Heliski safety and risk management

Purpose of this presentation

- Explain the operational parameters of heliskiing
- Learn about the aircraft operation and the flying environment
- Examine common hazards associated with flying in this environment
- Identify controls and their purpose, along with processes to mitigate associated hazards for various elements that make up this kind operation
- Discuss and formulate what “good looks like”

What is heliskiing?

- Definition: the highly repetitive transportation of **professionally guided** recreational skiers, from the bottom to the top of downhill ski runs. This is not groomed downhill skiing as you would expect to see at a ski hill (e.g., Mt. Ruapehu), but rather referred to as ‘powder snow’ skiing.
- Can be conducted in either an alpine environment or within the tree line at lower altitudes. Each environment presents different challenges (hazards) to the skiers.

What are the hazards?

- Weight Altitude Temperature performance issues (HIGE & HOGE)
- Controlled Flight Into Terrain (CFIT) – consequence of not having visual ques, or entering IMC
- Lack of visual cues/spatial disorientation
- Flat light
- Blowing snow/recirculating snow, also known as “snowball”
- Dynamic Rollover – consequence of not having visual ques
- Lack of Tail Rotor Effectiveness (LTE)
- Vortex Ring State (associated with lack of visual cues)
- Centre of Gravity (C of G) issues
- Off level landings
- Few options to conduct an urgent or emergency landing
- Main rotor/tail rotor blade strikes
- Icing conditions
- Avalanche
- Exposure

