Addendum 1

To Operations/Human Performance Group Factual Report

Attachment 6

DCA11IA040

Meeting Notes – Airbus

Meeting summary for United Airlines flight 497 Incident, A320 Runway Excursion, April 4, 2011 (NTSB # DCA11IA040)

A. Participants: NTSB

Katherine Wilson (Operations/Human Performance Group)
Roger Cox (Operations/Human Performance Group)
Bob Swaim (Systems Group)
Daniel Bower (Investigator In Charge)

ALPA/United Airlines
Marc Ghafouri (Operations/Human Performance Group)

Airbus
Jean Daney (Director of Flight Safety/Accident Investigator)
Philippe Pupin (Flight Test Engineer)
David Viguie (Senior Flight Operations Engineer)
Christopher Cail (Flight Test Pilot)
David Owens (Senior Director Flight Crew Development)
Rudy Canto (Director Flight Operations Technical, Airbus Americas)

BEA
Romain Bévillard (Accredited Representative, Safety Investigator)
Nathalie de Ziegler (Operations/Human Performance Group Member)
Sylvain Molé (Safety Investigator)

B. Location: Toulouse, France

C. Dates: September 20-21, 2011

D. Objectives:

1. To allow the NTSB Operations/Human Performance Group and Systems Group to discuss issue areas related to the incident and receive clarification from Airbus personnel on unresolved items.

E. Summary:

The NTSB traveled to Toulouse, France, and conducted meetings with Airbus personnel at the Airbus headquarters on September 20-21, 2011. While the operations/human performance issues were discussed in conjunction with systems issues, this document is a summary of the notes taken by the NTSB Operations/Human Performance Group chairmen. A separate document will summarize the information gathered by the Systems Group.

As a result of the meetings with Airbus, the following issue areas were discussed and information obtained:

1.0 Avionics smoke ECAM – logic and presentation

- An avionics smoke ECAM is triggered when smoke is detected by the sensor in the avionics compartment. See Appendix 1 for related cockpit and ECAM indications.
- The entire avionics smoke procedure is 31 lines. The ECAM screen can display a maximum of 7 lines at a time.
- A timer begins when smoke is first detected. If smoke dissipates before 5 minutes, the procedure will disappear and cannot be recalled by the crew.
- According to the A320 System Description Note, “an electrical procedure is applied to eliminate the origin of the smoke if the smoke emission persists more than 5 minutes”.
- If smoke is detected for 5 minutes, the avionics smoke warning is “latched” and remains active in the FMC even if smoke is no longer detected. To remove the warning requires maintenance supervision to reset the circuit breakers in the cockpit.
- If the procedure is cleared by the crew and then latches, it will not reappear until it is recalled by the crew. If the procedure was cleared on the ground, the crew will get a LAND ASAP message on takeoff.
- If the procedure latches and is then cleared by the crew, it can be recalled on the ECAM. If a warning is recalled, there is no chime or master caution.
- The crew must push the RCL (recall) button for 3 seconds to recall a warning canceled by EMER CANC (emergency cancel). If the warning was cleared by pushing the CLR button, the crew just has to push and release RCL.
- The timer will count down from 5 minutes as a conditional statement on the ECAM. If the timer reaches zero and smoke is still detected, the conditional statement will disappear. This occurs even if the event was initiated on the ground before the crew arrived at the aircraft.
- If a latched avionics smoke procedure is cleared from the ECAM and the master caution is pushed before the crew arrives at the airplane, the GEN 1 line smoke amber light and the Blower and Extract amber fault lights should still be illuminated on the overhead panel. In addition, the amber vent blower and vent extract messages should have been displayed on the lower ECAM when recall was pressed. Pushing recall is part of the preliminary cockpit prep flow.
- Regarding when a crew will be alerted to an avionics smoke warning – an alert will be displayed when the airplane is on the ground (engines running or not running) and airspeed is below 80 knots; an alert will be displayed in flight above 1500 feet after takeoff until 800 feet before landing; an alert will be inhibited if triggered when on the ground and the airspeed is above 80 knots; an alert will be inhibited if triggered in flight when below 1500 feet after takeoff and below 800 feet on landing. Inhibited means that the alert is triggered but is not displayed until the airplane is outside of the inhibition

criteria. If the alert is triggered and displayed and then the airplane meets the inhibit criteria, the alert will remain displayed.

