

# THINKING OUTSIDE THE (BLACK) BOX

Industry specialists are examining alternatives to the traditional method of delivering data that crash investigators need.

BY LINDA WERFELMAN

The fruitless search for the flight recorders from the Air France Airbus A330 that crashed into the Atlantic Ocean on June 1 has stirred new interest in the development of alternate methods of delivering vital black box data to accident investigators.<sup>1</sup>

One alternative — the deployable flight incident recorder — has been in use for decades on military aircraft; the future of a second alternative — transmission of flight data to a ground station — is intertwined with technological advances that are improving computer data transmission between air and ground.

“Both ideas have advantages and disadvantages that must be carefully evaluated,” said Sandy Angers, a spokeswoman for Boeing Commercial Airplanes.

In almost all crashes, the flight data recorder (FDR) and cockpit voice recorder (CVR) are recovered without much difficulty. But on some occasions, as in the case of the Air France

A330 and a Yemenia Airways A310 that crashed in the Indian Ocean on June 30, 2009,<sup>2</sup> the search has gone on for weeks or months — continuing even after the end of the 30-day period in which underwater locator beacons, or “pingers,” transmit signals to alert searchers to the location of the boxes.

Historically, most accidents in which flight recorders have been pronounced “not recoverable” have not been in water but rather in “unusually inhospitable terrain, such as mountains,” Angers said.

Years ago, recorders sometimes were so badly damaged by post-impact fire or by water that some of their information was irretrievable. In recent years, however, as solid-state digital media have replaced tapes, this has happened less frequently, said James Cash, the U.S. National Transportation Safety Board’s (NTSB’s) chief technical adviser for recorders.

“If anything, it’s fire that did the recorders in,” Cash said. “We’ve never lost one because of impact damage, but ... older, tape-based units were more easily damaged by fire.”

## Closer Look

Current standards call for large commercial airplanes to be equipped with an FDR and a CVR installed separately — not in a single combined unit.

In the aftermath of the Air France crash, however, some in the industry pressed for a closer look at other methods of collecting flight data and of recovering the information in the event of a crash.

The deployable flight recorder (Figure 1, p. 26) was developed in response to a suggestion made in the 1960s by the National Research Council of Canada, which expressed concerns about locating aircraft that crashed in remote areas and proposed “some form of detachable and automatically



A deployable flight recorder — which incorporates a flight data recorder, cockpit voice recorder and emergency locator transmitter — is automatically ejected when sensors detect that the aircraft is crashing.

activated ELT [emergency locator transmitter] system.”<sup>3</sup>

Deployable recorders were developed and have evolved into combined FDR/CVR units that incorporate an ELT. Such units have been installed for 25 years in military aircraft and in helicopters used in North Sea energy exploration. In that time, about 110 military aircraft equipped with deployable recorders have crashed, and all 110 recorders have been recovered for use by accident investigators, said Peter Connolly, vice president and general manager of DRS Technologies, which manufactures the devices.

The recorders are housed in an airfoil unit that is automatically ejected when on-board sensors determine that the aircraft is crashing.

“That’s the smart part — it goes away from the crash,” Connolly said.

The deployable recorder’s ELT immediately transmits the aircraft

identification number and its longitude and latitude to the Cospas-Sarsat Programme, the international network that coordinates the detection of distress signals. If the aircraft crashes in water, the airfoil unit floats.

Connolly noted that the concept of installing deployable flight recorders in commercial aircraft had been the subject of considerable discussion after the July 16, 1996, crash of a Trans World Airlines 747 into the Atlantic Ocean minutes after takeoff from Kennedy International Airport in New York.<sup>4</sup>

Three years later, P. Robert Austin, a DRS senior systems engineer, told an international transportation recorder symposium that proposals to modify flight recorder standards by requiring the installation of dual combined recorder systems in commercial transport aircraft should include a provision that one of the systems be a deployable FDR/CVR recorder.<sup>5</sup>

“The standards for the fixed and deployable components of the system should be compatible to optimize the probability of recovery of recorder information from one of the two systems under any conceivable crash scenario,” Austin said.

Boeing’s experience with deployable flight recorders on military 707s identified several issues requiring further consideration, Angers said, such as how to prevent a recorder from being ejected into the ground if the airplane is in a vertical attitude, how to avoid injuring anyone on the ground when a recorder deploys and how to avoid accidental deployment.

Even if deployable recorders are installed in an aircraft, Boeing’s position is that the aircraft also must be equipped with standard, fixed recorders.

Michael Poole, chairman of the International Society of Air Safety

Investigators (ISASI) working group on flight recorders, agreed.

Poole, a former member of the Transportation Safety Board of Canada, said that he would encourage the use of deployable recorders — but only if the deployable unit was installed in an airplane that also was equipped with a traditional fixed recorder.

Poole noted the higher cost of installation and maintenance of deployable recorders, in comparison with standard, fixed recorders, and said he could foresee events — such as some types of runway overrun accidents — in which deployable recorders might fail to deploy away from the crash scene.

**Manufacturer Initiatives**

Both Airbus and Boeing have been examining the use not only of deployable recorders but also of other alternative technologies for collecting flight data.

Soon after the Air France crash, Airbus said it had begun a study to “reinforce flight data recovery capability,” including an examination of the feasibility of extended data transmission.<sup>6</sup>

“Various technical means for reinforcing flight data recovery and data transmission to ground centers are principally available,” said Airbus President and CEO Tom Enders. “We will now study different options for viable commercial solutions, including those where our experience with real-time data transmission from our own test aircraft could support the further development of such solutions.”

