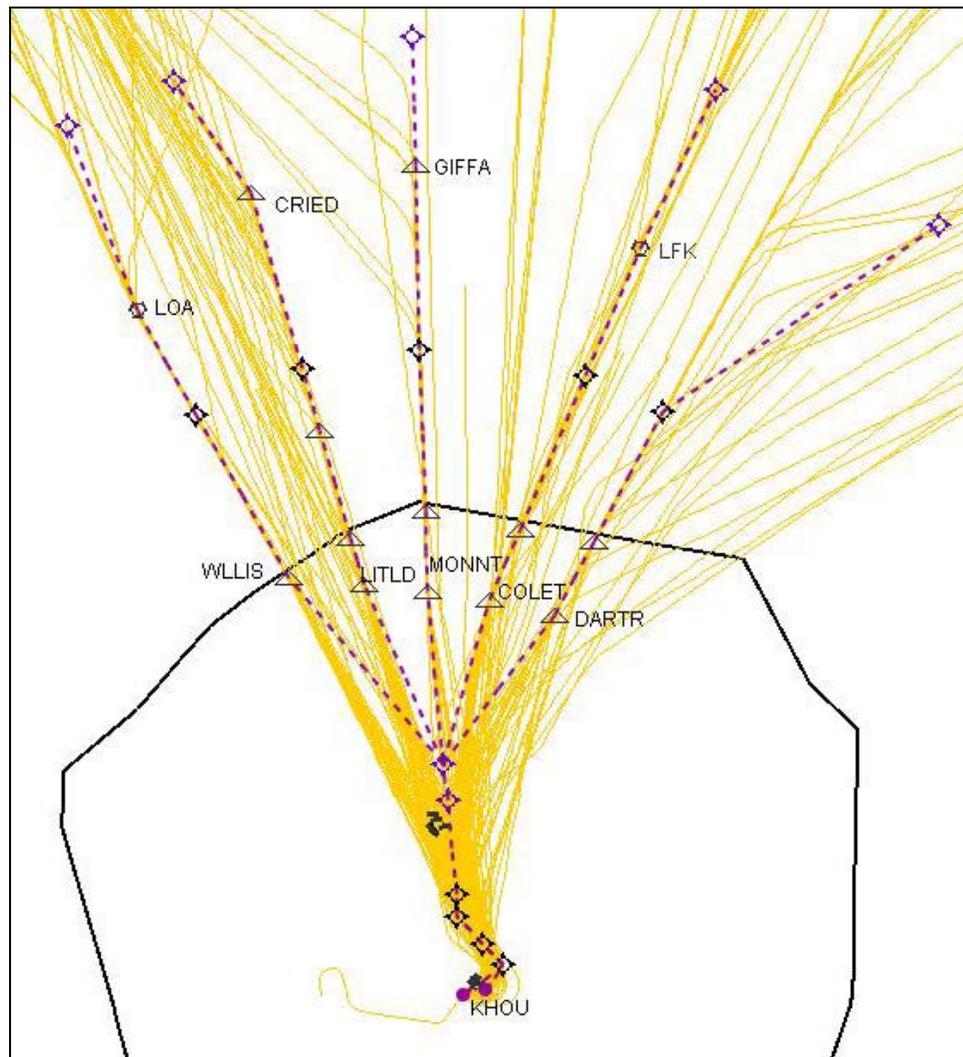


Figure 4. Study Team Proposed HOU Northbound SIDs

## OAPM Design Package: Houston Metroplex WYLSN RNAV SID

### Proposed Final Design

The Design Team proposed six RNAV SIDs to replace today's six northbound SIDs: LOA, CRIED, GIFFA, LFK, ELD and AEX. These SIDs would be replaced by the STYCK, DREMR, WYLSN, INDIE, LURIC and STRYA SIDs. The WYLSN SID would begin with a radar vector because a more efficient departure could not be built using current RNAV SID criteria.

The WYLSN SID would replace the current GIFFA SID.

The Design Team created two en route transitions after coordination with the North Texas OAPM Team regarding their designs that will be implemented in December 2014. Prior to North Texas OAPM implementation, aircraft will fly the GIFFA transition to DFW. After North Texas OAPM implementation, aircraft will fly the MAJKK transition to DAL.

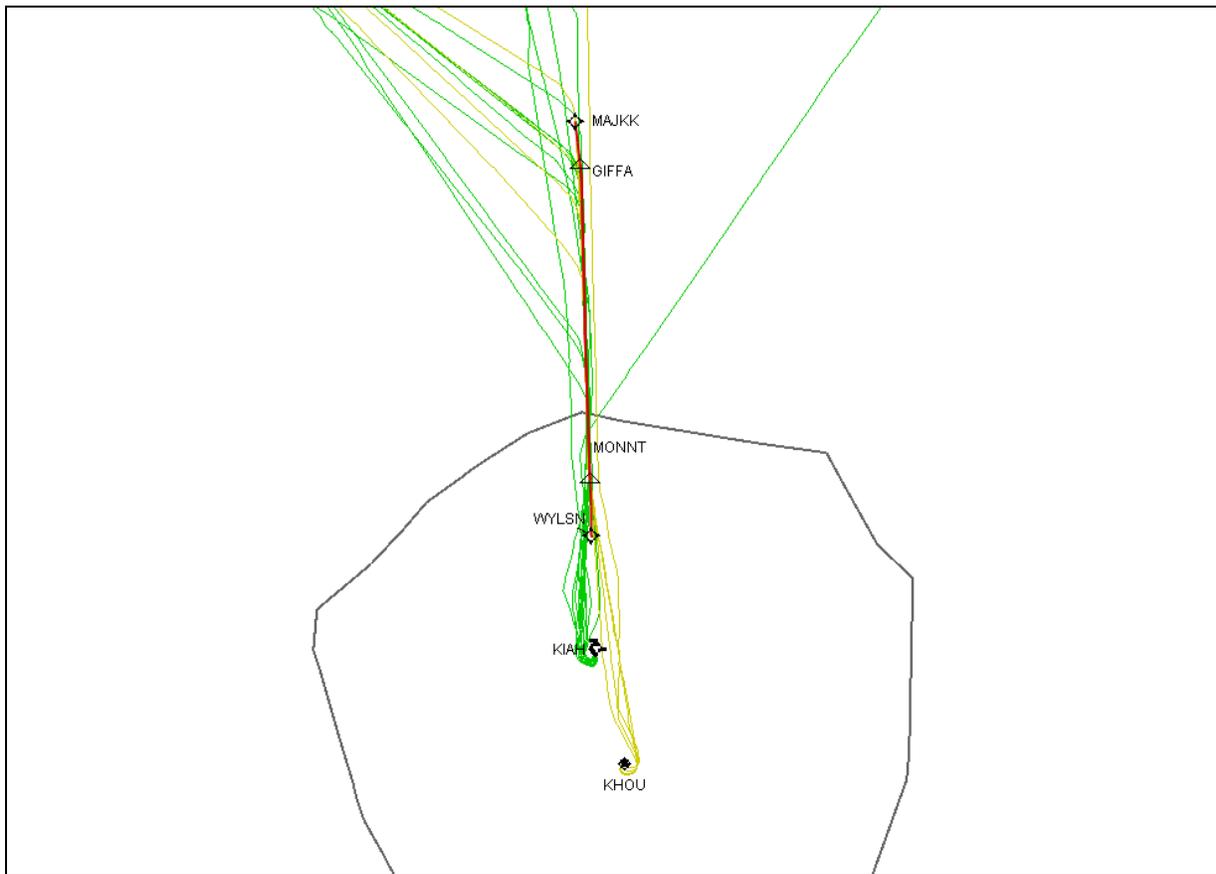


Figure 5. Proposed WYLSN SID

## **OAPM Design Package: Houston Metroplex WYLSN RNAV SID**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

**None**

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZFW, ZHU, and I90 internal Standard Operating Procedures and Letters of Agreement.

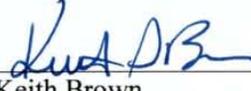
### **Attachments**

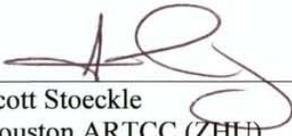
1. Phase III TARGETS File
2. WYLSN TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
4. Procedure Change Table

## OAPM Design Package: Houston Metroplex WYLSN RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 Mark Phipps Houston Metroplex FAA Lead	<u>6-25-12</u> Date	 Keith Brown Houston Metroplex NATCA Lead	<u>6/25/12</u> Date
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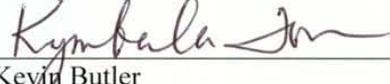
 Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>6/25/12</u> Date	 Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>6/28/12</u> Date
--	------------------------	---	------------------------

 Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>6-20-12</u> Date	 Steve Prichard Houston TRACON (I90) NATCA Lead	<u>6-25-12</u> Date
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## OAPM Design Package: Houston Metroplex WYLSN RNAV SID

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 Allen Borchers George Bush Intercontinental Tower (IAH ATCT) FAA Lead	<u>6/26/12</u> Date	 John Olinger George Bush Intercontinental Tower (IAH ATCT) NATCA Lead	<u>6/26/12</u> Date
 Mike Sapp William P. Hobby Tower (HOU ATCT) FAA Lead	<u>        </u> Date	 Kevin Butler William P. Hobby Tower (HOU ATCT) NATCA Lead	<u>6/28/12</u> Date

## OAPM Design Package: Houston Metroplex HUDZY HOU Conventional STAR

<b>Name of Change</b>	<b>HUDZY STAR</b>	<b>Date</b>	<b>09-21-2012</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>N/A</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 23, 26, 36, 38, 40, 42, 81 <b>ZFW Sectors:</b> 30, 86 <b>Ft. Polk Approach</b>	<b>Facility Points of Contact</b>	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> WHACK	<b>Associated Data Files:</b>	<b>1. Houston OAPM D&amp;I Master TARGETS File</b> <b>2. TARGETS Distribution Package</b>

**Purpose**

This design package addresses issues with the northeast HOU STARs. In addition to RNAV OPD STARs, the Houston D and I Team was tasked to develop conventional arrival procedures to provide non-RNAV equipped aircraft access to the Houston terminal area.

**Study Team Recommendation**

The Houston Study Team recommended that conventional STARs be developed during the Houston D&I Team process. The Houston Study Team proposed at least one conventional path per cornerpost, aligned as closely as possible with the proposed RNAV routing.

## OAPM Design Package: Houston Metroplex HUDZY HOU Conventional STAR

### Proposed Final Design

The Design Team is proposing the new conventional HUDZY STAR for non-RNAV jet arrivals to HOU as depicted in Figure 1. HOU HUDZY arrivals will cross WAPPL at FL220 and 280 knots.

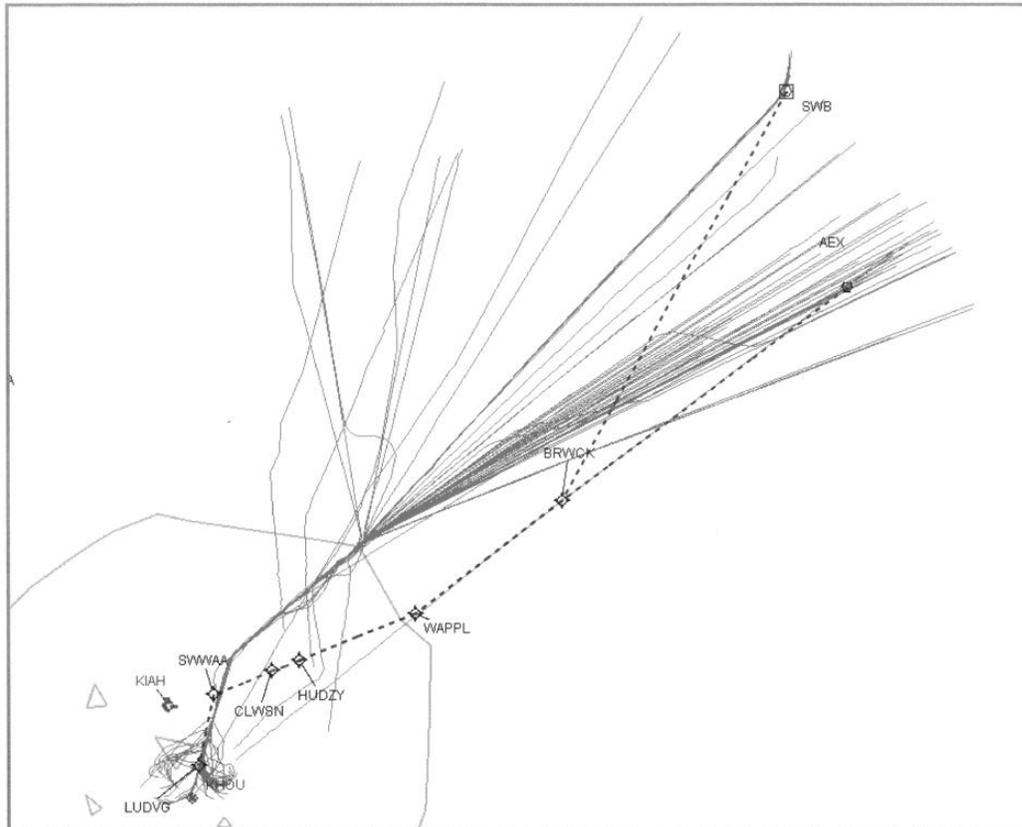


Figure 1. Proposed HUDZY STAR

## **OAPM Design Package: Houston Metroplex HUDZY HOU Conventional STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

WHACK

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated. Lateral boundaries of low altitude sectors were reviewed and need to be modified to accommodate the new procedures.

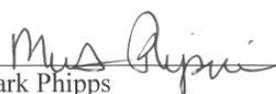
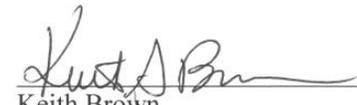
### **Attachments**

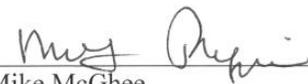
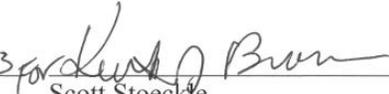
1. Houston OAPM D&I Master TARGETS File
2. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
3. TARGETS Distribution Package

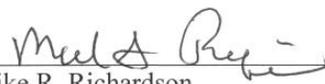
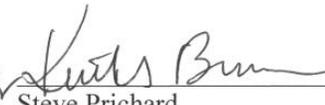
## OAPM Design Package: Houston Metroplex HUDZY HOU Conventional STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>1-9-13</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>1/9/13</u> Date
--	-----------------------	---	-----------------------

<i>For</i>  _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>1-9-13</u> Date	<i>for</i>  _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>1/9/13</u> Date
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<i>For</i>  _____ Mike R. Richardson Houston TRACON (I90) Facility Lead	<u>1-9-13</u> Date	<i>for</i>  _____ Steve Prichard Houston TRACON (I90) NATCA Lead	<u>1/9/13</u> Date
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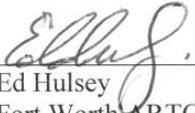
## OAPM Design Package: Houston Metroplex HUDZY HOU Conventional STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
Mark Phipps  
North Texas Metroplex  
FAA Lead

1-9-13  
Date

  
Ed Hulsey  
Fort Worth ARTCC (ZFW)  
NATCA Lead

1/9/13  
Date

## OAPM Design Package: Houston Metroplex OHIO IAH Conventional STAR

<b>Name of Change</b>	<b>OHIO STAR</b>	<b>Date</b>	<b>09-21-2012</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>N/A</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 23, 26, 36, 38, 40, 42, 81 <b>ZFW Sectors:</b> 30, 86 <b>Ft. Polk Approach</b>	<b>Facility Points of Contact</b>	<b>Zeb Snyder 281.230.5553</b> <b>Ken Wilson 281.230.5553</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> WHACK	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>TARGETS Distribution Package</b></li> </ol>

### Purpose

This design package addresses issues with the northeast IAH STARs. In addition to RNAV OPD STARs, the Houston D and I Team was tasked to develop conventional arrival procedures to provide non-RNAV equipped aircraft access to the Houston terminal area.

### Study Team Recommendation

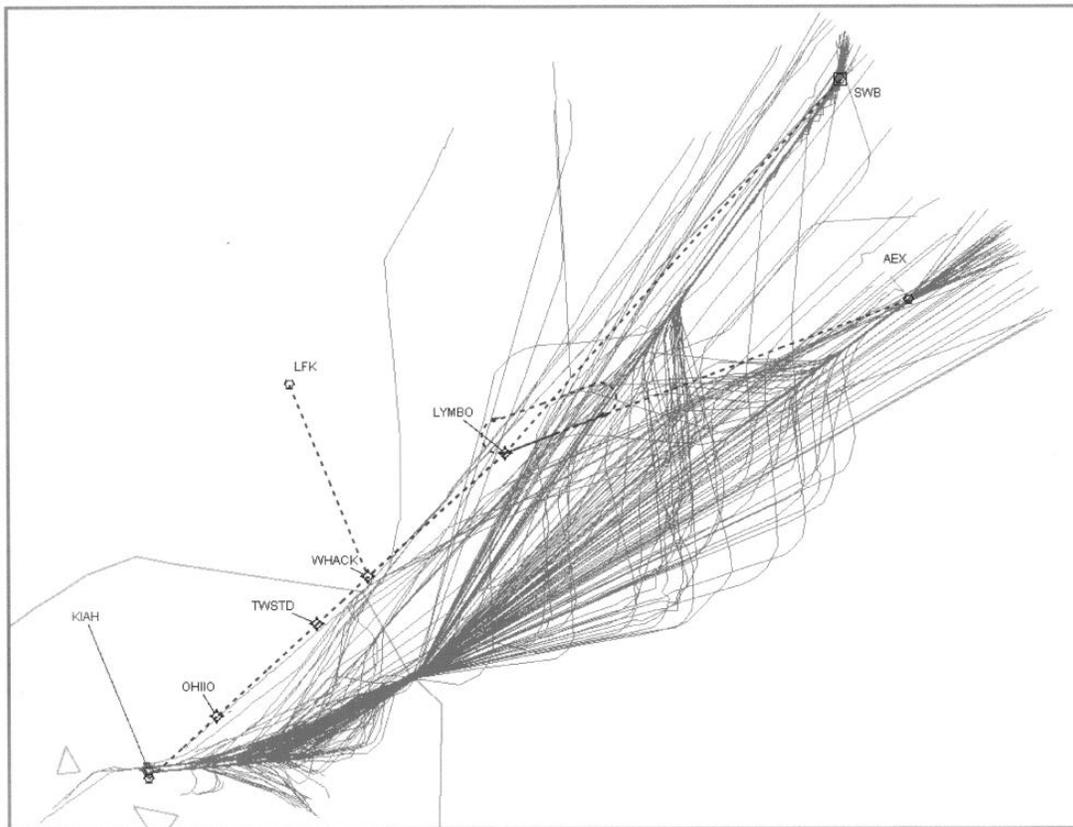
The Houston Study Team recommended that conventional STARs be developed during the Houston D&I Team process. The Houston Study Team proposed at least one conventional path per cornerpost, aligned as closely as possible with the proposed RNAV routing.