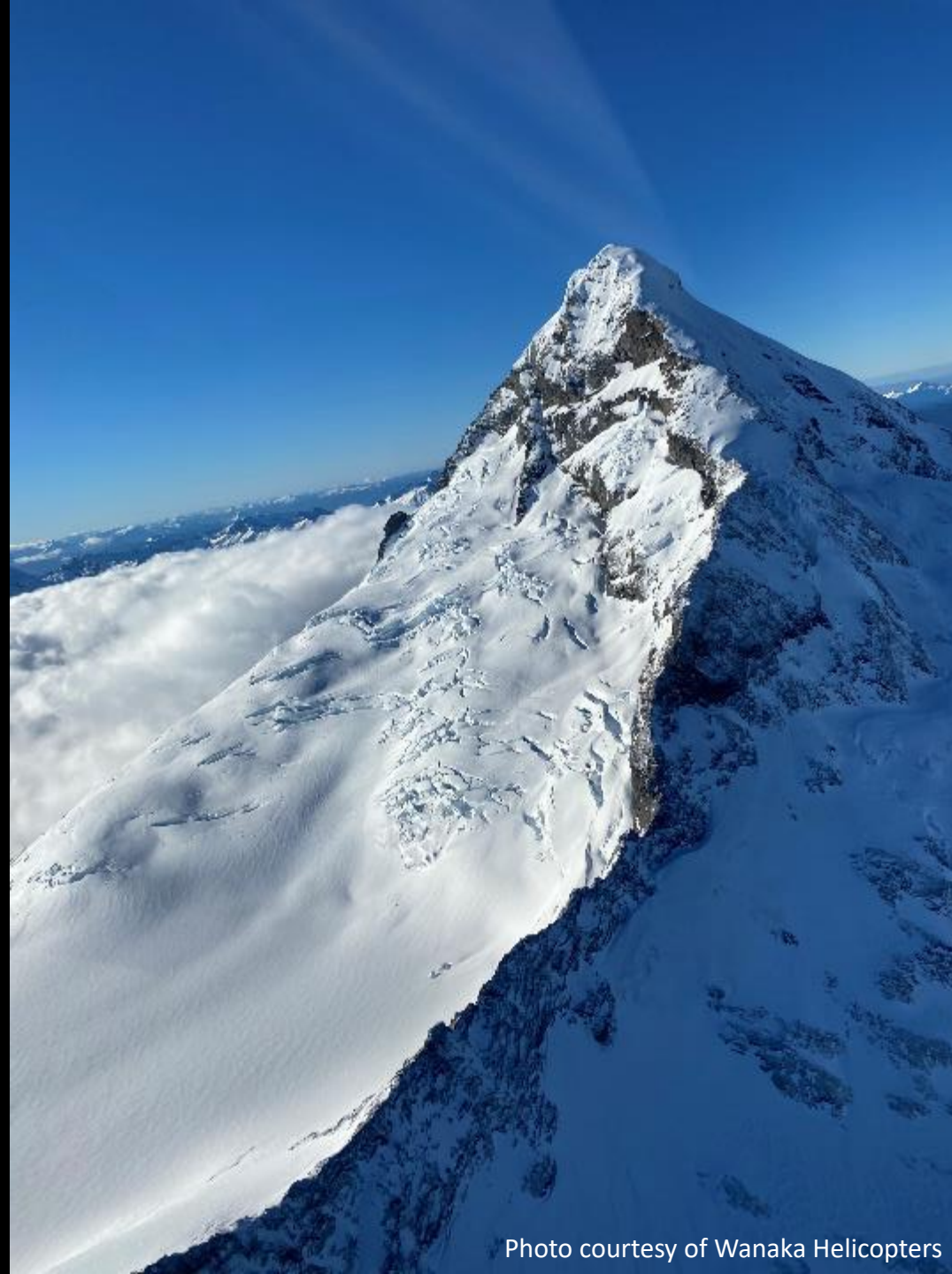


Photo courtesy of Wanaka Helicopters

The Heliski Guide

An integral safety component of the operation

What do they do?

- At the coalface, the heliski guide will take skiers down an ungroomed mountain side that may/may not have been skied prior. As a rule of thumb, the lead guide directs the path to be skied, with other skiers following suit. Passing the heliski guide going down the mountain is usually forbidden. However, there is latitude for skiers to 'fan out' laterally (within reason) to take advantage of an undisturbed snowpack. As well, they are instrumental in ensuring passengers (skiers), and their gear, are loaded into the helicopter safely (access and egress). More on this later.
- Lead guides are often members of and qualified under NZMGA/IFMGA (New Zealand/International Federation of Mountain Guides Associations)
- Additionally, most guides hold other qualifications: advanced first aid (as a minimum), explosive control, and mountain rescue training
- For now, lets focus more on the heliski guides area of expertise to better understand what they do, as there is a lot of preparatory work completed prior to a day's skiing sessio
- **Avalanches** are of a paramount concern when skiing in the mountains. Because of this, heliski operators and guides adopt processes to reduce the risk and potential exposure to the avalanche hazard
- This means that selection of the appropriate terrain on any given day is one of the best ways of avoiding avalanche involvements

How do they do it?

- The first line of defense when working in avalanche terrain is hiring **trained** professional mountain guides who have appropriate skills and qualifications to work in mountain terrain in the winter
- Heliski guides are concerned with 3 major precursors to avalanche activity: precipitation (snow/rain), wind and temperature
- As such, guides are usually expert at interpreting weather/weather patterns, which is usually checked in the morning prior to the days skiing
- Along with observing/interpreting a detailed weather prognosis, guides will usually conduct field observations

Some field tests…

- Rutschblock Test
- Crystal Card and Magnifier
- Shovel shear test, Hand Shear or Ski Pole Block
- Potato Chip Test
- And there are more: all designed to test the stability of the snowpack for risk of avalanche

Photo courtesy of Wanaka Helicopters

A typical day (in general)…

- **Starts with a morning guides meeting:** Snow stability, weather, avalanche and flying considerations are discussed. Based on this, a run list is prepared for the day. The pilot, in some capacity (either on site or via cell), should be involved with these discussions
- **Time to go skiing!** Guests are organised, briefed (video to follow), and loaded for pick-up, to commence the days heliskiing
- **Field observations and tests** are usually made throughout the day, with detailed notes being made and retained
- **Explosive testing and control** may be conducted: this is done in a dedicated machine. This activity has its own protocol/SOP and various other considerations
- **An evening guides meeting:** Daily log of weather, snowpack and avalanche observations are recorded. The pilot(s) present any special concerns that they may have had regarding the flying or related issues

Example safety briefing: Harris Mountains Heli-Ski – Daily Operations and Safety

Heliski Guide Safety Briefing

Overall, a good safety briefing. Any observations?

Here's a couple:

Not quite clear on how many guest packs are issued?

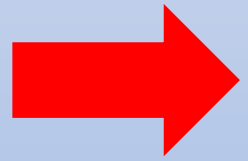
Instructions read on how to use the transceivers **after** the avalanche has occurred? Individual and group search practices should be conducted **prior** to heliski operations. Are there any Avalanche Airbag Systems in use (video on page 14)?

Note that the helicopter is called in: how is the rescue plan co-ordinated between the heliski operator and the helicopter organisation?

In summary

Heliski Guides:

- Are professionally trained
- Are proficient interpreting Wx
- Conduct morning and evening briefings
- Conduct field observations
- Are expert at snow analysis
- Some conduct explosive testing and control



How and how often does this information get to the aviation participant?

