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Ground Based Augmentation System (GBAS) News

GBAS Installed at Newark Liberty International Airport

Last summer, the Federal Aviation Administration (FAA), the Port Authority of New York and New Jersey (PANYNJ), and Continental Airlines signed a Memorandum of Understanding (MOU) that established an agreement to advance the implementation of Ground Based Augmentation System (GBAS) technology at Newark Liberty International Airport (EWR). The PANYNJ has since purchased and installed GBAS equipment and managed its installation at Newark Liberty International Airport. The PANYNJ is the sponsor of the GBAS system, responsible for maintenance and support provided through Honeywell. PANYNJ will also complete the facility and service approvals required for GBAS Category (CAT) I operations.

In its assigned role under the MOU, the FAA has developed the first public Ground Based Augmentation Landing System (GLS) approach procedures to be used in revenue service. GBAS procedures will be available for all runway ends at Newark Airport that currently have an Instrument Landing System (ILS) approach procedure. In the future, the GBAS will also provide precision approach capability to the one other runway end that currently does not have an instrument approach procedure and may also support other complex terminal area procedures. The FAA also provided data collection equipment, developed and coordinated prototype terminal procedures, and completed the collection of data and analysis performance in support of GBAS facility and service approval. In its role, Continental Airlines has obtained a Supplemental Type Certificate (STC) for the use of GBAS avionics in their Boeing 737NG aircraft. They started taking delivery of GBAS-equipped aircraft last summer. As of August of this year, they will have eighteen aircraft that are GBAS GLS-capable. They will continue taking delivery of GLS-capable aircraft at the rate of about one per month. Continental has already obtained their operational approval from the FAA to allow them to fly the GLS approaches with their 737NG aircraft. Continental will also support FAA data collection activities, conduct flight test operations, and support procedure development and simulation. Continental will be the only air carrier flying the GBAS GLS approach procedures at Newark until other airlines become equipped and receive operational approval.

The 737 NG is the first of Continental's fleet to receive operational approval to fly GBAS GLS approaches

Pending the completion of facility and service approvals, the preliminary flights of Continental using the GBAS station at Newark are planned for early next year. Continental will initially fly the GBAS approaches in visual meteorological conditions (VMC).

Radio Frequency Interference (RFI) was detected at Newark Airport on the protected L1 frequency shortly after the GBAS installation was complete. Although these events have been infrequent, the RFI caused the GBAS system to shut itself down, which is how it is designed to operate if it detects a threat. A working group

The SatNav News is produced by the Navigation Services (ATO-W) branch of the Federal Aviation Administration (FAA). This newsletter provides information on the Global Positioning System (GPS), the Wide Area Augmentation System (WAAS) and the Ground Based Augmentation System (GBAS).

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consisting of FAA, Spectrum, FCC, MITRE, Raytheon, Ohio University, Honeywell, BAE, and PANYNJ determined the cause of the RFI to be illegal jamming devices in vehicles traveling on the New Jersey Turnpike which is in very close proximity to the Newark Airport. The working group has developed several mitigation strategies for the RFI and in October presented the PANYNJ with its analysis. The PANYNJ will meet with the FAA Technical Center and the GBAS Program Office in early November to decide on a mitigation strategy and start developing a plan and schedule for instituting that strategy. The Spectrum Office and the FCC are working with other Government agencies on the enforcement actions for those who use these illegal jamming devices. The RFI issue detected at Newark affects all GPS navigation technologies and the lessons learned from the working group will assist in the siting and installation of future GBAS systems.

The FAA GNSS Operational Implementation Team is continuing to work with Continental, New York/New Jersey air traffic control, and the FAA Technical Center to develop, model, simulate, and flight test other complex GBAS approaches for Newark.

- Kristi Peterson,FAA AJW-9132/NAVTAC

Newark Project Initiative Underway to Support Operational Implementation of GBAS

The Memorandum of Understanding (MOU) signed last summer between the Federal Aviation Administration (FAA), the Port Authority of New York and New Jersey (PANYNJ), and Continental Airlines is part of a larger project to conduct an operational demonstration using the capabilities of GBAS in a complex airspace environment. The goal is to achieve efficiency, safety, and capacity enhancements by supporting aircraft and airspace separation in a highly-congested area with a single GBAS unit installed at Newark Airport to serve all runway ends. This project will also provide controllers and pilots with operational experience using GBAS.

