Death Review Panel: Four Fatal Aviation Accidents Involving Air Taxi Operations on British Columbia's Coast

REPORT TO THE CHIEF CORONER OF BRITISH COLUMBIA

March 2012

Preamble

The purpose of a coronial death review panel is to examine the facts and circumstances of deaths in order to provide advice to the chief coroner with respect to matters that may impact public health or safety and the prevention of deaths. At the conclusion of the review, the panel's chair reports to the chief coroner key findings and any recommendations the panel may make respecting the prevention of similar deaths. The panel must not make any finding of legal responsibility or express any conclusion of law.

The chief coroner may publish and distribute materials, including the findings and recommendations of a death review panel, for the purpose of advancing public safety and informing the public about matters respecting the prevention of deaths. The chief coroner may forward some or all of the panel's recommendations to individuals, government agencies or any other organizations identified by the panel of experts.

On October 19, 20 and 21, 2011, a Death Review Panel was convened at the Office of the Chief Coroner in Burnaby to examine the circumstances surrounding four commercial seaplane accidents that occurred in recent years on British Columbia's Coast:

28 February 2005, collision with water off Quadra Island
03 August 2008, collision with terrain near Port Alice on Vancouver Island
16 November 2008, collision with terrain on South Thormanby Island
29 November 2009, collision with water at Lyall Harbour on Saturna Island

The accidents selected for review by this panel resulted in 23 deaths. Each of the four accidents had been previously investigated by the BC Coroners Service. The Death Review Panel was informed by reports, abstracts and other information collected by the Coroners Service and other agencies, including the Transportation Safety Board of Canada. Following the panel's initial sessions in October 2011, additional consultations took place between the chair and panel members in subsequent weeks, resulting in the formulation of recommendations for the chief coroner's consideration.

Terms of Reference

The terms of reference for this panel were established under section 49(2)(c) of the *Coroners Act* and were as follow:

- review coroners' investigative findings and information provided by other organizations and individuals, with respect to the 23 deaths, including the investigative findings of the Transportation Safety Board;
- identify environmental, technological and mechanical factors, and any organizational and human factors involved in these incidents;
- identify any trends, patterns or themes that may be associated with these fatal incidents, and identify any public safety implications evident from such trends;
- address the safety of workers commuting to remote work locations, recognizing the distinct circumstances of workers, as a subgroup of the travelling public;
- examine the deaths in the context of the regulatory framework, in place at the time of the incidents, and/or currently in place;
- identify any significant developments in public safety, which may have taken place since the fatal incidents that are the subject of this review;
- identify any tools and strategies outside of the regulatory framework, which may enhance the safety of passengers and crew travelling onboard small commercial passenger aircraft;
- identify any challenges or impediments to public safety, in relation to travel onboard small commercial passenger aircraft, and any challenges or impediments to processes that are intended to enhance safety of this sector;
- explore options for practical and feasible prevention measures;
- provide the chief coroner with advice on how to prevent similar deaths in the future;
- maintain confidentiality of the proceedings.

Panel members were appointed by the chief coroner under section 49 of the *Coroners Act* and included pilots, members of the commercial floatplane community, safety professionals and subject matter experts drawn from the ranks of regulatory bodies and other government agencies. Regardless of their employment or other affiliations, individual panel members were asked to earnestly exercise their mandate under the *Coroners Act* and express only their own opinions and conclusions. Consequently, the findings and recommendations contained in this report need not reflect, or be consistent with, the policies or official positions of any other organizations. Although absolute consensus was not required, the intent was to generate a product reflecting the panel's collective spirit. The panel's findings and recommendations were reported to the chief coroner by the chair, who endeavoured to accurately document the will of the panel, but who is solely responsible for any errors or omissions in the content of this report.

Tom Pawlowski, Chair

Background

Over a period of ten years, from January 2000 to December 2009, 111 fatal aviation incidents occurred in BC, resulting in 202 deaths. Commercial flight was involved in 34%, or 38 of these incidents, resulting in 85 deaths, or 42% of all fatalities. The largest percentage of commercial aviation deaths resulted from incidents involving transport of workers to remote worksites or camps (29 deaths).

Given the geography of British Columbia, air travel is critical to maintaining the social and economic fabric of the province. For many remote coastal communities, it is the only practical link with the larger urban centres. For the residents of those communities, and for workers in remote camps, air travel is not a luxury, but a necessity. However, the same geographical constraints that make air travel in BC such an essential mode of transportation also create significant challenges that affect the safety of travellers. Air travel, especially on the coast, often involves extended flights over water, mountainous terrain, and in adverse weather conditions.

