2021 Third meeting of GBAS-SBAS Implementation Task Force (GBAS-SBAS ITF/3)

Video Teleconference

27-28 September 2021

AIRSERVICES GBAS CERTIFICATION JOURNEY

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AIRSERVICES GBAS JOURNEY

NOTE: TIMELINE NOT TO SCALE

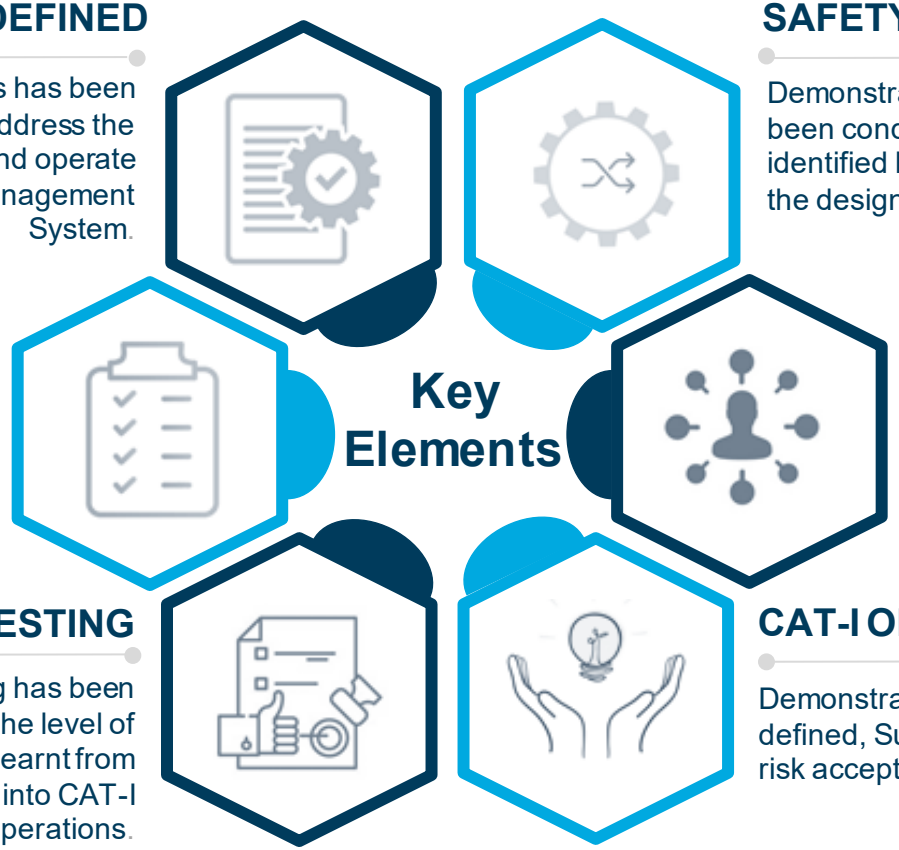
ACRONYMNS

FAA – Federal Aviation Administration
SDA – System Design Approval
CASA – Civil Aviation Safety Authority

TO CERTIFY GBAS FOR USE IN AUSTRALIA, AIRSERVICES NEEDED TO DEMONSTRATE:

"The Air Traffic Management System will be acceptably safe during and after the implementation of the Ground Based Augmentation System to support CAT-I landing operations"

KEY ELEMENTS OF THE CERTIFICATION ARGUMENT



CONCEPT DEFINED

Demonstration the concept of operations has been adequately defined and documented. Address the question how will the GBAS integrate and operate within Airservices existing Air Traffic Management System.

SAFETY ASSURANCE

Demonstration that safety assurance activities have been conducted for the system as a whole and that identified hazard controls have been incorporated into the design and implementation.

DESIGN AND IMPLEMENTATION

Demonstration that the system has gone through adequate system design and implementation process. Demonstration that the design and implementation meets legislative requirements and conforms with ICAO SARPS.

SUPPORT SYSTEMS

Demonstration that the necessary sustainment systems are in place, which are adequately defined with acceptable controls in place to reduce the level of risk to As Low As Reasonably Practicable.

