National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: November 17, 2010

In reply refer to: A-10-132 through -135

The Honorable J. Randolph Babbitt
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On June 10, 2010, about 1034 central daylight time, a Bell 206 L-3 helicopter, N108PH, experienced a tail rotor failure, and the pilot made a forced landing in the Gulf of Mexico. After a controlled touchdown, the helicopter rolled inverted within seconds due to faulty inflation of the emergency floats. The commercial pilot was not injured, and the two passengers sustained minor injuries. The helicopter was registered to Petroleum Helicopters, Inc. (PHI), Lafayette, Louisiana. A company visual flight rules flight plan was filed for the flight, which had departed the company's base in Port O'Connor, Texas, destined for an oil platform (Mustang Island Block 103). Visual meteorological conditions prevailed for the on-demand air taxi flight conducted under 14 *Code of Federal Regulations* Part 135.[1]

After the helicopter rolled over, the pilot and the two passengers exited the inverted helicopter and were rescued within 15 minutes by a nearby boat. Examination of the float system revealed that the right-side mid float had burst from excessive pressure and that the right-side aft float did not fully inflate. The hoses from the mid and aft floats were found installed incorrectly to the port fitting, having been interchanged (crossed), which allowed nonrestricted and excessive gas flow to the mid float, resulting in the burst, and restricted and insufficient gas flow to the aft float. The National Transportation Safety Board (NTSB) is concerned that the design of the float system makes it possible for maintenance staff to accidentally interchange the hoses and, thus, could lead to a failure of a float to inflate properly. In an emergency situation, this could put aircraft occupants at serious risk.

The incident helicopter was equipped with an Apical Industries, Inc. (Apical), emergency float system that has a total of six floats: one attached to each skid at the forward, mid, and aft positions on each side of the helicopter. The emergency floats are connected by hoses to a composite-wound-cylinder reservoir containing helium gas at 3,600 pounds per square inch pressure that supplies compressed gas to all six floats through an activation valve. Once the valve is activated, the gas travels from the reservoir through a hose to a T-fitting located on the forward

[1] Preliminary information about this incident, CEN10IA314, can be found on the National Transportation Safety Board's website at <http://ntsb.gov/ntsb/query.asp>.

crosstube of the helicopter. (See figure 1.) The gas then splits off into two 0.30-inch-diameter hoses (left and right) and travels to two Y-shaped port fittings (left and right) mounted to the bottom of the crosstube. Each port fitting then distributes the gas to all three floats on that side of the helicopter through 0.30-inch-diameter hoses. (See figure 2.)

On the inside of the port fitting are two different-sized reducers (0.125 inch for the hose intended to lead to the forward float and 0.145 inch for the hose intended to lead to the mid float) that control the gas flow to the forward and mid floats so that the floats inflate with equal pressure despite their different capacities and distances from the cylinder. The forward float has a smaller gas capacity, thus requiring less gas and a shorter time to inflate and, therefore, has a reducer of 0.125 inch. The mid float is closest to the port fitting but has a larger gas capacity, thus requiring more gas and, therefore, has a reducer of 0.145 inch. The aft float is the farthest from the port fitting with a larger gas capacity, thus requiring more gas and time to inflate and, therefore, has no reducer to allow nonrestricted gas flow.

