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

June 16, 2014

Airworthiness Group Chairman's Factual Report – Addendum 1

NTSB No: DCA12FA024

A. ACCIDENT

Operator: AAR Airlift Corporation
Aircraft: Bell 214ST, Registration Number N5748M
Location: 7 miles south of Camp Bastion, Helmund Province, Afghanistan
Date: January 16, 2012
Time: 1045 local time[1] (0615 coordinated universal time)

B. AIRWORTHINESS GROUP

Group Chairman:	Chihoon Shin National Transportation Safety Board Washington, District of Columbia
Member:	Ronald Price National Transportation Safety Board Washington, District of Columbia
Member:	Harold Barrentine Bell Helicopter Textron Fort Worth, Texas
Member:	David Gridley General Electric Lynn, Massachusetts
Member:	Bob Drake Federal Aviation Administration Washington, District of Columbia
Member:	Tom Howell AAR Airlift Corporation Melbourne, Florida
Member:	Maj. Scott Frisius United States Transportation Command Scott Air Force Base, Illinois

[1] The local time in Afghanistan is Coordinated Universal Time (UTC) +4:30.

LIST OF ACRONYMS

AMC	Air Mobility Command
BHT	Bell Helicopter Textron
CFR	Code of Federal Regulations
DC	District of Columbia
FAA	Federal Aviation Administration
FL	Florida
KTAS	knots true airspeed
NTSB	National Transportation Safety Board
PIC	pilot-in-command
TX	Texas
USTRANSCOM	United States Transportation Command
UTC	coordinated universal time
VA	Virginia

C. SUMMARY

On January 16, 2012 at 1045 local time, a Bell 214ST helicopter, registration number N5748M, operated by AAR Airlift Corporation crashed about 7 miles south of Camp Bastion, Helmund Province, Afghanistan. The accident helicopter, one of two helicopters on a 14 *Code of Federal Regulations* Part 135 flight under contract with the Air Mobility Command (AMC) of the United States Transportation Command (USTRANSCOM), departed Camp Bastion with no passengers on board. The three-member crew on board the accident helicopter consisted of the pilot-in-command (PIC), the second-in-command (SIC), and the crew chief. The helicopter impacted the ground on relatively flat terrain. All three crew members were fatally injured and the helicopter was destroyed by impact forces and subsequent fire. Weather was reported to be clear with unrestricted visibility.

Witness accounts from the crew of the second helicopter flying behind the accident helicopter reported both helicopters were at an altitude of about 800 to 1000 feet, climbing at a rate of about 300 feet per minute with an airspeed of about 120 knots, when the crew saw the accident helicopter roll sharply to the right in conjunction with a steep, nose-down pitch, during which the tailboom was observed to begin separating from the helicopter. The helicopter continued its descent with a nose-down pitch until ground impact. There were no reported mayday or distress calls.

Under the provisions of Annex 13 to the Convention on International Civil Aviation, the National Transportation Safety Board (NTSB) accepted full delegation of the accident investigation from the Ministry of Transport and Civil Aviation of the Islamic Republic of Afghanistan. The NTSB did not launch to perform an on-site investigation. The ground impact area and debris field were examined and photographed by the US military and AAR Airlift's Director of Ground Support Operations in Afghanistan. The wreckage was then collected and transported to the NTSB Training Center in Ashburn, Virginia (VA) for examination.

On September 9, 2013, members of the Airworthiness Group convened at Bell Helicopter Textron (BHT) facilities in Hurst, Texas (TX) to discuss with BHT engineers the information needed to run a math model to simulate the helicopter's response to a sudden and severe reduction in main rotor collective pitch. Results from the simulation predicted the helicopter would respond with a severe right roll and a nose-down pitch following a failure of the collective flight control system. On March 5, 2014, representatives from the NTSB and AAR Airlift convened at AAR Airlift facilities in Melbourne, Florida (FL) to witness a collective torque shaft support bracket removal from an exemplar Bell 214ST.

