NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

June 19, 2019

SURVIVAL FACTORS

Survival Factors Group Chairman's Factual Report

ERA18MA099

I. ACCIDENT

Operator	:	Liberty Helicopters
Airplane	:	Airbus Helicopter AS350B2 [N350LH]
Location	:	New York, NY
Date	:	March 11, 2018
Time	:	1908 eastern daylight time (EDT)

II. SURVIVAL FACTORS GROUP

Group Chairman	:	Emily S. Gibson National Transportation Safety Board Washington, DC
Member	:	Jason T. Fedok National Transportation Safety Board Washington, DC
Member	:	Amanda M. Taylor Federal Aviation Administration Oklahoma City, OK
Member	:	Ethan Fang NYON Air Kearny, NJ

III. SUMMARY

On March 11, 2018, about 1908 eastern daylight time, an Airbus Helicopter AS350B2, N350LH, was substantially damaged when it impacted the East River during an autorotation after the pilot reported a loss of engine power near New York, New York; the helicopter subsequently rolled inverted. The pilot egressed from the helicopter and sustained minor injuries. Five passengers were unable to egress from inside the helicopter and were fatally injured. The doors-off aerial photography flight was scheduled for 30 minutes and was operated by Liberty Helicopters under the provisions of Title 14 Code of Federal Regulations (CFR) Part 91. Visual meteorological conditions prevailed, and no flight plan was filed for the flight, which originated from Helo Kearny Heliport (65NJ), Kearny, New Jersey, about 1850 EDT.

IV. DETAILS OF THE INVESTIGATION

The accident helicopter was removed from the water and transported to the New York Police Department's (NYPD) Aviation Unit hangar on March 12, 2018. A Survival Factors Group was formed, and documentation took place March 13-16, 2018.

1.0 Helicopter Configuration

Photograph 1*- The accident helicopter N350LH.*

The helicopter was equipped with two double occupant bench seats in the rear of the cabin (providing four occupant seating positions) and an additional double occupant bench seat in the

front left side of the cabin. A single pilot seat was located at the front right side of the cabin. Rear seating positions were identified as 1-4 from the left side of the helicopter to the right side (see figure 1)[1].

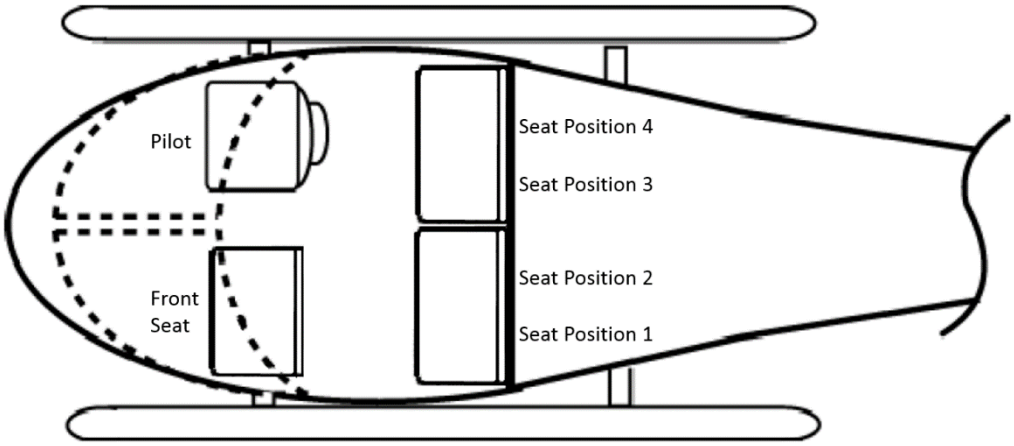


Figure 1- *Interior diagram of N350LH.*

Each passenger seat position was equipped with an FAA-approved Technical Standard Order (TSO) C114 3-point restraint[2], while the pilot's seat was equipped with a TSO 127a 4-point restraint. During FlyNYON[3] doors-off flights, 5 passenger seat positions were also equipped with an additional passenger restraint system, consisting of a fall protection full body harness (supplied by NYONair) connected via a locking carabiner to a looped tether that was affixed to hard points on the aft seat tube or floor of the cabin. Although worn by all passengers, the harness/tether system allowed passengers in seats 2 and 3 to release their FAA-approved restraints inflight and move to the side of the helicopter and sit on the floor, so passengers could take "shoe-selfie" photos (photos of their shoes with prominent landmarks in the background) and unobstructed view photos without the danger of falling. These seats were referred to by NYONair as "adventure seats." Passengers seated in the outboard seats rotated outboard to extend their feet outside the helicopter during portions of the flight. More information on the harness/tether system is contained in section 3 of this report.

The tethers were routed in a crossing pattern such that the tether for occupant in seat 1 was attached to a hard point on the aft seat tube of seat 4, the occupant in seat 2 was attached to a hard point on the aft seat tube at seat 3, the occupant in seat 3 was attached to a hard point on the aft seat tube of seat 2, and the occupant in seat 4 was attached to a hard point on the aft seat tube of

[1] The front seating positions were also identified as seat position 5 and seat position 6 from the left side of the helicopter. Only one passenger occupied the front seating position (position 5), therefore it is referenced in this report as the front seat passenger.

[2] A TSO is a minimum performance standard for specified materials, parts, and appliances used on civil aircraft. When authorized to manufacture a material, part, or appliances to a TSO standard, this is referred to as TSO authorization. Receiving a TSO authorization is both design and production approval.

[3] The accident flight was operated by Liberty helicopters who performed aerial photography flights under 14 CFR Part 91 as a contractor with NYONair from Kearny Heliport. For more information about the relationship between FlyNYON, NYONair, and Liberty Helicopters see the Operations Group Factual Report.

seat 1 (see figure 2). The front seat tether was attached to a fitting in the helicopter floor located at the inboard side of the front double occupant seat.

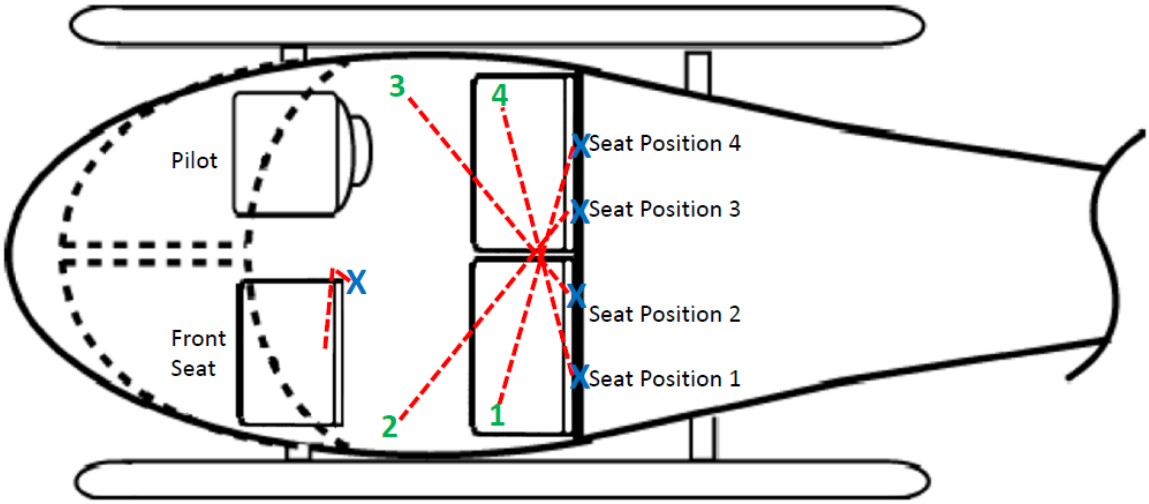


Figure 2*- Occupant tether routing and hard point attachment locations for N350LH.*

2.0 Helicopter Documentation

Upon arrival at the NYPD aviation hangar, the helicopter was intact, and no seats were dislodged.

2.1 Definitions

- Restraints- FAA-approved TSO C114 seatbelt safety system to include the lapbelts and the upper torso restraint.

- Harness- Velocity Full Body Harnesses were worn by the passengers in this accident and manufactured by Guardian Fall Protection. These harnesses were yellow in color and were compliant with Occupational Safety and Health Administration (OSHA) and American National Standards Institute (ANSI) standards. These harnesses had no FAA approval standard. Air Rescue Systems (ARS) harnesses meeting FAA TSO C-167 approval[4], which were blue in color, were also available but not used on the accident flight.

- Hard point- stationary rings/fittings affixed to the floor of the helicopter or seat tube.

- Tether- chain of fabric loops connected via carabiner to the ring on the back of the harness to the hard point in the helicopter.

[4] According to interview with the NYC terminal manager, NYONair had 15 of the blue ARS harnesses at the time of the accident. 5 in use and 10 hanging in the harness room "awaiting cutters."

- Tail- excess tether loops created once the tether was adjusted and connected to the occupant.

- Supplemental Passenger Restraint System (SPRS)- an FAA-approved restraint system that consisted of three general components: harness, lanyard, and attachment point on aircraft.

- Harness/tether system- the harness and tether combination developed by NYONair which was used prior to and on the day of the accident.

2.2 Seats

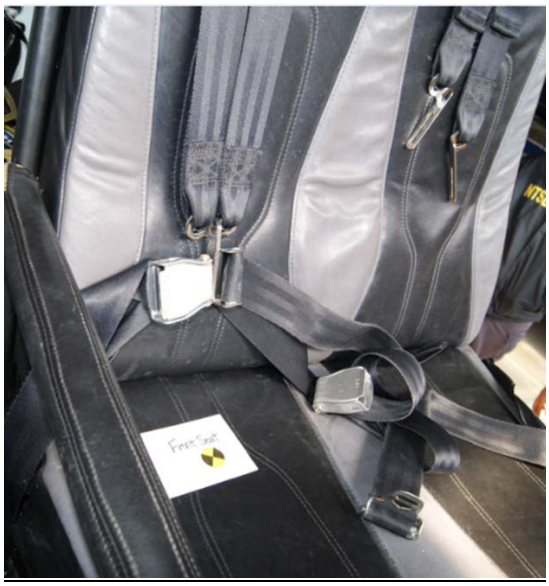
2.2.1 Pilot Seat

Photograph 2- *Pilot seat.*

The helicopter was equipped with a pilot seat installed on the right side of the cockpit. The seat manufactured by Zodiac Seats France (formerly Sicma Aero Seat) was designed to comply with TSO-C127A. The seat was attached to seat tracks mounted to the cockpit floor and was adjusted to full rearward position. There was no indication of vertical stroking. There was a data tag that read:

P/N 159120
RFF F279593
CCE 2113250
N UNV 16275 11/2012
Complies with TSO-C127A (when installed on an approved TSO (illegible) A Seat)
The rest of the data tag was illegible.

