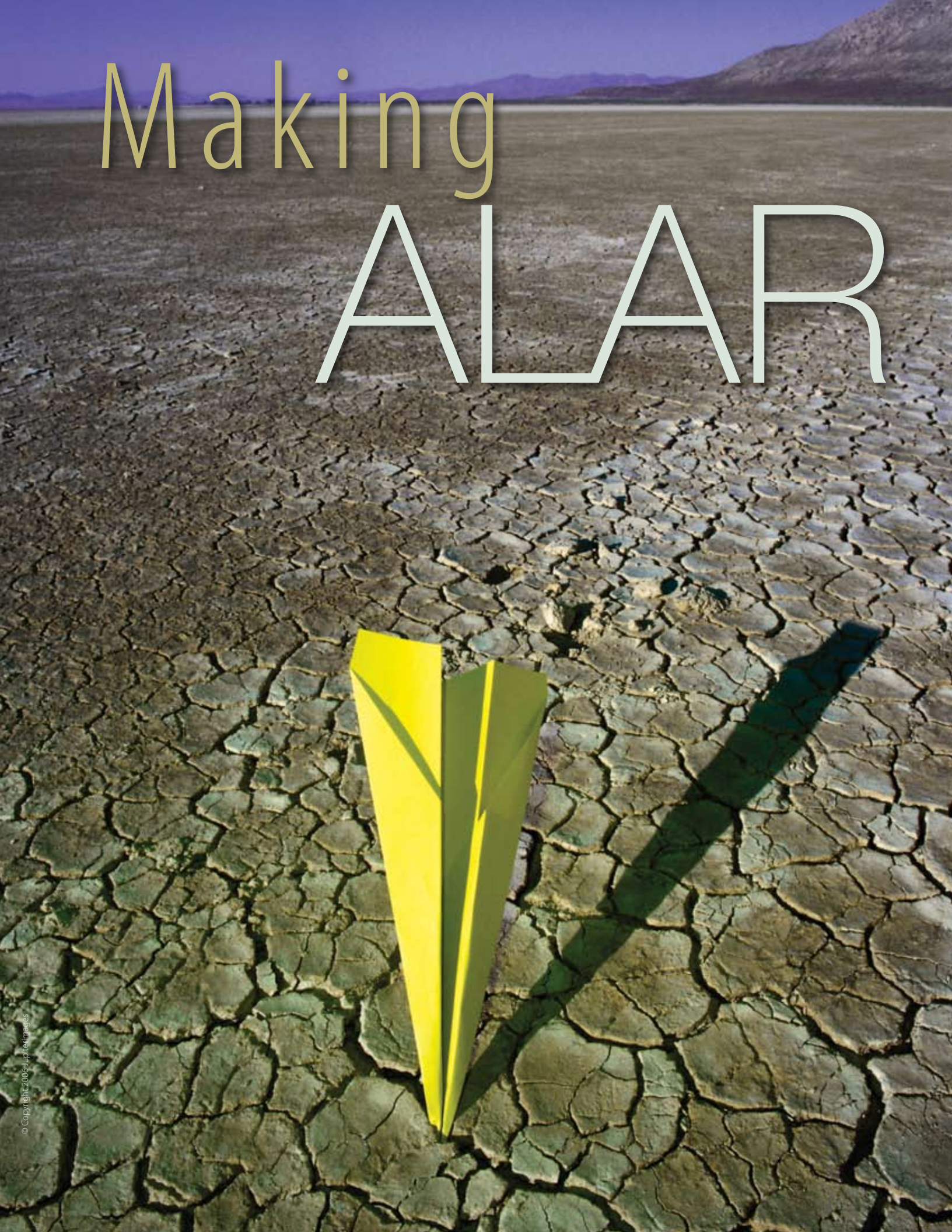
Making ALAR



pervasive

Five years of workshops have propelled the FSF *Approach and Landing Accident Reduction Tool Kit* into many corners of the world. That's not enough.

BY WAYNE ROSENKRANS

As the projection screen darkened and chandeliers illuminated a hotel conference room in New Delhi, a workshop attendee expressed concern about the up-and-down history of certain types of accidents since the Flight Safety Foundation (FSF) *ALAR Tool Kit* was released in early 2001.[1] "[Can] we really say that the approach and landing accident reduction [ALAR] program has really worked in the reduction of the CFIT?" he asked presenters at the ALAR workshop.[2,3]

"We don't say it's really worked," replied Jim Burin, FSF director of technical programs. "That's why we're still doing workshops. So we in no way claim victory or say that we have done our job … we've reduced the controlled flight into terrain rate by 30 percent but it's not zero. We think that we have helped reduce the risk of approach and landing accidents but we sure haven't eliminated them."

Even though India has recorded six years of accident-free airline operations, the Foundation was invited to present a workshop updated for airlines that did not exist when Indian specialists conducted their first national ALAR seminar in 2002. This 22nd workshop marked the sixth year of the FSF global ALAR outreach through regional team leaders (see "Regional Team Leader Updates," page 37).

Worldwide from 2001–2005, 47 approach and landing accidents (ALAs) involving hull loss occurred among large commercial jets — those heavier than 60,000 lb/27,000 kg maximum takeoff weight. A total of 870 deaths occurred in 19 of these accidents. During the period, controlled flight into terrain (CFIT) accidents claimed 17 of these aircraft; 889 deaths occurred in 14 of these accidents. This persistence of ALAs remains a critical issue in aviation safety, Burin said.[4]

No final report of an ALA investigation in this period identified a causal factor that made the FSF CFIT/ALAR Action Group say, "We missed that one." "Yet, 13 of 19 hull-loss accidents during 2005 were ALAs, including five CFIT accidents in commercial jets and 12 in commercial turboprops," he said. "This contrasts sharply with 2004 when — for the first time in many years — there were no CFIT accidents among large commercial jets and fewer than 50 percent of the hull-loss accidents in these aircraft were ALAs." (See "Foundation Refines ALAR Strategies," page 29.)

