NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Aviation Engineering Division
Washington, DC 20594

November 5, 2004

MISCELANEOUS INFORMATION

DCA02MA001

A. ACCIDENT

Location:	Belle Harbor, NY
Date:	November 12, 2001
Time:	09:16:14 EST
Aircraft:	American Airlines Flight 587, Airbus Model A300-605R, N14053 Manufactures Serial Number (MSN) 420

B. STRUCTURES GROUP

Chairman: Brian K Murphy
National Transportation Safety Board
Washington, DC

C. AIRBUS REPORT

1. American Airlines Flight 903 Merged Timeline of Events

NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594
September 17, 2004

AA903 Merged Timeline of Events

Blue Text – Airbus Timeline
Red Text – AAL Timeline

Date	Description
May 12, 1997	Flight 903 accident occurs.
May 13, 1997	Airbus and NTSB Miami field office receive notice of what American Airlines describes as a "turbulence encounter." The NTSB initiates a Field Investigation managed by the Miami Regional Office. Airbus was not a party to, nor did it participate in this field investigation.
May 12-14, 1997	American conducts inspections of 070 in MIA, including inspection for "flight in excessive turbulence," per Airbus Maintenance Manual. (AA 0117829-0117835; 0117850-0117851).
May 14, 1997	American ferries the aircraft to JFK for repair per Airbus Maintenance Manual. (AA 0117850-0117851).
May 16, 1997	Airbus receives the DFDR data from American (AIB 0295652; AIB 0019421-0019424). Airbus states that American is "very interested" in Airbus' analysis of the data since the aircraft experienced high g loads, extreme pitch angles, roll angles and rates and heading changes. (AIB 0295652).
May 21, 1997	Airbus Flight Guidance Systems Manager Olivier Illes acknowledges in an email that the "DFDR data have been well received and decoded today." (AIB 0017850-0017851). Mr. Illes also provides a summary of the data.

May 22, 1997 (Public Hearing Exhibit 2S): American Airlines Captain David Tribout writes a letter to Airbus' Captain William Wainwright expressing his concern on the emphasis on use of rudder in the AAMP program.

May 23, 1997 (Public Hearing Exhibit 2S): Captain Wainwright affirms that he shares the concern expressed by Captain Tribout and agrees to a later teleconference.

May 28, 1997 Airbus's technical representative in Tulsa, Ike Bullamore, reports that American has invited Airbus to come to DFW to review the original DFDR tape and receive an explanation of the data correlation. (AIB 0019403).

May 29-30, 1997 Larry Rockliff attends the American Airlines AAMP conference in DFW at the invitation of AAL. At this conference, he has side discussions with Ken Higgins of Boeing and Tom Melody of McDonnell Douglas. All share the concern about the emphasis in AAMP on the use of rudder in inappropriate situations and the use of simulators to validate maneuvers well outside the flight envelope.

June 3, 1997 The NTSB Operational Factors Group conducts the initial Flight 903 interviews. (AIB 0017725-0017739).

June 4, 1997 After discussions with Boeing, MD, and the FAA on the side of the AAMP conference and Airbus officials in Toulouse, Airbus Vice-President for safety Larry Rockliff writes the first draft of the joint letter that was ultimately sent to Captain Cecil Ewell of American Airlines on 20 August 1997 (Public Hearing Exhibit 2C). He sent the draft to Ken Higgins (Boeing), Tom Melody (McDonnell Douglas), and Airbus internal training and flight test personnel. The draft states, "Excessive emphasis on [the rudder's] superior effectiveness over aileron/roll spoiler in high alpha environments is the focus of concern …artificially manipulating a simulator into an environment which is way beyond data package reference is not conducive to substantiated learning … the net result is high potential for negative learning experience …my concerns form only a small part of the AAMP program, however they have the most dramatic and controversial results."

June 4, 1997 John Schade of the NTSB meets with BEA and Airbus to discuss the FDR data from Flight 903. (AA 0117761-0117762).

June 5, 1997 (Proposed and Rejected Public Hearing Exhibit): Captain Ken Higgins of Boeing Flight Test writes to Cecil Ewell to criticize the AAMP program's emphasis on use of rudder in upset recovery training. This draft

incorporates the same ideas discussed with Larry Rockliff and Tom Melody at the DFW conference.

June 5, 1997 — Gilles Robert of Airbus attends a meeting at the NTSB in Washington, D.C. (AIB 0295638-0295639).

June 5, 1997 — NTSB Operations Group issues its Field Notes from the June 3 interviews. (AIB 0017725-0017739).