2.0 Avionics smoke ECAM – expected crew response

- Completion of the avionics smoke procedure is dependent on "direct detection by the crew" – either by smell or sight – followed by "secondary detection by a detector which is considered as a help" (per the A320 System Description Note).
- If a crew perceives smoke, they are to complete the procedure. If smoke is not perceived, they are not to do the procedure, even if the procedure has latched.
- According to Airbus, 4 flight tests were accomplished in 1987, and in all cases the crew was able to detect smoke. Airbus states that a crew will be able to perceive smoke if the avionics smoke alert is real.
- A310 and A320 airplanes are certified for crew to be the primary confirmation of smoke before completing the avionics smoke procedure. Other Airbus fleets are not.
- Airbus did not have any records of flights in which an avionics smoke warning was real and the crew did not detect smoke.
- Avionics Smoke is a Level 2/amber warning requiring attention but not immediate action. This also is true for the amber LAND ASAP message.
- Airbus provided a copy of the FCOM Volume 1 which provides a lot of detail, including the chimes and cautions associated with autothrust abnormals
- The group discussed whether it was possible for 48 other crews (based on FOQA data) to have missed such obvious indications of an avionics smoke alert prior to flight unless they were not available to the crew. Airbus could not provide any technical explanation for why it would not be displayed.

3.0 ECAM training materials provided to operators, including avionics smoke

- Airbus does not train avionics smoke specifically. They train air conditioning smoke because they feel it is a more difficult procedure to accomplish.
- Airbus A320 training courseware includes slides for use of ECAM. The avionics smoke procedure is presented, but not the full ECAM.
- Airbus provides initial qualification training but no recurrent training.

4.0 EMER ELEC configuration

- The EMER ELEC configuration will occur when the airplane generators are shut off. See Appendix 2 for related ECAM indications.
- There will be a slight blanking of screens as airplane switches to EMER ELEC configuration.

- When in the EMER ELEC configuration, the crew can use the FMGS to navigate the approach until the landing gear is extended.
- The only way for a crew to know what systems are inop (e.g., that one thrust reverser is inop) when in the EMER ELEC configuration is to press the status key and read the list. There are 14 amber items on the list, and reverser 2 is at the bottom.
- Airbus did not believe there was any difference in operations if Gen 2 is turned off before Gen 1.
- If crew turned Gen 2 on before extending the landing gear, the airplane would return to normal electrical configuration. If Gen 2 is not turned on, the airplane will go to battery power.
- The normal network consists of two independent channels (channel 1 and channel 2). Each channel consists of an AC network and DC network. The emergency network is a single channel that consists of an AC network and DC network.

5.0 Battery power – flight operations

- When the gear is extended and the airplane is on battery power, ELEC ESS BUSSESS title will appear on the ECAM. When the gear is raised, the entire procedure will appear on the ECAM.
- There are no cockpit indications available to a crew to tell them how much battery power is remaining when on battery power only. Without battery power, the side sticks do not function.
- Low battery power would not result in graying out of the captain's PFD screens in the cockpit. Portions of the captain's PFD go to grey scale when on battery power to reduce the heat generated by color displays. Fans are turned off at that point.
- The battery is certified to last 30 minutes, which allows for 22 minutes of flight time and 8 minutes for landing and evacuation.
- Airbus did not know the reported battery life vs. actual battery life; it was not tested.
- When on battery power, AC and DC essential are powered. Battery 1 runs the AC at about 1 KVA. Battery 2 runs the DC. When below 100 knots, both batteries come together. When below 50 knots, AC is shed.
- Crew must push STS or clear the failure to view the status page and inoperative systems on the ECAM.
- TR1 and TR essential are interchangeable.