OPRERATIONAL TESTING

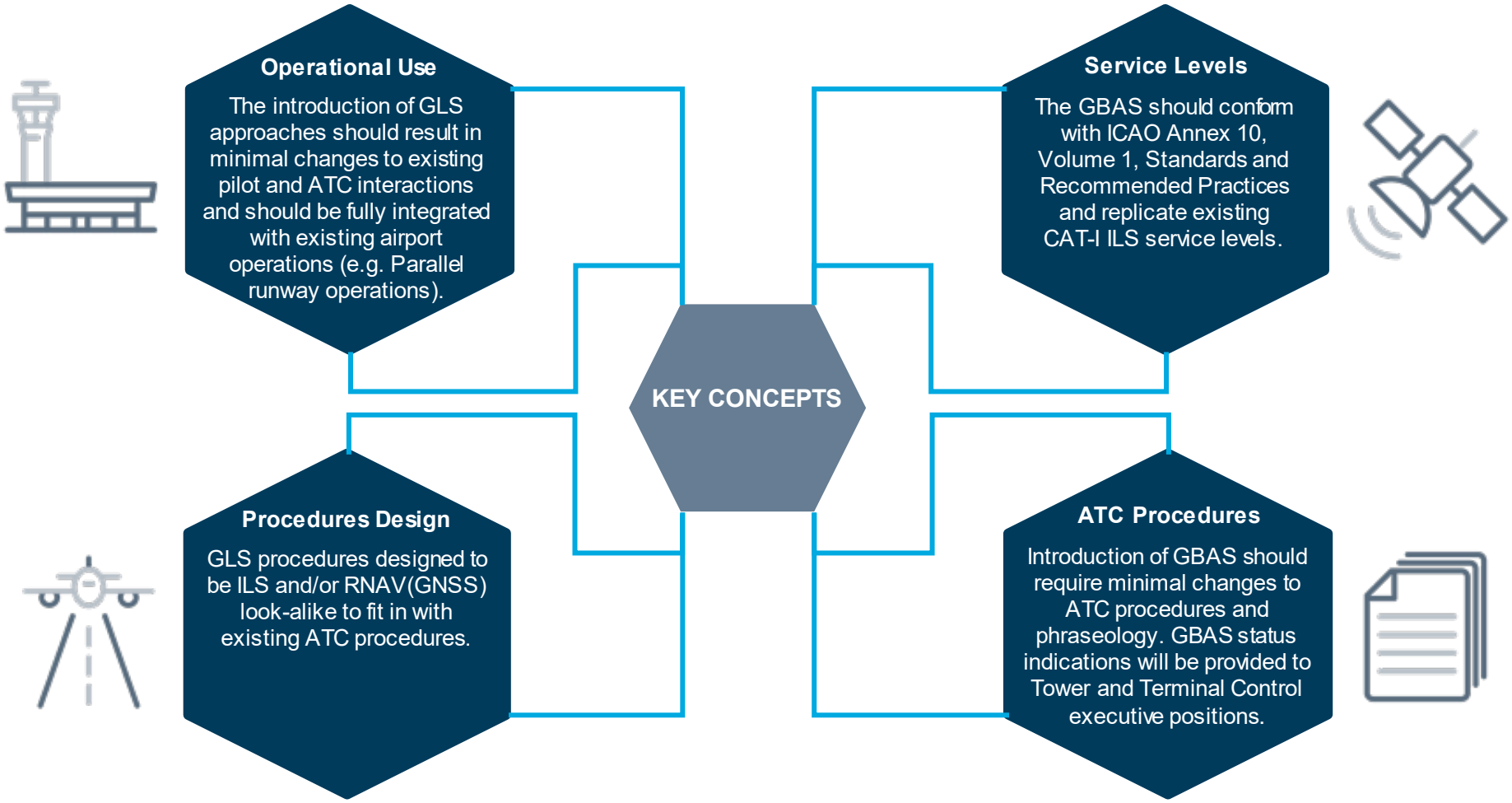
Demonstration that Operational Testing has been adequately defined, completed and that the level of risk is acceptable. Any lessons learnt from Operational Testing have been integrated into CAT-I operations.

CAT-I OPERATIONS

Demonstration that CAT-I landing operations are defined, Support Systems updated and the level of risk acceptable.

CONCEPT DEFINED

A dedicated GBAS Concept of Operations was developed to articulate how the GBAS would be used in the current Air Traffic Management environment. The Concept of Operations was critical to developing Operational Requirements and deriving technical requirements.



SAFETY ASSURANCE ACTIVITIES COMPLETED

APPLICATION OF AIRSERVICES SAFETY MANAGEMENT SYSTEM TO THE GBAS IMPLEMENTATION.

HAZARD IDENTIFICATION AND ANALYSIS

- Hazard identification and analysis workshops undertaken to identify, analyse and develop controls for **hazards associated with integrating the GBAS into Australian airports**
- Key stakeholders included Operations, Engineering, Procedures Design, Airlines, Regulator and Maintenance.
- Eight high level hazards identified
- Three operational hazards accepted due to the low probability of occurrence

HUMAN FACTORS ASSESSMENT

- SLS-4000 GBAS has a number of computer based interfaces with operational personnel, either ATC or maintenance
- Human Factors analysis undertaken to demonstrate systems were fit for purpose

WORKPLACE HEALTH AND SAFETY

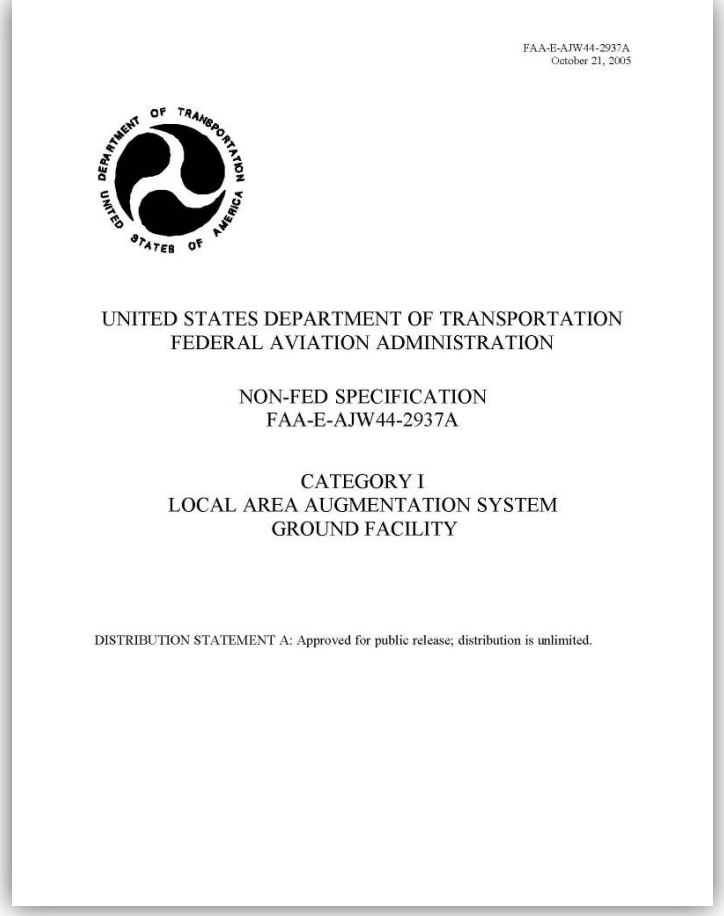
- Workplace health and safety impacts, due to the installation of the system, ongoing occupancy of the GBAS shelter
- Hazards identified, assessed and controlled through the Work Health & Safety assessments