The Newark Project will identify and validate GBAS benefits, and is planned to facilitate more efficient arrival and departure routings as envisioned in the FAA's NextGen plan. This project is designed to offer an air traffic control tool that can provide flexibility, adaptability, reliability, and environmental benefits. Additional benefits expected from this demonstration project include:

- Reduced ground delay and ground stops
- Response to recommendations by the PANYNJ Flight Delay Task Force Report
- Improve airspace separation in the congested New Jersey/New York airspace environment
- Opportunity to conduct flight tests with Continental Airlines B-737NG aircraft
- Development of overlays to existing ILS and RNAV/RNP procedures
- Testing of future complex GNSS procedures.

- Kristi Peterson,FAA AJW-9132/NAVTAC

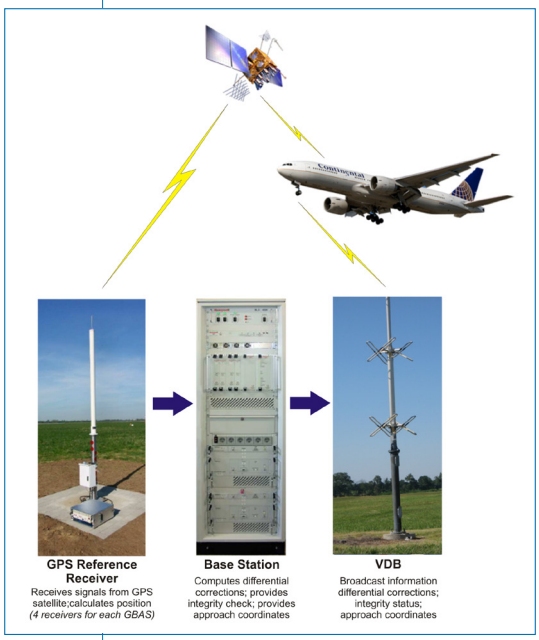
GBAS Reaches Key Milestone Approval

Last year, on September 3, 2009 system design approval (SDA) of the Honeywell SLS-4000 SmartPath System was achieved.

SDA is an extensive and thorough review comparing the requirements in the FAA system specification against the system design of the vendor, in this case Honeywell, to ensure all requirements have been met in a satisfactory manner. The FAA verified that all requirements in the GBAS specification traced to Honeywell's SLS-4000 specification. This was an extensive process covering nearly 600 requirements. In addition to requirements review, the FAA reviewed each test case that Honeywell developed to verify these procedures as sound. As a result of this thorough analysis, the FAA put its seal of approval on the design of the system. The next steps for GBAS will be facility approval and then operational approval. These subsequent approvals will be site-specific.

The Port Authority of New York and New Jersey has SLS-4000 GBAS equipment installed at Newark International Airport in cooperation with Continental. The FAA also has been using a Honeywell SLS-4000 for testing at the William J. Hughes Technical Center in Atlantic City. The SDA approval that has been granted to Honeywell by the FAA extends to and covers the equipment currently installed in all these locations. Internationally, there are also several air navigation service providers - such as those in Spain, Germany, and Australia - implementing this system.

GBAS is the International Civil Aviation Organization (ICAO) term for a landing system that uses GPS combined with augmented signals transmitted by datalink from the ground. The FAA's implementation of GBAS has often been referred to as the Local Area Augmentation System (LAAS). GBAS and LAAS are sometimes used synonymously. Additionally, Honeywell refers to the specific model of their GBAS/LAAS that received system design approval from the FAA as the SLS-4000 or the SmartPath™ Precision Landing System.



Now that SDA has occurred, initial LAAS certification will be accomplished when the first of these SDA-approved installations completes site certification. At that point, the equipment will be officially commissioned and can begin broadcasting its highly accurate and dynamic navigation guidance to users the in the NAS.

- Alan Hankin, FAA AJW-9132/NAVTAC

GBAS Category II/III Technology Passes Milestone

Ground Based Augmentation System (GBAS) Category II/III technology has passed a significant milestone in its development and implementation. The Enterprise Architecture Board (EAB) of the FAA, recognizing the maturity of GBAS technology for Category II/III , has approved the program to enter the Concept and Requirements Definition (CRD) phase, meaning that the concept and requirements of the project have been defined and agreed upon.

