Aviation Investigation Final Report

Location:	JUNTURA, Oregon	**Accident Number:**	SEA98GA159
Date & Time:	August 8, 1998, 15:05 Local	**Registration:**	N291B
Aircraft:	Bell 212	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	1 None
Flight Conducted Under:	Public aircraft		

Analysis

The pilot-in-command (PIC) had just maneuvered the Bell 212 helicopter into a 100 foot hover above a small reservoir to fill a 'Bambi' bucket for fire-fighting operations. The rotorcraft began to settle. The PIC, perceiving that he had encountered rotor vortex conditions, slipped the helicopter to the right with the bucket still in the reservoir. This, in turn, increased the angle of the long line from the vertical or zero degree reference. Immediately thereafter, the PIC noted a loss of power in the #1 engine. He then executed a single-engine autorotation, during which a rotor blade impacted a dead tree. Post-crash examination revealed that the long line had pulled aft and left from its vertical reference into the airframe structure (the 7:30 position of the hell hole in the belly of the helicopter) resulting in 1) the separation of one of the #1 engine push/pull rods, and 2) the deformation of engine control rods associated with the #1 engine flight idle stop (solenoid) which then sheared. The shearing of the flight idle stop resulted in a restriction/cessation of fuel flow to the #1 engine fuel control unit, and subsequent engine shutdown.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The pilot-in-command's failure to maintain proper clearance between the long line cable and hell hole structure resulting in airframe contact and binding of the cable. This resulted in separation/disabling of the fuel control solenoid and a subsequent restriction/cessation of fuel flow to the #1 engine. Contributing factors were separation of the #1 engine push/pull rod and a tree.

Findings

Occurrence #1: LOSS OF ENGINE POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation: HOVER

Findings
1. (F) THROTTLE/POWER LEVER,PUSH/PULL ROD - SEPARATION
2. (C) FUEL SYSTEM,FUEL CONTROL - DISABLED
3. (C) FLUID,FUEL - FLOW RESTRICTED
4. (C) EXTERNAL LOAD CABLE/HOOK - BINDING(MECHANICAL)
5. (C) CLEARANCE - NOT MAINTAINED - PILOT IN COMMAND

Occurrence #2: FORCED LANDING
Phase of Operation: DESCENT - EMERGENCY

Occurrence #3: ON GROUND/WATER ENCOUNTER WITH TERRAIN/WATER
Phase of Operation: LANDING - FLARE/TOUCHDOWN

Findings
6. (F) OBJECT - TREE(S)

Factual Information

HISTORY OF FLIGHT

On August 8, 1998, approximately 1505 mountain daylight time, a Bell 212, N291B, registered to Air One Helicopters, Inc., being operated by the Bureau of Land Management (Vale District), and being flown by an airline transport pilot, incurred substantial damage during a single engine auto-rotation landing following a total loss of power in the number one engine. The accident occurred approximately nine miles northwest of Juntura, Oregon, and the pilot was uninjured. Visual meteorological conditions prevailed and a company flight plan was in effect. The flight, which was engaged in fire fighting, was to have been operated as a Public Use mission.

The pilot reported in a written statement that he was "supporting fire fighters on the Beulah Butte fire in Oregon" and that "approximately 2PM in the afternoon I was dipping the last bucket on the third fuel cycle with a 100 foot line into a cattle tank. As the Bambi bucket settled onto the water I applied collective to maintain altitude while the bucket sank. The aircraft settled as I applied collective which initially I thought was settling in my own rotor vortex. Collective was reduced and the aircraft slipped to the right for the purpose of gaining clean air. As collective was reapplied to stop the descent the low rotor warning sounded. I looked at the triple tacometer [sic] in the door which indicated around 90% Nr then looked at the number one and two N1 guages [sic]. Number one was directly on '0' and number two was in the high '90's.' At this point an autorotative glide was established toward the shoreline and the hook release activated. Upon landing in the shallow end of the tank the main rotor blade struck a branch on a dead tree."

