PROFESSIONAL PILOT

OUR 43rd YEAR

JANUARY 2009

Honeywell

Shortens the path safely for RNP SAAAR with Go Direct Services

Situational Awareness

Honeywell advances RNP SAAAR benefits in the corporate cockpit

Ultraprecise terminal ops will replace nonprecision approaches.

Mountains along the flightpath during the RNP approach to Runway 13R at PSP (Palm Springs CA) as the aircraft passes the YOCUL intersection.

By Woody McClendon
ATP/Helo. Challenger 604

We're gliding along at 160 kts on the RNAV (RNP) Z approach to PSP (Palm Springs CA). We're at 7000 ft MSL—2000 ft above the rocky terrain—and I'm looking out the windshield of a Gulfstream G550 at mountain ridges all around us.

Minimum safe altitude (MSA) on the approach plate is 12,700 ft MSL. The G550 is flying an elliptical track that in minutes will have us lined up with PSP's Runway 13R. It is a typical Palm Springs morning—bright blue skies and unlimited visibility. We could as well be flying this approach at midnight in rain or snow—if we were we could watch the terrain displayed in 3D synthetic vision on the primary flight display (PFD).

This is the new world of required navigational performance, special aircraft and aircrew authorization required (RNP SAAAR)—a long name for highly precise terminal operations that will replace nonprecision approaches (NPAs). At PSP the usual method of getting to Rwy 13R is a VOR-B approach, circle to land in a valley surrounded by mountains. Minimums for the VOR-B circle are 1826 ft AGL and 3 miles—for the RNP approach, 277 ft AGL and 1 mile.

RNP SAAAR is a major step forward in the long process of modernizing airspace. It exploits leading-edge technology that tightens position determination from traditional values of 5.0 nm down to 0.3 nm and below. In the close-in sectors of RNP operations, final approach courses and missed approach segments, required accuracies are down to 0.1 nm—that's a 500-ft box on either side and above and below the aircraft. (Current-generation GPS receivers—those that comply with AC20-138—deliver sensor accuracies of 36 meters 95% of the time. GPS augmented with a ground-based augmentation system (GBAS), currently being developed in Europe, delivers sensor accuracies of better than 2 meters.) With those tight navigational tolerances locked in, the airspace box for IFR operations shrinks from miles to hundreds of feet, opening up almost unimaginable possibilities for flexible traffic management and ending delays, no matter how much the traffic volume grows.

The immediate benefits of RNP SAAAR are enormous—safer approaches and departures to terrain-challenged airports (the ones that access all the ski lodges), more efficient use of terminal airspace, and significant fuel savings (reducing cost and air pollution).

Go Direct

Honeywell is taking the lead in driving RNP SAAAR technology to market. A major vendor in onboard precision navigation systems and ground-based systems, Honeywell has recently begun offering RNP SAAAR hardware and software upgrades for most aircraft equipped with the company's avionics systems. Older aircraft may require upgrades to their inertial platforms and EGPWS, along with software changes to their FMS computers, while newer airplanes will require only software upgrades.

Honeywell's flight department was the first Part 91 operator approved by FAA for RNP SAAAR operations, and is passing its experience securing that approval to its customers. Go Direct, a new Honeywell service, is a consultancy wherein Honeywell engineers and pilots help operators write the approval submission package, design training, procedures and documentation, and, after FAA approval, integrate it all into the operator's current systems. Honeywell became an FAA-designated "RNP consultant" earlier this year enabling this new service.

Reprint from *Professional Pilot* magazine January 2009 issue

FAA approval process

FAA grants approval for RNP SAAAR operations through a process defined in Advisory Circular 90-101. It is roughly similar to the approval methodology for Cat II operations. AC90-101 is organized into 7 appendices which provide a guidance package to apply for approval and operate an RNP SAAAR program. They are:

- RNP SAAAR instrument approach procedures. This establishes the link to the TERPs system for designing approaches and describes RNP operations' unique features.
- Aircraft qualification. This provides technical detail for airframe and avionics manufacturers to demonstrate compliance with RNP requirements.
- Navigation data validation program. Reflecting the criticality of onboard navigation data to RNP operations, this appendix provides guidance for operators to validate navigation databases and document the process on a continuous basis.
- Operational considerations. This provides a broad overview of RNP operations, MEL considerations, inflight monitoring and systems management.
- Training. This provides detailed training goals for Part 91 crews and additional items for Part 121 and 135 pilots and dispatchers.
- RNP monitoring program. This defines a program to monitor the success rate of RNP approaches and document the results on a continuous basis (similar to Cat II programs).
- RNP application package contents. This lists all the elements that FAA will look for in an RNP SAAAR application.