Avalanche Airbag

Video: Avalanche airbag compilation

Assurance of safe outcomes

Questions to ask within your organisation

- What assurance do you have that the organisation can safely manage the heliski programme, including oversight of the heliski guiding component of operations?
- How does your organisation conduct performance management of both your aircrew and the interfaces with third parties, to deliver a successful ski season.
- How do you see yourselves in terms of conducting best and safe practices? How do you know you are achieving this? Where do you source this information?

Consider…

Even though each organisation is a separate corporate identity, the success of any heliski programme requires a high degree of engagement and coordination of the two companies

This requires effective collaboration and communication between the aviation participant and the heliski operator

The aviation participant must bring in the heliski operator to conduct the following:

Consider…

- **Training:** Heliski guides must be trained (initially and recurrent) on passenger safety briefings, including demonstrating/practicing operation of aircraft doors (including emergency operation), securing ski baskets, loading passengers, location(s) and operation of ELT, first aid and survival equipment. Communication protocols with aircrew should also be covered. Training records must be retained, as well as a system that tracks and ensures new hires do not undertake guiding duties unless trained to do so.

- **Safety meetings**: Heliski guides should be in attendance, or air crew should be attending guides' safety meetings. Both parties should also be sharing safety communiques for distribution. This is crucial so that both parties are aware of what happens "on the hill"

- **Management meetings**: At the appropriate level, these discussions should touch on the logistics, costs, pressures, and performance issues with individual pilots and guides alike. It is not unusual to have pilots or guides replaced in the field for various reasons

- **Safety management processes**: Training, Safety Meetings, Management Meetings outputs should feed into the aviation participant's internal audit programme, MOC (if required) and the constant evolution of SOPs (this list is not exhaustive)

- **Occurrence reporting**: There should be a transparent process whereby both organisations ensure incident/accident reporting, including how well these were triaged, and lessons learned and disseminated as a result

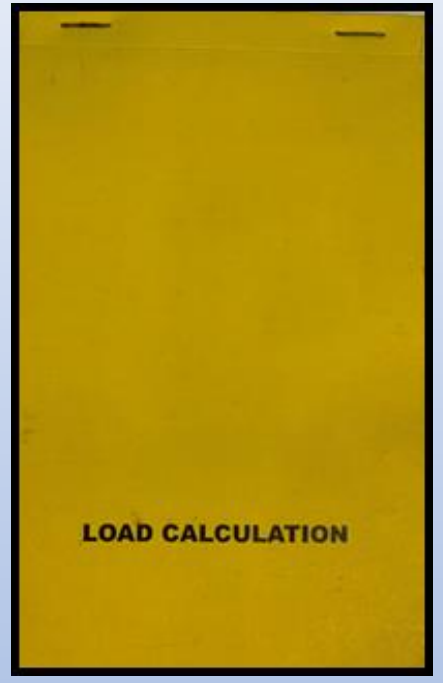
A word about best practices

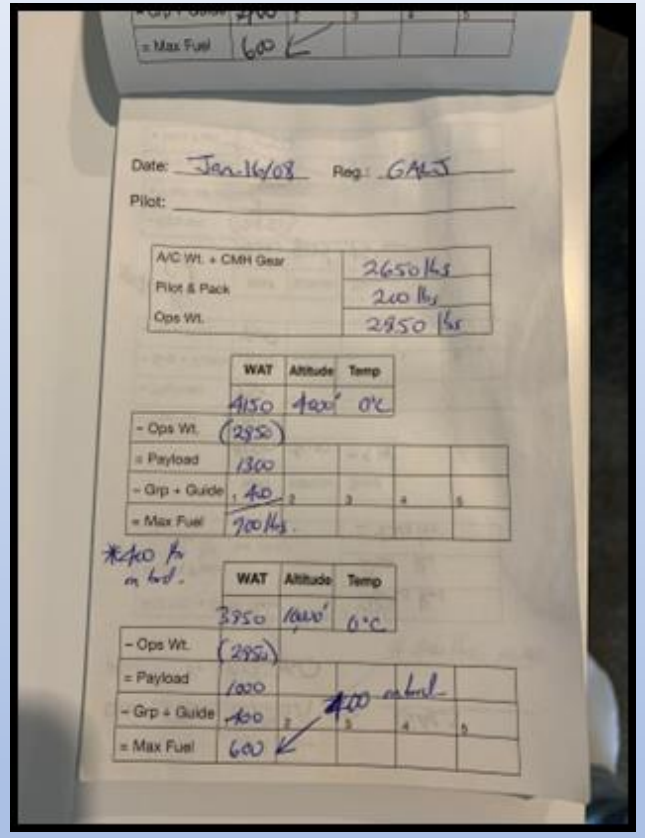
- Best practices are a set of guidelines, ethics, or ideas that represent the most efficient or prudent course of action in each business venture or operation
- Best practices may be established by authorities, such as regulators, self-regulatory organisations, or other governing bodies, or they may be internally decreed by a company's management team
- Is the organisation endeavoring to:
  - Research other companies or look at how heliskiing is conducted in different parts of the world? Helicopter Association of Canada (HAC) Heliski Training Best Practices is a good reference (free online)
  - Join/contribute to governing associations? E.g., the Heli-Ski U.S. Association, the NZMGA/IFMGA, etc.
  - Ensure key staff share their experiences from other organisations?