IDENTIFIED CONTROLS WERE INTEGRATED INTO THE GBAS DESIGN AND IMPLEMENTATION AND VERIFIED TO BE MET IN THE SAFETY CASE

DESIGN AND IMPLEMENTATION – CERTIFIED PRODUCT

KEY COMPLIANCE WITH REGULATOR SPECIFICATION AND STANDARDS

- FAA published a Non-Federal Specification for a Category I Local Area Augmentation System Ground Facility (FAA-E-AJW44-2937A which was later updated to FAA-E-3017)
- Traceable to ICAO Annex 10, Volume 1 Standards and Recommended Practices for GBAS
- Honeywell SLS-4000 GBAS was found to be compliant with the FAA Specification with approved waivers and deviations
  - **Honeywell SLS-400 GBAS achieved FAA System Design Approval (SDA)**
- SLS-4000 GBAS product developed to RTCA DO-278 and DO-254 and System Safety Processes complaint with ARP-4754 and ARP-4761.



FAA-E-AJW44-2937A
October 21, 2005

UNITED STATES DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

NON-FED SPECIFICATION
FAA-E-AJW44-2937A

CATEGORY I
LOCAL AREA AUGMENTATION SYSTEM
GROUND FACILITY

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

DESIGN AND IMPLEMENTATION – APPLICABILITY IN AUSTRALIA

FOCUS FOR AIRSERVICES IS ON CERTIFYING A PRODUCT DESIGNED FOR THE USA FOR USE IN AUSTRALIA

FAA SPECIFICATION

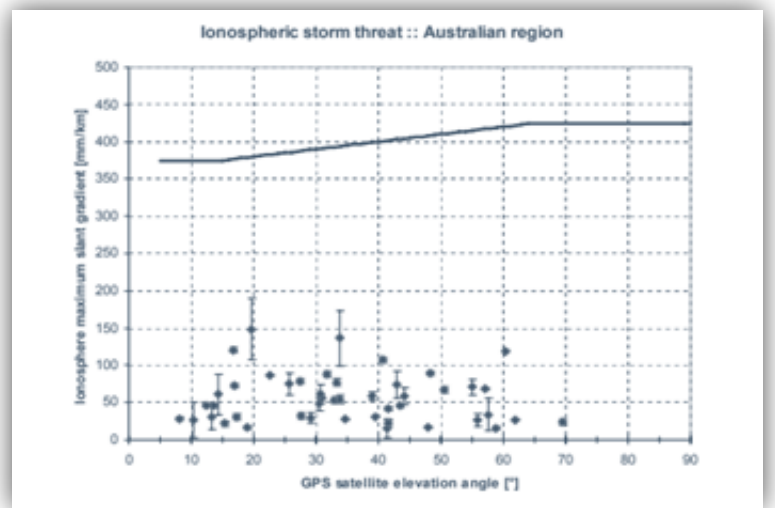
IS THE FAA SPECIFICATION SUITABLE FOR USE IN AUSTRALIA? *MAJORITY APPLICABLE*

- Each requirement in the FAA Specification reviewed, assessed and marked as "Applies in Total", "Partially Applies" or "Does Not Apply" for Australia
- Primary differences were in local infrastructure requirements (e.g. electrical, structural, siting standards)
  - these requirements were integrated into a local requirements baseline
- Independent assessment of the FAA waivers and deviations to the Specification
  - all deviations and waivers found to be acceptable in Australia

IONOSPHERE THREAT MODEL

IS THE THREAT MODEL SUITABLE FOR USE IN AUSTRALIA? *YES*

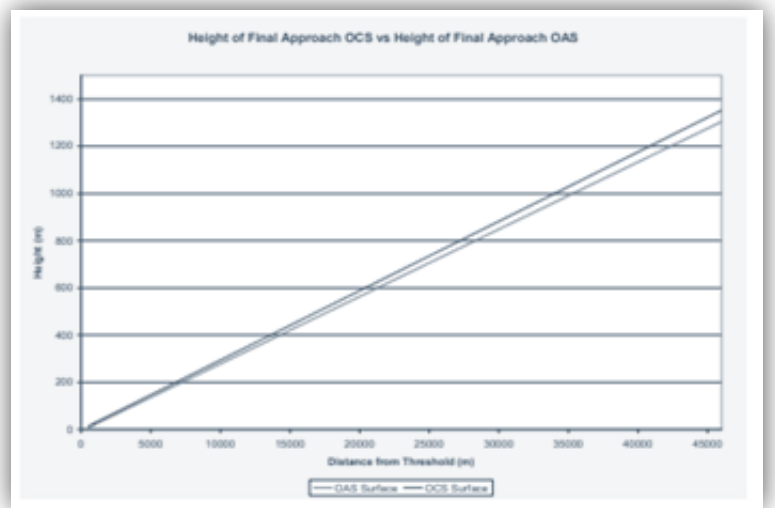
Independent study concluded *"All observations of anomalous ionospheric gradients in the Australian mid-latitude region in this study fell within the parameters of the ionospheric threat model integrated into the CONUS certified Smartpath GBAS design"*



ERROR CONTAINMENT

DO OAS METHDOLOGIES WHOLLY CONTAIN THE MAXIMUM IONOSOHPERE INDUCED ERROR IN VERTICAL POSITION? *YES*

"existing OAS methodologies, which are used for ILS protection, protects against the worst case aircraft height for both approach and missed approach phases of flight."