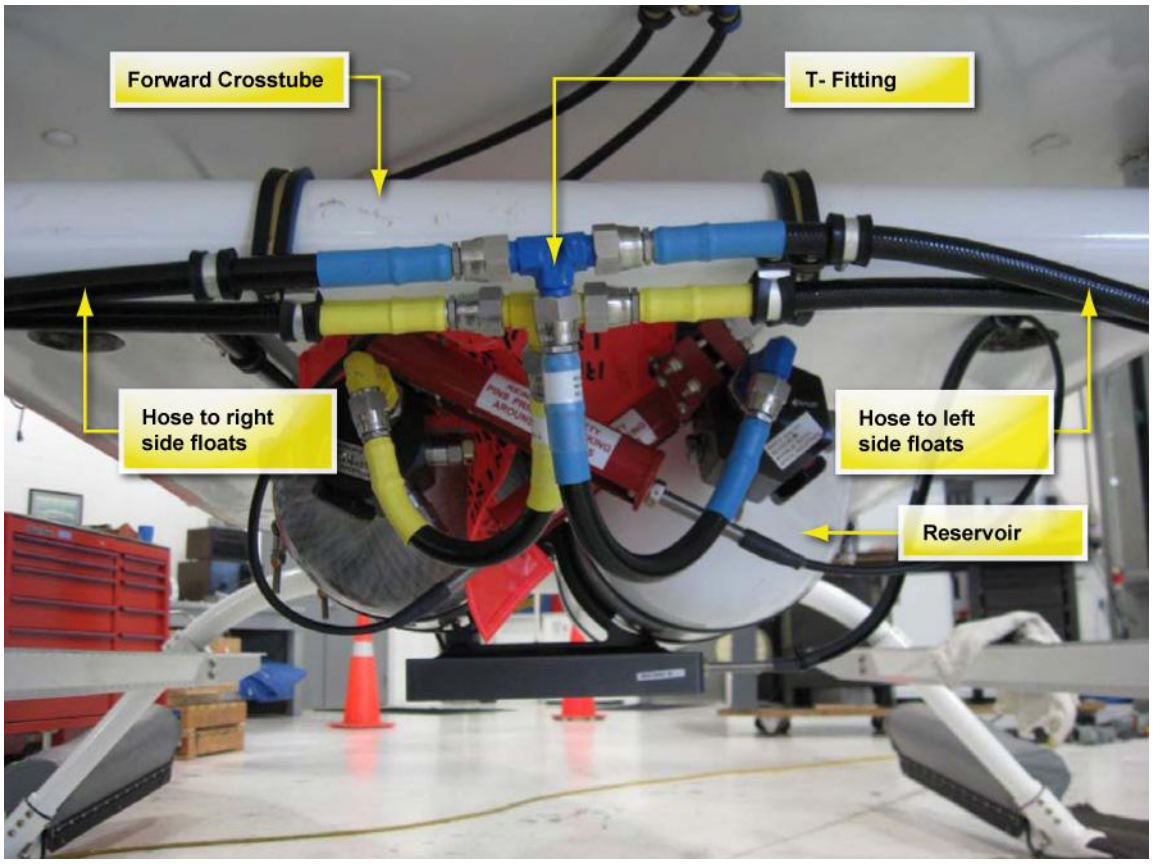

Figure 1. Apical emergency float system hose connections between the reservoir and the floats.