6.0 Explanation of certain DFDR parameters

- Smoke detection data is sent to the DFDR from the AEVC at the same time as it goes to the smoke light on the overhead panel. If it was recorded as on it should have been displayed to the crew.
- The Avionics Smoke warning was actuated when the recorder powered up at engine start.

- According to Airbus, based on the FDR, the crew did not turn on the RCDR pushbutton during preflight, which they should have done.
- Airbus indicates the airplane was powered when the crew arrived. The avionics smoke warning was cleared before the FDR started (either by the crew or someone else).
- Airbus provided a sequence of events based on which system displays were recorded. Crew checked the status page on taxi and should have seen the vent blower and vent extract items as inoperative. Airbus believes the crew manually selected the engine page after 1500 feet.

7.0 Data on real and false avionics smoke history

- Airbus has received 63 reports of avionics smoke caution worldwide since 1996 on the A320. Of these, 42 were false, 11 were true and 10 were unknown. 27 of the false indications were ionic detectors and 5 were the optical detector. (Falsing is possible with the optical detector, but less likely.)
- An Airbus TFU (technical follow up) was issued in 1999 directed at spurious avionics smoke and LAND ASAP messages, but it was only directed to line maintenance.

8.0 Status of ionic detector replacements worldwide

- The optical detectors were installed on new aircraft starting with MSN 1523 (event aircraft was MSN 462). (4790 aircraft have been delivered). Of 1443 aircraft available for retrofit, 473 (33%) are completed, and 222 (15%) are forecasted to be completed. 748 aircraft are either refused or unreported.
- See Airbus Service Bulletin 26-1052.

