# CENIPA Final Report from the accident of Fokker-100 PT-MRK

# TAM flight 402, 31 October 1996

**Excerpt containing Accident Board Recommendations (Text extracted from the printed English translation.)**

## VI. RECOMMENDATIONS

### 1. Primary Homologation Bodies

a. They are to improve the quality of the analyses of all bulletins, even if considered MINOR CHANGES, regardless of their classification, and are to determine that it is mandatory, for the manufacturers, to remake the FAULT TREE A NALYSI S for every and any proposition of modification in any of the systems, that may in some way interfere with the aircraft's airworthiness.

b. They are to issue a Rule Proposition Notice ( N P R), suggesting a modification of FAR 25.933, particularly as for the provision of automatic reduction of the thrust lever, because there is no specific requirement defining the effort levels such device should withstand.

c. They are to revise the data sampling rates of the SSFDRs they homologate, with the objective that same may reflect in their recordings, in the way closest to reality, the data regarding the several positions of the thrust reverser shells installed on aircrafts' engines, as well as to revise the sampling rates about other parameters that may have a recording behavior similar to the SSFDR.

d. They are to revise the requirements of the SSFDRs they homologate, with the objective that: the THRUST LEVER ANGLE (TLA) data are included among the data to be recorded mandatorily.

### 2. To the Homologation Division of IFI/CTA

a. To study and issue a Rule Proposition Notice (NPR) with the purpose of analyzing and implementing a Cockpit Video and Voice Recorder system, initially with the intent of aiding in the field of Aeronautical Accident Investigation, and in the future, once the possible obstacles of a legal nature have been removed, to aid in prevention also.

### 3. RLD

a. To revise the fault trees of the several systems of the FOKKER 100, for them to really meet the items of FAR 25.1309 and FAR 25.933.

b. To revise the homologation requirements of the FOKKER 100 so that by design a simple failure may not inhibit a warning, if the information is available to another system of the aircraft.

c. To develop an airworthiness directive (BLA):

-For the reversers system of aircraft FOKKER 100, that determines the possibility of visual and external verification, during the pre- and post-flight inspections, of the position of the mechanical locking system of the SECONDARY LOCK. To include such visual check in the aircraft's maintenance plan and in the external inspection prior to each flight.

-Modifying the FLIGHT WARNING COMPUTER (FWC) so that the REVERSER ENGINE 1/2 warning is classified as LEVEL 3, informing the crew through the MASTER WARNING.

-Modifying the FWC so that the REVERSER ENGINE 1/2 warning is not inhibited, and is informed to the crew during any phase of the flight.

-That it eliminates the STOW LIMIT RELAY, this way keeping the STOW side of the selector valve energized always, except when there is an actual command of the reverser.

-That it modifies the electric wiring of the alarm system, so that the signal indicating that the reverser shell is not locked (THRUST REV NOT STOWED), that passes by the contacts of the T/R SEC LOCK RELAY 1 ENG 1/2 is sent directly to the alarm system (FWS), not permitting that in case of a failure of such relay the alarm in the cockpit may be inhibited.

-That it introduces a protection against sparking of terminals A1/A2 upon the turning off of the inductive load of the SECONDARY LOCK ACTUATOR.

-That it introduces a modification in the TIR SELECTOR VALVES, avoiding that any unstable balance may result in easier opening of the shells, in case of a lock failure of the SECONDARY LOCK ACTUATOR in the U NLOCKED position, associated or not to an hydraulic leak problem on the STOW line.

**4. FOKKER**

a. To modify the electric system of the reverse system so as to meet the airworthiness requirements, particularly FAR 25.1309 and 25.933, according to the contemporaneous philosophy of their interpretation.

b. The present FEEDBACK CABLE SYSTEM connected to the lever has been associated to an ATS failure. FOKKER is to evaluate a system connected directly to the FUEL CONTROL UNIT, regardless of the lever position, and that meets fully the airworthiness requirements of FAR 25.933(a)(1) and FAR 25.933(a)(3), which determine that on the opening the reverser in flight the engine produces no power exceeding IDLE.

c. To review the FEEDBACK CABLE SYSTEM to meet the requirement of FAR 25.933(a)(1) entirely, because there are time intervals in the opening and closing of the shells as compared to the position of the thrust lever, during which the reverser is open in flight and there is the condition for the engine to be producing power higher than IDLE.

**5. CENIPA / CECOMSAER**

a. They are to render feasible, under the coordination of CECOMSAER, clarification and integration activities of the Panel, Seminar, Lecture and Symposium types, about Flight Safety, to the professionals of the media.

b. For aeronautical accidents with a great public repercussion, they are to define a physical location (auditorium) where daily collective divulgences shall be made, in order to clarify all communications means (TV, Radio, Newspapers, etc. ), and consequently the public opinion, avoiding conflicts and facilitating information.

c. They are to render feasible, under the coordination of the Regional Air Commands, the carrying out of Lectures and Seminars on Initial Action in case of mass aeronautical accidents, to the Organizations subordinated to the Public Security State Secretariats (Civil Police, Military Police, Fire Department, Civil Defense, etc.).

d. They are to include, in the CIAA of the accidents with a great public repercussion, one Public Relations Officer and one Information Officer at the site of the accident, and another Public Relations Officer at the place where the collective Press interviews are to take place.