The pilot was also interviewed by a member of the Department of the Interior, Office of Aircraft Services (a participant in the investigation). The pilot reported during the interview that he "was all morning - probably on my third fuel load - slinging water to the fire on a 100-foot line with a Bambi bucket, 320-gallon one. I had just put the bucket onto the pond that I was dipping out of and noticed the aircraft starting to settle. I immediately assumed that I was possibly in my own vortex, lowered the collective, moved a little to the right to fly out of it as I reapplied the collective it continued to sink further and I got a low rotor rpm warning horn. I immediately realized something was wrong and was not going to continue hovering there. I went into the autorotative mode, turned the aircraft towards the level area on the pond there on the shoreline where I thought I could make a successful run-on landing. At the same time [I] attempted to punch off the bucket. Either I punched it or there was slack or I was not quick enough to punch off the line. There was a little bit of a jolt that I felt on the belly hook and after that I slid it successfully onto the shore of the dip site" (refer to ATTACHMENT INTV-I).

PERSONNEL INFORMATION

The pilot-in-command reported to the Federal Aviation Administration (FAA) at his last medical examination, a second class conducted November 3, 1997, that he had a total of 12,000 hours of flight experience. He reported on the attached Pilot/Operator Report (NSTB Form 6120.1/2) that he had a total of 500 hours in the Bell 212 rotorcraft (all pilot-in-command), with 80 and 50 hours in the previous 90 and 30 days respectively. Additionally, he reported that he had completed a bi-annual flight review (or equivalent) in the Bell 212 rotorcraft but did not report that date of this review. Records indicated that this review was conducted on May 11, 1998.

The operator reported that the pilot had flown a total of 4.9 hours within the 9 hour crew duty day on the day previous to the accident. On the day of the accident he had flown a total of 3.7 hours in a 7 hour crew duty day.

AIRCRAFT INFORMATION

The rotorcraft was equipped with two Pratt & Whitney PT6T-3 turboshaft engines. The "Bambi" bucket, according to the pilot, had a capacity of 320 gallons, which, at 8.345 pounds per gallon of water, would yield a load weight of 2,670 pounds exclusive of the empty bucket weight and associated hardware. The bucket was designed to easily tip over and sink when set in water to facilitate expeditious filling (refer to photograph 1).

The rotorcraft's maximum gross takeoff weight was reported by the operator as 11,200 pounds. The weight of the rotorcraft at the time of the accident was estimated based upon the following information:

6,320 pounds rotorcraft empty weight 246 pounds pilot weight (from 11/20/98 medical) 400 pounds fuel according to pilot 200 pounds Bambi bucket/line/shackle/cable 2,670 pounds 320 gallons of water @ 8.345#/gal

9,836 pounds rotorcraft weight at the site

No information was available from either the Office of Aircraft Services or Bell Helicopter Textron defining the maximum long line angle displacement allowable (from the vertical) during long line operations. Specifically, neither the operator nor the manufacturer were able to provide any documentation which the pilot could routinely use defining a maximum angle (from the vertical) for long line displacement before the line, hook, bumper or other hardware might come in contact with the surrounding hell hole structure. Nor was there any information available regarding the effectiveness of the long line hook release mechanism at angles other than purely vertical.

Additionally, no sensing system exists, nor is one required on the Bell 212 such that when any portion of the long line hardware contacts the hell hole structure the pilot is provided with a warning (e.g., horn, caution light, etc.). A member of the Office of Aircraft Services discussed the operating characteristics of the Bell 212 with the USDA Forest Service Region 4 Helicopter

Program manager who reported that pilots "normally can feel the cargo hook hitting the stops when the load is oscillating."

The pilot's assessment of angular displacement of the long line is acquired exclusively through visual observation through the rotorcraft's side window.

METEOROLOGICAL INFORMATION

The density altitude at Burns, Oregon, situated 4,144 feet above mean sea level (MSL) was calculated. Based upon the 1453 (mountain time) surface observation reporting a temperature of 30 degrees Centigrade and a station pressure setting of 30.04 inches of mercury, the approximate density altitude was 6,749 feet. The density altitude at the accident site at 1500 on the afternoon of the accident was estimated as 7,000 feet.

WRECKAGE AND IMPACT INFORMATION

The accident site was reported to be at 43 degrees 52.7 minutes north latitude and 118 degrees 6.3 minutes west longitude (refer to CHART I), approximately 4,700 feet MSL, and adjacent to a small reservoir (cattle tank).