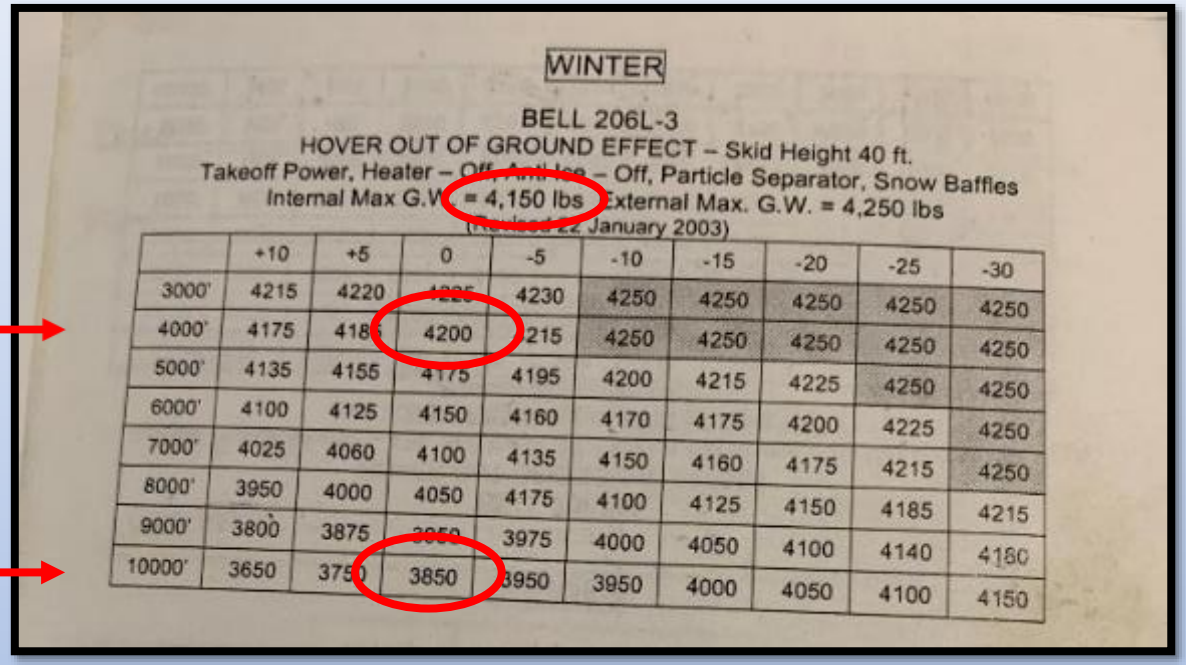
A word about best practices

- Does the organisation's management of change facilitate best practices? If so, what does this look like?
- Are best practices measurable? Are they reviewed for efficiency and effectiveness?
- Are near miss and hazard Identification reporting utilised to change or modify practices and procedures?
- Is there a mechanism to foster new ideas from staff?

Weight and balance







WINTER

BELL 206L-3

HOVER OUT OF GROUND EFFECT – Skid Height 40 ft.