2.2.2 Front Double Bench Seat



Photograph 3- *Front double bench seat.*

Photograph 4- *The back of the front double bench seat.*

The front double bench seat was manufactured by Dart Aerospace. It was adjusted to the furthest forward position. The top of the armrest to the floor measured 19.75”. The distance from front seatback to the front of the rear bench seat was 20”. The front seat cushion measured 16” deep by 27” wide. The seatback cushion thickness was 2-3”. The horizontal distance from the upper portion of the cushion to airframe was 16.5”. The vertical distance from front corner of cushion to airframe was 21” and the horizontal distance from the front of the seat bottom cushion to airframe was 9.5”.

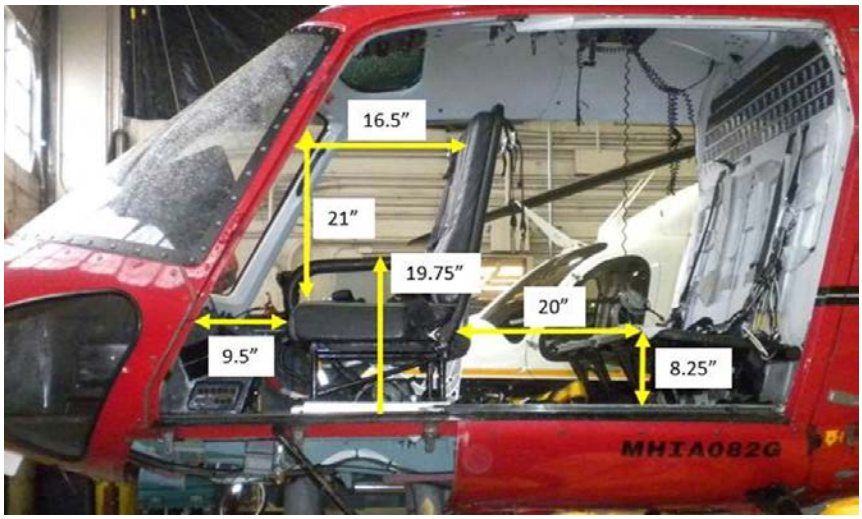


Figure 3*- Measurements of the helicopter cabin.*

2.2.3 Rear Bench Seats

Photograph 5*- Picture showing rear double bench seats.*

The two rear bench seats were manufactured by Airbus and each consisted of two seating positions. Each bench seat was attached to the floor of the helicopter with 2 screw points. The aft seat tube was attached to the rear bulkhead via a locking yoke. Each bench measured 32.5” across and had a height at the front edge of 8.25” from the floor.

No rear bench seat cushions were present, and fabric strips was had been installed over the hook and loop fasteners.

2.3 Helicopter Restraint Systems

2.3.1 Pilot Restraint System

The pilot seat was equipped with a 4-point TSO C114 rotary restraint system that was found unbuckled. The rotary buckle was functional. It was labeled Pacific Scientific Co with a code identification number of 45402. The inertia reel was functional. The lapbelt (inboard) was adjusted to a length that measured 11.5". The lapbelt (outboard) adjusted to a length measured at 13.75". The belts were labeled:

Pacific Scientific 45402
Duartte, CA 91010
PN 2000115-213
FA2000115-101
Date of Mfg. 02/13
Rated Strength 2500 lbs.
Conforms to TSO C114

2.3.2 Passenger Seat Restraint System

2.3.2.1 Rear Bench Seat Restraint System

The passenger seats on the accident helicopter were equipped with FAA-approved 3-point TSO C114 restraints. These restraints consisted of lapbelts with lift latch buckles and inertia reel shoulder harnesses. All the lift latch buckles released when opened to approximately 90°.

Upon arrival at the NYPD aviation hangar, the lapbelt of seat position 1 was buckled. Seat position 2 was fully assembled with the shoulder belt attached to the buckle and seat position 3 was unbuckled. Seat position 4 was fully assembled with shoulder belt attached to the buckle. The outboard front seat passenger restraint was unbuckled. The inboard front seat passenger restraint was fully assembled, and the pilot seat restraints were unbuckled. According to NYON Standard Operation Procedures (SOP)[5], the Customer Service Representative (CX)[6] would attach the FAA-approved shoulder belt restraint under the arm. According to multiple interviews, this was done so passenger could easily twist outward toward the aircraft door for taking pictures. See photograph 6.

[5] See Attachment 1 for NYON SOP

[6] NYONair ramp agents, referred to as "CX's" (customer experience representatives), assisted the pilots in the loading and securing of the passengers to the helicopter for FlyNYON flights.

Photograph 6- *Picture showing FAA approved shoulder harness restraint routed under the arm.*

2.3.2.2 Front Seat Restraints

There were two seat positions in the front double passenger bench seat, each equipped with 4-point restraints conforming to TSO-C114. The lower lapbelt portion was affixed to the seat at the seatpan seatback intersection. The buckle assembly was a lift latch design, with the tang of the buckle inserted through the ends of the upper shoulder belt restraints. The shoulder belts were then routed over the top of the seat back and were joined in an inverted Y configuration prior to terminating in an inertia reel that was mounted to a bracket, which was attached to the seat frame.

The inboard front seat passenger restraint, the seat position closest to the pilot, was buckled and no data information was obtained.

The outboard front seat passenger restraint, where the occupant was seated for flight, was found unbuckled and manufactured by Amsafe. It adjusted to its full 27” length. The webbing showed cupping from 14” to 21” in the proximal to distal direction.

The data tag read:

Amsafe
P/N 4147-2-041-2396
ASSY No. 4147-2030412396
Date Mfg. 40713
Rated 3000 lbs.
Cust P/N D4071-041
Conforms to FAA TSO-C114

The shoulder harness inertia reel was functional. The outboard length of the outboard front seat passenger restraint between the buckle and adjuster measured 11". The inboard length between the buckle and adjuster measured 11".

The inertia reel of the outboard front seat passenger restraint was labeled:

Date A0713
C/N D4071-041
P/N 4147-2070412396
CALIB 1.25 +/- 0.25 g
Rated 2500 lbs.
Conforms to FAA TSO C114

2.3.2.3 Seat Position 1 Restraints

Seat position 1's lapbelt was found buckled. The outboard (buckle) portion was adjusted to 13" and the excess was tied in a knot.

The data tag read:

P/N 34914010-12-070
Type 349
3000 lbs.
02-12 date
Model obscured
TSO C114 QAC 170
Anjou Aeronautique
49126 Tierce France

The inboard (insert tab) portion was adjusted to its full length of 44". The webbing showed some signs of cupping at 27" to 41" in the proximal to distal direction.

It was labeled:

P/N 34914010-12-070
49126 Tierce France

The shoulder harness was not connected to the standoff button on the insert tab. The inertia reel was functional. There was fraying around shoulder belt hardware.

2.3.2.4 Seat Position 2 Restraints

Seat Position 2 lapbelt was found buckled. The outboard length measured 17.5". It was labeled P/N 34914010-12-070 and everything else was illegible. The inboard (insert tab) portion

was adjusted to a length of 39”. The shoulder restraint connected to the buckle assembly and the inertia reel was functional. There was fraying around the shoulder belt hardware.

The data tag read:
P/N 34914010-12-070
Type 349
3000 lbs.
02-12 date
Model obscured
TSO C114 QAC 170

2.3.2.5 Seat Position 3 Restraints

Seat Position 3 lapbelt was found unbuckled and adjusted to full travel. The length measured 21”. It was labeled P/N 34914010-12-07; however, the last part was illegible. The insert tab side of the lapbelt (outboard) was adjusted to full travel. The length measured 45”. The shoulder restraint was not connected. The inertia reel was functional. There was fraying around the shoulder belt hardware.

The data tag read:

P/N 34914010-12-070
Type 349
3000 lbs.
02-07 date
Model obscured
TSO C114 QAC 170
Anjou Aeronautique
49126 Tierce France

2.3.2.6 Seat Position 4 Restraints

Seat Position 4 lapbelt was buckled. The length measured 13” and the excess was tied. The tag was illegible. The insert tab side of the lapbelt (inboard) was adjusted to full travel. The length measured 44.5”. The shoulder restraint was not connected. The inertia reel was functional. There was fraying around the shoulder belt hardware.

The data tag read:

P/N 34914010-12-070
Type 349
Rated 3000 lbs.
02-07 date
Model illegible
Conforms to TSO (the rest is illegible)
Anjou Aeronautique

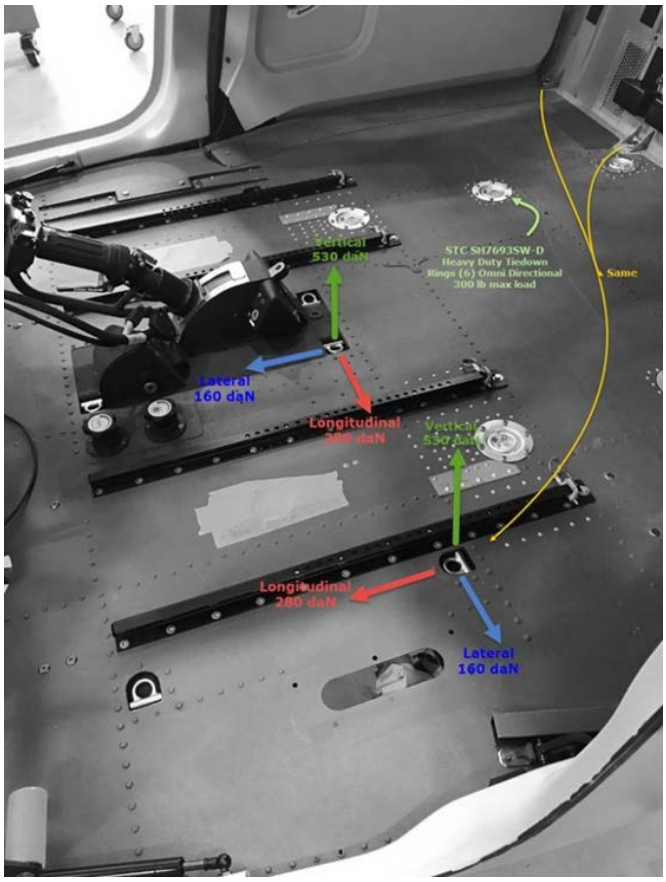
3.0 Harness/Tether System

Passengers were secured in the helicopter on FlyNYON flights (using both NYONair and Liberty Helicopters aircraft) by means of a harness worn by each passenger, and a tether attached to the harness (via a locking carabiner) and secured to a hard point in the helicopter cabin. According to the NYONair chief executive officer (CEO), the harness/tether system was developed by a production associate with the company and other production pilots and allowed passengers to move towards the side of the helicopter while it was in flight. He stated it was a concern of his that someone might unbuckle and fall out of the helicopter.