9.0 EMER/ELEC and battery power - PA use and evacuation alarm

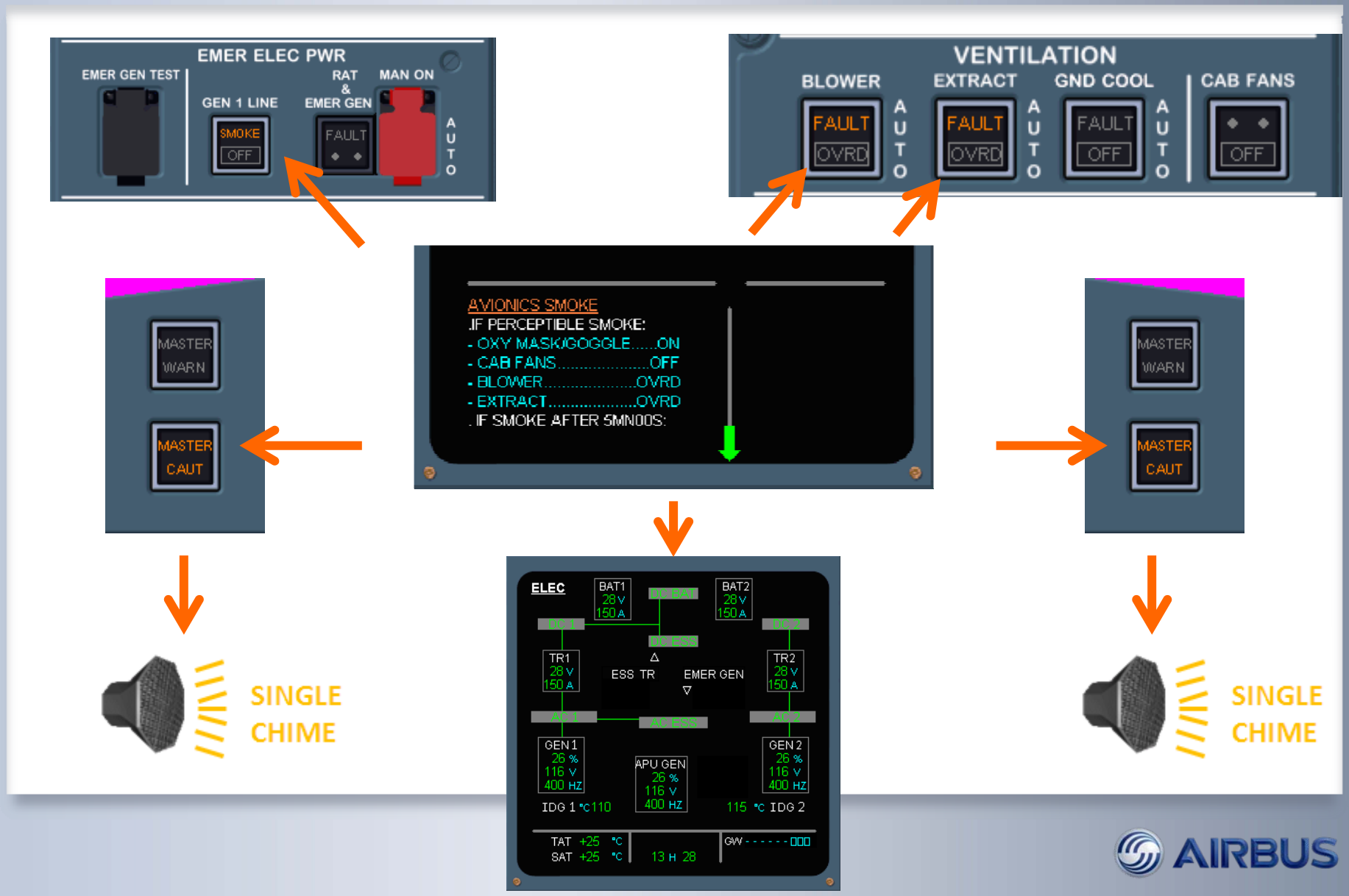
- PA should remain active in EMER ELEC configuration. Airbus said they heard of cases where the PA cuts off during power interruption but could not cite examples. They believe that the handset will have to be put back in the cradle and then picked up to become active. Rekeying the mic will not reactivate the PA.
- In the cockpit, the evacuation alarm switch is guarded. There is a non-guarded switch that can be pushed to silence the alarm in the cockpit. In the cabin, on the CIDS panel, there is a non-guarded switch to activate the evacuation alarm – one is located by door 1L and another by door 2L. The alarm can also be silenced in the cabin.
- The CIDS is powered by the DC service bus and DC essential bus.
- Airbus was aware of few incidents in which the evacuation alarm failed to operate. They cited Air France in Toronto, however, Airbus believes there was power to the CIDS panel based on passenger pictures during the evacuation and therefore the alarm should have worked. Report by TSB of Canada said the alarm did not work because there was no power available. Other incidents include United Airlines in Jackson Hole and United Airlines in New Orleans.

- The PA system should not degrade as batter power is drained.
- Testing of A319 and A320 door slides at various angles is a part of normal certification requirements.
- Airbus does not know the decibel level of the Evac alarm or if there is a certification requirement.

