HAC

Helicopter Association of Canada

Helicopter Guidelines for Canadian Onshore Seismic Operations

HELICOPTER ASSOCIATION OF CANADA BEST PRACTICE

First Published 09 - 2009

Rev 1 – Jan 2013

Table of Contents

DISCLAIMER 3
INTRODUCTION 4
ACKNOWLEDGEMENT 5
1.0 SAFETY MANAGEMENT SYSTEMS (SMS) 6
2.0 PROGRAM OPERATIONS 12
3.0 TRAINING, COMPETENCY AND STAFFING LEVELS 24
4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE) 38
5.0 HELICOPTER PERFORMANCE AND ROLE EQUIPMENT STANDARDS 40
6.0 BASE CAMP/STAGING AREA/HELIPAD INFRASTRUCTURE & EQUIPMENT REQUIREMENTS 44
7.0 SINGLE / TWIN ENGINE RISK ASSESSMENT - HELICOPTER PERFORMANCE PLANNING 51
8.0 SINGLE / TWIN ENGINE RISK ASSESSMENT - CONSIDERATION FOR SELECTING HELICOPTER TYPE 52
9.0 SINGLE ENGINE AIRCRAFT OPERATION 53
10.0 TWIN ENGINE AIRCRAFT OPERATION 54
ANNEX A – RISK ASSESSMENT (HELICOPTER/ONSHORE SEISMIC SUPPORT RISK ANALYSIS) 55
ANNEX A – RISK ASSESSMENT (SUPPORT SPECIFICATIONS) 56
ANNEX A – RISK ASSESSMENT INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) 57
ANNEX A – RISK ASSESSMENT (HELICOPTER/ONSHORE SEISMIC SUPPORT RISK ANALYSIS) 58
ANNEX A – RISK ASSESSMENT (HELICOPTER AND CREW DETAILS) 60
ANNEX A – RISK ASSESSMENT (GENERAL HAZARDS RISK MATRIX) 62
ANNEX B - GENERIC HAZARDS & CONTROL INVENTORY 65
ANNEX C - HAC CLASS D EXTERNAL LOADS TRAINING GUIDELINES 73
ANNEX D - HAC MOUNTAIN FLYING TRAINING GUIDELINES 79
ANNEX E – FATIGUE MANAGEMENT PROGRAMS 81
GLOSSARY 84
ACRONYMS 90

DISCLAIMER

This document provides guidance to members of the Helicopter Association of Canada (HAC) wishing to establish or adopt industry best practices.

This document is not, and is not intended to be, all inclusive.

While every effort has been made to supply accurate and up to date information, the HAC and the company's and individuals associated with its production assume no responsibility or liability for the accuracy, adequacy, or completeness of any information presented in the Document and assume no responsibility for any errors or omissions, or outcomes arising directly or indirectly from its use.

In the event of any conflict, discrepancy, error, or omission between the information presented in the document and any applicable provincial and/or federal law, regulation, directive, order or recommendation, the applicable provincial and/or federal law, regulation, directive, order or recommendation shall prevail.

The HAC and the companies, organizations, and individuals that are a part of the association or contributed to the development of the document make no representation, warranty, or guarantee in connection with the publication or the contents of the document, and hereby disclaim liability or responsibility for loss, damage or harm of any kind resulting from its use or the violation of any legal requirement with which any provision in the document may conflict.

The information in the document is intended as a guide only and does not provide the only acceptable method of dealing with the topics addressed herein. The document is not a definitive or exhaustive guide to compliance with government regulations and does not release users of this document from their responsibilities under applicable laws, regulations, directives, orders or recommendations.

The HAC and the companies, organizations, and individuals that are part of the association or contributed to the development of the document assume no liability in publishing the document. In each case, companies, organizations or individuals using this document should conduct their own due diligence by way of performing specific testing, research, development and implementation of individual methods of controls and should familiarize themselves with all applicable laws, regulations, directives, orders or recommendations.

INTRODUCTION

Heli-Portable (and/or Heli-Assist) onshore seismic operations have become a common methodology used for acquiring seismic data and is a major sector of today's helicopter industry; as the technology and practices within this industry have continued to evolve, so have the innovations that improve safety performance.

This Best Practice is intended to be the collective voice, mediator and liaison for the Canadian Helicopter and onshore seismic exploration industries as it applies to onshore seismic exploration activities. This Best Practice document combines many of the items that were once contained within the Canadian Association of Geophysical Contractors (CAGC) Best Practice for Heliportable Seismic operations, with the items from the HAC developed Best Practice. By combining two similar documents that were written both from the perspective of helicopter operators and from the land based exploration industry, it was felt that two similar documents could become one, with input from a broader range of industry representatives.

The intent of this Best Practice is to further assist in the reduction of the accident/incident rate outlined by the International Helicopter Safety Team (IHST) and to alleviate exposure to risk from members actively involved in both the aviation and onshore seismic exploration industries in Canada.

This document has been developed and supported with input by the Helicopter Association of Canada (HAC), Canadian Association of Geophysical Contractors (CAGC), Canadian Association of Petroleum Producers (CAPP) and the International Association of Oil and Gas Producers (OGP).

The Helicopter Guidelines for Canadian Onshore Seismic Operations Best Practice is a living document and will be reviewed as needed, or every 2 years during the election process of HAC committee executives.

GUIDELINES FOR USE

Throughout this document, four parties will be assumed to be involved during the duration of the seismic program:

- Client;
- Helicopter Operator;
- Prime Contractor;
- Seismic Contractor.

Specific definitions for these parties as they pertain to this document can be found in the glossary of this document.

Specific regions, operating roles or special program circumstances may dictate additional safety requirements. These additional requirements should be identified and implemented by senior, qualified staff of the aforementioned parties to the program operations.

HELICOPTER OPERATIONS

Helicopter operations are to be conducted in strict compliance with all applicable federal and provincial regulations and legislation.

No guidelines or requirements specified in this document are to be construed as the authority to operate or conduct helicopter operations, other than in strict compliance with the regulations of the country in which a helicopter is registered to operate.

When Transport Canada or either one of the four involved parties has established more stringent requirements, those requirements will take precedence, provided they are not in conflict with applicable regulations and legislation.

ACKNOWLEDGEMENT

The Helicopter Association of Canada would like to thank the following participants for their contributions and participation in the development of this Best Practice. Acknowledgements are listed below with the individual's company of employment at the time of contribution:

HELICOPTER OPERATOR SPECIAL ADVISORS:

- Brian Halbert — Gemini Helicopters
- Corey Taylor — VIH Helicopters
- Fred Jones — Helicopter Association Of Canada (President)
- Grant Louden — Helicopter Association Of Canada (Board Of Directors)
- Matthew Collins — VIH Helicopters
- Mark Pellow — Shell Helicopter International
- Robert Gallagher — Skyline Helicopters Ltd

OIL & GAS INDUSTRY SPECIAL ADVISORS:

- Doug Iverson — Talisman Energy (CAPP)
- Eric Crawford — CGGVeritas (CAGC)
- Forrest Burkholder — CGGVeritas (CAGC Board of Directors Chair)
- Gary Deren — Shell Canada EPW (CAPP)
- Kelli Whitehead — CAGC
- Ken Lengyel — Suncor (CAPP)
- Marvin Lebeau — Geokinetics (CAGC Health & Safety Chair)
- Tony Cramp — SAI (OGP Aviation Sub-committee)

1.0 SAFETY MANAGEMENT SYSTEMS (SMS)

Safety Management Systems, (SMS) are comprehensive systems used to manage all aspects of health and safety throughout an organization, while providing a systematic approach for identifying hazards and controlling the risk those hazards present.

All onsite contractors should have a basic health and safety management system in place that clearly identifies the policies, standards, procedures and work practices intended to be adhered to by all personnel while in the workplace. The SMS should be comprehensive enough to provide management, supervisors and personnel with the guidance to carry out their duties and comply with occupational health and safety legislation, environmental protection legislation and industry standard, as well as the company's policies, practices and procedures. Elements of an effective SMS include:

- Management involvement;
- Hazard identification and control;
- Rules and work procedures;
- Training;
- Communication;
- Incident and accident reporting and investigation.

Transport Canada regulations already require a comprehensive SMS program for airline operations and will soon add helicopter operations to this regime. The helicopter industry is being proactive in implementing SMS policies and procedures as an extra layer of protection to keep personnel safe.

Application of SMS's in the Oil and Gas Industry support a move away from prescriptive based regulations toward a more performance-based approach. In other words, when properly incorporated into an organization, SMS's allow companies to develop their own policies and systems aimed at reducing risk and creating a pro-active culture.

1.1 SAFETY PLAN

During the planning stage of the program, the Prime Contractor is responsible for ensuring that a detailed Safety Plan is developed and that all contractors are consulted and involved during the development of the program Safety Plan. At a minimum, the Safety Plan should include the following information:

- Identified hazards and mitigation measures;
- Program Emergency Response Plan (ERP);
- Determination of the number of and the amount of training needed for medics on the program;
- Location(s) of the medic(s) throughout the program, with planned response route and identified access points;
- Special training for crews when required to support the medic, i.e. assistance for evacuation and communication during an emergency situation;
- Terrain evaluation

Safety Plans are considered to be living documents, meaning they are subject to change as conditions change on the job site. The Safety Plan must be reviewed with every individual on the job site as part of their orientation.

It is recommended that Prime Contractors conduct selective pre-contract safety audits on sub-contractors in order to verify orientation and safety training, job hazard analysis, and safe work procedures have been completed.

1.0 SAFETY MANAGEMENT SYSTEMS (SMS)

In order to identify existing strengths and weaknesses within the Safety Plan it is strongly recommended that they be tested and a risk evaluation be conducted on any identified deficiencies.

1.2 RISK ASSESSMENT

A Risk Assessment is a process for identifying, quantifying and controlling hazards and risks. They examine possible loss exposures resulting from hazards, changing conditions and system failures.

Risk Assessments must be conducted in accordance with all applicable provincial and federal regulations and legislation during or prior to:

- The commencement of any onshore seismic operations;
- During the planning stages of any seismic onshore operations, and;
- Shall continue throughout the lifespan of any seismic onshore operations.

1.2.1 Ultimate responsibility for the Risk Assessment process lies with the Prime Contractor. The Prime Contractor is responsible for ensuring all onsite contractors conduct a Risk Assessment, and that a process is in place so that all information collected is conveyed to all personnel during the lifespan of the program.

1.2.2 It is the responsibility of all parties to conduct and prepare Risk Assessments, Risk Assessment reports and Hazard Maps.

1.2.3 Hazards identified during the Risk Assessment process are to be shown on a Hazard Map by way of a symbol with a legend describing the embedded symbol.

1.2.4 A separate Hazard List must be maintained which should be presented to each worker during job site orientation.

1.2.5 Hazard Maps and lists must be reviewed in-depth during job site orientations upon the arrival of new people to the program.

1.2.6 Risk Assessment must be reviewed and updated as conditions on the program change, or as new hazards are identified.

Annex A – Risk Assessment provides an example of Risk Management.

Annex B - Generic Hazards & Control Inventory provides a generic hazard register. The register presents an inventory of known hazards to helicopters supporting onshore seismic operations. It also incorporates suggested controls that may be used to reduce the risks presented by these hazards. The inventory captures industry experience on causes of incidents and accidents in the past, and should be consulted when compiling a formal Hazard Register.

1.3 EMERGENCY RESPONSE PLAN (ERP)

The primary emphasis of a safety program is the prevention of incidents and accidents through hazard identification, risk assessment and risk control. A successful ERP will minimize injuries, damage and other losses resulting from an emergency.

The complexity of an ERP varies with the type, size and location of the potential emergency. The plan must be concise and well organized with sufficient detail to ensure quick access to critical information. Some degree of communication, equipment, personnel and service redundancy is needed to ensure that action can be taken to resolve the emergency.

Some ERP's are required by legislation, such as those for Transportation of Dangerous Goods (Emergency Response Assistance Plan for CAGC ERAP member companies; ERP2-0150), worker injuries and hazardous material spills. Prudent organizations have an ERP in place for all potential loss scenarios to minimize the loss or resources, conclude the event safely and return to normal operations.

ERP's should be tested and documented on a regular basis.

1.3.1 ERP Contents

Emergency response procedures/plans should be in line with the Prime Contractor and include the following, at a minimum:

- Date of Issue – the ERP is subject to change therefore an individual must be able to determine the most current version;
- The latitude and longitude coordinates of the staging area, and the nearest airport;
- Location and directions to the nearest hospital or clinic;
- Contact phone numbers of program management team;
- Contact phone numbers for local Police, Fire, Ambulance Services, Occupational Health and Safety (OHS), and Worker's Compensation Board (WCB);
- CAGC emergency response number;
- If Stars Air Ambulance has jurisdiction in the area of the program, they should be contacted and the program site registered. The registration number must be listed on the ERP as well as the location of the Landing Zone (LZ) that Stars would use in the event of an emergency evacuation;
- List of all radio frequencies being utilized on the program, by frequency and channel number;
- Established quick flow chart for downed helicopter, injured or lost personnel and Medevac callouts;
- Helicopter overdue;
- Loss of communications;
- Established procedures upon receiving a Mayday/distress transmission;
- Helicopter accident/downed helicopter;
- Established procedures for precautionary landings (e.g. chip-light, hydraulic, low fuel etc.);

- Medevac and Search and Rescue (SAR) procedures;
- Decision/Approval matrix for Medevac and SAR;
- Means to coordinate with local emergency agencies on location response;
- Establish roles and responsibilities for responding personnel;
- Dropped load procedures;
- ERP practice/drills;
- Hijack procedures;
- Forest fire fighting procedures (1 Bambi Bucket, or equivalent, minimum, when conditions warrant);
- Reference Client or Prime Contractor fire protection plan;
- Mutual aid procedures;
- Alternative call out procedures. This includes call-out procedures within the local aviation community and local emergency responders, and must also consider establishing a response team within Ground Crew personnel in the event of a delayed response from local authorities.