4.0 Hard Points

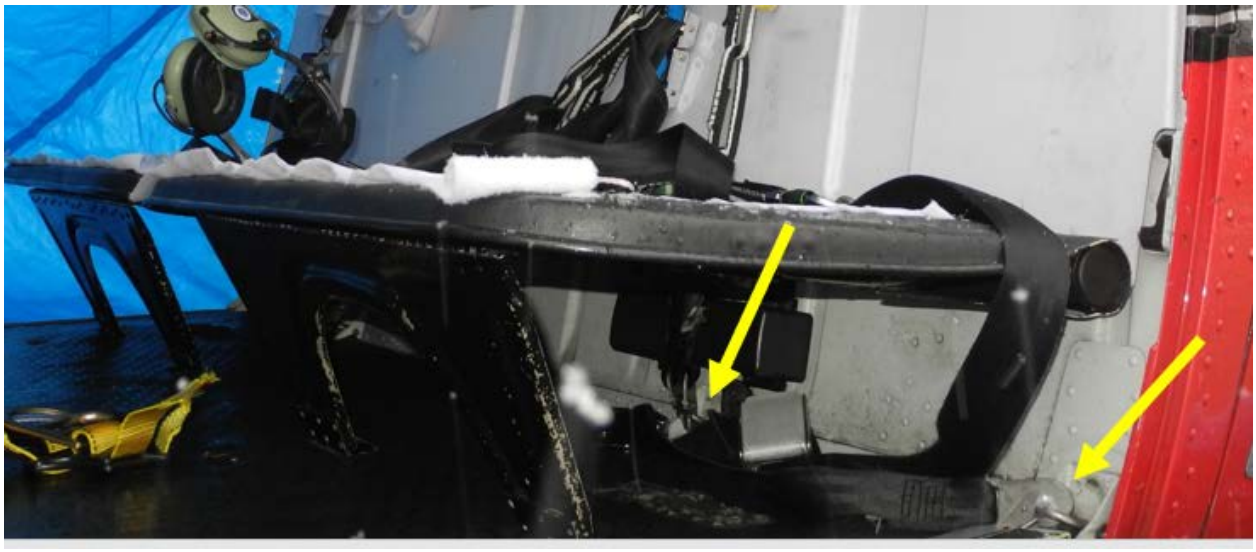
The front-left passenger and the rear bench seat tethers was connected to hard points via carabiners. The front-left hard point swiveled laterally. Load limitations are provided for the use of transport cargo in case of front left seat removal and rear benches folding back according to the AS350 B2 system Description Section 25-20-00, Chapter 01 ("Equipment and Furnishings – Seats – General), §4 ("Cargo"). The load limitations in the fore-aft, lateral, and vertical axes are described in photograph 7. Carabiners with tethers were attached to hard points on the rear bench bar tube anchors. According to the AS350 B2 documentation, no use is described on these anchors except for the lapbelts. According to Airbus, load limitations are not provided for the anchors located on the rear bench bar because they are not supposed to be used for anything other than the standard lap seat belts.

For all four seat positions on the rear bench, each seat's lapbelts were found connected to the floor anchors/hard points adjacent to the rear bulkhead. According to the AS350 B2 Maintenance Manual section 25-22-00, chapter 4-4 ("Removal / Installation – Rear Seat Bench Passenger Seats"), tasks requested that the seat lapbelts to be disconnected/connected to the rear bench tube anchor for the four-seat rear bench configuration. No task was available to disconnect/connect the seat lapbelts on the floor. Figure 1 of the AS350 B2 Maintenance manual section 25-22-00, chapter 4-4 ("Removal / Installation – Rear Seat Bench Passenger Seats") showed a partial representation of the lap seat belt connected to the rear bench bar tube anchor for the four-seat rear bench configuration. A diagram showing the complete lap seat belt connection configuration for all four-seat positions on the rear bench was not available in the AS350 B2 Maintenance Manual.



Photograph 7 *- Load limitations for the hard points in helicopter.*

Photograph 8 *- Lapbelts connected to the floor anchors/hard points adjacent to the rear bulkhead.*



Photograph 9 *- Lapbelts connected to the floor anchors/hard points adjacent to the rear bulkhead.*

Photograph 10 *- Floor anchors/hard points adjacent to the rear bulkhead*

Photograph 11*- Carabiner attaching tether to a rear bench seat tube hard point in helicopter.*

Photograph 12*- Carabiner attaching tether to the front seat floor hard point in helicopter.*

5.0 Tethers

5.1.1 General

Tethers were manufactured by METOLIUS and were chains of several loops of 11 mm Monster webbing of varying lengths.[7] Tethers were rated for a strength of 22 kN. All loops documented on-scene were of the nominal elongated oval shape and held a shape when squeezed.

[7] The loop colors in the already-assembled tethers corresponded to different loop lengths: tethers consisted of different color loops and each of these measured different lengths: yellow = 3", black = 4", green = 5". The rear seat tether was predominantly black loops and the front seat tether was predominantly blue loops. See below for additional information about each tether.

Investigators labeled each hard point attachment carabiner with duct tape and numbers corresponding to its associated hard point.

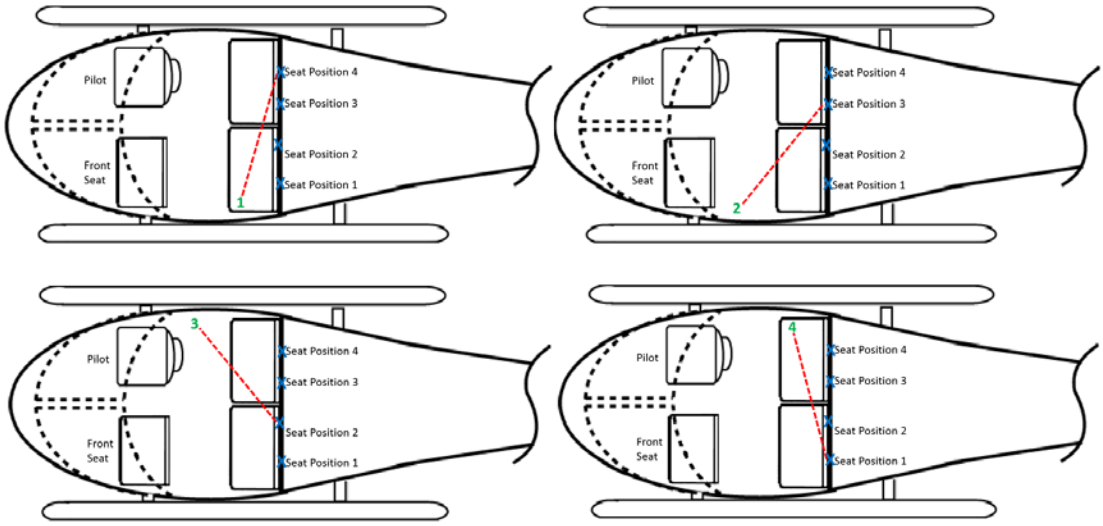
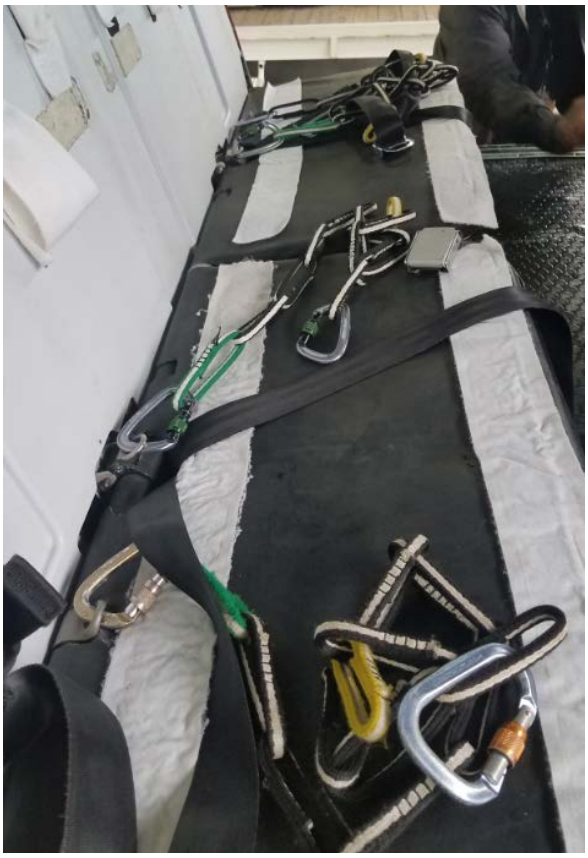


Figure 4*- Seat position, hard point attachment, and tether routing for rear bench seat.*



Photograph 13*- Tethers and carabiners attached to hard points on rear bench seat.*

5.1.2 Tether 1

Tether 1, connected to the hardpoint at seat position 4, consisted of 12 loops on the tether with 1 green loop, 10 black loops, and 1 yellow loop. The carabiner was in the 10th loop. The 9th loop was black. The tail consisted of 2 loops, 1 black and 1 yellow. The length from the hard point to the passenger harness attachment point was 40". The carabiner at the hard point connection had a silver screw, a gold body, and was fully locked. It was labeled 25/8/8kN. The carabiner at the occupant had an orange screw, a silver body, and fully locked. It was labeled 24/7/7kN.

