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Conclusion of a series focusing on the development and safety benefits of precision-like approaches, a project of the FSF International Advisory Committee.

BY DAVID CARBAUGH

Good for Business

Beyond their safety benefits, precision-like constant descent angle approaches are good for an airline's bottom line. One of the key items in any business case is protection from disaster — insurance to allow the organization's survival. As safety specialists often point out, "If you think safety is expensive, then you should see the cost of an accident." History shows that a controlled flight into terrain (CFIT) accident or an approach-and-landing accident can be devastating to an airline. There have been cases in which such accidents initiated a downward spiral in business and passenger confidence that eventually resulted in the demise of the airlines.

Airline CEOs often point out that safety is their highest priority, and rightly so. They worry about profits and safety, and understand that the absence of the latter could destroy the former. An accident or serious incident imposes many direct costs, and studies have shown that the indirect, or "hidden," costs are generally four times higher and not covered by insurance. Hidden costs accumulate from rescheduling, leasing, lost revenue, investigation and auditing, among many other factors. Another significant hidden cost results from the loss of confidence among potential passengers and investors.

When deciding what to do, CEOs understand what *The Economist* magazine has stated: "An airline's reputation for safety has an economic value." Because the accident rate during nonprecision approaches is four to eight times higher than during precision approaches, it makes business sense — as well as safety sense — for an airline to incorporate precision-like constant descent angle approaches in its standard operating procedures.

Shades of Green

Beyond eliminating or reducing the safety risks of nonprecision approaches, other benefits can be realized from conducting constant descent angle approaches. One is contributing to the protection of the environment. There is tremendous pressure on airlines today to operate "green." Although the overall production of emissions by air carrier aircraft is relatively low, airlines need to be able to show improvement in this area. Regulators and activists are demanding action.

While newer airplanes, new-technology engines, etc., provide obvious levels of improvement, constant descent angle approaches are among new operational strategies that can show very dramatic progress. An example is the implementation by airlines of more efficient required navigation performance (RNP) arrival routes at several airports in Australia. A recent report by Airservices Australia said that the RNP routes substantially reduced emissions of carbon dioxide, a "greenhouse gas." There are other examples of reduced emissions resulting from more efficient arrival routes established by airlines in Canada, the United States and elsewhere. "Greener" operations can be accomplished with the airplanes that airlines operate today by a dedicated transition from traditional approaches to more efficient approaches.

Directly related to emissions improvement is the reduction of fuel consumed during more efficient operations. Most approaches today, even precision approaches, have level segments either during the final approach or associated with the maneuvering required to reach a level segment just prior to the final approach fix. These level segments require relatively higher power settings, especially when operating at slower speeds with the flaps, slats and landing gear extended. Multiple step-down altitudes often are associated with arrival procedures, vectoring by air traffic control (ATC) and with the final approach procedure.

Airlines, manufacturers, regulators, ATC authorities and approach designers should find ways to enable flight crews to conduct descents with power set at idle or near idle to capture a constant descent angle final approach path. With the advent of modern navigation capability, mainly RNP-based, ever-increasing numbers of airlines are finding success and benefits in conducting these approaches routinely. With fuel accounting for one-third of many carriers' expenses, the benefit of saving fuel is obvious. The RNP arrival routes implemented at the Australian airports also have resulted in an average savings of 450 lb (204 kg) of fuel per approach, according to the Airservices Australia report. One airline estimated that this equals the total profit per flight that it previously had achieved. The cumulative effect of such fuel savings over a large fleet is astonishing.

Another direct environmental effect of conducting precision-like constant descent angle approaches is reduced noise levels. For many years, airlines have struggled to be good neighbors to the communities near their airports by implementing noise-reduction procedures such as steeper-than-normal arrivals and reduced-flap approaches, especially for night arrivals at "noise-sensitive" airports. Unfortunately, these attempts have not always resulted in success, and safety risks have to be considered before implementing these procedures. Further improvements can be made with the consistent use of constant descent angle arrivals and approaches. Idle or near-idle descents greatly reduce engine noise. By eliminating level segments, the overall descent gradient of an arrival and approach can be steeper. The overall result is that the crew can fly a long, stabilized, visual-like approach in instrument meteorological conditions; the steeper approach can be flown with idle or near-idle power, delayed flap and gear extension, and power increased only when the airplane is about 2 nm (4 km) from the runway. This is a welcome improvement for those who live under a formerly level segment of an approach to a busy airport.

Focused Training

The business case for training is certainly a powerful one. Today, the airlines must ensure that their flight crews are trained and maintain proficiency in many types of instrument approaches. This is a daunting challenge for many airlines. The costs of implementing and maintaining procedures, publications and training syllabuses, and conducting proficiency checks are substantial. However, many of these traditional instrument approaches can be conducted with a well-planned constant descent angle final approach segment, a common procedure that crews can be trained to conduct.