## OAPM Design Package: Houston Metroplex OHIO IAH Conventional STAR

### Proposed Final Design

The Design Team is proposing the new conventional OHIO STAR for non-RNAV jet arrivals to IAH as depicted in Figure 1. IAH OHIO arrivals will cross WHACK at 12,000 feet and 250 knots in an IAH west flow operation and will cross WHACK at 17,000 feet and 280 knots in an east flow operation.

Non-RNAV equipped arrivals capable of 280 knots destined airports north of J2 will use the OHIO conventional STAR regardless of flow at IAH. These arrivals will cross WHACK at 10,000 feet and 250 knots. IAH turbo-prop arrivals operating at speeds below 280 knots destined IAH will cross WHACK at 8,000 feet in all flows at IAH. Other north satellite arrivals will be addressed in Letters of Agreement. Table 1 below identifies I90 satellite airports.



**Figure 1. Proposed OHIO STAR (En Route)**

## OAPM Design Package: Houston Metroplex OHIO IAH Conventional STAR

Airport ID	Airport Name South of J2		Airport ID	Airport Name North of J2
AXH	Houston Southwest		CXO	Lone Star Executive
EFD	Ellington Field		DWH	David Wayne Hooks Memorial
GLS	Scholes International		EYQ	Weiser Air Park
HPY	Baytown			
IWS	West Houston			
LBX	Brazoria County			
LVJ	Pearland Regional			
SGR	Sugar Land Regional			
TME	Houston Executive			
T00	Chambers County			
T41	La Porte Municipal			
54T	RWJ Airpark			

**Table 1. Houston OAPM Satellite Airports**

**Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

**STARs:**

WHACK

**Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated. Lateral boundaries of low altitude sectors were reviewed and need to be modified to accommodate the new procedures.

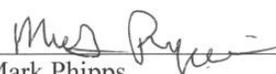
**Attachments**

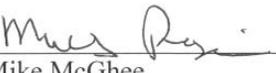
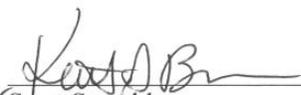
1. Houston OAPM D&I Master TARGETS File
2. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
3. TARGETS Distribution Package

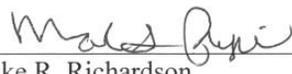
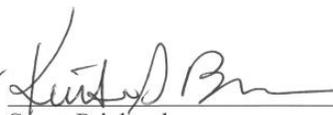
## OAPM Design Package: Houston Metroplex OHIO IAH Conventional STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>1-9-13</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>1/9/13</u> Date
--	-----------------------	---	-----------------------

<i>For</i>  _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>1-9-13</u> Date	<i>for</i>  _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>1/9/13</u> Date
--	-----------------------	---	-----------------------

<i>For</i>  _____ Mike R. Richardson Houston TRACON (190) Facility Lead	<u>1-9-13</u> Date	<i>for</i>  _____ Steve Prichard Houston TRACON (190) NATCA Lead	<u>1/9/13</u> Date
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## OAPM Design Package: Houston TAKKL Conventional STAR

<b>Name of Change</b>	<b>TAKKL STAR</b>	<b>Date</b>	<b>11-30-2012</b>
<b>Change Classification</b>	Terminal Procedures	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E10, E11, E17, E29, I7</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 74, 78, 80, 82, 83, 96 <b>ZFW Sectors:</b> 46, 96	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs:</b> DRLLR TTORO MSCOT KIDDZ <b>SIDs:</b> BNDTO DOBBY PITZZ	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>Table of Procedures</b></li> </ol>

### Purpose

This design package addresses issues with the northwest HOU STARs. In addition to RNAV OPD STARs, the Houston D and I Team was tasked to develop conventional arrival procedures to provide non-RNAV equipped aircraft access to the Houston terminal area.

### Study Team Recommendation

The Houston Study Team recommended that conventional STARs be developed during the Houston D&I Team process. The Houston Study Team proposed at least one conventional path per cornerpost, aligned as closely as possible with the proposed RNAV routing.

## OAPM Design Package: Houston TAKKL Conventional STAR

### Proposed Final Design

The Design Team is proposing the new conventional TAKKL STAR for non-RNAV jet arrivals to HOU, EFD, GLS and LBX airports as depicted in Figure 1. This STAR will be used in both east and west flows. HOU TAKKL STAR arrivals will cross KIDDZ at 12,000 feet and 250 knots.

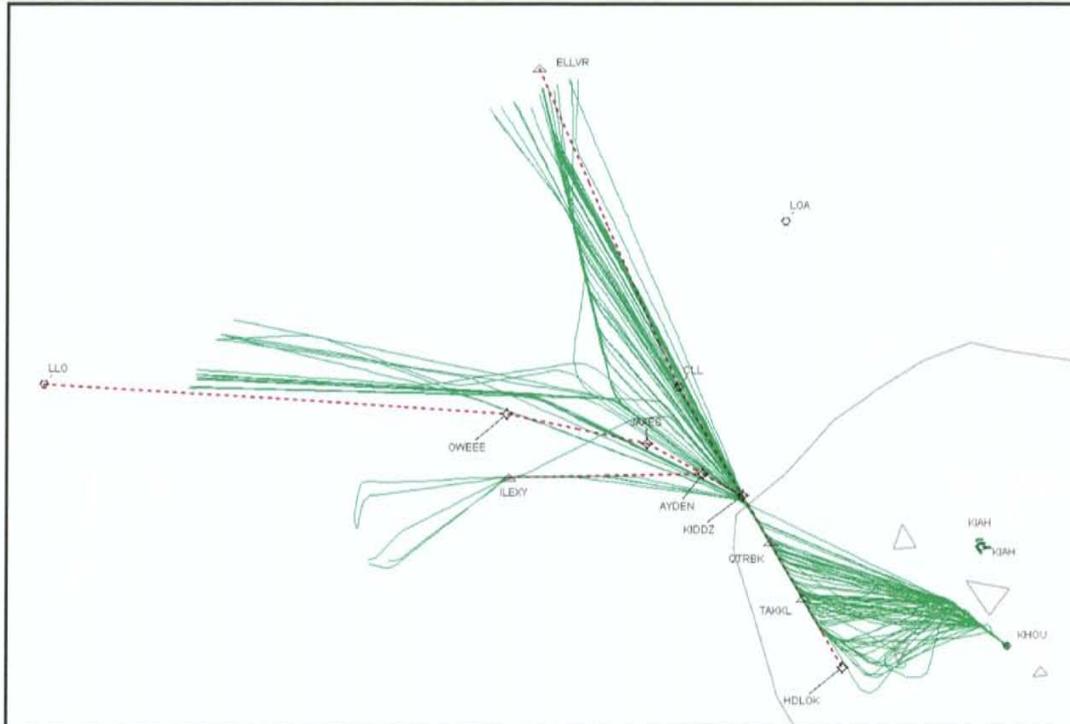


Figure 1. TAKKL STAR

## **OAPM Design Package: Houston TAKKL Conventional STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

#### **STARs:**

DRLLR  
MSCOT  
TTORO  
KIDDZ

#### **SIDs:**

BNDTO  
DOBBY  
PITZZ

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. The vertical and lateral limits of low altitude sectors and positions in I90 were reviewed and may need to be modified to accommodate the new procedures.

### **Attachments**

1. Phase IV TARGETS File
2. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
3. Procedure Change Table

## OAPM Design Package: Houston TAKKL Conventional STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

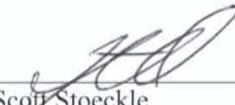
1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

12/27/12  
Date

  
\_\_\_\_\_  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

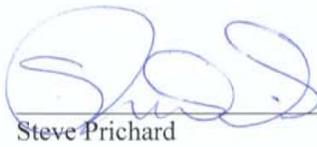
1/2/13  
Date

  
\_\_\_\_\_  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

12/28/12  
Date

  
\_\_\_\_\_  
Mike Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/4/13  
Date

**OAPM Design Package: Houston Metroplex  
TCHDN Conventional STAR**

<b>Name of Change</b>	<b>TCHDN STAR</b>	<b>Date</b>	<b>10-11-2012</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>None</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 ZHU Sectors: 58, 59, 87, 92, 95</b>	<b>Facility Points of Contact</b>	<b>Will Hutson 281.230.5556 David Kidd 281.230.5556</b>
<b>Related/Dependent Submissions</b>	<b>STARs: HTOWN TEJAS BELLR KIDDZ</b>	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>2. TCHDN TARGETS Distribution Package</b></li> </ol>

**Purpose**

Specific procedures for conventional arrivals to Houston Terminal Area were not addressed by the Houston OAPM Study team. The proposed TCHDN STAR will provide an arrival procedure for all non-RNAV equipped aircraft arriving from the southwest destined HOU and satellite airports listed in Table 1. The TCHDN STAR replaces the ROYOH STAR to more closely align with the proposed BELLR RNAV STAR.

**Study Team Recommendation**

The Houston OAPM Study Team did not propose conventional arrival procedures.

## OAPM Design Package: Houston Metroplex TCHDN Conventional STAR

### Proposed Final Design

The Design Team is proposing the new conventional TCHDN STAR, as depicted in Figure 1, for all non-RNAV equipped aircraft destined to HOU and satellite airports as listed in Table 1. Jets and turboprops capable of 280 knots or greater landing HOU will cross BELLR at 12,000 feet and 250 knots. Turboprop arrivals operating at speeds below 280 knots landing HOU will cross BELLR at 9,000 feet. All piston powered aircraft landing HOU and satellite airports listed in Table 1 will cross BELLR at 7,000 feet. Jets and turboprops capable of 280 knots or greater landing satellite airports in Table 1 will cross BELLR at 10,000 feet and 250 knots. Turboprop arrivals operating at speeds below 280 knots landing satellite airports in Table 1 will cross BELLR at 8,000 feet. The TCHDN conventional STAR is not flow dependent.

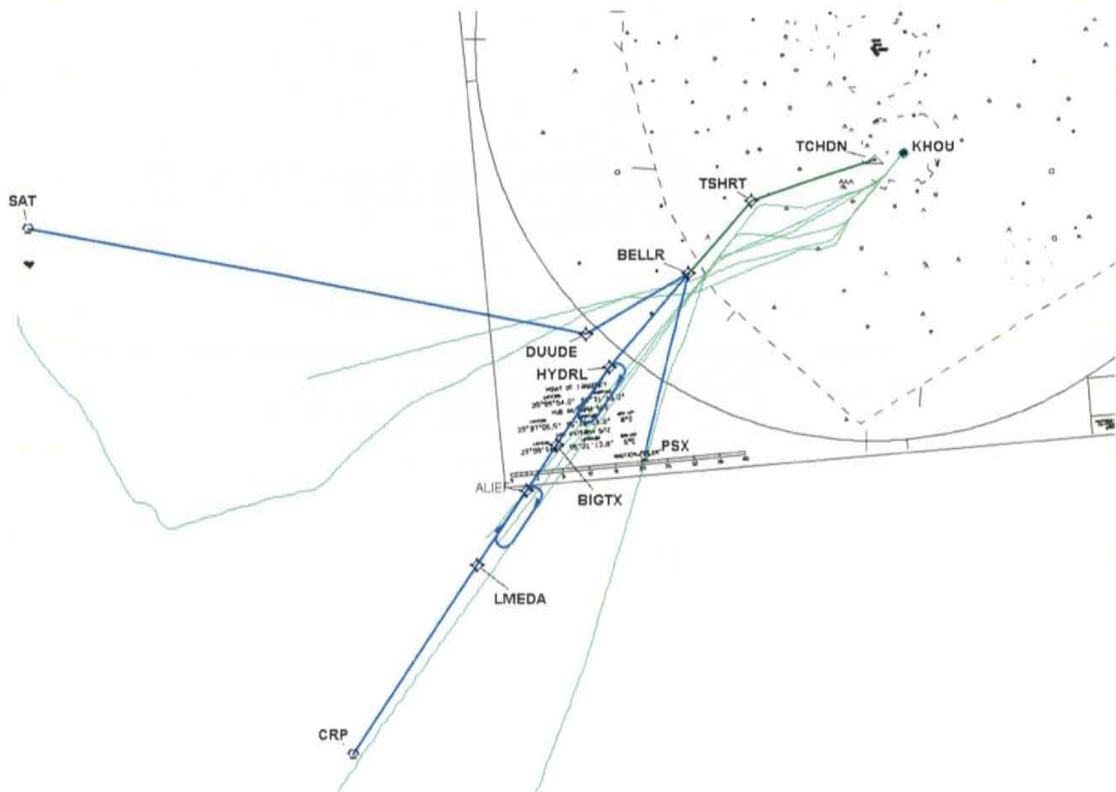


Figure 1. Proposed TCHDN STAR

## OAPM Design Package: Houston Metroplex TCHDN Conventional STAR

Airport ID	Airport Name
AXH	Houston Southwest
EFD	Ellington Field
GLS	Scholes International
HPY	Baytown
IWS	West Houston
LBX	Brazoria County
LVJ	Pearland Regional
SGR	Sugar Land Regional
TME	Houston Executive
T00	Chambers County
T41	La Porte Municipal
54T	RWJ Airpark

**Table 1. Applicable Satellite Airports**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedure(s):

**STARs:**  
HTOWN  
TEJAS  
BELLR  
KIDDZ

### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

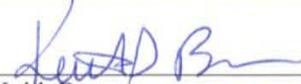
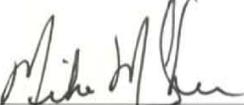
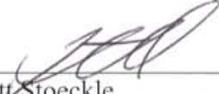
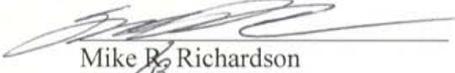
### **Attachments**

1. Houston OAPM D&I Master TARGETS File
2. TCHDN TARGETS Distribution Package

## OAPM Design Package: Houston Metroplex TCHDN Conventional STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>1-8-13</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>12/27/12</u> Date
 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>1/2/13</u> Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>12/28/12</u> Date
 _____ Mike Richardson Houston TRACON (I90) Facility Lead	<u>1-4-13</u> Date	 _____ Steve Prichard Houston TRACON (I90) NATCA Lead	<u>1/4/13</u> Date

**OAPM Design Package: Houston Metroplex  
WHAEL Conventional STAR**

<b>Name of Change</b>	<b>WHAEL STAR</b>	<b>Date</b>	<b>10-02-2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>None</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 ZHU Sectors: 58, 59, 76, 87, 95, 92</b>	<b>Facility Points of Contact</b>	<b>David Kidd 281.230.5556 Will Hutson 281.230.5556</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> TEJAS BELLR KIDDZ HTOWN <b>SIDs:</b> HUBEE DOBBY PITZZ BNDTO	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>WHAEL TARGETS Distribution Package</b></li> </ol>

**Purpose**

Specific procedures for satellite airports were not addressed by the Houston OAPM Study team. The proposed WHAEL STAR will provide an arrival procedure for all aircraft arriving from the southwest destined CXO and DWH.

**Study Team Recommendation**

The Houston OAPM Study Team did not propose satellite airport arrival procedures.

**Proposed Final Design**

I90 satellite airport arrivals destined CXO and DWH will use the WHAEL conventional STAR regardless of flow at IAH. All arrivals will cross EATIT or FFSSH at 9,000 feet. This route mitigates interactions with aircraft arriving and departing IAH. The WHAEL conventional STAR is not flow dependent.

## OAPM Design Package: Houston Metroplex WHAEL Conventional STAR

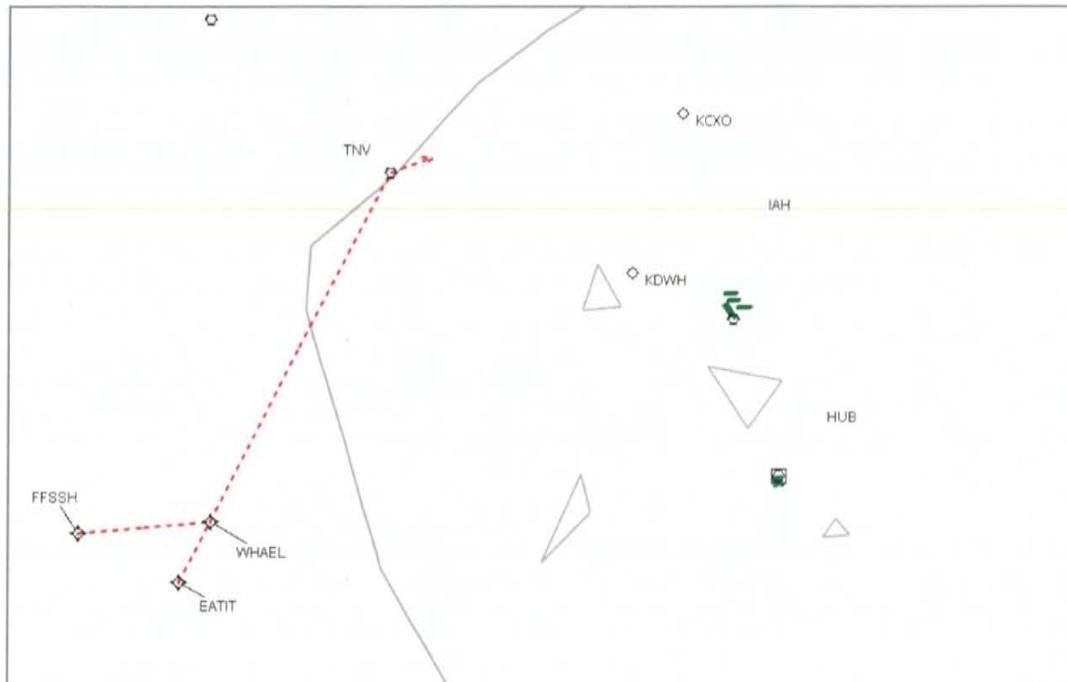


Figure 1. WHAEL Conventional STAR

### Proposed Design and Implementation Dependencies

This design is dependent on the following procedures:

**STARs:**  
TEJAS  
BELLR  
KIDDZ  
HTOWN

**SIDs:**  
HUBEE  
DOBBY  
PITZZ  
BNDTO

### Additional Design Considerations

Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

## **OAPM Design Package: Houston Metroplex WHAEL Conventional STAR**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement.