D. DETAILS OF THE INVESTIGATION

1.0 MATH MODEL SIMLUATION OF A SUDDEN AND SEVERE COLLECTIVE PITCH REDUCTION WITH PILOT AFT CYCLIC INPUT

Several math model simulations were performed by BHT involving a failure of the collective control system followed by a pilot aft cyclic response. A case was simulated where the main rotor collective pitch was reduced with blade pitch controlled by the collective (i.e. the collective controls remained "healthy"). An additional case was simulated where the collective pitch was reduced but collective control between the main rotor blades and the collective stick was severed. The case of the severed collective control predicted the helicopter would react with a sudden right roll and a nose-down pitch. Though this simulation predicted a main rotor flap angle exceedance resulting in hub stop contact, the simulation predicted the blades could get close to the tailboom but not exceed the nominal clearance of 100 inches between the main rotor blade tip and the tailboom. However, the math model did not consider the effects of tailboom bending in the simulations. According to BHT, the math model simulations were run both at 120 knots true airspeed (KTAS) and 145 KTAS, with no significant difference in the results. The results from the math model simulations are shown in **Figures 1 thru 6**, with "healthy" collective flight controls (left graph) compared to the math model simulation involving a failure of the collective control system (right graph). The collective pitch reduction input into the model begins at time (seen on the x-axis) 0.8 and concludes at time 1.0.

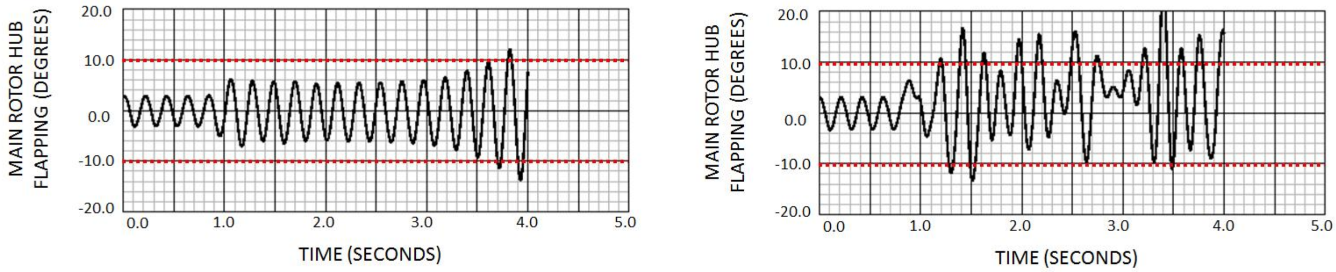

Figure 1. The predicted main rotor hub flapping from the "healthy" collective control simulation (left) and the severed collective control simulation (right). The red dotted lines indicate the location of the hub stops.

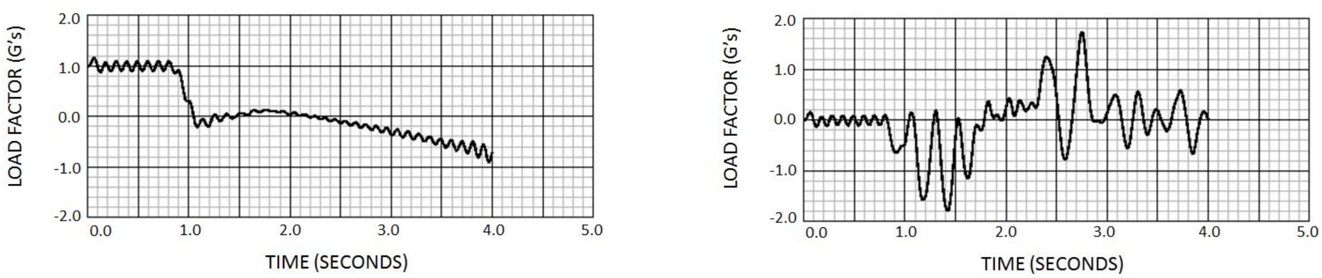

Figure 2. The predicted load factor experienced by the helicopter from the "healthy" collective control simulation (left) and the severed collective control simulation (right).

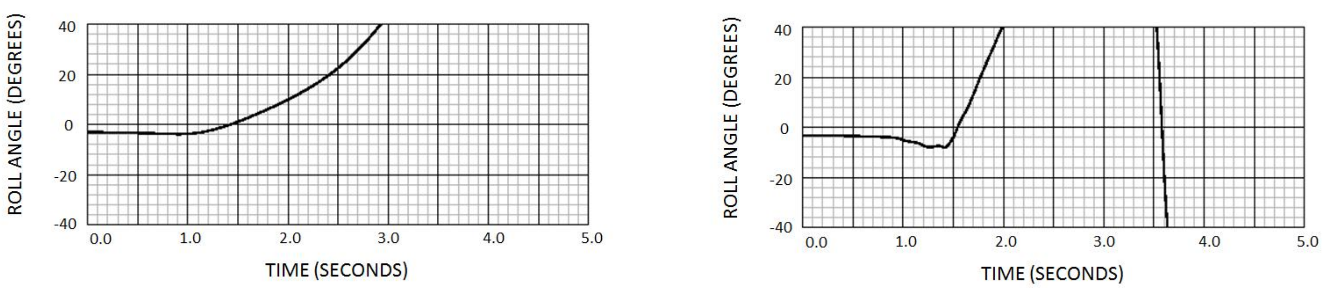

Figure 3. The predicted helicopter roll reaction from the "healthy" collective control simulation (left) and the severed collective control simulation (right). Positive values on the y-axis indicate a right roll.