Airbus said that retrieving flight recorder data after an accident is a challenge for the aviation industry, in part because the air-to-ground data links used by aircraft communications addressing and reporting systems (ACARS) to transmit maintenance data “do not offer the bandwidth that would be needed for a fully real-time transmission of all the data stored in the [digital] FDR and CVR.”

Angers said that Boeing recognizes similar difficulties.

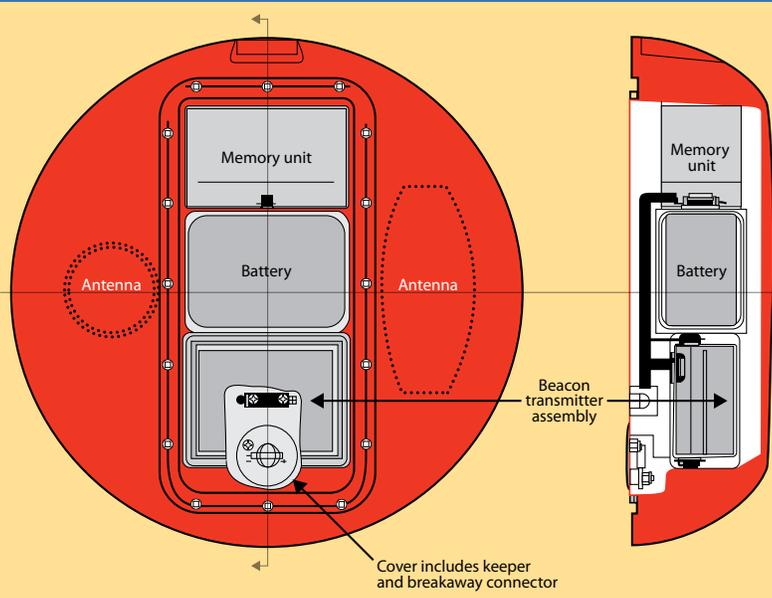
“Although real-time data streaming is possible, an enormous amount of data is collected by flight data recorders,” she said. “Current regulations require FDRs to record a minimum of 88 parameter groups. To meet this requirement, all current production airplanes record more than 1,000 individual parameters. Also, consider the fact that there are tens of thousands of commercial transport jets flying today. The current satellite system and ground architecture would be unable to support a large number of airplanes continuously streaming data.”

Poole added that if CVR data were transmitted along with FDR information, bandwidth requirements would be even greater.

In addition, in some situations, especially those involving aircraft in unusual attitudes, it could be difficult, if not impossible, to maintain a constant link between an aircraft and a satellite, he said. Satellite transmissions also are affected by bad weather, and if a satellite went out of service for any reason, data would be lost, he added.

Other issues include where data would be stored, who would have access to it, how it would be maintained and by whom, and how to protect the privacy of pilots whose communications would be included in data transmissions.

**Deployable Flight Recorder**



Source: DRS Technologies

**Figure 1**

“The concept sounds really elegant,” Poole said. “But there are a lot of impediments.”

Poole said that, although he does not believe the constant transmission of data from all large commercial airplanes can replace flight recorders, he would encourage the industry to implement a system that would allow satellite transmission of data from “an airplane in distress.” In these situations, data transmission might be triggered by a pilot’s “mayday” call, or by some on-board conditions that indicated the airplane was experiencing difficulty — as was the case for the Air France A330 through ACARS messages — or by some other action by the crew or air traffic control.

“You don’t need all that bandwidth being used up with constant data transmissions, but with any airplane in distress, it’s not a bad idea to send the data real-time going forward and transmit the recorded data back in time,” Poole said.

Nevertheless, the NTSB’s Cash said that the eventual alternative to the traditional black box most likely would involve some method of real-time data transmission, perhaps an event-triggered transmission of data to a ground station.

“Data link is going to get more attention,” Cash said, noting the technological developments in recent years that have provided passengers with Internet access. “Airplanes already are being equipped with the hardware.”

**Notes**

1. The second phase of the search for the A330’s flight recorders ended in late August. At press time, the French Bureau d’Enquêtes et d’Analyses (BEA) was considering organizing a third search phase. The airplane crashed during a flight from Rio de Janeiro,



© Associated Press

Brazil, to Paris. All 228 passengers and crew were killed. The investigation of the accident is continuing.

2. Aviation Safety Network. *Accident Description*. < <http://aviation-safety.net/database/record.php?id=20090630-0>>. The Yemenia Airways A310-300 crashed off the coast of the Comoros Islands during an approach to the Mitsamiouli airport after a flight from Yemen. All but one of the 153 people in the airplane were killed. The wreckage sank in waters up to 4,000 ft deep, and at press time, news reports said that the airplane’s flight recorders had been located but not recovered.
3. Austin, P. Robert. “The Use of Deployable Flight Recorders in Dual Combi Recorder Installations.” Presentation to the International Symposium on Transportation Recorders, Arlington, Virginia, U.S. May 3–5, 1999.
4. The NTSB said the probable cause of the accident was “an explosion of the center wing fuel tank resulting from ignition of the flammable fuel/air mixture in the tank.” The explosion probably was caused by a short circuit outside the tank that “allowed excessive voltage to enter it through electrical wiring associated with the fuel quantity indication system,” the report said. The FDR and CVR were recovered one week after the crash by U.S. Navy divers.
5. Austin.
6. Airbus. *Airbus Launches Initiative to Reinforce Flight Data Recovery Capability*. July 2, 2009.

Workers in Recife, Brazil, unload debris from an Air France A330 that crashed into the Atlantic Ocean during a flight from Rio de Janeiro to Paris on June 1. The airplane’s flight recorders have not been located.