June 6, 1997 — Airbus Miami training center receives faxed list of participants in 3 June 1997 meeting called by NTSB to discuss AAL 903. NTSB representatives include Paul Misencik, Corky Smith, and Evan Byrne. Attendees include Warren Vanderburgh, Joe Oyler, Tom McBroom, and Dave Tribout (all of American Airlines) as well as other employees of American and members of the Allied Pilots Association. No one from Airbus was invited to attend this meeting. The information discussed at that meeting was not shared with Airbus.

June 6, 1997 — NTSB holds a teleconference with BEA's Accredited Representative Daniel Cohen-Nir regarding the Flight 903 investigation. The Safety Board requests the BEA's assistance in the Flight 903 investigation. (AIB 0017779-0017781).

June 9, 1997 — Arnaud Blanc-Nikolaitchouk of Airbus asks Thierry Delest of "AS A/BTE/EG/CA" and Dieter Quast of DA Hamburg to investigate "[w]hether this aircraft could have exceeded certified loads and what would be the inspections to be performed?" (AIB 0019400). This same day, Airbus forwards the Flight 903 DFDR data to Marie Pierre of Airbus, Duncan Patrick of BAE and Dieter Quast of DA Hamburg (See Public Hearing Exhibit 7-LL, page 7; AIB 0295509-0295510). American was unaware of these internal Airbus communications until their recent production in the litigation.

June 11, 1997 — NTSB apparently generates DFDR plot marked "Revised June 11, 1997" that shows lateral acceleration levels up to 0.7g. The NTSB traces contained the same information as used by Airbus to estimate the loads to which the aircraft had been subject.

June 11, 1997 — William Wainwright records the telephone advice he gave to the Technical Group of American Airlines, including David Tribout, Chief Technical Pilot on AAMP's recommendations on rudder use. The Exhibit states, "Although rudder becomes more effective for roll control as speed is reduced, the normal lateral control (aileron + spoilers) is effective down to the stall on a/c such as the A300/310. …rudder is used as necessary (to avoid sideslip) it is not the primary source of roll. … simulators are not

accurate in non-linear parts of the flight envelope. They are particularly inaccurate for large sideslip angles, & a pilot may draw the wrong conclusion from maneuvers involving use of rudder at low speeds."

June 12, 1997 — Dieter Quast of DA Hamburg advises Mr. Blanc-Nikolaitchouk and four others that he "urgently recommends an inspection of this A/C [aircraft] . . . due to the promised relevant exceedance of Design Limit Loads A300-600R." He asks that this be sent via the "AS/DA FLT-Emergency Line" (AIB 0019399). American was unaware of this internal Airbus communication until its recent production in the litigation.

June 12, 1997 — NTSB formally transfers control of the investigation from their Miami office to the Washington, D.C. office. Richard Rodriguez is named IIC.

June 13, 1997 — Arnaud Blanc-Nikolaitchouk advises Jean Daney and Yannick Malinge of Airbus Flight Safety (with a copy to Airbus's Michel Curbillon) that DA Hamburg loads engineers have "clear concerns" about the rear part of the aircraft "which could have encountered loads higher than the design limit loads…. Additional investigation is currently under process within each partner company." (AIB 0295512). American was unaware of this internal Airbus communication until its recent production in the litigation.

June 16, 1997 — T. Thuernagel and C.L. Tanck of Daimler-Benz Aerospace transmitted a three-page document entitled "Preliminary Investigation on A300-600R, American Airlines, MSN 513 Rudder Movement vs. Rudder Travel Limiter." This report stated that six times during the Flight 903 event the actual rudder travel exceeded the design limit of the RTL, including one event involving a 63% exceedance. The document also stated, "From former development flight test and from our Design maneuver simulations, we have learned, that rudder movement from one side to the other, also with small amplitudes, generate high loads on fin and rear fuselage. . . . Rudder movement from left limit to right limit will produce loads on fin/rear fuselage **above ultimate design load**. (Emphasis in original.)" The document states that these high load factors and their combination "are not covered by loads design maneuvers according to JAR/FAR 25." (AIB 0295493-0295498). American was unaware of this internal Airbus communication until its recent production in the litigation.

June 17, 1997 — NTSB Vehicle Performance Engineer, John O'Callaghan, advises the BEA's Accredited Representative that the Safety Board is forming the Flight 903 Performance Group and asks BEA to provide data to form the basis of a technical study of the flight characteristics of the A300-600. (AIB 0018788-0018790). Mr. O'Callaghan invited Airbus to become a formal member of the group. He also noted that "earlier this month"

members of the FDR Group (including BEA and Airbus) had met to discuss the preliminary FDR readout.

June 18, 1997 — Airbus provides American with its analysis of the DFDR data. (AIB 0017853-0017860).

