EGNOS SERVICE PROVISION WORKSHOP 2016

DFS: EGNOS vertical guidance for Baro-VNAV procedures

German history and background information

member of FABEC

DFS Deutsche Flugsicherung

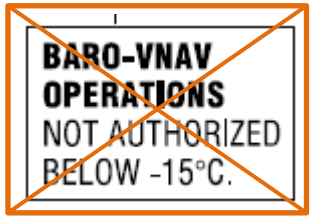
Agenda

- Facts and Figures for Approach Procedures in Germany
- Brief History of EGNOS
- Current DFS EGNOS projects
- Additional EGNOS benefits

Facts and Figures for Approach Procedures

Use of EGNOS

OCA (OCH)	A	B	C	D
LNAV	790 (390)	800 (400)	800 (400)	810 (400)
LNAV / VNAV	700 (300)	700 (300)	740 (340)	740 (340)
LPV	702 (300)	702 (300)	702 (300)	702 (300)



LNAV/VNAV operations may be flown using SBAS certified equipment;
If supported by avionics, no temperature limitation exist;
No FAS-Datablock necessary – less integrity compared to LPV

LPV operations down to 250 ft DA (APV I) or down to 200 ft DA (CAT I) possible; FAS Datablock necessary; Higher integrity compared to LNAV/VNAV operations based on SBAS vertical guidance

Facts and Figures for Approach Procedures

- Germany has **57** civil IFR-Airports and **2** IFR-Heliports in operation.
- Those airports have **129** Thresholds (THR) for IFR procedures.
- For **81** THRs procedures with ILS vertical guidance are available.
- For **8** THRs procedures with GLS vertical guidance are available.
- For **90** THRs procedures with Baro-VNAV vertical guidance are available.
- For **33** THRs procedures with SBAS vertical guidance are available.
- ICAO Res 37-11 is fullfilled for **90%**!

- For **13** THRs (**10%** of the THRs; 12 Airports and 1 Heliport) procedures with vertical guidance are not available. Outlook later!

Brief History of EGNOS

Milestone	Year	Step
1	2008	Planning process for Baro-VNAV started.
2	2009	Publishing of first Baro-VNAV procedures.
3	2010	MT0 removal without declaration of SoL-Signal.
4	2011	Baro-VNAV and SBAS available.
5	2015	Planning process for SBAS CAT I started.
6	2017	First SBAS CAT I planned.

Brief History of EGNOS

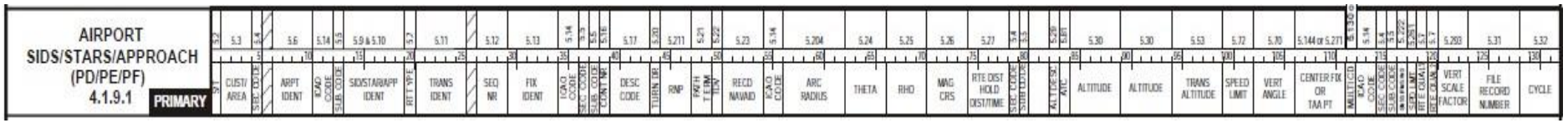
1 2008

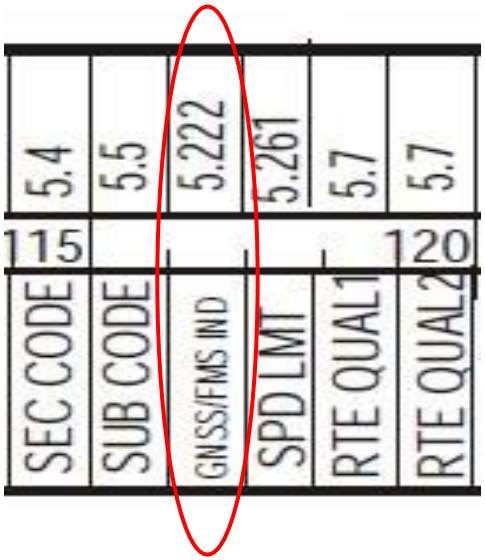
- DFS started planning process to implement Baro-VNAV procedures.
- ICAO Doc 8168 Amdt. 5 was the basis :

  „Aircraft equipped with SBAS class 2, 3 or 4 avionics may use SBAS instead of baro vertical guidance when flying a Baro-VNAV procedure developed in accordance with this chapter.“ this means -> the new obstacle surface „W“- is to be regarded for OCA/H-calculation
- How is this controlled by avionics? Story next pages!
- How is this controlled by regulators? Story next pages!