The remaining Acquisition Management System (AMS) milestones are the Investment Analysis Readiness Decision (IARD), expected in September 2011 and the Initial Investment Decision (IID) expected in March 2012. The Final Investment Decision (FID) is proposed to be determined in September 2012.

- Dieter Guenter, FAA AJW-9132/NAVTAC

Highlights of 10th International GBAS Working Group, Brussels, Belgium, June 3-6, 2010

The 10th International Ground Based Augmentation System (GBAS) Working Group (IGWG) was hosted by Eurocontrol at Eurocontrol Headquarters in Brussels, Belgium.

The working group is chaired by the FAA and Eurocontrol. It addresses relevant issues for the development and implementation of GBAS and facilitates the exchange of data and information which can be used by the participants in formulating their business strategies and implementation plans.

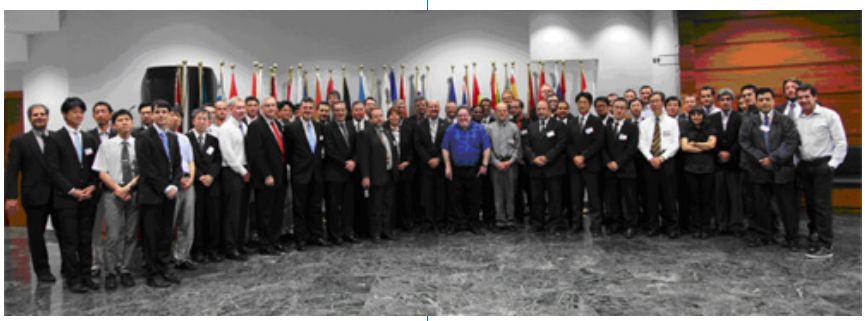
The national updates and briefings at this meeting reflected increasing activities and focus on implementation of GBAS Category (CAT) I, but also dealt with planning for GBAS CAT II/III. This activity is driven in part by the FAA NextGen initiatives and the Single European Sky ATM Research (SESAR) master plan activities. Many international service providers have ongoing GBAS validation projects with near to mid-term implementation plans.

Airbus and Boeing continue their support for GBAS and outlined their plans for fleet equipage. All Airbus aircraft will eventually be GBAS capable. Already, 62 percent of all current A380 aircraft orders include the request for the GBAS GLS option. Boeing 737-800, 787, and 747-8 will also be GBAS-capable. This capability will be standard on B787and B747-8 models.

The working group activities have led to increased data sharing with participants agreeing to use a common tool for data evaluation (Eurocontrol Pegasus) and identifying a need for harmonization of multipath assessment tools. Other outcomes from the working group activities include increased cooperation in IONO (ionosphere) data gathering and analysis activities and an initiative to establish world-wide coordination of IONO research (i.e. models, threat analysis). Discussions at the operational level centered on post-implementation issues, such as simultaneous parallel approach operations using GBAS, and the coordination of CAT II/III Concept of Operations (CONOPS) between FAA and Eurocontrol.

The meeting was extremely successful from the perspective of the co-chairing organizations and the participants also expressed their satisfaction with the outcome of the meeting.

- Dieter Guenter, FAA AJW-9132/NAVTAC



WAAS Enabling New Operational Benefits to Users

The FAA has entered in to a number of cooperative arrangements to advance the benefits of the Wide Area Augmentation System (WAAS). These initiatives, developed under the FAA's Other Transaction Authority (OTA) policy, include projects with Northern Air Cargo, Horizon Air, NetJets Aviation, Inc. (NetJets), CareFlite, Bell Helicopter, Associated Aircraft Group (AAG), and Cape Air. Here are some recent highlights of these projects.

❖ *Horizon Air Enters Revenue Service with WAAS Avionics*

On December 30, 2009, Horizon was the first FAR Part 121 passenger carrier to fly revenue operations with WAAS. They have started equipping their Bombardier Q-400 turboprop aircraft with the UNS-1EW Wide Area Augmentation System (WAAS) Flight Management System (FMS).

Horizon Air has identified WAAS as a technology that provides better access into the airports into which they fly and improved passenger service. On Horizon's first day using WAAS in revenue service, benefits were realized. The Instrument Landing System (ILS) at Portland was inoperative, but Horizon was able to land using WAAS.

Flying with WAAS avionics also mitigates the Receiver Autonomous Integrity Monitoring (RAIM) prediction requirements referenced AC 90-100A.