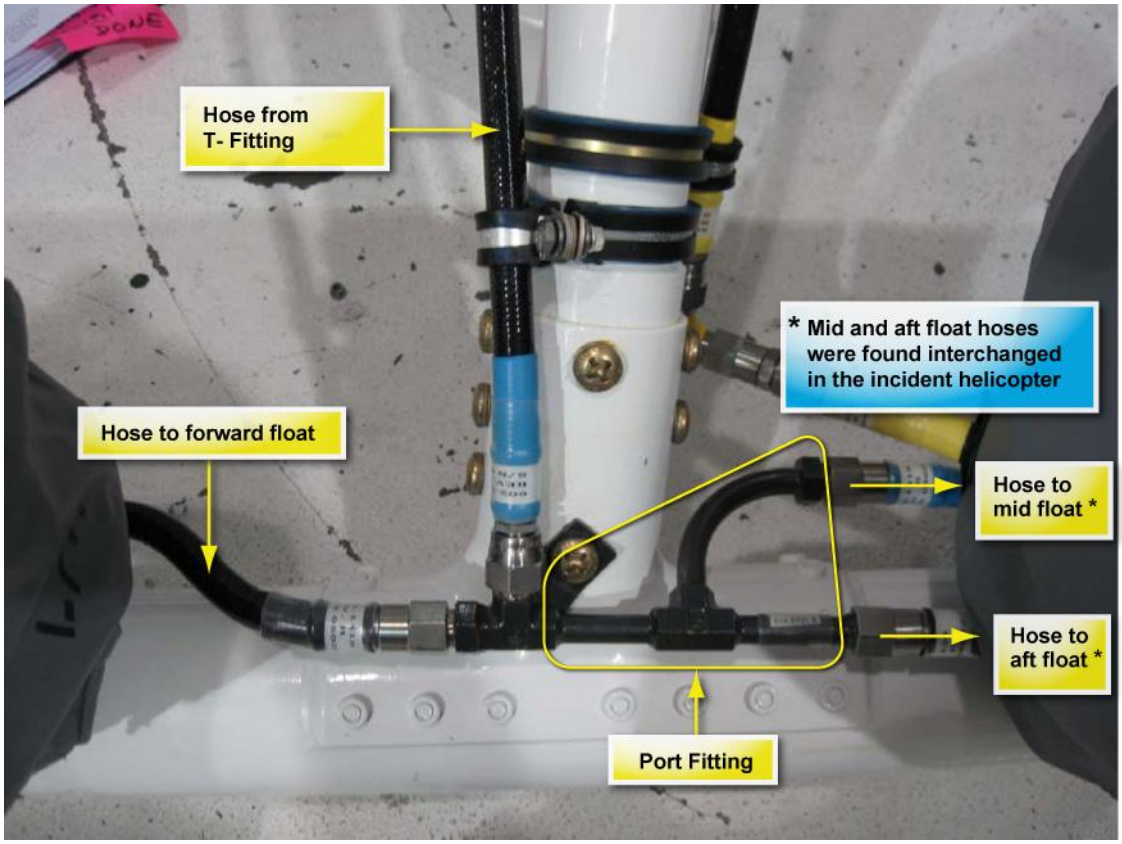

Figure 2. Apical emergency float system port fitting and hose connections to forward, mid, and aft floats.

As noted, examination of the incident helicopter revealed that the hoses for the mid and aft floats were interchanged, allowing nonrestricted gas flow to the mid float. This mistake is possible because both hoses can connect to either hose connection at the port fitting. According to Apical, if these hoses are interchanged and installed incorrectly to the port fitting, the gas will not distribute properly through the port fitting and the mid float will inflate quicker than the aft float. This error will result in increased pressure beyond the mid float's designed capacity, which can lead to bursting, and reduced pressure and insufficient gas flow to the aft float. This uneven gas distribution can lead to the risk of inversion because the floats will not inflate uniformly.

During 2003 and 2004, PHI installed the Apical emergency float system on 80 Bell 206 and 407 helicopters. The float system must be tested and inspected every 18 months and given a more extensive test and inspection every 3 years. The 18-month test and inspection includes removing the floats, inflating the floats using shop air, inspecting for leaks, and replacing the floats. The 3-year inspection includes testing of the float system by activating the reservoir assembly and using the gas in the cylinder to inflate the floats, replacing the cylinder, pressure testing the hoses, and replacing hoses and cable assemblies as needed. At the end of both the 18-month and 3-year tests and inspections, the floats are disconnected at the port fitting and replaced with newly packed floats that require reconnection to the port fitting.

In October 2006, during a 3-year test and inspection, PHI discovered improper inflation of the mid and aft floats on one of the helicopters due to incorrect installation of the hoses at the port fitting. PHI initiated a fleetwide campaign and inspected 72 helicopters. During this campaign, PHI found 18 helicopters with mid and aft float hoses interchanged at the port fitting, on either both sides or just one side of the helicopter.

As a result, on October 24, 2006, Apical issued a service instruction letter to operators of Bell 206A, 206B, 206L-L4, and 407 helicopters with emergency float systems and emergency float systems with attached liferafts to provide clarification regarding the proper installation of the float hoses running from the port fitting to the mid and aft floats and recommending that a hose-routing inspection be performed as soon as possible.

In 2009 and 2010, PHI began conducting another 3-year test and inspection of its helicopters' Apical float systems. On April 30, 2010, PHI found a helicopter with the mid and aft float hoses interchanged at the port fitting. That day, PHI initiated another fleetwide campaign to inspect the float system on Bell 206 and 407 helicopters. During this campaign, PHI found two more helicopters with the aft and mid float hoses interchanged at the port fitting.