Brief History of EGNOS

- ARINC 424 coding details (only for illustration of the complexity):





5.222 GNSS/FMS Indicator (GNSS/FMS IND)

Definition/Description: The "GNSS/FMS Indicator" field provides an indication of whether or not the responsible government agency has authorized the overlay of a conventional, ground based approach procedure with the use of a sensor capable of processing GNSS data or if the procedure may be flown with FMS as the primary navigation equipment. The field is also used to indicate when and RNAV procedure has been authorized for GNSS-based vertical navigation.

Source/Content: The Indicator will be selected from the table below.

Indicator Definition	Field Content
Procedure Not Authorized for GNSS or FMS Overlay – **Authorization not published.**	0
Procedure Authorized for GNSS Overlay, primary Navaids operating and monitored.– **Authorization not published.**	1
Procedure Authorized for GNSS Overlay, primary Navaids installed, not monitored **Authorization is published. Example: Procedure Title includes "(GPS)" or "(GNSS)"**	2
Procedure Authorized for GNSS Overlay, Procedure Title includes "GPS" or "GNSS"	3
Procedure Authorized for FMS Overlay	4
RNAV (GPS) or RNAV (GNSS) Procedure SBAS use authorized (Note 2)	A (Note 1)
RNAV (GPS) or RNAV (GNSS) Procedure SBAS use not authorized *(Note 2)*	B (Note 1)
RNAV (GPS) or RNAV (GNSS) Procedure, SBAS use not specified	C (Note 3)
Stand Alone GPS (GNSS) Procedure	P

Note 1: **WAAS and EGNOS are the only SBAS Systems approved at this time.**

Note 2: **The GNSS/FMS IND of "A" indicates that the RNAV (GPS) or RNAV (GNSS) or RNAV RNP procedure is authorized for GNSS-based vertical navigation. (LPV and LNAV/VNAV approaches). The GNSS/FMS IND of "B" indicates that the RNAV (GPS) or RNAV (GNSS) or RNAV RNP procedure is not authorized for GNSS-based vertical navigation. (LNAV only approaches).**

Note 3: **Procedure use of SBAS not published.**

Indicator Definition	Field Content
Procedure Not Authorized for GNSS or FMS Overlay – **Authorization not published.**	0
Procedure Authorized for GNSS Overlay, primary Navaids operating and monitored.– **Authorization not published.**	1
Procedure Authorized for GNSS Overlay, primary Navaids installed, not monitored **Authorization is published. Example: Procedure Title includes "(GPS)" or "(GNSS)"**	2
Procedure Authorized for GNSS Overlay, Procedure Title includes "GPS" or "GNSS"	3
Procedure Authorized for FMS Overlay	4
RNAV (GPS) or RNAV (GNSS) Procedure SBAS use authorized (Note 2)	A (Note 1)
RNAV (GPS) or RNAV (GNSS) Procedure SBAS use not authorized *(Note 2)*	B (Note 1)
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Note 3: **Procedure use of SBAS not published.**

Brief History of EGNOS

2 2009

- German Baro-VNAV procedures took into account the obstacle surface “W”, thus they would support SBAS avionics in conduction of Baro-VNAV operations down to LNAV/VNAV minima.
- Procedures have been implemented before EGNOS SoL was available.
- No further statement in AIP or State publications in regard to that fact.
- No statement within EASA AMC 20-27 in regard to that fact.

Brief History of EGNOS

3 2010

- MT0 removal by ESSP without declaration of SoL-Service
  - Until 2010: „C“-record was coded by NAV-DB Providers -> Use of SBAS not specified -> means for ANSP: EGNOS will be used by several avionics for vertical guidance on published Baro-VNAV procedures.
  - Safety critical for all published RNAV-Non Precision Approaches and esp. for published Baro-VNAV procedures.
  - German regulator: Issued NOTAMs for all RNAV APCHs to forbid usage of EGNOS.
- Nav-DB Providers consequently coded „B“ in APCH-records ->SBAS Use not authorized

Brief History of EGNOS

4 2011

- EGNOS SoL declared by ESSP ☺!
  - DFS: Clarification with Regulator and NSA according to Doc 8168 Amdt. 5 (W-surface) and ARINC 424.
  - Outcome December 2011: Regulator published a regulation in the AIP (ENR 1.5) and released the EGNOS system for the use on SBAS procedures as well for Baro-VNAV.
  - Nav-DB Providers were now in a position to code „A“-records (enables SBAS vert. guidance).
- **45 Procedures with SBAS (EGNOS) vertical guidance were at a stroke available in Germany ☺ ☺ ☺!**

Brief History of EGNOS

5 2014

- ICAO Doc 8168 Amdt. 6: No further statement in Baro-VNAV chapter according the use of SBAS
- W-surface was eliminated:
  - EVERY published Baro-VNAV procedure is qualified for operations with SBAS vertical guidance (if supported by avionics); statement in AIP in regard to that fact is essential for NAV-DB Providers (source to code „A-“records).
  - Essential to coordinate closely with regulator and Nav-Database Providers! NAV-DB Providers will be grateful for a clear and doubtless statement in official sources.