ACRONYMNS

CONUS – Conterminous United States
OAS – Obstacle Assessment Surface

DESIGN AND IMPLEMENTATION – REQUIREMENTS BASELINE

DEVELOPING LOCAL REQUIREMENTS

- A dedicated set of requirements was developed for each site focusing on unique requirements in Australia
- These included:
  - Operational Requirements (ATC)
  - Legislative requirements (state and federal)
  - GBAS monitoring requirements
  - Installation specific requirements
  - Site specific requirements
  - Maintenance requirements
- All requirements were consolidated into a single requirements baseline for each site

EXAMPLE: AUSTRALIAN SPECIFIC REQUIREMENTS

1. *"All electrical installations shall comply with AS/NZS 3000 (wiring rules) in particular, but not limited to Appendix K in relation to the installation, alteration, repair, maintenance and testing of high voltage electrical installations (Electricity Safety (Installations) Regulations 2009)."*

2. *"The GBAS System shall have a status of NOT OK when any of the following conditions are met:*
   a) GBAS is in NOT AVAILABLE mode as defined in FAA-E-3017 section 3.1.4.2;
   b) GBAS is in TEST mode as defined in FAA-E-3017 section 3.1.4.2;
   c) A failure of the Monitoring System;
   d) A Predicated Constellation Alert; or
   e) An Actual Constellation Alert."

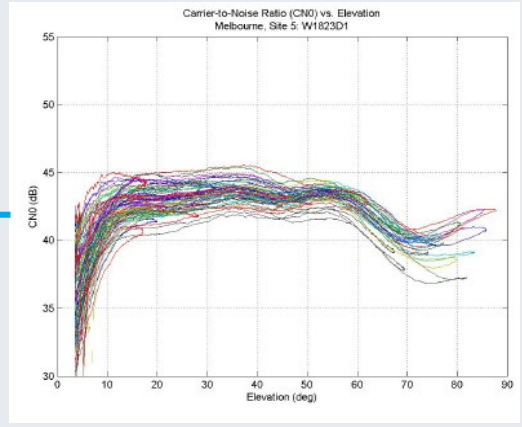
3. *"The GBAS shall meet the general safety requirements of AS/NZS 60950.1:2003 (Information technology equipment - Safety Part 1: General requirements)."*

4. *"All masts & towers shall be designed in accordance with Australian Standard – Design of steel lattice towers and masts (AS 3995-1994)."*

DESIGN AND IMPLEMENTATION – SITE ASSESSMENT

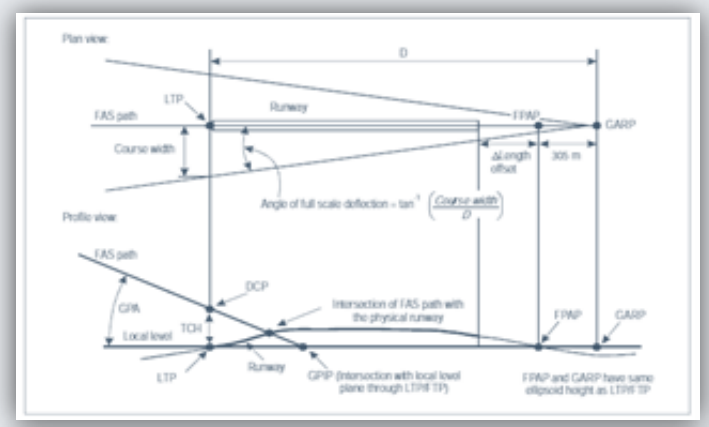
SITE SELECTION PROCESS

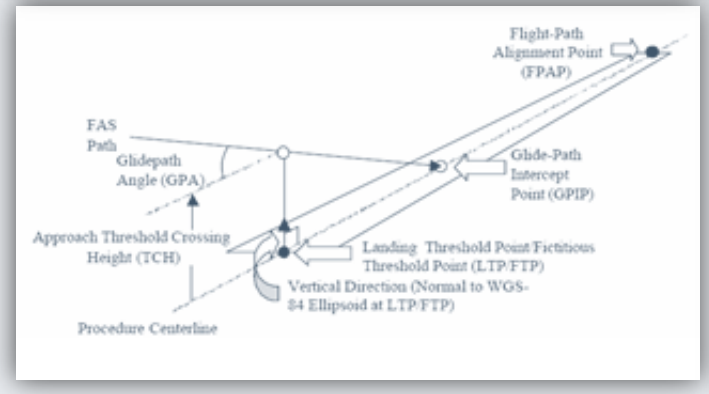
- Identify preliminary sites based on Honeywell Siting Process
  - Soil stability, VDB siting, RR siting, Protection Surfaces and future infrastructure
- Set up a GPS antenna/receiver to evaluate GPS environment
  - GPS Multipath
  - Radio Frequency Interference
- VHF coverage modelling using available software tools