June 19, 1997 — Internal Airbus report states that "the DFDR was given to AIB for analysis and the study confirms high load factors for longitudinal and lateral aspects. Although these actual load factors are lower than previously announced, it appears that for some areas of the airplane limit design loads have been exceeded and for some others such as rear fuselage, fin and empennage the ultimate design loads could have been reached. In such conditions, it is necessary to require a closer inspection of the A/C. This inspection has to be done as early as possible. "

June 19, 1997 — Public Hearing Exhibit 7LL): E-mail 942.6272/97 from AI/SE to AAL stating that "the aircraft have sustained very high loads, in particular in the aft part … [and] … require the aircraft to be deeply inspected."

June 19, 1997 — Bernard Heciak of Aerospatiale Toulouse sends an email to Jean Daney in the Airbus Safety Department (with a copy to Gennaro Squeglia, Genevieve Superville, Georges Mousquet and Bernard Bissey) stating that "it appears that for some reason the airplane limit design loads have been exceeded and for some others such as the rear fuselage, fin and empennage, the ultimate design loads could have been reached." (AIB 0017902). American was unaware of this internal Airbus communication until its recent production in the litigation. [To our knowledge, Airbus has not provided copies of any reports or calculations containing the analysis, which led to Mr. Heciak's communication.]

June 19, 1997 — Thomas Grotsky of Airbus informs American that "some areas of the aircraft have sustained very high loads, in particular the aft part of the aircraft," and requests the results from American inspection of 070. (AIB 0017903). Grotsky does not disclose to American that Airbus believes that the 070 tail was exposed to lateral loads at or exceeding the "ultimate load" or that RTL limits were exceeded several times.

June 19, 1997 — American provides the initial inspection results to Airbus. (AIB 0017907-0017921).

June 20, 1997 — American Airlines fax providing details of inspections performed. All inspections of vertical stabilizer elements indicated "OK". The American Airlines inspection report lists substantial damage to the aircraft in the form of sheared fasteners, deformed nacelles, and engine component damage. This would suggest that the engine pylons and wing roots were

overloaded (sheared bolts). Internal American Airlines documents state that both engines were later replaced.

June 20, 1997 (Public Hearing Exhibit 7LL): E-mail from head of Airbus customer support to several members of Airbus internal investigation team not including loads engineers stating that, "AAL were informed about our serious concern in this issue and that we refrained from putting the a/c on the ground only because of the inspection results received from them today."

June 20, 1997 (Public Hearing Exhibit 7LL): E-mail from customer support to heads of Airbus internal teams involved in investigation and Airbus flight safety department summarizing for internal group the results of "our conference call today". The e-mail states, "further to inspection report and results provided by AAL, it has been decided not to recommend grounding of the A/C as it was previously considered, but to performed (sic) some additional inspections at the next opportunity, no later than the next A Check if external visual. … AAL is aware that additional inspections will be required and they agree to do them as requested." Finally, the message requests all recipients to provide details of all further inspections to be requested ASAP.

June 20, 1997 Based on the inspection results, Airbus states that, "it has been decided not to recommend grounding of the aircraft as it was previously considered." (AIB 0295587-0295588).

June 23-25, 1997 Airbus provides additional recommended inspection tasks. (AIB 0295576-0295577); (AA 0047911-0047912; AA 0047925-0047926). American and Airbus confer and agree on the final inspections.

Sometime after the June 3 meeting, NTSB headquarters took over the AAL 903 investigation from its Miami field office, and formed Operations, DFDR, Performance, and Systems groups. The NTSB called the first meeting to include Airbus as a party on June 26. By this point, the loads / stresses issues had long been fully developed and discussed between Airbus and American Airlines as part of the "return to service" process, much of which was discussed at the AAL 587 Public Hearing. The aircraft had been inspected, repaired, and cleared for further operation. The focus of the NTSB investigation was on the precipitating events.

June 24, 1997 Richard Rodriguez of the Safety Board requests documentation of the inspections conducted following the Flight 903 accident. (AA 0117862).

June 25, 1997 — John Darbo sends an email to Mr. Rodriguez with a compilation of maintenance performed prior to and after the Flight 903 accident. (AA 0117888-0117889).

June 26, 1997 — American takes 070 out of service.

June 27, 1997 — American completes the additional inspections as per Airbus instructions and returns the aircraft to service. (AA 0049713-0049720).

June 27, 1997 — AAL forwards results of additional inspection tasks to Airbus. Though some damage is noted to wing areas and engine nacelles, inspection report describes no damage on vertical stabilizer or fittings

June 30, 1997 — Airbus's technical representative in Tulsa sends all inspection data to Airbus in Toulouse.