The Accidents

Quadra Island On February 28, 2005, at approximately 1010 hours, a de Havilland DHC-2 (Beaver) floatplane departed Campbell River with a pilot and four passengers who were travelling to remote forestry worksites in Frances Bay and Knight Inlet. The weather on the day of the incident was variable and subject to localized fluctuations, with rain and fog predominating. The actual itinerary was subject to change and was being determined based on the weather conditions along the route. When the aircraft failed to arrive at the expected time at the logging camp in Knight Inlet, the staff at the camp placed calls to Campbell River at 1035 hours and subsequently at 1157 hours, enquiring about the whereabouts of the flight. The operator of this charter flight relied on the pilot's cellular phone for maintaining communications with the base. When attempts at communicating with the pilot failed, the airline's dispatcher contacted the company's chief pilot who commenced a search for the missing aircraft. Following a third call from the logging camp, the aircraft was reported overdue to the Victoria Joint Rescue Coordination Centre at approximately 1416 hours and a formal search was initiated at that time. The efforts were hindered by lack of a flight plan and lack of any indication of approximate location of the downed aircraft or time when the aircraft went down. Only the body of one of the passengers was recovered; the autopsy documented death due to drowning. The plane's wreckage was located on the ocean floor a few months later, through the efforts of the families of the deceased individuals. Examination of the wreckage revealed that an onboard clock had stopped at 1016 hours. All of the seatbelts were found unbuckled. Seven of the eight available life vests were still in their stowing places.

Alice Lake On August 3, 2008, at approximately 0708 hours, a Grumman G-21A (Goose) amphibious aircraft departed Port Hardy Airport on a Visual Flight Rules (VFR) flight to Chamiss

Bay. Onboard this charter flight, were the pilot and six passengers who were being transported to a remote logging operation. At the time of departure, clouds covered some of the ridges between Port Hardy and Chamiss Bay, but sunny skies were reported at the destination point. At approximately 0722 hours, the aircraft stalled aerodynamically while attempting to climb over a ridge and subsequently collided with a steep, forested slope near Alice Lake, approximately 14 miles from Port Hardy. The pilot and four passengers died in the collision; two passengers survived with injuries and managed to exit the aircraft through a tear in the fuselage. An electrical discharge from exposed wires caused ignition of spilled fuel and the resultant fire consumed most of the wreckage. Although the airline's operations manual required the pilot-in-command to maintain communications with the company's flight watch facility, the area's mountainous terrain often precluded continuous communications. Also, weather conditions sometimes forced pilots to land en route while out of communications range and await improvements to conditions before continuing with their flight. At approximately 0929 hours, after unsuccessful attempts at communicating with the pilot, the airline dispatched another aircraft tasked with locating the missing airplane or establishing radio contact. The incident flight was reported overdue to the Victoria Joint Rescue Coordination Centre at 0953 hours and a formal search was initiated; the efforts were hampered by thick forest canopy and lack of a signal from the electronic locator transmitter (ELT), which had been destroyed on impact. One of the survivors used his cellular phone to send messages and reported hearing the search and rescue aircraft. The wreckage was located at 1610 hours and the two survivors were evacuated more than eight hours after the collision.

Thormanby Island On November 16, 2008, at approximately 1032 hours, a Grumman G-21A (Goose) amphibious aircraft collided with a hillside on South Thormanby Island. Dense fog and visibility of approximately 1 mile was observed in the passage between the island and the mainland; on the island, visibility of approximately 100 metres was observed at sea level and approximately 20 metres at the elevation of the crash site. The aircraft had departed 19 minutes earlier from the water aerodrome at the Vancouver International Airport and was bound for a remote work camp in Toba inlet, with an intermediate stop planned at Powell River. The pilot and six passengers died in the collision, while one passenger survived with injuries. The aircraft was destroyed in the collision and post-impact fire. The onboard Emergency Locator Transmitter (ELT) was also destroyed and failed to emit an alert about the crash and identify its location. Although the aircraft was reported overdue at Powell River, the airline's staff misinterpreted the signals from a SPOT personal tracker carried onboard and concluded that the aircraft had reached its final destination. The flight was eventually reported overdue to the Victoria Joint Rescue Coordination Centre at 1210 hours and the wreckage was subsequently located at approximately 1415 hours.