Current DFS EGNOS projects

SBAS Steep Angle Helicopter Approach (6.3°)

- Implementation of steep angle helicopter APCH (6.3°) using EGNOS vertical guidance in addition to existing SBAS APCH (4.58°) at Donauwörth Heliport (Airbus Helicopters).

6 SBAS procedures to EGNOS based CAT I

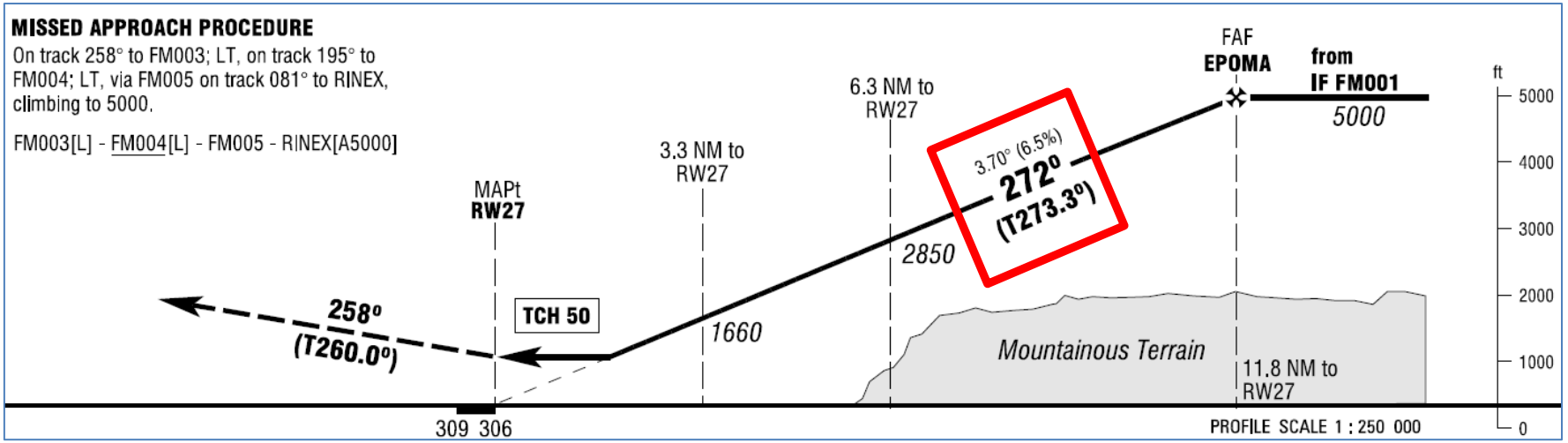
- Upgrade of existing SBAS procedures to EGNOS based CAT I procedures is beginning in Q1 2017. 1st airport will be Bremen. Why Bremen? Bremen was the first airport with GLS CAT 1!

ICAO Res 37-11

- Today 90 % of IFR-Thresholds are equipped with procedures using vertical guidance.
- The 100% target is planned for 2018!

Additional EGNOS Benefits

Mannheim City (EDFM)



OCA (OCH)	A	B	
LNAV*	1030 (730)	1060 (750)	
CIRCLING** OCH RELATED TO AD ELEV	1300 (990)	1300 (990)	

* 1500m GROUND VISIBILITY REQUIRED.
** CIRCLING SOUTH OF AERODROME ONLY. 3000m VISIBILITY, 1100ft CEILING REQUIRED.

- Today the procedures at EDFM are without vertical guidance, because of topography which causes a VPA of 3.70° / 6.5%.
- Baro-VNAV is not possible, VPA is limited to max 3,5°.

Additional EGNOS Benefits

Mannheim City (EDFM)

- SBAS **(APV I)** possible from procedure design perspective: Doc 8168 Appendix 5 to SBAS based approaches -> steep angle approach criteria for APV SBAS up to 6.3°:
  - Will be an option for EDFM but requires special approval by CAA; Business case not yet finished!
  - Good experience with existing steep angle SBAS approach at Heliport Donauwörth (VPA of 4.58°).
  - SBAS CAT I („LPV200“) not possible due to Procedure Design criteria.

Overall Conclusion: With EGNOS the Aviation System is much more flexible and safe! Thanks to the ESSP!

Thank you for your attention!

DFS Deutsche Flugsicherung