Recent CFIT accidents have occurred exclusively among the 8 percent of the world's airline fleet that still operates without any ground-proximity warning technology. Terrain awareness and warning system (TAWS) equipment has reduced this risk for most airline operations, and helped to achieve the decline in the rate of CFIT accidents, said FSF President and CEO Stuart Matthews.

"The Foundation's position is that as one element of CFIT-prevention measures, no airline currently should be operating without TAWS," Matthews said. "To date, no large commercial jets equipped with TAWS have been involved in a CFIT accident."

India's ALAR Leadership

After the New Delhi workshop, several aviation safety professionals on the front lines of ALAR efforts in India told *Aviation Safety World* that they are applying current knowledge while actively seeking the latest safety analyses available from competitors, civil aviation authorities and international organizations (see "Highlights of the ALAR Workshop," page 30).

P.K. Chattopadhyay, joint director general, Directorate General of Civil Aviation (DGCA) of India, said, "India's biggest aviation-safety challenge at the moment is the tremendous growth rate of aviation — 23 percent in 2004 and 2005. Yet, airline operations in this country have become much easier — we are progressing very fast in the use of modern air traffic control [ATC] equipment at almost every airport. Our ATC radar coverage currently is well done, and flights are now operating with reduced vertical separation minimums across India and some RNP 5 en route flight path navigation standards."[5]

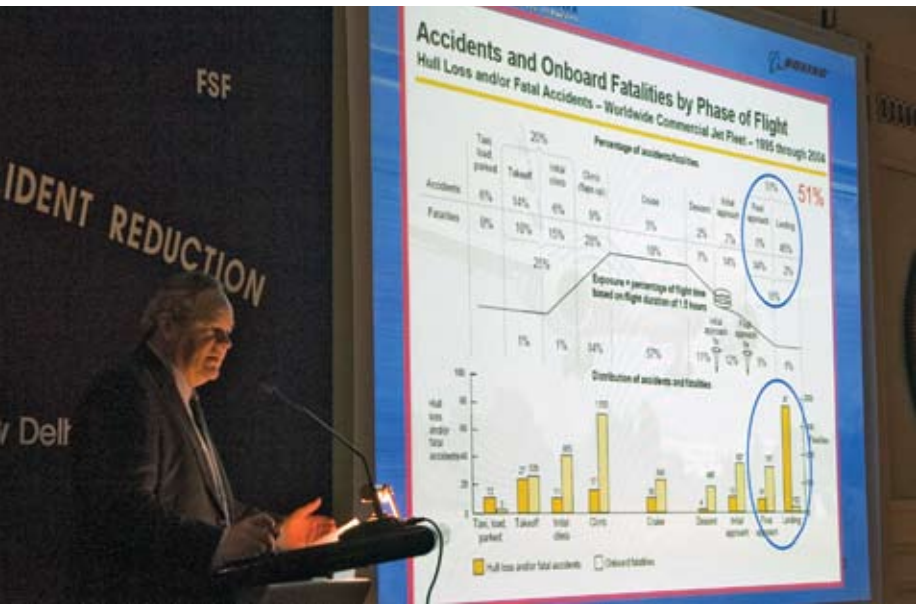
Achieving airline safety targets throughout South Asia requires selectively adopting key recommendations of the South Asian Regional Aviation Safety Team (SARAST), U.S. Commercial Aviation Safety Team (CAST) and ALAR task forces, he said. Elements of the FSF *ALAR Tool Kit,* for example, were adapted and supplemented by Indian specialists to produce DGCA's *ALAR India Tool Kit* in 2002.

"India has not had an airline accident [since July 2000]," Chattopadhyay said. "DGCA has been taking a very predominant and proactive role in providing the *ALAR India Tool Kit.* We also have accepted 10 CAST safety enhancements as recommended in the SARAST meetings."

Emerging technologies should accelerate development of a more cost-effective and ALAR-oriented civil aviation infrastructure. "We are thinking very widely about communications, navigation, surveillance [CNS] and air traffic management [ATM] in India, including future use of India's GPS-aided geo-augmented navigation [GAGAN] system, which includes a satellite that will provide proper coverage of the entire Indian sky when it is in position and certified [in 2010]," Chattopadhyay said. "DGCA already has approved GPS as primary navigation for oceanic routes. We also want to make GPS the primary navigation system for land areas, including GPS approaches, but we have not completed this work yet."[6]

Preparation for the transition includes revising aeronautical charts that did not comply with World Geodetic System 1984 (WGS-84), the standard used for GPS navigation and terrain/obstacle data, he said.

Among completed infrastructure improvements, the Airports Authority of India in December 2005 equipped Runway 28 at New



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Capt. Gary E. Hudson, senior safety pilot for The Boeing Co., addresses the New Delhi workshop.

Foundation Refines ALAR Strategies

The Flight Safety Foundation (FSF) Board of Governors sees value in further data analysis of approach and landing accidents (ALAs) to ensure the most effective use of the FSF *ALAR Tool Kit* and ALAR workshops, said FSF President and CEO Stuart Matthews. "We will update the *ALAR Tool Kit* at the appropriate time, but my prediction is that we will not find reasons to change its safety recommendations in the near future," Matthews said. "If we were to see a consistent trend of ALAs dropping to fewer than 50 percent of hull-loss accidents, however, we then could tackle some more compelling issue based on risk."