1.3.2 Emergency Contacts

An emergency contact list is needed for every job site. This contact list should be kept up-to-date to ensure telephone numbers are correct and the service company is still available. It is recommended that service companies on the contact list be contacted prior to program commencement in order to verify the telephone number is correct and availability and capability of the service that might be required is available on short notice.

- Contact information should be readily available for: Emergency Services (Police, Fire, Ambulance, hospital, aviation, poison control etc.);
- Company contacts (safety coordinator, emergency response coordinator etc.);
- Client contacts (site supervision, emergency response coordinator etc.);
- Federal and provincial government contacts (helicopter and marine distress, CANUTEC, OHS, energy and resources, environmental protection etc.).

The Prime Contractor & onsite Program Managers are required to test the effectiveness of the ERP using drills or simulations. The Operator should be involved in ERP exercises, up to and including the installation of stretchers and similar activities. After each practice drill the management team should conduct an analysis of effectiveness. Any deficiencies in the ERP should be corrected at that time and a new ERP distributed to personnel working on the program.

1.3.3 Emergency Evacuation Plan (Weather)

Due to the Visual Flight Rule (VFR) limitations on helicopters, an Evacuation Plan needs to be in place and communicated to all personnel on the job site. If the job site is remote with poor road access, it may be necessary to have a supply of caches on the program near the working groups. These caches should include basic survival gear and first aid equipment in case individuals are forced to stay out on the program over night.

The decision as to when to shut down operations and pull personnel from the field due to weather will be made by the helicopter Pilot and Observer.

If the possibility of worker(s) abandonment due to weather exists on the job site, and the worker(s) may be forced to spend time out in the field without support, provisions must be made for the worker(s) to access emergency survival gear.

1.3.4 Evacuation Configurations

An evaluation of the ERP and Safety Plan should be conducted to verify the intent of usage of the helicopter as an Emergency Transport Vehicle for injured personnel. If the ERP calls for this usage, then verification that the helicopter will accommodate a full-length stretcher with room for an attendant needs to be completed.

1.3.5 Class D Human External Cargo

If Class D helicopter long line rescue is utilized for evacuation and rescue purposes, the choice of helicopter used must be compatible with the Class D human external cargo suspension system. The type of helicopter utilized must be powerful enough to lift at least three (3) people, plus the Pilot in extreme conditions where terrain, temperatures and weather might affect evacuation; this must be addressed in the planning phase of the program.

1.3.6 Crash Response Equipment

The Prime Contractor shall provide crash response equipment at onsite base camp or staging areas; this equipment should be kept in a heli-portable crash box suitable for rapid aerial deployment and loading, or slinging for transport to a remote crash site and should be flyable by the smallest helicopter selected as outlined in the ERP. Crash equipment should include:

- Fireman type axe;
- Large axe
- Heavy duty hacksaw with 4 spare blades;
- Grab hook with long handle or 30 meters of 10mm non-plastic rope;
- Harness knife with sheath;
- Heavy duty crowbar of 1 meter length;
- 24 inch (61 cm) bolt cutters;
- 2 pairs flameproof gloves;
- 2 torches (flashlights) with spare batteries;

- 10 inch adjustable spanner/wrench;
- 2 fire blankets;
- Wire cutting pliers;
- 1 set assorted screwdrivers;
- Metal ladder (8 ft minimum).

1.3.7 Third Party Considerations/Other Stakeholders

Activity of other stakeholders working in the same area of the seismic program must be considered as the activities of both the helicopter and seismic crews may create new hazards for these other stakeholders; or the activity of other stakeholders may create new hazards for the helicopter and seismic crews. A list of all stakeholders in the program area must be compiled and kept available for aviation and seismic personnel to use for notification in case of an emergency.

Any requests (e.g. for fuel or transportation either by land or air during an emergency situation) from third parties or other stakeholders not related to the program should be handled directly by the Prime Contractor or Party Manager; however requests received from local authorities or other Helicopter Operators regarding SAR, or any other aviation emergency should be honored forthwith, providing flight safety is not compromised, as per aviation industry best practice.

2.0 PROGRAM OPERATIONS

Daily operational meetings should be held prior to the commencement of daily job site activities with all applicable onsite personnel (including Flight Crew) being required to attend. Daily operation meetings should include the following:

- Daily production objective;
- Journey management of personnel travelling to and from the field;
- Flight and Seismic crew assignments;
- Flight plans;
- Detail crew-by-crew production expectations;
- Positioning of all medical, evacuation, and rescue personnel;
- All hazards identified on the program.

2.1 PROGRAM MAPS

An up-to-date map of the program should be maintained and communicated to all onsite personnel indicating:

- Geography of the area and terrain classification;
- Infrastructure such as roads and airports;
- The seismic program and all prepared base camps, staging areas, heli-pads and drop zones;
- All hazards identified on the seismic program.

Program maps shall be made available to the Flight Crew. If a flight tracking system is used, the same map should be used as background on the monitor screen, if compatible.

2.2 PERFORMANCE PLANNING / CALCULATIONS

Performance planning is used to validate the performance figures established in the Risk Assessment when identifying additional hazards.

Performance calculations (using minimum/maximum expected temperatures and altitudes) based on the program map analysis of the operational area, should be completed and documented in the Risk Assessment.

Daily performance calculations (Hover Out of Ground Effect (HOGE), One Engine Inoperative (OEI) and loads sheets) should be completed and documented using actual weights, forecasted temperatures and planned operating altitudes. Any individual flights falling outside of these calculations should be revised.

2.3 ADVERSE WEATHER

Flight operations shall be in strict compliance with all applicable federal and provincial regulation and legislation. Long line procedures developed by the Seismic Contractor and/or Helicopter Operator with regards to adverse weather conditions shall also be taken into consideration. In the event one party's standard is more stringent, the most stringent standard shall prevail.

2.3.1 Prior to each flight period a reliable weather forecast for the entire program area should be obtained. In remote areas, consideration should be given to all available forecasting resources.

It is recommended that the Seismic Contractor also assist when continually monitoring for weather conditions within the program area, and have a system in place to communicate any changes to the Pilot.

2.3.2 Changing and marginal weather conditions in a low-level flight regime should be taken into consideration when planning seismic activities.

2.3.3 When more stringent requirements are not provided, a ceiling of 400 feet (122 meters) and visibility of 1 nautical mile (1800 meters) must be utilized as the minimum weather criteria for helicopter operations. This can be verified by using a "weather check" flight limited to Essential Crew.

2.3.4 The Pilot's judgment with respect to suitability to fly in adverse conditions is final.

2.4 TERRAIN ASSESSMENT

Consideration must be given to the type of terrain crews will be working in. An initial Terrain Assessment will assist in establishing tolerance and flexibility for the placement and location of receiver and source points. A Secondary Terrain Assessment conducted during line construction will determine hazard level. This information should be placed on corresponding chaining notes and the hazard map, or a dedicated terrain map to assist in planning work and evacuation procedures in high risk areas (difficult access/steep terrain).

The Secondary Terrain assessment should be used by front line supervisors to plan Personal Protective Equipment (PPE), work procedures, and evacuation needs.

For more information, please refer to the CAGC's Terrain Operation Assessment Guidelines.

2.5 FLIGHT FOLLOWING

2.5.1 The Pilot shall report to the Flight Follower the total number of passengers onboard and fuel endurance prior to every take-off and landing;

2.5.2 Positive flight following either by the Ground Crew or designated flight following personnel must be maintained with the helicopter when airborne; a minimum position report shall be conducted every 15 minutes;

2.5.3 A procedure for continuous communication (rather than a formal position report) between Flight Crew and the radio operator is considered acceptable practice, providing it is formal and includes the obligation of keeping up-dated records on helicopter position.

2.5.4 The use of a Global Positioning System (GPS) tracking system when flight following is strongly recommended;

2.5.5 Daily confirmation of the when the first and last flights of the day occurred should be confirmed and recorded in the flight logs.

2.6 TRANSPORTING INTERNAL AND EXTERNAL CARGO

2.6.1 Load Control

All loads should have accurate weights provided before they are transported. In the event standard repetitive loads are used, the contents must be accurately established before program commencement.

2.6.2 External Load Operation Planning Factors

The Helicopter Operator must have a training syllabus and Standard Operating Procedures (SOP) in place outlining the procedures of external load operations; including the use of bag runners, carousels, short and long lines, hooks, as well as any other device being used for external load operations.

Procedures, such as minimum weights to be attached, safe transit speeds and handling characteristics, should also include the minimum applicable requirements when flying without a load attached to the long line.

2.6.3 Sling Operations

A large portion of onshore seismic programs consists of long line operations. The following safe work procedures have been established to protect flight and Ground Crew, equipment and the environment:

To provide a safe and efficient sling operation, Helicopter Operators should provide the following equipment:

- long lines of sufficient length to clear all obstacles encountered in the area of work (long lines to be of sufficient strength to support 5 times the maximum weight to be carried);
- 1 single point electric hook;
- 1 cargo net;
- 2 lanyard with bearing swivels;
- 2 nylon straps;
- 1 barrel sling (3 drums);
- 1 carousel (8, 10 or 12 hooks);
- 1 Bambi Bucket (during Spring/Summer/Fall Operations)

All lifting equipment should be inspected prior to any sling operation, and daily thereafter. Annual inspections should be documented and kept on file at the Operator's office.

Inspections of sling equipment should be as per the following procedures:

- Long lines:
  - General condition (no kinks, no cuts);
  - Electric cord (no cuts, plugs not damaged, check electric continuity);
  - Shackles (no damage, pin is tightly secured and locked);

- Single point:
    - General condition (cage, keeper, tongue):
        - Electric cord (no cuts, plug condition, continuity);
        - Release system (electric and manual);
- Lanyards with swivels:
    - General condition (no cuts);
    - Hooks (no cracks, lock device, keeper);
    - Shackles (pin secured and manual);
- Nets:
    - General condition (straps, rings);
- Barrel slings and straps:
    - General condition (no cuts, no excessive wear);
    - Shackles and hooks (secured and locked, hook not open);
- Carousel:
    - General condition (cracks, deformation);
    - Hooks (condition and operation);
    - Control box (condition, reset light, wires);
    - Attachment points (condition, clevises locked, and ring);
- Helicopter hook:
    - General condition (cracks, keeper, tongue);
    - Release mechanism (electric, manual, long line, carousel);

All equipment found defective should be tagged unserviceable and repaired or replaced prior to commencement of sling work;

As an inherently risky procedure, sling operations should be executed only by trained and qualified personnel. The following procedures are a guide to help both Pilots and Ground Crew achieve their respective duties in the safest and most efficient manner:

- Only trained staging hands/ human-bag runners may stand beneath the helicopter during slinging operations. Spotter(s) shall be wearing the following PPE:
    - Hard hat with chin strap;

  - High visibility clothing;
  - Hearing protection;
  - Eye protection.

- Personnel involved in slinging must have received a safety briefing prior to start-up any sling operation;
- "OK" Hand signal to Pilot will NOT be given, nor will it be accepted by the Pilot, until the worker responsible for hooking/unhooking the long line, and all other personnel, are clear;
- The Pilot has the sole authority to accept or to refuse a sling load;
- The Pilot should communicate via Very High Frequency (VHF)-FM radio with the Ground Crew;
- The Pilot should be advised of load weight and any dangerous goods to be carried;
- No passengers are allowed in the helicopter during slinging operations;
- Flight over habitations or built-up areas during slinging operations is prohibited;
- Pilots must avoid flying over Ground Crew personnel during slinging operations;
- Slinging operations shall cease when lightning occurs in the vicinity (within 5 miles) of job site;
- No slinging within 30 metres of power lines;
- The helicopter should keep a power reserve of 5-10% of torque, depending on the area to be flown;
- All incidents or accidents shall be reported and an investigation shall be performed prior to continuation of sling operations;
- Helicopter Operators and Seismic Contractors must have procedures in place for positioning or detaching the long line whenever the helicopter is shut down. The same procedures should also be used for those situations when the helicopter lands with the line still attached (such as refueling);
- To mitigate the risk of departure with an unintentional long line attached, all take-off procedures should include coming to a stabilized hover and checking the hook for an attached long line prior to continuing any further transition. Marking the first three (3) feet or more of the line with a fluorescent sleeve will increase its visibility to the Pilot;
- Transit without a load attached to the short line must not be conducted. It is best practice to consider a short line to be part of the load; dropping or picking up the load is done by releasing or attaching the short line to the cargo hook;
- To mitigate potential rotor strikes, consideration should be given to provide clearance regarding terrain restrictions;
- The length of the long line required should be established prior to program commencement, or by the Pilot prior to commencing flight operations.

2.7 INTERNAL CARGO

Cargo carried inside the passenger compartment must be adequately secured using cargo nets and tie down straps without obstructing normal or emergency exits.