The FAA has engaged Horizon Air in a three-year data collection effort to provide operational data relating to economic and operational advantages of WAAS equipage on a regional airline platform.

For more information, please see Horizon Makes Aviation History with First WAAS Flight (http://www.alaskasworld.com/Newsroom/QXNews/QXstories/QX_20100108_104108.asp)

- Tom Salat, FAA AJW-9131/NAVTAC

❖ *AAG Helping to Advance Vertical Flight Criteria using WAAS*

On January 29, 2010, the Associated Aircraft Group (AAG) reached a significant milestone in their three-year project to further the development of advanced vertical flight criteria utilizing the Wide Area Augmentation System (WAAS). On that date, four months ahead of the project schedule, the second of two Sikorsky S-76C++ aircraft operated by AAG completed the installation of the Universal UNS-1Fw WAAS-enabled FMS and associated system elements. Approximately one month later, AAG completed the requisite training of their pilot staff to allow the utilization of GNSS/WAAS navigation technology. Collection of WAAS-enabled data has commenced for this project and is being compiled and analyzed for use in establishment of helicopter routes and approaches in the heavily congested New York area.

The focus of this project is to collect data that contributes to further development of advanced helicopter criteria and WAAS equipage in the helicopter community. The endeavor will deliver applications that enable en route and terminal area operations for the Teterboro airport and the primary heliports/helipads servicing the Manhattan area within the New York/New Jersey (NY/NJ) airspace. This effort includes installation and certification of Technical Standard Order (TSO) Wide Area Augmentation System (WAAS) receivers into helicopters, operational trials conducted using Area Navigation (RNAV) and WAAS routes and procedures to collect data for WAAS
benefits and validation of helicopter specific criteria, and integration of rotary-wing traffic into the Instrument Flight Rules (IFR) routing structure using Global Navigation Satellite System (GNSS)/WAAS technology.

As a part of this project, AAG is serving as the program manager for the involvement and support of Mirus Technologies, Hughes Aerospace, and the Eastern Region Helicopter Council.

- Chris Jaran, FAA AJW-9131/NAVTAC

❖ *Safety Approval Granted for CareFlite to Use WAAS Approaches into Dallas Area Trauma Centers*

CareFlite recently reached a significant milestone in their three-year project to further the development of advanced helicopter flight criteria using the Wide Area Augmentation System (WAAS). The milestone was the signing of the Safety Risk Management Decision Memo (SRMDM) which sanctions WAAS approaches to Dallas area trauma centers for CareFlite EMS Helicopters. CareFlite operates five helicopter bases throughout north central Texas, flying Agusta A109E helicopters equipped for instrument flight and operated under FAR Part 135.

This project is sponsored by the FAA under an Other Transaction Agreement with CareFlite to assist in the development of WAAS-enabled helicopter low altitude IFR flight operations, in this case for emergency medical service (EMS) providers.

This is the first of three phases in the Safety Management System/Safety Risk Management process concerning CareFlite. The other two phases are: Helicopter Routing Structure for the Dallas MetroPlex area and Instrument Departure Procedures.

The SRMDM was signed by the FAA District Manager of the Dallas Air Traffic MetroPlex Area.

A SRMDM documents the decision that the proposed change does not impact the National Airspace System (NAS) safety. The memo includes a written statement of the decision and the supporting argument. It is signed by the local air traffic manager (ATM) and kept on file for a period equivalent to the lifecycle of the system or change. The issuance of this memo streamlines the process by eliminating the requirement for a full safety risk analysis for these approaches, a very detailed process that can go on for six months or more.

The signing of the SRMDM keeps the cooperative work between the FAA Satellite Based Augmentation System Team (also often referred to as the FAA WAAS Team) and CareFlite on schedule. Specifically, this allows for the commencement of flights using WAAS localizer performance with vertical guidance (LPV) approaches to trauma centers in the Dallas Metroplex area. The rapid processing of this safety approval for these approaches was facilitated by the use of WAAS/LPV overlays to existing approaches.