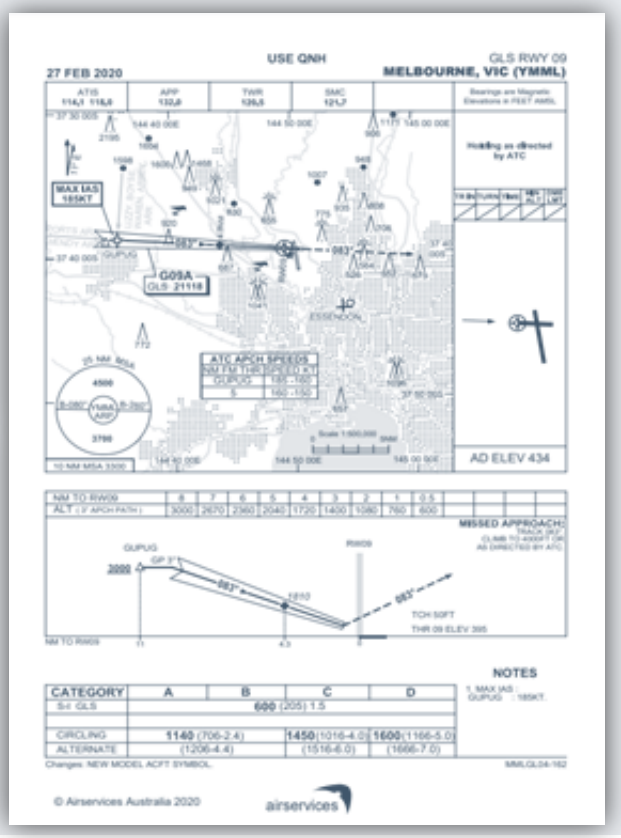


DESIGN AND IMPLEMENTATION – PROCEDURES DESIGN

FAS DATA AND APPROACH PLATE DEVELOPED BY PROCEDURES DESIGNER. PROVIDED TO ENGINEERING TO CONVERT INTO A BINARY FILE FOR LOADING ONTO THE GBAS.







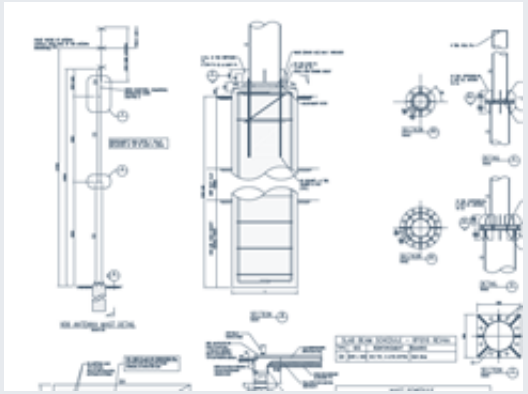
Aerodrome Location	Frequency (MHz)	Runway	Channel	IDENT
YMML	115.4	09	21118	G09A

Item	Units	Range of Values	Resolution	Value
Operation Type	-	0 = Straight in Approach 1 to 15 = Spare	1	0
SBAS Service Provider	-	0 to 13 = Not used in Australia 14 = FAS Data Block is to be used with GBAS only 15 = FAS Data Block can be used with any SBAS service provider	1	14
Airport ID	-	AAAA to ZZZZ	-	YMML
Runway Number	-	1 to 36	1	9
Runway Letter	-	0 = no letter 1 = R (right) 2 = C (centre) 3 = L (left)	1	0
Approach Performance Designator	-	0 = GAST A or B 1 = GAST C (Category I) 2 = GAST C and GAST D 3 = GAST C, GAST D and an additional approach service type to be defined in the future 4 = GAST C, GAST D and two additional approach service types to be defined in the future 5 to 7 = Spare	1	1
Route Indicator	-	A to Z	-	W
Reference Path Data Selector (RPDS)	-	0 to 48	1	2
Reference Path Identifier	-	3 or 4 letter alphanumeric characters (IDENT)	-	G09A
LTP/FTP Latitude	degrees	± 90.0°	0.0005 arcsec	-37°39'58.7055"
LTP/FTP Longitude	degrees	± 180.0°	0.0005 arcsec	144°49'20.1030"
LTP/FTP Height	metres	-512.0 to 6041.5 m	0.1 m	125.8 m
Δ FPAP Latitude	degrees	± 1.0°	0.0005 arcsec	-0°00'05.4185"
Δ FPAP Longitude	degrees	± 1.0°	0.0005 arcsec	0°01'33.0230"
Approach Threshold Crossing Height (TCH)	metres or feet	0 to 3276.7 feet or 0 to 1638.35 m	0.1 feet or 0.05 m	50.0 ft
Approach TCH Units Selector	-	0 = Feet 1 = Metres	-	0
Glide Path Angle (GPA)	degrees	0 to 90.0°	0.01°	3.00°
Course Width	metres	80 to 143.75 m	0.25 m	105.00 m
Δ Length Offset	metres	0 to 2032 m	8 m	0 m
FASVAL	metres	0 to 25.4 m	0.1 m	10.0 m
FASLAL	metres	0 to 50.8 m	0.2 m	40.0 m