Just a scan of AC90-101 will convince the most fearless aviation manager that taking on this project without expert advice and council would cause major pain. In establishing the Go Direct consultancy service, Honeywell is certainly motivated by the potential for a new profit center and sales of upgrade products, but it doesn't take much analysis to show that the costs for engineering, documentation and extra flight time one would spend building an RNP SAAAR application from scratch would far exceed what Honeywell would charge for the job. There are many undertakings—producing MELs, ops manuals and maintenance tracking programs, for example—that can theoretically be produced by anyone with a word processor and a spreadsheet program, but broad experience shows that such efforts end up as nightmare projects and ultimately false economies.

Photos by Jim Veihdeffer

(L–R) Honeywell VP Crew Interface Products Chad Cundiff presents key points of the company's Go Direct program. Product Mgr Mike Lydon offers support as McClendon absorbs the facts about Go Direct, which supports customers intending to commence RNP SAAAR operations.

Honeywell invited us for a demonstration of RNP SAAAR ops in the company's G550. VP Crew Interface Products Chad Cundiff and Chief Pilot, Corporate Aviation Ron Weight conducted the technology briefing at Honeywell's flight ops base at PHX (Sky Harbor, Phoenix AZ). Cundiff took us through the key points of Go Direct, the benefits of RNP SAAAR to operators, Honeywell's experience securing operational approval and the challenges this presented, and how the company offers its experience to help customers.

Among the points that came out during the briefing was the evolution in operational philosophy that comes with new-technology navigation systems. Traditionally, crews setting up an approach select a primary navigation source for the pilot flying, and a separate source as backup to be monitored by the pilot not flying. As long as both sources present an on-track picture, everything is go. If a disagreement surfaces, the approach is abandoned.

New technology concepts

In new-technology systems, inputs from multiple sensors are blended by software into a single source, each available input analyzed for data quality, repeatability and reliability, then queued in order of quality. If the data from one source degrades, the system advises the crew with a warning. Standard procedure is still to abandon the approach, but the system remains sufficiently accurate, even with the degraded source, to provide acceptably precise course guidance for the missed approach procedure.

The key difference between old and new is that nav sources aren't perceived as failed—only as degraded from optimum, but still adequate to provide guidance for safe flight. The concept is similar to that in fly-by-wire flight control design, a system malfunction triggering a reversion to a lesser functional level, with the system still capable of providing aircraft control within the boundaries of safe flight.

As he described how Honeywell avionics operate in the RNP SAAAR environment, Cundiff spoke of another breakthrough that pilots will welcome. In older avionics systems, if a go-around is required the pilot initiates it by pressing a takeoff/go around (TOGA) button, usually on one of the thrust levers. The system commands a standard pitch-up attitude and heading mode on the flight director and disengages the autopilot. Then, while working intently to establish a climb and reconfigure the airplane, the crew must select a navigation source to fly the missed approach course and then re-engage the autopilot. Depending on the system, this can take several tense seconds, double-

checking that the missed approach course guidance is in the selected navigation source, then directing it to the flying pilot's displays.

Honeywell, whose latest version of Primus Epic software will soon be released, has streamlined the process. Selecting TOGA initiates the pitch-up process, but there is no break in the navigation source and the autopilot remains engaged. Missed approach course guidance is displayed to the pilot with no interruption from the previous input. The crew's only requirement is to verify that the LNAV mode for the autopilot remains engaged. This upgrade may be available in some older Honeywell avionics systems, depending on individual configurations.

Certifying the hardware and software upgrades is Honeywell's responsibility. Once FAA-certified, products are released to the airframe manufacturers, who must then install and integrate them, and seek FAA certification in their aircraft in accordance with AC90-101, Appendix 2.

While the benefits of RNP SAAAR operations are most dramatic at airports like PSP, they are equally powerful when considered in the context of airspace management. Cundiff described how low RNP technology, and the highly repeatable determination of 3D aircraft position, will become the basis for building tighter arrival and departure corridors, deconflicting terminal airspace and increasing traffic capacity.

Honeywell G550 Capt Marc Lajeunesse points out the challenging terrain on the flightpath defined in the RNAV (RNP) Z Rwy 13R approach displayed on the copilot's MFD in the G550.

