



## AIR LINE PILOTS ASSOCIATION, INTERNATIONAL

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July 17, 2008

Mr. Joe Sedor  
Investigator in Charge  
National Transportation Safety Board  
490 L'Enfant Plaza, SW  
Washington, DC 20594

Reference: Northwest Airlines Flight 74, **DCA05MA095**

Dear Mr. Sedor:

In accordance with the Board's rules, the Air Line Pilots Association, International (ALPA) submits the attached comments and conclusions concerning the landing with the nose gear retracted by a Boeing 747-200 operating as Northwest Airlines Flight 74. This accident occurred on August 19, 2005 during landing at Guam-Antonio B Won Pat International Airport (GUM) Agana, Guam.

The attached submission contains ALPA's analysis of the facts surrounding the accident based upon the information obtained from the NTSB's investigation. ALPA's Safety Recommendations are included and are based upon these facts. Other safety concerns were also identified during this investigation and are discussed in the attached report.

ALPA appreciates the opportunity to have participated as a party to the investigation, and hopes that the attached conclusions and safety recommendations will be of assistance as the NTSB concludes its investigation.

Sincerely,

William B. Etzold  
Northwest Airlines Chief Accident Investigator

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Attachment



SUBMISSION OF THE  
AIR LINE PILOTS ASSOCIATION  
TO THE  
NATIONAL TRANSPORTATION SAFETY BOARD  
REGARDING THE ACCIDENT INVOLVING

Northwest Airlines Flight 74

Agana, Guam

August 19, 2005

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## **I. SUMMARY**

On August 19, 2005, Northwest Airlines Flight 74, a Boeing 747-200, N627US, landed with its nose gear retracted at Guam-Antonio B Won Pat International Airport (GUM) Agana, Guam. An emergency evacuation was initiated several minutes after the airplane came to a stop on the runway. Of the 16 crewmembers and 318 passengers onboard, 2 received minor injuries during the evacuation. The airplane was substantially damaged.

The results of the Air Line Pilots Association's (ALPA) analysis revealed that there were several factors that led to the failure of the gear to extend, the subsequent error by the crew in identifying the malfunction, and ultimately to the accident landing, including

1. The design/part numbering of the nose gear door lock key
2. The design of the landing gear indications on the Flight Engineer's panel
3. The procedures related to landing gear abnormal checklist
4. The failure of the nose landing gear actuator
5. Northwest Airlines prohibiting crews from performing fly-bys
6. Northwest Airlines not advising Boeing 747-200 crews of the reason for the changes to the Red Gear Light Remains On (After Gear Extension) procedure, following a Boeing manual change, which was the result of several other accidents.

## II. HISTORY OF FLIGHT<sup>1</sup>

The crew reported for duty at 0851 local time in Tokyo for Flight 74 Tokyo-Narita International Airport (NRT) to Guam-Antonio B Won Pat International Airport (GUM). The Captain was the Pilot Flying (PF) and according to crew member statements all phases of flight were normal until the final approach segment.

As the airplane made its final approach to runway 6L at GUM with the gear handle in the down position and flaps at 20 degrees, the Captain called for the flaps to be extended to 25 degrees and for the “Before Landing Checklist”. When the flaps were selected to 25 degrees, the flight crew stated that they heard the landing gear aural warning horn and they observed the red landing gear light on the forward instrument panel was illuminated. The Captain initiated a go-around, had the flaps retracted to 10 degrees, left the gear in the extended position, and the First Officer (FO) advised Air Traffic Control (ATC) “they were going around to work on a problem.”

Following the go-around, the Captain stated that he had the FO fly the airplane and communicate with ATC. He then asked the Second Officer (SO) to take out the Cockpit Operations Manual (COM). The SO and the Captain read through the *Red Gear Light Remains On (After Gear Extension)* procedure. During the procedure they checked both the Primary and Alternate proximity switches and concluded that all the gear were down.<sup>2</sup> Based on the CVR transcript prior to starting the COM procedure, the Captain asked the SO for the status of the gear lights. The SO responded “four here.”<sup>3</sup> In fact, the procedure which they later accomplished told the crew to look for five, not four lights. Unfortunately, while running the COM procedure instead of referencing the five lights as written in the procedure, the crew repeatedly stated that they had “all” the gear down.

Following the completion of the COM procedures, the Captain resumed his PF duties and the flight proceeded inbound and was cleared for a visual approach to runway 6L at GUM. When the flaps were re-selected to 25 degrees and the landing gear aural warning horn began to activate, the SO silenced it by pulling the appropriate circuit breaker. The initial touchdown was normal, the speed brakes deployed and reverse-thrust was selected on all four engines. At that point, ATC advised the flight crew that the nose gear was not down and to initiate a go-around. Both the FO and SO also called for a go-around, but since the reversers had been deployed the Captain determined that, “the safest course of action at that time was to stop the airplane on the runway.” The Captain flew the aircraft in a manner that allowed him to, “stay off the brakes and fly the nose to the ground.” He said he used, “the entire length of the runway to stop the airplane with minimal braking.” He estimated that the nose of the airplane slid in contact with the runway surface for about “700-1000 feet.”