The data tag read:
METOLIUS made in USA
CE0082
EN566
UIAA
22kN
2015
Small tag 03

***Photograph 14**- Investigator in seat position 1 wearing harness connected to tether (Tether 1 attached to the hardpoint at seat position 4).*

5.1.3 Tether 2

Tether 2, connected to the hardpoint at seat position 3, consisted of 12 loops on the tether, with 1 green loop, 10 black loops, and 1 yellow loop. The carabiner was in the 9th loop. The 8th loop was black. The tail consisted of 3 loops, 2 black loops and 1 yellow loop. The length from

the hard point to the passenger harness attachment point was 40.75”. The carabiner at the hard point had a green screw, a silver body, and was fully locked. It was labeled 25/8/8kN. The carabiner at the occupant connection had a green screw, a silver body, and fully locked. It was labeled 25/8/8kN.

There was no data tag on the tether.
The data tag read:
METOLIUS made in USA
CE0082
EN566
UIAA
22kN
2017
Small tag- 08

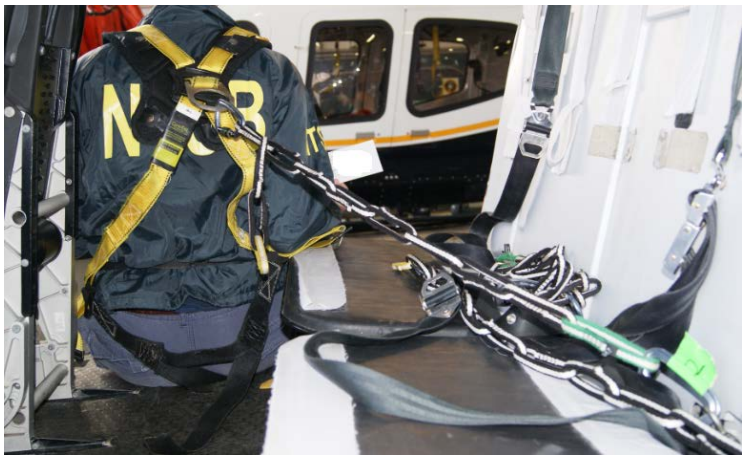
Photograph 15*- Investigator seated on left doorsill wearing harness connected to tether (Tether number 2 attached to the hardpoint at seat position 3).*

5.1.4 Tether 3

Tether 3, attached to the hardpoint at seat position 2, consisted of 12 loops, with 1 green loop, 10 black loops, and 1 yellow loop. The carabiner was in the 9th loop. The 8th loop was black. The tail consisted of 3 loops, 2 black loops and 1 yellow loop. The length from the hard point to the passenger harness attachment point was 39”. The carabiner at the hard point had a green screw, a silver body, and was fully locked. It was labeled 25/8/8kN. The carabiner at the occupant connection had a green screw, a silver body, and was fully locked. It was labeled 25/8/8kN.

The data tag read:

METOLIUS made in USA
CE0082
EN566
UIAA
22kN
2017
Small tag- 02



Photograph 16*- Investigator seated on right doorsill wearing harness connected to tether (Tether number 3 attached to seat position 2).*

5.1.5 Tether 4

Tether 4, attached to the hardpoint at seat position 1, and consisted of a total of 11 loops, with 10 black loops and 1 yellow loop, no green loop was present. The carabiner was in the 9th loop. The 9th loop was black. The tail consisted of 2 loops, one black and 1 yellow, and was 7 inches long. The length from the hard point to the passenger harness attachment point was 39.5". The carabiner at the hard point had a green screw, a silver body, and was fully locked. It was labeled 25/8/8kN. The carabiner at the occupant connection had a green screw, a silver body, and fully locked. It was labeled 25/8/8kN. There was no data tag on the tether.

Photograph 17*- Investigator in seat position 4 wearing harness connected to tether (Tether number 4 attached to seat position hardpoint 1).*

5.1.6 Front Seat Occupant Tether

The front seat occupant's tether was of a different design than the rear passengers. It was also manufactured by METOLIUS and rated for 22 kN. There was a total of 6 loops. There was 1 long 15-inch blue loop, 4 short 5-inch blue loops, and 1 5-inch yellow loop. The tether measured 40 inches. The carabiner was in the third loop. The tail contained 3, 5-inch loops for a total length of 15 inches and the terminating loop on the tether tail was yellow (see photograph 16). However, the length of the tail could be 20 inches in some configurations depending on positioning of the carabiner within the loop it was attached to. (See photograph 20). The data tag read:

METOLIUS made in USA
CE0082
EN566
UIAA
22kN
2016
Small tag 09

Photograph 18*- Front seat occupant tether.*

Photograph 19*- First long blue loop of front seat occupant tether.*

Photograph 20*- Front seat occupant's tether showing additional tail length (4 loops) resulting from positioning of the carabiner within the attach loop (aft looking forward).*

5.1.7 Front Passenger Seat Observations

The survival factors group examined the area within the cockpit to verify the potential reach of the tether tail to the floor-mounted controls when routed over or under the armrest. A group member secured in the harness/tether system was seated in the front seat, and then moved through a range of positions similar to those necessary to accommodate a "shoe selfie." According to multiple interviews, there was no standard procedure for routing the tether from the occupant to the hard point on the cabin floor. However, according to the pilot interview he generally routed the tether under the armrest during his flights.

Photograph 21*- Front seat occupant's tether routed over the armrest.*

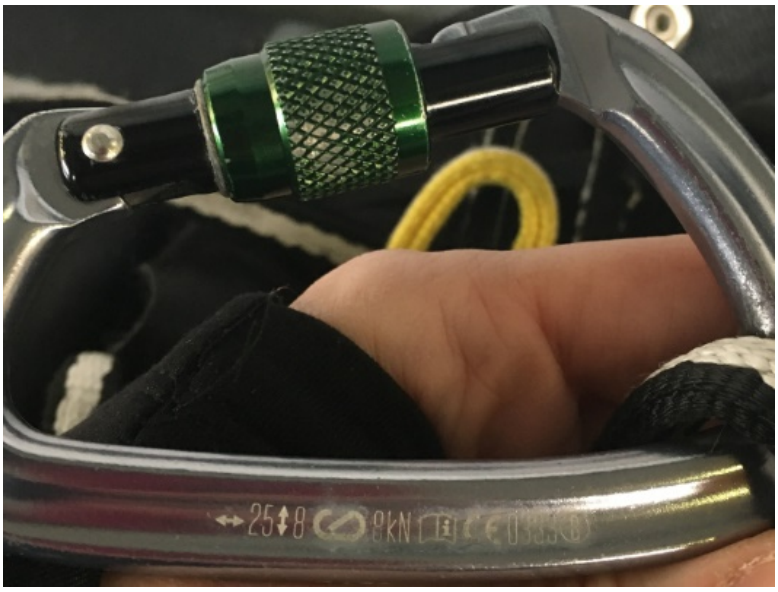
Photograph 22*- Front seat occupant tether routed under the armrest.*

Photograph 23*- Male subject seated upright in position to take a "shoe selfie" while wearing the FAA-approved restraints and harness/tether system.*

Photograph 24*- Male subject in front seat reclined in position to take a "shoe selfie" with tether tail loops visible.*

5.2 Carabiner Types

There were three different carabiners located on the aircraft. A green screw silver body carabiner, an orange screw silver body carabiner, and a silver screw gold body carabiner. All the carabiners were labeled. One of the carabiners was labeled with a rated 8kN strength and two with a rated strength of 7kN.



Photograph 25*- Green screw silver body carabiner (Label 25/8/8kN CE0333).*

Photograph 26*- Orange screw silver body carabiner (Label 24/7/7kN CE0333).*

Photograph 27*- Silver screw gold body carabiner (Label 24/7/7kN CE0333).*

5.3 Harnesses

5.3.1 General

The harnesses used on the accident flight were labeled as Velocity Full Body Harnesses and were manufactured by Guardian Fall Protection performance safety gear and marketed as fall protection harnesses and were compliant with Occupational Safety and Health Administration (OSHA) and American National Standards Institute (ANSI) standards. These Guardian harnesses were also depicted in a safety video provided to passengers by NYONair. The Guardian harnesses were yellow and did not meet any FAA approval standard. They were equipped with a ring attachment point, that when the harness was worn, would be positioned on the passenger's upper back.

During the survival factors group's familiarization tour of the NYONair terminal facility, it was noted that NYONair also owned 15 blue harnesses[8] with data tags containing FAA TSO-C167.[9] These harnesses were equipped with multiple attachment points on the passenger's chest, upper back, and lower back.

Portions of four of the five yellow harnesses were recovered. Two of the harnesses were obtained from the NYPD 19th precinct, one was obtained from the Medical Examiner Office, and one was found inside the helicopter.

Each harness was equipped with a pouch. The pouch was located on either the right or left side of the harness near the shoulder. Inside the pouch was a cutter. Passengers were instructed

[8] Only 5 of the 15 blue harnesses were used as 10 were waiting to be equipped with cutters.
[9] TSO-C167, Personnel Carrying Device Systems (PCDS), also known as Human Harnesses tells manufacturers what minimum performance standards (MPS) their systems must first meet to obtain approval and identification with the applicable TSO marking. TSO-C167 standards apply to equipment intended to transport personnel externally from a helicopter human external cargo (HEC)operations.

that the cutters were to be used as a means to cut the tether during an egress from the helicopter. Also attached to the harnesses was a lanyard that was secured to a smartphone holder with a handle. The harness was put over the shoulders like a backpack, then buckled via 2 mating buckles in the front with a rubber elastic strap fitted around the buckle. Two black straps were fitted around the legs and buckled together using 2 mating buckles. Carabiners were also used as an adjustment device to tighten the harness on a smaller individual. The harnesses could also be removed by unclasping the buckles located across the chest and thighs.