Takeoff Power, Heater – Off, Anti-Ice – Off, Particle Separator, Snow Baffles

Internal Max G.W. = 4,150 lbs External Max. G.W. = 4,250 lbs

(Revised 22 January 2003)

	+10	+5	0	-5	-10	-15	-20	-25	-30
3000'	4215	4220	4225	4230	4250	4250	4250	4250	4250
4000'	4175	4185	4200	4215	4250	4250	4250	4250	4250
5000'	4135	4155	4175	4195	4200	4215	4225	4250	4250
6000'	4100	4125	4150	4160	4170	4175	4200	4225	4250
7000'	4025	4060	4100	4135	4150	4160	4175	4215	4250
8000'	3950	4000	4050	4175	4100	4125	4150	4185	4215
9000'	3800	3875	3950	3975	4000	4050	4100	4140	4180
10000'	3650	3750	3850	3950	3950	4000	4050	4100	4150

This takes a pilot all of 3 minutes to calculate. Can be calculated numerous times a day for any altitude and temperature

Processes to examine and identify

Check **Weight & Balance** calculations for aircraft configuration in use. Consider the following:

- Actual passenger weights used, including allowances for snow gear: ski wear, boots, helmets, and packs.
- Proper station utilised for the installation of the dual front seat placement, including C of G range (lateral and longitudinal) from a maximum load to minimum fuel weight state.
- Controls in place to ensure dual front seat placement weight limitations are not exceeded. This would include heliski basket and all baggage compartments utilised.

Example FMS for forward two-place seat

1 GENERAL

This Supplement applies to the aircraft equipped with the two-place seat. When it is mounted in lieu of the copilot's seat the aircraft can carry seven persons.

2 LIMITATIONS

All the limitations specified in Section 2 remain applicable with the exception of the following specific limitations :

- The maximum number of persons carried is increased to seven (including pilot).
- The total weight of the two passengers on the forward two-place seat shall not exceed 154 Kg (339 lb).
- The optional dual controls shall be removed in order to install the forward two-place seat.

3 EMERGENCY PROCEDURES

All the emergency procedures specified in the basic Flight Manual remain applicable.

Example FMS for forward two-place seat

4 NORMAL PROCEDURES

The normal procedures given in the basic Flight Manual remain applicable. Special attention shall be paid to c.g. determination.

★ CAUTION : C.G. LIMITS AT EMPTY WEIGHT ARE TO BE RE-DETERMINED IN ACCORDANCE WITH THE INFORMATION CONTAINED IN THE MAINTENANCE MANUAL, WORK CARD No. 25.22.20.401.

★ NOTE : Flying with one pilot, then with 7 persons on board present very significant differences in c.g. limits. It is imperative that this be checked in every configuration.
The C.G. locations and variations can be determined rapidly from the charts of chapter 6.1.

★ If the c.g. limits of the aircraft at empty weight lie within the area (1), limit flight configurations (1 pilot, then 7 persons) may be contemplated without changing the ballast. This should be confirmed by calculation.

- CG location of passengers on forward seat bench : 1.70 m (66.9 in).
- Approximate weight of the removable components of the installation :

  High-back seat : 10 Kg (24 lb)
  Low-back seat : 12 Kg (27 lb)

5 PERFORMANCE

The performance data given in the basic Flight Manual remain applicable.

Aircraft operations

Image courtesy of Air Safaris

What controls are in place to ensure that aircraft are not loaded and operated outside of manufacturers' limitations?

A quick refresher …

Weight & Balance calculations must be conducted prior to each flight. Factors to be considered:

- Proper aircraft configuration: basket, baggage compartments, and the installation of the two person "love seat" in front with the pilot (AS350/Squirrel helicopters)
- Aircraft performance: Hover In Ground Effect (HIGE) & Hover Out of Ground Effect Hover (HOGE) performance charts to be consulted in the Aircraft Flight Manual. Sometimes also referred to as Weight Altitude & Temperature (WAT) calculations. Depending on how high the operations are being conducted, these numbers are usually less than aircraft gross weight at sea level on a standard ICOA day
- For planning purposes, the operational area (sometimes referred to as the tenure) needs to be examined for highest landing, valley pick ups, and fuel depot locations. These considerations should be addressed in the organisation's documentation process (more on this)

Have you differentiated operational taskings and the requirements to successfully achieve safe outcomes? For example, a flagging operation prior to skiing vs avalanche control?

- When flying “in the white”, visual cues become critical. Consider a blue-sky day, where landing can be achieved almost anywhere on the mountain. Long shadows, flat light and recirculating/blowing snow changes the equation
- Are flagging or staking protocols/SOPs in place?
- If there is a staking programme, then this usually takes place prior to the ski season commencing, on “blue bird days” with essential crew only
- Do participants in conjunction with heliski operators conduct avalanche control? If so, how is this conducted?
  - Amex/powder with blasting caps?
  - Percussion bell on a longline?