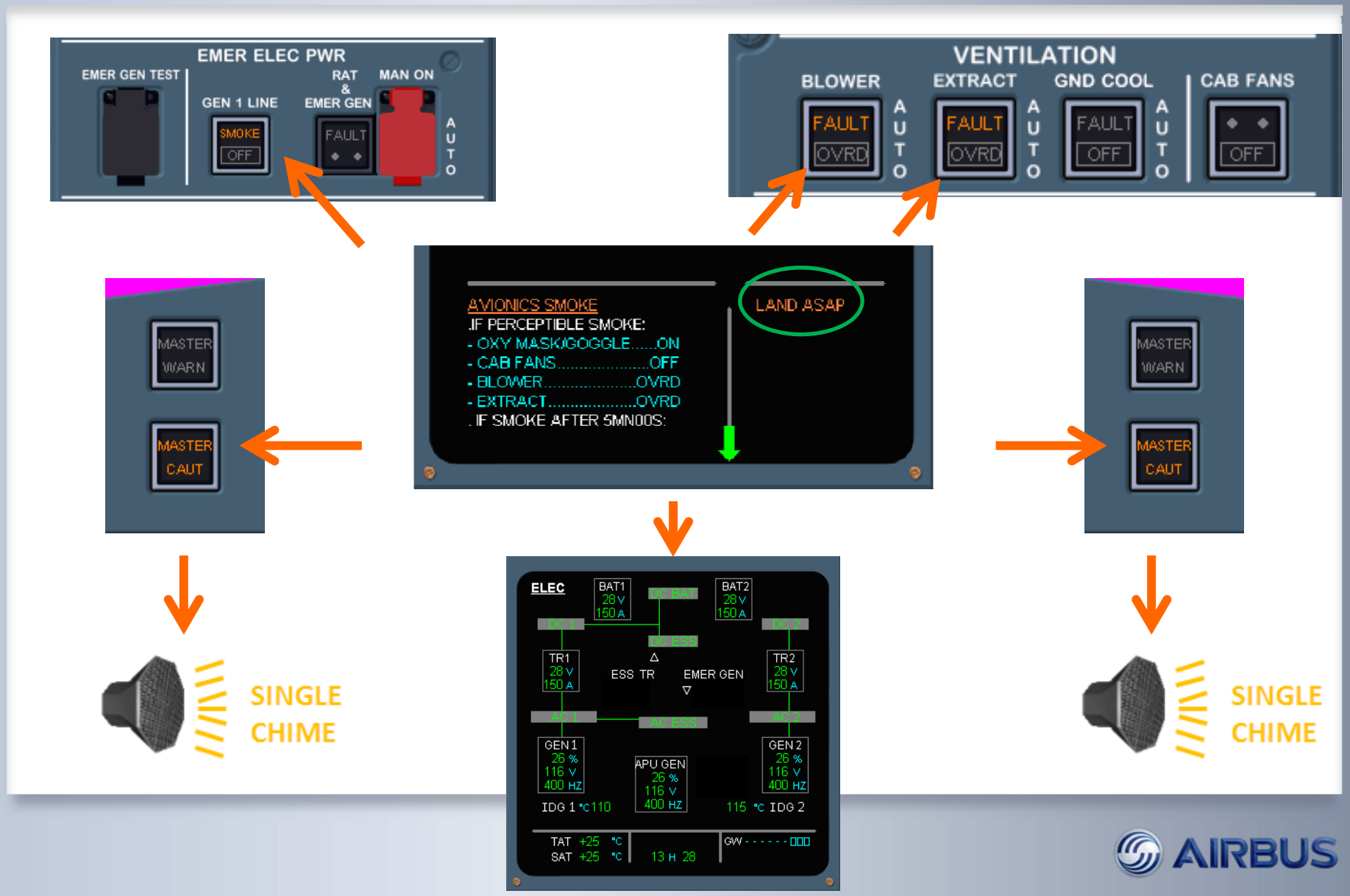
Appendix 1

Avionics Smoke Cockpit and ECAM Indications

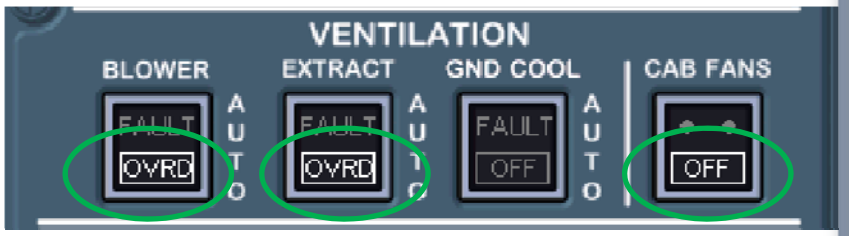
ON GROUND – CKPT effects

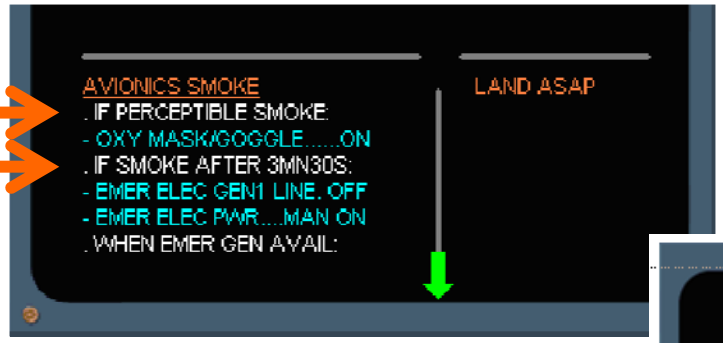


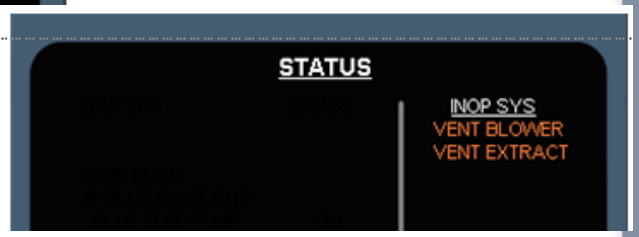
IN FLIGHT – CKPT effects