Photograph 28*- Forward and aft view of the occupant harness.*

Photograph 29*- Right and left side view of the occupant harness.*

5.3.2 Harness A

A portion of harness A was recovered and had a Benchmade olive green pouch attached that was labeled “made in the USA.” In the pouch there was a Benchmade Model 7 cutter, model number, NSN 4240-01-543-9618. There was an orange non-locking carabiner present, part #:11160-QC DOM 10/2015 and Serial # /01716.

Photograph 30*- Harness A as recovered.*

5.3.3 Harness B

A portion of harness B was recovered still connected to tether and floor hard point at the front seat occupant position in the helicopter. It was missing the strap section that would hold this pouch and cutter. There was a part number present, Part #: 1160-QC DOM 05/2017 and Serial # 26765/ 03778.

Photograph 31*- Harness B as recovered.*

5.3.4 Harness C

A portion of harness C was recovered. It was equipped with a black pouch to house a cutter however it was missing the cutter. There was a green non-locking carabiner present. It was labeled with part #: :11160-QC DOM: 05/2017 and serial #: 26765/ 04858.

Photograph 32*- Harness C as recovered.*

5.3.5 Harness D

This harness was removed from the female occupant by the Medical Examiner. The harness was labeled as a Guardian Fall protection performance safety gear. The harness had a black pouch attached to the left side of the harness. In the pouch there was a StatGear cutter. There was no part number present on the cutter. There was a blue non-locking carabiner present, it was labeled 24 7 7kN 0333. There was a green locking carabiner attached to the two aft shoulder strap portions of the harness. It was labeled 25 8 8kN 033B 7214. A blue lanyard was tied to the right shoulder strap. Attached to the blue non-locking carabiner as a zip tie with a headset cord. The wires at the tip of the cord was frayed.

Photograph 33*- Harness D as recovered.*

5.3.6 Harness E

This harness was never recovered.

6.0 Cutter

Each harness was equipped with a pouch on either the right or left side shoulder strap of the harness. Inside the pouch was a cutter[10].

Photograph 34- *Cutter secured inside a pouch of an exemplar harness.*

Photograph 35- *Cutter found with harness D.*

[10] A Statgear SuperVizor XT rescue cutter was also found wedged in the forward right green skylight of the helicopter.

Photograph 36- *Harness A cutter (Benchmade olive green pouch with a Benchmade Model 7 rescue cutter).*

According to the NYONair's safety video for passengers, the cutter was provided in the event of an emergency and secured to one of the chest straps that would allow you to "quickly cut through the harness if you are unable to reach the quick release carabiner." The video showed that the cutter was located on the left side of the harness and it stated that the cutter was "to cut through the harness." However, the video showed the cutter being used to cut the tether instead of the harness. The tether used in the safety video was a different webbing design than that used in the accident helicopter and was not affixed to a hard point on the aft seat tube. See photograph 34.

Photograph 37- *Screen capture from the NYONair safety passenger video showing use of a cutter.*

According to post- accident interviews, during the loading process, when the harnesses were being connected to the tethers neither NYONair personnel nor Liberty pilots showed passengers where to cut the tether. According to these post-accident interviews, Libery pilots had questioned whether the cutter would be effective; and the Liberty safety officer told the Liberty chief pilot that he was researching new cutters and tethers for passengers on FlyNYON flights. In late February 2018 the Liberty safety officer, the Liberty Director of Training, and the NYONair lead NYC pilot tested the cutters for effectiveness and found it to be difficult. The NYONair lead NYC pilot stated she was able to cut through a tether using the cutter in use at the time of the accident but not easily[11]. She also stated that the new cutter that had been tested cut very easy. The issue was added to the pilot safety meeting agenda for further discussion. Early March 2018 NYONair NYC lead pilot reported that the company was going forward with a bulk inventory purchase which included the new style cutters. NYONair managers told investigators the new tethers and cutters had not yet been ordered.

As shown photographs 37-39, the survival factors group documented a passenger removing a cutter from its pouch and reaching for the tether as shown in the passenger safety video. The group noted that, due to the routing of the tether behind the passengers, it was not possible to access the tether while two passengers were seated next to each other (as one passenger's upper body was obstructing it). The inboard passenger needed to lean over for the outboard passenger to have access to the tether. It was also noted that the outboard passenger's inboard rotation to reach the tether was restricted due to the tension in the tether caused by the rotation of the upper body.

Photograph 38- *Investigator wearing the harness/tether system removing the cutter from its stowage pouch.*

[11] The issue was added to the pilot safety meeting agenda for discussion.

Photograph 39- *NTSB investigator wearing the harness/tether system attempting to cut the tether with the cutter with another investigator seated beside him leaning forward to facilitate access to the tether.*

7.0 Personal Flotation Device

According to NYON SOP, a personal flotation device (PFD) was given to each passenger after they arrived at the aircraft. NYONair's CX was to retrieve the PFDs from the helicopter and the pilot and CX were to put them on the passengers. The PFD was strapped around the passengers' waists, but beneath their harnesses. The SOPs stated the CX would explain how they worked before takeoff. The safety video also showed how the PFDs were used, however, in the safety video, the PFDs were stowed in a bubble window or in a tray inside the helicopter and passengers were instructed to unfasten their seatbelt first, retrieve, open and put them on.

Photograph 40*- PFD positioned around a passenger with the harness.*

One personal flotation device (PFD) was found in good condition, unopened, with the helicopter wreckage. It was an adult life preserver. It was labeled:

Model KSE-35HC2L8
Adult Life Preserver
P/N P0723E129P
FAA TSO-C13e
U.S. Patent No. 7,854,639
SER 17032270018
PNO: PO723E129P
Vest DMF: 20170330
Fabric DMF:012017

Two other personal flotation devices were recovered by the Medical Examiner's office. These PFDs were attached to the front seat occupant and the passenger in seat 1. The PFDs were unused and still in packaging. These PFDs were labeled:

Model KSE-35HC2L8
Adult Life Preserver
P/N P0723E129P
FAA TSO-C13e
U.S. Patent No. 7,854,639
SER 17042240102
PNO: PO723E129P
Vest DMF: 201700427
Fabric DMF:032017

Model KSE-35HC2L8
Adult Life Preserver
P/N P0723E129P
FAA TSO-C13e
U.S. Patent No. 7,854,639
PNO: PO723E129P
Vest DMF: 20170330
Fabric DMF:012017

8.0 Emergency Flotation System

The accident helicopter had an emergency flotation system manufactured by Dart Aerospace and were installed on the helicopter in 2013. For detailed information on the emergency flotation system installation, procedures, limitations and performance, see the Emergency Flotation System Group Chairman's Factual Report in the docket for this investigation.

9.0 Headsets

Once the passengers were seated in the helicopter, headsets with coiled cords, were provided by the CX or the pilot. The headsets were plugged into audio jacks above the aft bench seat by the CX or pilot. There were no frangible links or break away points positioned between the headset and the jacks. The headset cords were routed through the rack on the ceiling to keep them from being entangled with one another and secured with zip ties to carabiners that were clipped to the back of the passenger harness. The passengers used the headsets to hear the pilot. They could not speak with one another nor could they speak to the pilot. The front seat passenger headset was plugged into the front instrument control panel in the 'passenger 6' position and was labeled FlyNYON 4 and LHI 13.

Photograph 41 –*Headset cord connected to harness using zip ties and carabiner.*

Photograph 42 *–Headset coiled cord connected to overhead audio panel.*

10.0 Pre-accident Guidance and Standards

The harness/tether system used on the accident flight did not, and was not required to, meet any FAA TSO. However, the survival factors group noted that FAA had published TSO-C167 *Personnel Carrying Device Systems (PCDS), also known as Human Harnesses* (effective June 9, 2004) that contained minimum performance standards for equipment intended to transport personnel externally from a helicopter, also referred to as human external cargo (HEC) operations which operate under 14 CFR Part 133. This equipment was intended for long-term, work-related activities where the user was required to remain in the device for extended periods of time.[12] Fifteen blue harnesses at NYONair were compliant with TSO-C167. The yellow harnesses were labeled as Guardian Fall protection performance safety gear and sold as fall protection harnesses which were compliant with Occupational Safety and Health Administration (OSHA) and American National Standards Institute (ANSI) standards[13].

The U.S. National Interagency Aviation Committee (NIAC) established requirements and guidance for the use of supplemental restraint systems used by law enforcement, search and rescue and resource management aviation for the U.S. Forest Service and Department of Interior. The requirements were found in the Interagency Helicopter Operations Guide (IHOG) used by the Forest Service, National Park Service, Fish and Wildlife Service, National Association of State Foresters and Fire Administration. The IHOG stated a secondary harness system may be required for personnel performing special activities while doors are open or removed and who need to be in a location other than seated with normal restraint system. It further stated the harness must be attached to an approved tether and helicopter hard point. Guidance provided in the U.S. Department of the Interior and U.S. Forest Interagency Aviation Life Support Equipment (ALSE) handbook suggested Aircrew Members use a secondary restraint system when performing certain duties when the aircraft doors are open or removed and the aircrew member is conducting specific duties in addition to normal seatbelt use.

Guidance from Australia was also reviewed. The Australian Technical Standards Orders (ATSOs), C1001, *Dispatchers Restraint Strap* dated June 2000 and C1003, *Helicopter External Personnel Lifting Devices*, dated January 2003 were applicable to harnesses used in search and rescue operations. ATSO-C1001 was for a dispatcher's restraint strap - an adjustable restraint strap attached to an occupant (e.g. camera operator or dispatcher) who was not seated with a seatbelt or harness fastened while the cabin door was open. The intent was to prevent the wearer from falling from the aircraft when carrying out duties at or near an open door or hatch. Among the requirements in ATSO-C1001 was that, "[t]he dispatcher's restraint strap shall incorporate quick release at the harness end of the strap. The quick release shall: i. be simple and obvious to action; ii. be able to easily release under load with one hand; and iii. be protected against inadvertent release."