Using the most modern methods for RNP-based arrivals and descents can greatly reduce training requirements. Essentially, in today's environment, all approach training should focus on instrument landing system (ILS) or RNP-based constant descent angle approaches. The vertical guidance enables crews to conduct consistent and reliable approaches. Reducing the types of approaches that crews are required to conduct also results in briefer and easier transition training to new aircraft types. Figure 1 shows expected progress in reducing approach training requirements.

Another benefit that can be gained is lower approach minimums. For airlines with modern, RNP-based equipment, the consistency of constant descent angle final approaches results in greater obstacle clearance than the traditional "dive-and-drive" nonprecision approaches.

Expected Reduction of Approach Training Requirements

TODAY		→	→	FUTURE
ILS	NDB-DME			
VOR	VOR-ARC			
NDB	NDB-NDB			
LOC	RNAV 2-D			
VOR-DME	RNAV-3-D	ILS/GLS (xLS) RNAV (RNP) Specials		Category III RNAV (RNP)
LOC-DME	GPS			
BCRS	PAR			
SDF	ASR			
LDA	Specials			

ILS = instrument landing system; VOR = VHF omnidirectional radio; NDB = nondirectional beacon; LOC = localizer; DME = distance measuring equipment; BCRS = back course; SDF = simplified directional facility; LDA = localizer-type directional aid; RNAV = area navigation; 2-D = two dimensional; 3-D = three dimensional; GPS = global positioning system; PAR = precision approach radar; ASR = airport surveillance radar; GLS = global navigation satellite system–based landing system; xLS = ILS or GLS; RNP = required navigation performance

Source: The Boeing Co.

Figure 1

Regulators acknowledge this safety improvement based on their long experience with ILS approaches. With RNP values set, trained, equipped and flown low enough, the results can be outstanding. Operators currently are flying RNP-based constant descent angle area navigation (RNAV) approaches to decision altitudes as low as 250 ft. In many locations, newly implemented RNP approaches have minimums that are lower than those for the pre-existing instrument approaches — in some cases, lower than an ILS approach. Airlines that have been using these procedures have reported numerous diversion "saves," in which the availability of RNP-based constant descent angle approaches has allowed flights to continue in situations that previously would have required expensive diversions. Of course, satisfied customers were on those flights also.

Fans and Ropes

The precise horizontal and vertical navigation that allows flight crews to consistently fly RNP-based constant descent angle approaches also provides airlines the further benefit of increased payload and/or range. With older nonprecision approach methods, the lack of accuracy requires conservative methods of conducting missed approaches. At some airports with large areas of protected airspace for the missed approach procedures, payloads have to be reduced to meet the required climb gradients.

Protected airspace can be visualized as a hand-held fan versus a rope: Because the protected airspace for the older nonprecision approaches depends on the relatively lower accuracy of the navigation aid, its angularity generally increases with distance, like a fan. However, with RNP, the protected airspace is like a rope of consistent width. The rope can be turned and twisted to achieve the optimum path for an arrival, approach or missed approach — for example, the RNAV (RNP) approach to Queenstown, New Zealand (Figure 2). The path can begin or end 50 ft above the runway threshold. This allows for high navigational accuracy during approaches and missed approaches, and allows tailoring of the approaches to optimize the trajectory. As a result, airlines can increase their maximum landing weights at these airports, typically by 5,000 to 13,000 lb (2,268 to 5,897 kg). That can be converted into extra payload, range and revenue.

The business case for RNP-based constant descent angle approaches does not apply only to the airlines. Regulators, airports and ATC achieve benefits also. For regulators, the maintenance and inspection of the many types of navigation aids and approach procedures are quite cumbersome, time-consuming and expensive. Implementation of approach procedures at new airports requires much attention to the development of the regulatory infrastructure. Reducing the types of approaches and navigation aids, and implementing tightly controlled arrival paths provide the potential of reducing the complexity and costs of the airspace system and infrastructure.

Most airports today have multiple navigation aids with high installation and maintenance costs. RNP-based constant descent angle approaches reduce the requirement for such expensive equipage and maintenance. At some airports, terrain — and, at times, weather conditions — preclude implementation of traditional approach procedures to certain runways. This problem can be solved by the use of RNP approaches. New travel destinations can be developed without the need for ground-based navigation aids.