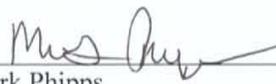
### **Attachments**

1. Houston OAPM D&I Master TARGETS File
2. WHAEL TARGETS Distribution Package

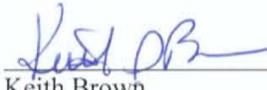
## OAPM Design Package: Houston Metroplex WHAEL Conventional STAR

### Review Signatures

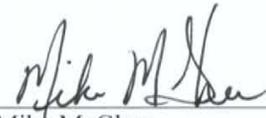
The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

12/27/12  
Date

  
\_\_\_\_\_  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

1/2/13  
Date

  
\_\_\_\_\_  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

12/28/12  
Date

  
\_\_\_\_\_  
Mike R. Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/4/13  
Date

**OAPM Design Package: Houston Metroplex**  
**George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, East Flow**

<b>Name of Change</b>	<b>IAH RNP AR Approaches, East Flow</b>	<b>Date</b>	<b>11/01/2012</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>RNP Approaches 4.3.3</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b>	<b>Facility Points of Contact</b>	<b>I90: Gregg Jones</b>
<b>Related/Dependent Submissions</b>	<b>BOOZZ RNAV STAR BRSKT RNAV STAR TWSTD RNAV STAR SKNRD RNAV STAR</b>	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li>1. Houston OAPM D&amp;I Master TARGETS File</li> <li>2. RNP AR Runway 08L SI Distribution Package</li> <li>3. RNP AR Runway 08R SI Distribution Package</li> <li>4. RNP AR Runway 08R RTDW Distribution Package</li> <li>5. RNP AR Runway 09 RTDW Distribution Package</li> <li>6. RNP AR Runway 09 SI Distribution Package</li> <li>7. Procedure Change Table</li> </ol>

**Purpose**

The Study Team developed conceptual RNP AR approaches to HOU Runways 04 and 12R for stabilized and efficient approach operations. The RNP AR approach transitions were tied to the proposed RNAV STARs to ensure maximum efficiency, both laterally and vertically.

**Study Team Recommendation**

The Study Team did not recommend any specific design of RNP AR approaches to IAH.

**Proposed Final Design**

The Design Team elected to design three RNP AR approaches for IAH east flow operations:

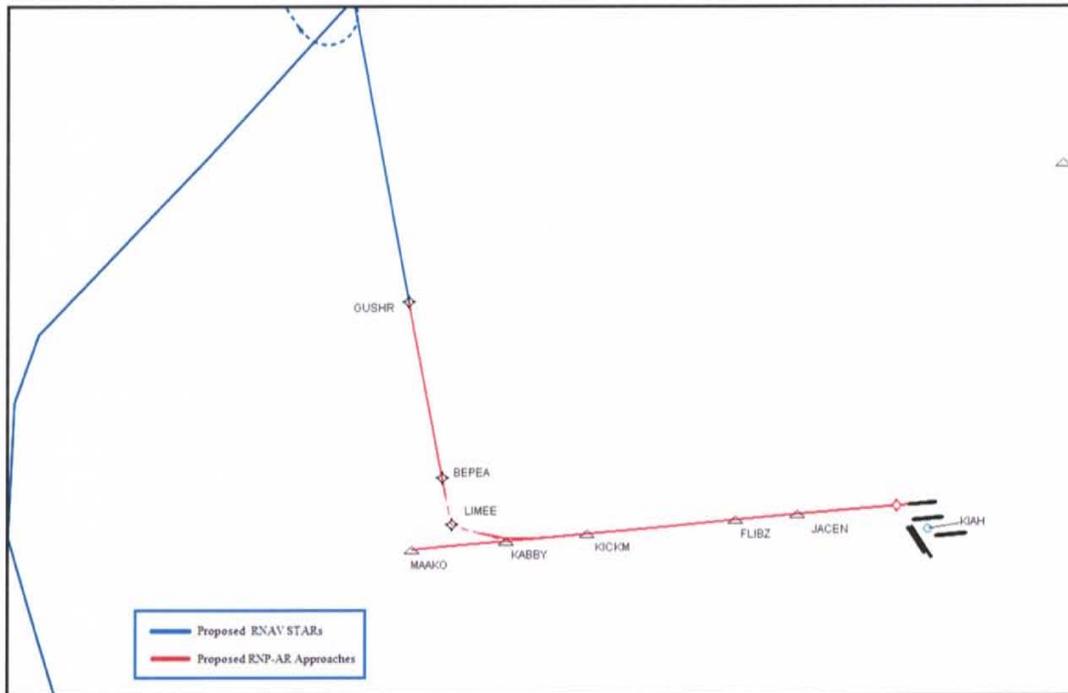
- IAH Runway 08L IF: Straight-In
- IAH Runway 08R IF: Straight-In and Right Turn to Downwind
- IAH Runway 09 IF: Straight-In and Right Turn to Downwind

These ATC assigned approaches would be flown by properly equipped jet and high performance turboprop aircraft with qualified aircrews.

**OAPM Design Package: Houston Metroplex**  
**George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, East Flow**

**IAH Runway 08L**

As shown in Figure 1, the RNP AR approach to IAH Runway 08L ties in directly to the proposed RNAV STARs from the northwest (GUSHR). Arrivals from the northwest will join the RNP AR approach to IAH Runway 08L at GUSHR. A straight in RNP AR approach to IAH Runway 08L has been designed that overlays the ILS Runway 08L final approach.

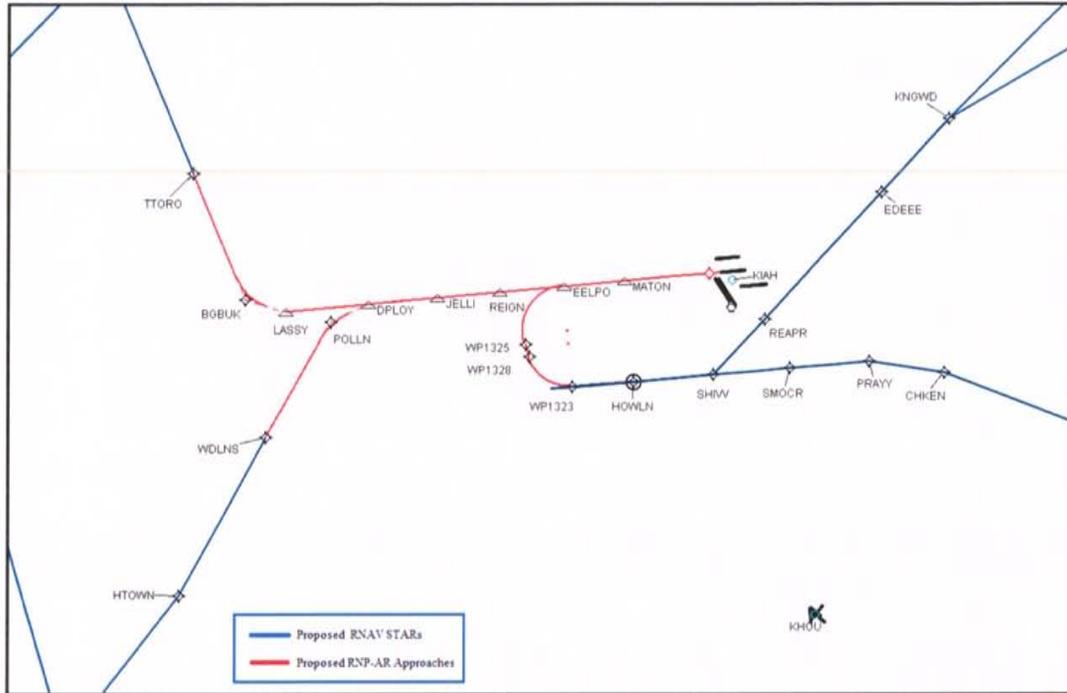


**FIGURE 1. PROPOSED FINAL DESIGN**

**IAH Runway 08R**

As shown in Figure 2, the RNP AR approach to IAH Runway 08R ties in directly to the proposed RNAV STARs from the northeast (TWSTD and SKNRD), southeast (BOOZZ and BRSKT), southwest (HTOWN), and northwest (TTORO). Arrivals from the northeast and southeast will join the RNP AR approach to IAH Runway 08R at HOWLN. Arrivals from the southwest will join the RNP AR approach to IAH Runway 08R at WDLNS. Arrivals from the northwest will join the RNP AR approach to IAH Runway 08R at TTORO. A straight in RNP AR approach to IAH Runway 08R has been designed that overlays the ILS Runway 08R final approach.

**OAPM Design Package: Houston Metroplex**  
**George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, East Flow**



**FIGURE 2. PROPOSED FINAL DESIGN**

**IAH Runway 09**

As shown in Figure 3, the RNP AR approach to IAH Runway 09 ties in directly to the proposed RNAV STARs from the northeast (TWSTD and SKNRD) and southeast (BOOZZ and BRSKT). Arrivals from the northeast and southeast will join the RNP AR approach to IAH Runway 09 at HOWLN. A straight in RNP AR approach to IAH Runway 09 has been designed that overlays the ILS Runway 09 final approach.

## OAPM Design Package: Houston Metroplex

### George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, East Flow

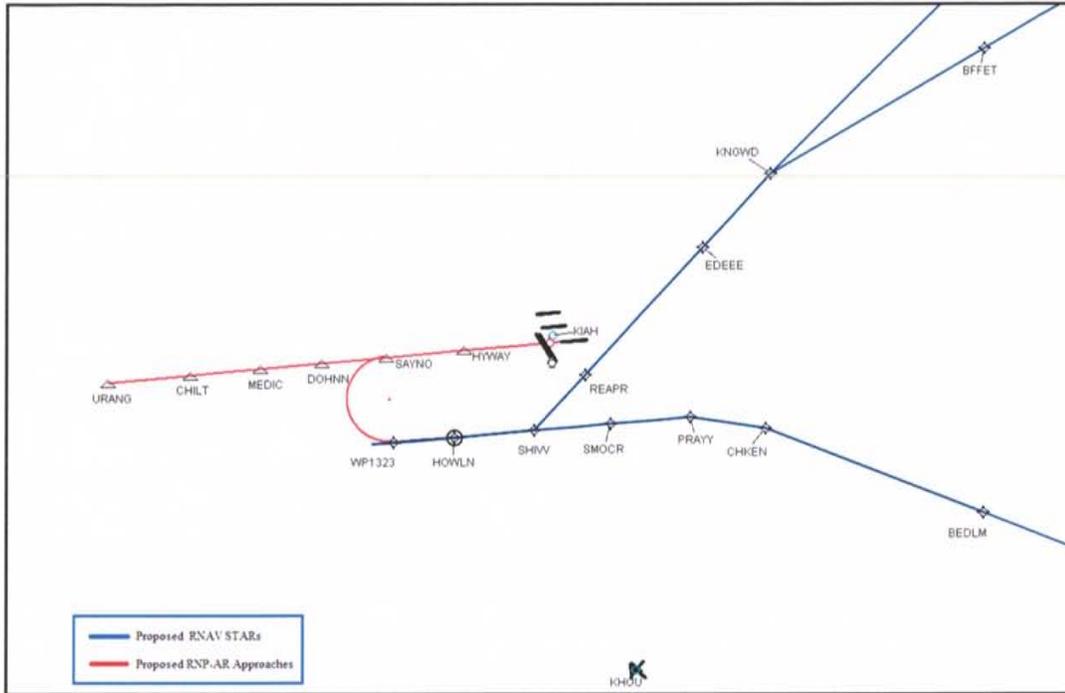


FIGURE 3. PROPOSED FINAL DESIGN

#### Proposed Design and Implementation Dependencies

This design is dependent on the following procedures:

#### **STARs:**

BOOZZ  
BRSKT  
TWSTD  
SKNRD  
TTORO  
GUSHR

#### Additional Design Considerations

This proposal requires modifications to I90 internal Standard Operating Procedures. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

**OAPM Design Package: Houston Metroplex**  
**George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, East Flow**

**Attachments**

1. Houston OAPM D&I Master TARGETS File
2. RNP AR Runway 08L Straight In Distribution Package

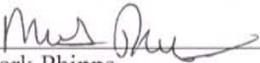
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3. RNP AR Runway 08R Straight In Distribution Package
4. RNP AR Runway 08R Base Turn to Final Distribution Package
5. RNP AR Runway 09 Base Turn to Final Distribution Package
6. RNP AR Runway 09 Straight In Distribution Package

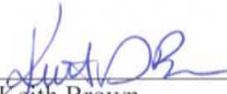
**OAPM Design Package: Houston Metroplex**  
**George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, East Flow**

Review Signatures

The D&I Team has reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

12/27/12  
Date

  
\_\_\_\_\_  
Mike R. Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/4/13  
Date

## OAPM Design Package: Houston Metroplex

*George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, East Flow*

### RECORD OF CHANGE

Change Number	Date	Document
001	01/09/2013	IAH RNP AR Approaches, East Flow
Updated TARGETS File	Updated TARGETS Distro	Updated Associated Data Files (if any)
N/A	N/A	N/A

### Description of Change

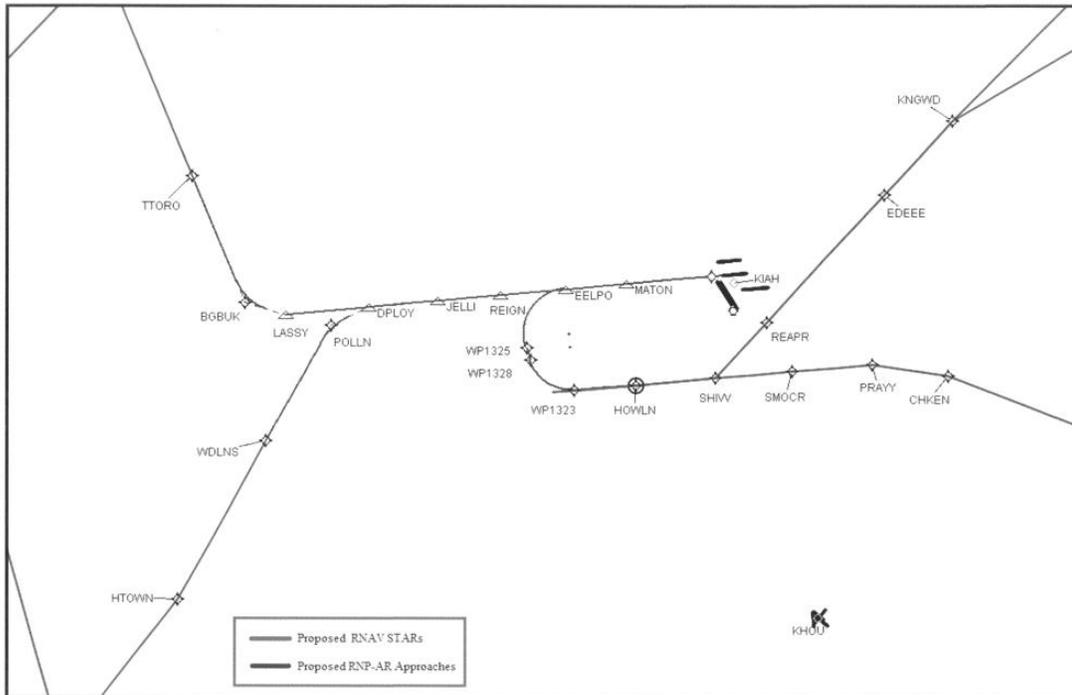
Under the **Proposed Final Design** section, the following was corrected:

#### **IAH Runway 08R**

Reference to the RNAV STARs from the northeast (TWSTD and SKNRD) was deleted as these procedures will not tie directly into the RNP AR approach to IAH Runway 08R. The original design proposal graphic is shown in Figure 1 and Figure 2 shows the corrected graphic.

### OAPM Design Package: Houston Metroplex

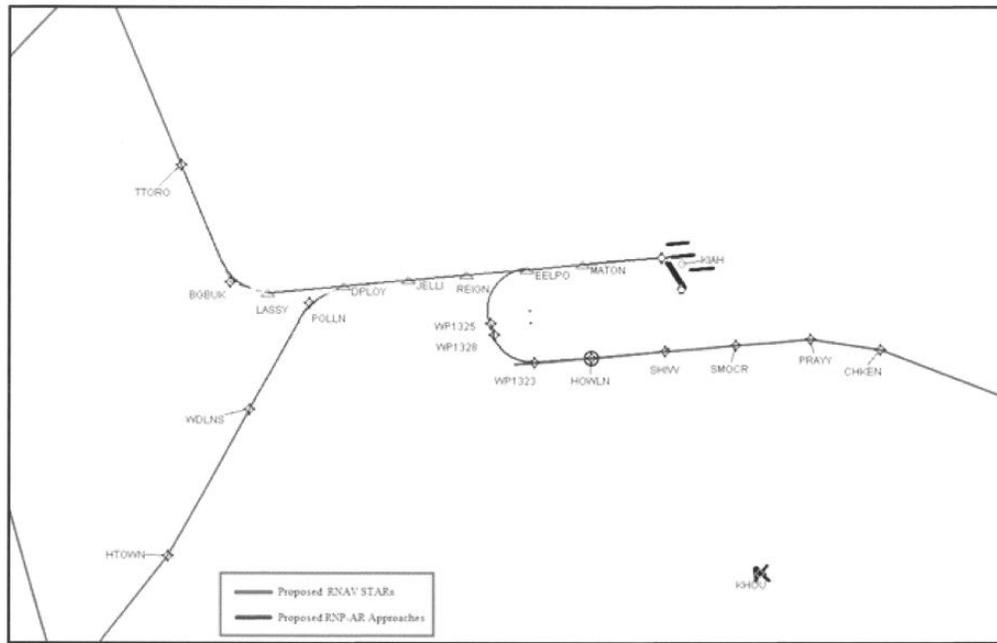
*George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, East Flow*



**FIGURE 1. PROPOSED FINAL DESIGN (Figure 2 in PFD)**

### OAPM Design Package: Houston Metroplex

*George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, East Flow*



**FIGURE 2. PROPOSED FINAL DESIGN (Will replace Figure 2 in PFD)**

**OAPM Design Package: Houston Metroplex**

*George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, East Flow*

Design Team Lead's Signatures indicates the appropriate coordination with any concerned parties has been conducted with regards to the changes/amendments listed on this document.

  
\_\_\_\_\_  
Mark Phipps  
Houston  
OAPM FAA Lead

1-10-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston  
OAPM NATCA Lead

1/10/13  
Date

**OAPM Design Package: Houston Metroplex**  
**George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, West Flow**

<b>Name of Change</b>	<b>IAH RNP AR Approaches, West Flow</b>	<b>Date</b>	<b>11/01/2012</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>RNP Approaches 4.3.3</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b>	<b>Facility Points of Contact</b>	<b>I90: Gregg Jones</b>
<b>Related/Dependent Submissions</b>	<b>DRLLR RNAV STAR MSCOT RNAV STAR TEJAS RNAV STAR</b>	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li>1. Houston OAPM D&amp;I Master TARGETS File</li> <li>2. RNP AR Runway 26L SI Distribution Package</li> <li>3. RNP AR Runway 26L RTDW Distribution Package</li> <li>4. RNP AR Runway 26R SI Distribution Package</li> <li>5. RNP AR Runway 26R RTDW Distribution Package</li> <li>6. RNP AR Runway 27 LTDW Distribution Package</li> <li>7. RNP AR Runway 27 SI Distribution Package</li> </ol>

**Purpose**

The Study Team developed conceptual RNP AR approaches to HOU Runways 04 and 12R for stabilized and efficient approach operations. The RNP AR approach transitions were tied to the proposed RNAV STARs to ensure maximum efficiency, both laterally and vertically.

