sharing arrangement with American will provide much benefit for the Canadian carrier. He noted that Air Canada is being much more aggressive on the cross-border market using its own aircraft. Air Canada is adding two Airbus A319s, two A340s, 12 Canadair Regional Jets and three Boeing 767-300s this year, giving it plenty of capacity for expanded cross-border service. In addition, Air Canada could code-share with its partner, Continental Airlines.

JENKINS SAID CAI'S point of sale marketing in Canada should help American fill its code-sharing flights. American also holds a 25% equity stake in CAI and has a long-term service support contract with the Calgary-based carrier. Jenkins said the code-sharing pact would be a separate agreement, keeping CAI's relationship with American "compartmentalized." U.S. government approval is needed before code sharing can begin with American.

Both Air Canada and CAI are interested in starting an hourly shuttle service between Toronto and LaGuardia. Air Canada had eight round trips between Toronto and LaGuardia before adding the four new slots. The airline is expected to buy more slots to increase the number of daily round trips above 10. Jenkins said CAI flights combined with code-sharing on American flights should give the airline service about once an hour, 12 times a day. The service will not be marketed as a shuttle initially.

AN AIR CANADA OFFICIAL also said the airline is working on establishing service between Washington and Ottawa, Montreal and Toronto and hopes to be able to obtain slots at Washington National Airport. Service would start with Canadair Regional Jets on these routes and then shift to DC-9s or A320s if demand warrants it.

CAI is exercising caution on the new cross-border market. "I think we are going to be quite careful about which routes we get involved with," Jenkins said. The carrier has no plans to offer service on routes being targeted by low-cost U.S. carriers. The routes it is adding to O'Hare and LaGuardia are designed to meet the needs of business travelers. Additional service to Vancouver will feed into CAI's key service to Asia. Jenkins noted the airline has nonstop service to Beijing and plans to add flights to Vietnam, Malaysia and the Philippines. ■

SCOTT BEUERLEIN PHOTO

Advanced maneuvers training gives pilots the skills necessary to safely recover from pitch-ups, uncommanded rolls, full stalls and engine failures shortly after takeoff.

UNITED PILOTS PRACTICE ADVANCED MANEUVERS

WILLIAM B. SCOTT/DENVER

United Airlines is training its pilots to recognize and recover from unusual aircraft attitudes that could cause loss of control in rare but dangerous "once-in-a-career" situations.

United's Advanced Maneuvers Package (AMP) is being integrated into standard transition and recurrent simulator training curriculums for each aircraft type the airline flies. About 400 pilots have been taught AMP techniques since they were introduced at United's Denver training center last summer. Other airlines' pilots, Air Transportation Assn. and manufacturer representatives, and National Transportation Safety Board and FAA officials also have flown the maneuvers in United simulators.

Both type-specific and generic, the training teaches pilots to deal with situations falling outside their aircraft's normal flight envelope. These can include:

- *Upsets that result in extreme* bank or pitch attitudes. These might be caused by flying into a large-aircraft's wake vortex, a rotor downwind of a mountain range, severe turbulence or mechanical failure.
- Inadvertent entry into a full aerodynamic stall. Airline training typically only exposes pilots to stall warnings—such as stick-shaker activation or light airframe buffet—leaving crews unaware of how the aircraft might behave if fully stalled.
- Engine failure immediately after takeoff or during a missed approach, when the aircraft is in a low-energy state and still close to the ground. Although engine-out training is an integral part of airline curriculums, most focus on "V_1 cuts" at on-runway *rotation speed. A more demanding* situation exists immediately after takeoff, when the aircraft is in a nose-high attitude *and climbing at slow speed.* Pilots rarely see this in training, but the chances of it happening during actual line flying are probably higher than an on-runway failure after V_1, according to United officials.

THE COMBINATION OF several loss-of-control accidents in the industry over the past few years prompted United to consider adding unusual attitude training to existing programs. These—plus the challenges associated with nose-high-attitude emergencies during a noise-abatement takeoff—led United to introduce AMP techniques into Boeing 757/767 training last summer. Roll and pitch upset elements also are being taught in United's Boeing 737 Continuing Qualification Program. Recurrent training curriculums for other types soon will include portions of AMP.

United appears to be taking the lead in formally introducing a broad set of advanced maneuvers into its training programs. Military flight training and some civil programs typically include unusual attitude elements, but there is little consistency. FlightSafety International recently added upset modules to its business jet training, and the U.S. Coast Guard's Aviation Training Center incorporated a similar segment to its Dassault HU-25 training programs (AW&ST Feb. 13, p. 57).

United has adopted the approach that, even if pilots received unusual attitude training early in their career, it either was long ago or was cursory and not standardized. AMP assumes minimal pilot experience with unusual attitudes.

"Our pilots love this training. They're hungry for it," L.S. Walters said. A standards captain for United's *757/767* fleet, Walters had a key role in developing and incorporating advanced maneuvers training into the airline's standard curriculums.

Because AMP is an added expense, it is noteworthy that the airline adopted the training voluntarily in today's highly competitive environment. Its primary objective is to ensure pilots have the knowledge, skills and situational awareness necessary to respond correctly in the first 5 sec. of an upset or rare emergency. Pilots then "retain the opportunity to recover. We want to make sure they don't spoil that opportunity," Walters said.