The flight was operated as part of a charter service agreement to transport personnel and cargo to a work camp in Toba Inlet, where a power-generating project was under development. The aircraft was equipped and approved for flight under Visual Flight Rules (VFR) only. The conditions at both the Vancouver and Powell River airports were below VFR limits on the morning of the incident. Low ceilings and low visibility were also forecast for areas along the flight route. The flight was given authorization for departure under Special VFR (SVFR), which allow departure from controlled airspace under conditions that are below VFR minima, in anticipation that VFR-appropriate conditions will be encountered outside of the control zone. The flight continued at low altitudes and under conditions that were below the weather minima required for visual flight. Incident investigation findings suggested that seconds before impact, the pilot attempted rapid altitude gain to clear the rising and treed terrain.

Lyall Harbour On November 29, 2009, at approximately 1603 hours, a de Havilland DHC-2 (Beaver) floatplane with one pilot and seven passengers onboard, was departing Saturna Island's Lyall Harbour on a flight to Vancouver International Airport. That afternoon, Lyall Harbour was subject to gusting and variable, but mainly southeast winds. The floatplane take-off area was in the lee of high terrain and was susceptible to development of turbulence. The pilot first attempted to take-off downwind, in a northwesterly direction, but was unsuccessful. He subsequently turned the aircraft southeast and took-off towards the harbour. Although airborne, the aircraft remained below the surrounding terrain and was being drifted towards a ridge. The pilot turned the aircraft to the left in another downwind attempt, but the aircraft stalled aerodynamically and subsequently collided with water. The force of impact caused deformation of the fuselage, jamming two of the aircraft's four doors. The pilot and one of the passengers managed to exit the rapidly sinking aircraft through the two functioning doors; they were rescued from the surface of the water by nearby persons. The remaining passengers drowned inside the aircraft. Of the seven life vests available onboard, five had remained in their stowage pouches under the seats, while two were found outside of their pouches, but had not been utilized.

Recommendations

Having examined the various environmental, technological, organizational and human factors involved in the fatal incidents that were the subject of this review, and having considered the outstanding areas of risk that continue to pose a challenge to aviation safety, along with potential mitigation measures and solutions, the panel submits to the chief coroner the following recommendations for review and distribution to the appropriate persons and organizations.

To: Transport Canada

1) **It is recommended that Transport Canada create a regulatory requirement that all new and existing commercial seaplanes be equipped with emergency exits that would allow rapid egress following a collision with water.**

Chair's Comments: In the aftermath of the Beaver aircraft incident at Lyall Harbour, the Transportation Safety Board of Canada (TSB) made a recommendation to the Department of Transport asking that commercial seaplanes be fitted with rapid egress exits. This panel wishes to echo the TSB's recommendation, recognizing that exits designed for rapid egress would enhance the safety of flight crews and passengers travelling over water. Viking Air Limited, the type certificate holder for the DHC-2 Beaver, has developed emergency pop-out windows and a new door latch design intended to facilitate emergency egress. The panel wishes to acknowledge the safety initiatives at Viking Air; however, recognizing that these retrofit kits only benefit one type of a floatplane, the Beaver, the panel wishes to encourage manufacturers of other airplanes to explore similar solutions for their aircraft.

While the panel acknowledges that aircraft of different design may present distinct challenges for the manufacture of easy egress features, the panel is optimistic that such solutions are attainable. Further, while acknowledging that advances in safety can be successfully driven by industry initiatives, as in the case of Viking Air and the airlines that have already adopted rapid egress retrofit kits, the panel urges Transport Canada to shepherd the safety processes and ensure uniform adoption of these important safety features by implementing the regulatory requirement.

2) **It is recommended that Transport Canada create a regulatory requirement that all passengers and crew of commercial seaplanes wear personal floatation devices (PFDs) during all stages of flight.**

Chair's Comment: This is another area where the panel wishes to voice its support for a recommendation previously made by the Transportation Safety Board in relation to the Saturna Island incident. The panel recognizes that passengers of aircraft involved in collisions with water are at a high risk of drowning after having survived the initial impact. Panel members with experience in underwater egress training have attested to the difficulties that even a trained person can experience attempting to retrieve, and subsequently don, a floatation device stored under the seat while in an inverted aircraft that is submerged in water. In circumstances where timely reaction to an emergency situation is measured in seconds, wearing a floatation device may mean a difference between life and death. The commercial floatplane community has been actively involved in discussions around the efficacy of wearing PFDs while in flight, with divided opinions on this issue. While the overall value of a properly deployed PFD following a collision with water has not been questioned, concerns have been raised that an untrained or panicked passenger may inflate a PFD while inside the aircraft, possibly trapping that passenger and other passengers inside. Further, it has been pointed out that the PFDs currently approved for use by Transport Canada would not be able to withstand the rigours of extended and frequent wear expected in commercial operations. Debates have also focused on what design configurations would be most appropriate for different applications and suitable for a variety of passengers.