**Study Team Recommendation**

The Study Team did not recommend any specific design of RNP AR approaches to IAH.

**Proposed Final Design**

The Design Team elected to design three RNP AR approaches for IAH west flow operations:

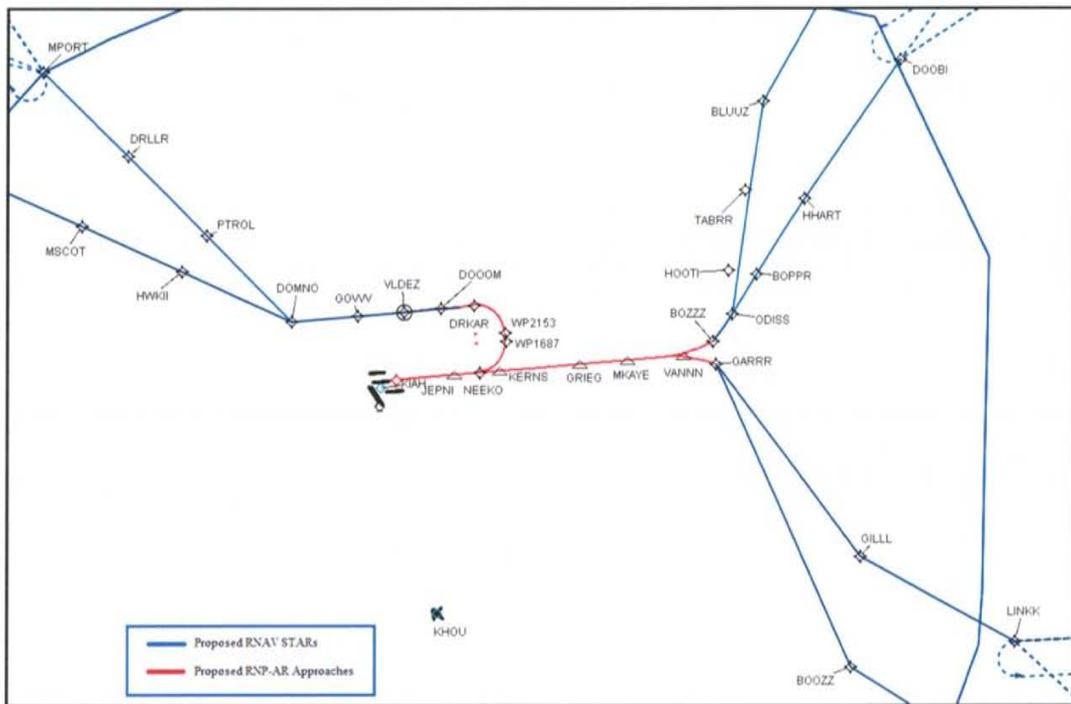
- IAH Runway 26L Straight-In and IAH Runway 26L Base Turn to Final
- IAH Runway 26R Straight-In and IAH Runway 26R Base Turn to Final
- IAH Runway 27 Straight-In and IAH Runway 27 Base Turn to Final

These ATC assigned approaches would be flown by properly equipped jet and high performance turboprop aircraft with qualified aircrews.

**OAPM Design Package: Houston Metroplex**  
**George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, West Flow**

**IAH Runway 26L**

As shown in Figure 1, the RNP AR approach to IAH Runway 26L ties in directly to the proposed RNAV STARs from the northwest (DRLLR and MSCOT), northeast (DOOBI and WHACK) and southeast (GILLL and BOOZZ). Arrivals from the northwest will join the RNP AR approach to IAH Runway 26L at VLDEZ. Arrivals from the northeast will join the RNP AR approach to IAH Runway 26L at BOZZZ. Arrivals from the southeast will join the RNP AR approach to IAH Runway 26L at GARRR. A straight in RNP AR approach to IAH Runway 26L has been designed that overlays the ILS Runway 26L final approach.



**FIGURE 1. PROPOSED FINAL DESIGN**

## OAPM Design Package: Houston Metroplex

### George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, West Flow

#### IAH Runway 26R

As shown in Figure 2, the RNP AR approach to IAH Runway 26R ties in directly to the proposed RNAV STARs from the northwest (DRLLR and MSCOT), northeast (WHACK) and southwest (TEJAS). Arrivals from the northwest and southwest will join the RNP AR approach to IAH Runway 26R at DOOOM. Arrivals from the northeast will join the RNP AR approach to IAH Runway 26R at HOOTI. A straight in RNP AR approach to IAH Runway 26R has been designed that overlays the ILS Runway 26R final approach.

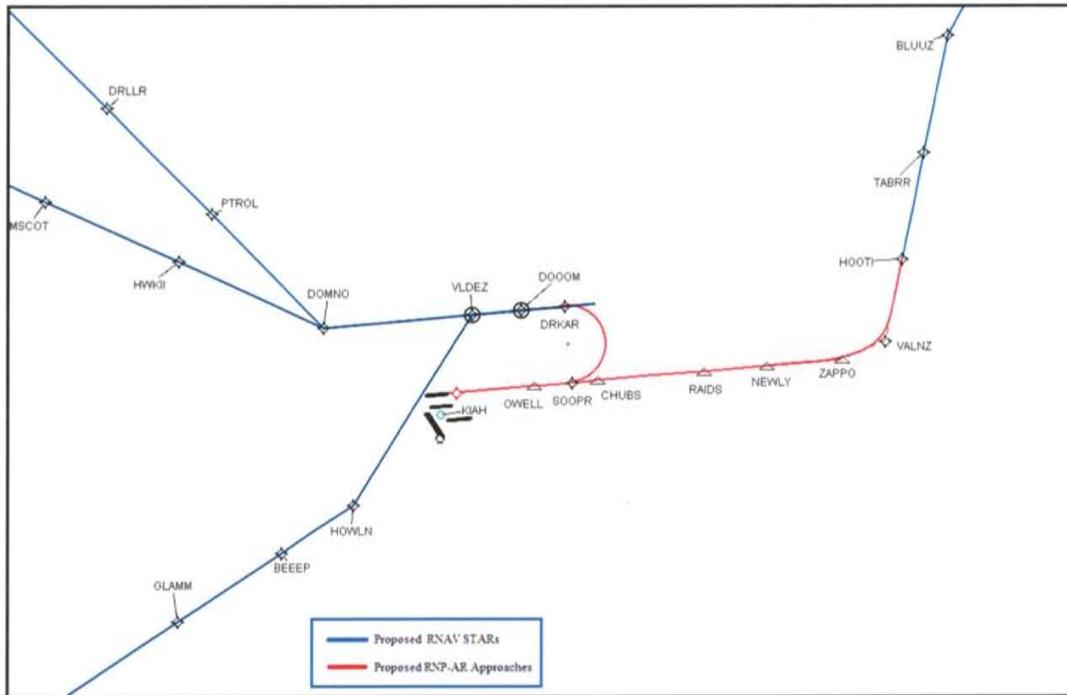


FIGURE 2. PROPOSED FINAL DESIGN

## OAPM Design Package: Houston Metroplex

### George Bush Intercontinental/Houston Airport (IAH) Required Navigation Performance (RNP) Authorization Required (AR) Approaches, West Flow

#### IAH Runway 27

As shown in Figure 3, the RNP AR approach to IAH Runway 27 ties in directly to the proposed RNAV STARs from the northwest (DRLLR and MSCOT), northeast (WHACK), southeast (GILLL and BOOZZ) and southwest (TEJAS). Arrivals from the northwest and southwest will join the RNP AR approach to IAH Runway 27 at PRAYY. Arrivals from the northeast will join the RNP AR approach to IAH Runway 27 at CLSIK. Arrivals from the southeast will join the RNP AR approach to IAH Runway 27 at RDFSH. A straight in RNP AR approach to IAH Runway 27 has been designed that overlays the ILS Runway 27 final approach.

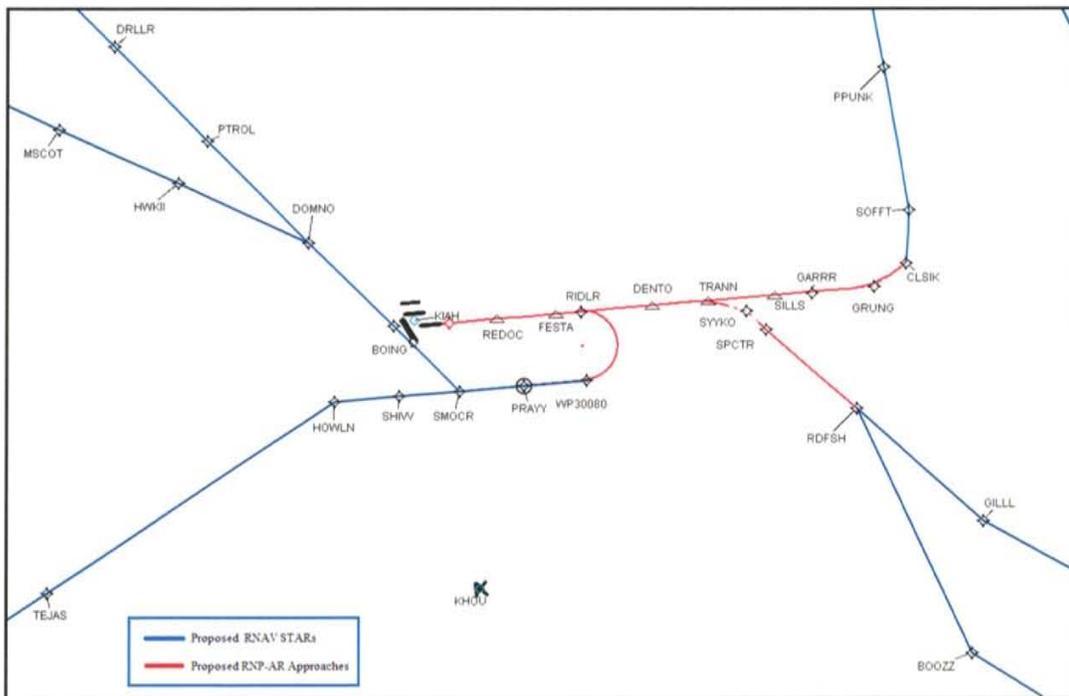


FIGURE 3. PROPOSED FINAL DESIGN

#### Proposed Design and Implementation Dependencies

This design is dependent on the following procedures:

- STARs:**
- BOOZZ
  - DRLLR
  - MSCOT
  - DOOBI
  - WHACK
  - GILLL
  - TEJAS

**OAPM Design Package: Houston Metroplex**  
**George Bush Intercontinental/Houston Airport (IAH) Required Navigation**  
**Performance (RNP) Authorization Required (AR) Approaches, West Flow**

**Additional Design Considerations**

This proposal requires modifications to I90 internal Standard Operating Procedures. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated.

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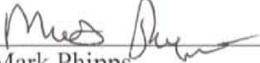
**Attachments**

1. Houston OAPM D&I Master TARGETS File
2. RNP AR Runway 26L Straight In Distribution Package
3. RNP AR Runway 26L Base Turn to Final Distribution Package
4. RNP AR Runway 26R Straight In Distribution Package
5. RNP AR Runway 26R Base Turn to Final Distribution Package
6. RNP AR Runway 27 Straight In Distribution Package
7. RNP AR Runway 27 Base Turn to Final Distribution Package

**OAPM Design Package: Houston Metroplex**  
**George Bush Intercontinental/Houston Airport (IAH) Required Navigation**  
**Performance (RNP) Authorization Required (AR) Approaches, West Flow**

Review Signatures

The D&I Team has reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

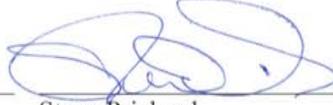
1-8-13  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

12/27/12  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Mike Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/4/13  
\_\_\_\_\_  
Date

**OAPM Design Package: Houston Metroplex  
RNAV TRANSITIONS TO GEORGE BUSH  
INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS  
08L and 08R**

<b>Name of Change</b>	<b>RNAV TRANSITION TO IAH ILS RWY 08L/08R</b>	<b>Date</b>	<b>10-01-2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>N/A</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b>	<b>Facility Points of Contact</b>	<b>Will Hutson 281.230.5556 David Kidd 281.230.5556</b>
<b>Related/Dependent Submissions</b>	<b>STARs: GUSHR HTOWN TTORO</b>	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li>1. Houston OAPM D&amp;I Master TARGETS File</li> <li>2. ILS HTOWN RWY 08R TARGETS Distribution Package</li> <li>3. ILS TTORO RWY 08R TARGETS Distribution Package</li> <li>4. ILS GUSHR RWY 08L TARGETS Distribution Package</li> <li>5. Procedure Change Table</li> </ol>

**Purpose**

To assist the controller responsible for traffic arriving IAH in an East Flow, the Design Team proposes the creation of RNAV STAR transitions to ILS approaches to IAH Runways 08L and 08R. These transitions to ILS approaches would eliminate the need for controllers to vector (qualified aircraft) in a limited area and permit them to more optimally scan traffic and perform other operational duties in busy arrival sectors.

**Study Team Recommendation**

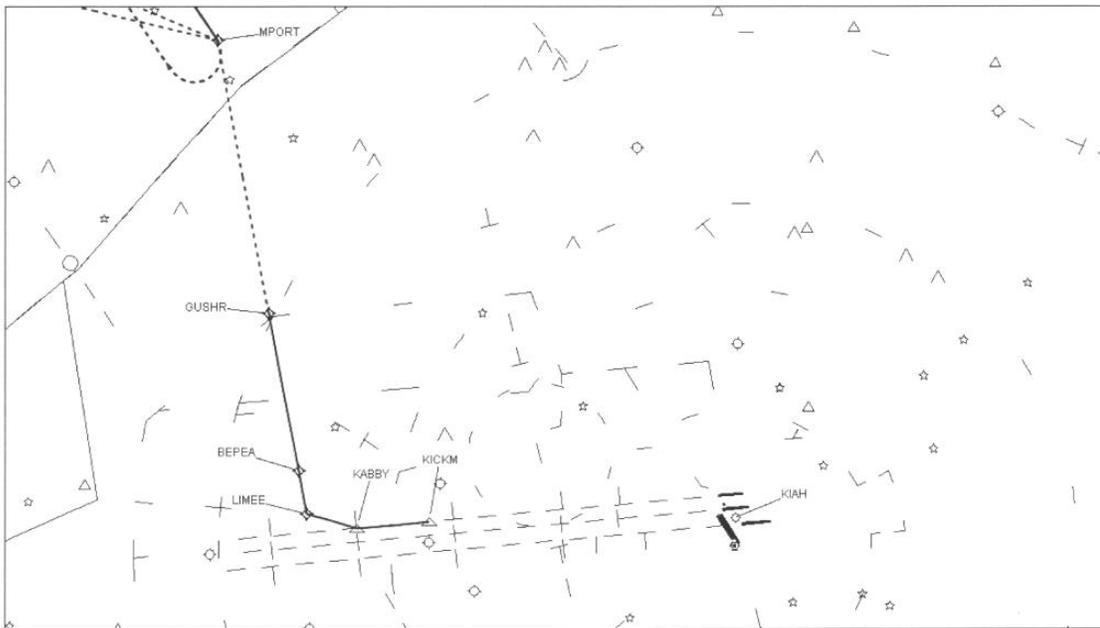
The Study Team did not address or recommend RNAV STAR transitions to ILS approaches.

## **OAPM Design Package: Houston Metroplex RNAV TRANSITIONS TO GEORGE BUSH INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS 08L and 08R**

### **Proposed Final Design**

These procedures will be for RNAV equipped jets and turbo-props and will be ATC assigned only. They will be flow and runway dependent.

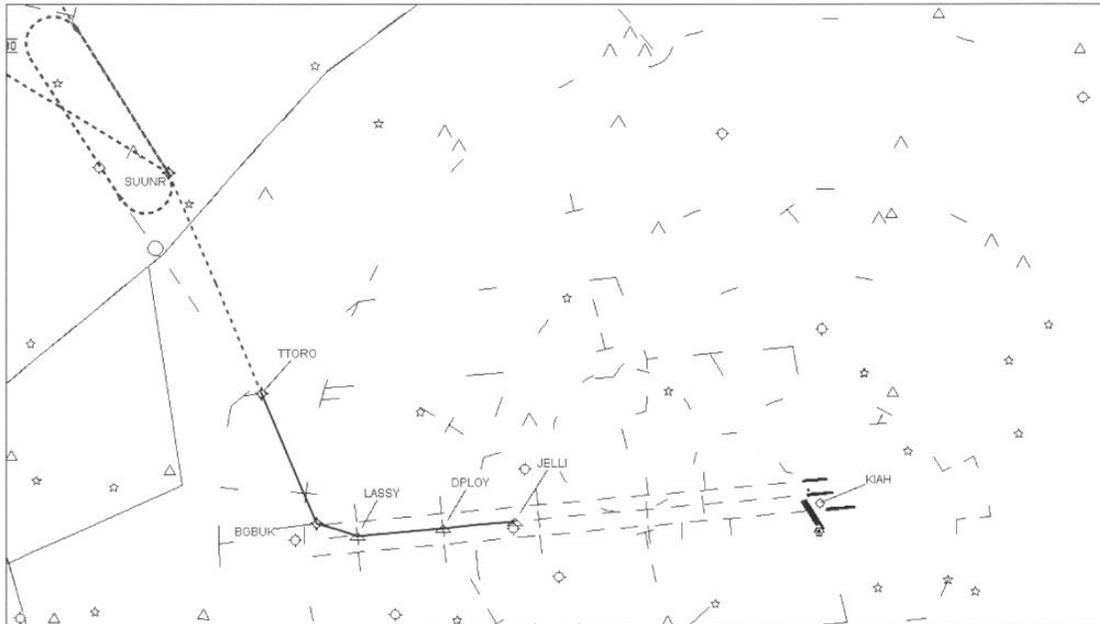
The GUSHR RNAV STAR from the northwest will have a transition to IAH ILS RWY 08L that will begin at GUSHR Fix and terminate at KICKM Fix where it will intercept the RWY 08L localizer as shown in Figure 1.



**FIGURE 1. GUSHR RNAV STAR AND TRANSITION TO IAH ILS RWY 08L**

The TTORO RNAV STAR from the northwest will have a transition to IAH ILS RWY 08R that will begin at TTORO Fix and terminate at JELLI Fix where it will intercept the RWY 08R localizer as shown in Figure 2.