RNP SAAAR examples

Cundiff cited 2 examples, the first already implemented, the other in work as part of the FAA's NextGen ATC program. The first is at GYY (Gary IN), a busy airport that supports a dense industrial community in northern Illinois and northern Indiana. Arrivals and departures at GYY are subject to traffic at nearby MDW (Midway, Chicago IL), a major airline airport operating at intensely high traffic levels. With the recently commissioned RNAV RNP Rwy 12 approach, operators now have precision access to both Rwy 30, with its ILS, and Rwy 12—and the RNP Rwy 12 approach keeps arriving aircraft below MDW's arrival corridors. This is a good example of the aviation community initiating a major deconflicting of terminal airspace to improve operations, without waiting for FAA.

The second example is at TEB (Teterboro NJ), the New York area's primary corporate airport, located in EWR (Newark NJ) terminal airspace. RNP-driven, highly precise arrival and departure corridors will be designed as part of the NextGen Air Traffic System, allowing aircraft operating into and out of TEB to avoid EWR arrivals and departures. The hours-long ground delays at Teterboro will become a memory.

Weight took his part of the preflight briefing to explain the plan for the demonstration flight. We would depart PHX and fly over to PSP—about a 40-min flight. On arriving at PSP we would execute the RNAV RNP (Z) Rwy 13R approach and fly the missed procedure to the PSP VOR. Then we would execute the RNAV RNP (Y) approach to Rwy 31L, with the missed approach taking us to the TRM (Thermal CA) VOR east of PSP and then back to PHX. I would occupy the jump seat, with Weight acting as captain and Marc Lajeunesse as co-captain.

Lajeunesse had N933H set up and the systems programmed when we arrived at the aircraft. He explained the preflight setup procedure for RNP using the special checklist Honeywell developed as part of the FAA approval process. The checklist is part of the Go Direct support package available to customers who contract for the service. It specifies maximum speeds for the G550 for various segments of RNP approaches in accordance with AC90-101, Appendix 1. These restrictions are RNP-specific and are separate from the approach categories, A through E, specified in the AIM.

RNP SAAAR cockpit setup

Referring to the checklist, Lajeunesse opened the nav source page on the FMS and deselected all the VOR receivers. AC90-101 specifically prohibits VOR updating of the RNAV system. Then he selected the RNP page and set the RNP window to 0.3 nm. This value was displayed on both PFDs in a small window in the lower right corner, along with another value labeled EPU (for estimate of position uncertainty). This value is constantly computed by the navigation system monitor, based on sensor accuracy, data quality and system performance. The display provides a continuous real-time assessment of nav system performance against a selected standard—in this case an RNP of 0.3. Later, during the flight I noted that the EPU window continuously displayed values of 0.10–0.15.

Leveling at FL 300, Lajeunesse and Weight began setting up the cockpit for the PSP approach. As we descended into PSP airspace, Lajeunesse negotiated with Approach Control for the RNP (Z) approach to Rwy 13R, even though the active runway was 31. Our promise of strictly a low approach satisfied the controllers and they cleared us direct to SBONO intersection—the initial approach fix (IAF)—with a descent to 9000 ft. Honeywell RNP SAAAR procedure calls for the active approach to be displayed in

vertical situation display (VSD) mode on the flying pilot's multifunction display (MFD) and the approach plate itself on the non-flying pilot's MFD. During the descent Lajeunesse and Weight had double-checked the waypoint string in the FMS against the approach plate, along with the prescribed altitudes for each.

Approach database audit

Calling up the approach plate from the FMS triggers an audit step in the database. Each aircraft is approved only for RNP approaches that have been validated to ensure that the waypoint data in the current database matches exactly what is on the approach plate. A data sheet in the RNP section of the airplane operating manual (AOM) lists approved approaches for the current month. If the approach is not on the list the database will not load it into the cockpit displays and an FMS message will appear.

RNP SAAAR operators are required to have in place an approved procedure for accepting, verifying and loading the database in each aircraft. As part of the Go Direct package Honeywell offers an FAA-approved process for database management which, given the complexity and the criticality of the task, is a powerful option for operators.

