1 - ALARMS

Toilet smoke
Tests confirmed that the alarm heard at 14 h 43 min 32.6 s was in fact a toilet smoke detection alarm. This alarm can be recorded by the CVR when the cockpit door is open.

Fire alarm
The bell heard three times after 14 h 43 min 22.8 s was identified as a fire alarm. This alarm, well known to aircrew, also includes a gong.

Gongs
14 h 43 min 23.5 s: this gong, which appears 0.7 s after the first ring of the bell, is part of the aural fire alarm.
14 h 43 min 28.2 s: this gong corresponds to the automatic switching of the electric pitch trim actuators.
14 h 43 min 37 s: this gong is probably related to the engine 2 alarm following the drop in oil pressure due to engine 2 shutdown. On the FDR the engine warning parameter appears again.
14 h 43 min 43 s: this gong, which appears 0.7 s after the first ring of the bell, is part of the aural fire alarm.
14 h 43 min 59.4 s: this gong, which appears 0.7 s after the first ring of the bell, is part of the aural fire alarm.
14 h 44 min 26.6 s: no explanation found.
14 h 44 min 27 s: no explanation found.

Note: two gongs generated by two different systems but separated by less than twenty milliseconds cannot be distinguished by spectral analysis.
2 - NOISES

- Noise at 14 h 42 min 30.4 s

This noise is identified as the “clicking” of the thrust levers. The normal procedure, during power up, is to advance the levers to their stop. This interpretation is consistent with the results from the FDR. The comparison of the time-frequency representations recorded on F-BTSC and of that recorded on F-BTSD are shown hereafter.

Noise on F-BTSC

Clicking of thrust levers during power up on F-BTSD

Change in background noise at 14 h 42 min 31.3 s

After the clicking of the thrust levers, there is an increase in the noise from the air conditioning, associated with the increase in engine noise. It is not possible to determine the rotation speed of the rotating parts of the engine.
- Noise of selector at 14 h 42 min 47.5 s

When passing through sixty knots. The "engine 4 take off N1 limiter" changes position automatically. Synchronisation with the FDR confirms this selector movement since the aircraft was passing through sixty knots when this noise was made.

- Noise at 14 h 42 min 55.1 s

The origin of this noise was not identified.

- Noise at 14 h 43 min 10.1 s

The origin of this noise was not identified. It is followed by a change in the background noise which couldn't be interpreted either.

- Noise at 14 h 43 min 16.1 s

The origin of this noise was not identified.

- Noise of selector at 14 h 43 min 21.3 s

The rate and auditory perception, as well as application of procedures, enabled this noise to be identified as being that of the movement of the TCU selector from "main" to "alternate". The time-frequency analyses of the noise on F-BTSC and on F-BTSD are shown hereafter.

![Noise of selector on F-BTSC (234 ms)](image)

Noise of selector on F-BTSC (234 ms)

![Noise of selector on F-BTSD (238 ms)](image)

Noise of selector on F-BTSD (238 ms)
Noise of selector at 14 h 43 min 26.2 s

On the FDR a decrease in engine speed is noted after this selector noise. There were four hypotheses to explain this decrease in speed. The first was independent of crew action in the cockpit, the three others were respectively an action on the thrust lever, a cut through movement of the HP fuel cock or a de-selection of auto-thrust. The spectral representation is very close to that of a thrust lever reduction or a HP fuel cock shutoff, though it is impossible to distinguish between them. The time-frequency analyses of the noise on F-BTSC and on F-BTSD are shown hereafter.
Noise of selector at 14 h 43 min 27.5 s

Several elements enabled identification of the electric pitch trim actuators: energy peaks at approximately frequencies, the duration of the signal and the time between the selector noise and the appearance of the gong 0.7 to 0.8 s later. The time-frequency analyses of the noise on F-BTSC and on F-BTSD are shown hereafter.

Distance between the selector noise and the appearance of the sound of the gong
Noise of selector at 14 h 43 min 29.3 s

The spectral representation closest to this noise corresponds to pulling the fire handle. The noise at 14 h 43 min 44.7 s confirms this action.

Noise at 14 h 43 min 37.3 s

The origin of this noise was not identified.

Noise at 14 h 43 min 38.4 s

The origin of this noise was not identified.

Noise of selector at 14 h 43 min 44.7 s

This noise is similar to activation of the “first shot” pushbutton which corresponds to the firing of the extinguishers in the engines. This action can only be taken if the fire handle has been pulled. The rate between the two energy peaks which make up this noise is characteristic of action on this button or, more exactly, of the destruction of the glass which covers this button. In the three time-frequency analyses that are shown hereafter, this time is between 0.35 and 0.4 s.

Noise on F-BTSC (408 ms)

First shot activated on F-BTSD with fire alarm (396 ms)
First shot activated on F-BTSD without fire alarm (338 ms)

- Noise at 14 h 43 min 53.0 s

  The origin of this noise was not identified.

- Noise at 14 h 44 min 10.5 s

  The origin of this noise was not identified.

- Noises of selectors between 14 h 44 min 24 s and 14 h 44 min 27.5 s

  Six selector movement noises are perceptible. None could be identified. However, two or three appear to be movements of engine thrust levers or HP fuel cock cut-offs.