Meanwhile, the board of governors wants to place the knowledge already available into the hands of many more airline pilots, Matthews said.

"The Foundation's key research question for 2006 is 'Are our ALAR strategies still valid?' — so we formally will look back at the past six or seven years of safety data," said FSF Executive Vice President Robert Vandel. "Ideally, we would like to know if data support the hypothesis that there has been a measurable result, a high probability of cause-and-effect relationship between ALAR strategies and the accident rate. We are open to updating the *ALAR Tool Kit* based on whatever we learn. We also want to keep our commitment to the FSF ALAR Task Force to maintain the integrity and relevance of their work."

Nevertheless, within overarching recommended practices for preventing ALAs, some priorities might shift in a future version of the *ALAR Tool Kit,* said Jim Burin, FSF director of technical programs. "Detailed analysis of the most recent ALAs and other recent research might show that something unrecognized has been occurring, such as a higher risk of runway overruns," Burin said.

Having disseminated more than 33,000 copies of the *ALAR Tool Kit* CD and conducted 22 workshops does not ensure that everyone takes full advantage of the work afterward, however.

"Some aviation safety professionals have just begun to get their arms around the breadth of the *ALAR Tool Kit* content," Vandel said. "The message still is not out broadly enough — the ALAR outreach has not really covered the globe. It competes for resources from civil aviation authorities and airlines in every country."

Building an FSF ALAR strategy on the concept of regional team leaders was a sound beginning, Burin said. The most critical strategy refinement in 2006 must be to effectively target the individuals responsible for implementing operating rules and procedures known to prevent ALAs, he added.

Wayne Rosenkrans (FSF)

Burin

Working with the International Air Transport Association and the Industry Safety Strategy Group, the Foundation recently helped to ensure that ALAR was factored into the Global Aviation Safety Roadmap, the government-industry strategy led by the International Civil Aviation Organization to raise airline operations worldwide to a common high level of safety, Burin said.

The Foundation's ALAR work has been supported generously by the aviation community, and before the end of 2006, the Foundation plans to organize a third workshop in the United States and a second workshop in Europe, Vandel said.

— WR

Delhi's Indira Gandhi International Airport with ILS Category IIIb capability.[7]

"New Delhi is where we get the maximum amount of fog, and that is where we have the most morning arrivals, including international flights," Chattopadhyay said. "We have ensured that our national airlines — Air India and Indian Airlines — have a large number of pilots trained for CAT IIIb."

Some private airlines accept delays at New Delhi when very low visibility occurs rather than incur the added expense of meeting stiffer training requirements. Pilots must have CAT IIIa qualification for a minimum of one year before seeking CAT IIIb qualification, he said.

"DGCA prefers that all operators — at least all those operating to New Delhi — train their pilots for CAT IIIb qualification and equip their aircraft accordingly," Chattopadhyay said.

In requiring Indian airlines to maintain flight operational quality assurance (FOQA)

Highlights of the FSF ALAR Workshop

Among take-away messages from Flight Safety Foundation's approach and landing accident reduction (ALAR) workshop in New Delhi were updates on ALAR-related safety enhancements in the United States developed by the Commercial Aviation Safety Team (CAST), said Kyle Olsen, acting manager of the Aircraft Certification Service, Transport Aircraft Directorate, U.S. Federal Aviation Administration. "In November 2005, 47 of 84 safety enhancements with a cost of about US$1 billion were on the prioritized list to be implemented," Olsen said. "The selected enhancements provide … a 73 percent overall projected risk reduction by 2007, and a slightly higher risk reduction by 2020. As of January 2006, 31 had been completed."

The seven states of the International Civil Aviation Organization (ICAO) Cooperative Development of Operational Safety and Continuing Airworthiness Program (COSCAP)–South Asia have agreed to implement 27 CAST safety enhancements. "CAST projects a 60 percent risk reduction after their 27 safety enhancements are implemented," he said.

Many actions taken by ICAO have positively influenced or soon will influence ALAR efforts, said Jim Burin, FSF director of technical programs. For example, TAWS is required after Jan. 1, 2007, for all aircraft with maximum certificated takeoff weight greater than 5,700 kg/12,500 lb or carrying nine or more passengers, although this requirement currently applies only to turbine-engine airplanes for which the individual certificate of airworthiness was issued on or after Jan. 1, 2004.

During 2006 and 2007, ICAO's ALAR-related work includes introduction of GPS approach procedures with vertical guidance (APV) from satellite-based augmentation systems (SBAS); quality assurance for approach-procedure design; improved design criteria for circling approaches; new standards for electronic terrain and obstacle data; revised basic criteria for the global navigation satellite system; and development of additional required navigation performance (RNP) approach criteria.

Bernard Vignault, flight operations safety enhancement engineer, Flight Operations Support and Line Assistance, Airbus, said, "Aircraft manufacturers have included the elements of a stabilized approach from the FSF *ALAR Tool Kit* in their materials and expect operators to incorporate them into their documentation. For vertical situational awareness, aircraft manufacturers are working so that, in the future, most transport aircraft will be equipped with vertical displays … first to show the terrain, but also the minimum safety altitudes and even the weather."

The president of the Mexican air traffic controllers association since 2002 has conducted ALAR workshops for both pilots and air traffic controllers, said Capt. Carlos Limón, deputy president of the International Federation of Air Line Pilots' Associations. "In Mexico City, we have 900 daily approaches — 70 per hour during high-density hours," Limón said. "The only way to accommodate this rate and fully utilize both runways is with visual approaches. As of 2006, however, all Mexican air traffic controllers can be assumed to be familiar with cockpit workload and ALAR practices."