2.8 PASSENGER TRANSPORT

2.8.1 Essential Crew

Passengers and external loads must not be carried at the same time; with the exception of Essential Crew in certain circumstances. All Essential Crew must be qualified and current in accordance with the training requirements stipulated by the Helicopter Operator.

Seismic personnel are not considered essential crew (during slinging operations) and should be treated as passengers.

2.8.2 Ground Crew (Passengers)

The transportation of passengers during seismic operations is subject to the following conditions:

- The helicopter must be equipped with seats and seat belts; provision of upper-torso restraints is recommended;
- The Helicopter Operator must be authorized by the regulatory authority to carry passengers;
- Passengers must be properly briefed on emergency procedures prior to their first flight and follow-up training schedules should be established.(see 3.1.1 Helicopter Orientation);
- Passengers must wear clothing and footwear appropriate to the environment;
- A passenger manifest must be prepared prior to each flight. For flights landing at remote helipads, passenger manifests may be in the form of a radio transmission, but there must be a record off the aircraft of personnel onboard;
- The Pilot must report to the Flight Follower the number of passengers prior to take-off.;
- Avoid loading additional internal cargo while transporting passengers, however, if additional internal cargo is going to be carried, it must be securely strapped down;
- Any sharp tools (such as axes or knives) should be placed in a suitable container that can be securely strapped down if carried in the cabin, or otherwise isolated and secured;
- It is recommended dual controls be removed and the pedals either disconnected or blocked before passengers are carried in the co-Pilots seat.

2.9 TRANSPORTATION OF DANGEROUS GOODS (TDG)

2.9.1 All dangerous goods shall be carried in accordance to the requirements provided by the local authority, or as specified by International Air Transport Association (IATA) / International Civilian Aviation Organization (ICAO) (in the absence of local requirements).

2.9.2 In the event that dangerous goods are to be transported, the Helicopter Operator must have approved procedures in place and personnel trained to ICAO and IATA (or equivalent) standards.

2.9.3 If dangerous goods are carried (other than a standard load carried externally), the PIC must be provided with a Shipper's Declaration of Dangerous Goods form (or equivalent) prior to departure. The following information must be included:

- Shipping name, UN number and class;
- Gross mass of the dangerous goods and, in the case of explosives and/or detonators, the net quantity.

2.9.4 Passengers will not be carried in conjunction with explosives;

2.9.5 Explosives and detonators shall not be transported as internal cargo at any time;

2.9.6 Explosives and detonators may be transported in an approved Type 10 Magazine (when used as a transportation container) as an external load; however, a provision must be made to maintain separation between the two to prevent possibility of an explosion or fire.

2.9.7 Bulk explosive material should be carried as an external load only;

2.9.8 Kerosene lamps/stoves, small gas engines, chainsaws etc. cannot be carried as internal cargo with passengers; it is recommended that they be transported in the utility basket, or as a slingload

2.10 AVIATION FUEL MANAGEMENT

2.10.1 Storage, Dispensing and Fire Safety

The correct grade of dry, uncontaminated fuel is essential to safe flight operations. Contamination in the helicopter fuel may cause engine flameout or may block fuel filters and fuel control units. Rigid handling procedures and contamination checks must be followed at each stage of movement of the fuel from the refinery to the helicopter in order to reduce the risk of fuel contamination due to water, dirt, or sediment. Risk of fire during fuelling operations is also a major safety concern and strict procedures must be followed at all times.

Due to the hazards of fuel handling, and the critical need for standard safety procedures only the Pilot, AME, or similarly trained personnel, shall fuel the helicopter. The Pilot or AME will also conduct the quality control checks described in this section. All other personnel shall remain clear of the fuelling area when fuelling operations are in progress, unless the Flight Crew asks for assistance.

2.10.2 Site Selection

The fuelling area is to be checked in accordance with the following requirements on initial set up:

- Helicopter fuel storage areas must be separate from other types of fuel stocks;
- Terrain must be fire proof and not susceptible to flooding. The site shall be as free of dust and debris as possible;
- Helicopter fuel storage and refueling areas must be as far as possible from all other personnel, equipment and living quarters. The minimum distance from the fuel storage tank, or drum stock, to living quarters is 100 meters;

- Refueling must be conducted at least 15 meters from non-essential personnel or sources of ignition;
- The tank designated for helicopter fuelling must be at least 15 meters from the centre of the helicopter unless using drums. Where drums are being used, store the empty fuel drums far enough from the helicopter to ensure they are not dislodged by downwash from the rotor.

2.10.3 Fuel Planning

Transport Canada stipulates that a minimum fuel reserve of 20 minutes airtime shall be maintained at all times, and is there for emergency use only. Operating regions with limited suitable landing areas or fuel support will require that higher fuel reserves be taken into account during flight planning.

2.10.4 Bulk Storage

This section applies to trailer-mounted cargo tanks or skid-mounted transportable tanks.

The two basic design criteria for storage tanks are cleanliness and safety:

- Only stainless steel, aluminum or glass-lined aluminum, epoxy lined steel or bladder type tanks will be accepted for bulk helicopter fuel storage;
- The tanks will allow for expansion (2% of full capacity) and will be fitted with vents to allow for temperature changes without tank distortion or entry of moisture/contamination;
- Tank bottoms will be supported to avoid distortion in the metal that may trap moisture/debris;
- All helicopter fuel storage tanks will contain only a single grade of fuel;
- Fuel contained in the storage tank (e.g. Jet B or A turbo fuel) will be clearly marked with the grade of fuel;
- The inside of all storage tanks will be clean and free of all foreign matter;
- All helicopter fuel storage tanks will be marked with placards in accordance with all applicable TDG, WHMIS, and Transport Canada Regulations;
- All helicopter fuel storage tank valve outlets will have dust covers;
- All helicopter fuel storage tanks, manhole covers, and valves will be locked to prevent fuel theft or contamination by unauthorized persons;
- Fuel leaks, of any amount, are unacceptable and will be contained and fixed immediately. Refueling operations will be prohibited until all leaks are fixed and any spills cleaned up;
- Bulk fuel tanks should be equipped with Secondary Containment with a capacity of no less than 1.5 times of total fuel capacity;
- All bulk fuel tanks must be grounded.

2.10.5 Drum Storage

Storage of helicopter fuel in drums is the least preferred method due to inherent risks of quality control, fuel contamination and security. Extreme caution shall be used when fuelling from drums due to the possible presence of moisture and/or sediment.

- All drums shall be in good condition with all required labels and placards attached, including the fill date;
- All drums should be stored within Secondary Containment with a capacity of no less than 1.5 times of total fuel capacity;
- If exposed to weather, all drums should be stored at a slight tilt to avoid rainwater build-up within the rim, or stored horizontally on the ground within a containment enclosure;
- The drum shall have been filled within two years prior to use;
- Only drums with the fuel grade designated will be used;
- Helicopter fuel drums will be stocked separately from other types of stock;
- Drums should be stored horizontally with the large bung and seam immersed in the product, thus keeping all seals submerged;
- Provide sufficient supports beneath the first tier of drum stock to prevent the drums from settling into the soil or resting in water puddles that may cause corrosion;
- Chock all drum stocks on both ends of the stack to prevent them from rolling;
- Contaminated, suspected, or substandard drums will be labeled and quarantined from acceptable stock. This will include drums that are used for storage of samples.

2.10.6 Quality Control and Contamination Checks

All fuel to be used in the helicopter, whether in bulk tanks or drums, will be supplied only by an accepted aviation fuel refinery or bulk dealer. All contractor companies supplying fuel to the helicopter job site shall indicate the source of the fuel to the chartered Helicopter Operator.

- Flight Crews will check the Bill of Lading to ensure the fuel is of the proper grade;
- A daily free water test of all helicopter fuel, in tanks or drums, using, as a minimum, a “clear and bright test” will be performed by the pilot and/or engineer. If any doubt whatsoever exists about the test results an accepted water detection kit will be used by the helicopter Pilot and/or engineer in accordance with fuel compliance procedures. Helicopter companies will be responsible for providing the water detection kits to their crews. The results of these tests will be recorded and filed at the Helicopter Operators base at the end of each month or at the end of the job, whichever comes first;
- Daily, before the commencement of fuelling operations, at least a one-half (1/2) liter sample of fuel from the drain at the filters/separator unit will be drawn and examined for the presence of water and/or sediment;

- The standpipe used to draw fuel from drum will be at least 2.5 centimeters clear from the bottom of the drum;
- Flight Crews will maintain written records of all required fuel contamination checks. These records will be available for inspection.

2.10.7 Fuel Dispensing

- It is the responsibility of the Flight Crew to ensure that fuel compliance procedures are followed at all times;
- No fuelling shall take place if there are thunderstorms in the vicinity of fuelling site;
- A spill kit should be available at each fuelling site;
- If a spillage occurs during fuelling, it shall be reported and cleaned up;
- The fuelling checklist form should be filled prior to any fuelling operation to ensure a safe and environmentally friendly operation;
- All mobile helicopter fuel dispensing equipment will comply with the latest applicable codes and standards for the dispensing of aviation fuel;
- All hoses will be compatible with jet fuel;
- Only helicopter fuelling equipment will be used for dispensing helicopter fuel. This equipment will be stored in a separate location from other types of fuelling equipment;
- Flight Crews shall maintain all hoses, hose couplers, pumps, filters/separators, nozzles and grounding/bonding equipment in top quality condition, according to all manufacturers' instructions;
- Short loops or kinks in the fuelling hose shall be avoided. Any lacerations, cracks or leaks in the fuel hose are unacceptable and refueling operations must cease until repairs and/or replacements are done;
- If a separate fuel pump and filter assembly is used, it will be positioned within a spill containment berm;
- The fuel pumps will be approved for the use of jet fuel and should incorporate bypass systems to present excessive pressure build-up in the delivery hose;
- The fuel pumps and filler nozzle will be bonded/grounded;
- Fuel pumps will be equipped with a shielded ignition source and will not be operated closer than three meters from the helicopter;
- The helicopter fuel pump outflow rate will be metered to a maximum of 50 gallons per minute or the rated capacity of the filter, whichever is less;
- At least one accepted filter unit will be located downstream from the fuel pump. All fuel filter cartridges will be of five microns or less, at a maximum fuel pump outflow rate of 50 gallons per minute. Fuel filter elements should be changed annually or whenever a reduction in fuel flow is observed. Changes will be recorded and attached to filter housings;

- All helicopter fuel nozzles will be equipped with dust caps and bonding clips or jacks. The nozzle should be off the ground and facing downward to preclude water contamination.

2.10.8 Bonding and Grounding

To minimize fire hazard from static or stray electricity on the helicopter or fuelling equipment, all equipment will be properly bonded/grounded before fuelling operations or the transferring of fuel from one storage tank to another.

- All bonding and grounding cables shall provide an easy path for the electricity to flow to the earth through a conductive lead, such as braided copper cable;
- All grounding rods will be driven into the earth at least several centimetres (this applies to winter operations as well when possible) otherwise bonding will be conducted;
- Cables, clips and plugs used for bonding and grounding will be inspected and tested for continuity;
- Resistance through any bonding or grounding circuit shall be less than 10 ohm;
- All connection points and grounding plugs shall be clean and unpainted;
- If the helicopter is without a bonding jack, attach the bonding clip at the end of the nozzle bond wire to the tank filter cap before the tank filler cap is opened to ensure that there is no difference in potential between the two elements. Maintain this contact until the flow of fuel has stopped and the filler cap replaced;
- Suspend fuel operations immediately when a lightning discharge hazard exists;
- When remote or mini staging areas are in use, the airborne fuelling equipment should be used and the drum should be positioned as far as possible from the helicopter;
- When fuelling from drums, the following precautions will be taken;
- Bond the drum or tank and nozzle to the helicopter before opening the filler cap.

2.10.9 Fire Safety

- At least two fire extinguishers will be provided by the Helicopter Operator and strategically located, prominently displayed, and readily available at all areas designated as helicopter fuelling locations;
- Extinguishers located in enclosed compartments will be readily accessible, and their location will be clearly marked in letters at least five (5) centimeters high;
- Extinguishers will be located upwind (prevailing) from the helicopter being fuelled;
- Smoking or any other source of ignition is prohibited within 30 meters of any area designated as a helicopter fuelling location;
- All personal not involved in the fuelling operation, including helicopter passengers, shall remain clear of the fuelling location by at least 30 meters;
- All Helicopter Operator personnel involved in fuelling operations will be given formal training by their respective companies concerning the use of the extinguishing equipment and the type of fires that may be encountered;

- An emergency safe-exit route from the fuelling location shall be available to the fuelling crew at all times.

2.10.10 Hot Refueling

Rotors turning or hot refueling of the helicopter is inherently more dangerous and should only be carried out if deemed to be operationally essential by the Pilot. If hot refueling is done, all of the following precautions will be taken:

- At least two fire extinguishers will be readily available;
- All bonding/grounding procedures will be followed;
- The Pilot will remain at the Pilot's position in the helicopter;
- No passengers will be on board;
- All helicopter internal combustion heaters, Auxiliary Power Units (APU), Ground Power Unit's (GPU) or battery carts must be off;
- A clear emergency exit path shall be available to the crew in the event of fire.

Refueling shall be discontinued if any fuel spillage is noted and fuelling shall not recommence until the spillage is cleaned up.

