

Indian Airlines Accident Report - APPENDIX I

RECOMMENDATIONS - Recommendations of the Court of Inquiry convened by the Government of India Director General of Civil Aviation to investigate and report on Indian Airlines Airbus A-320 aircraft accident on 14th February, 1990 at Bangalore.

COMMENTS - Government of India, Ministry of Civil Aviation, decisions on the Recommendations from the Report of the Court of Inquiry on the accident to Indian Airlines Airbus A-320 aircraft on 14th February, 1990 at Bangalore.

1. Accident/incident investigation authority should be totally independent of the DGCA and all organizations connected with aviation in India. Only this can ensure an impartial and unbiased investigation looking into the role of every organization connected with the accident/incident including the DGCA.

Gov't Comment - At present only minor accident/incidents are investigated by DGCA as in other countries. Any major fatal accident is invariably inquired into by a Committee or by a Court of Enquiry, totally independent of DGCA or the Ministry. Therefore, this recommendation is not acceptable.

2. Whenever an investigation *is* ordered under Rule 71 of the India Aircraft Rules, 1937 and later a formal investigation is ordered under Rule 75, automatically the Inspector of Accidents should only indicate the finding based on factual evidence and no interpretation or recommendation should be made to avoid embarrassment to the formal investigation.

Gov't Comment - This is acceptable. But the stipulation is to be laid down by the Committee or by a Court of Inquiry.

3. A highly experienced pilot should always be associated with the Inspector of Accidents officially if he is from an engineering background and the pilot's report should be recorded whenever an airline accident is to be investigated.

Gov't Comment - Recommendation is accepted to the extent of association of a Pilot with the investigation whenever necessary.

4. DGCA should formulate procedures and develop information formats which has to be completed in all respect every time a new aircraft is introduced into the airline to cover all training aspects and exemptions/validations to be granted.

Gov't Comment - Acceptable

5. DGCA should form a board of officers competent to deal with all aspects of training with if necessary senior experienced training personnel from the airline to assist such a board officially to evaluate the proposed training programmes prior to acceptance whenever a new aircraft is introduced into the airline in the future. Minutes of meetings of such a board should be properly recorded.

Gov't Comment - Acceptable

6. DGCA should develop a machinery in coordination with the Ministry of Defence for supervision of Government aerodromes including Ministry of Defence aerodromes in respect of facilities offered to civil aircraft operating through those aerodromes on scheduled flights to ensure adequate safety standards.

Gov't Comment - Acceptable

7. DGCA should insist that on the first route check, be it for release as a co-pilot or for training towards PIC endorsements, should be with an approved flight instructor or examiner.

Gov't Comment - The DGCA has already implemented this recommendation even prior to the receipt of report and has made extensive changes in the norms of route checks.

8. It would be advisable to have at least a category I ILS installed at every airport in India and for every R/W used by jet transport aircraft on scheduled services.

Gov't Comment - The NAA is already installing ILS facilities at many airports in India. To install an ILS on every airport and on every runway would require heavy capital investment and an ILS may not be necessary in airports which are infrequently used.

9. Time recording should always be available on ATC tapes and regular checks should be carried out to ensure proper recording.

Gov't Comment - Acceptable

10. HAL should have proper communication facilities with the airport emergency services and all communications between the ATC and the emergency services should be recorded on one of the ATC channels.

Gov't Comment - Acceptable

11. A crash siren at Bangalore airport should be installed which could immediately alert all fire stations of HAL. They may look into having two different types of sirens, one to indicate an aircraft emergency and the other to indicate a factory emergency.

Gov't Comment - Acceptable

12. The crash fire bell at the airport fire station should be of good quality and should be louder and similarly the red light should be larger and brighter.

Gov't Comment - Acceptable

13. The bushes on either side of the road and ramp should always be kept cut to a low level so that visibility is not impaired at any time even for a person sitting in a low level vehicle.

Gov't Comment - Acceptable

14. HAL should develop good roads leading to all exit gates of the airport on which all fire and rescue vehicles could move at high speed. One set of keys to the locks of every locked gate should be available with every airport fire services vehicle.

Gov't Comment - Acceptable

15. Mock exercises should be carried out by the airport fire services for fighting an aircraft fire outside the airport boundary wall.

Gov't Comment - Acceptable

16. HAL should evaluate the VASI at Bangalore to improve its colour identification from longer distances during the hours of bright sunlight.

Gov't Comment - Acceptable

17. All audible sounds generated by movement of various controls and levers which could be recorded on the CVR 'tape should be carefully analysed to obtain a correlation with the DFDR as accurately as possible particularly during the most critical period of the flight. The excellent capabilities that are available with various premier establishments in India should be properly documented for use in future.