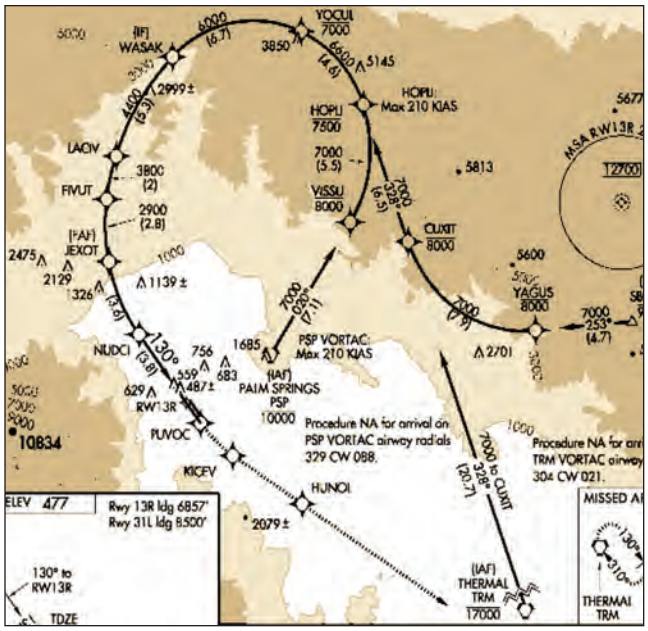
Passing SBONO, Weight slowed the G550 to 180 kts and called for Flaps 20. After Lajeunesse set the flaps, Weight slowed the aircraft to 155 kts—approximately Vref +20. The descent profile, displayed in the bottom of the flying pilot's MFD, shows the airplane's path in red superimposed on the vertical profile.

As we passed HOPU intersection and rolled into a near 180° turn back toward the airport, I saw why Weight had slowed the airplane. Negotiating that turn at any higher speed could have been unpleasant, especially if the mountains were churning up turbulence. At this speed the autopilot commanded small bank angles, and the ride was so smooth that if the passengers weren't looking out the window they would have no idea we were flying a curving path through high terrain. At WASAK intersection the aircraft joined the computed glideslope. Typical of these sophisticated approaches, the descent is initiated while the flightpath is still curving toward the runway. Weight called for gear down and Lajeunesse configured the G550 for landing.

At minimums Ron pressed the TOGA button on the thrust lever, the aircraft pitched up and the autothrottles set go-around power. Lajeunesse re-engaged LNAV mode and the aircraft joined the missed approach course. We set a course to arrive west of the PSP VOR so we could turn and intercept the inbound leg for the RNAV RNP (Y) Rwy 31L procedure at the VOR. Lajeunesse configured the FMS for the approach and it appeared in the MFDs—VSD on the left side, approach plate on the right. We joined the procedure at HIXOV. This procedure includes a radius-to-fix (RF) turn all the way around to TIVUC, where we would intercept the computed glideslope.

Weight again configured N933H for 155 kts as we passed the PSP VOR. The turn through the RF portion was a constant, small bank angle as smooth as the previous approach. As we descended on the computed glideslope, about halfway between JISOP and the runway threshold, we passed near a small hill off our left side. Ron disengaged the autopilot and positioned the G550 off to left of course to demonstrate an off-course warning. In RNP operations, a full dot course deflection is 0.3 nm—roughly 1600 ft—a deflection that would trigger the warning.

Apparently we didn't quite reach that deviation as we didn't get a warning. Weight re-engaged the autopilot and the airplane smoothly recaptured the inbound course. At the call for minimums, Weight selected TOGA and the airplane flew the missed approach course. As we headed toward the TRM VOR, Lajeunesse secured our clearance back to PHX and 40 minutes later we were back at the Honeywell facility.



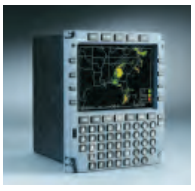
RNP SAAAR approach to Rwy 13R at PSP through mountainous terrain, arriving at the runway threshold with an MDA of 277 ft. Minimum flightpath ground/obstacle clearance is 1465 ft in between HOPU and YOCUL intersections. Minimums are 300 ft and 1 mile.

A technology asset

FAA continues its struggle with NextGen. But the airlines—and an increasing number of corporate and charter operators—recognize the benefits of RNP SAAAR and are implementing RNP operations and pushing the development of specialized arrival and departure procedures and approaches. Air - space users themselves are no longer waiting for the air traffic infrastructure to fully evolve, having witnessed a decades-long process with less-than-forecast progress. Now, for a finite investment in equipment and operational upgrades, operators can reap immediate benefits from RNP SAAAR operations. Hard benefits from technology are historically infrequent, but RNP SAAAR is one of them and it's here to stay.

Woody McClendon flies jets and helicopters and has contributed to Professional Pilot *for many years.*

eco-situational awareness



Precision Guidance with Go Direct Services

Unlock your aircraft's capabilities with Required Navigation Performance (RNP). Honeywell's Go Direct Services helps you through the process of obtaining RNP approval as well as improve your operations for approaches and departures at terrain-challenged or congested airports. With authorization, your aircraft will be flying more direct routes and reducing fuel consumption. For operators, the bottom line is safety and better fuel efficiency. And the high ground in environmental responsibility. ***Engage Safety.***

Honeywell

For more information, please go to **www.honeywell.com/godirectservices**