The refueller shall use extreme caution with regard to the helicopter's turning rotors.

2.10.11 Free Water Test

Dry fuel is essential to flight safety. There are numerous ways that water enters fuel systems; the most common are leakage at manholes and tank plumbing, water-laden transport deliveries, and condensation of atmospheric moisture in partially-filled storage tanks.

For further information on fuel management please refer to Transport Canada; Aerodrome Safety Circular ASC 2006-029: http://www.tc.gc.ca/eng/civilaviation/opssvs/nationalops-audinspmon-program-safetycirculars-2006029-872.htm

3.0 TRAINING, COMPETENCY AND STAFFING LEVELS

Each jurisdiction has specific legislation to ensure the health and safety of personnel. There are many pieces of legislation that employers, personnel and contractors must abide by in the process of performing work. In most provinces, the primary legislation for protecting worker health and safety is the Occupational Health and Safety Act; in British Columbia, the Personnel Compensation Act provides the legislation.

Employers are responsible for ensuring the health and safety of not only their personnel on a job site, but of all personnel at the job site, and are required to ensure that personnel engaged in the work of the employer are aware of their responsibilities and duties under the jurisdiction's act and regulations.

Employers are also responsible to ensure that personnel are informed of job site hazards; of the appropriate best practices and safe work procedures, in order to minimize the risk of hazards; and that personnel are competent to perform their work safely.

In the event of an accident, an employer must also be able to prove due diligence was exercised in preventing the occurrence of an accident. On job sites where a Prime Contractor is designated, the Prime Contractor assumes the obligation to ensure that all legislation and regulations are complied with, including establishing that the worker is aware of hazards.

3.1 ORIENTATIONS

The initial period of employment is critical. During this phase, each worker develops the knowledge, skills, attitudes, and abilities that are necessary to work successfully. An orientation is the process of introducing new, inexperienced, and/or transferred personnel to the organization, industry and jobsite. In the oil and gas industry, there are three types of orientations that should be conducted:

- Company/Industry Orientation – introduces and familiarizes the new worker with the industry and organization, their supervisors, co-workers, work areas, and jobs;
- Safety Orientation - orients and trains employees to all safety procedures, policies, and practices within the company and the industry to ensure personnel are fully aware of all the hazards associated with their position and workplace. Three general topics that should be covered during a Safety Orientation are;
    - Rights and Responsibilities;
    - Workplace Hazards;
    - Safe Work Procedures.
- Job Site Orientation - orients and trains all employees who enter a job site to the prevalent hazards associated with the tasks and area in a specific location.

3.1.1 Helicopter Orientation

All personnel being transported in a helicopter shall be given a complete helicopter orientation by the Pilot prior to their first flight. Personnel will be given specific orientations for each helicopter they will be transported in during the course of the program.

A record of the helicopter orientation shall be completed and signed by all personnel confirming they have been informed and understand the safety information regarding the helicopter. Helicopter orientations should include the following items, as a minimum:

- Location and means of operation of safety belts;

- Location and means of operation of normal and emergency exits;
- Smoking prohibited;
- Danger areas or rotor and turbine exhaust;
- Boarding and exiting procedures;
- Location of first aid and survival equipment;
- Landing areas to be kept free of debris;
- No loose objects, clothing, hats etc. to be worn;
- Location and function of the Emergency Locator Transmitter (ELT);
- No passengers while transporting explosives and/or detonators;
- No pepper spray in passenger compartment;
- All necessary winter hazards;
- Cargo must be carried, not thrown;
- No objects above shoulder height.

3.1.2 Permits & Government Approvals

A copy of all permits and approvals should be made available to crew management. Any specific restrictions may be discussed during the orientation process and at safety meetings.

3.1.3 Muster Areas

All muster areas must be identified during the orientation process.

3.1.4 Journey Management

Journey management plans must be discussed and explained to all onsite personnel during the orientation process.

3.2 TRAINING STANDARDS FOR NON-FLIGHT CREW PERSONNEL (ONSHORE SEISMIC GROUND CREW)

Ground Crew personnel are defined as: any Staging, Shot Hole Drilling or Data Acquisition staging personnel, and/or Load Masters, Helicopter Refueller, Mechanics and Explosive Providers that work on the ground and in the vicinity of any onsite helicopters.

Employers must ensure that all personnel are trained and qualified to safely carry out the tasks outlined in their job description; they should also ensure that only trained and authorized persons are allowed to operate equipment. A qualified person may provide onsite training or instruction; but outside formal training may be required. Employers are responsible for confirming capabilities/limitations of personnel operating equipment or engaged in high hazard tasks and must also provide information such as known hazards to all personnel on a daily basis.

3.0 TRAINING, COMPETENCY AND STAFFING LEVELS

Ground Crew personnel may be provided by either the Helicopter Operator or the Seismic Contractor. Training will need to comply with the minimum standards of both companies.

All Ground Crew personnel must be compliant with regulatory and industry training requirements. Both the Prime Contractor and the Seismic Contractor are responsible for verifying the certification and work experience of all personnel prior to the personnel arriving onto the job site.

3.2.1 Industry Required Safety Training

Prior to job start-up, personnel are required, by industry, to be trained and competent in the following:

- First Aid (50% of personnel onsite, plus 1 is the industry best practice);
- H2S Awareness;
- Hazard Awareness and Identification;
- Wildlife Awareness;
- Workplace Hazardous Material Information System (WHMIS).

3.2.2 Job and Site Specific Safety Training

Some jurisdictions, positions (such as Blasters) and Clients may require personnel have additional training in order to carry out their specified duties. The following safety courses or certifications may be required:

- Chainsaw Faller Certification;
- First Aid Transportation Endorsement (British Columbia only);
- General Oilfield Driver Improvement (GODI);
- H2S Alive;
- Off Highway Vehicle (ATV, UTV, Snowmobile) Training;
- S-100 Basic Fire Suppression & Safety (British Columbia only);
- Seismic Blaster Safety Training;
- Seismic Field Operations Supervisor (SFOS);
- Transportation of Dangerous Goods (TDG);
- Valid Driver's License;
- Passenger and landing zone management;
- Sling load preparation and handling;

- Passenger and cargo manifests;
- Operation of doors, cargo hatches, cargo securing etc.;
- Helipad and drop zone housekeeping;
- Marshalling and other communication with Flight Crew (hand signaling);
- Radio communication and proper terminology;
- Managing static electricity;
- Correct hook-up procedures and use of external cargo equipment;
- Aviation hazards (e.g. electrical lines, trees, foreign obstacles etc);
- Requirement for control under the helicopter including:
  - Actions in the event of an helicopter emergency;
  - Procedures for positioning a load suspended on a long line;
  - Use of absolute minimum number of people;
- Required PPE and its proper use;
- Proper use of fire extinguishers (PASS technique);
- Refueling procedures including procedures for hot refueling;
- SMS training;
- Any additional site specific training;

For more information please refer to the CAGC's Training Standards for the Seismic Industry Best Practice.

3.2.3 Radio Operators

Additional training for Radio Operators (or anyone communicating with the Pilot during program operation) according to the stipulations set forth by Industry Canada are as follows:

- Licensed where applicable;
- Fluent in the appropriate language(s);
- Experience in helicopter operations, procedures and aviation radio terminology;
- Formal training in handling and recording radio transmissions;
- Procedures and actions required for normal and emergency operations (ERP);
- Flight following, flight watch;

- Knowledge of weather, able to receive and retransmit weather reports and forecasts.

3.3 AVIATION TRAINING STANDARDS FOR FLIGHT CREW

Initial and recurrent training is a vital factor in flight safety and must be carried out to ensure that professional standards are set and maintained;

Flight Crew shall complete an internal company training program as outlined in the Helicopter Operators training manual. This internal company training program will consist of ground and flight instructions including:

- It is recognized that the use of Flight Simulators allows for practice in handling emergencies that cannot be practiced in the air. Flight Simulators are preferred for internal and refresher training in a Complex Environment;
- A Complex Environment may include dual crew, dual engine, difficult weather, congested airspace, congested radio communication, or anything that increases workload on the flight crew beyond normal operational levels;
- Where an appropriate device is available, the Helicopter Operator should establish a Flight Simulator training program at a preferred frequency of 12 months and not less than once per 24 months;
- The emphasis of training should also be on the development of Crew Resource Management (CRM) for multi-crew helicopter, and/or Pilot Decision Making (PDM) for single-piloted helicopters;
- Recurrent Flight Crew training and flight checks must be conducted as per Transport Canada requirements. Annual flight training should be a minimum of three (3) hours (one type), which can include Flight Simulators and/or Pilot Proficiency Checks (PPC)
- Pilots should receive training for mission specific tasks for seismic. (i.e. Bag Runner, Carousel, Navigation System, etc.)

It is recommended, as a minimum, that recurrent training include the following:

Ground:

- Helicopter Systems;
- Applicable Transport Canada regulations and changes;
- CRM/PDM;
- Proper use of fire extinguishers (PASS technique);
- First Aid;
- Helicopter Emergency Procedures;
- Appropriate Geographical Location (e.g. mountainous terrain, high density altitudes etc.);
- Weather / Meteorological Conditions;
- Refueling;
- Emergency survival equipment carried on the helicopter;
- Hazardous Materials (Hazmat);
- Minimal Equipment List (MEL) and/or Minimal Departure Standards (MDS);

- Weight and Balance;
- SMS Training;
- Company SOP's;
- Helicopter Performance.

Flight:

- Helicopter Emergency Procedures that includes:
  - Low visibility training, focusing on avoidance of inadvertent Instrument Meteorological Conditions (IMC);
  - Role and Environment Specific (e.g. brownout and whiteout).
- SOP's;
- Role Specific (i.e. vertical reference/long-line);
- Confined Area Operations;
- Environment Specific where applicable (i.e. high altitude, mountain, winter operations etc.).

3.3.1 Aircraft Maintenance Engineers (AME)

At a minimum, AME's are required to attend annual recurrent training programs as established by the Helicopter Operator. As a minimum, recurrent training programs shall include the following:

- Helicopter type instruction;
- Regulations and change to existing regulations;
- Equipment fit including both PPE and equipment used to maintain the helicopter (appropriate modifications and support equipment/lifting equipment);
- Human factors as related to aviation accidents/incidents;
- Proper use of fire extinguishers (PASS technique);
- First Aid;
- SMS training;
- Helicopter Operator Maintenance Manual.

3.0 TRAINING, COMPETENCY AND STAFFING LEVELS

3.4 FLIGHT CREW QUALIFICATIONS AND EXPERIENCE

3.4.1 Pilot Qualifications

It is recommended that Pilots conducting flying operations during onshore seismic operations:

- Have a minimum of 1,000 hours of logged PIC flight experience;
- Should the 1,000 hour requirement not be met a Management of Change (MOC) should be executed prior to the pilot being dispatched to the jobsite;
- A formal MOC client acceptance process must be identified as follows;
    - The Operator contacts the Client to explain the situation
    - Execute a MOC process internally to determine the inherent risk level
    - Determine if in fact the pilot is suitably qualified for the scope of work
    - Document all communication and the risk assessments performed
- If the Pilot is expected to perform a Class D operation rescue, they must be trained in conjunction with a rescue agency approved to do so, and must meet the minimum Transport Canada requirements.

  See section 3.3.4 Helicopter External Transport System (HETS) for more information on HETS operations or Annex C - HAC Class D External Loads Training Guidelines.

3.4.2 Mountainous Terrain Experience

It is recommended that additional experience for flight operations in mountainous terrain be stipulated for Flight Crews as follows:

- If the operational environment requires operating in mountainous terrain, Pilots must have received instruction as per the approved HAC mountain flying syllabus.

3.4.3 External Load Experience

The Helicopter Operator must have a company training syllabus and SOP's outlining the conduct of external load operations. These should include:

- The use of bag runners, carousels, short and long lines, hooks as well as any other device being used for external load operations;
- Minimum requirements applicable when flying with no load attached to the long line, such as minimum weights to be attached, safe transit speeds and handling characteristics.

It is recommended that additional experience for external load operations be stipulated for Flight Crews as follows:

- 300 hrs and/or demonstrated competency to safe level in vertical reference operations, as well as currency:
  - External load currency requires 3 hours of relevant flying within the last 90 days, or,
  - If within the previous 90 days the Pilot has demonstrated proficiency during a long line/external load evaluation conducted by a qualified Training Pilot, the Pilot is considered current.

3.4.4 Helicopter External Transport System (HETS)

HETS (or Class D operations as referred to by Transport Canada) can be used to provide prompt evacuation of sick or injured personnel from remote areas and in rough terrain. The HETS sling rescue system consists of a variety of helicopter engineered components that are designed to fly safely with a helicopter.

Each component in the HETS system carries a Supplemental Type Certificate (STC) or Limited Supplemental Type Certificate (LSTC) verifying it is airworthy. It is important to note that a regular long line and cargo hook designed to carry heli-bags consisting of recording equipment is not approved equipment to carry human external cargo - even in an emergency.

It is against Transport Canada Regulations to perform Helicopter Long Line Rescue without such approved equipment. Severe penalty and liability may accompany any unapproved rescue that goes wrong.