While these are all important considerations, they should not detract from the overall life-saving potential offered by a PFD worn while in flight. The issues in question can be appropriately addressed through purposeful passenger briefings and by embracing the latest advances in personal floatation technology. Recognizing that some of the PFDs potentially available to the aviation sector surpass the specifications stipulated in regulations, Transport Canada is considering regulatory changes that would allow the use of floatation devices that currently do not meet the definitions in the existing regulations. Recent developments in the design of floatation devices have translated into improvements in the equipment durability and comfort of use. Further improvements in the design are likely to take place as the practice of in-flight wear becomes a requirement and an accepted standard.

3) **It is recommended that Transport Canada create a regulatory requirement that illumination strips identifying emergency exits be installed onboard all commercial seaplanes.**

Chair's Comment: The panel considered the challenges associated with exiting an aircraft that has been involved in a collision with water. Passengers and crew who survive the initial impact may be injured and are likely to be disoriented due to stressful circumstances that may involve overturned aircraft that is quickly filling with cold water. With the poor visibility that ensues underwater, the ability to quickly identify points of emergency egress is critical to improving chances for survival. Installation of exit illumination strips is an uncomplicated and relatively inexpensive solution that can add to the overall strategy of enhancing seaplane safety.

4) **It is recommended that Transport Canada introduce a requirement that all certified aircraft be equipped with a battery-disconnect "gravity switch" or a similar system that severs connections with electrical power sources in a collision, thus removing a potential source of post-impact fires.**

Chair's Comment: In the Alice Lake incident examined by the panel, as the aircraft broke apart on impact, an electrical discharge from exposed wires caused the ignition of spilled fuel, which led to a fire that consumed most of the aircraft. The panel recognized that there is a continuing risk to occupants who survive the initial impact, unless ignition sources within the aircraft electrical systems are not eliminated by means of impact-activated electrical circuit breakers.

Similar technology is already utilized in emergency locator transmitters (ELTs) where automatic activation of the transmitter is accomplished by a deceleration-sensing inertia switch as the unit senses crash-specific forces. Disconnect switches for aircraft batteries are also available. "Gravity switch" or "G-switch" technology ensures activation in crash situations only, and is not responsive to hard landings, turbulence, or other normal operating conditions; reset switches allow for an override of the disconnect function if electrical power needs to be restored.

In a 2006 Safety Issues Investigation Report (SIIA0501), the Transportation Safety Board proposed that there is a significant risk for post-impact fire (PIF) with fire-related injuries and fatalities in small aircraft accidents. Occupants of small aircraft appear to be at a particular risk partly because of the limited energy-absorption characteristics of small aircraft airframes in crash conditions and partly because of the close proximity of fuel to occupants. The inability of emergency response personnel to suppress PIFs in sufficient time to prevent fire-related injuries and fatalities was also listed as a factor; one that would be of particular relevance to aircraft operations in remote locations.

Two of the cases discussed by the panel involved collisions with terrain that were survived by at least one occupant and where the ensuing fire created a threat to the survivors. In non-urban settings that form the backdrop of most seaplane collisions with terrain, the most likely ignition source is the aircraft electrical system and eliminating this ignition source through devices such as battery disconnect switches would enhance the post-collision survival chances of the occupants.

The TSB study concluded that the most effective defence against post-impact fire is to contain onboard fuel, prevent ignition, or both. Applicable technology has already been proven in helicopter and automotive applications. Whereas fuel-containment technology holds promise for new aircraft designs, battery-disconnect mechanisms offer simple and inexpensive solutions that are available for immediate application.

5) **It is recommended that Transport Canada undertake a formal review of the efficacy of available stall warning systems, including angle of attack indicators, for applications in all certified aircraft, with the objective of identifying systems that would enhance pilot's awareness of the angle of attack and allow for early recognition of situations that may result in an aerodynamic stall if uncorrected.**

Chair's Comment: An aerodynamic stall occurs when an airplane reaches a condition in which the wings can no longer provide the lift necessary to sustain flight. This occurs when the critical angle of attack is exceeded, such as when the angle between the airplane's wings and the flight path becomes too steep, resulting in excessive airflow separation and a rapid loss of lift. A pilot can be alerted to an impending stall through the inherent aerodynamic behaviour of the airplane that may manifest itself by airframe buffeting and a reduction in controllability; stall warning can also be effected with the help of dedicated warning systems; for example, a horn that emits an audible alert when the aircraft is approaching a stall position, or a control stick shaker.

