

# THE IMPORTANCE OF SHARING SAFETY INFORMATION

**Michael R. Grüninger and Capt. Carl C. Norgren** examine the factors contributing to one of the world's worst aviation disasters and the deaths of all 228 onboard



**"**On June, 1, 2009, an Airbus A330-200 operated by Air France on a scheduled passenger flight from Rio de Janeiro to Paris CDG as AF447 exited controlled flight and crashed into the Atlantic Ocean with the loss of the aircraft and all 228 occupants. It was found that the loss of control followed an inappropriate response by the flight crew to a transient loss of airspeed indications in the cruise which resulted from the vulnerability of the pitot heads to ice crystal icing." This is a short summary of an interesting case at Skybrary.

Roger Rapoport and Shem Malmquist have authored a book where they discuss this accident and examine its wider implications for aviation safety. The book bears the title "Angle of Attack", focusing on one of the main aspects of this particular accident.

There is another aspect that is not mentioned in the book's title, but is important nevertheless. It is the functioning of a reporting and feedback system permitting airlines and the airline transport industry as a whole to prevent such accidents in the future.



## Precursors

In fact, the safety departments of Air France, Airbus and EASA knew of previous occurrences caused by malfunctions of the pitot probes installed on the Airbus 332.

The investigating authority Bureau d'Enquêtes et d'Analyses (BEA) indicates in its final report on AF447 that more than 16 occurrences with temporary speed indication anomalies had occurred prior to the AF447 flight. Four of these occurrences had happened within Air France itself, others with TAM, Qatar Airways, Northwest and Air Caraïbes Atlantique.

The BEA study of the occurrences found that they contained similarities on a number of significant points in terms of environment, the effect on

automated systems and flight path control.

Regarding the environment, these occurrences happened on flight levels between FL340 and FL390, in highly unstable convective air masses and a static air temperature of below minus 40 degrees Celsius. The static air temperatures were higher than ISA (Int. Std. Atmosphere) by 10 degrees Celsius or more. All occurrences happened in Instrument Meteorological Conditions and in turbulent conditions.

Related to the automated systems, in all cases the autopilot disconnected itself and flight information, the flight director in particular, disappeared. In twelve cases, the flight control law changed to alternate until the end of the flight. In one case, this transition was temporary.

Related to speed anomalies, intermittent drops or spikes in speed indication occurred. Alternatively, the speed indications dropped and remained at a lower value.

Related to flight path control by the crews and crew's reactions, the variations in altitude were contained within about one thousand feet. There were five cases of deliberate descent, including one of 3,500 feet. These descents followed a stall warning. Four crews did not identify the unreliable airspeed situation. In two cases, the crew concluded that there was an inconsistency between the angles of attack. In the two other cases, the crew considered that the speeds were erroneous rather than unreliable.

The fact is that Air France, Airbus and EASA had knowledge of the temporary speed indication anomalies caused by pitot tube icing. At regular Airworthiness Review Meetings between Airbus and EASA these cases were reviewed. And yet, EASA decided against issuing an Airworthiness Directive requiring

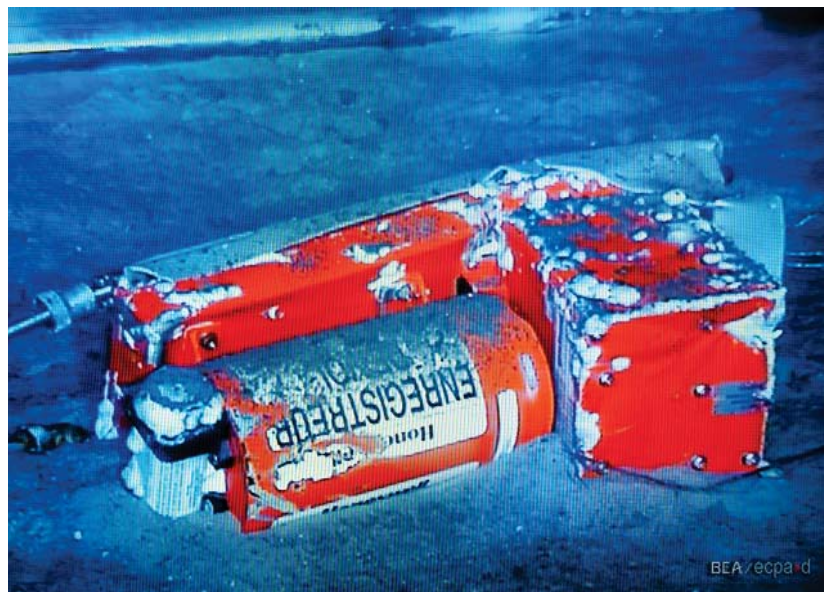
**FATAL**  
Marines recover debris from the missing Air France jet in the Atlantic (top). Ice crystals blocking the pitot probes (below).