- Chris Jaran, FAA AJW-9131/NAVTAC

❖ *FAA and Bell Helicopter Complete Next Step Toward the Validation of Public Criteria for WAAS LPV PinS Approach Procedures*

On March 11, 2010, a flight data collection system, developed for the Federal Aviation Administration Flight Technologies and Procedures Division's (AFS-420) by the University of Oklahoma, was successfully installed and integrated with a Bell 429 helicopter at Bell Helicopter's facility in Mirabel, Quebec, Canada. The FAA has engaged Bell Helicopter in a data collection effort which will enable the FAA to develop design criteria for public-use localizer performance with vertical guidance (LPV) Point-In-Space (PinS) instrument approach procedures using the Wide Area Augmentation System (WAAS). To accomplish this task, a data collection system that provides real-time, true aircraft position in space is required. The integrated system was flown through a series of flight tests that included hover and in-flight maneuvers, as well as 5 degree, 7.5 degree, and 9 degree (coupled and uncoupled) localizer performance with vertical guidance (LPV) approaches. The successful integration and validation of this system in the Bell 429, achieved within budget and one month ahead of schedule, is a significant milestone in the ongoing terminal instrument procedure (TERPS) criteria development project between Bell and the FAA. The project is now positioned to move directly into the data collection and analysis portion of the effort.

The portable light-weight data collection "truthing" unit was developed and provided to the FAA by the University of Oklahoma Department of Electrical and Computer Engineering. The AFS-400 Flight Data Collection System is a self contained, self-powered unit which is isolated from aircraft power transients. Installation of this system takes less than ten minutes and does not require the aircraft to be put into the experimental operating category. The system is unique as it provides a measurement of the performance of the navigation system, the pilot, and the airframe in the precision approach mode. The truthing system provides up to a 20Hz time resolution of the aircraft's position which allows the user to measure dynamic data associated with the airframe and navigation system. This system also includes a data collection system to measure the performance of the GPS system that provides guidance to the aircraft. This data collection system provides an independent measure of the roll and pitch of the aircraft as well as parameters such as ground speed, latitude, longitude, and altitude. The system is capable of capturing both digital ARINC and RS232 outputs, along with analog outputs such as horizontal and vertical deviations of the navigation system under test. It provides continuous data collection onboard the aircraft for up to 6 hours. This new truthing system allows the FAA to quickly determine the navigational performance of a Global Positioning System (GPS)/WAAS navigation system used onboard the aircraft.

This project is sponsored by the FAA under an Other Transaction Agreement (OTA) with Bell Helicopter to assist in the development of WAAS-enabled helicopter low altitude Instrument Flight Rules (IFR) flight operations and in this case supports the validation of Special Helicopter WAAS LPV criteria for use as public criteria.

- Tom Salat, FAA AJW-9131/NAVTAC

Stay tuned for more updates on these and other projects in future editions of the SatNav News and on our website (http://gps.faa.gov).

Satellite Navigation Approach Procedures Updates

The number of Wide Area Augmentation System (WAAS) enabled approach procedures continues to rapidly increase. A listing of current LPV locations and associated information can be found on our website at http://gps.faa.gov by selecting the GPS/ WAAS Approaches button from bottom of page.

The FAA's Aviation System Standards organization keeps an inventory of all approach procedures available for the National Airspace System.

WAAS-Capable Approaches (by Procedure Type)

	Procedures (Part 139 Airports)	Procedures (Non-Part 139 Airports)	Total Number of Procedures
LNAV Procedures	1701	3208	4909
LNAV/VNAV Procedures	1176	1104	2280
LPV Procedures *(LPV-200)*	1100	1227	2327 *(396)*
GPS Stand-Alone Procedures	36	389	425

(Data as of September 23, 2010)

Instrumentation Approach Procedures (IAPs) Based on Traditional Navaids

ILS	1,336
ILS (CAT II)	168
ILS (CAT III)	122
NDB	967
VOR	1,375
VOR / DME	973

(Data as of July 3, 2010)

Table truncated for publication. Full table available at http://avn.faa.gov/index.asp?xml=nfpo/inventory-summary.

Some highlights from this inventory, last updated in July is shown in the table above. A notable take-away from the information in these two tables is the growing proportion of area navigation (RNAV) approach procedures, based on satellite navigation systems, compared to approach procedures enabled by traditional ground-based navigation systems.

- Mary Ann Davis, FAA AJW-9131/NAV TAC

WAAS GEO Outage Information

Background

The WAAS signal-in-space is currently broadcast by two leased geostationary satellites (GEO).