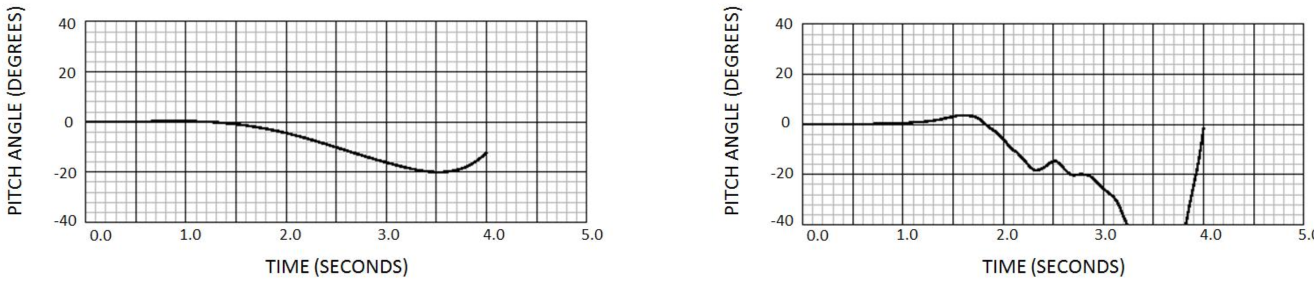

Figure 4. The predicted helicopter pitch reaction from the "healthy" collective control simulation (left) and the severed collective control simulation (right). Negative values on the y-axis indicate a nose-down pitch.

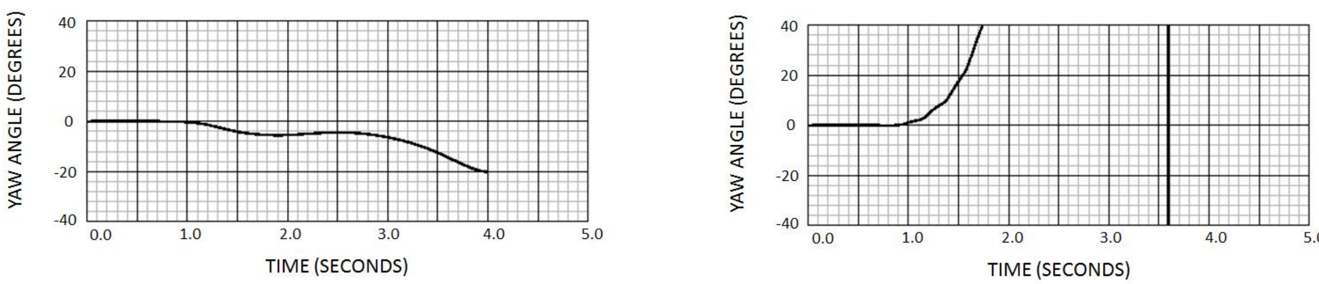

Figure 5. The predicted helicopter yaw reaction from the "healthy" collective control simulation (left) and the severed collective control simulation (right). Positive values in the y-axis indicate a right yaw.

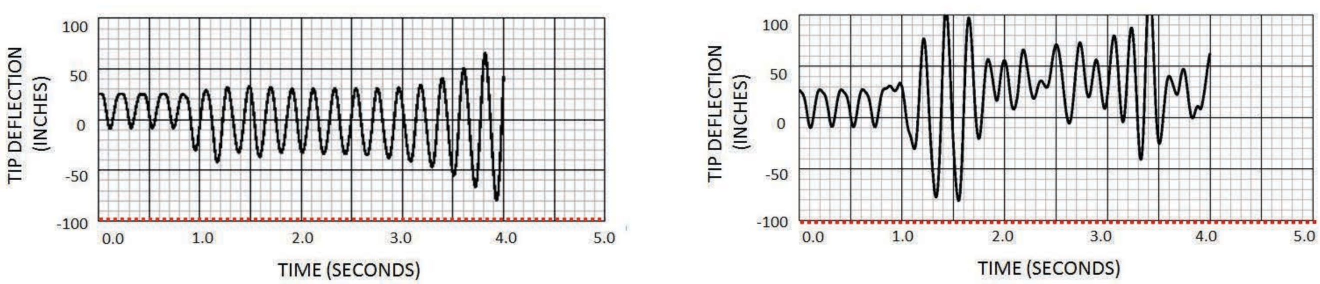

Figure 6. The predicted main rotor blade tip deflection from the "healthy" collective control simulation (left) and the severed collective control simulation (right). The red line at the bottom of the graph indicates the nominal clearance of 100 inches between the main rotor blade tip and the tailboom.