— WR

Wayne Rosenkrans (FSF)

Presenters Limón, Olsen and Capt. Fareed Ali Shah, ICAO COSCAP–South Asia, learn workshop details from P.K. Chattopadhyay, DGCA of India.

programs, DGCA works towards having flight data from every scheduled flight analyzed.

"DGCA-approved inspectors review FOQA exceedances, and a DGCA officer goes to the airline, checks that exceedances were identified in the preceding month and asks what the airline has done to follow up," Chattopadhyay said. "We only want to verify that airlines keep records of what refresher training has been done and how it has gone. DGCA does not use FOQA data for the purpose of punitive action, but we do identify the crew for the purpose of confidential counseling or refresher training."

DGCA also has worked to reduce the risk of helicopter ALAs. "[Indian operators] had been having very frequent helicopter accidents — 18 in the three years prior to March 31, 2005," Chattopadhyay said. "A number were ALAs, and some were CFIT accidents. Others involved wire strikes, striking part of an offshore helideck, heavy lifting, offshore operations or mountain operations. The biggest risks occurred during political campaigns before elections when helicopters are operated within confined areas to crowded helipads. From this date [through late January 2006], there were no helicopter accidents."

DGCA initiatives included face-to-face discussions with operators, letters specifying safety issues to address, guidance to achieve precision in writing operations manuals and procedures, a new discrete pilot-to-pilot communications frequency and improved ground security around helipads.

Monsoon ALAs

Operation in Indian monsoon[8] conditions requires additional pilot qualifications and equipment-operating standards. A DGCA advisory circular and annual updates reiterate the training requirements and specify that before takeoff, every transport aircraft crew must ensure that certain equipment is serviceable, such as TAWS, thrust reversers, wiper motors, antiskid braking system, weather radar, anti-icing and deicing. "We want to ensure that a pilot who is flying in weather — especially in the monsoon months — not be overtaxed," Chattopadhyay said.

The clear link between monsoonal heavy-rain conditions and ALAs in India drives many ALAR-related activities, several airline safety professionals said.

"The risk is primarily visibility-related but also involves engine performance, wet runways and slippery conditions — managing those factors during landing is critical," said Harpreet A. de Singh, deputy general manager, Training (Operations), Air India. "In the heaviest rain, pilots cannot see a thing even with wipers at full speed. All of the risk factors discussed in ALAR materials can be present. Highlights of monsoon training are repeated as part of the annual refresher to reinforce knowledge about severe conditions even for captains operating the same type aircraft. DGCA requires that in many other career situations — such as a new captain or a captain changing aircraft type — pilots also repeat monsoon training."

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De Singh teaches a refresher course in Mumbai to Air India instructors responsible for combined CRM, ALAR and security training.

SpiceJet uses FOQA data analysis to monitor the performance of crews and aircraft in monsoon conditions, said J.V. Naidu, the airline's manager of flight safety and security. Monsoon operations are expected to generate exceedances.

"Most of our exceedances involving high vertical acceleration occurred during the 2005

monsoon season," Naidu said. "They included high vertical accelerations during cruise and at touchdown, and prompted us to issue a safety circular, including analysis of an incident in which two passengers were injured. We usually don't select for review the type of airspeed exceedance in turbulence that occurs during monsoons, however."

In India during the monsoon, if airport visibility is decreasing, it probably will go to zero — but the pilot can expect zero visibility to last only for half an hour, Naidu said.

"For the ceiling to rise from ground level to 1,000 ft may take another 45 minutes, but the ceiling then will maintain that height," he said. "So, although we have had CAT IIIb capability at New Delhi, we hardly ever use it — maybe eight or nine times a year. Otherwise, low visibility may delay a flight for three hours. Maybe after three or four years of analyzing FOQA data, we will see the risks entirely differently, however."

ALAR India Origins

When DGCA and Indian airlines received a prerelease version of the FSF *ALAR Tool Kit* in September 2000, safety professionals nationwide were asked to critically review the contents, said de Singh.

Capt. Dilip Kharkar, chief flight operations inspector for DGCA (now retired), set up the ALAR Task Force–India and chaired a project involving all the major airlines of India at the time. A core team of coordinators for the task force comprised Capt. A. Ranganathan of Air Sahara (currently with Spicejet), V.K. Ginotra of Alliance Air and de Singh.[9]

DGCA found that about 60 percent of accidents in Indian civil aviation in 1986–1998 were ALAs; 50 percent of the ALAs were CFIT accidents, accounting for about 80 percent of fatalities; 60 percent of the ALAs were caused by flight crew errors; 90 percent of ALAs and CFIT accidents occurred in adverse weather

Extensive photography and video recordings, directed by Capt. A. Ranganathan of SpiceJet, show monsoon conditions in India's *Adverse Weather Operations Training Kit.*

D. Satyajit

conditions; and 60 percent occurred in hilly terrain. Most ALAs were caused by noncompliance with standard operating procedures and adverse weather conditions. The ALAR Task Force–India also scored Indian airline ALA causal factors as aircraft, 11 percent; maintenance, 8 percent; weather, 7 percent; ATC/airport, 9 percent; and flight crew, 62 percent.

Members of ALAR Task Force–India in April 2002 compared their experience with findings and recommendations of the FSF ALAR Task Force. With support from the Aeronautical Society of India, de Singh conducted the train-the-trainer ALAR seminar in New Delhi for all Indian airlines.

Some Indian instructors experienced difficulty, however, when they initially tried to cover the Foundation's entire CD in classes and materials, according to Ranganathan. Several pilots of international airlines also found the large amount of text a barrier to self-study, he said.

"Instructors soon focused on using the 'ALAR Briefing Notes' element, and I decided to illustrate key points as much as possible with photos and videos to improve understanding," Ranganathan said.