[12] 14 CFR 133.45 specifies limitations for external-load operations as rotorcraft-load combination Class D. The certification requirements for HEC operations are found in 14 CFR § 27.865 or 14 CFR § 29.865, as applicable.
[13] ANSI coordinates the development and use of voluntary consensus standards in the United States. An ANSI standard implies a consensus of those substantially concerned with its scope and provisions, and is intended as a guide to aid manufacturer, the consumer, and the general public. Specifically, ANSI/ASSE Z359: Fall Protection Standards System.

ATSO-C1003 was for a Helicopter External Personnel Lifting Device, such as a "winchman's harness", also called a Rescue Harness. This was a full harness worn by a person when suspended outside a helicopter from a winch hook. Another piece of equipment covered under C1003 was a Rescue/Retrieval Strop combination, which was a piece of equipment that was used in either a single or double lift. It was fitted under the patient's arms, across the back and was secured in the front of the chest. A second strop could be used to carry a hypothermic lift. All items covered by this ATSO were also to comply with the applicable sections of FAA FAR part 29.865 "External Loads" at the latest amendment. ATSO-C1003 discussed additional safety requirements for harnesses or strops used in HEC operations that incorporate quick release devices. Stating that if they are used the quick release devices should be 1) simple and obvious to action; 2) be able to easily release under load with one hand; 3) be protected against inadvertent release; and 4) require two distinct and separate physical actions to initiate release of the load from the winch hook.

The Civil Aviation Safety Authority of Australia (CASA) issued airworthiness bulletin AWB 25-007 on August 5, 2016 titled "Personnel Harnesses, Restraint Straps and Approved Attachment Points." The airworthiness bulletin reviewed issues related to use of harnesses and straps by personnel performing duties related to personnel in an aircraft operating near an open door and it referenced ATSO-C1003 and ATSO-C1001. In its discussion on safety harnesses the bulletin stated, "The safety design features for a personnel harness approved for use in aircraft operations include provisions for adequate adjustment to the wearer, strength, durability, and quick-release fittings to allow quick detachment from the aircraft following ditching, fire, forced landing, etc. Any personal safety harness which uses screw carabineers to attach to the restraint strap, for example, would not be an approved harness."

11.0 FlyNYON Passenger Experience

11.1 Briefing at NYONair

According to interviews and discussions with NYONair personnel, passengers who booked a FlyNYON flight arrived at the NYONair terminal at 78 John Miller Way, Kearny, NJ 07032 approximately 2 hours before their scheduled tour. Passengers were greeted by NYONair personnel at a front desk location and asked to complete and sign a waiver on a tablet device if they had not completed the waiver online prior to arrival. Passengers provided a form of identification, of which NYONair made a photocopy, and were instructed to wait in a lounge area that contained a helicopter fuselage for passenger familiarization, a virtual reality room to familiarize passengers with aerial vantage points, and operations center to monitor active flights and weather, a coffee/tea bar, and FlyNYON/ NYONair merchandise for purchase.

Once all the passengers with a tour reservation had arrived, they were taken to a room, and behind a closed door, were provided a safety briefing by a NYONair CX. The passengers were instructed to watch a 3 minute 22 second safety video. See Attachment 2 for safety video. The safety video instructed the passengers to remain with a NYONair representative at all times and that loose items were not allowed on the aircraft unless secured by an approved securing device. There was to be no smoking and in the unlikely event there was an emergency they were instructed to wait until the aircraft came to a complete stop and then follow the directions given in the video for use of a PFD or a fire. The safety video showed the PFD stowage location in the front chin bubble of the helicopter and how to use them. They were instructed to wear headsets at all times

so they could hear the pilot speaking. The safety video showed the fire extinguisher location and how to operate it. The safety video stated that shoes were to be securely on, no slip-ons were allowed, and long hair should be tied back. The safety video allowed go-pro mounts strapped around the chest but stated head mounts were not allowed. The safety video stated that the "shoe selfie was permitted only over water and feet must remain on the outside of the skid tube." Lens changes were not allowed inside the helicopter and all items were required to be attached to a carabiner. The safety video showed a passenger being fitted with a harness and stated the harness would be attached to the aircraft. The safety video also stated in the "rare case of an emergency the harness could be released by opening the quick release clip [carabiner] in the back of the harness." It stated, "a cutter is also secured to one of the chest straps that would allow to quickly cut through the harness[14] if unable to reach the quick release clip." It stated that passengers were to exit only in an emergency and when instructed by the pilot. The safety video also demonstrated how to open the doors in the event of an emergency.

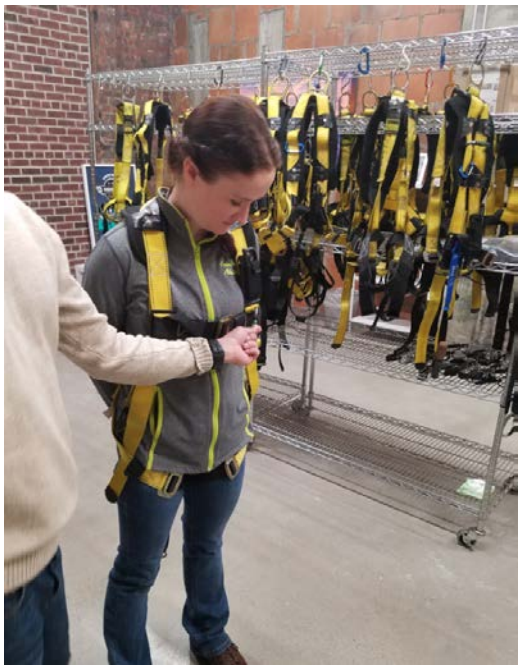
After the video the CX asked if there were any questions. The CX reiterated safety briefing items such as, tie up long hair, double and triple knot shoelaces, tucking jewelry in, and that personal belongings in pockets would need to come out and be left behind in lockers. The CX also reiterated camera equipment would need to be secured to the harnesses and cellphones would need to be put into special cases provided by NYONair (also secured to the harness).

The CX asked passengers where they would like to sit on the helicopter and allowed passengers to choose their preferred seat. The CX asked about any points of interest the passengers would like to see. They recommended passengers use restrooms just before they were put into the harness.

11.2 Harnessing Procedures

Prior to passengers being harnessed, they were asked to put all items into a bin. The bin would be locked, and passengers were "wanded" with security wands and "patted down" to check for any additional items left in pockets.

[14] The video stated harness however showed an individual cutting through a yellow tether. The tether shown was neither different than currently used and different than what was used in the accident helicopter. See Photograph 34



Photograph 43 *– NYONair harnessing rack.*

As stated previously in section 5.3, The harness was put over the shoulders like a backpack by the CX, then buckled via 2 mating buckles in the front with a rubber elastic strap fitted around the buckle. Two black straps were fitted around the legs and buckled together using 2 mating buckles. The leg straps were adjusted to a tight fit around the passenger and the shoulder straps were also tightened to fit the passenger. To tighten the shoulder straps for smaller passengers, a carabiner was used to draw the back-shoulder straps closer together. The CX continued the process until it was tight enough. The harness was equipped with a metal ring on the upper back of a passenger, that would be connected to a tether via a carabiner upon being seated in the helicopter. A carabiner was placed on the back of the harness to secure the headset once at the helicopter and an additional carabiner was placed on the front left to securely strap a camera. Cellphones were put into a holder connected with a blue lanyard and attached on a ring at the front right side of the harness. According to an interview, the CX showed the passenger where the cutter was and explained to cut the tether; however, no tether was present during this explanation.

11.3 Additional Preflight Items

The CX offered goggles to anyone wanting them as well as hair ties for longer hair. Passengers were put on a digital scale to cross check their weight against what was provided during the wavier process. Weights were recorded on the "flight sheet."[15] The CX explained that they frequently have multiple groups flying at the same time and the groups would go through the process together. Each group, however, had their own assigned CX. After weights were recorded, the bins with passenger items were locked and the CX took the flight sheet to NYONair operations center. This flight sheet was kept with the CX and given to the pilot. Once operations verified the

[15] A flight sheet was a paper given to the pilot with first names of passengers, passenger weights, the location passengers were seated in the helicopter, and points of interest.

information on the flight sheet and "signed off," they would contact the pilot that passengers were on their way. Passengers were then loaded into a NYONair van and driven to the heliport where the Liberty helicopters were waiting.

11.4 Pilot Preflight Briefing

While in the van, the CX explained what to expect at the heliport. They were told to stay with the group as it was an active heliport with other helicopters taking off and landing. Once through the gate, passengers were offloaded from the van where a pilot was waiting.

The pilot introduced himself and was provided the flight sheet by the CX.[16] The passengers introduced themselves and while being introduced the pilot would visibly compare person to the written weight on the flight sheet to ensure it looked correct. According to NYON SOP, it was permissible for either the CX or the pilot to strap the PFDs on the passengers. They were strapped around the waist but routed under the harness.

According to interviews, the pilots checked to ensure cellphones were tethered tightly and all carabiners were tight. They rechecked the harness by pulling from the back to ensure once tethered there would not be any excess slack.[17]

There was no standard briefing card inside the helicopter for these flights, however, there was no FAA regulation requirement for briefing cards to be on the helicopter. Each pilot could conduct what they deemed to be their own safety briefing for FlyNYON flights. The NYONair CX Training Manual included a "Helicopter Safety Checklist (for pilot)". These items included a verbal explanation to passengers on each step of the loading process until they are "locked in." To ensure and verbally tell passengers that both ends of the tethers were "clipped and locked" and to clip the headset to the harness and "warn of wind pulling headsets off." The checklist also listed that the seatbelt should be secured and how to take it off in an emergency should be shown to passengers. See Attachment 3- NYONair CX Training Manual.

11.5 Briefing and Loading Process

After the briefing, passengers were loaded into the helicopter. According to NYON SOP, the Liberty pilots were to tether in all the passengers because it would ensure it was always done to the pilot's preference. According to interviews with Liberty Helicopter pilots and the Liberty loader,[18] they would begin the loading process with the right side but both sides were done

[16] According to interviews with Liberty Helicopter pilots, Liberty Helicopter pilots were not provided with a standardized briefing for passengers secured to the aircraft by means of a harness/tether and locking carabiner. Pilots were provided "customer service" SOP for FlyNYON flights. See Attachment 4 – NYONair Customer Service Pilot Training. For more information about Liberty Helicopters procedures for interaction with passengers and the pilot's interaction with the accident passengers, see the Operations Group Factual Report.