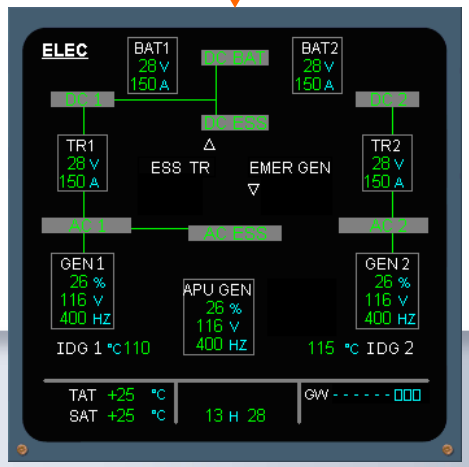


ECAM checklist

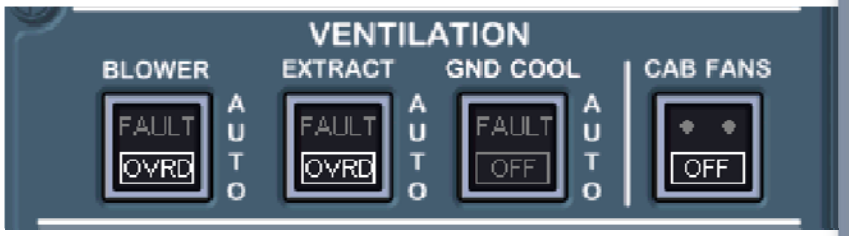


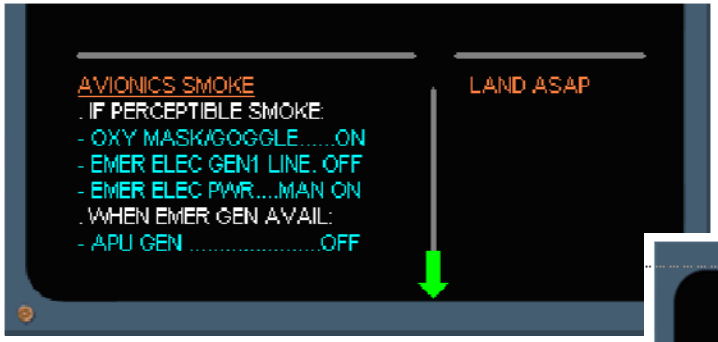


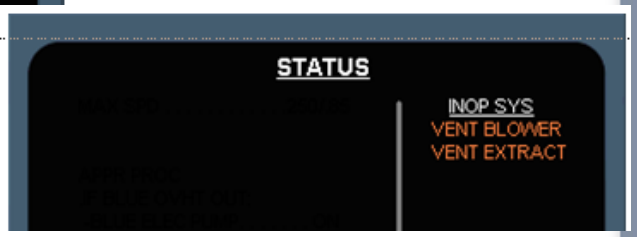


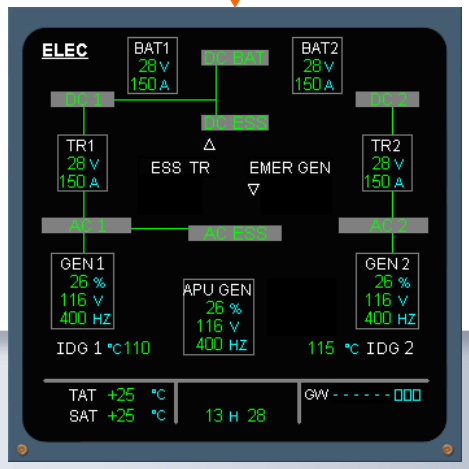


ECAM checklist after 5 minutes