- Intelsat (CRW) 133°W, PRN - 135
- Telesat (CRE) 107.3°W, PRN - 138

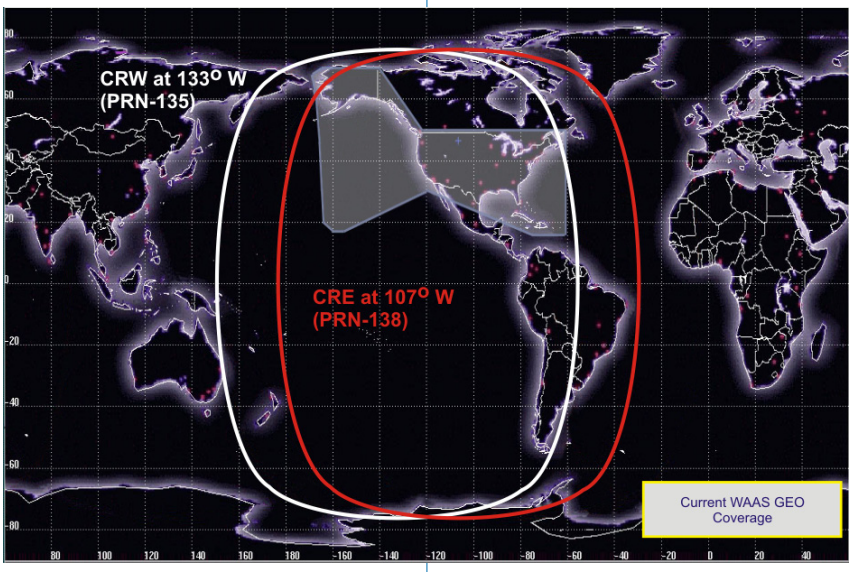
In April 2010, the Federal Aviation Administration was notified of a technical issue being experienced by the Intelsat (CRW) GEO. Communication with the portion of the satellite that manages its movement had been lost. As a result, the satellite had started drifting from its correct position. For WAAS, there was no immediate impact to service, but the FAA has been monitoring the situation closely as the satellite continues to drift.

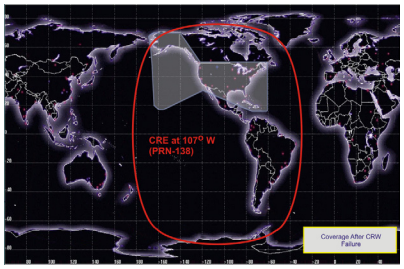
Potential Impacts to WAAS Service

Due to this technical issue, there soon will be a point in time when CRW will no longer be used to broadcast the WAAS signal-in-space. Criteria have been established for discontinuing the CRW broadcast. An exact time has not been set, but it is expected that the broadcast will end in October 2010. When this occurs, the FAA will issue a NOTAM under the Anchorage Air Route Traffic Control Center to alert users of the affected area.

There are two ways in which WAAS service will be impacted once the CRW broadcast ends:

- Diminished WAAS Coverage in Northwest Alaska
- Infrequent Short Term Outages During Maintenance Operations





❖ *Diminished WAAS Coverage in Northwest Alaska*

There are 16 airports in Northwest Alaska where WAAS LPV service will be affected due to the loss of the CRW GEO - all north of a line from 70°N 150°W and 64°N 164°W.

Currently, none of the 16 affected airports have published LPV approaches and users will still be able to continue to fly the existing LNAV procedures. Operators using TSO-C145/C146 receivers for en route, terminal, or IFR approach operations in the area of Northwest Alaska designated in the paragraph above will be required to confirm that GPS receiver autonomous integrity monitoring (RAIM) will be available for the flight during planning. This is required in accordance with (IAW) Aeronautical Information Manual (AIM) paragraph 5-1-15 f.

Due to reduced WAAS availability, any required alternate airport in this area must have an approved instrument approach procedure, other than GPS, that is anticipated to be operational and available at the estimated time of arrival and which the aircraft is equipped to fly IAW AIM paragraphs 1-1-20 c 6 and the note in 1-1-19 g.

This information is being provided as a courtesy for our WAAS users. Please refer to Anchorage Center NOTAMS for specific guidance. For any WAAS airspace other than that of the Northwest portion of Alaska referenced here, there are no other WAAS restrictions related to this issue.

