Attachment 2 To Operations/Human Performance Group Factual Report

DCA11IA040

Flight Simulator Observation

Simulator Evaluations for United Airlines (UAL) A320 Flight 497 Incident Avionics Smoke Indication and Runway Excursion, New Orleans, Louisiana, April 4, 2011 (NTSB # DCA11IA040)

Device:	Airbus	A320 Full Motion simulator, UAL Training Center, Denver, Colorado
Participants:	NTSB	
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Date: May 19, 2011

A. Objectives:

- 1. To allow the NTSB Operations/Human Performance Group to familiarize themselves with the A320 cockpit, UAL procedures, and ECAM usage.
- 2. To observe and evaluate the A320 Avionics Smoke and Emer Elec events, including related ECAM procedures and cues available to flight crews.

B. Overview:

Two airline transport pilot members of the operational factors/human performance group who were type-rated on the A320 participated as flight crew members in an observational study at the United Airlines Training Center in Denver, Colorado, on May 19, 2011. Other members of the operational factors/human performance group were observers. The simulator used for the observations was an A320 level D full motion-based training simulator.

The purpose of the simulations was to observe and evaluate the A320 Avionics Smoke and Emer Elec ECAM procedures. In addition, visual and aural cues available to flight crews during these events were documented. The conditions and steps taken by the simulator flight crew mimicked as closely as possible those taken by the incident flight crew.

C. Simulator tasks and observations

Task 1: Observe aircraft start up and completion of Avionics Smoke ECAM on the ground.

- 1. Avionics Smoke was activated from the instructor's panel.
- 2. Single chime heard and ECAM procedure appears on bottom left side of upper ECAM (see Figure 1).
- 3. White conditional statement is visible. Under the conditional statement is blue "to do" items. Green arrow on right side of procedure indicates there are more steps than are appearing on the screen (see Figure 1).
- 4. As blue "to do" items are cleared by the crew, a second white conditional statement became visible on the ECAM. (Figure 7 shows the two conditional statements as seen in flight.)
- 5. A timer appears as a part of the second conditional statement on the ECAM. When the timer goes to zero, the conditional statement disappears and the blue "to do" items under that conditional statement remain. They now appear directly below the "to do" items related to the first conditional statement.
- 6. If the crew cleared the Avionics Smoke ECAM and then went to the "status" page, there was a "vent blower" and "vent extract" message under inoperative systems (see Figure 2). Blower and Extract "fault" lights were also illuminated on the overhead panel (see Figure 3). Pack 2 "fault" and Gen 1 Line "smoke" lights were illuminated (see Figures 3 and 4). (Note: Pack 2 fault was possibly a simulator glitch.)



Figure 1: Upper and lower ECAM displays; Avionics Smoke procedure visible on lower left of upper ECAM.



Figure 2: STATUS page of ECAM indicating VENT BLOWER and VENT EXTRACT under inoperative systems (INOP SYS).



Figure 3: View of overhead panel; Ventilation blower and extract fault lights and Pack 2 fault light illuminated.



Figure 4: View of overhead panel; Gen 1 Line Smoke light illuminated on left side of picture; Ventilation blower and extract fault lights and Pack 2 fault light illuminated on right side of picture.

Task 2: Observe Avionics Smoke ECAM in flight when activated between 80 knots and 1500'.

- 1. Avionics Smoke was activated from the instructor's panel.
- 2. "T.O. Inhibit" purple message and "Land ASAP" amber message appeared on the lower right of upper ECAM (see Figure 5).
- 3. STS appeared on lower portion of upper ECAM (see Figure 6).
- 4. Blower and Extract "fault" lights and Gen 1 Line "smoke" light illuminated on overhead panel.
- 5. No audible chime.
- 6. Passing through 8000', the ECAM procedure had not appeared on the ECAM. (Note: This was believed to be a simulator glitch.)
- 7. "Status" page on lower ECAM indicated a "vent blower" and "vent extract" message.
- 8. Crew hit "recall" and Avionics Smoke procedure appeared on the ECAM (see Figure 7).
- 9. The white conditional statement with the time had about 60 seconds remaining.
- 10. Crew ran through the procedure and before they got to the conditional statement with the timer, the timer went to zero and the message disappeared. It then seemed that the blue "to do" items pertaining to the timer conditional statement were a part of the previous conditional statement (see Figure 8).
- 11. When oxygen masks removed from housing, "oxygen mask/goggles...on" to do item does not disappear.

- 12. When crew selected Gen 2 off, all screens in the cockpit went black and after several seconds the captain's screens reappeared.
- 13. Chime heard and Emer Elec Conf appeared on the lower left of the upper ECAM. Red "Land ASAP" message appeared on lower right of upper ECAM. Lower ECAM was black (see Figure 9).
- 14. No visual indication that the RAT deployed.
- 15. On electrical page, crew could tell RAT deployed by seeing "Emer Gen" message (see Figure 10).
- 16. When selected, the "status" page appeared on the upper ECAM (see Figures 11 and 12).
- 17. To tune/dial in the approach, crew had to use the "standby nav" or RNP.
- 18. An item on the Emer Elec ECAM procedure states as white conditional "before landing gear extension" then blue to do "gen 2…on" (see Figure 9).
- 19. When flaps extended to flaps 3, crew received a continuous repetitive chime and red master caution warning because the gear was not extended.
- 20. Crew extended the landing gear.
- 21. Amber "Use manual pitch trim" message appeared on the captain's left PFD screen and the right PFD screen went black.
- 22. Upper ECAM was still available. "Elec Ess Buses on Bat" appeared in red on lower left of upper ECAM.
- 23. PA was working in the simulator.



Figure 5: View of upper ECAM with takeoff inhibit (T.O. INHIBIT) visible as purple message and Land ASAP visible as amber message.



Figure 6: ECAM displaying STS (status) indicator message.



Figure 7: Avionics Smoke procedure displayed on the ECAM; two conditional statements visible.



Figure 8: Avionics Smoke ECAM procedure after conditional statement "If smoke after..." timer reaches zero.



Figure 9: Emergency electrical configuration procedure displayed on upper ECAM.



Figure 10: Electrical page on ECAM with indications that the RAT has deployed.



Figure 11: Status page 1 on upper ECAM when selected in emergency electrical configuration.



Figure 12: Status page 2 on upper ECAM when selected in emergency electrical configuration.

Task 3: Observe Avionics Smoke ECAM in flight when activated above 1500'.

- 1. Avionics Smoke was activated from the instructor's panel.
- 2. STS appeared on lower portion of upper ECAM.
- 3. A few seconds after STS message, single chime heard and amber master caution light illuminated.
- 4. Avionics Smoke procedure appears on lower left of upper ECAM.
- 5. Crew completing "to do" items under first conditional statement. Timer on second conditional statement is still visible and is indicating 3 minutes 30 seconds remaining.