Pacific Southwest Region – Lessons Learned

Main Rotor-Blade Strike, North Pass Fire, Mendocino National Forest

September 1st, 2012

Narrative:

At approximately 1515 PDT, a Sikorsky S-61 experienced a main rotor-blade strike during a water drop mission on the North Pass Fire on the Mendocino National Forest. The helicopter, operating under a CWN contract, was coordinating water drops with a Hotshot crew on Division V when the main rotor- blades struck a snag. This fire was being managed by a Type 2 Incident Management Team, with an Air Attack and Helicopter Coordinator, on scene when this incident occurred. All positions under the aviation branch were filled with qualified personnel.

Pilot Qualifications:

Both pilots were designated Pilot-in-Command (PIC) by the company and were carded for the mission they were performing. The pilot flying left seat was flying as the PIC, and has logged over 2,000 flight hours. This is his first year as a PIC with the company. The pilot in the right seat, Second–in-Command (SIC) has logged over 20,000 flight hours.

This incident happened on their 2nd drop on this particular spot, however, it was their 21st drop of the day. The pilots had flown together in the past but this was the first time they flew together with reversed roles as PIC and SIC.

Sequence of Events:

The helicopter, equipped with a fixed-tank was utilizing a dip site at Howard Lake located at approximately 3900 ft in elevation, and dropping the water on a hot spot located about 1000 ft below the dip site. Both Pilots are qualified as PIC for this aircraft, but the pilot with less time was at the controls of the aircraft for this mission to gain experience with a high time pilot (PIC). As the pilots made the approach to the target area, they could see smoke rising from the intended drop area, and set up for a downslope approach for their first of two drops on the target. The first drop was uneventful, and on the second drop the pilots were again, descending for a downslope drop. As the water was released, the Second-in-Command heard/felt the blades strike the tree and immediately called for power and to pull up. As the PIC initiated a climb-out from the site, the pilots noted a “lateral shudder” in the aircraft. When the strike occurred, the pilots were uncertain about the integrity of the blades and initiated emergency procedures. The SIC (the more experienced pilot) took over the controls from the PIC, and notified the Helicopter Coordinator (HLCO) of the incident and relayed their intentions to return to Howard Lake to do a precautionary landing. The pilots had previously identified suitable landing areas, including Howard Lake, in the event of an emergency. The HLCO located the helicopter in flight and followed it to the landing site. Another helicopter was working in the area, and picked up a load of water and circled the landing zone, as a precaution. After landing, the SIC contacted the HLCO to let him know they had landed safely and were shutting down.

After shut down was complete, the pilots inspected the main rotor-blade damage and noted that all 5 main blades incurred damage to the trailing edge about 18” inboard from the tip.

The HLCO platform landed to retrieve the pilots and fly them back to the Airport/Helibase. Enroute to the Airport/Helibase, they flew by the area where the strike had occurred and located a "buckskin" snag about 30 ft higher than the other trees. The snag was missing its top, and was estimated to be about 4-5" in diameter at the point where it had broken off.

"Snags are lurking in the smoke just waiting for you"…Chief Pilot

Informational: With metal blades, the manufacturer allows a substantial number of blade pockets to be completely missing and still maintain flight. However, when main rotor blades are damaged, the response of the blades to control inputs is compromised, due to loss of blade mass, length and/or stiffness. Additionally, blade damage can lead to a disruption in the smooth flow of air over the airfoils. The aerodynamic characteristics of the blade are subsequently degraded, and can reduce the lift capability.

Damaged blades also affect the rotor's fixed-system disk motion, resulting in an imbalance and the development of vibrations. Vibrations can be distracting to the pilot, can exceed structural fatigue endurance limits, can cause aeromechanical instabilities and can reduce helicopter performance. Depending on the amount of damage incurred and the distance the helicopter has to fly to get to a safe emergency landing zone, the aircraft controllability and outcome of rotor strikes can obviously vary.

Lessons Shared:

Pilot-in-Command (Left Seat Pilot):

The PIC admitted that he was focused on making the perfect drop for the "boots on the ground". This is a common error trap for many pilots as they want to do a good job for the people they are serving and can temporarily compromise their Situational Awareness (SA). The PIC shared that his focus should have been on flying the aircraft to the drop zone, and not so much on the target itself.

The PIC also noted that he should have maintained more altitude over obstacles on the approach to the drop. He feels that he may have been drawn to "fly like an experienced PIC" because he was performing well that day, even though he recognizes he is a low-time PIC.

The PIC also stated, "I've replayed the flight over a million times in my head and don't know how I missed seeing the tree or even getting the aircraft close enough to contact the tree. Yes, even with it being smoky and the snag sticking out of the top of the trees I never should have been in a position to make contact with a tree".

Second-in-Command (Right Seat Pilot):

The SIC was lulled into a false sense of comfort with the demonstrated abilities of his left seat pilot. As he was advising the new PIC during the first 10 or so drops, he admitted to being on the edge of his seat, looking out, and saying, "Go left, Get higher". He was more involved in the safety of mission because it was the first time he had flown with this pilot as a PIC. After a few drops, he got comfortable because he felt the other pilot was doing a great job. He feels he let his guard down and became target fixated and did not notice the obstacles around them. Pilot simply stated, "I got complacent, period".