❖ *Infrequent Short Term Outages during Maintenance Operations*

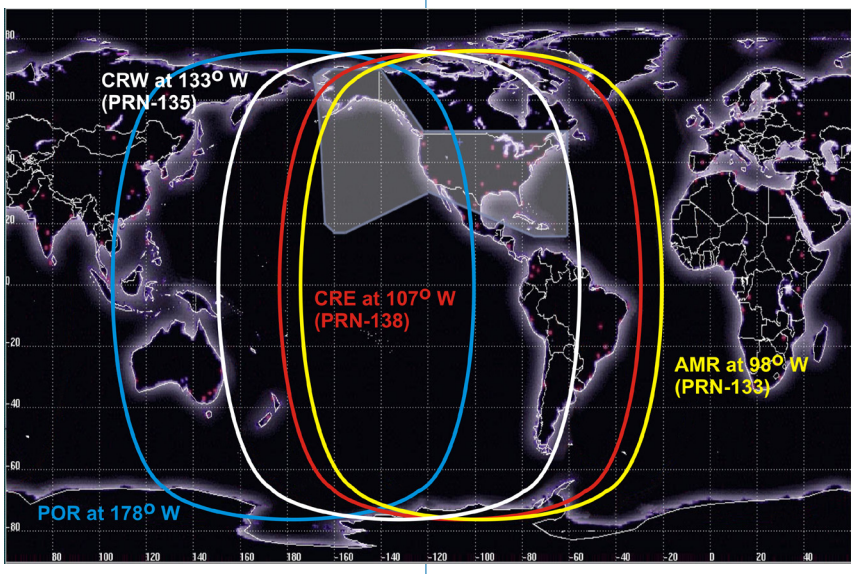
The other impact to WAAS service, due to the loss of CRW, may be infrequent, temporary service outages throughout the WAAS service volume due to lack of redundant GEO coverage. This may occur when a switch between the primary and backup GEO uplink subsystem (GUS) occurs. Although these switchovers are rare events, it may take up to five minutes to fully restore LPV service after such an occurrence.

Next Steps

The FAA has an initiative, already in progress, to integrate a new GEO (known as AMR) into WAAS. The integration of AMR (98°W, PRN-133) was originally expected to be complete by December 2010, but the FAA is now working to accelerate this integration to allow operational use of the GEO by November. The successful integration of AMR will eliminate any infrequent, short-term maintenance outages over all of CONUS and in some portions of Alaska that would occur with the loss of CRW.

The FAA is also investigating options for restoring WAAS LPV and LNAV/VNAV service to the Northwest area of Alaska. One potential solution is the re-integration of the POR GEO (178°W, PRN-134). POR was formerly used by WAAS prior to the transition to the CRW GEO.

The FAA is committed to keeping its users aware of any potential changes that may affect WAAS service and will provide updates as the situation evolves. Periodic updates on this topic will also be provided on the Satellite Based Augmentation System (WAAS) / News section of our website accessible from http://gps.faa.gov.



Europe Certifies Satellite-Based Navigation System for Aviation

On August 2010, the European Geostationary Navigation Overlay Service (EGNOS) entered a transition phase leading to Safety of Life Service (mostly for aviation use) to be operational by the end of the year. EGNOS is the European equivalent of the U.S. Wide Area Augmentation System (WAAS). Both systems monitor and provide correction updates to Global Positioning System (GPS) signals and support aircraft flight operations including departure climb, enroute flight, arrivals and landing – using only guidance from satellites. This new operational capability will boost the availability and utility of worldwide satellite based augmentation system (SBAS) service. SBAS is the international term for navigation systems such as WAAS and EGNOS. More information on EGNOS can be found on the European Satellite Services Provider (ESSP) website at http://www.essp-sas.eu/