DESIGN AND IMPLEMENTATION – INSTALLATION & INTEGRATION

1

Site Design



2

Civil Works

3

Shelter & Tower Installation

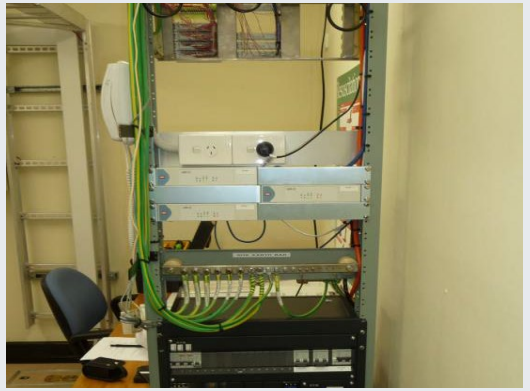
4

RSMU Installation

5

VDB Installation

6

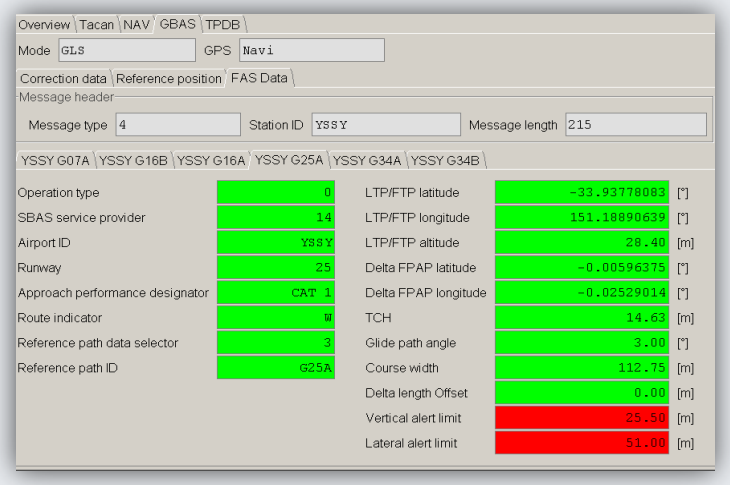


Integration into ATM Systems

DESIGN AND IMPLEMENTATION - VERIFICATION ACTIVITIES

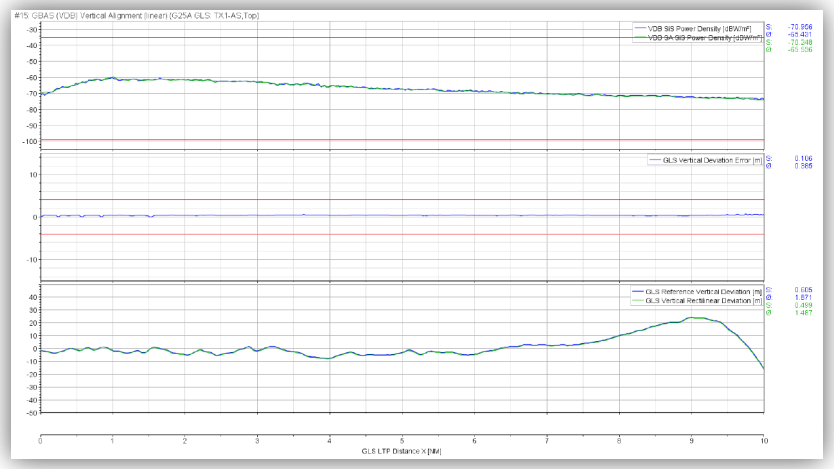
FACTORY ACCEPTANCE TESTING

Verify Honeywell SLS-4000 GBAS is operating correctly and identification of any issues before installation.



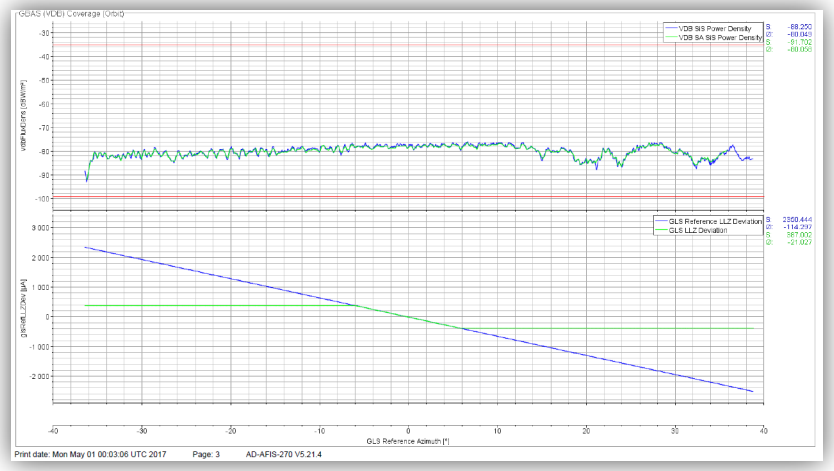
SITE ACCEPTANCE TESTING

Stability testing, end to end functionality testing of the installed system, configuration audits and initial performance analysis.