Pilots may not always be aware of the proximity to a stall situation. Aircraft with benign stall characteristics, inconspicuous pre-stall warning buffet, and lacking an early warning system, may not provide the pilot with feedback about an imminent stall early enough to prevent the stall from occurring.

Pilots are trained to recover from aerodynamic stalls, but a successful recovery may not be possible before impact with terrain if the stall occurs at a very low altitude, close to terrain features or tree canopies. Even dedicated devices, such as horn-type stall warning systems, may not provide the pilot with early enough warning to allow sufficient time for recovery.

Angle of attack indicators are instruments that provide continuous feedback on the angle of attack and enable the pilot to make necessary adjustments before the situation becomes critical. When used to supplement other stall warning systems, such devices may be especially effective in mountain flying and in various other typical flight applications on British Columbia's coast; however, at this time, most aircraft flying in those situations are not equipped with angle of attack indicators.

6) **It is recommended that Transport Canada create a regulatory requirement that all new and existing commercial aircraft be equipped with real-time satellite tracking systems.**

Chair's Comment: In all four cases referenced by the panel, the aircraft were equipped, as required by regulations, with distress radio beacons or ELTs (Electronic Location Transmitters) intended to activate on impact and alert authorities of the crash and its location. No ELT signal was received by the authorities in any of the four cases. In the case of collisions with terrain, the ELTs may be destroyed on impact, as was the case in two of the incidents examined by the panel; in the case of collisions with water, the aircraft often inverts and may sink, reducing or eliminating the effectiveness of the ELT system.

Real-time satellite tracking systems have proven to be an effective tool; they can be utilized as a supplement, or perhaps even an alternative, to ELTs. The issue of accurate tracking of aircraft location was a point of discussion in three of the cases reviewed by the panel. In two of these accidents, accurate real-time tracking would have likely resulted in speedier rescue of the injured survivors. In the Quadra Island case, although it is not possible to determine the survival potential of all of the aircraft occupants given the multitude of factors that play into a search and rescue effort, degree of incapacitation from possible injuries and cold water survivability, the circumstances suggest that a properly utilized and monitored satellite tracking system, combined with prompt and effective notification and deployment of rescue resources, might have produced a different outcome for at least some of those onboard.

7) **It is recommended that Transport Canada initiate research into technologies that would allow seaplanes to stay afloat, or significantly delay the rate of sinking following collisions with water.**

Chair's Comment: The Saturna Island accident demonstrated the rapid rate of sinking, which can occur with float aircraft following a collision with water. Even though they are designed for take-offs and landings on water, once their floats are damaged by impact, float planes are susceptible to sinking.

Rapid sinking of aircraft complicates egress, denies the survivors a safety platform on the surface of the water and deprives search and rescue personnel of a highly identifiable visual marker. Although it was not within the panel's scope to attempt to identify specific technological solutions to the problem, the panel envisioned potential for integration of buoyancy materials within aircraft structures.

To: Transport Canada

and

To: Viking Air Limited

8) **It is recommended that the configuration of the pilot seat and restraint system as observed in the Beaver aircraft involved in the Saturna Island accident, and currently in use on some other Beaver aircraft, be examined to determine whether it meets its intended purpose of providing efficacious restraint of the occupant in a survivable collision.**

Chair's Comment: The panel was informed that in one of the cases involving a collision with water, the pilot's seat sustained a structural failure, which rendered inoperative the seat-belt restraint system, thus contributing to the pilot's injuries and likely impacting on his ability to render assistance to the passengers. Although critical seat component damage may be expected in higher impact collisions, the Saturna Island collision with water did not generate impact forces that would have been expected to render the seat restraint system inoperative. Similar seat and restraint system configurations on some other Beaver aircraft may also pose a continuing safety risk.

To: **Transport Canada**

9) **It is recommended that Transport Canada develop a process for issuing of Operational Directives, similar to the existing Airworthiness Directives processes, to enable speedy and efficient dissemination of safety related information and directives addressing operational safety issues.**

Chair's Comment: Introduction of amendments to the Canadian Aviation Regulations (CARs) involves complex processes that involve not only the work of Transport Canada, but also reviews by various committees, consultations with stakeholders and participation from other government bodies such as the Department of Justice and the Treasury Board of Canada Secretariat. This is a lengthy proposition, which may take years and is not conducive to implementing quick changes, even if those changes are strongly indicated in order to address critical risks and ensure safety of air travellers.