June 30, 1997 — Ike Bullamore writes to customer support department, stating "the [additional tasks requested of AAL in Exhibit 48-49 and clarified in Exhibit 54-55] was completed on 27 June with AAL structural engineering Tom Forsberg on site and there were no findings."

July 1, 1997 — NTSB Systems Group asks all parties if there are "any additional issues/questions that the systems group should be addressing." (AIB 0017788-0017790).

July 23, 1997 — NTSB letter requests that American Airlines provide records of all inspections and maintenance done on the aircraft subsequent to the 903 event. Airbus is not aware of whether American Airlines fulfilled this request.

August 20, 1997 — (Public Hearing Exhibit 2C): Boeing, Boeing's Douglas Products Division, Airbus, and the FAA write to Cecil Ewell to comment and warn about the AAMP program's emphasis on use of rudder and simulator training of upset recovery.

September 22, 1997 — (NTSB Document Number DCA97MA049): The NTSB Operations/Human Performance Group Chairman's factual report makes no mention of rudder inputs or loads on the fin, though the topic of "Approach to Stall and Recovery Training" is a topic of the report.

October 6, 1997 — (Public Hearing Exhibit 2C): American Airlines writes to Boeing, Boeing's Douglas Products Division, Airbus, and the FAA to reject the advice given in the 20 August 1997 letter. AAL initially hesitates to send the letter, and the intended recipients do not receive this letter until 20 January 1998.

November 7, 1997 — NTSB Systems Group Chairman John Delisi circulated the draft Systems Group Factual Report. This report contained no discussion of the multiple failures of the RTL system that permitted rudder movements in excess of the design limit by as much as 63% in an incident in which the pilots were criticized for having overcontrolled the aircraft during a stall recovery or that this was not the first such event on Airbus aircraft. (As shown above by the June 16, 1997 Daimler-Benz Aerospace document, Airbus was aware, but did not disclose to the Safety Board or the parties, the multiple RTL exceedances.)

November 13, 1997 — Airbus submits its response to the draft Systems Group Factual Report. Again, no mention is made of RTL system's failure to contain the rudder within design limits or the loads incurred by the vertical stabilizer.

May 15, 1998 — Group Chairman John O'Callaghan circulates the first draft of the Aircraft Performance Study and requests comments from all parties. (AA 0116952-0117048).

June 10, 1998 — Airbus submits its comments to the draft Aircraft Performance Study.

June 30, 1998 — The Flight 903 Performance Group issues its final Aircraft Performance Study. (AA 0118958-0119051).

August 12, 1998 — Airbus provides its formal Submission to the NTSB (AA 0119058-0119059; 0119065-0119070):

- Airbus states, "The factual reports of the various Groups show that the pertinent events were thoroughly examined and the significant factors associated with these events were fully understood, considering the limitation of the information available."
- Airbus is aware, but its submission does not disclose, that:
  - The vertical fin was exposed to loads that exceeded ultimate load.
  - The A300-600 rudder travel limiter system failed and allowed the rudder to exceed its limits by as much as 63%. (AIB 0295497).
- Airbus's submission also fails to disclose:
  - The 1991 Interflug event in which an A310, also recovering from a stall, incurred lateral loads on its tail that exceeded ultimate load as a result of rudder reversals.

- Any of the other A300/310 high load events listed in public hearing Exhibit 7Q.

- Airbus's submission agrees with the Performance Group report that "careful use of the rudder to recover the bank angle when the lateral controls are ineffective is appropriate." Airbus further notes that rudder use may be appropriate if the aircraft is not responding appropriately to full aileron inputs. [As shown in the video at the NTSB public hearing, AAMP taught the same principles.]

- Airbus's recommended corrective action was limited to issuing a March 1998 Temporary Revision to the A300-600 Flight Crew Operating Manual ("FCOM") and the Quick Reference Handbook, alerting flight crews that the A300 primary flight display could momentarily blank out during recovery from unusual upsets.

August 28 1998 (Public Hearing Exhibit 2V): The Airbus Industrie Submission on AAL 903 highlights the incorrect nature of the crew's upset recovery response, stating, "Techniques that attempt to maintain a nose-high attitude while controlling bank angle with large rudder and wheel inputs result in secondary stalls and large lateral/directional oscillations experienced by AA903. ***… Rudder reversals such as those that might be involved in dynamic manoeuvres created by using too much rudder in a recovery attempt can lead to structural loads that exceed the design strength of the fin and other associated airframe components."*** All parties and technical advisors to the NTSB investigation are copied on the Airbus submission to the NTSB. Copied parties include American Airlines, the Allied Pilots Associations, and the FAA.