FLIGHT INSPECTION

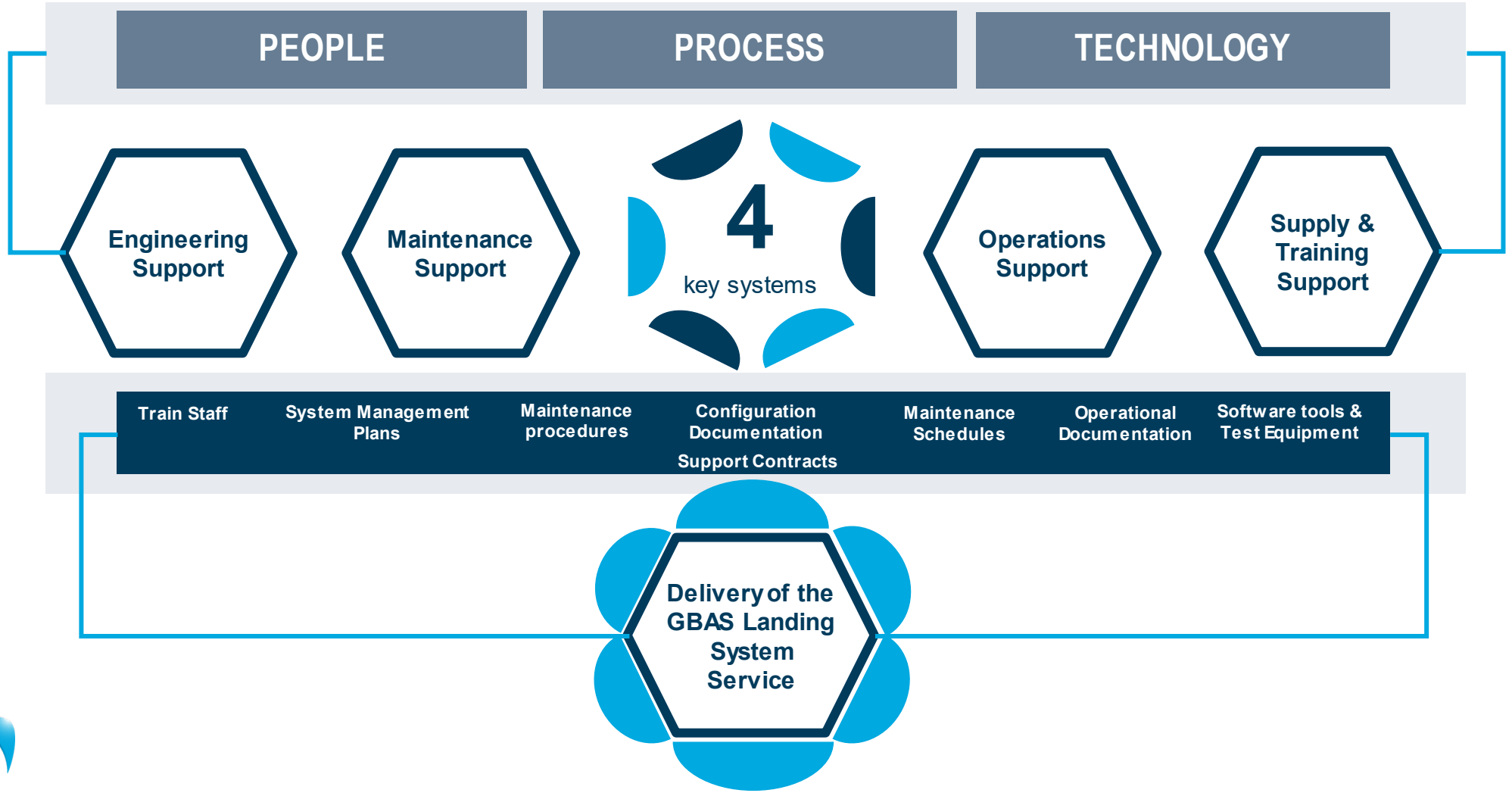
Verify VHF Data Broadcast (VDB) coverage, validate Final Approach Segment data and conduct a position domain functional check.



SUPPORT SYSTEMS

Airservices were required to establish a number of Support Systems in order to effectively operate and maintain the GBAS. This was a critical element to demonstrate to the regulator that the appropriate people, process and technology were in place to support Service delivery.

Key Elements

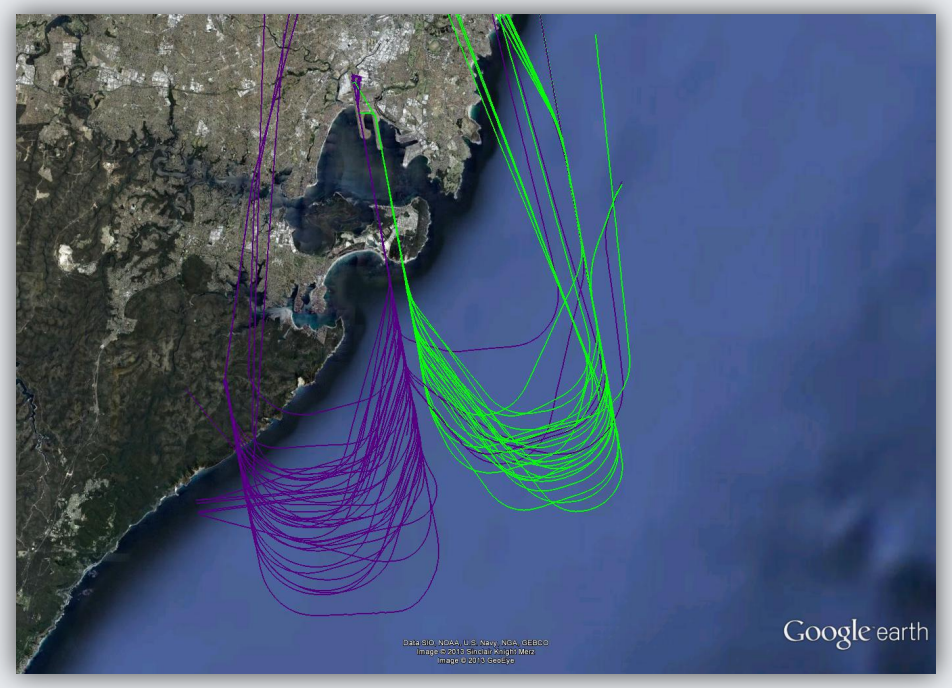


OPERATIONAL TESTING

At this stage there was no change to Airservices Aeronautical and Radionavigation Service Provider Certificate. Operational Evaluation was conducted under test transmissions.