**6. GRUMMAN / FOKKER / FM / RLD**

a. The reversers' SECONDARY LOCK ACTUATORS are to be re-analyzed and have their reliability increased, including final tests of impedance and electric resistance, prior to delivery and post-assembly on the aircraft.

b. To define a primary maintenance process determining the failure mode of the SEC LOCK ACTUATOR, aiming to avoid the dormant fail of such component.

c. To determine an analyses and tests program for the SEC. LCK ACTUATOR, with the objective of explaining the causes of the contamination of the internal switches of such actuator, providing an effective way to avoid it.

d. To re-design the FEEDBACK CABLE so that on its moving due to the DEPLOY command, the (MORSE/GRUMMAN) connection finds no 'free' space as that one existing inside the TURNBUCKLE, where an inadvertent separation may occur. Or further, within the same philosophy, to modify the coupling process between the rear and front portions of the FEEDBACK CABLE, preventing said separation.

**7. FOKKER / RLD**

a. To analyze the present application of RELAY P/N FOKKER FON9-6105D4L, manufactured by LRE FRANCE under PIN M400-D4L003, and by other manufacturers, utilized on FOKKER 100's THRUST REVERSER SYSTEM, carrying out a study jointly with LEACH and the other manufacturers of the same type of relay, with the purpose of establishing the actual reliability of such relay.

b. To define a primary maintenance process determining the failure mode of T/R SEC.LCK RELAY, aiming to avoid the dormant fail of such component.

c. To analyze the incorporation of a component or circuit for protection against sparking of the contacts of T/R SEC LCK RLY 1 ENG 1/2, produced by the inductive loads of the solenoids that are placed in the same electric circuit.

d. They are to emphasize, to the crews, that a failure in the ATS system causing a lever [retard] will normally affect both levers. It should be emphasized also that in case of non-intentional [retard] of a lever during take-off or the initial climb, the crew is not to try to reopen the lever - it should handle the situation as if it were an engine failure.

**8. FOKKER / DOWTY AEROSPACE HYDRAU LICS / RLD / CAA**

To introduce a modification in the THRUST REVERSER SELECTOR VALVES P/N 114168001 , avoiding that any unstable balance may result in easier shell opening, in case of a failure of the lock of the SECONDARY LOCK ACTUATOR at the UNLOCKED position, associated or not to an hydraulic leak problem on the STOW line.

**9. TAM**

a. To amend the aircraft log, with the objective of improving the failure entries so that each sheet is detached at every transit, with a copy remaining at the base that has carried out the aircraft return to the flight. The original is to be sent for processing on the TROUBLE SHOOTING, and the other copy is to remain in the log, within the aircraft, for reference by the crew, while there is an item pending.

b. SIPAA and the company's Engineering shall develop a program, jointly with the manufacturer, with the objective of listing all situations of basic failures that accept RESET, analyzing each case in depth, and preparing a training program for the flight group, particularly the technical crew members, with the purpose of changing the organizational environment formed, as a function of the operation of extremely computerized aircrafts, where failures that accept RESET do not need to be entered in the aircraft log.

c. It is to give more emphasis to the training sessions carried out on flight simulators in relation to the opening of the reverse in the several phases of the flight.

d. In the initial and revalidation training sessions it is 10 emphasize to the importance of not performing actions below 400 feet.

e. To be included in the theoretical and in the simulator training is a procedure for the case of non-commanded delay of one of the thrust levers during the take-off and climbing phases.

f. It is to increment CRM (COCKPIT RESOURCE MANAGEMENT) training to all the company's crew members. Circular 227-AN-136 of OACI, Human Factors Digest no. 3, is to be observed.

g. Although it has had no influence to the occurrence of the accident, it has been verified that sometimes the crew members flight schedule came out with daily working hours exceeding those

permitted. The Company is to prepare flight schedules for all crew members complying with what is provided for in Law 7183, of 05 April 1984.

h. The Operations Officer of said Company is to emphasize to the flight group personnel (pilots and copilots) the obligatoriness of reading the checklist, as provided for in the Operations Manual.

**10. IFI**

To study and propose to DAC *[Translator's Remark: Civil Aviation Directorate of the Ministry of Aeronautics]* the implementation of a recommendation of a procedure restricting the manipulation of the engine's thrust levers by copilots, at critical flight phases, below safety height, to the effect of avoiding precipitated initiatives and without the due supervision and coordination of the Pilots, for crews operating under RBHA 121.

**11. DAC**

a. Based on the chain of events verified in this accident, to strengthen the safety instructions to be observed in case of unprecedented situations arising during critical operation phases (such as: acceleration on take-off and stabilization during the final approach for landing, etc.), to the effect that actions are performed orderly, without precipitations that might occasion fatally improper initiatives or conflict in the cockpit.

b. To determine to the operators of big cargo aircrafts to guide the pilots group to respect, particularly for aircrafts with a high degree of automatism sophistication, the limits of actuation of the flight controls management systems, like in the case of the levers (auto-throttle), avoiding any precipitation in their use.

**12. DAC/STE**

a. Considering that in the antecedent occurrences occasioned by failures of the reverse in flight the crews have had difficulties in recognizing the failure or its seriousness, STE is to give more emphasis to the requirements of flight simulator training sessions, both for companies that are authorized to operate already and those for which operation authorization will be granted in the future.

b. To study the feasibility of establishing, through RBHA or IAC, for the companies that operate according to RBHA 121, a procedure for utilization of the FDR in a PREVENTIVE way, turned to flight safety.

**13. DAC / CENIPA**

a. They are to carry out a study in order to provide, as soon as possible, DAC's DIPAA with an Emergency Fund for use by the CIAAs, with the purpose of covering costs (daily wages, tickets, lodging, etc.) of the personnel involved in the Investigation that do not belong to the Ministry of Aeronautics, complying with what is provided for in NSMA 3-6.

b. To develop a program for divulgence and implementation of rescue techniques in cases of mass aeronautical accidents, with the purpose of implementing communication, control and coordination among the agencies involved and the CIAA, with the objective of preserving the evidences essential to the investigation of the aeronautical accident.