After the airplane came to a stop on the runway, a flight attendant notified the Captain that there was smoke in the forward cabin area. The Captain advised the FO and

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<sup>1</sup> History of Flight is based upon the Operations/ Human Performance Factual and the Flight Crew statements

<sup>2</sup> Reference Cockpit Voice Recorder Group Factual 388949, page 11 of 27

<sup>3</sup> Reference Cockpit Voice Recorder Group Factual 388949, page 6 of 27

SO to secure the cockpit and he went downstairs to assess the situation. The Captain stated, “he saw smoke coming from an access hatch and told the flight attendants to move the passengers aft of door two.” He directed the upper deck flight attendant to move the passengers from the upper deck down to the main cabin deck and aft of door two. When he noticed that the smoke was getting worse, he advised the flight attendants to “open the doors, inflate the slides, and evacuate the airplane.” All passengers and crew evacuated the airplane on the runway and two passengers received minor injuries during the evacuation. The passengers were bussed to the terminal following the evacuation.

The subsequent investigation revealed that a nose gear landing door actuator lock key had been installed incorrectly. Although during the on-aircraft testing of the gear, it functioned normally, a bench test of the actuator suggested that the incorrectly installed lock key could allow the actuator to bind, preventing gear extension. This appears to be a transient malfunction in that it is also possible for the gear to function normally with the key installed incorrectly.

### **III. LOCK KEY DESIGN AND INSTALLATION**

During the Airworthiness Group field work, the NTSB and parties to the investigation conducted a tear-down on the nose landing gear door actuator. During the disassembly of the actuator, the Group noted that one of the two lock keys had been installed backwards.

Although this was a previously identified issue<sup>4</sup> in another incident, the problem was not completely rectified. After an incident involving an Air France aircraft in 1999, Smiths did change the lock key design to prevent a similar occurrence. Unfortunately, the new design was not given a new part number, so there is no way for an airline to know which design is on that aircraft and could allow a similar incorrect installation, which in fact did occur in this case. Not changing the part number also would make it very difficult for an airline to ensure all of their aircraft had been retrofitted with this new design.

### **IV. HUMAN FACTORS RELATED TO THE FLIGHT ENGINEER PANEL**

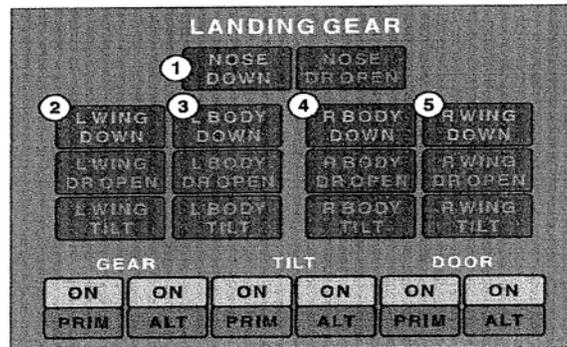
During the course of the investigation it became clear that there had been at least three previous events with the Boeing 747-200 which involved very similar circumstances. In each of the three previous accidents the flight crews landed with the nose gear retracted after seeing four green lights on the Flight Engineer Panel. Subsequent to these accidents Boeing published an Operations Manual Bulletin which instructed operators to change the *Red Gear Light Remains Illuminated Following Gear Extension* (which in Northwest Airlines’ COM is referenced as the *Red Gear Light Remains On (After Gear Extension)* procedure) verbiage from “all green” lights to specifying that there should be “five (5) green” lights. This change however did not address the underlying human factors issue with regards to this portion of the Flight Engineer Panel.

Typically in most transport category aircraft, cockpits are designed with a “dark cockpit” philosophy; that is, if everything is functioning correctly and the switches are in their appropriate position that the lights in the cockpit should not be illuminated. If a switch is

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<sup>4</sup> Reference Airworthiness Group Factual 360111, page 7

in an incorrect position it might be annunciated in a variety of ways, but typically with an amber or red light. In the Boeing 747-200, the landing gear portion of the Flight Engineer Panel does not follow this typical human factors logic. To ensure that the gear is down, the Flight Engineer must verify that there are five green lights. If there are not five, the unlocked gear will not be red, but will be dark. The specific issue with the nose gear is that all the main gear lights are in a straight-line on the panel and the nose gear is above that offset to the left.



Therefore if the nose gear is not extended, the Flight Engineer may observe only the four green lights and assume that all the gear are extended. Increasing the likelihood of this type of event occurring is the fact that as part of his normal preflight, the Flight Engineer checks the Tilt of the main gear and is looking for four lights. The other design factor that may have prevented this accident was the gear indications on the forward panel. On most transport category aircraft there is a green light for each set of gear on the forward instrument panel, near the landing gear lever. In this case if there had been five lights on the forward panel, it may have alerted the crew to the possibility that the nose gear was indeed not in the down and locked position.

With regards to the accident flight, based on the statements specifically from the Second Officer, it appears as though he felt that he saw the number of lights he was supposed to see. The Cockpit Voice Recording indicates that at 1407:27, the Captain asks the Second Officer “what do you have for the gear lights?” Six seconds later at 1407:33, the Second Officer states “four here.” The remainder of the recording the Captain and Second Officer both state that all the gear is down, but never verbalize another number.