TESTING IN A REAL WORLD ENVIRONMENT

- Subsequent to Engineering readiness, Safety Case (Version 1) submitted and accepted by CASA
- Objectives
  - Validate GBAS is meeting designed System Performance parameters
  - Validate that the service is operating as intended through aircraft using the GLS service
- Open to "CASA Authorised Operators" only. Visual conditions only (Decision Height: 2100 feet and Visibility: 5000 m)
- Temporary Local Instruction in place for ATC



Pilot Feedback:

"Very good intercept and approach was flawless"

CAT I OPERATIONS

Airservices Aeronautical and Radionavigation Service Provider Certificate was updated to include GBAS.

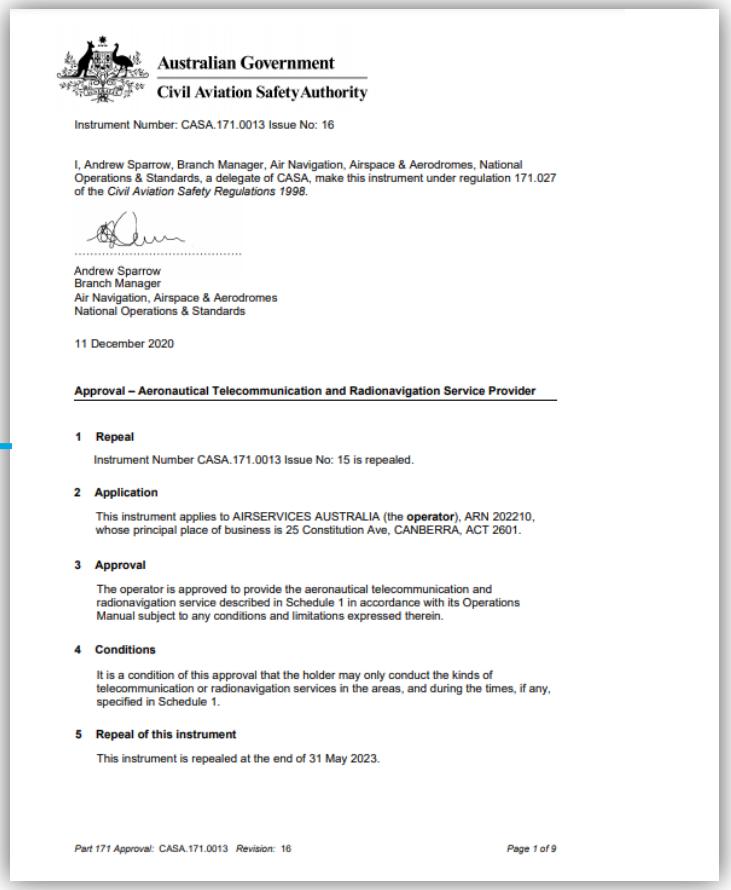
OPERATIONALISING THE CHANGE

- Hazards reviewed and updated to reflect CAT-I operations
- ATC instructions integrated into procedures and Aeronautical Information Publication documents update
- All evidence collated during the Operational Evaluation consolidated into Version 2 of the Safety Case and accepted by CASA
- Future GBAS deployments managed as any other Navigation Aid deployment

CASR-171 Service Classifications (Chapter 2 MOS Part 171)	Coverage	ICAO Defined Services	Airways Systems	Support Services (External)
AERONAUTICAL RADIO NAVIGATION	National	Aeronautical Radio Navigation	• Distance Measuring Equipment • Instrument Landing System – Localiser, Glide Path and Marker • Non Directional Beacon • Very High Frequency Omni-Range • Ground Based Augmentation System **Common Systems** • Communications systems - Microwave radio links - Satellite ground stations - Terrestrial cabling - Multiplexers - Data networking systems • Voice Communication and Control System • Audio and Control Systems • ATC Consoles	• Public Telecommunication Networks - Telstra - Optus • Copper and Fibre cables(Airport Owner)

List of Airways Systems updated to include GBAS

CASR-171 Certification



Australian Government
Civil Aviation Safety Authority

Instrument Number: CASA.171.0013 Issue No: 16

I, Andrew Sparrow, Branch Manager, Air Navigation, Airspace & Aerodromes, National Operations & Standards, a delegate of CASA, make this instrument under regulation 171.027 of the *Civil Aviation Safety Regulations 1998*.

Andrew Sparrow
Branch Manager
Air Navigation, Airspace & Aerodromes
National Operations & Standards

11 December 2020

Approval – Aeronautical Telecommunication and Radionavigation Service Provider

1 Repeal

Instrument Number CASA.171.0013 Issue No: 15 is repealed.

2 Application

This instrument applies to AIRSERVICES AUSTRALIA (the **operator**), ARN 202210, whose principal place of business is 25 Constitution Ave, CANBERRA, ACT 2601.

3 Approval

The operator is approved to provide the aeronautical telecommunication and radionavigation service described in Schedule 1 in accordance with its Operations Manual subject to any conditions and limitations expressed therein.

4 Conditions

It is a condition of this approval that the holder may only conduct the kinds of telecommunication or radionavigation services in the areas, and during the times, if any, specified in Schedule 1.

5 Repeal of this instrument

This instrument is repealed at the end of 31 May 2023.

Part 171 Approval: CASA.171.0013 *Revision:* 16 *Page 1 of 9*

THANK YOU

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