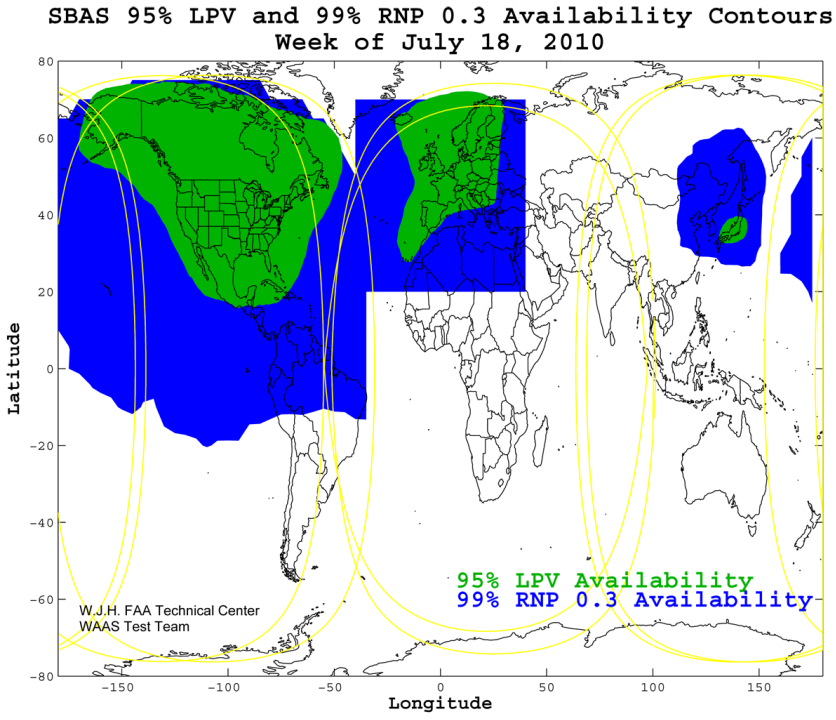
The U.S. and Europe have worked closely together during the development of both systems to ensure interoperability. Both navigation systems have been developed to the same international standards. Avionics receivers designed for WAAS will be capable of using EGNOS; and receivers designed for EGNOS will be capable of using WAAS. Both systems will also have comparable levels of service. The approach with vertical guidance (APV) service provided by EGNOS is equivalent to the

U.S. localizer performance with vertical guidance (LPV) service provided by WAAS. In addition to WAAS and EGNOS, other comparable navigation systems are being developed and fielded around the world using the same interoperability standards.

The European Satellite Services Provider (ESSP) will be the EGNOS system operator and EGNOS Safety of Life (SoL) service provider. On July 12, 2010, ESSP received the certification of Air Navigation Service Provider, a final prerequisite needed for ESSP to provide navigation services to airspace users in Europe. Initial service will support enroute flight and lateral guidance approaches (LNAV). According to an ESSP press release, "After an operational period of 3 months, the EC will declare the Safety of Life (SoL) service available to the aviation community, enabling the publication of precision approach procedures with vertical and lateral navigation guidance (APV) based on EGNOS". More information on ESSP is available on their website at http://www.essp-sas.eu/company_structure.

The U.S. has already realized substantial benefits from WAAS and the European community is looking forward to the same. In a press release, ESSP comments that European air navigation service providers will be in position to implement satellite based precision approaches without the need for ground equipment at the airport and with performance similar to that of Instrument Landing System (ILS) Category I service. Europe sees EGNOS APV as an opportunity to provide a cost-effective alternative to ILS Category I. In the U.S., the Federal Aviation Administration shares this same viewpoint. In fact, there are now more LPV approaches available in the U.S. than ILS approaches. Additionally, according to information on the EGNOS website, it is projected that EGNOS will help all users reduce delays, diversions, and cancellations due to bad weather at all sizes of airports and heliports. As in the U.S., Europe is also looking at phasing out other ground-based navigation aids to help reduce operating costs. In Europe, these cost savings may enable the future reductions in landing fees. Europe also foresees environmental benefits from EGNOS in the form of more precise and shorter approaches resulting in less fuel consumption, carbon dioxide (CO2) emissions, and noise. At a high-level, EGNOS will support Europe's Single European Sky ATM Research (SESAR) program just as WAAS has an important role to play in FAA's NextGen program. The availability of WAAS and EGNOS to the aviation community will provide a navigation platform to support the seamless transition between the airspace systems of the future that are currently taking shape as a result of the U.S. NextGen and European SESAR programs.

LPV is currently only approved in the U.S., Canada, and Mexico, but EGNOS will be approved for this same level of service in the near future. This graphic also shows the availability of service for RNP and LPV for Japan's Multi-Functional Transport Satellite (MTSAT) Satellite-based Augmentation System (also known as MSAS for short); however, Japan has not yet certified MSAS for LPV.



The graphic shows current worldwide SBAS coverage. Blue represents 99% availability for Required Navigation Performance (RNP) 0.3 coverage, equivalent to non-precision approach (NPA) service. Green represents 95% availability for LPV service.