What went Right:

The Flight crew conducted a mission risk assessment, based on the flight environment, terrain and identified very few options for emergency landing areas. Because of this, they looked for suitable landing areas and pre-planned their course of action should an emergency occur. They established a protocol for emergency procedures that included the pilot in the right seat taking the controls from the PIC, and deferring to level of experience of the SIC. When the emergency occurred, they were able to implement a plan they had already made, resulting in a smooth hand-off of the controls. **(They were able to implement a plan rather than to have to "develop" a plan when the emergency occurred).**

The Flight crew had pre-identified Howard Lake as their emergency landing zone (LZ) while they were working in Division V. The PIC stated after the rotor-strike occurred: "There was not a lot of lateral vibration; I've felt more lateral vibration during balance blade tracking; I knew I could make it to the road and make it easier for the mechanics, but only a fool passes up a perfectly good LZ during an emergency".

Additional coordination and support provided by the Air Attack and Helicopter Coordinator during the precautionary landing sequence helped to ensure an organized response of an "Incident within an Incident" and assured the safety of the flight crew. The Air Attack and HLCO managed the incident with the HLCO handling the emergency traffic with the aircraft and following them to the LZ and keeping Air Attack apprised of situation. This enabled Air Attack to start making notifications and still control the airspace which was essential in maintaining safety for all incident aircraft.

Lessons Learned:

Unfortunately, rotor-strikes are not an uncommon event, and a review of the Forest Service accident database shows that over 30 rotor strikes have been reported in the past 10 years with five fatalities resulting from 2 separate accidents. As a result, lessons learned from each of the events have been developed. Some of the common factors that contributed to the strikes were:

- **Ground personnel not communicating potential hazards to flight crews**
- Complacency – leading to loss of Situational Awareness and minimal clearance over terrain or obstacles
- A smoke obscured background can create a "flat light" where obstacles, such as snags can blend into the background making identification of obstacles difficult to locate in flight.
- Target fixation – due to production mentality to "get the job done"
- High/low - level recons of the drop area were not adequate or not done
- Pilot flying the helicopter below ETL (Effective Translational Lift) during drop missions (spot dropping requiring a hover profile—an important consideration at high density altitudes) – Not a factor in this incident, but a good reminder.

A Lessons Learned document on Rotor-Strikes was published in 2008 (IA 08-02) and was recently recirculated in light of the increased trend in rotor strikes this season. As a result the following information was shared:

- Do a low level recon of the area before the drop; give consideration to the wind and terrain
- Do not get drawn into the desire to please the customer
- Remain above the canopy and operate according to the Interagency Helicopter Operations Guide (IHOG), Chapter 11, paragraph XIII D3, 4 as cited below:
    - "In areas of sloping terrain or with obstacles rising to one or more sides of the cargo pickup/drop off area, or dipsite, the pilot shall maintain rotor clearance from all obstacles equivalent to the IHOG Chart 8-1 landing area safety circle requirements."
- When obstacles present a risk of contact with aircraft or rotor blades, the pilot should decline the mission until hazards are removed, additional line can be added or a better location can be identified. Pilots have the final say in accepting and/or denying any mission."

As stated above, rotor-blade strikes are unfortunately common in wildland fire suppression efforts. For this reason, Incident Management Teams are encouraged to brief regularly on the hazards and mitigations for operational "External Load" missions at helibase briefings. The risk assessment is documented and can be found within the Aviation Risk Management Workbook, under Helicopter Program: http://www.fs.fed.us/fire/av_safety/risk_management/index.html#ra

Air Operations Branch Directors should communicate to ground crews at morning briefings, the need to identify aerial hazards to pilots when they are working with them.

All helicopter managers should download and review the links listed below with their crew and pilot(s), these provided additional guidance and information on rotor-blade strike prevention:

http://wildfirelessons.net/documents/Rotor_Blade_Strike_Lessons_Learned.pdf

http://www.fs.fed.us/fire/av_safety/promotion/safety_alerts/04_08.pdf

http://www.fs.fed.us/fire/av_safety/promotion/lessons_learned/IA%20LL%20Rotor%20Strikes%2008-02.pdf

It is important to remember that rotor strikes with a stationary object could result in catastrophic outcomes, and it is important to share the Lessons Learned. The following are two different examples, that are reminders of rotor-blade strike occurrences, under Forest Service control that resulted in fatalities:

1. In 2007, a Bell 205++ was delivering blivits to a drop site, and had lowered the blivits into place and was moving upslope toward a large pine tree. As the helicopter maneuvered to take slack out of the line with the intent to release the blivits from the remote hook, the pilot did not arrest the upslope movement and impacted a tree located at his 4:00 position. Impact with the tree continued until the main stem of the tree was severed in several places. The aircraft climbed and then turned left toward the only egress route. But with the long-line still attached and entangled in trees, the pilot was unable to recover and crashed. The pilot did not survive. (Source, FS Accident database)

> *"Ground forces did not communicate a known hazard to the pilot"*

2. On August 13, 2006, a Eurocopter AS-350-B3 crashed, fatally injuring the commercial pilot and his three passengers. The helicopter had departed a Forest Service Helibase to transport a relief Fire Lookout to a lookout tower and return. Several Forest Service personnel at the Helibase said that the pilot would commonly navigate by following the mountain ridges. The visibility was reported to be "limited by smoke to 1 mile" in the lower valleys, but improved with elevation.

   The main wreckage was found on a Forest Service Road with all three main rotor blades attached to their respective blade sleeves. All of the blades exhibited impact damage from 20 to 30 inches inboard from their respective tips. All of the main rotor blade tip weights were missing. The NTSB determined the impact damage was the result of a main rotor strike with a snag that was estimated to be 90 ft tall. (Source, NTSB and FS Accident Database)

> *"Smoky conditions may limit the ability to identify obstacles in flight"*

All questions should be directed to: Yolanda R. Saldana, Region 5 - Aviation Safety Manager