The regulatory amendment process can be contrasted with the speed and efficiency involved in the issuance of Airworthiness Directives (ADs). Airworthiness Directives are instructions issued by Transport Canada, or foreign national aviation authorities, mandating specific actions to ensure aircraft's conformance to its type design and safe operating condition. The Minister of Transport issues ADs in relation to safety issues of relevance to Canadian registered aircraft and its engines, propellers and other equipment onboard. ADs notify aircraft owners of unsafe conditions and of the mandatory actions required to ensure safe operation; under exceptional circumstances, they may even involve interdiction of flight until corrective actions are developed.

The panel is proposing the development of a process of Operational Directives to address safety risks in the area of Operating and Flight Rules, similar to the way Airworthiness Directives address issues related to aircraft airworthiness.

The panel envisioned such Operational Directives as a system of "short term safety fixes" to address safety gaps that should not wait for the lengthy regulatory amendment processes. Although it was not the panel's intention to propose any specific or exhaustive guidelines for the application and implementation of the proposed system, the panel anticipated that some issues, such as the standards for personal floatation devices or standards for mountain flying training, could be addressed through Operational Directives.

10) **It is recommended that Transport Canada eliminate the granting of Operations Specifications that allow commercial VFR fixed-wing operations in reduced visibility conditions.**

Chair's Comment: In two of the cases examined by the panel, reduced visibility caused by atmospheric conditions contributed directly to the collisions. In the discussions on this subject, the panel expressed concerns over the safety of any VFR operations conducted in reduced visibility and recognized that such high risk practices are currently legitimized in some cases through the issuance of Operations Specifications that may encourage pilots to conduct flight in marginal and deteriorating conditions.

The Canadian Aviation Regulations specify that daytime visibility of not less than two miles is required to operate a fixed-wing VFR flight conducted at less than 1000 feet above ground level in uncontrolled airspace; however, special authorization may be granted in the Air Operator Certificate, reducing the visibility limit to one mile.

An Air Operator Certificate and Operations Specifications outline the authorizations and limitations imposed on a particular air operator by the Department of Transport. Operations Specifications are issued pursuant to Canadian Aviation Regulations, but may authorize deviations from the standard regulatory provisions. VFR flights conducted under reduced visibility may be authorized under Operations Specifications as long as certain equipment, operational, organizational and pilot training requirements are in place.

Whereas the regular visibility limits may, arguably, already be quite low, they do provide a certain margin of safety: for example, when a flight is operated at the required two mile visibility limit and the conditions suddenly deteriorate to one mile visibility, the pilot may be able to retreat to safety; however, if the flight is conducted at the reduced visibility limit of one mile and the conditions deteriorate further, the situation becomes dangerous.

11) **It is recommended that Transport Canada require commercial VFR operators to provide their pilots with annual decision-making training specific to the scope of operations; and further, that Transport Canada require commercial VFR operators to provide annual decision-making training to all critical personnel that provide support to the pilot, including flight followers and company management.**

Chair's Comment: The panel identified the issue of pilot decision-making as being an important factor in all four cases it examined, giving rise to the notion that pilot decision-making (PDM) training needs to be seen as an essential component of training for all commercial pilots involved in passenger transport; this holds particular salience in the case of VFR operations.

At the same time, the panel recognized that pilot decisions do not materialize in a vacuum, but are framed within a context that includes management support, organizational dynamics and various external influences. The panel recognized that in the complex operating environments involved in charter and air taxi sectors, pilots require the empowerment that comes from knowing that the difficult decisions they need to make, such as a decision not to fly in adverse conditions, in spite of customer or other pressures, will be fully supported by management.

12) **It is recommended that Transport Canada develop standardized curriculum for underwater egress training and make underwater egress training mandatory for flight crews involved in commercial seaplane operations; and further, that enhanced safety briefings outlining underwater egress procedures be mandatory on all commercial seaplane flights.**

Chair's Comment: In view of the extreme challenge involved in attempting to escape from submerged aircraft, the panel wished to emphasize the value of underwater egress training. Such training should be mandatory for seaplane flight crews, and strongly recommended for passengers who frequently fly over water, such as workers commuting to remote coastal workplaces; likewise, the panel recognized that the infrequent flyers that make up a large percentage of passengers on seaplane flights would benefit from enhanced pre-flight safety briefings that contain instructions on underwater egress.

In June 2011 Transport Canada issued a Civil Aviation Safety Alert (CASA 2011-03), which encouraged floatplane operators to voluntarily adopt industry best practices, including emergency egress training for flight crews and passenger safety briefings that address proper usage of personal floatation devices during and after emergency egress. While the issuance of the Safety Alert was a significant recognition of the critical importance of underwater egress training to seaplane safety, the panel suggested a more compelling approach involving the use of regulatory provisions to ensure widespread compliance.