**OAPM Design Package: Houston Metroplex  
RNAV TRANSITIONS TO GEORGE BUSH  
INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS  
08L and 08R**



**FIGURE 2. T TORO RNAV STAR AND TRANSITION TO IAH ILS RWY 08R**

The HTOWN RNAV STAR from the southwest will have a transition to IAH ILS RWY 08R that will begin at WDLNS Fix and terminate at JELLI Fix where it will intercept the RWY 08R localizer as shown in Figure 3.

## OAPM Design Package: Houston Metroplex RNAV TRANSITIONS TO GEORGE BUSH INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS 08L and 08R

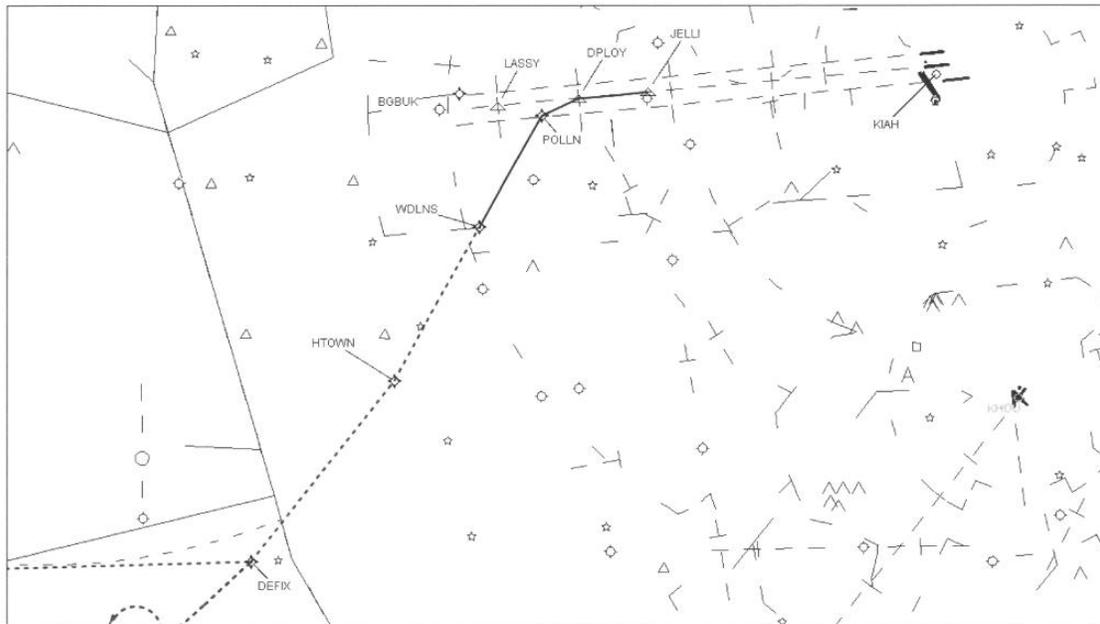


FIGURE 3. HTOWN RNAV STAR AND TRANSITION TO IAH ILS RWY 08R

### Proposed Design and Implementation Dependencies

This design is dependent on the following procedures:

#### **STARs:**

GUSHR  
HTOWN  
TTORO

### Additional Design Considerations

No spectrum analysis or additional benefit analysis is required. This proposal requires modifications to I90 internal Standard Operating Procedures. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated.

### Attachments

1. Houston OAPM D&I Master TARGETS File
2. ILS HTOWN RWY 08R TARGETS Distribution Package
3. ILS TTORO RWY 08R TARGETS Distribution Package

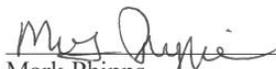
**OAPM Design Package: Houston Metroplex  
RNAV TRANSITIONS TO GEORGE BUSH  
INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS  
08L and 08R**

4. ILS GUSHR RWY 08L TARGETS Distribution Package
5. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
6. Procedure Change Table

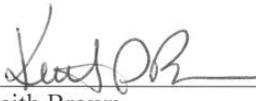
**OAPM Design Package: Houston Metroplex  
RNAV TRANSITIONS TO GEORGE BUSH  
INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS  
08L and 08R**

**Review Signatures**

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
Mark Phipps  
Houston Metroplex  
FAA Lead

1-8-13  
Date

  
Keith Brown  
Houston Metroplex  
NATCA Lead

12/27/12  
Date

  
Mike Richardson  
Houston TRACON (I90)  
Facility Lead

1-4-13  
Date

  
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NATCA Lead

1/4/13  
Date

**OAPM Design Package: Houston Metroplex  
RNAV TRANSITIONS TO GEORGE BUSH  
INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS  
26L, 26R AND 27**

<b>Name of Change</b>	<b>RNAV TRANSITION TO IAH ILS RWY 26L/26R/27</b>	<b>Date</b>	<b>10-01-2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>N/A</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b>	<b>Facility Points of Contact</b>	<b>Will Hutson 281.230.5556 David Kidd 281.230.5556</b>
<b>Related/Dependent Submissions</b>	<b>STARs: GILL DOOBI WHACK</b>	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li>1. Houston OAPM D&amp;I Master TARGETS File</li> <li>2. ILS DOOBI WHACK RWY 26L TARGETS Distribution Package</li> <li>3. ILS WHACK RWY26R TARGETS Distribution Package</li> <li>4. ILS GILL RWY 26L TARGETS Distribution Package</li> <li>5. ILS GILL RWY 27 TARGETS Distribution Package</li> <li>6. ILS WHACK RWY 27 TARGETS Distribution Package</li> <li>7. Procedure Change Table</li> </ol>

**Purpose**

To assist the controller responsible for traffic arriving IAH in a West Flow, the Design Team proposes the creation of RNAV STAR transitions to ILS approaches to IAH Runways 26L, 26R and 27. These transitions to ILS approaches would eliminate the need for controllers to vector (qualified aircraft) in a limited area and permit them to more optimally scan traffic and perform other operational duties in busy arrival sectors.

## OAPM Design Package: Houston Metroplex RNAV TRANSITIONS TO GEORGE BUSH INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS 26L, 26R AND 27

### Study Team Recommendation

The Study Team did not address or recommend RNAV STAR transitions to ILS approaches.

### Proposed Final Design

These procedures will be for RNAV equipped jets and turbo-props and will be ATC assigned only. They will be flow and runway dependent.

The GILL RNAV STAR from the southeast will have two transitions, one to IAH ILS RWY 26L and one to IAH ILS RWY 27. The RWY 26L transition will begin at GARRR Fix and terminate at GRIEG Fix where it will intercept the RWY 26L localizer. The RWY 27 transition will begin at RDFSH Fix and terminate at DENTO Fix where it will intercept the RWY 27 localizer. Both designs are shown in Figure 1.

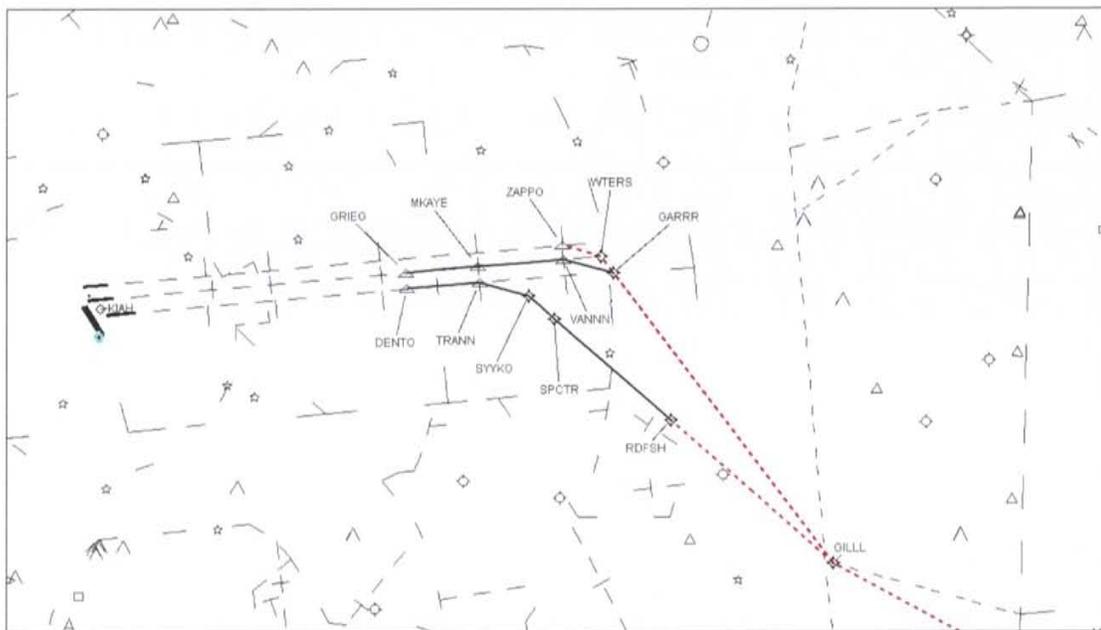
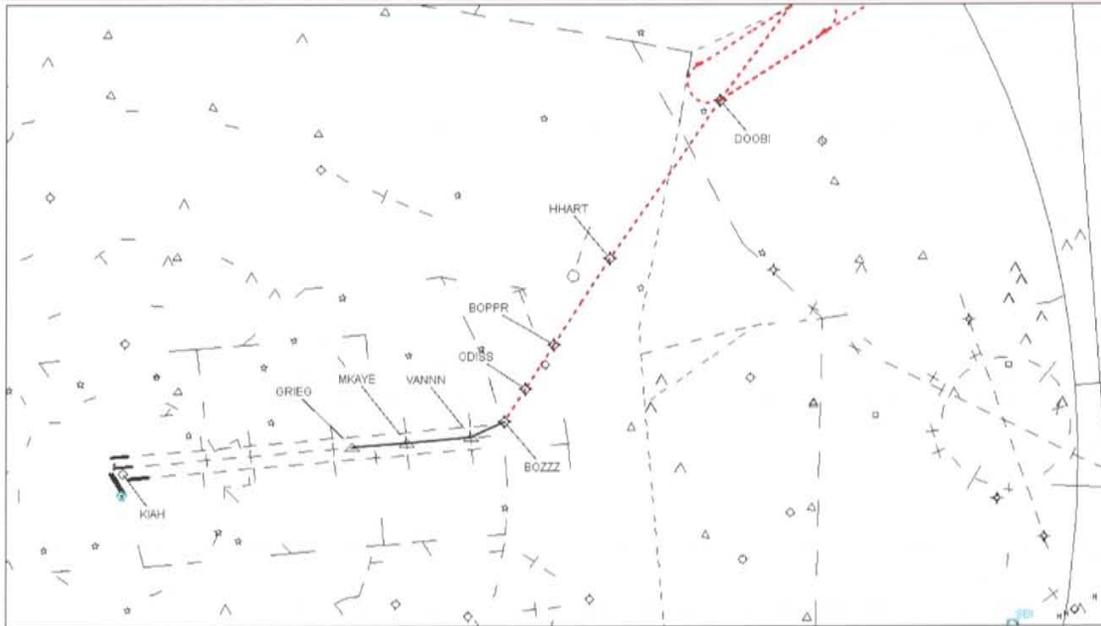


FIGURE 1. GILL RNAV STAR AND TRANSITIONS TO IAH ILS RWYS 26L/27

## OAPM Design Package: Houston Metroplex RNAV TRANSITIONS TO GEORGE BUSH INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS 26L, 26R AND 27

The DOOBI RNAV STAR from the northeast will have a transition to IAH ILS RWY 26L that will begin at BOZZZ Fix and terminate at GRIEG Fix where it will intercept the RWY 26L localizer as shown in Figure 2.



**FIGURE 2. DOOBI RNAV STAR AND TRANSITION TO IAH ILS RWY 26L**

The WHACK RNAV STAR from the northeast will have three transitions, one to IAH ILS RWY26L, one to IAH ILS RWY26R and one to IAH ILS RWY 27. The RWY 26L transition will begin at BOZZZ Fix and terminate at GRIEG Fix where it will intercept the RWY 26L localizer. The RWY 26R transition will begin at HOO TI Fix and terminate at RAIDS Fix where it will intercept the RWY 26R localizer. The RWY 27 transition will begin at CLSIK Fix and terminate at DENTO Fix where it will intercept the RWY 27 localizer. All three designs are shown in Figure 3.

## OAPM Design Package: Houston Metroplex RNAV TRANSITIONS TO GEORGE BUSH INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS 26L, 26R AND 27

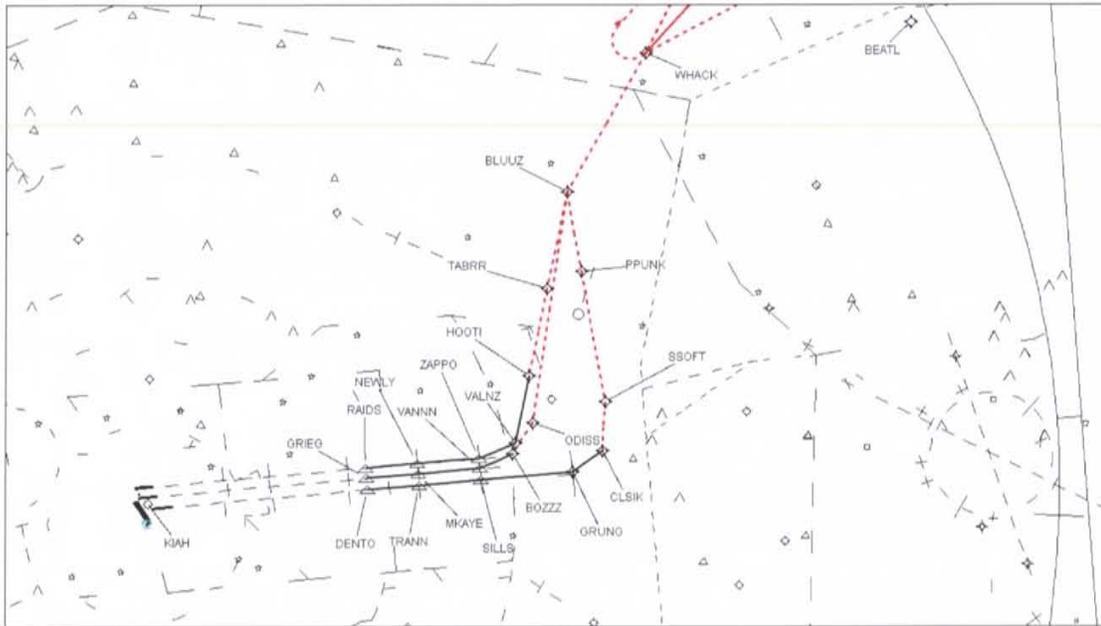


FIGURE 3. WHACK RNAV STAR AND TRANSITIONS TO IAH ILS RWYS 26L/26R/27

### Proposed Design and Implementation Dependencies

This design is dependent on the following procedures:

**STARs:**  
GILLL  
WHACK  
DOOBI

### Additional Design Considerations

No spectrum analysis or additional benefit analysis is required. This proposal requires modifications to I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is anticipated.

### Attachments

1. Houston OAPM D&I Master TARGETS File
2. ILS DOOBI WHACK RWY 26L TARGETS Distribution Package

**OAPM Design Package: Houston Metroplex  
RNAV TRANSITIONS TO GEORGE BUSH  
INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS  
26L, 26R AND 27**

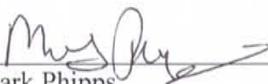
3. ILS WHACK RWY26R TARGETS Distribution Package
4. ILS GILL RWY 26L TARGETS Distribution Package
5. ILS GILL RWY 27 TARGETS Distribution Package
6. ILS WHACK RWY 27 TARGETS Distribution Package
7. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
8. Procedure Change Table

**OAPM Design Package: Houston Metroplex  
RNAV TRANSITIONS TO GEORGE BUSH  
INTERCONTINENTAL/HOUSTON AIRPORT (IAH) ILS RWYS  
26L, 26R AND 27**

Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

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\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

1-8-13  
Date

  
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Keith Brown  
Houston Metroplex  
NATCA Lead

12/27/12  
Date

  
\_\_\_\_\_  
Mike Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/4/13  
Date

**OAPM Design Package: Houston Metroplex  
RNAV TRANSITION TO WILLIAM P HOBBY AIRPORT (HOU)  
ILS RWY 04**

<b>Name of Change</b>	<b>RNAV TRANSITION TO HOU ILS RWY 04</b>	<b>Date</b>	<b>11/01/2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>None</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b>	<b>Facility Points of Contact</b>	<b>I90: Gregg Jones</b>
<b>Related/Dependent Submissions</b>	<b>STARs: BELLR KIDDZ</b>	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>2. ILS KIDDZ BELLR RWY04 TARGETS Distribution Package</b></li> </ol>

**Purpose**

To assist the controller responsible for traffic arriving HOU, the Design Team proposes the creation of an RNAV approach transition to the existing HOU ILS Runway 04 Approach. This transition to the ILS approach would eliminate the need for controllers to vector qualified aircraft in a limited area and permit them to more optimally scan traffic and perform other operational duties in busy arrival sectors.

**Study Team Recommendation**

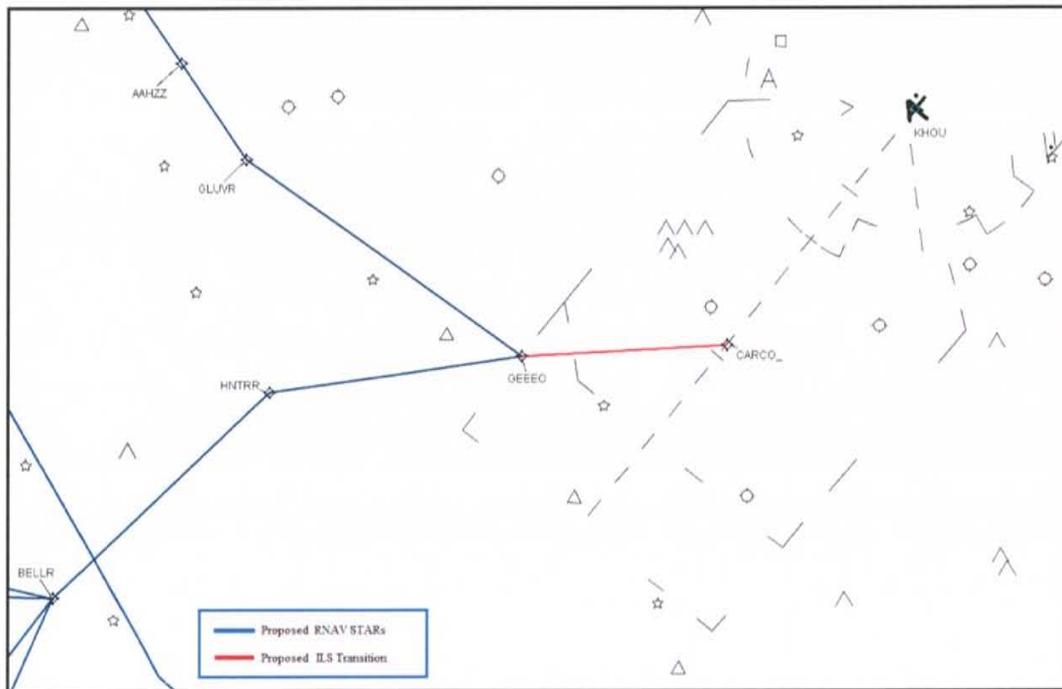
The Study Team did not address or recommend RNAV approach transitions.