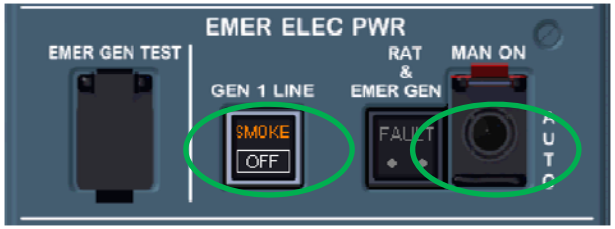


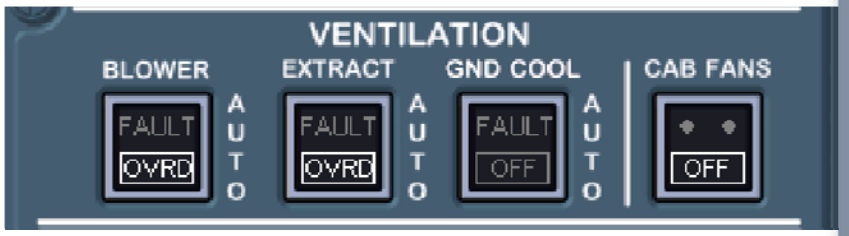


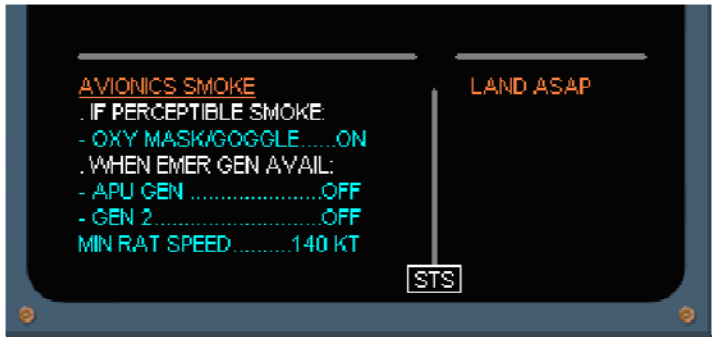


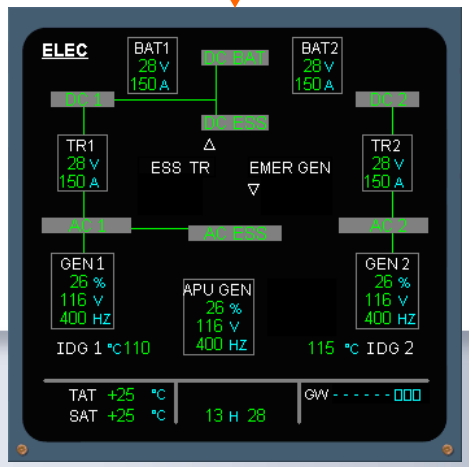


ECAM checklist after 5 minutes





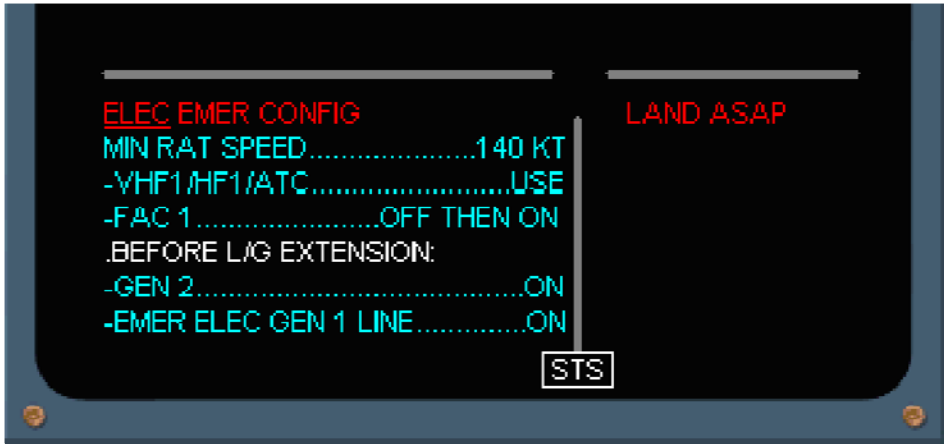




Appendix 2

Emergency Electrical ECAM Indications