Training for Class D operations must be done in accordance with the Helicopter Operator's approved operations manual. Transport Canada approves the following training guidelines:

- Pilots must have a minimum of 2,000 hours flying time;
- At least 200 hours on the helicopter type to be used in Class D operations;
- At least 1,000 hours experience in the area of operation if rescue services are to be conducted in Designated Mountainous Areas 1 or 2 as defined in the Designated Airspace Handbook (TP 1820);
- Pilots must pass a precision long line test;
- All participants in Class D operations must participate in a minimum of 8 hours ground school covering topics such as rescue philosophy, regulations, system configuration, and communications procedures etc.;
- There are minimum flight times for Rescuers, Spotters and Pilots;
- Annual recurrent training is required.

The Helicopter Operator must be Class D HETS approved by Transport Canada. This approval should be documented in their operations manual.

It is the responsibility of the Helicopter Operator to ensure the Pilot has met the standards for Class D External Loads based on the principles outlined in the HAC Class D External Loads Training Guidelines. For more information please refer to Annex C - HAC Class D External Loads Training Guidelines.

3.4.5 Memorandum of Understanding (MOU) Regarding HETS

A close working relationship is required between the Helicopter Operator and the Emergency Responder organization to ensure coordinated proficiency and mission safety. Terms of Reference shall be documented in a written agreement and will define the following:

- Responsibility of PIC and Rescue Specialist(s);
- Required operational capabilities and scope of operation;
- Coordinated rescue mission SOP's;
- Mission authorization and control process, including communication procedures; and
- Coordinated air operator and emergency response user agency training program conducted on an annual basis.
- Use of a HETS Go-No-Go Chart is mandatory (example contained in Annex C)

3.5 FLIGHT CREW COMPETENCY REQUIREMENTS

Evaluation of Flight Crew competencies shall be the responsibility of the Helicopter Operator. The Helicopter Operator will certify their Pilots' competency and are required to develop effective evaluation procedures that clearly demonstrate Pilot competency for the required knowledge and skill.

3.5.1 External Load

Pilots shall demonstrate a thorough understanding of how to competently execute external load operations. Specifically:

- The evaluation of, and the theoretical and practical knowledge of, various loads presented for external transport;
- The evaluation of practical skills, such as flying loads with precision placement on long lines utilizing vertical reference;
- Demonstration of competency for weight/balance control and performance planning.

3.5.2 Long Line / Vertical Reference

Definition of Vertical Reference/Long Line flying: the helicopter is out of ground effect, line length is 50 feet (15 meters) or greater, and the primary flight reference is vertical reference.

A test load shall be lifted from the ground (without the load being dragged or swung) and flown for a circuit at appropriate airspeed for the load, or VNE (do not exceed speed), then placed back on the ground within a predetermined 10 feet x 10 feet (3 meters x 3 meters) area, while maintaining smooth coordinated flight. This exercise must be repeatable on the initial evaluation.

4/5 times with a tolerance of +/- 5 feet (1.5 meters) on the target area, and zero tolerance for load placement velocity. Gently place load on target.

3.5.3 Precision Load Placement

A test load to be held on the end of a long line, 100 feet (30 meters) in length or longer, over a pre-determined 3 feet x 3 feet (0.9 meters x 0.9 meters) area at a height of 3-4 feet (0.9 - 1.2 meters), Above Ground Level (AGL) for 30 seconds while maintaining smooth coordinated control. The tolerance is 1 foot.

3.5.4 Class D External Load

Pilots shall demonstrate the theoretical understanding and practical skills involved when conducting Class D External Load operations as outlined in the Canadian Aviation Regulations (CARs) and as per HAC Class D Best Practices.

Pilots conducting Class D External Load operations are required to meet the standards prescribed by the Helicopter Operators approved Class D training program, and as outlined in the Helicopter Operators Operations Manual and SOP's. Pilots must also comply with, and be competent with all requirements outlined in Canadian Aviation Regulations.

For more information please refer to Annex C - HAC Class D External Loads Training Guidelines.

3.5.5 Hover Exit

Pilots shall demonstrate competency in Hover Exit operations as outlined in the Helicopter Operators Operations manual.

Pilots shall demonstrate competency regarding Hover Emplaning and Deplaning operations. The various flight regimes to be demonstrated while maintaining smooth coordinated control:

1. While in a 3 feet (0.9 meter) hover;
2. With one skid in contact with the ground and;
3. With the aircraft toed in.

Theoretical knowledge of procedures and limitations for Hover Exit operations as set out in Helicopter Operators Operations Manual; in particular hover exit briefing prior to conducting Hover Exit maneuvers.

Pilots shall also be required to comply with, and be competent with all requirements outlined in the Canadian Aviation Regulations.

3.5.6 Confined Area Operations/Reconnaissance

Pilots shall demonstrate competence regarding the theoretical understanding and skill regarding Confined Area Operations/Reconnaissance. This can be achieved by ensuring competency in the following areas:

- Pilots shall demonstrate competency regarding Confined Area Reconnaissance by utilizing the 6-S procedures and eye level passes if applicable;
- Pilots shall demonstrate the use of sound judgment and Pilot decision making skills during the reconnaissance portion of competency evaluation, and are required to evaluate early recognition of main rotor and tail rotor clearance;

- Steep Approach Procedures - Pilots shall demonstrate competence when performing a steep approach procedure as outlined in the Helicopter Operators Training Syllabus, with emphasis on theoretical understanding of Ground Effect and Translational Lift and the effects of each on rotorcraft performance);
- Precision Hover Exercises – a Pilots skill at precision hover techniques, including turns around the mast, nose, and tail while maintaining smooth coordinated control shall also be considered;
- Max Performance Take-off Profiles - skills at maximum performance take-off and rejected take-off procedures as outlined in the Helicopter Operators Training Syllabus shall also be evaluated;
- Rejected Take-off Procedures;
- Assessment of constructed helipad structures, including factors that may result in the rejection of a helipad.

3.5.7 Mountain Flying

Pilots shall demonstrate knowledge and practical skills when flying in mountainous terrain using sound judgment and ensuring the safety of the flight.

It is the responsibility of the Helicopter Operator to ensure the Pilot has met the standard for mountain flying through an approved mountain course based on the principles outlined in Annex D - HAC Mountain Flying Training Guidelines.

3.6 RESERVED

3.7 OTHER PERSONNEL AND VISITORS TO ONSHORE SEISMIC OPERATIONS

All personnel involved in onshore seismic operations, including all visitors, should receive a basic helicopter safety briefing as part of their job site orientation. As a minimum this briefing should include the following:

- Information about the helicopter and where it is used;
- All helicopter landing, parking and refueling areas are to be considered “Restricted Areas”;
- Risks related to approaching a helicopter (i.e. running rotors).

3.8 MINIMUM STAFFING

3.8.1 Flight Crew

Number of Flight Crew present and available should allow for the performance of the required operations without exceeding the maximum flying periods stipulated for Flight Crews in section 2.2 Performance Planning / Calculations.

3.8.2 Single and Two Pilot Factors

For passenger carrying flights in high workload environments, two Pilot operations are accepted best practice. Factors affecting a high workload environment include heavy radio traffic, difficult weather conditions, or any factor that causes greater than normal workload and may cause diversion of attention in one pilot.

However, due to considerations of payload, helicopter performance and Pilot resources, proximity to the ground and associated time constraints when conducting vertical reference operations; the use of a single Pilot may be proposed subject to a satisfactory risk assessment.

Factors taken into account when assessing the risk of using a single Pilot includes the following and should be considered as acceptable requirements when completing a risk assessment:

- Helicopter type:
  - Certified for single Pilot in country of use;
  - Equipped for single Pilot long line and vertical reference operations in compliance with the appropriate Flight Manual Supplement (FMS), including load cell, as well as exceedance monitors incorporating audible warning.
- Remote flight following (Automatic Flight Following (AFF) Satellite systems preferred);
- Pilot training:
  - Annual operational long line/vertical reference training ;
  - Annual line check completed in addition to annual check flight;
  - Pilot Decision Making course completed within two (2) years by qualified provider or facilitator;
  - Low visibility training with a focus on **avoiding inadvertent IMC**.
- Flight environment
  - Planned and conducted in Day VFR only;
  - Uncongested airspace – likelihood of air collision minimal, including other helicopter on same task. Radio procedures in place for airspace separation;
  - Navigation complexity versus navigation equipment in use;
  - Types and size of landing areas suitable for single Pilot crew. No additional lookout required.
- Fatigue Management:
  - Single Pilot flight duty hours applied without extension (See section 2.2 Performance Planning / Calculations);
  - Satisfactory environmental factors (extreme heat or cold effectively mitigated).

3.8.3 Aircraft Maintenance Engineers (AME)

A minimum staffing policy for maintenance personnel in remote locations will be assessed, and communicated with the client while considering the number of aircraft and complexity of the project.

3.8.4 Ground Crew Personnel

Subject to the completion of a Risk Assessment and based on the terms agreed to by either the Prime and/or Seismic Contractor, the number of personnel required on a program will vary depending upon terrain, access, type of program, and timeline.

All parties should be consulted as to the size of their crews for their specific operation; Ground Crew personnel should be sufficient and in line with the program specifications, allowing for Flight Crew and AME's to concentrate on their prime duties.

3.8.5 Radio Operator

One Radio Operator to be available for flight following duties any time a helicopter is scheduled for operation.

3.9 FLIGHT AND DUTY TIMES FOR FLIGHT CREW

It is recommended that Helicopter Operators develop a fatigue management policy that addresses the wide variety of fatigue factors encountered during remote onshore seismic operations, including:

- Rest breaks should be of a minimum of 30 minutes. Hot refueling does not constitute as a rest break for Flight Crew;
- A maximum of two (2) fuel cycles, or three (3) hours may be flown between shut downs. This provides for a pilot rest break and an opportunity to inspect the aircraft.
- A rest period of at least 10 consecutive hours should be made available following each flight period;
- A maximum shift cycle of 28 days on, followed by a minimum of 14 days off is recommended. Variance from this requires a documented Management of Change (MOC) process by the Helicopter Operator;
- A duty day should not exceed 14 hours; this includes travel to and from the job site, preparation planning, briefing, safety meetings etc.;
- For single Pilot operations the following limits shall be observed:
    - Two fuel cycles or Three (3) hours continuous maximum flight time between rest breaks; a 30 minute rest break will reset this period;
    - Maximum of 8 hours flight time per day;
    - Maximum of 6 hours external load flight time per day for pilots with less than 300 hours of vertical reference experience;
    - Maximum of 56 hours flight time in any consecutive 7 days period;
    - Maximum of 120 hours flight time in any consecutive 28 days period;
    - Maximum of 1000 hours in any consecutive 365 days period.

A Risk Assessment must be conducted to determine a further reduction of maximum flight times in case of high frequency, repetitive external load operations. Please refer to Annex E – Fatigue Management Programs for more information.

- For two Pilot operations the following limits should be observed, provided two qualified Pilots share this duty:
    - Maximum 2 fuel cycles or 3 flight hours between rest breaks;
    - Maximum of 10 hours flight time per day;
    - Maximum of 60 hours flight time for any consecutive 7 days period;
    - Maximum of 120 hours flight time for any consecutive 28 days period;
    - Maximum of 1,200 hours in any consecutive 365 days period.

4.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE and safety equipment help reduce the consequences of worker exposure to various job site hazards. PPE and safety equipment must be worn by personnel where danger of personal injury exists. Once hazards are eliminated or reduced to a point where no danger of personal injury exists, PPE may not be required.

A hazard assessment must be conducted to determine the proper PPE requirements for a particular program. Employers are required to ensure that PPE and safety equipment are readily available and personnel know how and when to properly use this equipment. Visitors to the job site are also required to use PPE when necessary.

4.1 TRAINING

To improve the knowledge of PPE and safety equipment, personnel should be trained in the proper fitting, use, cleaning, maintenance and storage of the equipment being used onsite.

4.2 MAINTENANCE

PPE and safety equipment must always be available and in good working condition. Regular, scheduled maintenance is the most effective means of ensuring this. Maintenance schedules and procedures should follow manufacturer's instructions and Canadian Standards Association (CSA), International Organizational for Standardization (ISO) standards.

When PPE is not in use, it should be stored in a way to avoid any damage.

Report any damage to PPE and discard any protective equipment that has suffered a shock or a crack

4.3 RECOMMENDED PPE FOR FLIGHT CREWS

4.3.1 Flying helmets manufactured to appropriate industry standards should be worn by Pilots for all onshore seismic operations. Head protection shall be worn as per the manufacturer's specifications.

4.3.2 Task specific PPE recommended for Flight Crew is as follows:

- Industry standard fire retardant flightsuit, encompassing hi-visibility markings;
- Adequate industry standard hearing protection (ear plugs or ear muffs) when noise is in excess of 80dba;
- Suitable footwear;
- Industry standard gloves for fueling operations;
- Climate related clothing

4.3.3 Task specific PPE recommended for AME's are as follows:

- Industry standard fire retardant coveralls, encompassing hi-visibility markings;
- Adequate industry standard hearing protection (ear plugs or ear muffs) when noise is in excess of 80dba;

- Suitable footwear;
- Head protection with attached chinstraps, preferably climbing helmets;
- Climbing helmets should be worn at all times when aircraft are active, and when the AME has to climb up on the aircraft;
- Appropriate industry standard eye protection;
- Industry standard hand protection (chemical grade for refueling personnel);
- Climate related clothing.