The 34 documents in the briefing notes are based on the conclusions of the FSF ALAR Task Force, data from CAST and the European Joint Aviation Authorities Safety Strategy Initiative. Each briefing note includes statistical data related to the topic, recommended standard operating procedures, discussion of factors that contribute to excessive deviations and suggested accident-prevention strategies.

"Before the 'ALAR Briefing Notes,' pilot communication about this subject was more like a grapevine, with individuals relying on their own conclusions," de Singh said. "Official recognition of the safety issues and FSF recommendations have been very important for pilots."

While the ALAR Task Force–India produced the *ALAR India Tool Kit,* Ranganathan was assigned by DGCA to produce a companion product called *Adverse Weather Operations Training Kit.* "Our task force found that more than 45 percent of all aviation accidents in India took place in the monsoon seasons, so I agreed to pass on my experiences of flying in the monsoons since 1973," Ranganathan said. "*Adverse Weather* uses a lot of material from the 'ALAR Briefing Notes.' I also use several videos [of operations in India] to highlight landing errors and especially to get across to young pilots the importance of ALAR."

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With these products in hand, some former task force members currently work at the interpersonal level to disseminate ALAR information more widely in India, de Singh said.

A related task is to obtain updated Indian accident data and incident data from DGCA to analyze variations in causal factors or emerging ALA trends in India, de Singh said.

"We can begin a new analysis as soon as we receive the DGCA reports," de Singh said. "Especially given our air transport expansion plans, India could be a case study of threat-and-risk management required during rapid growth."

ALAR Influences

Methods used to implement ALAR tactics in operations at Air India, SpiceJet and Jet Airways varied. "At Air India, ALAR training is coupled with crew resource management [CRM] training and security training," de Singh said. "We have produced video recordings of Air India simulator scenarios based on feedback and examples from some of the captains in our CRM class. The scenarios were not India-specific but had happened within Air India."

Safety professionals have to be especially vigilant about possible negative trends coming from

"Before the 'ALAR Briefing Notes,' pilot communication about this subject was more like a grapevine, with individuals relying on their own conclusions."

the pace of airline expansion. "Our ALAR emphasis of recent years has been absolutely essential in staying on the right track during this rapid growth, for example," de Singh said. "Out of concern about pilots' adequate integration of procedures and familiarization, we have not been in a rush. We are in a phase where we must watch airline developments with a lot of caution for the next three or four years. The new airlines and legacy airlines alike have to train their crews so deeply that they can respond instinctively to any situation."

Some Indian specialists expect the infrastructure issue of replacing nonprecision approaches to be resolved in the broader context of worldwide transition to CNS ATM, including GPS approaches and required navigation performance area navigation (RNP RNAV) approaches, according to de Singh.

"Some Indian nonprecision approaches could be supplemented by ILS installations in the future," she said. "A more modern infrastructure for instrument approaches throughout India definitely would enhance safety. With airline routes expanding very fast, we are now flying from airports like Amritsar and many airports close to New Delhi — all of them affected by fog."

Air India also has been developing proprietary constant-angle nonprecision approaches — also known as constant-descent final approach for nonprecision approaches — as an intermediate risk-reduction step. "Our proposed approach charts — with all the distance-to-height ratios and the visual descent points marked — are ready," de Singh said.

Despite all they have accomplished, de Singh and Ranganathan said that they have observed many opportunities to improve ALAR efforts in India. From de Singh's perspective, ALAR outreach has yet to engage enough of the mid-level airline professionals and government officials. Moreover, Indian airlines' lack of a recognized forum for discussing ALAR seems to constrain information exchange, several specialists agreed.

ALAR-related FOQA data analysis within Air India has prompted reconsideration of requirements for downwind landings, said Capt. M.B. Morris, joint general manager, Air Safety; Arvind D. Waghmare, deputy chief engineer, Air Safety; and S.N. Gupta, general manager, Air Safety (Engineering).

"At specific airports during certain times of the year, our pilots land with a tail wind component of less than 10 kts," Morris said. "But a runway-overrun incident at Mumbai involving one of our aircraft during the 2005 monsoon season prompted us to ask 'How does this practice affect the approach and landing phase?' There can be a tendency to land deep — beyond the touchdown zone — and to float longer, so we made a software modification to report an exceedance if the pilot flares and floats for more than 11 seconds, because this means wasting a lot of available runway. Since mid-2005, we have analyzed the approach segment below 1,000 ft and the landing of every flight to see if there was a strong tail wind component or floating for more than 11 seconds. This is the type of targeted ALAR tactic we can use in addition to complying with the minimum DGCA requirements. Because our pilots land at such a variety of airfields — many of very limited length — a

Waghmare watches Capt. Y.C. Mathur, a consultant, analyze FOQA data at Air India's Air Safety Department in Mumbai.

Wayne Rosenkrans (FSF)

Iqbal K. Mohammed

float of more than 11 seconds could mean either they will experience blown tires while trying to stop the aircraft or have a runway overrun. We pass these exceedances to Training for whatever action they see fit."

Comparison of FOQA data to ATC instructions also has identified issues that affect ALAR, especially with increasing airspace congestion.

"We know that Indian ATC has had to increase the arrival rates and departure rates within norms that DGCA has laid down, but when controllers instruct a flight crew to descend below 10,000 ft with no speed restriction, what [is the flight crew] to understand?" Morris said. "Can the aircraft safely operate in the terminal area at 300 kts or 320 kts? We addressed this by training pilots to reduce speed — even when ATC says no speed restriction below 10,000 ft — to 250 kts before entering the terminal area, to 230 kts within 20 nm, 210 kts within 15 nm, 180 kts to intercept the final approach course, then 160 kts down to the four-mile final. Otherwise, crews would be in congested airspace with a much greater turning radius. They gradually reduce speed by this procedure, consistent with being absolutely stabilized at 1,000 ft, one of the elements of the stabilized approach. All FOQA data should show this pattern of speed control."