February 11, 2000 NTSB issues the probable cause finding with respect to Flight 903.

February 11, 2000 The 2000 NTSB Accident Synopsis (NTSB Document Number DCA97MA049) "determines the probable cause(s) of this accident as . . . [t]he flight crew's failure to maintain adequate airspeed during leveloff which led to an inadvertent stall, and their subsequent failure to use proper stall recovery techniques."

November 12, 2001 Flight 587 accident.

Late-November 2001 American orally recommends that the Safety Board evaluate other events involving rudder reversals, including Flight 903.

February 8, 2002 NTSB issues Safety Recommendations resulting from Flight 587.

February 22, 2002 NTSB and Airbus participate in a telephone conference and agree to recommend that the vertical stabilizer undergo NDT. (AA 0047771).

February 28, 2002 Airbus Customer Support Director sends a letter to American's Vice President Engineering and Quality Assurance stating, "the experience gained through the investigation of the accident of MSN 420 has led us to review the event, which occurred on MSN 513 during the summer of 1997. The result is that this aircraft sustained high lateral loads which are clearly exceeding the loads envelope for which this a/c is certified." This is the first time that Airbus told American that the Flight 903 tail saw loads in excess of the certified loads. Airbus recommends for the first time removal of the vertical stabilizer for non-destructive testing.

March 4-11, 2002 Airbus NDT inspectors inspect the removed vertical stabilizer from aircraft 070 and uncover minor delamination around the right rear lug of the vertical stabilizer and notify American of the finding. (AA 0040310-0040358). American receives conflicting messages from Airbus on the significance of the findings. Airbus on-site personnel orally inform American that the delamination found on the vertical stabilizer would be considered within factory repair limits. However, others within Airbus are recommending that American replace the vertical stabilizer.

March 11, 2002 Airbus issues press release concerning Flight 587 stating that it is "aware of only one event that involves loads approaching the severity of those encountered in the accident of flight 587 – one having occurred in Florida in 1997 and also involving an American Airlines aircraft." (AIB 0100948). No mention was made of the 1991 Interflug incident or any of the other high load events.

March 15, 2002 FAA issued AD 2002-06-09, amendment 39-12686, which applied to all A300, A300-600 and A310 airplanes. The AD required inspections of the airplane vertical stabilizer and other components following in-flight incidents resulting in extreme lateral loading.

March 18, 2002 Airbus sends American an Operators Information Telex discussing lateral loads on the vertical stabilizer and states that the Flight 903 event has been "reanalyzed" and the loads "recalculated using the latest available tools and methods. As a result, higher lateral load on the vertical stabilizer than those established in 1997 were generated during that event. In fact, the level of loads is evaluated to be beyond ultimate loads." (AIB 0017386).

June 6, 2002 Ernie Bracken of Airbus sent a follow up letter to American's VP Engineering and Quality Assurance. The letter states that Airbus had used

an "enhanced analysis process" to confirm that the loads experienced by the Flight 903 tail "far exceeded the maximum loads currently considered in the framework of the initial certification." Airbus stated that the 070 fin "must be replaced before further operation of the aircraft" because the tail was "exposed to loads above ultimate load". (AA 0040563).

July 9, 2002

Airbus (Marc Rolin, Ernie Bracken, and Jacques Leborgne) gave a Flight 903 presentation, designed to explain the need to scrap rather than repair the vertical stabilizer, to American engineers in Tulsa. (I attended this presentation.) Based on the Airbus presentation, it appeared that the rudder exceeded the RTL limits numerous times. When asked about this, the Airbus presenter confirmed this fact, explaining, that "the rudder load limiter is very slow," it is "not meant at all to react in this situation" and that the system has a "very big problem if speed increases quickly." They also reported this had been a long-term known problem with the RTL. This makes me question why Airbus did not either correct the deficiency or notify operators of the limitation. When asked when Airbus had discovered that the RTL had failed to work as designed, the Airbus representative replied that in 1997 they knew the loads were at or near 1.5 times limit load, but that they did not have the ability to do an accurate calculation until new techniques were developed after the American 587 accident. This was the first time American was advised that the Flight 903 rudder movements exceeded the limits of the rudder travel limiter system. In an effort to justify the need to replace the tail, Airbus explained that once they determined that the loads exceeded 1.5 times limit load they did not know how much load it would be able to sustain without failing. Therefore, it was not the degree of damage found during the inspection that dictated the tail replacement, it was the determination that the loads exceeded ultimate. (This raises the question of why the tail from the Interflug event in 1991 was not replaced.)