4.4 RECOMMENDED PPE FOR ONSHORE SEISMIC PERSONNEL

Due to the nature of work Ground Crew is involved in (work near running helicopters, rotor down wash, dusty areas, sling work, etc.), seismic personnel are required to wear, as a minimum, the following PPE:

- Adequate hearing protection (ear plugs or ear muffs) when noise is in excess of 80dba;
- CSA approved safety eye protection;
- CSA approved hard hat;
- Safety vest or optional high visibility marked coveralls.

5.0 HELICOPTER PERFORMANCE AND ROLE EQUIPMENT STANDARDS

5.1 HELICOPTER SELECTION

Onshore seismic operations require helicopters to be operated in a low-level, low-speed regime. Careful consideration of the equipment required for a heli-portable seismic program need to involve all parties working on the program. Configuration should be made during the initial planning and tendering phase of the seismic operation with appropriate input from the Helicopter Operator.

Issues that need to be discussed are:

- Time of Year – The latitude of the program will determine the amount of daylight available for flight operations. Heli-portable work can only be done in daylight hours;
- Weather Extremes – Hot weather affects the performance of helicopters. The hotter the temperature, the less efficiently a helicopter operates. Helicopters are restricted to VFR flight on heli-portable operations;
- Elevation – Helicopters are less efficient at higher elevations, as the air is less dense;
- Terrain and Vegetation Coverage – This will determine the type of long line equipment required. The rougher the terrain, or the higher the canopy, the longer the long line will have to be;
- Transportation of Personnel – Factors including road access, remoteness of program, emergency response, size of crews, and proximity of job sites to LZ's will determine the best type of helicopter to be used for moving people around the program;
- Emergency Response – If the Safety Plan requires helicopter support for the transportation of injured personnel, at least one of the helicopters on the program must be able to accommodate a full-length spine board and stretcher;
- The helicopter being used must be approved and registered with an applicable aviation authority such as Transport Canada, the Federal Aviation Administration (FAA), etc.;
- If the helicopter is heavily relied upon as a rescue tool and the weather becomes too extreme to fly, field operations should be reduced to having personnel in areas where rescue and evacuation can be done by foot and/or vehicle.

5.1.1 When determining the type of helicopter to be used (its configuration and the operational parameters to be specified for a specific program), - the Helicopter Operator should first determine if the program will be conducted in either a Hostile or Non-Hostile Environment:

- Hostile Environment: An environment in which a successful emergency landing cannot be assured, or the occupants of the helicopter cannot be adequately protected from the elements, or SAR response/capability cannot be provided consistent with the anticipated exposure.
- Non-Hostile Environment: An environment in which a successful emergency landing can be reasonably assured, and the occupants of the helicopter can be adequately protected from the elements. SAR response/capability can be provided consistent with the anticipated exposure.

5.0 HELICOPTER PERFORMANCE AND ROLE EQUIPMENT STANDARDS

5.2 SINGLE AND MULTI-ENGINE HELICOPTERS

One of the most significant choice to be made when determining helicopter selection on an onshore seismic program is between the use of single and multi-engine helicopters. General guidance is given below; however a final decision should be based on the Risk Assessment completed prior to program commencement:

5.2.1 Single-Engine Helicopters

- Acceptable single-engine helicopters are those that have met the terms of the Risk Assessment when being used in hostile environments;
- The maximum load permissible should be calculated by referencing Hover Out of Ground Effect (HOGE) performance charts for corresponding density altitude;
- For internal, or non-jettisonable external loads, the allowable payload should be reduced by 10-15% to provide a larger safety margin
- External load operations should only be conducted with a helicopter for which an approved supplement to the helicopter Flight Manual for external load operations exists;
- Helicopters should have engine trend analysis recorded and reviewed on a scheduled basis by technical staff;

5.2.2 Multi-Engine Helicopters

- In built up or congested areas, the helicopter's OEI performance should be such that the HOGE is achievable without an external load attached. When flying over built up or congested areas cannot be avoided, a multi-engine helicopter should be considered that is capable of meeting these requirements, after jettisoning the external load;
- The maximum load permissible should be calculated by referencing HOGE performance charts for that density altitude. The helicopter should still be capable of OEI flyaway performance after jettisoning the external load;
- A multi-engine helicopter able to sustain OEI flight, after jettisoning any external load, is recommended for onshore seismic operations in a predominantly hostile environment.

5.3 INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) PERFORMANCE CLASS

DELETED

5.4 HELICOPTER EQUIPMENT FIT

5.4.1 All helicopters involved in onshore seismic operations should meet the manufacturer's requirements and should (variances to be established through MOC process) have the following items:

- Fuel low level warning light;
- Engine-monitoring device (if available for the helicopter type);
- Appropriate environmental control, including air conditioning for operations in high ambient temperatures and/or heating for cold ambient temperatures (where air conditioning is not practical. Consideration must be given to reducing flight times in order to mitigate fatigue);

- Where available for helicopter type, Health and Usage Monitoring System (HUMS);
- For passenger operations, upper torso restraints are required for all seats;
- Survival kit applicable to the environment and climate specific conditions within the operating area, and scaled to the expected number of passengers;
- SAR Satellite-Aided Tracking (SARSAT), ELT or Emergency Position Indicating Radio Beacon (EPIRB) is within the reach of the Pilot. Integrated GPS in any emergency beacon is recommended;
- Bear Paws for work in soft terrain regardless of season;
- Aviation approved GPS receivers.

5.5 ADDITIONAL REQUIREMENTS FOR EXTERNAL LOAD OPERATIONS

All helicopters used for external load operations should have the following items:

- External mirrors;
- Bubble windows or approved and installed camera to enable unobstructed view of the cargo hook area.
- Operable manual and electrical release (flight deck) and external release (hook);
- For external load operations involving vertical referencing (long line), bubble windows (or equivalent allowing direct vision to load on long line) are to be provided, or doors maybe removed if approved for the helicopter type.
- If approved for the helicopter type, remote first limit indicator or remote fire warning and caution lights that are within the view of the Pilot when observing the load;
- Specialized navigation equipment used for accurately pinpointing the location of the pick-up and drop zones, and for accurate flight following;
- A load cell (scale) that allows the Pilot to check the weight of the external load;
- Radio equipment to meet regulatory and local ATC requirements, including effective 2-way communication with Ground Crews and flight controller.

  See Section 6.6 Communications and Navigation Beacons for more information.

5.6 REQUIREMENT FOR DUPLICATE INSPECTIONS OPERATIONS

After any disturbance or disassembly of a control system or vital point of a helicopter, most regulators will call for independent inspections to be made and certified by two (2) appropriately qualified persons, before the next flight. Such duplicate inspections are strongly recommended.

If Pilots are used as duplicate inspectors, a formal training qualification should be in place with recurrent training and consideration should be given to the Pilots rest periods if they are required to assist the maintenance task.

5.7 HELICOPTER MINIMUM EQUIPMENT LIST (MEL) OR MINIMUM DEPARTURE STANDARD (MDS)

DELETED (RESERVED FOR FUTURE REVIEW)

5.8 MAINTENANCE AND INSPECTION

There must be a written program for the maintenance and inspection of slings, cargo hooks, nets and any device involved in the lifting of external loads - including carousels, bag runners, long lines and remote hooks.

6.0 BASE CAMP/STAGING AREA/HELIPAD INFRASTRUCTURE & EQUIPMENT REQUIREMENTS

6.1 BASE CAMP/STAGING AREA

The base camp/staging area shall be sufficient dimension as to allow the installation of a fuel storage tank (fuel truck or drums) and the positioning of the helicopter. Distances between equipment are as follows:

- Helicopter from fuelling equipment: 15 meters;
- Fuel storage tank from accommodations: 100 meters;
- Any other equipment not associated with helicopter operations (trucks, trailers, etc.): 50 meters.

6.1.1 All helicopter staging areas should be roped or marked with pylons. The staging area should be clean and free of any articles or equipment that could be blown in the air by the down wash of the helicopter rotors.

6.1.2 Staging areas should be located at a reasonable distance from camps, roads and other obstacles. "Low Flying Helicopter" signs should be installed when operations are within reasonable distance of these obstacles.

6.1.3 All staging areas should be marked with "No Smoking" signs.

6.1.4 All staging areas or primary fuelling sites shall be equipped with 2 dry chemical fire extinguishers with a minimum rating of 10A, 60BC. The fire extinguishers should be strategically located, prominently displayed and readily available at a distance no less than 10m from the fuel storage tanks.

6.1.5 Fuel storage tanks should be located on a firm and level surface to avoid any flooding.

6.1.6 Full and empty fuel drums should be stored in a way to avoid any movement (chocked at both row-ends).

6.1.7 Local topography affects the aviation aspects of base camp selection and for this reason the following locations should be avoided:

- Valley and bowl locations, which may present obstacles during take-off and unacceptably steep approach/departures. Early morning mist is slow to clear and may, in mountainous areas, give rise to excessive turbulence;
- Non-grassy areas likely to give rise to excessive dust during dry periods;
- Sites close to population centers, which could cause undue nuisance to local population and/or risk exposure;
- Sites that cannot easily or economically be made secure have the potential to affect the entire seismic operation and are particularly sensitive to threats such as sabotage, hijacking and tampering with fuel supplies. The local security situation should be fully assessed;
- Low lying areas susceptible to flooding have the potential to affect aviation fuel storage, quality control, and helicopter maintenance. Mosquito nuisance may affect evening and night maintenance;
- Where power lines or high obstacles are present, the following is recommended:

- Flight Crew to be fully briefed on the potential hazard;
- Familiarization flights for pilots to show positions of overhead cables and other hazards; pilots' topographical maps will be marked accordingly in conjunction with Annex A – Risk Assessment;
- When appropriate and in particular for power lines and high obstacles close to any base camp, efforts should be made to get these marked (marker balls, flashing lights) by the owner of these installations.

6.2 HELIPADS (AKA LANDING ZONES OR LZ)

Onshore seismic operations are often executed in large forested areas where unprepared landing zones are required. Site selection, preparation and approval are crucial to safe helicopter operations. Factors such as slope of the terrain, approach, and departure obstacles and site surface conditions must be considered when selecting a site.

6.2.1 Site Selection

- Approximate helipad locations should be determined prior to program commencement;
- The Prime Contractor will determine size and spacing, with input from the Helicopter Operator and Line Construction Crew;
- Consult the Safety Plan when determining locations and spacing; generally 35 meters in diameter and not more than 1 kilometer apart;
- Consider terrain slope and surface conditions, and approach and departure obstacles;
- Locate on firm, level ground with consideration to helicopter approach and departure angles and air movement (updrafts & downdrafts);
- To reduce hazard to construction crews, select locations in the following order:
  - Available natural or existing pads first;
  - Areas of low-density timber stands;
- Avoid areas with excessive tree height, low spots or rock outcroppings, which can restrict Pilot options during landing and take-off in adverse weather/lift conditions;
- The Pilot has the final decision in accepting or rejecting a landing zone;

6.2.2 Helipad Identification

- Each helipad should have a unique numerical label (e.g. 123-456). GPS coordinates for each location should be recorded; helipads should be included on maps. The GPS coordinate reference system should be determined by the Ground Crew and the Crew Manager prior to the commencement of any ground work (e.g. UTM, DMS etc.);
- Windsock should be installed in all staging areas;
- Ribbon flagging should be tied to trees, when possible, at all helipads to provide wind direction to Pilots.

6.2.3 Helipad Construction

The safe operation of helicopters requires consideration of helicopter performance during all stages of a flight. To achieve the required level of safety during take-off and/or landing procedures, extensive clearance and careful preparation of sites may be necessary.

- Prepare helipads during the line construction phase;
- Helipad sites (natural, existing or new cuts) should be constructed to accommodate the largest size helicopter expected to be using the site. Due to the different sized light helicopters available and also the use of medium lift helicopters on a job site, it is strongly recommended that an obstacle free area of 35 meters in diameter be cleared;
- A 35 meters diameter window in the tree canopy should be maintained to reflect the 35 meters diameter at ground level;
- In order to facilitate the safe landing and take-off of the helicopter and the access/egress of passengers, all woody materials must be cut and cleared to ground level in the central area of the helipad(s).The remaining area of the helipad will be cut and cleared to ensure that a tail rotor strike, damage to the helicopter fuselage, foreign object damage, etc., does not occur;
- If slope exceeds 5% or the ground is too soft, log footing for the rear of the helicopter should be provided.
    - Log footing must be of adequate diameter, 4.5 meters or longer and should be secured.

      Note: Ensure that securing stakes are below the top of the logs;
    - If log cribbing is required, it should be designed in a manner that will support the helicopter rear skid pads and the front skid tubes just behind the forward cross tube;
- All dangerous trees within 35 meters of a helipad should be identified, controlled and/or removed. Controlled danger trees are to be reported to the Party Manager and placed on the hazard map;
- The alignment of helipads and helicopter operating areas should take into account factors such as wind and the need to avoid over-flying populated areas during take-off and approach to landing;
- Power lines and other high obstacles such as towers, are a particular hazard, especially near a heavily helipad. Depending on the proximity of these obstacles the position of the helipad must be considered with regard to approach and departure routes;
- Where power lines or high obstacles are present the following is recommended:
    - All identified hazards within 500 meters of any helipad should be clearly marked on the program hazard map.