Air India's FOQA program is nonpunitive, and safety specialists currently are evaluating software to enhance pilot counseling with exceedance visualization, Waghmare said.

"Knowing the cultures and background of our crews, we also would be able to replay a serious incident in CRM courses and to refine CRM concepts — all with the crew de-identified," Waghmare said.

SpiceJet, which began domestic service in May 2005 using a low-fare business model, applies ALAR principles in computer-based instruction; classes taught by the vice president of operations, chief pilot and general manager of training; and seminars and examinations for route familiarization and adverse-weather operations.

The company exceeds DGCA minimum requirements in capturing up to 1,400 flight parameters and generating tabular and graphical printouts, said Anirudh Choudhary, safety assurance analyst for SpiceJet.

"We monitor all parameters but currently give more emphasis to exceedances that involve factors that could lead to an incident or accident if not controlled," Choudhary said. "For example, an airspeed exceeding a structural-limit speed such as maximum operating velocity or maximum operating Mach, or exceeding a flap/slat extension speed or a late extension of landing flaps — those are given more importance. We also keep a record of all TAWS warnings."

Managers of the FOQA program must take into account the current traffic environment in congested Indian airspace. "Normally, a crew will not exceed 250 kts below 10,000 ft," Choudhary said. "But at New Delhi, where the aircraft may be number 17 in the landing sequence, the ATC instruction may be, 'Either you hold or you exceed 250.' If data show that the pilot exceeded 300 kts, that is a problem. But 270 or 280 kts in this situation is OK."

"A float of more than 11 seconds could mean either they will experience blown tires while trying to stop the aircraft or have a runway overrun."

"We developed our own analysis of potential causes for ALAs and exceedances … [and] developed a seven-page ALAR guideline document."

The most common exceedance was high taxi speed; these exceedances decreased month by month after pilot counseling and awareness programs were conducted. Exceedances typically are not intentional, Naidu said. In addition to complying with DGCA requirements for its FOQA program, the airline conducts performance monitoring using operational data from the airframe and engines. "Centralized reports cover any exceedance selected to be reported to Engineering and Operations — such as a flap-extension speed exceeded by 10 kts or more," Naidu said.

Other ALAR-related FOQA data showed short flares — three seconds or less. Standard operating procedures specify that the flare should be held longer than four seconds. "In one short-flare exceedance, the aircraft dropped 30 ft in three seconds," Naidu said. "FOQA data also showed a few long flares — under DGCA criteria, floating more than 10 seconds — in which the crew used excessive length of the runway."

SpiceJet had 28 captains by January 2006, most of them arriving at SpiceJet during the previous three months, said Capt. R.P. Barnwal, manager of safety assurance for the airline.

"We developed our own analysis of potential causes for ALAs and exceedances," Barnwal said. "We also developed a seven-page ALAR guideline document. Except for FOQA, captains would not know about many of these issues."

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In detecting late flap extension for landing, for example, the company's exceedance limit is that the airplane should be fully configured for landing at 600 ft, Choudhary said. "For trend-monitoring purposes, we have kept that limit at 1,000 ft," he said.

During the approach phase, the analysts use the following for exceedance levels:

- Below 500 ft, approach speed greater than V_{REF} plus 25 kts;
- At 200 ft, airspeed greater than V_{REF} plus 20 kts;
- At touchdown, airspeed greater than V_{REF} plus 15 kts;
- During any segment of the approach and landing, airspeed less than V_{REF}.

Data monitoring focuses on maximum rate of descent during approach; average percent engine rpm during approach; maximum localizer deviation; and maximum glideslope deviation; pitch attitude during the last 1,000 ft and at touchdown; acceleration, rate of descent and airspeed at touchdown; and maximum pitch and roll at touchdown.

"Without software tools, analysts could not detect approach speed high or low in the data," Naidu said. "In all approach-airspeed exceedances through January 2006, the issue was airspeed low — less than V_{REF}. Among all exceedances during approach, the most common issues were high vertical acceleration or approach speed low or, at the time of flap selection, the airspeed was high."

Capt. Ranbir Singh, general manager of FOQA for Jet Airways, said that the main source of ALAR-related training enhancements within the airline has been pilot input and information and recommendations from accident and incident investigations.

"The best examples might be our stress on adherence to SOPs, which are reviewed periodically, and emphasizing the use of automation for the approach," Singh said.

FOQA analysis with voluntary pilot reports, line operations safety audits and similar tools

Regional Team Leader Updates

Previous Flight Safety Foundation (FSF) articles and news releases highlighted the work of CFIT/ALAR Action Group regional team leaders in 2001–2003. Regional team leaders periodically provide updates.

At the New Delhi ALAR workshop, Capt. Fareed Ali Shah, regional flight operations expert and program coordinator for the International Civil Aviation Organization (ICAO) Cooperative Development of Operational Safety and Continuing Airworthiness (COSCAP)–South Asia, said, "Seven CFIT ALAs in 2004–2005 in this region continue to be a cause of concern." Based in Colombo, Sri Lanka, COSCAP–South Asia comprises Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. Since June 2002, their South Asian Regional Aviation Safety Team has promoted CFIT prevention and ALAR practices, including regulatory aspects. "CFIT/ALA issues have been discussed at the last couple of [team] meetings," Shah said. "In 2005, adoption of 10 U.S. Commercial Aviation Safety Team safety enhancements related to ALAR was discussed at length by the state directorates general of civil aviation."