Following the accident Northwest Airlines was able to jack the aircraft and swing the nose gear. They performed 27 retraction/ extension cycles and noted that the indications correctly illuminated all five green lights in both the primary and alternate positions on the Flight Engineer Panel<sup>5</sup>. This test demonstrates that when the nose gear was actually in the fully extended position that the nose gear light did function correctly.

## V. NORTHWEST COCKPIT PROCEDURES MANUAL AND TRAINING

After the accident, the Northwest COM for the Boeing 747-200 was changed to add the “five” lights portion of the procedure in accordance with the Boeing 747 Operations

<sup>5</sup> Email from Jared Kirsling, Project Engineer- 747 Engineering, Northwest Airlines; September 7, 2005

Manual Bulletin 00-1. Unfortunately, neither the Boeing nor Northwest procedure provides the crew with additional information that may have helped this crew.

The first note in the procedure states that “Fly-bys are considered to be of no value in confirming locked/unlocked condition of landing gear and are not authorized.” While ALPA understands the rationale that in cases where a gear is down but not locked, a fly-by would not help the crew in determining the status of the landing gear, in this case a fly-by would have alerted the crew that the nose gear was not extended at all. Thus, ALPA feels that a complete prohibition on fly-bys is inappropriate.

Although the procedure has been modified to clarify the number of lights and ALPA applauds Northwest’s effort subsequent to the accident flight in adding panel diagrams to the COM for the *Red Gear Light Remains On (After Gear Extension)* the procedure still does not provide any additional guidance to the crews on the gear horn. If a short explanation of the gear horn logic was added to this procedure, like that in the NWA Flight Operations General Bulletin provided to the 747-200 crews subsequent to the accident, it may have alerted the accident crew that the problem had not been corrected.

With regards to the training provided by Northwest, it does not appear that the Operations Group looked at Northwest’s training in the area of the landing gear system. Interviews with pilots who had recently attended ground school or ground school instructors may have provided a better insight into the training that the Northwest pilots receive. It would have been valuable to note the depth of training that is provided on landing gear abnormalities, gear horn logic, and any detailed analysis of previous accidents that were landing gear related.

## **VI. CONCLUSIONS**

The accident at Agana, Guam resulted from several failures within the system. The design of the Flight Engineer Panel is atypical from a human factors standpoint and has contributed to at least four accidents. The nose landing gear door actuator’s lock key was designed such that it could be installed incorrectly without any obvious signs and the actuator failed the actuator lock test and the manual uplock test which can, under a limited set of circumstances, prevent the nose gear from extending. Northwest’s training and COM did not provide the crew with the systems information that the crew needed to understand why the gear horn continued to sound. The final factor was the crew not reading the COM procedure thoroughly and ensuring that all five lights were illuminated green.

Subsequent to the accident, Northwest issued a Flight Operations General Bulletin to all the Boeing 747-200 crews that discussed the previous accidents and the changes that were being made to the *Red Light Remains On (After Gear Extension)*. These changes include a graphic that was added to the COM to give crews a visual picture of the lights they are to look for. The Flight Operations General Bulletin also provided crews with an increased level of systems knowledge so crew would have a better understanding of the gear lights and horn logic. ALPA believes that the information presented to the crews in the Flight Operations General Bulletin should have been part of the initial and recurrent training for Boeing 747-200 crews.

## **VII. FINDINGS**

1. The Nose Landing Gear Door Actuator Lock Key design was modified to preclude the key from being installed incorrectly, but the part number remained the same.
2. The Nose Landing Gear Door Actuator Lock Key was incorrectly installed.
3. The Northwest COM was in compliance with the Boeing manual, but neither provided additional detailed information to the crew on gear warning horn logic.
4. A Fly-By would have alerted the crew that the nose gear was not down, but the procedure is prohibited by the airline.
5. Based on the CVR evidence and the testing of the panel by Northwest subsequent to the event, it appears likely that this crew saw the four green lights and not five which resulted in the crew initiating their second landing attempt with the nose gear retracted.
6. The crew silenced the landing gear aural warning horn by pulling the aural warning circuit breaker.
7. There was insufficient information to ascertain the effectiveness of the systems training provided by Northwest with specific emphasis on the training of the landing gear system.

## **VIII. SAFETY RECOMMENDATIONS**

As a result of this investigation, the Air Line Pilots Association, International suggests the following recommendations.

1. To the Federal Aviation Administration, require manufacturers to change part numbers when a design change is implemented as a result of a safety re-design.
2. To the Federal Aviation Administration, require Boeing to modify the *Red Gear Light Remains Illuminated Following Gear Extension* procedure to include a diagram of the Landing Gear module on the Flight Engineer panel and highlight the five lights that should be illuminated.
3. To the Federal Aviation Administration, ensure that airlines do not prohibit procedures which, under some circumstances, may have a value in troubleshooting a safety problem. In addition, ensure that airlines provide adequate training to flight crews on proper use and potential misuse of those procedures.