13) **It is recommended that Transport Canada create a requirement that all commercial seaplane pilots undergo training that includes a component on avoidance of, and recovery from, sudden encounters with hazards such as conditions that are below Visual Meteorological Conditions (VMC) minima, low level flight over glassy water and in poor visibility, and other typical hazards frequently encountered by seaplane pilots.**

Chair's Comment: The panel discussed a range of hazardous conditions regularly encountered by VFR pilots in seaplane operations, coming to a conclusion that the current training standards do not effectively address these challenges, and that the standard actions taught for avoidance and recovery from potentially hazardous situations such as, executing a 180° turn using instruments in order to avoid entering a cloud, may not be adequate or appropriate in case of low level flight over glassy water.

14) **It is recommended that Transport Canada develop standardized curriculum for Mountain Flying Training and develop criteria for measuring students' proficiency in reaching the acceptable standard.**

Chair's Comment: Flying in mountainous terrain is one of the most challenging tasks, even for experienced pilots. Hazards associated with mountain flying include highly variable weather conditions, challenging navigation, turbulence producing air currents and dangerous optical illusions. These and other factors exert physical and mental stresses on the pilot, and demand use of special techniques and strategies.

Although mountain flying training is offered by various flight schools, the curricula may vary widely and there are no defined standards for what constitutes the necessary set of skills for a mountain pilot, or for gauging pilot proficiency in this area.

To: NAV CANADA

15) **It is recommended that NAV CANADA engage in a consultation process with Environment Canada Meteorological Services staff and British Columbia's floatplane community, with the objective of improving the quality of weather camera imagery available through the Aviation Weather Web Site and increasing the number of web camera placements in critical coastal locations.**

Chair's Comment: NAV CANADA is a private sector, non-share capital corporation that provides Canada's civil air navigation services. The company took over the responsibility for the country's Air Navigation Services from Transport Canada in 1996. NAV CANADA provides air traffic control, flight information, weather briefings, aeronautical information services, airport advisory services and electronic aids to navigation. NAV CANADA operates a network of digital weather cameras, which capture imagery that can subsequently be viewed on the company's Aviation Weather Web Site (AWWS). The weather camera images are utilized by Environment Canada forecasters who generate Aviation Weather Forecasts and by pilots who access them to obtain an indication of weather conditions along the flight route.

The panel's discussions revealed concerns over the quality of imagery available from the network's new generation of cameras; whereas the quality was considered to be good during fair weather conditions, the panel was informed that in less than perfect weather, when the information is most critical to the end users, the quality of images was considered inadequate for the intended use and inferior to similar products available from other sources. One of the concerns expressed by the panel referenced the cameras' apparent inability to adequately adjust to changing light conditions; distortion of the image, as introduced by the wide angle lens, was also considered a problem as it translated into difficulty in inferring cloud heights. The panel also pointed out a need for an improved system to mitigate the obscuration of the images by water droplets collecting on the camera lens.

A significant number of British Columbia seaplanes operate in remote coastal areas, making access to information about meteorological conditions along the flight route critical to flight planning and safety. Given the high degree of weather variability along British Columbia's coastline, the spatial frequency of weather observations is critical in order to ensure adequate coverage. In this aspect, again, the panel was of the opinion that improvements to the existing system, in the form of additional camera placements along common seaplane routes, were desirable. Although it was outside of the panel's scope to develop prescriptive submissions for additional camera placements, the panel was optimistic that consultation with end users, including the float plane community and Environment Canada aviation forecasters would result in valuable input; in addition, the panel's discussions generated suggestions that consideration might be given to exploring weather camera placements at existing meteorological data collection sites and other suitable sites operated by various provincial ministries and other entities such as BC Hydro and various private industrial operations.

The panel also wished to acknowledge the significant contribution to aviation safety in the form of weather observations collected by lightkeepers at lightstations along British Columbia's coastline; although the lightstations are operated mainly for the purpose of providing aids to marine navigation, weather observations reported from staffed lightstations are also utilized and considered indispensable by aviation weather forecasters and seaplane pilots.

To: Floatplane Operators Association

and

To: 703 West Coast Floatplane Association

16) It is recommended that the British Columbia floatplane industry associations develop a strategy for gathering metrics that identify accident rates and patterns, show safety trends and support the development of accident prevention measures.

Chair's Comment: The panel recognized that while information is available on aviation accidents that result in fatalities or other serious consequences, little may be known about the overall rate of incidents involving commercial float aircraft. Similarly, there is no established mechanism for consistently monitoring incident trends or challenges to safety.