Gov't Comment - Acceptable to the extent of maintaining a library of audible sounds generated inside the cockpit for identification of sounds recorded on CVR tape, of the same type of aircraft. Exact co-relation with DFDR, however, may not be possible for technical reasons.

18. As the DFDR data can have highly erroneous recordings, a very critical analysis of every critical DFDR parameter in comparison to factual evidence should be made for acceptance or rejection of such data.

Gov't Comment - This is normally done in all investigation of accident/incidents.

19. Similarly a very careful analysis of CVR transcript is necessary to look at all possibilities before it could be used towards any conclusions.

Gov't Comment - This is normally done in all investigation of accident/incidents.

20. Due to considerable number of dead passengers having leg injuries which may have prevented them from escaping, a provision of a foam pad around the bottom rear bar of the seat should be examined wherever the pitch **between the seats is such that** it could cause these types of injuries.

Gov't Comment - Acceptable for the purpose of future study.

21. As large number of passengers and survivors had faced neck and head injuries possibly due to the seat ahead not being vertical, it is advisable to issue instructions to all cabin crew to check and insist on the laid down procedures of seats to be upright, seatbelts tightly fastened and tray tables stored properly. Seatbelts sign could be put on earlier for them to carry out this function.

Gov't Comment - Already being followed. Instructions will be repeated.

22. DGCA should distribute a large number of printed autopsy formats corresponding to their air safety circular 3 of 1984 to all airports in India. They must be available in adequate numbers depending on the passenger capacity of the aircraft using the airfield and these should be made available to police authorities in case of any fatal accident with a request for strict adherence to its contents.

Gov't Comment - Acceptable and noted for action.

23. Experienced aviation pathologists either from Civil or Military Aviation should be made use of in an advisory capacity. A large number of copies of the above circular if sent to various hospitals around airports could assist in wider dissemination of information among the doctors of the hospitals.

Gov't Comment - Acceptable and noted for action.

24. In the light of the test flight conducted at Toulouse in the presence of an Assessor Airbus Industrie needs may examine the design aspects of the accelerometers and the DFDR recording system as used on the A-320 to improve accuracy of recordings particularly after a flight at high angles of attack.

Gov't Comment - Airbus Industrie will be informed.

25. Some slides did not display when door exits were opened from inside. It is recommended that slide activation mechanism should be evaluated for improvement.

Gov't Comment - Airbus Industrie will be informed.

26. Installation of a conventional airspeed indicator unconnected with any computers with a speed bug which could be manually set at the desired V-app, generating an unmistakable audio warning

(again unconnected with any computers) fitted on all aircraft when speed drops more than 5 knots below the bug, which have computer generated display of airspeed to be used as the primary speed display may be considered. A provision should be available to check this warning, during the pilots pre flight check. Such warning should be serviceable, for release of the flight. Airbus Industrie and Indian Airlines to evaluate retrofit such a feature in place of their present standby airspeed indicator on the A-320.

Gov't Comment - Not acceptable as a conventional airspeed indicator with a provision of speed bug setting is already available in the aircraft. Too many warnings would only tend to confuse the pilots.

27. Expanded indication of the value of the current (speed) against the lubber line in the PFD is recommended for better appreciation of current speed value.

Gov't Comment - Acceptable. Would be brought to the notice of the Airbus Industrie.

28. A provision of a low speed warning even under pitch normal law should be examined by the certification authorities at about 1.14 to 1.15 V_{sg} for this type of FBW aircraft to prevent a similar accident in future.

Gov't Comment - Airbus Industrie has already brought out a modification by which the aircraft will automatically go into speed mode whenever the speed reaches Lowest Selectable Speed (VLS). As such, this recommendation is not necessary.

29. Due to possibility of mistaking altitude and vertical speed knobs one for the other, a modification is recommended where vertical speed knob would have a wheel to be operated vertically up and down instead of the present clockwise and anticlockwise direction of movement of the knob.

Gov't Comment - This will be referred to Airbus Industrie as it requires a design change.

30. A very serious human factors evaluation is necessary using ordinary line pilots regarding the loss of direct physical and visual cues by the type of sidestick controls in use in A-320 when compared to dual control wheels operating in unison of the earlier aircraft to determine the adverse impact it may have under critical conditions of flight like that of VT-EPN. Human factor evaluation of moving auto throttles giving feel of thrust increase or decrease versus the static thrust levers of the A-320 auto thrust system using line pilots is recommended to establish advantages and disadvantages.

Gov't Comment - Airbus Industrie has informed the Court that in a conference of users of A-320 aircraft held in Cairo early this year, there was an unanimous opinion for not adopting moving thrust levers. The recommendation is, therefore, not acceptable.

31. Option of moving auto throttles is desirable in all future aircraft if static auto thrust system similar to A- 320 is to be installed in such aircraft.