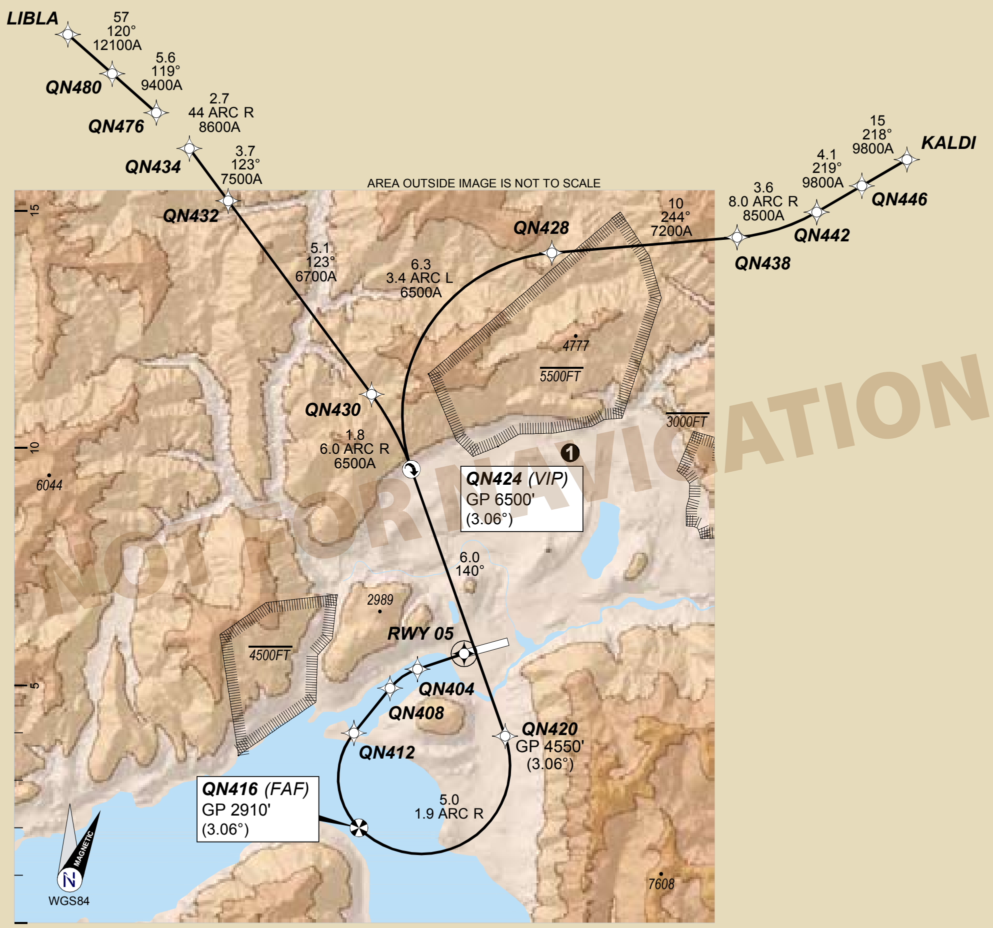
ATC benefits from the predictability of approach paths come rain or shine. Arrivals can be tailored to meet noise, terrain and timing needs, thus reducing direct intervention by controllers. With predictable arrivals and descents, the controller's primary job of maintaining separation becomes easier to manage.

Looking Ahead

Cleaner, quieter, more efficient operation is a worthy goal. Of greater importance, however, is the challenge of further reducing the accident rate despite the projected increase in air traffic. With the advent of the global shortage of qualified pilots, training already has become a burden for airlines and regulators. Cost control is here to stay, and the economics of the airline business will continue to be a challenge

This is the fourth and final article in a series discussing the development and benefits of precision-like constant descent angle approaches. The articles are the products of the Precision-Like Approach Project, launched by the Flight Safety Foundation International Advisory Committee (IAC) three years ago. The first article, by Capt. Tom Imrich, reviews the history of all-weather approach operations, from road maps, pilotage and dead reckoning to RNP and satellite-based approaches (*ASW*, 9/07, p. 22). In the second article, Capt. Etienne Tarnowski describes the recommended methods and operational procedures for conducting traditional nonprecision approaches and constant descent angle approaches (*ASW*, 10/07, p. 12; an enhanced version of the article is available on the FSF Web site, <flightsafety.org>). The third article, by Don Bateman and Capt. Dick McKinney, takes a closer look at the many hazards of nonprecision approaches and provides strategies to reduce the risks (*ASW*, 11/07, p. 13).

RNP-Tailored RNAV Approach



RNP = required navigation performance RNAV = area navigation

Source: Etienne Tarnowski

Figure 2

approaches, training will be simplified and airplanes will be designed and operated in a simplified manner. Imagine just pushing the "APPROACH" button, watching the course deviation pointers and flying a curved Category III type approach to a runway that previously could not be served by an instrument approach. Idle descents and specific arrival paths will greatly reduce the emissions, noise and fuel penalties we suffer from today. ATC will be able to "modify the rope" and tailor the RNP arrival paths to avoid weather, terrain and other inhibiting factors while maintaining optimum idle-power descents and timing of aircraft arrivals to maximize airport operations.

for many operators. Constant descent angle approaches will help to ensure a bright future.

Some day, we likely will see all approaches conducted as uninterrupted idle or near-idle descents from cruise altitude to short final. The capability exists today to conduct RNP-augmented approaches with consistent precision and on a constant descent angle down to Category III operating minimums. These approach procedures can be implemented at nearly every airport runway end worldwide without the massive investment in infrastructure and navigation aids that is necessary for traditional approaches. Because there will be only one way to fly these

For many airlines and pilots, the future is now. They are making the changes and investments needed to conduct constant descent angle approaches. They are enjoying the benefits in the many areas we have discussed. And, they are doing it safely, using proven methods and modern tools. We should join them.●

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