The ALAR experience of airlines, regulators and air traffic service providers in Mexico, Central America, South America and Caribbean countries makes a useful case study for any regional team, said Capt. Carlos Limón, deputy president of the International Federation of Air Line Pilots' Associations. "Crews are the last resort against ALAs," Limón said. As of 2006, Pan American Aviation Safety Team (PAAST) members had briefed about 13,000 pilots from 35 airlines — about 76 percent of pilots in Mexico, Central America, South America and the Caribbean; facilitated ALAR training of instructor pilots; and briefed air traffic controllers. Most of the region's major airlines have incorporated ALAR into the initial and recurrent training of pilots.

"Our Mexican success showed that these kinds of safety initiatives can be implemented nationally with a relatively low cost when all the sectors of the industry coordinate work with a single goal," he said. "Many Mexican air force pilots and air traffic controllers voluntarily attended ALAR seminars, and some then became volunteer ALAR instructors. Our success among Mexican commercial airlines has been measurable as a reduction in national rates of ALAs, and since ALAR implementation began in 2001, Mexico has not experienced a CFIT accident in an airline jet."

PAAST members met in March 2006 to discuss methods of continuing ALAR initiatives in addition to their work on runway incursions, according to Raymond Ybarra, ICAO regional director in Lima, Peru. Members also are pursuing low-cost options for producing FSF *ALAR Tool Kit* CDs for ongoing efforts.

As of early 2006, more than 700 *ALAR Tool Kit* CDs had been distributed during workshops and missions to states in ICAO's North American, Central American and Caribbean Region (NACC), and upon request by regional flight schools and other aviation organizations, said Capt. Jan Jurek, NACC's Mexico City-based regional officer–operations. The fifth ALAR/CFIT workshop presented by PAAST was held in May 2006 in Curacao, Netherlands Antilles, where a team of regional presenters was augmented by specialists from Airbus, Boeing and FAA. Jurek said that the region's CFIT/ALAR efforts struggle with an insufficient supply of CDs and FSF *CFIT Checklists* to meet demand, difficulty

Wayne Rosenkrans (FSF)

Demuren

recruiting presenters for workshops in remote locations, and problems coordinating ICAO specialists.

FSF–West Africa helped to obtain a Nigerian regulation requiring completion of an ALAR course as a condition for initial issuance and renewal of a pilot license, according to Dr. Harold O. Demuren, the organization's president and director general–CEO of civil aviation of the Nigerian Civil Aviation Authority. Computer systems for training and record keeping were being implemented by the agency in early 2006 to support this requirement, and the change was being coordinated with airline training departments, he said. FSF–West Africa recently has worked with ICAO's COSCAP–Banjul Accord Group (English-speaking West African nations), based in Abuja, on regional safety-oversight efforts compatible with ALAR recommendations.

Since FSF–Iceland and the Foundation conducted a 2002 ALAR workshop, awareness of stabilized-approach criteria has improved within

Icelandair, according to Oddgeir Arnarson, the airline's safety officer. "In May 2004, ALAR material was prepared and released as an FSF–Iceland venture," Arnarson said. "The following autumn, Icelandair used this material for its flight crews during ground school recurrent training." The material includes a Microsoft PowerPoint presentation that contains, among other elements, nonprecision approach charts for Icelandic airports that demonstrate the complexity of step-down operations vs. constant-angle descents, plus methods of conducting stabilized approaches with adequate anticipation of a go-around on every approach.

South African Airways continues to apply *ALAR Tool Kit* elements introduced when it hosted a 2001 ALAR workshop, according to Capt. Cobus Toerian, flight safety specialist for the airline. Elements were incorporated into all fleet operations training, safety presentations for new pilots, simulator sessions, conversion courses and command courses.

"We still use the *CFIT Checklist* whenever we audit/review Africa and Indian Ocean destinations, and it has been a nice tool both for standardization and to show airfield authorities how the *ALAR Tool Kit* identifies what is deficient — that deficiencies are not our opinion alone — and they listen," Toerian said. "A 'go-around culture' has been well manifested, and crews even are reporting the various events for statistical benefit. All fleet safety pilots, fleet captains and CRM facilitators have the *ALAR Tool Kit,* and we use the data to brush up and refresh these pilots wherever and whenever we can."

During 2004, COSCAP–North Asia conducted ALAR seminars in North Korea and Mongolia and issued an advisory bulletin on CFIT/ALAR crew training to assist states developing legislation, regulations and/or standards, said Capt. Len Cormier, ICAO's chief technical advisor for COSCAP–North Asia. The program also arranged the 2005 FSF ALAR workshop in South Korea.

As of 2006, the program's North Asian Regional Aviation Safety Team focused on adopting ALAR-related CAST safety enhancements, including regulations and training for the terrain awareness and warning system, standard operating procedures, precision-like approach implementation, flight operational quality assurance and voluntary reporting programs, crew resource management, ALAR and CFIT-prevention training, safety culture, safety management systems, minimum safe altitude warnings, and ATC CFIT prevention-training.

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contribute to ALAR efforts, he added. "FOQA program staff manage voluntary reports from pilots," Singh said. "We receive a good amount of information from pilots calling on mobile phones from the cockpit when the aircraft is on the ground — often immediately after a near incident or an actual incident. Air Safety and FOQA staff analyze trends with the help of 100 percent monitoring of digital flight data recorders and random monitoring of cockpit voice recorders, with an assurance to pilots that the purpose is only to monitor trends and not for punitive action. Greater cooperation is needed among airlines in India, to share each other's experiences and learn from each other's mistakes. A semiannual meeting for this purpose would help. Jet Airways pilots and air traffic controllers also meet periodically for lunch or dinner and have free and frank discussions for better understanding of each other's problems."

