Delta Air Lines - Noah Flood



KSFO RNAV TO GLS DEMONSTRATION





Three Key Components

- 1. Global Navigation Satellite System A. GPS/Galileo/GLONASS
- 2. Ground Based Augmentation System A. FRA/SYD/EWR/IAH
- 3. GLS Equipped Aircraft
 - A. Airbus A320/A320NEO, A330, A350 and A380 Optional
 - B. Boeing 737MAX, 747-8, 777X, 787 Baseline 737NG Optional

Airport-Based Elements

GPS/Galileo/GLONASS



Receivers (4)

Terminal

VHF Antenna

Aircraft

Aircraft Equipage



RNP to GLS Approach



Benefits

- Eliminate ILS hold short lines
- No False or Mirror glideslopes
- No bending localizer
- Service Volume increased to 23 NM Dmax
- **Increased Reliability**
- **Reduce TCAS RAs**
- **Reduce Fuel Burn**
- **Reduce Carbon Emissions**
- Reduce Noise!!!!



GLS Introduction - 3 Phases

- Phase I Overlay current ILS approaches
 - Allow Pilots and Controllers to achieve comfort level
- Phase II Increase Glidepath (up to 3.25 degrees)
 - Reduce fuel burn/noise/carbon emissions
- Phase III Advanced Concepts Demonstrated at KSFO

SFO Challenges

- Noise Abatement
- Terrain
- Airspace Constraints
- Weather Frequent Reduced Visibility
- Runway Configuration
 - 2 Sets of parallel runways 750 feet apart

- SFO Demonstration of Phase 3 Advanced Concepts
 - Reduce Noise, Fuel Burn, and Carbon Emissions & Add Precision Approaches



SIMULTANEOUS OFFSET INSTRUMENT APPROACHES SFO 28L/R

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Noise/Wake Turbulence Mitigation – Displaced Threshold & Angular Separation



VIEW FROM THE OFFICE – SFO 28R





GLS V 28R

CLOSELY SPACED PARALLEL OPERATIONS





Required Spacing per FAA 7110.65



RNAV to GLS Final Report



OPTIMIZE GROUND TRACK



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■ NOISE REDUCTION 19R

OPTIMIZE VERTICAL PATH

OPTIMIZE VERTICAL PATH



FLAPS 2/180 KTS/IDLE

CONSTANT DESCENT APPROACH

- Minimize Speedbrakes
- Delay Configuring



FLAPS 5 Approaching COTE2

GEAR DOWN/FLAPS 15 at 2000 FT AFE

Procedural Separation Permits Simultaneous Operations at KSFO and KOAK

Noise Impact of Ground Track/Vertical Path



Constant Descent Approach GLS R 19R



SUMMARY OF 19R RNP TO GLS BENEFITS

Arrival Route to 19R	Distance [nm]	Estimated Fuel Burn [lbs]	CO ₂ Emissions [lbs]
Long Vector	40.3	980	3092
Short Vector	36.3	792	2319
GLS R 19R	20.5	424	1338
Savings with GLS R 19R compared to the Long Vector	19.8 nm	556 lbs fuel	1754 lbs CO ₂

Existing Procedure to Runway GLS R 19R	Delta Distance [nm]	Delta Fuel Burn [lbs]	Delta CO ₂ Emissions [lbs]	Noise Exposure [people]
Baseline Long Vector	+19.8	+556	+1,754	+249,200
Baseline Short Vector	+15.8	+368	+981	+282,300



- Airports Install GBAS
- Airlines GLS Equipped Aircraft
- ATM Build CDAs and Initiate At Higher Altitudes
- Air Traffic Controllers Accept GLS approaches
- Pilots Accept and Fly GLS approaches





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Table 11