operators to replace these pitot tubes. Airbus issued a Service Bulletin which left the decision of modification up to the operator.

### Decision Making in Management

That is where this Safety Sense kicks in.

The Pitot probes installed on AF447 met requirements that were stricter than the certification standards.



Analysis of the events related to the loss of airspeed indications had led Airbus to issue a Service Bulletin to replace C16195AA pitot probes by the C16195BA model. Air France had been modified the first aircraft on 30 May 2009.

EASA had analyzed Pitot probe icing events; it had confirmed the severity of the failure and had decided not to make the probe change mandatory.

Air France management decided to replace the pitot tubes over a certain period of time. The pitot tubes of the accident aircraft were scheduled to be replaced after landing in Paris at the end of the accident AF447 flight.

Airbus fly-by-wire protections are designed to prevent aircraft from stalling. The protections rely on the well-functioning of the sensors and the maturity of the programming. Management had decided not to brief the pilots on known anomalies of the automated flight control management system believing that the in-built stall protections would prevent any stall.

### In-service Feedback

BEA thus recommends: In-service feedback is an essential prerequisite in the process of improving flight safety. It is notable that the reports written by crews after events do not always reveal their severity or all of the elements of an operational appreciation. This makes the preservation of the indispensable elements needed for an investigation somewhat ran-

dom. Thus it is difficult for the operator, the manufacturer and the authorities to evaluate the associated risks and threats and to undertake an exhaustive analysis that makes it possible to take appropriate measures.

The French DGAC failed to produce and disseminate an operational directive or safety information in 2008, despite the OCV (Organisme du Contrôle en Vol, the in-flight inspection organization of the DGAC) having recommended it do so.

Air France's maintenance department, department of safety and department of quality failed to sufficiently evaluate the continuing airworthiness of the A330 in light of warnings and reports from Air Caraïbes.

### Acting on Safety Knowledge

Air France did not respond sufficiently to a prescient alert from its pilot union in 2002. The union had requested Air France training classify stall recovery as an emergency procedure that demanded pilots respond using memorized procedures instead of written checklists.

There was a lack of follow-up by DGAC on NTSB Recommendation A-96-56. This 1996 recommendation asked that aircraft manufacturers provide pilots with some means of determining when their aircraft might be operating in icing conditions that exceed the aircraft's certification limits.

The obstruction of the Pitot probes by ice crystals during cruise was a phenomenon that was known to the aviation industry at the time of the accident. In fact, nobody had briefed the pilots on the particular hazards of pitot tube icing at high altitudes. This failure of the corporate Safety Management System to recommend such a briefing and to perform appropriate training is one of the contributing factors to the AF447 accident.

### Prevention

Aircraft operators, aircraft manufacturers, the authorities and indeed all participants in the aviation industry need to take precursors seriously. Permanent monitoring of data and diligent analysis are required to identify and evaluate precursors correctly. This requires an interdisciplinary evaluation involving specialists from all relevant fields in order to evaluate risks correctly and to take preventive measures in a timely fashion.

Commentators on the AF447 accident argue that if Air France had provided its pilots with a briefing and training on the handling of obstructed pitot tubes, the outcome of the icing event might have been different.

Certainly, one key safety lesson to learn from the AF447 is that safety information must be shared with front line personnel.



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### RETRIEVAL

*The cockpit voice recorder was recovered from the sea floor nearly two years after the accident.*