On-site examination by FAA personnel revealed that the rotorcraft came to rest approximately 60 feet beyond the south edge of the reservoir. Skid marks were observed leading from the water's edge up to the rotorcraft's skids (refer to photograph 2). The underside of one rotor blade displayed a radial gouge which the pilot reported as being associated with the blade's impacting a dead tree at the site. Tearing deformation was noted on the underside of the rotorcraft in the hell hole area. This deformation was observed to extend along an axis oriented toward the seven o'clock position (when looking at the rotorcraft from above with its nose oriented in the twelve o'clock position - refer to photograph 3).

Examination of the interior of the hell hole area revealed a separation between the aft end of the number one engine fore/aft push-pull control tube where it connected to the bell crank for the number one engine jackshaft (refer to photograph 4, DIAGRAM I, and ATTACHMENT I). This separation would have effectively disconnected the pilot's throttle control between the collective twist grip and the number one engine's fuel control (refer to DIAGRAM I, item 10).

Additional examination revealed that the number one engine jackshaft (refer to DIAGRAM I, item 12) had been deformed and that the deformation was in an area associated with the rotorcraft's cargo hook if the hook were moved into the seven o'clock position (when looking at the rotorcraft from above with its nose oriented in the twelve o'clock position). The rubber bumper surrounding the hook was observed to have been torn in its seven o'clock position (refer to ATTACHMENT II).

Further examination revealed that the flight idle stop (solenoid) for the number one engine had been sheared (refer to ATTACHMENT III). This shearing would have effectively terminated fuel

flow to the engine and resulted in the shutdown of the number one engine (refer to DIAGRAM I, item 24).

TESTS AND RESEARCH

Rotorcraft systems and components were examined both at the accident site and also at the Juntura airport. The cargo hook electric and manual release modes were checked and found operational. The airframe fuel filter was opened and found to contain fuel. Fuel was also found in the number one engine inlet line as well as the transducer line. The electric, number one engine-driven boost pump was tested and found to operate satisfactorily with illumination of its corresponding annunciator light. The tank interconnect valve was found to be open and tested satisfactorily. No other engine control disconnects were noted other than those described previously. Both engine intakes were clear of debris and both exhausts displayed normal coloration with no evidence of foreign object damage within either engine.

The number one engine fuel pump, manual and automatic fuel control assemblies, and fuel valve, were removed from the aircraft and tested at the facilities of Allied-Signal West Coast Support under the oversight of an FAA inspector. All components tested were found to be within acceptable limits and/or normal wear considerations (refer to ATTACHMENT AS-I).

The engine was subsequently test run following repairs to the rotorcraft's airframe by the owner. The engine was reported to have run satisfactorily with no malfunctions.

Pilot Information

Certificate:	Airline transport; Commercial; Flight engineer; Flight instructor	**Age:**	50,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land; Multi-engine sea	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Helicopter; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	November 3, 1997
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	12000 hours (Total, all aircraft), 500 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N291B
Model/Series:	212 212	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	30842
Landing Gear Type:	Skid	**Seats:**	10
Date/Type of Last Inspection:	August 8, 1998 Continuous airworthiness	**Certified Max Gross Wt.:**	11200 lbs
Time Since Last Inspection:	4 Hrs	**Engines:**	2 Turbo shaft
Airframe Total Time:	11806 Hrs	**Engine Manufacturer:**	P&W
ELT:		**Engine Model/Series:**	PT6T-3
Registered Owner:	AIR ONE HELICOPTERS, INC.	**Rated Power:**	1600 Horsepower
Operator:	BLM (VALE DISTRICT)	**Operating Certificate(s) Held:**	None
Operator Does Business As:		**Operator Designator Code:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	BNO ,4144 ft msl	**Distance from Accident Site:**	40 Nautical Miles
Observation Time:	14:53 Local	**Direction from Accident Site:**	230°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	Unknown	**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	0°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	30°C / 16°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	BURNS (BNO)	**Type of Flight Plan Filed:**	Company VFR
Destination:		**Type of Clearance:**	None
Departure Time:	00:00 Local	**Type of Airspace:**	Class G

Airport Information

Airport:		**Runway Surface Type:**	
Airport Elevation:		**Runway Surface Condition:**	
Runway Used:	0	**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	43.719627,-118.019973(est)

Administrative Information

Investigator In Charge (IIC):	Mccreary, Steven
Additional Participating Persons:	JOHN R BLACK; BOISE , ID KENNETH M BROWN; VAN NUYS , CA ROBERT L PEARSON; SEATTLE , WA LARRY BROSNAN; BOISE , ID
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