[17] NYONair required passengers must be at least 12 years of age and used the blue ARS harness for children and for passengers of smaller stature. NYONair SOP stated the pilot had final authority and if a passenger arrived at the helicopter with a yellow harness that they felt was too big they could ask the CX to retrieve a smaller blue harness.

[18] It was noted that Liberty Helicopters also employed a loader whose duties overlapped with those of the pilot and CX on the ground.

similarly. They had the passenger assigned to the outboard seat position sit in the seat facing outboard toward the helicopter door opening and the inboard passenger sit on the floor of the helicopter cabin also facing outward. NYON SOP stated the CX would have the adventure seat passengers sit on the floor, back of knees/legs tight to airframe and the passengers seated at the door facing out.

The pilot connected the tethers to the back of the passengers as shown in figure 2.[19] According to an interview with Liberty Helicopters' safety officer, he connected the tethers to the back of the passengers so that the passengers' upper bodies could not get beyond the doorframe of the helicopter and the excess tether length (tail) was left to hang freely. NYON SOP also stated the pilot should zip tie the carabiner. There was no standard procedure on what should be done with the excess tether tail, however, the excess end of the FAA approved seat belt was to be tied in a knot, according to NYON SOP, so not to flap in the wind in the event an outside passenger inadvertently removed their seatbelt. The passengers were then instructed to move back into their respective seats where they were secured with the helicopter's FAA-approved restraints over their harnesses. According to NYON SOP, the CX would buckle passengers into the FAA-approved restraints. The shoulder restraint was also placed over all four aft passengers' body harness; however, it was positioned under the outboard passengers' arm in order to allow for freedom of movement and prevent rubbing of the neck once they could turn outboard and take photographs. The inboard passengers were briefed (as listed in the NYON SOP) to rebuckle their seatbelts once they got up and moved to the doorway during flight so that the seatbelt buckles would not damage the aircraft or hurt anyone due to the high winds.

Once all the rear bench passengers were in position, the front seat passenger was loaded into the front double bench seat. This passenger was instructed to sit all the way back facing outward toward the helicopter door opening so the passenger's leg was bent at the knee at the seat bench. The pilot or loader[20] would connect and lock the carabiners for the tether to the back of the passenger so that his upper body could not get outside the door frame. The passenger was tethered to a fitting in the helicopter floor located at the inboard side of the double seat. NYON SOP did not state which hardpoint the tether should be attached, only to ensure it was attached to the airframe hardpoint and not the seat. Although NYON SOP did not state the standard location for the tether routing, the accident pilot stated that he generally routed the tether under the front seat's inboard armrest. The excess tether length (tail) was left to hang freely, as it was for the aft passengers.

The front passenger was then instructed to face forward in the outboard seat where he or she would be buckled correctly into the FAA-approved 4-point restraint. NYON SOP stated the pilot would position the inboard shoulder restraint under the right arm so that it would not impinge upon the passenger's neck when he or she turned outboard to take photographs. The second seat of the front double seat bench had the same 4-point restraint harness, but according to interviews with Liberty Helicopter pilots the seat was rarely used for FlyNYON flights. If it was used, it was loaded the same as the outboard seat. According to interviews with Liberty Helicopter pilots, they

[19] SOP stated pilots connected the tethers to the passenger's harness, however there was conflicting information when Liberty Helicopter loader was present. It was stated he would also connect the passengers to the harness via the tethers.

[20] NYONair SOP did not mention the Liberty Helicopter loader.

would brief this passenger that at any time the seat restraint was to unbuckle, and the pilot noticed he would tap them on the shoulder and say “seatbelt.” According to these interviews this occurred repeatedly.

Once all the passengers were loaded the pilot would “sign off” the flight sheet and hand it back to the CX. According to NYON SOP, the pilot would brief the passengers in the helicopter.

Liberty Helicopters provided a list of items the pilot was required to orally brief passengers prior to each takeoff. It included the following:

- Smoking
- Seatbelts
- Doors and Emergency Exits
- Location of Helicopter Survival Equipment
- Location and Use of Fire Extinguishers
- Ditching Procedures
- Portable Electronic Devices

NYON SOP required the pilots briefing to include the following:

- Seatbelts
- Headsets
- Portable Flotation Devices
- Effects of wind
- Location and use of cutters
- Egress instruction

The pilots stated that the process to load passengers took about 20-25 minutes.

Once the helicopter landed back at the heliport, carabiners were removed from the back of harness. The headsets were removed, and the seatbelts were taken off. Passengers exited the helicopter starting with the outboard passengers, then the inboard passengers. PFDs were removed from passengers and placed back inside the helicopter. Passengers were loaded back into the van and taken to NYONair terminal where harnesses were removed.

12.0 Accident Summary

The accident occurred during an evening 30-minute doors-off photography flight operated by Liberty Helicopters through an agreement with NYONair. The passengers checked in for the flight at the NYONair terminal and signed waiver forms. The passengers were taken into a briefing room where they received a video safety briefing and afterwards, were able to ask questions. According to a witness who had booked a separate flight with NYONair and was present for the safety briefing with the accident flight, he was concerned that some passengers were not dressed properly for cold conditions during a doors-off operation. He also voiced concern over the possibility of missing the opportunity for a “sunset flight” because other passengers seemed to be slowing the process by “joking around.” He stated he got a “whiff” of what smelled like alcohol from one the occupants on the accident helicopter. He stated no one had any questions about the

safety video briefing. There were 3 different flights that departed at the same time carrying 12 passengers. These passengers were weighed, fitted into harnesses and then loaded into passenger vans and transported to the helicopters. A text message was sent from NYONair operations center at 1845 letting the pilot know the passengers were enroute. 1845 was the original scheduled departure time for the flight.

According to the accident pilot, when the five passengers arrived, he briefed the passengers and then he and Liberty's loader secured them into the helicopter using the helicopter FAA-approved restraint systems along with the harness/tether system. The loader and pilot described the loading process as securing the right-side passengers first then the left side. Since the two passengers in the "adventure seats" were allowed to unbuckle themselves from their seatbelts and shoulder harnesses and sit on the floor of the helicopter during flight , they had those passengers sit on the floor facing out and the passenger in seat position 1 and 4, respectively, sit facing out. The pilot and loader attached the tethers to the back of the harness ring by having the passenger lean forward and adjusting the tether so they could not move any further from that position. The NYON SOP state an additional zip tie would be placed on the carabiner. The CX stated she checked the security of the seatbelts along with the harness/tether system. The CX also helped passengers with donning their headsets. The pilot provided additional information about what to expect during the flight.

During the flight, passengers took pictures of the NYC area that included the Statue of Liberty and other NYC landmarks. According to the accident pilot, the helicopter experienced an engine failure and he saw engine and fuel pressure warning lights and made a mayday radio transmission. He stated once he was clear of the buildings, he activated the floats. He stated he reached down to check the fuel flow control lever and noticed that the emergency fuel cutoff lever was up. He shoved the fuel cutoff lever down (ON) and attempted a second start. He saw the engine temperature rise almost immediately; however, he was too close to the water and had to commit to the autorotative landing. As the front skids contacted the water, water quickly covered the floor, and the helicopter continued a roll to the right, submerging the cockpit and cabin. He stated by the time he unbuckled his seatbelt he was "fully under water" and used two hands to grab the door frame and pull himself out. He said that his harness was a four-point rotary buckle that was easy to get off. He tried to swim to the surface, but he did not go up as fast as he thought he would. He reached for the pitot tube, but his hands were slipping, and he could not get a grip. He said the helicopter was "rolling on top" of him and he surfaced about 4 feet away from the nose of the helicopter and crawled up onto the belly.

13.0 Emergency Response

According to NYPD Scuba Team interviews, a tugboat named Foxy 3, was passing by and responded first. The crew recovered the pilot who self-evacuated. FDNY Marine 6 was the first emergency response vessel on scene. It deployed a rescue swimmer on a tether with a cold-water immersion suit. The aircraft was reported to be submerged upside down with the floats inflated. The NYPD divers made entry into the passenger compartment and stated the passengers were "strapped in" and the harnesses had to be cut before the passengers could be removed. The water temperature was documented using NWS buoy observations in the area. The Battery Park New

York, BATN6 Buoy was located 5 miles south-southwest of the accident site at the entrance of the East River and reported a water temperature of 39.7° F or 4.3° C.. According to diver interviews, visibility was near zero under the water and the port door to the helicopter was open.

13.1 Response Timeline

Approximate Time	Event
1908	NYPD Aviation Unit operations desk received a land line call from LGA advising a helicopter had crashed into the East River
1910	NYPD Aviation Unit #20 and #22 responded to a helicopter crash in the East River
	Upon arrival, #22 located the aircraft tethered to tugboat, "Foxy 3"
1925	#22 deployed two scuba divers into the water
	All five passengers were recovered from aircraft
2020	Divers exited the water

Table 1*- Key events from the accident.*

14.0 Post-accident Actions

After the accident on March 26, 2018, the FAA issued a *"Doors-off" and "Open-door" Flight Prohibition: Emergency Restriction/ Prohibition Order* to all operators and on April 10, 2018, the FAA issued a notice, *Emergency Order of Prohibition Pertaining to "Doors-Off" Flight Operations for Compensation or Hire* (N8900.457), to all inspectors informing them of the *"Doors-off" and "Open-door" Flight Prohibition: Emergency Restriction/ Prohibition Order*. The order prohibited the use of supplemental passenger restraint systems that could not be released quickly in an emergency during flight operations for compensation or hire with the doors open or removed.

The emergency order defined the term "supplemental passenger restraint system" (SPRS)[21] as "any passenger restraint that is not installed on the aircraft pursuant to an FAA approval…" The order stated that doors off flights using SPRS could continue after a determination by the Acting Administrator that the restraints could be "quickly released by the passenger with minimal difficulty and without impeding egress from the aircraft in an emergency." The order further stated that ability of a passenger to quickly release the SPRS must be inherent and not require the use of a knife to cut the restraint, any other tool, or the assistance of any other person. Finally, it stated the SPRS also must not require passenger training beyond what would be provided in a preflight briefing.[22]

[21] Before this accident there was no formal definition within the FAA for a supplemental passenger restraint system.
[22] 29 CFR Part 1910.140 (b), required personal fall arrest systems to consist of 3 components: a body harness, anchorage, and connector. Although many of the individual components meet various certification standards with the OSHA, ANSI, National Fire Protection Association (NPFA), or Australian Civil Aviation Safety Authority (CASA), the FAA does not have specific certification requirements for SPRS.

