Descend-Via Lessons Learned and Benefits of MAIER and EAGUL RNAV Arrival Operations at Phoenix Sky Harbor International Airport

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CNS Task Force Meeting
Dallas-Fort Worth
18 April 2007
Outline

• PHX RNAV STAR Implementation
  – MAIER ONE RNAV STAR and EAGUL ONE RNAV STAR
    • Vertical guidance / descend-via arrival operations
    • Implementation date: 10 October 2006

• Implementation Lessons Learned
  – Mixed Jet/Turboprop operations
    • Center/TRACON coordination
  – Vertical and speed profiles
    • Route-based vs. ATC assigned altitudes/speeds

• Initial Implementation Benefits
  – VNAV/descend-via arrival operations
    • Improved descent continuity ⇒ fuel burn and flight time benefits
Lateral and vertical guidance …

… descend-via operations effectively apply to aircraft transitioning on the “long fix” for a particular landing configuration

PHX RNAV Equipage: 87%
Implementation Lessons Learned (1 of 2)

• **Discussion:** Air Traffic Control (ATC) will clear pilots to fly departure, arrival, and approach procedures, using phraseology such as “join”, “resume”, “proceed via”, “descend via”, and “climb via.” Pilots should understand the following key points regarding published altitude and speed constraints in order to fully comply with the intent of these clearances.

• **Cancellation of constraints**
  - **Altitude constraints**
    • Cancellation of one or more altitude restrictions will normally include the use of “maintain” and/or “except” phraseology, which does not cancel published speed constraints associated with the procedure.
  - **Speed constraints**
    • Cancellation of published speed constraints will be indicated by the use of “speed your discretion” or “cancel speed restriction(s)/constraint(s)” phraseology. The use of “except” phraseology may also be used, for example, “except cross MAVVS at 250 knots.”
Implementation Lessons Learned (2 of 2)

• Resume normal speed
  – The phraseology “resume normal speed” does not cancel published speed constraints; rather, per Air Traffic Order 7110.65 Air Traffic Control, it cancels speed constraints previously issued by ATC and returns the aircraft to the published speed for the procedure.

• Speeds between waypoints with published speed constraints
  – Departure and missed approach procedures
    • Pilots should not exceed published speeds associated with a waypoint until passing that waypoint.
  – Arrival and instrument approach procedures (excluding missed approach procedures)
    • Pilots should plan to cross waypoints with a published speed restriction in accordance with the published speed and should not normally exceed this speed after passing the associated waypoint unless authorized by ATC or published note.
Initial Implementation Benefits

• **Initial Operational Evaluation**
  – Radar data (VMC)
    • Pre-implementation data
      – 27, 29 September and 2, 4, 9 October 2006
    • Post-implementation data
      – 11, 14, 16, 17, 27 November and 1 December 2006
  – Operational benefits associated with VNAV/descend-via arrival operations
    • Improved descent continuity ⇒ fuel burn and flight time benefits
Pre-Implementation Arrival Operations

COYOT

BUNTR

Altitude (ft MSL)

Track Color

< 2,000

2,000 – 4,000

4,000 – 6,000

6,000 – 8,000

8,000 – 10,000

10,000 – 24,000

> 24,000

Altitude (ft MSL)

Track Color

< 2,000

2,000 – 4,000

4,000 – 6,000

5,000 – 8,000

8,000 – 10,000

10,000 – 24,000

> 24,000

PHX

PHX

MAIER ONE STAR route

EAGUL ONE STAR route

4 October 2006

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F083-B07-014
Post-Implementation
All Arrival Operations

MAIER

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BRUSR 12000/250
HOKEY 9000/210
EDDNA 8000/180

EAGUL

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HOMRR 12000/250
BADNE 9000

27 November 2006
Post-Implementation RNAV Arrival Operations

MAIER
- BRUSR 12000/250
- HOKEY 9000/210
- EDDNA 8000/180

Track Color Altitude (ft MSL)

- < 2,000
- 2,000 – 4,000
- 4,000 – 6,000
- 6,000 – 8,000
- 8,000 – 10,000
- 10,000 – 24,000
- > 24,000

EAGUL
- HOMRR 12000/250
- BADNE 9000
- QUENY 8000/210

Track Color Altitude (ft MSL)

- < 2,000
- 2,000 – 4,000
- 4,000 – 6,000
- 6,000 – 8,000
- 8,000 – 10,000
- 10,000 – 24,000
- > 24,000

27 November 2006
Descent Profile Analysis

- **Operational changes**
  - Shorter average level flight segment at 8000 ft
  - Longer average level flight segment at 9000 ft

- **Key results**
  - About 77-second reduction in level flight time at 8000 and 9000 ft
  - About 23% reduction in level flight time entering/in TRACON

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<td>Post-Implementation</td>
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PHX Descend-Via Benefits

• **Observed Operational Changes**
  – VNAV/Descend-via operations ⇒ more continuous descent profiles
    • Fuel burn
      – Reduced time in level flight, i.e. more continuous descent profiles
    • Flight time
      – Flight crew, maintenance
  – Estimated annual user benefit ⇒ $2.4M per year

• **Potential Operational Changes**
  – RNAV STARs for arrivals from the South ⇒ $1.9M per year
  – Increased VNAV Usage at PHX ⇒ $0.9M per year
  – Potential total benefit at PHX ⇒ $5.3M per year

• **Note**
  – Preliminary evaluation
  – Full realization of benefits requires that reductions in level flight at low altitudes enable extended flight at cruising altitudes
Thank You

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