2.0 COLLECTIVE TORQUE SHAFT SUPPORT BRACKET MAINTENANCE PROCEDURES

The operator stated that they follow the manufacturer's maintenance manual, BHT-214ST-MM, for maintenance procedures. Chapter 67 of BHT-214ST-MM contains the maintenance procedures for the flight controls and section 67-9 contains the maintenance procedures for removal of the collective control system. The maintenance procedures contains instructions to index the parts during removal for the purpose of reinstalling any removed parts in the same location; to note the stack up of attachment hardware and direction of bolt heads; and to disconnect control tubes and "remove in a logical sequence." Because the sequence for disconnecting the control tubes could be open for interpretation, the procedures for the removal of the collective torque tube assembly, including the support bracket that was replaced the day before to the accident flight, was examined further by the Airworthiness Group to determine whether a certain logical sequence for disassembly could be detrimental to the components, and is discussed later in this report.

Additional instructional steps in section 67-9 are provided specifically for the removal of the pilot and co-pilot's collective stick, the collective jackshaft and stick supports, and the collective hydraulic actuator. Section 67-13 contains maintenance procedures for the installation of the collective control system, the end of which contains instruction to: check the collective control rigging; check controls for freedom of movement throughout full travel; and check security of all attachment hardware.

On March 5, 2014, representatives from the NTSB and AAR Airlift convened at AAR Airlift facilities in Melbourne, FL to witness a collective torque shaft support bracket removal from an exemplar Bell 214ST. The collective torque shaft support bracket is attached to the airframe by four bolts (**Photo 1**) while the torque shaft and torque tube are attached to four clevis connections (**Photo 2**). An attempt was made to try and remove the support bracket without disconnecting any of the clevis connections. In order to do this, the two bolts securing the torque shaft to the support bracket would need to be removed (**Photo 3**). However, due to the working space constraints within the open access port on the underside of the helicopter, directly underneath the main transmission, the wrench could not be practicably used to remove the two bolts securing the collective torque shaft to the support bracket; the method of first disconnecting the torque shaft from the support bracket without removing the four clevis connections was determined to be impractical. The second method attempted to remove the support bracket from the airframe involved: 1) disconnecting all clevis connections from the collective torque tube, 2) removing the four bolts securing the support bracket to the airframe, and 3) removing the collective torque tube assembly in its entirety (with the torque shaft and support bracket still installed) from the helicopter. This was found to be the most practical and logical sequence for removing the support bracket from the airframe. The reverse of the aforementioned procedures could be performed for the reinstallation of the collective torque tube assembly with the support bracket attached.

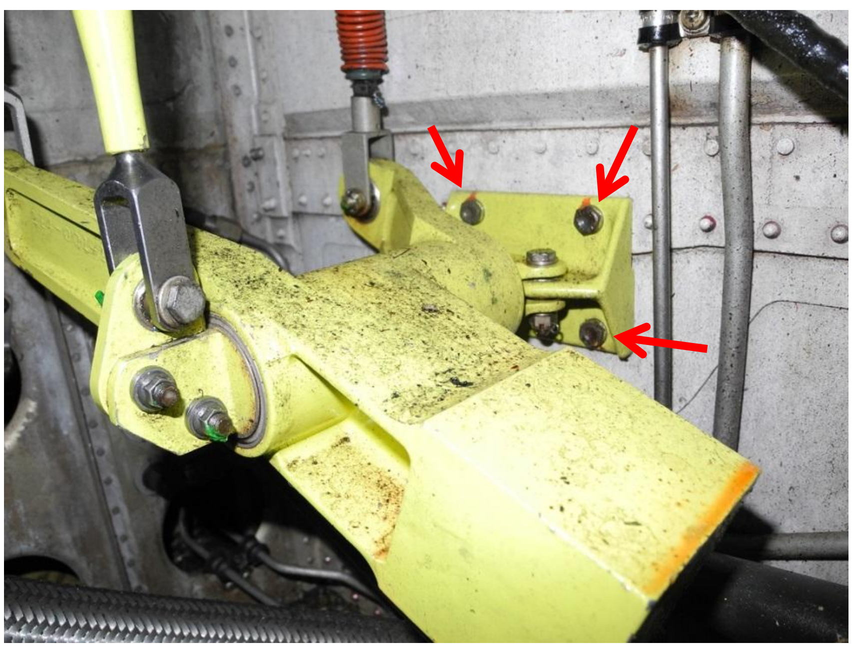

Photo 1. An overall view of the collective torque tube assembly. The red arrows point at three of the four bolts securing the support bracket to the airframe (fourth bolt is not visible in this photo).