More on flagging…

- Landing areas may need to be identified and staked prior to landing with skiers. Guidelines for flagging may need to be established by the operator as applicable
- Double flagging may be appropriate to indicate orientation critical to a site
- Lead-in or lead-out flags may be distinguished from landing area flags by orientation, color, or placement
- Discuss staking requirements with guides: pilots' decision takes precedent
- In a bowl (cirque), lead-in flags may be used to indicate wind and approach path

What limits have you established for what your passengers have access to on the aircraft, versus the heliski guides? For example, operation of the ski basket and securing of aircraft doors, etc.?

- This must be controlled by and communicated from the aviation participant to the heliski operator. Documentation and processes should consider:
  - Is the safety briefing reviewed on a periodic basis?
  - Does the aviation participant train the heliski guides?
  - What is the assurance process that is in place to ensure all heliski guides are trained to conduct safety briefings?
  - Does the pilot conduct/augment the safety briefings as well?
  - Does the aviation participant hold training records for heliski guides?


Environment

Ask yourself

Do your rescue plans relate to the risks presented by the environment you operate in, including but not limited to, ERP and medivac procedures?

With reference to the previous question, are these practiced and/or communicated to the heliski guiding company? If so, when does this occur and how often?

What is your accountability once your clients depart the aircraft? What are your responsibilities under HSWA?

Consider the following:

- The Rescue Plan is usually established by the heliski company and reviewed annually by the helicopter operator. Under the aviation participant's internal audit plan, this should be reviewed seasonally
- The Rescue Plan should also be reviewed during initial and recurrent heliski training. Does this review get filtered down to the practitioners of the plan (pilots and heliski guides), or is it a Management Review item conducted around the boardroom table?
- Besides avalanche, what about medivac procedures? For example, cardiac arrest or a broken limb on the hill?
- Is there anything noted pertaining to Rescue Plans in the aviation participant's ERP? If so, are 'mock' exercises (for heliski operations) conducted seasonally? Is the ERP dependent on ground ambulance or air ambulance transport? What if one of these services isn't available (contingency)? Are safety lessons learned fed back into the Rescue Plan/ERP and other safety processes within the organisation?
- Other scenarios: Aircraft AOG on the mountain, or an aircraft accident occurs, rapidly changing weather, pilot has a disagreement with one of the guides, one of the guests' conduct is such that a hazard is created?
- This list is by no means exhaustive: Other considerations?

Training Programme

In general, how is your heliski training programme conducted? Has your organisation's training programme considered pilot skill fade?

- The first question is very general and is designed to initiate a discussion.
- Skill fade occurs because of lack of currency, which leads to lack of proficiency. Flying skill sets are perishable, if not constantly practiced.
- A few ways this can be addressed:
  - Additional training, over and above the minimum rule requirements.
  - Hire pilots that have just concluded heliski operations overseas.
  - Constant safety communications and briefing to aircrew to engage the environment with caution, reinforcing good PDM skills. Potential to jointly communicate this message to the heliski operator as well, as this is where the "push" in the field will come from.

If you use a Part 141 service provider, how do you ensure that the training deliverables meet your expectations for the area of your operation and aircraft type operated?

- The aviation participant should have control of the training programme in terms of what the Part 141 should be focusing on.
- There should be a component of ground school, covering the tenure to be flown (local area knowledge).
- Ideally, the flight training should be conducted in the actual terrain, or similar terrain.
- The training pilot should have commensurate experience to train in this environment (more on this later).

What are the elements that make up your training syllabus?

The Training Syllabus (whether delivered by a Part 141 or not) should include the following:

- Weather
- Morning briefings
- Visibility
- Pilot decision making
- Aircraft performance
- Hazards (avalanche, cornice)
- Evolution of a typical ski day
- Staking/flagging system
- Multiple aircraft operations
- Passenger management
- Weight and Balance
- Heliski baskets
- Rescue plans

What are the elements that make up your training syllabus? (continued)

- Safety briefings
- Rescue gear
- Airmanship
- Personal protective equipment
- Flight watch
- Wind
- Recces
- Pilot flight and duty times
- Avalanche control

The intention here is to ensure that the training programme has a context for the environment that the aircraft and crew will be operating in.

What are the heliski training pilot/instructor qualifications for your organisation?

Helicopter Association of Canada (HAC) recommendations:

- Past experience in mountainous and heliski operations
- Minimum 2000 hours helicopter Pilot-in-Command
- 100 hours of heliski operations
- 1000 hours in mountainous terrain
- Prior instructing experience
- Total time on aircraft to be used
- Past experience in geographical region.

What is your metric?

When selecting a pilot for this type of operation, what are the minimum requirements by way of previous mountain and winter operations?