## OAPM Design Package: Houston Metroplex RNAV TRANSITION TO WILLIAM P HOBBY AIRPORT (HOU) ILS RWY 04

### Proposed Final Design

This procedure will be for RNAV equipped jets and turbo-props and will be ATC assigned only.

The KIDDZ RNAV STAR from the northwest and the BELLR RNAV STAR from the southwest will each have a Runway 04 transition that ends at GEEEO waypoint and the proposed RNAV approach transition will begin at GEEEO waypoint and terminate at CARCO waypoint where it will intercept the Runway 04 localizer, as depicted in Figure 1.



**FIGURE 1. RNAV transition to HOU ILS RWY 04  
(and KIDDZ and BELLR RNAV STARs)**

## **OAPM Design Package: Houston Metroplex RNAV TRANSITION TO WILLIAM P HOBBY AIRPORT (HOU) ILS RWY 04**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

KIDDZ

BELLR

---

### **Additional Design Considerations**

This proposal requires modifications to I90 internal Standard Operating Procedures and Letters of Agreement.

Validation through a Human-in-the-Loop simulation (HITLs) is anticipated.

### **Attachments**

1. Houston OAPM D&I Master TARGETS File
2. ILS RWY04 TARGETS Distribution Package
3. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)

## OAPM Design Package: Houston Metroplex RNAV TRANSITION TO WILLIAM P HOBBY AIRPORT (HOU) ILS RWY 04

### Review Signatures

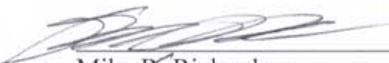
The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

12/27/12  
Date

  
\_\_\_\_\_  
Mike Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
Date

  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/4/13  
Date

## OAPM Design Package: Houston BLUBL Conventional STAR

<b>Name of Change</b>	<b>BLUBL STAR</b>	<b>Date</b>	<b>12-27-2012</b>
<b>Change Classification</b>	Terminal Procedures	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E10, E11, E17, E29, I7</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 74, 78, 80, 82, 83, 96 <b>ZFW Sectors:</b> 46, 96	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs:</b> DRLLR TTORO MSCOT KIDDZ <b>SIDs:</b> BNDTO DOBBY PITZZ	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>Table of Procedures</b></li> </ol>

### Purpose

This design package addresses issues with the northwest HOU and south satellite STARs. In addition to RNAV OPD STARs, the Houston D and I Team was tasked to develop conventional arrival procedures to provide non-RNAV equipped aircraft access to the Houston terminal area.

### Study Team Recommendation

The Houston Study Team recommended that conventional STARs be developed during the Houston D&I Team process. The Houston Study Team proposed at least one conventional path per cornerpost, aligned as closely as possible with the proposed RNAV routing.

## OAPM Design Package: Houston BLUBL Conventional STAR

### Proposed Final Design

The Design Team is proposing to retain the BLUBL conventional STAR as shown in Figure 1 below. The BLUBL STAR will be used by turbo-prop and piston aircraft destined to HOU and south satellite airports operating with RNAV and non-RNAV equipped aircraft. The BLUBL STAR will also be used by jet aircraft destined to AXH, HPY, IWS, LVJ, SGR, TME, T00, T41 and 54T airports. Table 1 below identifies 190 satellite airports. All jet, turbo-prop and piston satellite arrivals will cross BLUBL at 9,000 feet.

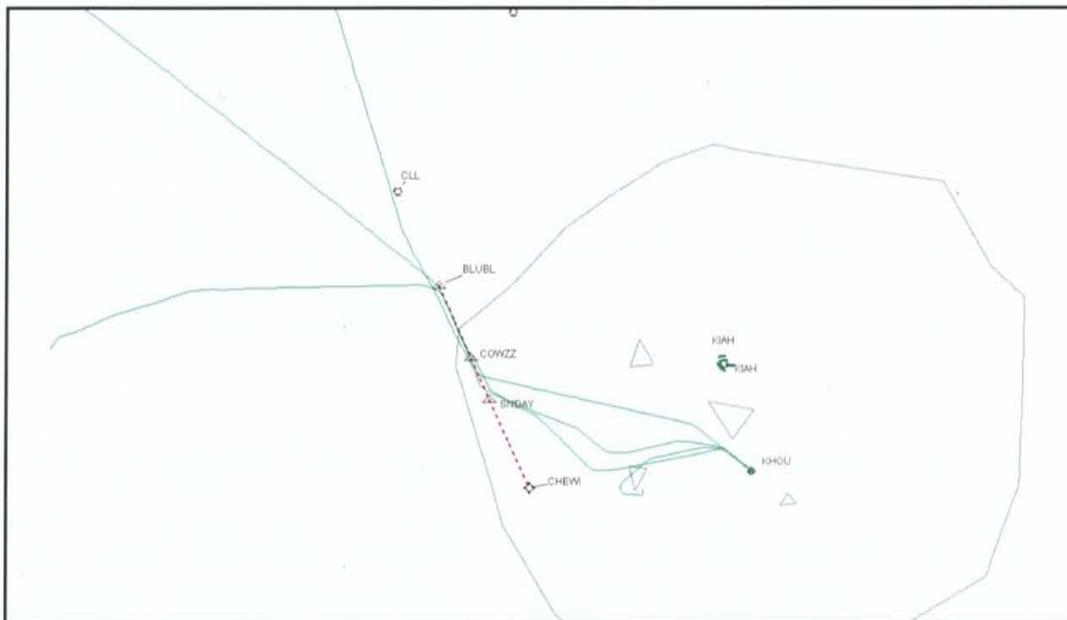


Figure 1. BLUBL STAR

## OAPM Design Package: Houston BLUBL Conventional STAR

Airport ID	Airport Name South of J2		Airport ID	Airport Name North of J2
AXH	Houston Southwest		CXO	Lone Star Executive
EFD	Ellington Field		DWH	David Wayne Hooks Memorial
GLS	Scholes International		EYQ	Weiser Air Park
HPY	Baytown			
IWS	West Houston			
LBX	Brazoria County			
LVJ	Pearland Regional			
SGR	Sugar Land Regional			
TME	Houston Executive			
T00	Chambers County			
T41	La Porte Municipal			
54T	RWJ Airpark			

**Table 1. Houston OAPM Satellite Airports**

### Proposed Design and Implementation Dependencies

This design is dependent on the following procedure(s):

#### **STARs:**

DRLLR  
MSCOT  
TTORO  
KIDDZ

#### **SIDs:**

BNDTO  
DOBBY  
PITZZ

### Additional Design Considerations

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. The vertical and lateral limits of low altitude sectors and positions in I90 were reviewed and may need to be modified to accommodate the new procedures.

### Attachments

1. Houston OAPM D&I Master TARGETS File
2. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)

**OAPM Design Package: Houston  
BLUBL Conventional STAR**

3. Procedure Change Table

## OAPM Design Package: Houston BLUBL Conventional STAR

### Review Signatures

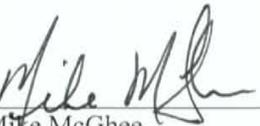
The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
Houston Metroplex  
FAA Lead

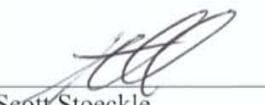
1-8-13  
Date

  
\_\_\_\_\_  
Keith Brown  
Houston Metroplex  
NATCA Lead

12/27/12  
Date

  
\_\_\_\_\_  
Mike McGhee  
Houston ARTCC (ZHU)  
Facility Lead

1/2/13  
Date

  
\_\_\_\_\_  
Scott Stoeckle  
Houston ARTCC (ZHU)  
NATCA Lead

12/28/12  
Date

  
\_\_\_\_\_  
Mike Richardson  
Houston TRACON (190)  
Facility Lead

1-4-13  
Date

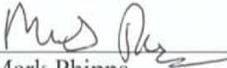
  
\_\_\_\_\_  
Steve Prichard  
Houston TRACON (190)  
NATCA Lead

1/4/13  
Date

## OAPM Design Package: Houston BLUBL Conventional STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
North Texas Metroplex  
FAA Lead

1-8-13  
Date

  
\_\_\_\_\_  
Ed Hulse  
Fort Worth ARTCC (ZFW)  
NATCA Lead

1/8/13  
Date

**OAPM Design Package: Houston Metroplex  
CARNE IAH Conventional STAR**

<b>Name of Change</b>	<b>CARNE STAR</b>	<b>Date</b>	<b>09-20-2012</b>
<b>Change Classification</b>	<b>Terminal Procedures</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E24, E25, E26, E27, E39, I3, I17, I18</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 ZHU Sectors: 58, 59, 76, 87, 95, 92</b>	<b>Facility Points of Contact</b>	<b>David Kidd 281.230.5556 Will Hutson 281.230.5556</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> TEJAS BELLR KIDDZ HTOWN <b>SIDs:</b> HUBEE DOBBY PITZZ BNDTO	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>2. Procedure Change Table</b></li> </ol>

**Purpose**

This design package addresses issues with the Southwest/South IAH STARs. In addition to RNAV OPD STARs, the Houston D and I Team was tasked to develop conventional arrival procedures to provide non-RNAV equipped aircraft access to the Houston terminal area.

**Study Team Recommendation**

The Houston Study Team recommended that conventional STARs be developed during the Houston D&I Team process. The Houston Study Team proposed at least one conventional path per cornerpost, aligned as closely as possible with the proposed RNAV routing.

## OAPM Design Package: Houston Metroplex CARNE IAH Conventional STAR

### Proposed Final Design

The Design Team is proposing to retain the CARNE conventional STAR for IAH non-RNAV equipped arrivals. The CARNE will be used for jet and turboprop aircraft landing IAH on east and west flows as depicted in Figure 1. IAH CARNE STAR arrivals capable of operating at 280 knots will cross HAMMU at 12,000 feet and 280 knots in a west flow operation. IAH CARNE STAR arrivals capable of operating at 280 knots will cross HAMMU at 12,000 feet and 250 knots in an east flow operation. IAH turbo-prop arrivals operating at speeds below 280 knots and using RNAV or conventional navigation will utilize the CARNE STAR and cross HAMMU at 8,000 feet regardless of flow. IAH piston arrivals will utilize the CARNE STAR and cross HAMMU at 5,000 feet regardless of flow.

I90 satellite airport arrivals destined to airports north of J2 will use the CARNE conventional STAR when IAH is on a west flow operation. Table 1 below identifies I90 satellite airports. Jets will cross HAMMU at 10,000 feet, turbo-props at 7,000 feet and piston aircraft at 5,000 feet.

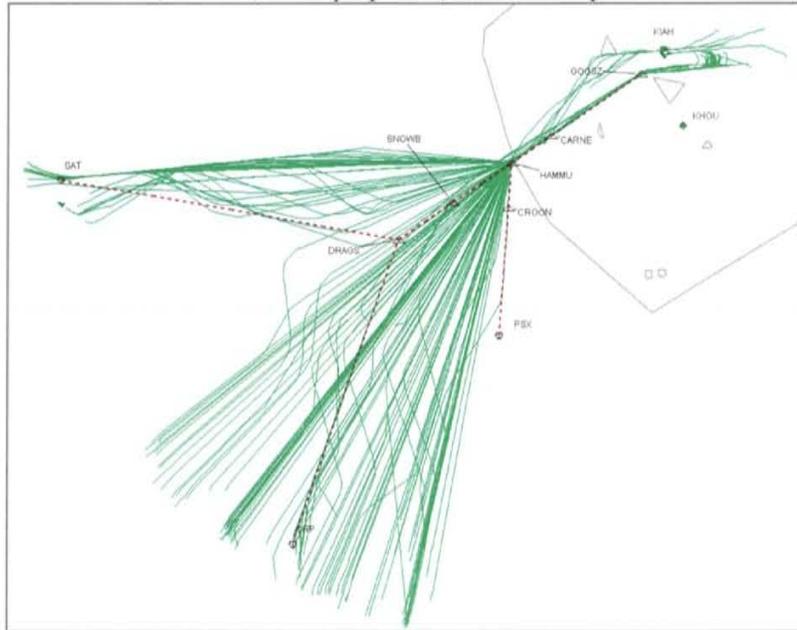


Figure 1. CARNE STAR

## OAPM Design Package: Houston Metroplex CARNE IAH Conventional STAR

Airport ID	Airport Name South of J2		Airport ID	Airport Name North of J2
AXH	Houston Southwest		CXO	Lone Star Executive
EFD	Ellington Field		DWH	David Wayne Hooks Memorial
GLS	Scholes International		EYQ	Weiser Air Park
HPY	Baytown			
IWS	West Houston			
LBX	Brazoria County			
LVJ	Pearland Regional			
SGR	Sugar Land Regional			
TME	Houston Executive			
T00	Chambers County			
T41	La Porte Municipal			
54T	RWJ Airpark			

**Table 1. Houston OAPM Satellite Airports**

### Proposed Design and Implementation Dependencies

This design is dependent on the following procedures:

**STARs:**

TEJAS  
 BELLR  
 KIDDZ  
 HTOWN

**SIDs:**

HUBEE  
 DOBBY  
 PITZZ  
 BNDTO

### Additional Design Considerations

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. The vertical and lateral limits of low altitude sectors and positions in I90 were reviewed and may need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots

## **OAPM Design Package: Houston Metroplex CARNE IAH Conventional STAR**

or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

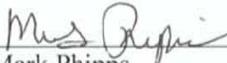
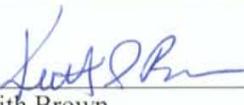
### **Attachments**

1. Houston OAPM D&I Master TARGETS File
2. Procedure Change Table

## OAPM Design Package: Houston Metroplex CARNE IAH Conventional STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	1-8-13 _____ Date	 _____ Keith Brown Houston Metroplex NATCA Lead	12/27/12 _____ Date
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 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	1/2/13 _____ Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	12/28/12 _____ Date
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 _____ Mike Richardson Houston TRACON (190) Facility Lead	1-4-13 _____ Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	1/4/13 _____ Date
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## OAPM Design Package: Houston Metroplex GILCO IAH Conventional STAR

<b>Name of Change</b>	<b>GILCO STAR</b>	<b>Date</b>	<b>09-21-2012</b>
<b>Change Classification</b>	<b>Terminal Procedure</b>	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E21, E36, E38, T5, T8, I23</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90 ZHU Sectors: 79, 68, 43, 23, 36, 24, 65, 37, 34</b>	<b>Facility Points of Contact</b>	<b>Robert Nelson 281.230.5552 Bruce Hinote 281.230.5552</b>
<b>Related/Dependent Submissions</b>	<b>STARs:</b> BRSKT GILL BAYYY PUCKS TKNIQ WAPPL <b>SIDs:</b> ELOCO GUMBY MMUGS PEECE FLYZA	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>1. Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>2. Procedure Change Table</b></li> </ol>

### Purpose

This design package addresses issues with the southeast IAH STARs. In addition to RNAV OPD STARs, the Houston D and I Team was tasked to develop conventional arrival procedures to provide non-RNAV equipped aircraft access to the Houston terminal area.

### Study Team Recommendation

The Houston Study Team recommended that conventional STARs be developed during the Houston D&I Team process. The Houston Study Team proposed at least one conventional path per cornerpost, aligned as closely as possible with the proposed RNAV routing.

## OAPM Design Package: Houston Metroplex GILCO IAH Conventional STAR

### Proposed Final Design

The Design Team is proposing to retain the GILCO conventional STAR for IAH non-RNAV equipped arrivals. GILCO will be used for jet and turboprop aircraft landing IAH on east and west flows as depicted in Figure 1. IAH GILCO STAR arrivals capable of operating at 280 knots will cross WOLDE at 12,000 feet and 250 knots in a west flow operation. IAH GILCO STAR arrivals capable of operating at 280 knots will cross WOLDE 12,000 and 280 knots in an east flow operation. IAH turbo-prop arrivals operating at speeds below 280 knots using conventional navigation will utilize the GILCO STAR and cross WOLDE at 12,000 feet.

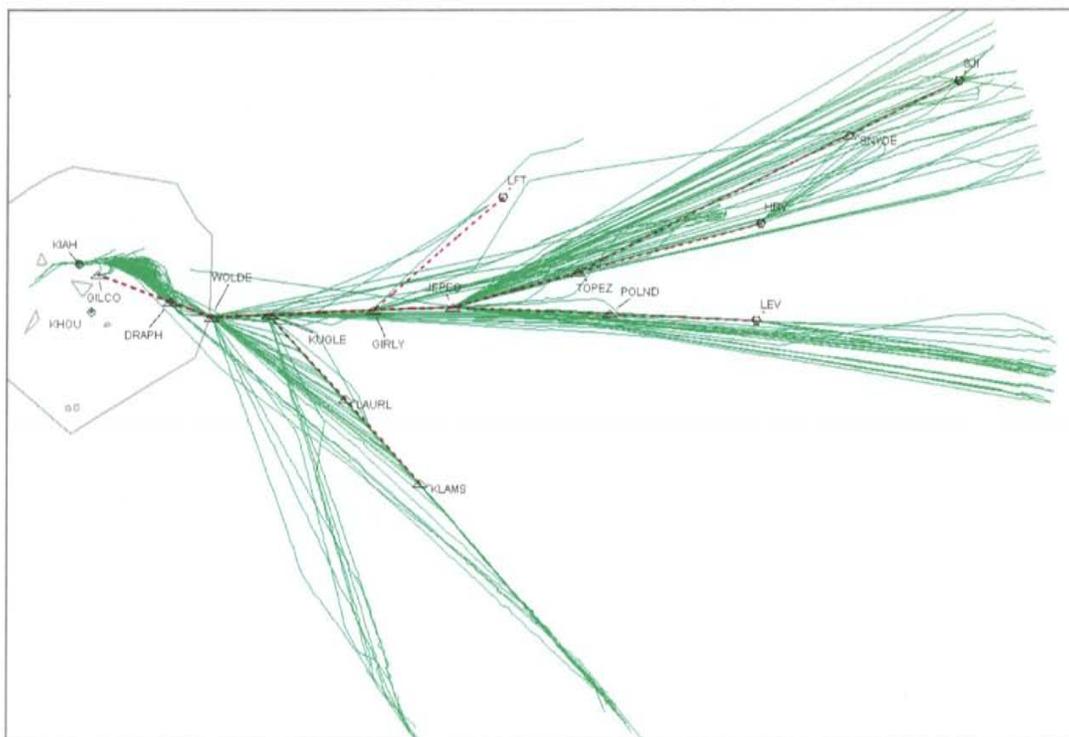


Figure 1. GILCO STAR

## **OAPM Design Package: Houston Metroplex GILCO IAH Conventional STAR**

### **Proposed Design and Implementation Dependencies**

This design is dependent on the following procedures:

#### **STARs:**

BRSKT  
GILLL  
BAYYY  
PUCKS  
TKNIQ  
WAPPL

#### **SIDs:**

ELOCO  
GUMBY  
MMUGS  
PEECE  
FLYZA

### **Additional Design Considerations**

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. Vertical limits of low altitude sectors were reviewed and may need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARs.