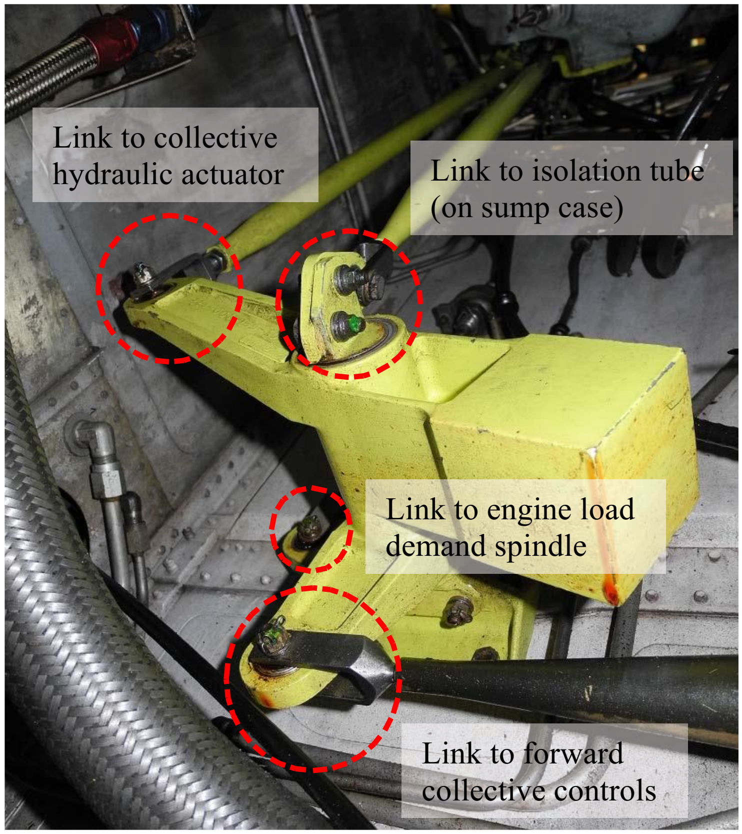

Photo 2. The four clevis connections on collective torque tube assembly (circled).

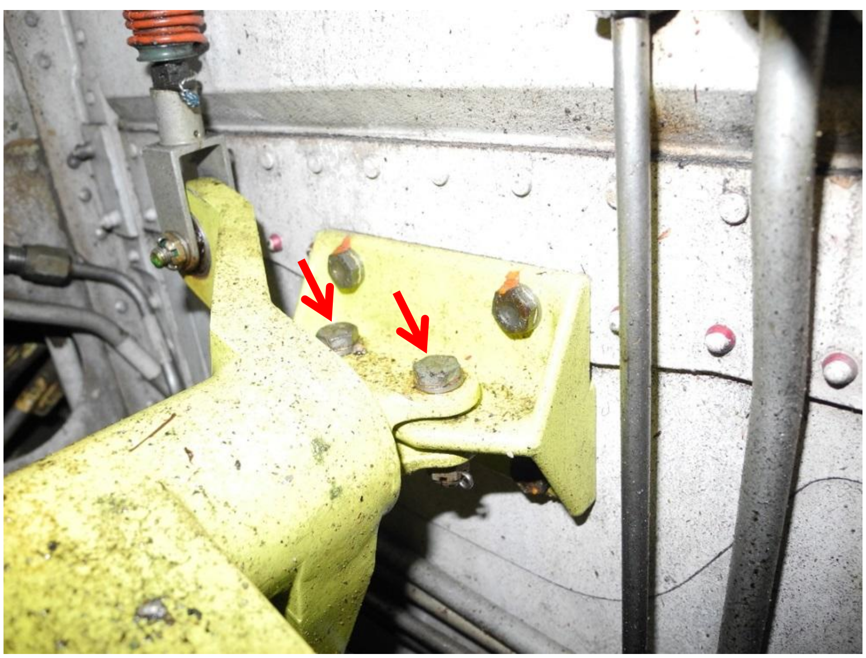

Photo 3. A view of the bolted connection between the support bracket and the torque shaft. The red arrows point to the two bolts securing the torque shaft to the support bracket.

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