Operators seeking authorization to conduct doors off flights using SPRS were required to submit information regarding the SPRS to the FAA for review, including the make and model of the system components, the certification standards applicable for each component, step by step instructions for the user regarding SPRS release for egress, and a video demonstration of the quick release in preparation for egress.

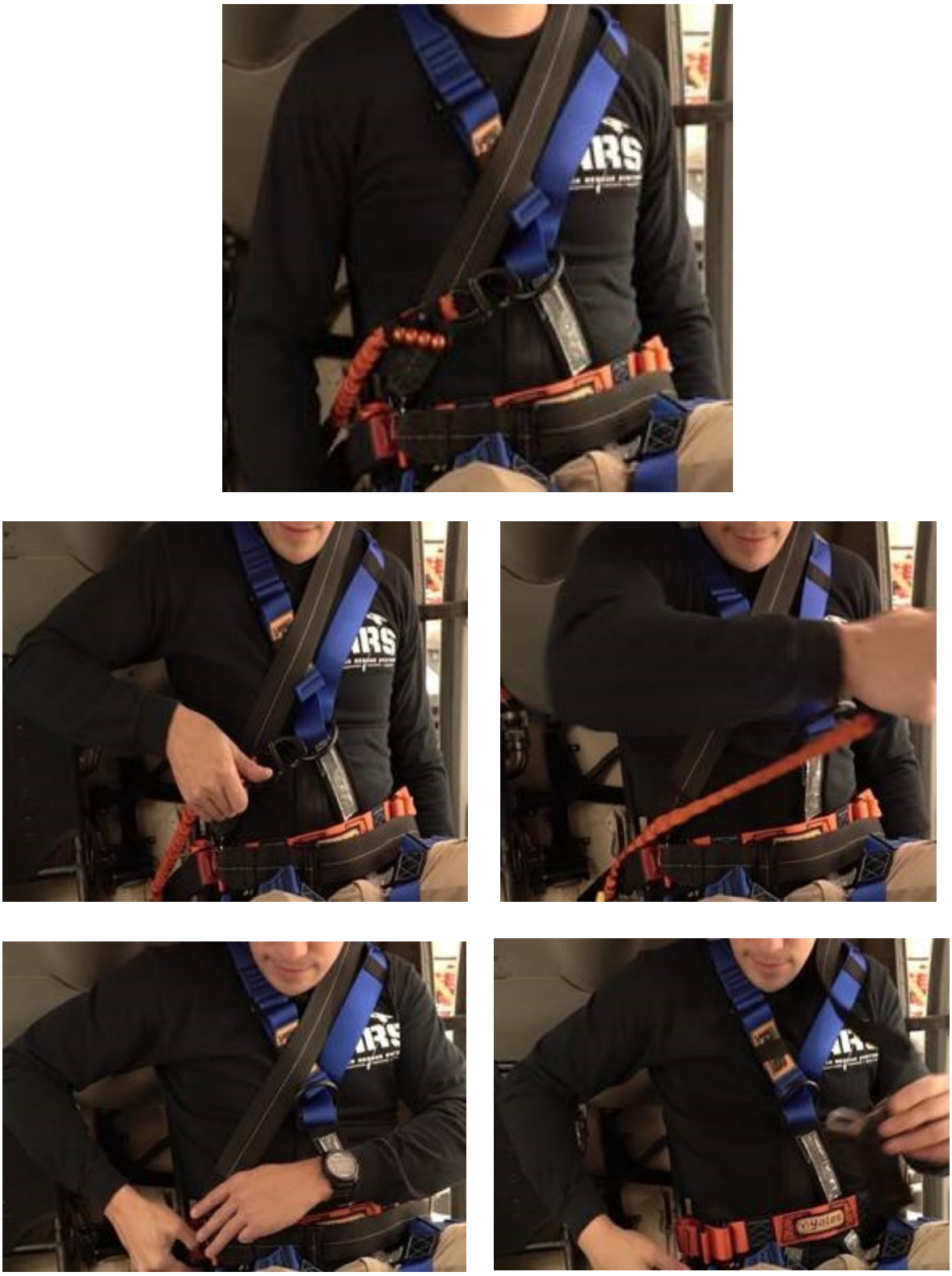
To comply with this order, NYONair submitted a video and information package to the FAA listing the components of a system they intended to use to meet the definition of an SPRS. The system included an Air Rescue Systems (ARS) 339 Heli-Ops Harness and the ARS Personal Retention Lanyard with Quick Release Device with an ARS 16-inch Primary Anchor.[23] (see Attachment 5 for specific information on these components and Attachment 6 and 7 for the submittal package and video submission. On June 18, 2018 the FAA issued a letter of authorization to EastWest Helicopters, LLC[24] stating that the FAA determined that the submitted SPRS met the FAA's criteria and could be quickly released by a passenger with minimal difficulty and without impeding egress from the aircraft in an emergency (see Attachment 8 for FAA approval letter).

NYONair suspended operations following the accident[25]. Doors-off operations resumed on April 8, 2018 but without the use of SPRS. Only the FAA approved restraint systems were used and a NYONair company designee remained onboard the helicopter with the passengers at all times to ensure compliance. No harness/tether system was used during this time. Following the FAA's issuance of a letter of authorization (June 18, 2018), NYONair implemented the approved SPRS.

[23] The certification standard for each of these components were listed as ISO 9001 "Advanced Helicopter Operations Equipment Certificate", NFPA 1983, and ANSI/ASSR 2359.12 (09)-1992 specifications for personnel restraints.
[24] For more on the relationship of EastWest Helicopters, LLC and NYONair see the Operations Group Factual Report.
[25] NYONair operates 5 helicopters in the U.S. all of which are based in New Jersey. The interior configurations are all the same. The maximum number of passengers per flight is 6.

Photograph 44 *– Air Rescue Systems (ARS) 339 Heli-Ops Harness.*

Photograph 45 *– ARS Personal Retention Lanyard with Quick Release Device.*



Photograph 46 *– Screen captures from NYONair's video submission to the FAA showing use of Air Rescue Systems (ARS) 339 Heli-Ops Harness with the ARS Personal Retention Lanyard with Quick Release Device and the FAA approved seatbelt.*

As of the date of this report, NYONair had a stock of 48 ARS 339 Heli-Ops harnesses in various sizes.

NYONair also issued new SOP for their employees on October 18, 2018. The revised SOP standardized the passenger check-in, briefing, and harnessing and loading. A new 5 minutes and 30 seconds safety video was to be viewed.

After viewing the safety video presentation, the revised SOPs stated that passengers were to be fitted with the new harnesses described in section 14.0 of this report.

After passengers were fitted with harnesses[26], passengers were required to both demonstrate and verbally confirm that they could release the harness system. This was accomplished by clipping a practice tether to the passenger at the front of the harness. The passenger is asked to pull on the beads with a forward outward motion by using one hand after hearing the word "EGRESS." If the passenger was not successful, the practice continued until they successfully demonstrated release of the tether. In addition, all passengers were given a pre-flight pilot briefing. According to a revised NYON SOP, before any loading of passengers, the pilot conducted safety briefing that included life vest operation and water landing egress, seatbelt operation, emergency equipment and emergency exit operation.

The revised NYON SOP stated for door off operations, passengers were loaded by both a Ramp Control Agent[27] and the pilot. The revised NYON SOP described the loading process as having the right-side passengers loaded by the pilot and the left side passengers loaded by the Ramp Control Agent. A quick release tether is attached to the front waist loop of harness and the passenger is to raise any lanyards around neck to allow for seatbelt to go under for attachment. It was noted the seatbelt and shoulder harness should not go under the arm and no tethers or lanyards should be attached to the seatbelt. The seatbelt should be placed over the PFDs and the PFDs be placed in the front of the passenger's body. The headset should be on passenger and the cord attached to aircraft. Passengers are shown the tether, and both ends, and it must be checked that they are clipped and locked. The Pilot and Ramp Control Agents switch sides to double check each other's work.

[26] Children over 12 years old are allowed on doors-off flights and allowed to sit in an open-door seat. Children under 12 are allowed and must sit in the pocket door or the middle between parents/guardian. The children wear harnesses if they are large enough. Parents/guardians must be on site and must sign a waiver giving a child permission to participate.

[27] New position created by NYONair post-accident whose job responsibilities were to aid in the loading and unloading process and escort passengers.

15.0 Medical and Pathological

15.1 Injury Table

Type of injury	Flight Crew	Flight Attendants	Passengers	Total
Fatal	0	0	5	5
Serious	0	0	0	0
Minor	1	0	0	1
None	0	0	0	0
Total	1	0	5	6

15.2 Injury Information

Autopsies were performed on the five fatally injured passengers by the State of New York Office of the Chief Medical Examiner on March 12th. The cause of death for all individuals was listed as "drowning." The manner of death for all individuals was listed as "accident." The pilot stated he sustained bruises inside his right palm from pulling hard on the flotation activation handle and received cuts to his left knuckles from "slamming" the fuel cutoff lever down in the downward position. See Attachment 9 for NTSB Medical and Pathological Information.

Emily Gibson
Survival Factors Investigator

Attachments

Attachment 1 - NYON SOP
Attachment 2 - NYONair Safety Video
Attachment 3 - NYONair CX Training Manual
Attachment 4 - NYONair Customer Service Pilot Training
Attachment 5 - ARS Heli-OPS Harness
Attachment 6 - Submission Package to FAA to continue operation
Attachment 7 - FAA submittal package/video
Attachment 8 - Signed FAA Approval letter
Attachment 9- Medical and Pathological Information
Attachment 10- Interview Summary- Kiara Martinez, NYONair CX
Attachment 11- Interview Summary -Eric Adams
Attachment 12- Interview Summary- Divers