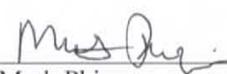
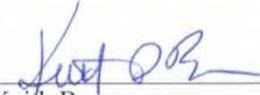
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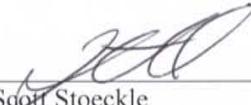
1. Houston OAPM D&I Master TARGETS File
2. Procedure Change Table

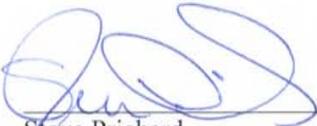
## OAPM Design Package: Houston Metroplex GILCO IAH Conventional STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	1-8-13 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	12/27/12 Date
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 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	1/2/13 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	12/28/12 Date
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 _____ Mike Richardson Houston TRACON (190) Facility Lead	1-4-13 Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	1/4/13 Date
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## OAPM Design Package: Houston RIICE Conventional STAR

<b>Name of Change</b>	<b>RIICE STAR</b>	<b>Date</b>	<b>9-20-2012</b>
<b>Change Classification</b>	Terminal Procedures	<b>Current Phase of Design</b>	<input type="checkbox"/> Preliminary Design (PD) <input type="checkbox"/> Operational Design (OD) <input type="checkbox"/> Operational Design Complete (ODC) <input checked="" type="checkbox"/> Proposed Final Design (PFD)
<b>OAPM Study Team Reference/s</b>	<b>E10, E11, E17, E29, I7</b>	<b>Implementation Date</b>	<b>December 2013</b>
<b>Impacted Facilities and Positions/Areas/Sectors</b>	<b>I90</b> <b>ZHU Sectors:</b> 74, 78, 80, 82, 83, 96 <b>ZFW Sectors:</b> 46, 96	<b>Facility Points of Contact</b>	Jason Park 281-230-5555 Rock Brown 281-230-5555
<b>Related/Dependent Submissions</b>	<b>STARs:</b> DRLLR TTORO MSCOT KIDDZ <b>SIDs:</b> BNDTO DOBBY PITZZ	<b>Associated Data Files:</b>	<ol style="list-style-type: none"> <li><b>Houston OAPM D&amp;I Master TARGETS File</b></li> <li><b>Table of Procedures</b></li> </ol>

### Purpose

This design package addresses issues with the northwest IAH STARs. In addition to RNAV OPD STARs, the Houston D and I Team was tasked to develop conventional arrival procedures to provide non-RNAV equipped aircraft access to the Houston terminal area.

### Study Team Recommendation

The Houston Study Team recommended that conventional STARs be developed during the Houston D&I Team process. The Houston Study Team proposed at least one conventional path per cornerpost, aligned as closely as possible with the proposed RNAV routing.

## OAPM Design Package: Houston RIICE Conventional STAR

### Proposed Final Design

The Design Team is proposing to retain the RIICE conventional STAR for IAH non-RNAV equipped arrivals. RIICE will be used for jet and turboprop aircraft landing IAH on east and west flows as depicted in Figure 1. IAH RIICE STAR arrivals capable of operating at 280 knots will cross BAATS at 16,000 feet and 280 knots in a west flow operation. IAH RIICE STAR arrivals capable of operating at 280 knots will cross BAATS at 9,000 feet in an east flow operation. IAH turbo-prop arrivals operating at speeds below 280 knots using conventional navigation will utilize the RIICE STAR and cross BAZBL at 9,000 feet regardless of flow. IAH piston arrivals will utilize the RIICE STAR and cross BAZBL at 9,000 feet regardless of flow.

I90 satellite airport arrivals destined to airports north of J2 will use the RIICE conventional STAR regardless of flow at IAH. Table 1 below identifies I90 satellite airports. All satellite arrivals will cross BAZBL at 9,000 feet.

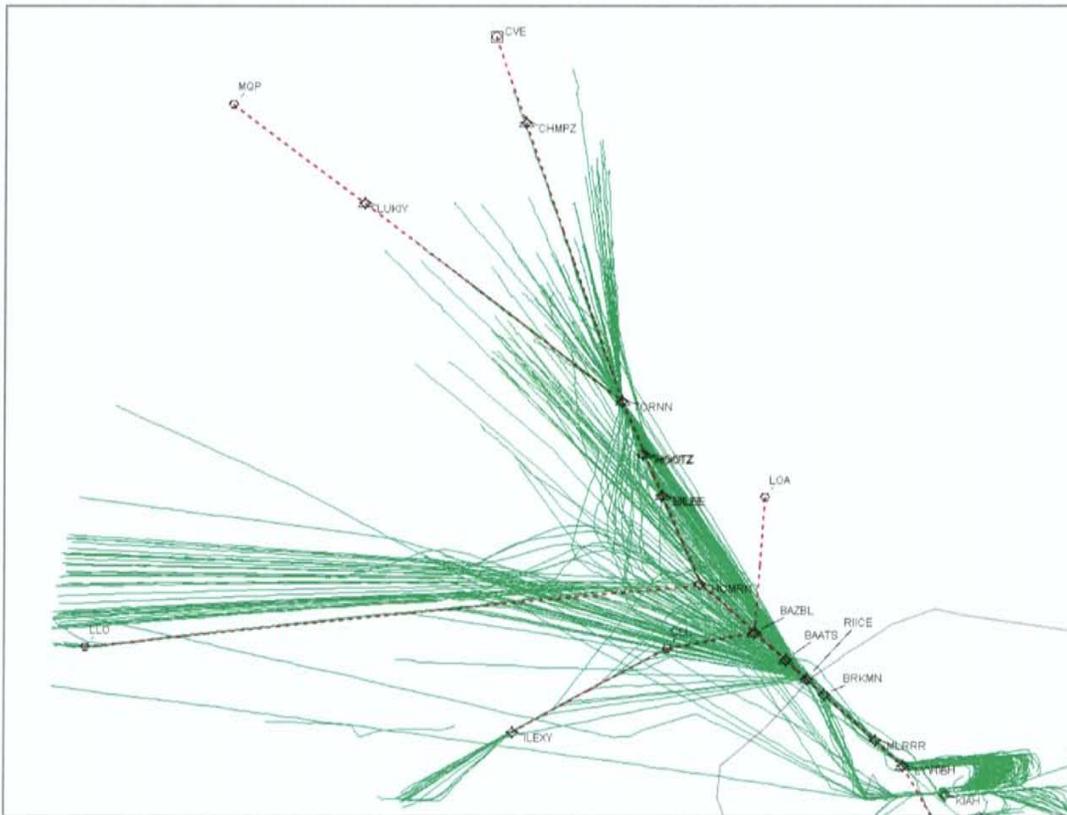


Figure 1. RIICE STAR

## OAPM Design Package: Houston RIICE Conventional STAR

Airport ID	Airport Name South of J2		Airport ID	Airport Name North of J2
AXH	Houston Southwest		CXO	Lone Star Executive
EFD	Ellington Field		DWH	David Wayne Hooks Memorial
GLS	Scholes International		EYQ	Weiser Air Park
HPY	Baytown			
IWS	West Houston			
LBX	Brazoria County			
LVJ	Pearland Regional			
SGR	Sugar Land Regional			
TME	Houston Executive			
T00	Chambers County			
T41	La Porte Municipal			
54T	RWJ Airpark			

**Table 1. Houston OAPM Satellite Airports**

### Proposed Design and Implementation Dependencies

This design is dependent on the following procedure(s):

#### **STARs:**

DRLLR  
MSCOT  
TTORO  
KIDDZ

#### **SIDs:**

BNDTO  
DOBBY  
PITZZ

### Additional Design Considerations

This proposal requires modifications to ZHU and I90 internal Standard Operating Procedures and Letters of Agreement. Validation through a Human-in-the-Loop simulation (HITLs) is not anticipated. The vertical and lateral limits of low altitude sectors and positions in I90 were reviewed and may need to be modified to accommodate the new procedures.

To implement optimized dual routes to IAH, the Design Team identified metering as an essential element of the proposed design. Confined terminal airspace limits vectoring areas to establish aircraft in arrival sequence. High performance aircraft regardless of type, capable of 280 knots or greater, must be sequenced as one flow. The application of time based flow management for

## **OAPM Design Package: Houston RIICE Conventional STAR**

IAH arrivals is required to efficiently address the identified complexities and provide a manageable traffic flow on optimized profile descent STARS.

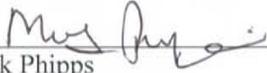
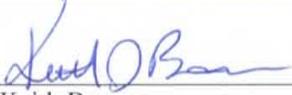
### **Attachments**

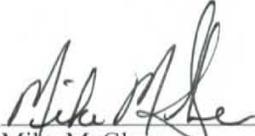
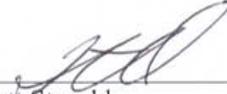
1. Houston OAPM D&I Master TARGETS File
2. RNAV Pro analysis results, if required (may be completed during Evaluation Phase)
3. Procedure Change Table

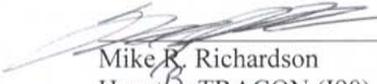
## OAPM Design Package: Houston RIICE Conventional STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	1-8-13 Date	 _____ Keith Brown Houston Metroplex NATCA Lead	12/27/12 Date
--	----------------	---	------------------

 _____ Mike McGhee Houston ARTCC (ZHU) Facility Lead	1/2/13 Date	 _____ Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	12/28/12 Date
---	----------------	--	------------------

 _____ Mike R. Richardson Houston TRACON (190) Facility Lead	1-4-13 Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	1/4/13 Date
---	----------------	---	----------------

## OAPM Design Package: Houston RIICE Conventional STAR

### Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

  
\_\_\_\_\_  
Mark Phipps  
North Texas Metroplex  
FAA Lead

1-8-13  
Date

  
\_\_\_\_\_  
Ed Hulsey  
Fort Worth ARTCC (ZFW)  
NATCA Lead

1/8/13  
Date

**OAPM Design Package: Houston Metroplex**  
*En Route Airspace Changes Proposed Final Design*

<b>Name of Change :</b>	<b>Date:</b>
ZHU En Route Airspace Changes Proposed Final Design	12/24/2012
<b>Change Classification:</b>	<b>Tracking:</b>
Airspace	PD <input type="checkbox"/> OD <input type="checkbox"/> ODC <input type="checkbox"/> PFD <input checked="" type="checkbox"/>
<b>OAPM Study Team Reference:</b>	<b>Anticipated Implementation Date:</b>
En Route Airspace	TBD
<b>Facilities and Areas/Sectors Impacted:</b>	<b>POCs:</b>
Houston ARTCC (ZHU) – Sectors 36, 38, 43, 49, 80, 83, 86, 87 and 96	– ZHU, Mike McGhee, 281-230-5520 – ZHU, Scott Stoeckle, 281-230-6310
<b>Related/Dependent Submissions</b>	<b>Associated Data Files:</b>
<b>STARs:</b> BRSKT BLUBL DRLLR GUSHR HTOWN TEJAS WAPPL  <b>SIDs:</b> BNDTO DOBBY DREMR GUMBY INDIE LURIC MMUGS PITZZ STRYA STYCK WYLSN	

**Purpose**

With the proposed Study Team procedures changes, it is necessary to redesign ZHU airspace sectorization to maximize procedure efficiency and minimize pilot and controller task complexity.

**Study Team Recommendation**

The Study Team did not specifically recommend changes to ZHU airspace.

**Proposed Final Design**

## **OAPM Design Package: Houston Metroplex**

### ***En Route Airspace Changes Proposed Final Design***

The Houston Metroplex Design Team is proposing the modification of ZHU airspace to support the implementation of the proposed RNAV and conventional STARs and SIDs. There will be several modifications to ZHU's airspace to support revised lateral and vertical tracks resulting from the new procedure designs. The following en route airspace changes will be completed:

ZHU Sector 36 will acquire airspace from ZHU Sectors 38 and to support the WAPPL STAR and the GUMBY and MMUGS SIDs.

ZHU Sector 49 and ZHU Sector 86 are currently surface to FL230 adjacent sectors to support the DREMR, INDIE, LURIC, STRYA, STYCK and WYLSN SIDs. ZHU Sector 86 will become a surface to 8,000 feet MSL sector serving low altitude traffic north of I90. ZHU Sector 49 will become a 9,000 feet MSL to FL230 sector serving all I90 north departure routes. This change mitigates potential departure flow level-off and coordination between controllers.

ZHU Sector 83 will acquire airspace from ZHU Sector 86 and exchange airspace at the ZHU Sector 83, ZHU Sector 80 and I90 common boundaries. The modification between ZHU 83 and ZHU 86 is to support the DRLLR and GUSHR STARs. ZHU Sector 83 transferred airspace from 9,000 feet to 12,000 feet MSL to ZHU Sector 80 that was no longer needed to support the BLUBL STAR.

ZHU Sector 96 acquired additional airspace from ZHU Sector 80 to mitigate coordination between the sectors. This change supports the BNDTO, DOBBY and PITZZ SIDs joining the STAR arriving San Antonio.

ZHU Sector 87 acquired airspace from ZHU Sector 86 and is delegating airspace to ZHU sector 80. These modifications support the DOBBY, BNDTO and PITZZ SIDs, and the HTOWN and TEJAS STARs.

ZHU Sector 43 acquired airspace from ZHU Sector 36. This modification supports the BRSKT STAR.

#### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation is not anticipated.

#### **Implementation Dependencies**

This design is dependent on the following procedures:

**STARs:**  
BRSKT  
BLUBL  
DRLLR  
GUSHR  
HTOWN  
TEJAS  
WAPPL

## **OAPM Design Package: Houston Metroplex**

*En Route Airspace Changes Proposed Final Design*

**SIDs:**

BNDTO  
DOBBY  
DREMR  
GUMBY  
INDIE  
LURIC  
MMUGS  
PITZZ  
STRYA  
STYCK  
WYLSN

---

Spectrum analysis is anticipated.

<b>Sector</b>	<b>VHF Frequency</b>	<b>UHF Frequency</b>
36	124.7	317.4
38	126.95	363.05
43	133.8	351.8
46	132.77	335.65
49	125.17	285.57
80	132.15	279.6
83	128.075	351.95
83	125.15	288.275
86	134.8	269.6
87	128.6	360.8
96	125.65	273.55

**TABLE 1. TABLE OF AFFECTED FREQUENCIES**

**Attachments**

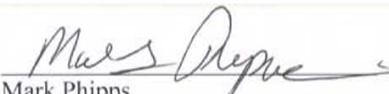
See associated PowerPoint Slides.

## OAPM Design Package: Houston Metroplex

### *En Route Airspace Changes Proposed Final Design*

#### Review Signatures

The D&I Team has reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 Mark Phipps Houston Metroplex FAA Lead	<u>1-8-13</u> Date	 Keith Brown Houston Metroplex NATCA Lead	<u>12/27/12</u> Date
 Mike McGhee Houston ARTCC (ZHU) Facility Lead	<u>1/2/13</u> Date	 Scott Stoeckle Houston ARTCC (ZHU) NATCA Lead	<u>12/28/12</u> Date

**OAPM Design Package: Houston Metroplex**  
*Terminal Airspace Changes Proposed Final Design*

<b>Name of Change :</b>	<b>Date:</b>
Terminal Airspace Changes Proposed Final Design	12/21/2012
<b>Change Classification:</b>	<b>Tracking:</b>
Airspace	PD <input type="checkbox"/> OD <input type="checkbox"/> ODC <input type="checkbox"/> PFD <input checked="" type="checkbox"/>
<b>OAPM Study Team Reference:</b>	<b>Anticipated Implementation Date:</b>
Terminal Airspace	TBD
<b>Facilities and Areas/Sectors Impacted:</b>	<b>POCs:</b>
Houston TRACON (I90) – Sectors A, B, D, E, G, H, I, J, L, M, N, O, P, R, T, U, W, X and, Z	– I90, Mike Richardson, 281-233-0560 – I90, Steve Prichard, 832-628-8052
<b>Related/Dependent Submissions</b>	<b>Associated Data Files:</b>
<b>STARs:</b> BAYYY BELLR BLUBL BRSKT CESAN DOOBI DRLLR GILLL GUSHR HUDZY KIDDZ MSCOT SKNRD TAKKL TKNIQ TTORO TWSTD WAPPL WHACK	<b>SIDs:</b> BNDTO DREMR FLYZA GUMBY INDIE LURIC MMUGS PEECE PITZZ PTRON RIITA STRYA STYCK WYLSN

**Purpose**

With the proposed Study Team procedures changes, it is necessary to redesign I90 airspace sectorization to maximize procedure efficiency and minimize pilot and controller task complexity.

**Study Team Recommendation**

The Study Team did not specifically recommend changes to I90 airspace.

**Proposed Final Design**

The Houston Metroplex Design Team is proposing the modification of I90 airspace to support the implementation of the proposed RNAV and conventional STARs and SIDs. There will be

## **OAPM Design Package: Houston Metroplex**

### ***Terminal Airspace Changes Proposed Final Design***

several modifications to I90's airspace to support revised lateral and vertical tracks resulting from the new procedure designs.

The following changes will be completed for each sector:

#### **Arrival East (D):**

Arrival East will be delegated airspace from the Beaumont Satellite, Departure East, Departure North and Tomball Satellite sectors to support the TWSTD, SKNRD and WAPPL STARs in an East Flow when IAH arrives either Runways 15 or 33 and HOU is in any runway configuration.

Arrival East will be delegated airspace from the Beaumont Satellite, Departure East, Departure North, Gulf Arrival and Tomball Satellite sectors to support the DOOBI, WHACK and HUDZY STARs in a West Flow when IAH arrives west of Runway 15 and HOU is in any runway configuration.

Arrival East will be delegated airspace from the Beaumont Satellite, Departure East, Departure North, Gulf Arrival and Tomball Satellite sectors to support the DOOBI, WHACK and HUDZY STARs in an East/West Flow and HOU is in any runway configuration.

#### **Arrival West (N):**

Arrival West will be delegated airspace from the Arrival East, Departure North, Departure West, IAH Final and Eagle Lake Arrival sectors to support the DRLLR and MSCOT STARs in a West Flow when IAH arrives Runway 15 and HOU is in any runway configuration.

Arrival West will be delegated airspace from the Arrival East, Departure North, Departure West, IAH Final and Eagle Lake Arrival sectors to support the DRLLR and MSCOT STARs in a West Flow when IAH arrives Runway 33 and HOU is in any runway configuration.