Gov't Comment - Airbus Industrie has informed the Court that in a conference of users of A-320 aircraft held in Cairo early this year, there was an unanimous opinion for not adopting moving thrust levers. The recommendation is, therefore, not acceptable.

32. After gear down and below 2000 feet radio altitude it is recommended that idle/open descent mode should be indicated in flashing red on the FMA associated with a single stroke chime.

Gov't Comment - Partly acceptable and Airbus Industrie will be requested to have a different colour for idle/open descent mode display on FMA during final approach.

33. Airbus Industrie should evaluate the provision of a feature, by which low thrust level occurring, during final approach, even on speed mode due to gusty wind conditions, would attract

immediate attention of the pilots; if it occurs every close to the ground it could lead to unsafe situations.

Gov't Comment - Not acceptable technically, as while on approach a pilot has to monitor speed and too many warnings at the critical phase of landing would only cause confusion.

34. It is recommended that the low range scale of the EPR gauge up to 1.10 should be expanded to give a better indication by the needle of a low thrust condition.

Gov't Comment - Not acceptable as considered not necessary.

35. Airbus Industrie may look into providing a range in red colour up to 1.02 EPR to attract pilots' attention of a low thrust situation when on final approach.

Gov't Comment - Not acceptable as considered not necessary.

36. Similar features as above could be evaluated and provided for operation in N1 mode.

Gov't Comment - Not acceptable as considered not necessary.

37. It is recommended that the emergency exit sliding window in the cockpit (direct vision window) should have the operating handle in the forward end to give a better leverage than at present, so that it could be easily opened by a comparatively frail lady pilot using any one hand only. Indian Airlines may check with Airbus Industrie if a retrofit modification is possible for their present fleet and future aircraft.

Gov't Comment - Acceptable - will be referred to Airbus Industrie.

38. Safety of operations would demand that Airbus Industrie execute the proposed modifications of increased approach idle by 2.5% N2 and ???? to thrust mode changing to Speed mode when aircraft speed drops to VLS, as top-most priority modifications. Indian Airlines should pursue the matter vigorously with Airbus Industrie in co-ordination with DGCA.

Gov't Comment - Already being incorporated.

39. Installation of a single master switch conveniently located to switch off both FDs when required is recommended; slave switches could be used to switch them 'on' individually or repositioning of both switches centrally be considered.

Gov't Comment - Acceptable. It will be referred to the manufacturer as it requires a design change.

40. A modification to prevent auto thrust mode change from speed mode to thrust mode during Alt* just by change of altitude selection is highly desirable. The mode change should occur only by pulling the altitude knob after change of altitude selection.

Gov't Comment - Already being incorporated.

41. Airbus Industrie should clearly define in their procedures and flight patterns the position at which they need the flight directors to be put off.

Gov't Comment - Use of flight directors is emphasised during training of pilots and a circular would be issued by the Indian Airlines.

42. Airbus Industrie should immediately amend A-320 FCOM bulletin No.09/2 of June 1990.

Gov't Comment - The FCOM bulletin has already been amended.

43. Indian Airlines should introduce simulator training session whenever a line pilot is required to change his seat from the co-pilot seat to the captain seat after a long period of operation from the right hand seat even when this is for obtaining 100 hours experience prior to PIC route check.

Gov't Comment - Partly acceptable to the extent that it will be followed during conversion of co-pilots to pilot-in-command.

44. In the interests of quality of training and safety, it is recommended that DGCA accords approval for all the 100 hours co-pilot experience to be obtained by a pilot slated for direct PIC training on to any type from the left hand seat only under the supervision of an approved check pilot/flight instructor/examiner. If airline needs to use these pilots from RH seat during this training period pilot should be given simulator training as PF from RH seat also.

Gov't Comment - Not acceptable as every pilot has to fly both from the left and right hand seats depending upon the situation.

45. Operation of the cockpit emergency exit windows (direct vision windows) either during pre flight check by pilots prior to commencement of their first leg of their series of flights or during daily certification of flight by aircraft maintenance engineers would ensure easy operation of the window by preventing the seals from sticking to the framework causing higher force requirements to open when need arises.

Gov't Comment - Redundant, as this is usually done.

46. A re-emphasis regarding a 3 seconds delay in alpha floor activation by angle of attack in case of windshear should be made to all A-320 pilots and Indian Airlines should recommend that pilots should not wait for alpha floor but react on thrust levers immediately if an adverse situation is encountered.

Gov't Comment - Not acceptable as Alpha floor is not activated by the pilot. The features of Alpha floor protection are adequately taught during the training.

47. It is recommended that Airbus Industrie and certification authorities to carefully re-evaluate the limit of 15° angle of attack (alpha max) was both simulator experiment and Airbus Industrie flight test under direct law going to slightly higher angles of attack have shown better performance and reduced altitude loss.