Practices absorbed into Jet Airways' safety culture have included effectively using TAWS, educating pilots on CFIT and reducing the number of approaches with a high rate of descent, Singh said.

Relatively new airlines have the opportunity to incorporate ALAR knowledge from day one and often have ALAR-related advantages inherent in their equipment. But they cannot afford to be complacent, Singh said.

"Jet Airways, for example, has the latest equipment compared with the older airlines, and that is a great ALAR-related advantage," Singh said. "The disadvantage is that some pilots do not expect failures. When they do have failures or malfunctions, their reactions are slower or they overreact. Some pilots react only to failures and do not bother to monitor for any degradation in the systems. Older Indian airline pilots always expect some system failures, so they continuously monitor any trend or degradation in the systems."

Comprehensive, well-executed ALAR projects have been crafted by aviation safety professionals worldwide, Matthews said. By careful design, the Foundation has functioned only as a

facilitator and catalyst, sharing consensus-based, data-driven solutions that others can adopt using their local expertise. ●

Notes

1. The Flight Safety Foundation (FSF) *ALAR Tool Kit* provides on compact disc (CD) a unique set of pilot briefing notes, videos, presentations, risk-awareness checklists and other tools designed to help prevent approach and landing accidents (ALAs) and controlled flight into terrain (CFIT). The tool kit is the culmination of the nine-year Foundation-led efforts of more than 300 safety specialists worldwide to identify the causes of ALAs and CFIT, and to develop practical recommendations for the prevention of these accidents.

2. The FSF approach and landing accident reduction (ALAR) workshop in New Delhi on Jan. 27, 2006, was attended by 111 aviation safety professionals from 11 airlines, five government and military agencies, two helicopter operators and three other organizations. The workshop was hosted by the Directorate General of Civil Aviation of India and the International Civil Aviation Organization (ICAO) Cooperative Development of Operational Safety and Continuing Airworthiness Program (COSCAP)–South Asia. Meeting facilities were sponsored by Air Sahara and Kingfisher Airlines. Volunteer presenters at New Delhi were Jim Burin, FSF director of technical programs; Capt. Gary E. Hudson, senior safety pilot, commercial airplanes, The Boeing Co.; Capt. Carlos Limón, deputy president of the International Federation of Air Line Pilots' Associations (IFALPA); Capt. John Long (retired), air safety representative for the Air Line Pilots Association, International; Kyle Olsen, acting manager of the Aircraft Certification Service, Transport Aircraft Directorate, U.S. Federal Aviation Administration; and Bernard Vignault, flight operations safety enhancement engineer, Flight Operations Support and Line Assistance, Airbus.

3. In 2003–2005, the following presenters also helped the FSF CFIT/ALAR Action Group to conduct ALAR workshops: Michel Béland, technical officer, Operations/Airworthiness Section, ICAO; Capt. David C. Carbaugh, chief pilot, Flight Operations Safety, Boeing Commercial Airplanes; Jim Daily; Capt. Andrés Fabre, director of flight operations, MasAir; Capt. Al Garin, Airbus A330 captain for US Airways; Capt. Angel Goñi, a representative of Aviation Pilots Union Association (ASPA) of Mexico and IFALPA; Dick McKinney, a captain retired from American Airlines; Capt. Tom Phillips of ALPA; and Michel Trémaud, senior director of customer services and head of safety management, Airbus.

4. Data for 2001 and 2002 included only Western-built large commercial jets; data for 2003–2005 included Western-built and Eastern-built large commercial jets.

5. Required navigation performance (RNP) in which a certified aircraft is capable of tracking within 5.0 nm (9.3 km) either side of the flight-path centerline.

6. The GPS-aided geo-augmented navigation (GAGAN) system will provide augmented information to aircraft flying within Indian flight information regions, according to India's March 2006 presentation to an ICAO advisory group. Space-based augmentation of GPS signals — using an Indian geostationary satellite, ground reference stations, uplink stations and a mission control center — initially will make GPS-based Category I precision approaches (decision height 200 ft and runway visual range limitation of 2,400 ft/800 m or 1,800 ft/550 m with touchdown zone and centerline lighting) widely available to Indian airports without requiring separate ILS ground infrastructure and systems. The Indian Space Research Organization's GSAT-4 satellite is scheduled to be launched in December 2006.

7. Decision height 100 ft above ground level and runway visual range limitation of 1,200 ft (350 m).

8. Directorate General of Civil Aviation, India. *Adverse Weather Operations Training Kit.* October 2002. The kit said that the Indian monsoon season basically involves a periodic reversal of winds generated by complex thermal conditions and land-sea interaction in the presence of mountain systems. Typical wind circulation causes extreme amounts of rain. Significant aviation hazards during monsoon months, but not limited to these months, include deteriorating surface visibility due to heavy showers, low cloud ceilings and strong surface winds over peninsular India. The Indian monsoon conditions typically occur over Kerala in the first week of June each year and within a few weeks dominate the Indian subcontinent until the end of September.

9. Other task force members in 2001–2002 included Capt. R.J. Darukhanawala of DGCA; Capt. Russi D. Bunsha and Capt. Mark Morris of Air India; Capt. V.K. Verma and Capt. Ashok Raj of Indian Airlines; Capt. S.S. Virk, Capt. N.S. Sra and Capt. S. Tomar of Jet Airways; Capt. F. Chhoi of Air Sahara; Capt. Javed Ahmad of Alliance Air; and Capt. J.P. Singh of Blue Dart Air. Capt. Len J. Cormier of COSCAP–South Asia was a facilitator of ALAR implementation.