Helicopter Association of Canada (HAC) recommendations:

- Past experience in mountainous operations
- Total time on aircraft to be used
- Past experience in winter operations
- Past experience in geographical region
- Historical decision-making process and CRM
- Ability to work with a team
- Trained in accordance with an approved mountain flying training syllabus, have achieved 500 hours flying in mountainous terrain and 4 years operating in winter conditions. In addition, demonstrated proficient operational knowledge in all aspects of mountain flight and winter operations

Good may look like this

	Check Details	E	S	S/B	U	Comments
1.Heli Ski Procedures	A. Exterior Snow and Ice Clearance					
	B. Breaking Ground					
	C. Blowing Snow Effect					
	D. Climb Track- Maintaining Visual Reference					
	E. Climb Track- Maintaining Visual Reference					
	F. Flagged - Approach and Landing					
	G. Un-Flagged – Approach and Landing					
	H. Snowball Avoidance at Touchdown					
	I. Flat light Visual Effects - Closure Rates					
	J. Steep Approach					
	K. Flat Approach					
	L. Reference management					
	M. Power Checks					
	O. Departures from Stake					
	P. Terrain following					
	Q. Pilot Decision Making					
	R. Flight Watch protocols					
2.Reduced Visibility	A. Climbing and Descending in Low Vis					
	B. Decision Points					
	C. Course Reversal- 180° turn					
	D. Whiteout Effect- Recognition and Effect					
	E. Closure Rates in poor Visibility					
	F. Refractive error on Windscreen					
	G. Failures in Reduced visibility					
3.Pre Flight	A. Aircraft Performance					
	B. W & B/Group Weights					
	C. Weather check					
	D. Safety Briefings					
5.Other	A. Flight reports					
→	B. T4 issues in the 407					
→	C. Avalanche/Cornice Hazards					
→	D. Rescue Plans Review					
	E. Rescue Gear and PPE					
6. General Assessment						
7. Other						