6.2.4 Helipad Maintenance

- The Prime Contractor is responsible for auditing the helipads for safety and operational compliance after construction;
- No loose objects shall be left in a landing zone (clothing, garbage, tarps, etc.);

6.2.5 Drop Zones (DZ)

Drop zones (DZ) are cleared or open areas on the shot point where the drill and compressor are placed by the helicopter.

- A minimum canopy size should be no less than four (4) square meters. Slope of terrain, tree height etc. may require larger DZ's;
- The Prime Contractor will determine size and spacing, with input from the shot hole drilling contractor (generally 4x4 meters);
- Use the same clearing criteria as helipad landing zones;
- The larger the helicopter, the larger the safety zone has to be around a DZ due to main rotor downwash;
- A certified Faller must evaluate the DZ for size, ground cover, down draft hazards and canopy opening, considering heli-drill hazards.

6.3 GENERAL LAYOUT

Pedestrian and vehicular traffic should be kept separated from helicopters when they are parked, being refueled, maneuvered or operated. Helipads and parking and refueling areas should be declared "Restricted Areas" with authorized access only. Warning notices advising personnel not to proceed beyond authorized areas should be prominently displayed.

- Approach and departure paths to and from the helipad should be kept clear of people, vehicular traffic (including off highway vehicles and seismic equipment such as drills and vibrators), and any obstacles or hazards;
- Allow for possible changes in flight paths with wind changes; wind direction indicators should be set up at all staging areas and other areas of heavy use;
- Pilots should be able to approach or depart the helipad with external loads without flying over people, equipment, vehicles, camp structures or third party buildings;
- Non-grassy and snow environments must be controlled to avoid whiteout / brownout conditions.

6.4 FINAL APPROACH/TAKE-OFF (FATO) AND/OR REJECTED TAKE-OFF IN STAGING AREA OR BASE CAMP

- The Helicopter Operators should be consulted during the design, location and construction process of any new helipads;
- A formal documented Quality Assurance (QA) procedure to sign off all new helipads before operational use should be implemented;

- Helipads should be kept clean and clear of any material or debris that can be affected by the rotor wash of the helicopter (garbage, plywood, corrugated iron, plastic sheets, etc);

- Helipads should be kept clean and clear of all obstructions in order to allow for the safe maneuvering of helicopters. All wires, ropes, antennas etc. should be well-marked and never erected near the approach or landing are of the helipad;

- Helicopter operations require a sufficient length of level, flat ground that is clear from all obstructions and capable of bearing the helicopter for a running landing in the event of an engine failure before a designated critical point in the take-off sequence is required. This can be calculated from the performance section of the flight manual as a horizontal distance and appropriate to ambient conditions. The minimum length required for the specific type of helicopter at a maximum weight for ambient conditions can be obtained from the Helicopter Operator;

- Whenever two or more helicopter types are being operated, the length of the rejected take-off area should be calculated to accommodate the most restrictive type. The minimum width of a helicopter rejected take-off area should be 2.5 times the length overall of the largest helicopter with its rotors turning;

6.5 HELICOPTER PARKING AREAS

A designated parking area for each helicopter may be required. When required the parking area shall be:

- Flat;

- Able to supply electricity for tools and heating;

- Should have adequate flood lighting;

- Should have access to a supply of potable water;

- Should be free of mud and snow to allow onsite AME access to the underside of helicopter;

- Dust control along roads accessing parking area or beside the parking area, may be considered when necessary.

6.6 COMMUNICATIONS AND NAVIGATION BEACONS

A vital part of any heli-portable program is communication. Maintaining communication in mountainous, hilly or treed terrain with limited access is a serious challenge and a plan must be developed that will ensure full communication capability between operatives throughout all phases of the program. This may include the use of the helicopter radio to relay communications but a more reliable contingency is through the use of sufficient radio repeater stations, located to provide for optimum coverage with field personnel.

- As a minimum requirement, multiple radios ensuring airborne helicopters are never out of contact with either base camp/staging area or the local Air Traffic Control (ATC) network should be installed.

- For logistic and local advisory information, VHF base equipment is appropriate for onsite use, provided the area can be covered by line of sight propagation; the alternate set may also be VHF.

  When continuous cover cannot be guaranteed, a VHF Repeater may be a viable option. Satellite voice communications, if provided by the flight tracking system can also serve as an alternate communication system;

- A designated radio frequency should be assigned to the helicopter and Ground Crew for flight operations;

- In remote areas, a third method of communication should be considered in the event of an emergency (i.e. satellite telephone - in particular if other communication systems may not provide contact if the helicopter is on the ground).

  In this case a "dial in" system may be acceptable, however preference should be given to those systems requiring little action and know how to be used properly.

6.6.1 Program Radio Requirements

- A common radio frequency for the different job sites on the program;

- A radio repeater station may be required to ensure a wide enough coverage area so that all work groups can communicate with each other in case of an emergency;

- Scheduled radio checks to a centralized controller to confirm connectivity of the radio net;

- All remote working-groups must have access to two radios;

- All radio frequencies in use must be identified on the Emergency Response Plan (ERP).

6.6.2 Repeater Requirements (Frequency)

A plan should be constructed and tested at the start of each program to ensure adequate coverage from repeater stations. It should also be monitored and adjusted for effectiveness throughout operations. The plan should include maintenance of the system itself (e.g. battery testing, replacement) and a commitment to react immediately when there is a failure in communication effectiveness.

Where crew personnel are dispersed on large programs, a separate or extended plan may be required to ensure that communication is fully maintained (e.g. manned relay station, satellite or cellular telephone, additional repeater antennae).

6.7 STAGING AND CAMP LIGHTING

Adequate lighting should be provided at both the helipad and helicopter parking areas to allow for inspection, preparation and loading of the helicopter during the hours of darkness. Subject to a security Risk Assessment for the area, peripheral security lighting should be considered and placed in a way that people approaching the helicopter will be clearly visible from a distance;

6.8 MISCELLANEOUS INFRASTRUCTURE

6.8.1 Operations Office

An operations office (trailer) is recommended for the duration of the program and should be located so the occupants have a clear view of the helicopter dispatching area.

Adequate shelf space for operations and flight manuals, as well as a quiet rest area for onsite Flight Crew should also be provided.

6.8.2 Maintenance Facilities and Workshops

Maintenance facilities and workshops are essential to program operations. Helicopter maintenance at base camps/staging areas will normally be restricted to line maintenance as major inspections are normally carried out at the Helicopter Operator's main base.

As a minimum the following should be provided when onsite facilities and workshops are being utilized:

- A secure storage area for spare helicopter parts, complete with rack and bin facilities appropriate to the number of helicopters on site;
    - Air-conditioning may be required depending on what is being stored;
- A secure and fireproof storage area for oils, greases and flammable liquids.

6.8.3 Sleeping Quarters

In order to comply with recognized Flight Time Limitation regulations and proactively mitigate fatigue, sleeping accommodations should be quiet, comfortable, furnished to a reasonable standard, well ventilated with climate control and adequately controlled facility lighting.

- Single accommodation must be provided for Pilots and AME's;
    - AME personnel may be required to work unusual hours, thus their accommodation should be equally and suitably appointed and separate from other groups;
- Single accommodation consideration should also be given to HETS Crews.

7.0 SINGLE /TWIN ENGINE RISK ASSESSMENT - HELICOPTER PERFORMANCE PLANNING

A significant choice to be made when determining helicopter selection on an onshore seismic program is between the use of single and twin engine helicopters. General guidance is given below; however a final decision should be based on the Risk Assessment completed prior to program commencement:

Program Name	
Helicopter Type	
Empty Weight in Task Configuration (lb or kg)	
Crew & Additional Equipment Weight (incl. Survival Gear)	
Operating Empty Weight (lb or kg)	
Maximum Take-off Weight (lb or kg)	
Maximum Fuel Load (This figure may exceed capacity)	
Planned Fuel Load (lb or kg)	
Take-off Weight (OEW + Fuel Load) (lb or kg)	
Transit Time to Task Area (hours – one way)	
Fuel Burn Rate During Transit (lb or kg per hour)	
HOGE Performance	**HOGE Available at Maximum Intended Operating Weight**
HOGE at Lowest Altitude of Intended Location (Density Alt @ Average Seasonal OAT) (lb or kg)	Yes/No
HOGE at Mid-altitude Above Sea Level (ASL) of intended Location (Density alt @ Average Seasonal OAT) (lb or kg)	Yes/No
HOGE at Highest Altitude (ASL) of Intended Location (Density Alt @ Average Seasonal OAT) (lb or kg)	Yes/No
OEI Performance for Twin Engines	**OEI HOGE Available at Maximum Intended Operating Weight**
OEI HOGE at Lowest Altitude (Density Altitude @ Average seasonal OAT)	Yes/No
OEI HOGE at Mid Altitude (Density Altitude @ Average seasonal OAT)	Yes/No
OEI HOGE at Highest Altitude (Density Altitude @ Average seasonal OAT)	Yes/No
Reserve Fuel Weight Required Upon Landing (lb or kg)	
Remarks:	

Note: when calculating HOGE or OEI, planned performance should be based on zero wind conditions, ambient temperature, seasonal average for the area, and density altitude for the lowest/mid/highest levels of the intended job sites. Account should be taken of the additional power required to transition to forward flight over and above what is required to HOGE.

8.0 SINGLE /TWIN ENGINE RISK ASSESSMENT - CONSIDERATION FOR SELECTING HELICOPTER TYPE

Choice of helicopter type for seismic support operations is dependent on a number of factors, but should include the exposure to risk in the event of an engine failure.

The risk in the event of an engine failure can be summarized in the following table:

	Non-Hostile Terrain	Hostile Terrain
Single-Engine Helicopter		
Twin Engine with OEI HOGE		
Twin Engine without OEI HOGE		
Total % Hostile Terrain (from Operating Conditions – page 55)		

Mitigation factors that apply to this operation:

1.	New FAA/Joint Aviation Authorities (JAA) 27/29 Certification Helicopter Type.	
2.	No Passenger Flights. Cargo/Load Only.	
3.	Routing to Avoid Hostile Terrain.	
4.	HUMS/Engine Vibration Monitoring (EVMS) Daily Monitoring.	
5.	Fuel Quality Assurance Completed Daily.	

Helicopter Type for Operation	
Type	**Role**

9.0 SINGLE ENGINE AIRCRAFT OPERATION

SINGLE AND TWIN ENGINE HELICOPTERS

Single-Engine Helicopters

- Acceptable single-engine helicopters are those that have met the terms of the Risk Assessment when being used in hostile environments;
- The maximum load permissible should be calculated by referencing Hover Out of Ground Effect (HOGE) performance charts for corresponding density altitude;
- For single engine aircraft, the HOGE weight should be restricted by 10-15% for internal or non-jettisonable external loads;
- External load operations should only be conducted with a helicopter for which an approved supplement to the helicopter Flight Manual for external load operations exists;
- Helicopters should have engine trend analysis recorded and reviewed on a scheduled basis by technical staff;
- The helicopter being used must be approved and registered with an applicable aviation authority such as Transport Canada, the Federal Aviation Administration (FAA), etc.;

10.0 TWIN ENGINE AIRCRAFT OPERATION

10.1 Twin Engine Helicopters

- In built up or congested areas, the helicopter's OEI performance should be such that the HOGE is achievable without an external load attached. When flying over built up or congested areas cannot be avoided, a multi-engine helicopter should be considered that is capable of meeting these requirements; after jettisoning the external load.

- The maximum load permissible should be calculated by referencing HOGE performance charts for that density altitude. The helicopter should still be capable of OEI flyaway performance after jettisoning the external load;

- A multi-engine helicopter able to sustain OEI flight, after jettisoning any external load, is recommended for onshore seismic operations in a predominantly hostile environment.

10.2 Final Approach/Take-Off (FATO) and/or Rejected Take-off in Staging Area or Base Camp

- To cover the case of engine failure after the critical point mentioned - when take-off would be continued on one remaining engine for a twin engine helicopter - the take-off flight path should be clear to a gradient in accordance with the performance section of the flight manual. Advice may be obtained from either the Helicopter Operator or company Aviation Advisor.

    - A slope of 1:20 for 1,200 meters horizontally may be used but only as a guideline.

ANNEX A – RISK ASSESSMENT (HELICOPTER/ONSHORE SEISMIC SUPPORT RISK ANALYSIS)

Client		Contract Name	
Program Title		Start Date	
Location		Estimated End Date	
Helicopter Operator		Contact Name	
Total Size (km)		Proposed Helicopter Types	
# of Sections			
Scope of Work:			
Remarks (list any general comments regarding this risk analysis):			

ANNEX A – RISK ASSESSMENT (SUPPORT SPECIFICATIONS)

Complete one for each program section:

Block Name:		
Support Type (bags, drills, personnel):		
Seismic Survey Lines	Direction:	
	Spacing:	
	Average Length:	
	Total Line Length (km):	
	Spacing:	
	Average Length:	
	Total Control Line Length (km):	
Total Line KM's This Block:		
Special Requirements for this Program:		
Remarks:		

ANNEX A – RISK ASSESSMENT INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)

PERFORMANCE CLASS

The description of the ICAO Standard contained in this section relies upon the current (amendment 23 – without exposure) status.

- **ICAO Performance Class 1 (PC1)**

  Operations with performance such that, in the event of failure of the critical power unit, the helicopter is able to safely continue the flight to an appropriate landing area, unless the failure occurs prior to reaching the Take-Off Decision Point or after passing the Landing Decision Point in which case the helicopter must be able to land within the designated area.