Gov't Comment - Attention of Airbus Industrie will be drawn.

48. In view of the results of the test flight at Toulouse it is recommended that, certification authorities including DGCA should carefully evaluate acceleration characteristics of an engine at high angles of attack to give better information to pilots as Airbus Industrie test flight has demonstrated different acceleration characteristics by the same two engines in the four profiles.

Gov't Comment - Not acceptable as Certification Authorities do not issue Type Certificate of Engines unless these parameters are carefully evaluated.

49. With the drastic change in high bypass turbo fan engine designs from the 1960's to the present day and the acceleration characteristics and net thrust developed during various stages of acceleration of present day engines it is recommended that certification authorities may re-examine the existing engine acceleration certification requirements.

Gov't Comment - Not acceptable as Certification Authorities do not issue Type Certificate of Engines unless these parameters are carefully evaluated.

50. Indian Airlines should include inadvertent engagement of IDLE/OPEN DESCENT on short final at heights very close to the ground as a profile during simulator training of pilots being converted onto A-320 and also during recurrent training and proficiency checks till such time all their A-320 aircraft are modified with the new proposed modifications.

Gov't Comment - This is a basic concept of jet flying which is already being taught.

51. As documentation supplied by Aeroformation to a large number of Indian Airlines pilots during training did not fully correspond to the Indian Airlines aircraft (which was not according to the minutes of the training conference) it is necessary for Indian Airlines to update these documents in co-ordination with Aeroformation.

Gov't Comment - Documents are continuously updated.

52. Indian Airlines should include recovery from a situation of low speed at idle thrust in close proximity to the ground in their check pilot training and instructors training on the simulator.

Gov't Comment - Not acceptable. Training is given to recognize the situations and to avoid them.

53. It is recommended that all pilots in India operating automated aircraft be advised that in case of any malfunction of any auto pilot or auto thrust systems or any engagement of undesired mode occurs at altitudes below 1000 feet above ground level manual control should immediately be taken over and if considered necessary a go around should be carried out. No critical investigation or correction on the automated system should be carried out at critical altitudes. Prohibiting the idle/open descent mode below 1000 feet radio altitude should be seriously considered.

Gov't Comment - Acceptable. A circular will be issued to all pilots.

54. Indian Airlines should very carefully evaluate with the DGCA and Airbus Industrie the advantages of introducing manual thrust operation when manual flight is being carried out on the A-320.

Gov't Comment - Not acceptable as auto-thrust provides greater safety level.

55. Indian Airlines should carefully evaluate with Airbus Industrie the auto thrust behavior during gusty wind conditions when speed suddenly increases beyond V-app and decreases at altitudes below 200 feet AGL and adverse implications if any to determine the limits of use of auto thrust system. This may have to be evaluated in both cases of Magenta speed or selected speed.

Gov't Comment - Not acceptable as considered not necessary.

56. The U. V. recording and sound spectrum analysis would help to identify the voices, as well as various other sounds; research and study of the science may be undertaken, so that in future its benefit would be available whenever necessary.

Gov't Comment - This is being done for the last 12 years in the DGCA.

57. A Human Factor Research centre may be established to study and analyse Human Factors in Aviation.

Gov't Comment - Not acceptable. This work is being done in other parts of the world where sophisticated aircraft are being manufactured.

58. A careful study be made to evaluate the advantages of having backward facing passenger seats with a shoulder harness towards improved passenger survivability at the time of accident. Such backward facing seats may prevent the type of head injuries, injuries to legs and hands, arms etc., that occurred in this accident.

Gov't Comment - This concept is being evaluated by many certification authorities.

59. Due to severe fire developing with hardly 3000 to 3300 Kgs., fuel, burning completely the interior furnishing, top of the fuselage and the floor of the cabin, DGCA should carefully evaluate along with other certifying authorities and manufacturers, the feasibility of providing oxygen cylinders for crew and for passengers in the least fire risk areas (well away from the fuel tanks namely front and rear of the fuselage) , with a provision of a valve close to the cylinders which

would be closed at levels below 1000 feet. This may help in delaying the spread of the fire in comparison to the oxygen generators distributed throughout the aircraft and may contribute to saving more lives.

Gov't Comment - Acceptable. Will be brought to the notice of Airbus Industrie.

60. DFDR should record the selections made by the pilots in the FCU; at present it is not possible to infer many of the actions taken by the pilots during the last phases of the flight. Practicability of getting DFDR recordings of instrument displays such as speed display also should be considered.

Gov't Comment - Acceptable.

61. All Airports used for civil transport aircraft operation should be inspected, assessed and certified as fit for such operation, by a competent authority.

Gov't Comment - Acceptable.

62. The DGCA shall be strengthening in all its aspects to meet the growing technological requirements, as indicated in Part-VII of this Report.

Gov't Comment - Acceptable.