After the June 2010 incident, PHI performed a third fleetwide campaign to inspect all helicopters and found five additional helicopters with the aft and mid float hoses interchanged. Despite heightened vigilance and multiple fleetwide campaigns to inspect and correct the mid and aft float hose installation at the port fitting, PHI has repeatedly found helicopters with incorrect installation because the design of the port fitting, with fittings and hose connectors of the same size, allows the float hoses to be easily misattached. Other operators also have reported instances of incorrect installation, including two instances reported to Bell Helicopter in the last 2 years and one instance reported to Apical by Astrum Helicopters in June 2010.

Based on the similar design and size of the connections of the float hoses to the port fitting and given repetitive findings by PHI and other operators, the NTSB concludes that the hoses that connect the mid and aft float to the port fitting can easily be interchanged and installed incorrectly, resulting in low inflation pressure in the aft float with simultaneous excessive pressure in, and rupture of, the mid float. The NTSB further concludes that a new design is needed to ensure that the required hoses will, in every instance, be connected only to their proper fittings. Such a design could use different sizes of hose-to-port fittings or different design connections so that a float's hose can only be connected to the proper opening at the port fitting and cannot be interchanged. Therefore, the NTSB recommends that the Federal Aviation Administration (FAA) require Apical Industries Inc., to redesign the emergency float system for helicopters such that the hoses for the mid and aft floats can no longer be interchanged and installed incorrectly to the port fitting. Once the redesigned emergency float system described in Safety Recommendation A-10-132 is available, the NTSB recommends that the FAA require operators of all helicopters currently equipped with Apical emergency float systems to install the redesigned system.

Until the float system is redesigned, significant risk remains that its hoses might be interchanged during helicopter maintenance. Although PHI has recently inspected its fleet, hose interchanges might have occurred after that inspection. Moreover, other operators have

helicopters equipped with Apical emergency float systems of the same design and may have the mid and aft float hoses interchanged at the port fitting. Therefore, the NTSB recommends that the FAA require operators of helicopters equipped with Apical emergency float systems to immediately conduct a one-time, two-person[2] visual inspection to ensure that the hoses from the mid and aft floats are properly installed to the port fitting. To mitigate the risk of improper installation following this inspection, the NTSB further recommends that the FAA, until the redesigned Apical emergency float system is installed as described in Safety Recommendation A-10-133, at every maintenance activity that requires disconnection of the hoses, require a two-person inspection of the re-installation of the hoses from the mid and aft floats to the port fitting and to sign a maintenance checklist attesting to proper installation.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration do the following:

> Require Apical Industries Inc., to redesign the emergency float system for helicopters such that the mid and aft floats can no longer be interchanged and installed incorrectly to the port fitting. (A-10-132)
>
> Once the redesigned Apical emergency float system described in Safety Recommendation A-10-132 is available, require operators of all helicopters currently equipped with Apical emergency float systems to install the redesigned system. (A-10-133)
>
> Require operators of helicopters equipped with Apical emergency float systems to immediately conduct a one-time, two-person, visual inspection to ensure that the hoses from the mid and aft floats are properly installed to the port fitting. (A-10-134)
>
> Until the redesigned Apical emergency float system is installed as described in Safety Recommendation A-10-133, at every maintenance activity that requires disconnection of the hoses, require a two-person inspection of the re-installation of the hoses from the mid and aft floats to the port fitting and to sign a maintenance checklist attesting to proper installation. (A-10-135)

In response to the recommendations in this letter, please refer to Safety Recommendations A-10-132 through -135. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our secure mailbox. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

[2] Since operators repetitively found interchanged hoses at the port fitting during their inspections, it is most likely that a single mechanic connected the mid and aft float hoses to the port fitting and then inspected and signed off on the work. Independent verification of one person's work by another person will provide another layer of redundancy and a system of checks and balances, lessen the potential for errors, and help ensure proper installation.

Chairman HERSMAN, Vice Chairman HART, and Members SUMWALT, ROSEKIND, and WEENER concurred with these recommendations.

[Orginal Signed]
By: Deborah A.P. Hersman
Chairman