Arrival West will be delegated airspace from the College Satellite, Departure West and Lakeside Satellite sectors to support the GUSHR and TTORO STARs in an East Flow and HOU is in any runway configuration.

Arrival West will be delegated airspace from the Arrival East, College Satellite, Departure North, Departure West and Lakeside Satellite sectors to support the DRLLR, MSCOT, GUSHR and TTORO STARs in an East/West Flow and HOU is in any runway configuration.

#### **Beaumont Satellite (J):**

Beaumont Satellite will be delegated airspace from the Arrival East, Gulf Arrival and SanJac Satellite sectors to support the CESAN STAR in an East Flow when IAH arrives Runways 15 or 33 and HOU is in any runway configuration.

## **OAPM Design Package: Houston Metroplex**

### ***Terminal Airspace Changes Proposed Final Design***

Beaumont Satellite will be delegated airspace from the Arrival East, Gulf Arrival and SanJac Satellite sectors to support the CESAN STAR in a West Flow when IAH arrives west or Runway 15 and HOU is in any runway configuration.

Beaumont Satellite will be delegated airspace from the Gulf Arrival and SanJac Satellite sectors to support the CESAN STAR in an East/West Flow.

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#### **College Satellite (U):**

College Satellite will not be delegated any airspace in any configuration.

#### **Departure East (E):**

Departure East will be delegated airspace from the Departure South sector to support the MMUGS and GUMBY SIDs in an East Flow when HOU arrives Runways 4 or 12.

Departure East will be delegated airspace from the Departure North and Departure South sectors to support the MMUGS and GUMBY SIDs when IAH arrives Runway 15.

Departure East will be delegated airspace from the Departure North and Departure South sectors to support the MMUGS and GUMBY SIDs when IAH arrives Runway 33.

Departure East will be delegated airspace from the Beaumont Satellite, Houston Final and Gulf Arrival sectors to support the MMUGS and GUMBY SIDs in an East Flow when HOU arrives Runway 22.

Departure East will be delegated airspace from the Beaumont Satellite and Gulf Arrival sectors to support the MMUGS and GUMBY SIDs in an East Flow when HOU arrives Runway 30.

Departure East will be delegated airspace from the Arrival East and Gulf Arrival sectors to support the MMUGS and GUMBY SIDs in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runways 4,12 or 30.

Departure East will be delegated airspace from the Arrival East, Houston Final and Gulf Arrival sectors to support the MMUGS and GUMBY SIDs in a West Flow when IAH departs west and HOU arrives Runway 22.

Departure East will be delegated airspace from the Arrival East and Gulf Arrival sectors to support the MMUGS and GUMBY SIDs in an East/West Flow.

#### **Departure North (M):**

Departure North will be delegated airspace from the Departure East and Departure West sectors to support the DREMR, INDIE, LURIC, STRYA, STYCK and WYLSN SIDs in an East Flow when HOU is in any runway configuration.

Departure North will be delegated airspace from the Departure East and Departure West sectors to support the DREMR, INDIE, LURIC, STRYA, STYCK and WYLSN SIDs when IAH arrives Runway 15.

## **OAPM Design Package: Houston Metroplex**

### ***Terminal Airspace Changes Proposed Final Design***

Departure North will be delegated airspace from the Arrival East, Departure East and Departure West sectors to support the DREMR, INDIE, LURIC, STRYA, STYCK and WYLSN SIDs in a West Flow when IAH arrives west or Runway 15 and HOU is in any runway configuration.

Departure North will be delegated airspace from the Departure East and Departure West sectors to support the DREMR, INDIE, LURIC, STRYA, STYCK and WYLSN SIDs when IAH arrives Runway 33.

Departure North will be delegated airspace from the Arrival East, Departure East and Departure West sectors to support the DREMR, INDIE, LURIC, STRYA, STYCK and WYLSN SIDs when IAH is in an East/West flow.

Departure North will be delegated airspace from Houston Final when HOU arrives Runway 22.

#### **Departure South (L):**

Departure South will be delegated airspace from the Lakeside Satellite sector to support the RIITA, FLYZA, PEECE and PTRON SIDs in an East Flow when HOU arrives Runway 22.

Departure South will be delegated airspace from the Departure East, Eagle Lake Arrival and Lakeside Satellite sectors to support the RIITA, FLYZA, PEECE and PTRON SIDs in an East Flow when HOU arrives Runway 30.

Departure South will be delegated airspace from the Gulf Arrival and Lakeside Satellite sectors to support the RIITA, FLYZA, PEECE and PTRON SIDs in an East Flow when IAH arrives Runways 15 or 33 and HOU arrives Runway 12.

Departure South will be delegated airspace from the Gulf Arrival and Lakeside Satellite sectors to support the RIITA, FLYZA, PEECE and PTRON SIDs in an East Flow and HOU arrives Runway 4.

Departure South will be delegated airspace from the Eagle Lake Arrival, Gulf Arrival and Lakeside Satellite sectors to support the RIITA, FLYZA, PEECE and PTRON SIDs in a West Flow when HOU arrives Runway 4; when IAH arrives west or Runway 15 and HOU arrives Runway 4; and in an East/West flow when HOU arrives Runway 4.

Departure South will be delegated airspace from the Gulf Arrival and Lakeside Satellite sectors to support the RIITA, FLYZA, PEECE and PTRON SIDs in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 12.

Departure South will be delegated airspace from the Departure East, Gulf Arrival and Lakeside Satellite sectors to support the RIITA, FLYZA, PEECE and PTRON SIDs in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 22.

## **OAPM Design Package: Houston Metroplex**

### ***Terminal Airspace Changes Proposed Final Design***

Departure South will be delegated airspace from the Gulf Arrival, SanJac Satellite and Lakeside Satellite sectors to support the RIITA, FLYZA, PEECE and PTRON SIDs in a West Flow when HOU arrives Runway 30.

#### **Departure West (W):**

Departure West will be delegated airspace from the Eagle Lake Arrival sector to support the BNDTO and PITZZ SIDs in an East Flow when HOU arrives Runway 4; and in an East/West flow when HOU arrives Runway 4.

Departure West will be delegated airspace from the Eagle Lake Arrival sector to support the BNDTO, FLYZA and PITZZ SIDs in an East Flow when HOU arrives Runway 12.

Departure West will be delegated airspace from the Eagle Lake Arrival sector to support the BNDTO, FLYZA and PITZZ SIDs and the TEJAS STAR in an East Flow when HOU arrives Runway 22.

Departure West will be delegated airspace from the Eagle Lake Arrival sector to support the BNDTO and PITZZ SIDs and the TEJAS STAR in an East Flow when HOU arrives Runway 30.

Departure West will be delegated airspace from the College Satellite and Eagle Lake Arrival sectors to support the BNDTO, FLYZA and PITZZ SIDs and the TEJAS STAR in a West Flow when HOU arrives Runway 12.

Departure West will be delegated airspace from the College Satellite, IAH Final and Eagle Lake Arrival sectors to support the BNDTO, FLYZA and PITZZ SIDs and the TEJAS STAR in a West Flow when IAH arrives west or Runways 15 or 33 and HOU arrives Runway 12.

Departure West will be delegated airspace from the College Satellite, IAH Final and Eagle Lake Arrival sectors to support the BNDTO, FLYZA and PITZZ SIDs and the TEJAS STAR in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 22.

Departure West will be delegated airspace from the College Satellite, IAH Final and Eagle Lake Arrival sectors to support the BNDTO and PITZZ SIDs and the TEJAS STAR in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 30.

Departure West will be delegated airspace from the College Satellite, IAH Final and Eagle Lake Arrival sectors to support the BNDTO and PITZZ SIDs and the TEJAS STAR in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 4.

#### **Eagle Lake Arrival (X):**

Eagle Lake Arrival will be delegated airspace from the Departure West and Lakeside Satellite sectors to support the TEJAS, BELLR and KIDDZ STARs in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 12.

## **OAPM Design Package: Houston Metroplex**

### ***Terminal Airspace Changes Proposed Final Design***

Eagle Lake Arrival will be delegated airspace from the Departure West and Lakeside Satellite sectors to support the TEJAS, BELLR and KIDDZ STARs when IAH arrives Runway 15.

Eagle Lake Arrival will be delegated airspace from the Departure West and Lakeside Satellite sectors to support the TEJAS, BELLR and KIDDZ STARs when IAH arrives Runway 33.

Eagle Lake Arrival will be delegated airspace from the Departure West and Lakeside Satellite sectors to support the TEJAS, BELLR and KIDDZ STARs in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 22.

Eagle Lake Arrival will be delegated airspace from the Departure South, Departure West and Lakeside Satellite sectors to support the TEJAS, BELLR and KIDDZ STARs in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 30.

Eagle Lake Arrival will be delegated airspace from the Departure West and Lakeside Satellite sectors to support the TEJAS, BELLR and KIDDZ STARs in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 4.

Eagle Lake Arrival will be delegated airspace from the Departure West and Lakeside Satellite sectors to support the TEJAS, BELLR and KIDDZ STARs in an East Flow when HOU arrives Runway 4; and in an East/West flow when HOU arrives Runway 4.

Eagle Lake Arrival will be delegated airspace from the Departure West and Lakeside Satellite sectors to support the TEJAS, BELLR and KIDDZ STARs in an East Flow when HOU arrives Runway 12.

Eagle Lake Arrival will be delegated airspace from the Departure West and Lakeside Satellite sectors to support the TEJAS, BELLR and KIDDZ STARs in an East Flow when HOU arrives Runway 22.

Eagle Lake Arrival will be delegated airspace from the Departure South, Departure West and Lakeside Satellite sectors to support the TEJAS, BELLR and KIDDZ STARs in an East Flow when HOU arrives Runway 30.

#### **Gulf Arrival (G):**

Gulf Arrival will be delegated airspace from the Departure North and Departure South sectors to support the BRSKT, TKNIQ and BAYYY STARs in an East Flow when IAH arrives Runways 15 or 33 and HOU arrives Runways 4 or 12.

Gulf Arrival will be delegated airspace from the Departure East, Departure North, Departure South and Houston Final sectors to support the BRSKT, TKNIQ and BAYYY STARs in an East Flow when HOU arrives Runway 22.

Gulf Arrival will be delegated airspace from the Departure East, Departure North and Departure South sectors to support the BRSKT, TKNIQ and BAYYY STARs in an East Flow when HOU arrives Runway 30.

## **OAPM Design Package: Houston Metroplex**

### ***Terminal Airspace Changes Proposed Final Design***

Gulf Arrival will be delegated airspace from the Beaumont Satellite, Departure East, Departure North and Departure South sectors to support the BRSKT, TKNIQ and BAYYY STARs in a West Flow when HOU arrives Runway 4; when IAH arrives west or Runway 15 and HOU arrives Runway 4; and in an East/West flow when HOU arrives Runway 4.

Gulf Arrival will be delegated airspace from the Beaumont Satellite, Departure East, Departure North, Departure South and Eagle Lake Arrival sectors to support the BRSKT, TKNIQ and BAYYY STARs in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 12.

Gulf Arrival will be delegated airspace from the Beaumont Satellite, Departure East, Departure North, Departure South and Houston Final sectors to support the BRSKT, TKNIQ and BAYYY STARs in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 22.

Gulf Arrival will be delegated airspace from the Beaumont Satellite, Departure East, Departure North and Departure South sectors to support the BRSKT, TKNIQ and BAYYY STARs in a West Flow when IAH arrives west or Runway 15 and HOU arrives Runway 30.

#### **Houston Final (H):**

Houston Final will be delegated airspace from the Gulf Arrival and SanJac Satellite sectors to support the TKNIQ STAR when HOU arrives Runway 30.

Houston Final will be delegated airspace from the Departure West, Eagle Lake Arrival and Lakeside Satellite sectors to support the TKNIQ and WAPPL STARs in an East Flow when HOU arrives Runway 12.

Houston Final will be delegated airspace from the Eagle Lake Arrival sector to support the TKNIQ and WAPPL STARs in a West Flow when HOU arrives Runway 12.

Houston Final will not be delegated airspace when HOU arrives Runway 22.

#### **IAH Final (A/I/O):**

IAH Final will be delegated airspace from the SanJac Satellite and Tomball Satellite sectors to support the MSCOT, DRLLR, TEJAS, BOOZZ and BRSKT STARs in an East/West Flow.

IAH Final will be delegated airspace from the SanJac Satellite and Tomball Satellite sectors to support the DOOBI, WHACK, MSCOT, DRLLR, TEJAS and GILLL STARs in a West Flow when IAH arrives Runway 15.

## **OAPM Design Package: Houston Metroplex**

### ***Terminal Airspace Changes Proposed Final Design***

IAH Final will be delegated airspace from the SanJac Satellite and Tomball Satellite sectors to support the DOOBI, WHACK, MSCOT, DRLLR, TEJAS and GILLL STARS in a West Flow.

#### **Industry Satellite (Z):**

Industry Satellite will be delegated airspace from the College Satellite, Departure West, Eagle Lake Arrival and Lakeside Satellite sectors to support the BLUBL, TAKKL and WHAEL STARS in an East Flow when HOU is in any runway configuration; and in an East/West Flow when HOU is in any runway configuration.

Industry Satellite will be delegated airspace from the College Satellite, Departure West and Lakeside Satellite sectors to support the BLUBL, TAKKL and WHAEL STARS in West Flow when HOU is in any runway configuration; and in West Flow when IAH arrives Runway 15 and HOU is in any runway configuration.

Industry Satellite will be delegated airspace from the College Satellite, Eagle Lake Arrival and Lakeside Satellite sectors to support the BLUBL, TAKKL and WHAEL STARS in an East/West Flow.

#### **Lakeside Satellite (P):**

Lakeside Satellite will be delegated airspace from the Departure West sector in a West Flow when HOU arrives Runway 12; from the Departure West and IAH Final sectors in a West Flow when IAH arrives Runway 15 and HOU arrives Runway 12; from the Departure West and IAH Final sectors when IAH arrives Runway 15 and HOU arrives Runway 12; and from the Departure West sector when IAH arrives Runway 33 and HOU arrives Runway 12.

Lakeside Satellite will be delegated airspace from the Departure West sector in a West Flow and HOU arrives Runways 22 or 30; and from the Departure West and IAH Final sectors in a West Flow when IAH arrives Runway 15 and HOU arrives Runways 22 or 30.

Lakeside Satellite will be delegated airspace from the Departure West sector in a West Flow when HOU arrives Runway 4; and from the Departure West and IAH Final sectors in a West Flow when IAH arrives Runway 15 and HOU arrives Runway 4.

Lakeside Satellite will not be delegated any airspace in an East Flow when HOU arrives Runways 4, 12, 22 or 30.

Lakeside Satellite will not be delegated any airspace in an East/West Flow when HOU arrives Runway 4.

## **OAPM Design Package: Houston Metroplex**

### ***Terminal Airspace Changes Proposed Final Design***

#### **SanJac Satellite (B):**

SanJac Satellite will be delegated airspace from the Beaumont Satellite sector to support the TKNIQ STAR in an East Flow when IAH arrives Runways 15 or 33 and Houston arrives Runways 4 or 12.

SanJac Satellite will be delegated airspace from the Beaumont Satellite sector to support the TKNIQ STAR in an East Flow when Houston arrives Runways 22 or 30.

SanJac Satellite will be delegated airspace from the Beaumont Satellite sector to support the TKNIQ STAR in a West Flow when HOU is in any runway configuration; and in a West Flow when IAH arrives Runway 15 and HOU is in any runway configuration.

SanJac Satellite will be delegated airspace from the Beaumont Satellite and Gulf Arrival sectors to support the TKNIQ STAR in an East/West Flow.

#### **Tomball Satellite (R):**

Tomball Satellite will be delegated airspace from the Arrival East, Departure East and College Satellite sectors in a West Flow when IAH arrives west or Runway 15.

Tomball Satellite will be delegated airspace from the Arrival East, Departure East and College Satellite sectors when IAH arrives west or Runways 15 or 33.

Tomball Satellite will be delegated airspace from the Arrival East and College Satellite sectors in an East/West Flow.

Tomball Satellite will be delegated airspace from the College Satellite sector in an East Flow.

#### **Additional Design Considerations**

Validation through a Human-in-the-Loop simulation is not anticipated.

#### **Implementation Dependencies**

This design is dependent on the following procedures:

##### **STARs:**

BAYYY  
BELLR  
BLUBL  
BRSKT  
CESAN  
DOOBI  
DRLLR

##### **SIDs:**

BNDTO  
DREMR  
FLYZA  
GUMBY  
INDIE  
LURIC  
MMUGS

**OAPM Design Package: Houston Metroplex**  
*Terminal Airspace Changes Proposed Final Design*

GILLL	PEECE
GUSHR	PITZZ
HUDZY	PTRON
KIDDZ	RIITA
MSCOT	STRYA
SKNRD	STYCK
TAKKL	WYLSN
TKNIQ	
TTORO	
TWSTD	
WAPPL	
WHACK	

Spectrum analysis is anticipated.

Sector	VHF Frequency	UHF Frequency
Arrival East (D)	120.05	379.1
Arrival West (N)	124.35	316.15
Beaumont Satellite (J)	121.3	377.1
College Satellite (U)	134.3	360.85
Departure East (E)	133.6	257.2
Departure North (M)	132.25	285.42
Departure South (L)	127.12	269.07
Departure West (W)	126.67	339.8
Eagle Lake Arrival (X)	119.17	291.67
Gulf Arrival (G)	119.62	226.67
Hobby Final (H)	133.05	229.4
IAH Final Center (I)	120.65	269.12
IAH Final North (A)	119.1	269.2
IAH Final South (O)	134.0	239.05
Industry Satellite (Z)	124.22	306.97
Lakeside Satellite (P)	123.8	257.7
SanJac Satellite (B)	134.45	284.0
Tomball Satellite (R)	119.7	281.4

**TABLE 1. TABLE OF AFFECTED FREQUENCIES**

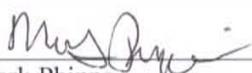
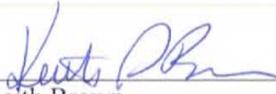
**Attachments**

See associated PowerPoint Slides.

**OAPM Design Package: Houston Metroplex**  
*Terminal Airspace Changes Proposed Final Design*

Review Signatures

The D&I Team reached agreement through consensus on these procedures using the OAPM process in accordance with the OAPM Memorandum of Understanding.

 _____ Mark Phipps Houston Metroplex FAA Lead	<u>1-8-13</u> Date	 _____ Keith Brown Houston Metroplex NATCA Lead	<u>12/27/12</u> Date
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 _____ Mike Richardson Houston TRACON (190) Facility Lead	<u>1-4-13</u> Date	 _____ Steve Prichard Houston TRACON (190) NATCA Lead	<u>1/4/13</u> Date
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