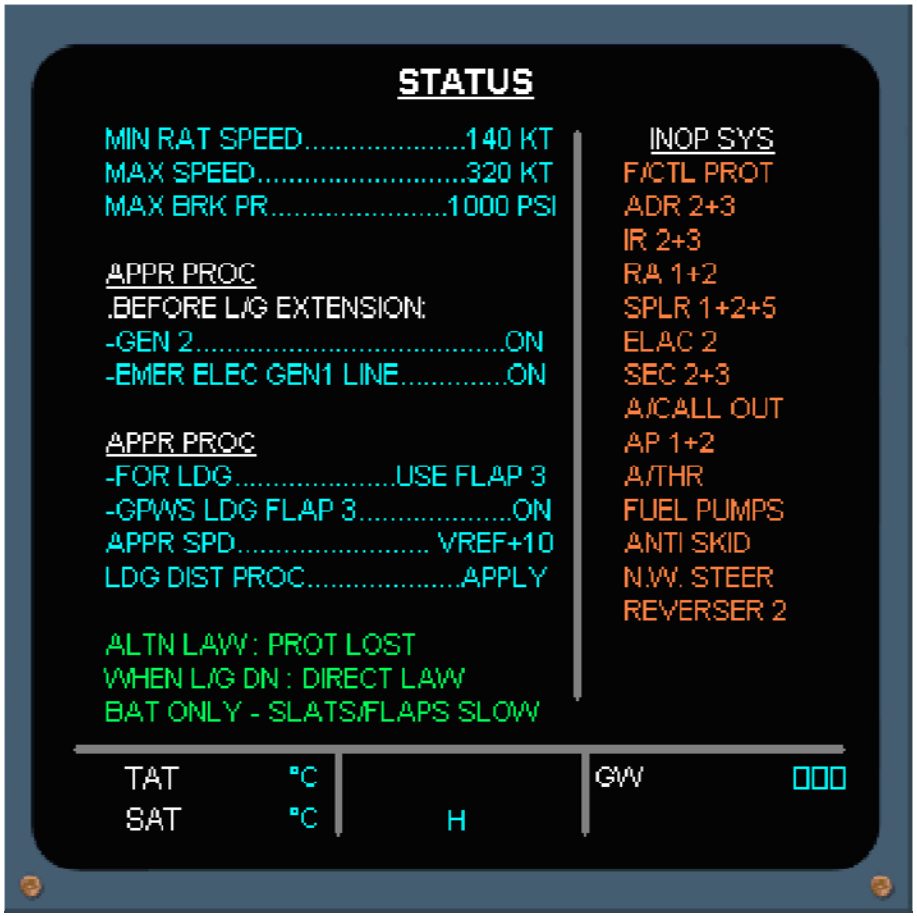
ELEC EMER CONFIG checklist



After recovery of Normal Elec. Config.

Recovery of normal braking and all reversers

If Normal Elec. Config. Not recovered



Anti skid, nose wheel steering and reverser 2 not recovered