The relative simplicity and effectiveness of United's advanced maneuvers were evident when this *AVIATION WEEK & SPACE TECHNOLOGY* editor and two other journalist/pilots flew them in a 757 simulator here. Although our pilot experience and flight proficiency varied widely, all of us adapted well enough to save the aircraft. Walters emphasized that the maneuvers focus on attitude flying only.

"WE KEEP IT SIMPLE—get the attitude corrected," Walters said. "If that's all [a pilot] remembers two years from now when he gets into a situation, that's fine. You can optimize conditions with power and drag, but the change is very minor compared to getting the nose back to where it has to be."

We flew several AMP maneuvers, such as:

■ Full stalls. Considerable aft-stick pressure was required to get the aircraft into heavy buffet, but full power would not fly us out of the stall. Recovery required pushing forward, controlling pitch-up tendencies as speed increased and power was added, and avoiding a secondary stall. Target recovery attitude was 15 deg. nose-up, as displayed on the attitude indicator.

■ Rolls and returns. Walters introduced a sharp roll-off typically caused by a strong wake vortex, then directed us to counter with full aileron and top rudder—what he called "step and roll" toward the attitude indicator's "sky pointer." With an indicated 90-135-deg. bank angle and staring at the ground, it was easy to see how a pilot would have an almost irresistible urge to pull on the yoke, not hold full aileron and top rudder. However, trying to pull under in a split-S is virtually an impossible recovery maneuver in a large transport. The 757 finally responded and rolled smartly back to wings-level, enabling a 2-2.5-g. pullout to minimize altitude loss.

Walters said getting airline pilots to use full-throw control inputs was difficult. "Their whole career has [emphasized] not spilling drinks in the back. They're not used to putting it all in, so we have to get them beyond that."

■ Uncommanded pitch-up to a nose-high attitude, possibly caused by trim runaway or atmospheric phenomena. A pilot's tendency is to keep pushing to get the nose down. United teaches that, before the attitude reaches 40 deg., the pilot should roll to at least 60 deg. but less than 90 deg. of bank, wait until the nose falls to the artificial horizon, then roll back to wings level. The roll off prevents speed loss that could trigger a stall and subsequent departure from controlled flight.

■ Engine failure shortly after takeoff. We simulated the uncomfortable, 20-deg. nose-high condition of a 757 noise-abatement takeoff from John Wayne Airport in Orange County, Calif. Within seconds of reaching this attitude, Walters failed an engine, speed dropped and a yaw developed immediately. United teaches pilots to first push the nose over to the 12.5-deg.-up mark on the attitude indicator, which preserves airspeed, and to stay off the rudders. The pitch attitude "isn't perfect, but it's in the ballpark," Walters said. "If you go for a rudder, and it's the wrong one, you've just used up your opportunity."

WINGS WERE LEVELED with aileron before rudder was fed in slowly to bang the yoke back to horizontal. Vertical speed was reduced to zero, enabling airspeed recovery with no additional altitude loss as the original heading was restored. Rudder was then trimmed to compensate for asymmetric thrust and the resulting yaw.

Simulation of these and other advanced maneuvers has its limitations, but the training value is substantial. Even a sophisticated, full-motion-base, CAE-built 757 simulator could not produce sustained g-loads or reproduce the disorientation and chaos of being upside-down.

The airline industry as a whole appears to be on the verge of giving pilots better tools to deal with unusual situations that could have disastrous consequences. ■

AMR CONSULTANTS SEE GROWTH MARKET IN ASIA

HONG KONG

Asia's numerous airport development projects and expanding airlines are turning to consultants to advise them on managing their growth, according to a U.S. consultancy that expects the region to provide a major share of its international business.

AMR Training and Consulting Group, a subsidiary of American Airlines' parent company, has signed 10 airline and airport clients since opening its Asia/Pacific office here 18 months ago, Vice President David P. Chambers said.

The latest is the Orient Airlines Assn., the 15-member trade group that represents most of the region's leading carriers. Chambers will lead an airline audit seminar for the OAA in its home city of Manila Apr. 18-21. The seminar will focus on risks and audit functions that are unique to airlines and standardization of audit procedures and controls.

OVERSEAS TRAINING projects include English language courses for 1,000 Turkish Airline employees, but not all the clients come with an aviation background, nor does AMR want them to.

"We are teaching English to petroleum refinery engineers in Rayong, Thailand," Chambers said.

But its core business draws on American Airlines' traditional areas of expertise: maintenance and engineering, aircraft sales and leasing, flight operations, financial, market and sales planning, and cabin crew training.

Projects have included a feasibility study for the Phase 2 expansion of Macau's new airport to develop a maintenance, training and cargo distribution center under a contract headed by Ralph M. Parsons. In Kuala Lumpur, AMR is an advisor to the Bovis-McClier-WTW Consultants consortium that is building a maintenance engineering hangar and the city's new airport at Sepang.

IT OPENED A BEIJING office in January and is helping an unnamed Chinese carrier with strategic planning. AMR is expanding into India and has entered negotiations with an unnamed carrier there to provide financial review services.

AMR's international business focuses on areas that are frequently unaccustomed to using consultants, but which may be having trouble managing their growth. Such conditions make them fertile ground for AMR, in contrast to better-developed markets like Europe, where the company faces stiff competition from local firms.

The fact that American Airlines is not a major presence in Asia is an advantage for the AMR Training & Consulting Group because it eliminates potential conflicts of interest, Chambers said. Internationally, AMR's biggest airline competition comes from Speedwing, British Airways' consultancy, he said. ■