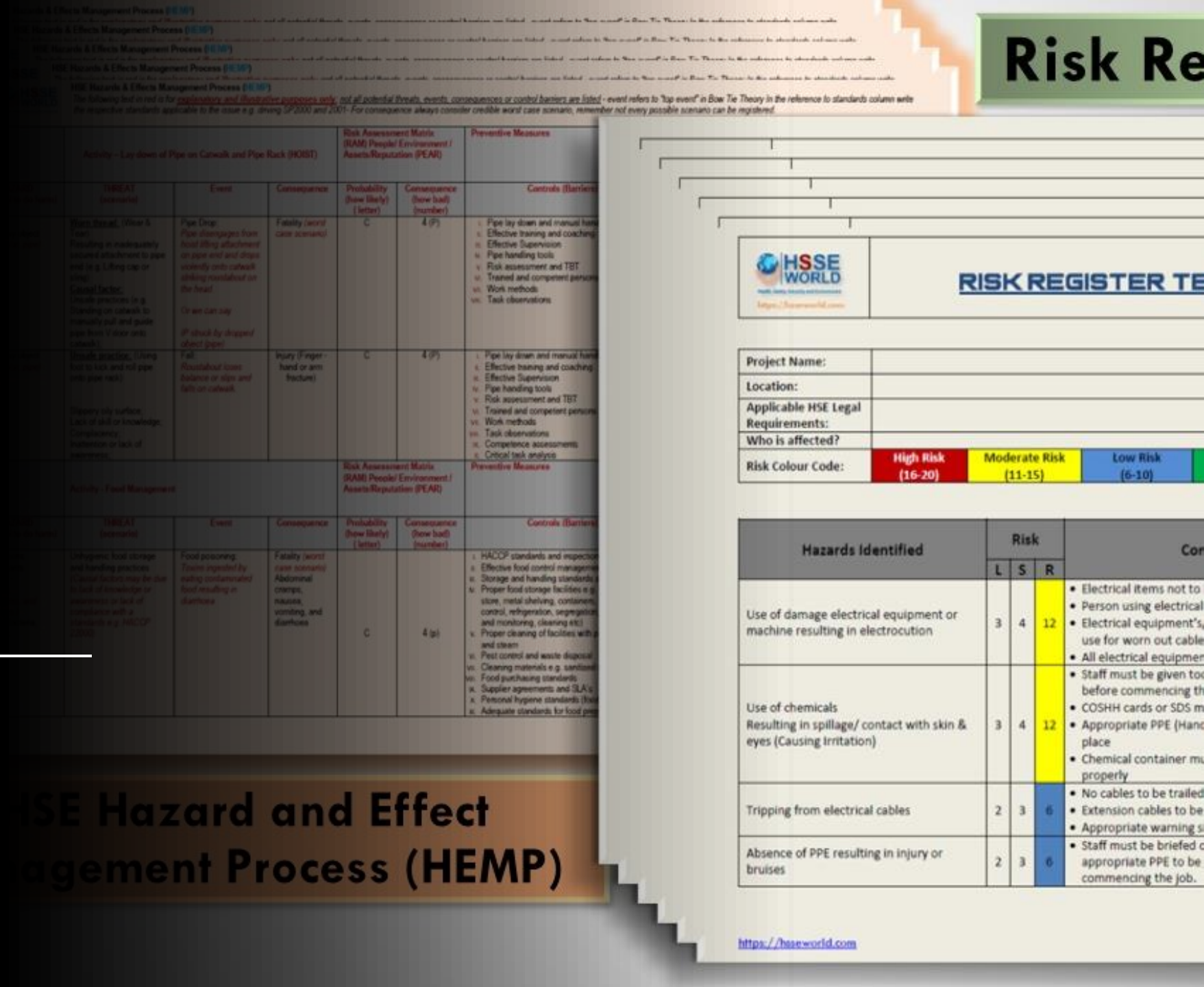
Supervision

Photo courtesy of Wanaka Helicopters

Participants should be able to demonstrate a system of oversight for their heliski programme. It employs different elements:

- A Flight Watch system: is this a passive process for the participant, whereby a Flight Follower is watching live tracking information or there is a radio protocol in place whereby the guide or pilot calls off each run? What is the documented process and is it fit for purpose?
- Is there a pilot mentorship/training program in place to safely transition a pilot with mountain experience into the heliski environment? If so, then the permissions and sign offs should be contained within the pilots' training files.
- Is there a key person responsible for the day-to-day operations of the heliski programme, including liaising with the heliski operator? There should be a documented protocol, including how issues are dealt with that arise in the field.
- Conversely, is there an appointed person from the heliski operator that conducts a similar role?
- Are progress checks conducted (by Chief Pilot/Part 141 Training Pilot) early season/mid-season on the pilots? This would be a critical safety check, especially for those pilots in their first season of heliskiing.
- Does the aviation participant's Safety Manager (or other designated person) conduct field spot checks to ensure company policy and procedures are being abided by? Is this documented and part of the safety programme? Does it form part of the organisation's management review?
- Are pilots being monitored for pressure imposed by the guides to conduct heliski operations that pushes either the **weather** or **fuel** considerations?

Control of hazards



Questions to ask within your organisation

Consider the hazards you have identified with heliski operations.

Given that the last few seasons may not have been atypical, how will you be adapting to a potential ramp up of operations? What changes have you made to existing controls? What new controls you have implemented?

How do you co-ordinate the control of hazards with the heliski guiding company? How are PCBU obligations and responsibilities shared? Is there any direct interface between your organisation and other authorities (e.g. DOC)?

Have you identified the hazards of co-ordinating operations with the heliski guiding company? Is there another entity that provides transportation of the ski party to a pickup point?

Hierarchy of controls

Participants should be able to demonstrate circumstances when heliskiing operations should be halted

Eliminate — Eliminate the hazard

Substitute — Use processes or methods with lower risk impact

Isolate/separate — Segregate hazards and/or targets

Engineer — Engineered safeguards:
PREVENTION Design to prevent an unwanted event
RECOVERY Design to mitigate harmful consequences

Organisation — Training, competency, communication

Procedures — Operating procedures, work instructions, permits, maintenance regimes, emergency response procedures

PPE — Personal Protective Equipment - protect the person

Wrapping it up

The primary duty of care refers to the idea that a PCBU must ensure its workers' health and safety so far as reasonably practicable. A PCBU must also ensure that other people are not put at risk by its work activities.

Risk Assessment Matrixes (RAM) and Hazard Registers for appropriate controls: most of which have been discussed in this presentation. Is 'skill fade' included?

Safety communications within each organisation and shared safety information.

Other third-party service providers: who are they, their function, purpose and are they suitably trained/informed to work peripherally in this environment?

Training programmes for air crew and guides (aviation participant orientated). What training is on offer to the aviation organisation (from the heliski operator)?

Management engagement between organisations.

Consider opportunities for field observations.

Assurance that heliski operations are safe comes from a total system view of safety management and a positive investment in leadership, culture, training and human behaviour.