The panel acknowledged the float plane sector's expressed commitment to flight safety; however, alongside it, was a recognition that in order to make further strides towards promoting a consistent and sector-wide culture of safety, the industry needs to gain a better understanding of outstanding safety issues and accident patterns, while at the same time acquiring the ability to document any positive safety trends and developments.

17) It is recommended that the British Columbia floatplane industry associations encourage the operators that make up their membership to formally compile information on significant hazards specific to the operators' routes and provide flight crews with formal briefings or training and information on such hazards, supplemented with information on standard operating procedures and best practices for mitigating these route-specific hazards.

Chair's Comment: In all four accidents reviewed by the panel, atmospheric conditions, or atmospheric conditions combined with local topography, were contributory factors. The panel's discussions indicated that the topographical features at Lyall Harbour were conducive to the development of atmospheric disturbances on the lee side of the island's high terrain, affecting the climb performance of the aircraft and thus creating challenging take-off conditions for float plane pilots during certain wind flow patterns. The development of strong air disturbances, in combination with limitations presented by the rising terrain and the presence of built-up areas, created challenging take-off conditions that demanded cautious planning of the flight path, and consideration of aircraft flight characteristics and payload distribution.

The panel recognized that while significant recurrent hazards may be generally well known along some routes, in other cases, such knowledge may not be uniform. Overall, the formal recognition of any such recurrent hazards in the airline's operational documentation, along with best practice direction on available mitigation procedures, will provide pilots with a valuable flight planning tool and likely lay a foundation for better managerial support behind pilot's decision making.

The float plane industry could further consider making information on hazards specific to given routes readily available by posting it to a public website where it could be accessed by all operators and by any industrial clients who may utilize this information for planning purposes and selecting areas for docking facilities.

To: British Columbia Forest Safety Council

18) It is recommended that the BC Forest Safety Council include in the SAFE Companies audit protocols a component that specifically addresses the issue of worker transport onboard aircraft; and further, that the BC Forest Safety Council develop a resource package specific to air carrier standards and best practices.

Chair's Comment: The BC Forest Safety Council is an organization dedicated to advancing forest worker safety through industry training programs and initiatives such as the SAFE Companies program, which establishes health and safety standards that forestry companies need to meet in order to obtain SAFE Certification. Eligibility for SAFE Companies Certification is established through audit protocols, which evaluate company safety programs. Referencing the issue of air transport safety within the SAFE Companies audit framework will highlight the role employers can play through actions such as the choice of air carriers, encouraging the use of PFDs and providing underwater egress training for workers who frequently fly over water.

Shortly after the Quadra Island accident, Interfor, the employer of one of the passengers who died in the collision, developed Air Carrier Standards, which apply to air operators providing transportation services to Interfor's employees. Interfor's Standards outline the company's expectations with regards to safety of their workers and place extensive requirements on air carriers providing services to this forestry company. Interfor's Air Carrier Standards initiative demonstrates the positive direction that employers can take to enhance the safety of their workers.

To: WorkSafeBC

19) **It is recommended that WorkSafeBC consider development of Guidelines to the Workers Compensation legislation promoting under-water egress training for employees who regularly commute to work-sites over water onboard aircraft.**

Chair's Comment: The panel acknowledged WorkSafeBC's restricted jurisdiction in areas that are federally regulated, including aviation; while at the same time recognizing that matters of occupational health and safety fall under provincial jurisdiction and the WorkSafeBC purview. The *Workers Compensation Act* places an obligation on employers to ensure the health and safety of workers; further, employers are required to provide workers with instruction and training necessary to ensure the health and safety of workers.

Air travel exposes workers to risks that may be as significant as those related to operating heavy machinery or working with hazardous materials, and yet, flying-related risks are largely outside of the individual worker's control.

While the greatest advances in float plane safety can only be achieved through regulatory initiatives as proposed in the remainder of the panel's recommendations, employers may also have a role in mitigating some of the risks that their workers are exposed to while travelling to remote workplaces and camps onboard aircraft. Employers can do their part through a number of measures such as judicious selection of air operators and insisting that only those operators who demonstrate the highest standards and commitment to safety are considered for worker transport. Further, employers should consider underwater egress training for workers who are routinely required to commute over water onboard aircraft; employers can also outfit workers with personal floatation devices to be worn while flying over water, along with training on deployment of such devices.

The panel recognized that significant safety gains could be accomplished in this area by WorkSafeBC through introduction of appropriate provisions into the Occupational Health and Safety Regulation, or alternatively, through development of Guidelines that encourage employers to proactively address safe transport of workers onboard aircraft.

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