- **ICAO Performance Class 2 (PC2)**

  Operations with performance such that, in the event of critical power unit failure, performance is available to enable the helicopter to safely continue the flight, except when the failure occurs early during the take-off manoeuvre or late in the landing manoeuvre, in which case a forced landing may be required.

- **ICAO Performance Class 3 (PC3)**

  Operations with performance such that, in the event of a power unit failure at any time during the flight, a forced landing will be required.

- **Conditions Affecting PC 2 & PC 3**

  ICAO conditions the use of PC 2 and 3 with the following Standard:

  "Performance Class 3 helicopters shall only be operated in conditions of weather and light, and over such routes and diversions there from, that permit a safe forced landing to be executed in the event of engine failure. The conditions of this paragraph apply also to performance Class 2 helicopters prior to the defined point after take-off and after the defined point before landing."

For passenger transport, PC 1 helicopters should be given preference. When not available PC 2 should be the next selected, and if neither available PC 3 helicopters can be used, subject to risk analysis.

For operations carrying more than 9 passengers, PC 3 helicopters are not recommended.

External load operations should only be conducted with a helicopter for which an approved supplement to the helicopter Flight Manual for external load operations exists, and which is in compliance with ICAO Performance Classifications.

Helicopters should have engine trend analysis recorded and reviewed on a regularly scheduled basis by technical staff.

See section 2.2 Performance Planning/Calculations for detailed performance planning requirements.

ANNEX A – RISK ASSESSMENT (HELICOPTER/ONSHORE SEISMIC SUPPORT RISK ANALYSIS)

Complete one for each block:

Program Name		
Weather	Prevailing wind direction	
	Avg. wind speed (knots)	
	Mean min temp (ºC)	
	Mean max temp (ºC)	
	Remarks	
Elevation (Feet MSL)	Minimum	
	Median (this value is required)	
	Maximum	
Helicopter Main Staging Area		
Location (latitude/longitude)		
Security/Proximity to Population Centre		
Obstacles and Power Lines in Vicinity		
Size of Helicopter Landing/Parking Area		
Surface of landing/parking area (dust, snow, mud, prepared surface etc)		
Proximity to Buildings, Fuel Storage etc.		
FATO/Rejected Take-off Area Size		
Approach and Departure Lane Restrictions and Slope		
Helipad Lighting and Maintenance Work Lights.		
Onsite Maintenance Facilities		
Site Accommodation		
Crew Sleeping Quarters (Hotel or on site)		
Fuel Supplier Name		
Fuel Storage / Delivery Method (tanker, buried tanks, bladder, and drums?)		

Flight Following System (satellite/radio etc)	
Fuel Filtration / Quality Control	
Primary and Alternate Communication	
Planned Communication Time Interval	
Line Helipads	
Minimum Size	
Surface	
Drop Zones	
Minimum size	
Local Aviation Facilities	
Nearest Airport Name and Identifier	
Distance from Main Staging Area	
Air Traffic Services/Control on site	
NAVAIDS; VOR, NDB, ILS, DME, GPS.	
Services (crash, fire, rescue, hangar)	

Terrain			
Block Name			
Terrain Gradient (m/km)	**% of Block**	**Surface**	**% of Block**
Flat (<10)		Water	
Gentle (11-50)		Scrub	
Undulating (51-150)		Wooded	
Steep (>150)		Pastoral	
Total (must be100)		Tree Height	
		Canopy Height	
Total Hostile Environment (%)			

ANNEX A – RISK ASSESSMENT (HELICOPTER AND CREW DETAILS)

Complete one for each block and helicopter type.

Block Name					
Hazards	**None**	**Few**	**Moderate**	**Many**	**Remarks**
Power Lines					
Towers/Masts					
Known Bird Activity					
Known Helicopter Activity					
Urban Areas					
Farm Houses					
Airstrips					
Blasting Areas					
Restricted/Danger Areas					
Politically Sensitive Areas					
Other Hazards/Comments:					
Helicopter Type					
Registration					
Expected Hours to be Flown on Task					
Total Airframe Time @ Start of Task					
Engine Hours Remaining (L/R)					
Continuing Airworthiness Program in Place?					

ANNEX A – RISK ASSESSMENT (HELICOPTER AND CREW DETAILS CONTINUED)

Any major components on time extensions?	
List major components that will expire during task	
Programmed Maintenance During Task	
# of Pilots of Each Flight	
# of Additional Crew on each Flight	
# of Pilots Onsite	
Local Security Officer/Observers Required	
# of Maintenance Personnel Onsite	
Remarks:	

ANNEX A – RISK ASSESSMENT (GENERAL HAZARDS RISK MATRIX)

Complete this part for all types of helicopter.

Hazards not directly related to engine failure (e.g. Controlled Flight into Terrain (CFIT), bird strike, etc.) must be considered in any risk assessment regardless of program size or helicopter type. The information collated in the previous pages is to be used in assigning an appropriate severity and exposure factors by assessing the presence or absence of the hazards listed below.

Hazards not listed in any particular order. Add more to the list as appropriate.

	✓
Steep mountainous terrain	
Ridge crossings at sharp angles (i.e. greater than 45 degrees)	
Persistent strong winds particularly when combined with significant terrain relief	
High elevation (i.e. above 8000 feet)	
Rapidly variable local weather conditions (e.g. fog, low cloud, low visibility)	
Significant population of birds	
Busy air traffic environment	
Limited local SAR resources	
Primitive refueling facilities (e.g. drums)	
Primitive maintenance facilities (e.g. no hangar or on-site personnel; poor parts availability)	
Significant number of man-made obstructions (e.g. towers, cables)	
Built-up or populated areas; activities on the ground (e.g. blasting)	
Environmental factors relating to crew workload and fatigue (e.g. very cold or very hot and humid)	
Environmental factors relating to helicopter maintenance and condition (e.g. sandy conditions)	
Poor accommodations to obtain suitable rest; limited available diet	
Limited Flight Crew experience on type in similar conditions	
Time constraints; anticipated client pressure to complete survey	
Poor personal security at operating base	
Security concerns in operating area while airborne	
Significant local health risks	
No rejected take off area at base site.	
Local/regulatory constraints on landing/drop zone size, below recommended	
Obstructions on take-off and approach paths	
Lack of NAVAIDS	
Lack of alternate landing areas	
Other Hazards not identified above:	

Severity (based on the presence of the above hazards).

5 Assigned when 15 or more of the hazards listed are present.

4 Assigned when 11 to 14 of the hazards listed are present

3 Assigned when 7 to 10 of the hazards listed are present

2 Assigned when 3 to 6 of the hazards listed are present.

1 Assigned when less than 3 of the hazards listed are present

Note: The above hazards may be weighted as considered appropriate (i.e. if there are a large number of one type of hazard it could be counted twice).

Exposure/Probability

5 Assigned for long duration (greater than six weeks) single Pilot operations with no rotations planned and only one Pilot on the site.

4 Assigned for long duration single Pilot operations with no rotations planned but more than one Pilot on site.

3 Assigned for short duration single Pilot operations.

2 Assigned for long duration two Pilot operations with no rotations planned.

1 Assigned for short duration two Pilot operations.

For each survey block and helicopter type, enter appropriate figures from above in the Table below to determine the Risk Factor.

Block Name	Helicopter Type	Severity	Exposure	Risk Factor
				0
				0
				0
				0

Use of the Matrix

The matrix is presented below, complete with suggested methods of reducing risk factors. The following index is then to be used to determine the risk management required for the proposed survey.

Risk Factor	Operation Conditions
16-25	Operation **not** to proceed as currently planned. Consultation between Operations Manager or Chief Pilot, Prime OSR, RCM is required to significantly amend plans.
9-16	Operation may proceed upon approval by the Operations Manager or Chief Pilot, Prime OSR, RCM or Aviation Advisor of amendments to current plan or other factors which mitigate identified risks.
1-9	Operation may proceed as currently planned.

ANNEX A – RISK ASSESSMENT (GENERAL HAZARDS RISK MATRIX CONTINUED)

Exposure/ Probability	Severity				
	5	4	3	2	1
5	25	20	15	10	5
4	20	16	12	8	4
3	15	12	9	6	3
2	10	8	6	4	2
1	5	4	3	2	1

Methods of Reducing Risk Factors – General Hazards

Exposure/Probability

1 Two Pilot operations preferred to single Pilot operations;

2 Reduced planned flight duration and or number of daily flights;

3 Assign more than one Pilot to a given single Pilot survey;

4 Increased frequency of Pilot rotation with overlapping periods to facilitate transitions;

5 Increased frequency of scheduled rest days.

Severity

- Helmets with visors, full harness, and clothing;
- Helicopter selection for airfield conditions; air conditioning;
- Increased terrain clearance;
- Airfield, main base and landing zone selection; for better surface, approach paths and facilities; possible improved environmental conditions.

ANNEX B - GENERIC HAZARDS & CONTROL INVENTORY

The following presents an inventory of known hazards in helicopter supported onshore seismic operations; it also incorporates suggested controls that may be used to reduce the potential risks presented by these hazards.

Risks (before and after controls are applied) must be assessed on a case-by-case basis, as they will depend on the type and location of an operation. The focus in this Annex is specific hazards related to helicopter supported activities. However some hazards common to other types of operations have also been included. Most general aviation hazards, such as mechanical failures of the helicopter or Pilot error etc. are not included.

ENVIRONMENTAL HAZARDS & SUGGESTED CONTROLS

Weather

Hazard Description	Suggested Controls
Adverse weather conditions that may affect helicopter operations include: ▪ Low clouds, fog, rain or snow reducing visibility, risk of: o Collision with obstacles; o Getting lost during VFR flights. ▪ Freezing temperatures that may result in: o Slippery walkways, o Ice accumulation on the helicopter. o Ice accumulation can also be the cause of breaking antenna wires etc. o Adversely affect engine performance (failure to start).	Plan operations taking into account prevailing weather conditions and the extremes that can be expected in the course of the operations. Ensure availability of regular, reliable weather forecasts and advanced warning system for adverse conditions. Avoid weather conditions that are outside the operating envelope of the helicopter in use. Availability and map of emergency landing locations. Incorporate weather conditions in Manual of Permitted Operations and Emergency Response Plan. The Pilot has the obligation and must have the authority to suspend or modify operations, without further approval from management, in case of adverse weather.
▪ Strong winds, especially around hilltop helipads can: o Affect the flight path of the helicopter; o Cause trees at edges of forest (helipads, rivers etc) to fall; o Cause dust or light objects in the air (FOD).	Avoid presence of personnel at edge of helipads as trees may fall inwards. Place camps, shelters etc well inside the forest. Minimize flying below tree line. Avoid dry dusty helipads, spray with water or treat/cover otherwise. Housekeeping: no loose light materials near helipad or flight path.
▪ Glare from low or reflected sun: o Can be blinding to Pilot; o May make helipad difficult to locate.	Take into account when positioning helipads and related direction of approach path. Avoid strongly reflecting surfaces near landing locations.

Weather Continued (Exposure)

Hazard Description	Suggested Controls
Helicopter operations may entail (extreme) exposure to: ▪ Cold, hypothermia (affects ability to perform tasks). Impact will be aggravated by wind (chill factor); ▪ Heat (exhaustion, heat stroke); ▪ Sunlight, the reflection of water effectively doubles this exposure (sunburn, eye damage/snow blindness, skin cancer).	Ensure helicopter windows can be adequately closed. Cabin heating when required. Cabin ventilation in hot climate. Sunglasses, UV absorbing window materials etc.

Lightning

Hazard Description	Suggested Controls
Helicopter may be stuck by lightning, presenting risk of: ▪ Instrument failure; ▪ Main or tail rotor failure. Lightning in the open is an extremely dangerous condition. It may strike personnel (usually fatal) or equipment (massive damage). Personnel present on open helipads during a thunderstorm are extremely exposed. Sources of heat (engines, human bodies), ionized (exhaust) gases and radiation (radio antenna's) attract lightning. Lightning strikes may cause electrical or electronic systems to fail. Lightning strikes may cause trees to fall.	Thunderstorm activity monitoring and avoidance during flight. Ground personnel to adhere to lightning precautions, such as: ▪ Take shelter in protective building or vehicle. Do not take shelter underneath trees; find open ground and crouch there or enter deeper in the forest; ▪ Stay away from high, exposed ground; ▪ Switch off radio transmitters; disconnect aerials/antenna, throw away metal objects. ▪ Stop small engines, such as small generators.

Turbulence

Hazard Description	Suggested Controls
Turbulence may occur during hot weather or in unstable clouds. Generally more pronounced near the ground ("low altitude turbulence") and presents possible risks of: ▪ Injury to Pilot or passengers; ▪ Damage to helicopter; ▪ Losing external cargo; ▪ Airsickness	Monitor weather; avoid flying through unstable cloud cover. In hot areas, give preference to flying early in the day. Avoid low altitude flying during hot periods of the day.

Flooding / Water Bodies

Onshore seismic operations around or in water requires extra care and caution. Personnel normally do not like to get their feet wet so they will try to find alternative means of crossing a creek. A stream crossing plan and procedure needs to be implemented if there are creeks and rivers on a program. The use of personal flotation devises must be considered. Water depth and current can change quickly and may be affected by distant weather disturbances.

If water is to be taken from a nearby lake, river stream, etc, it may be necessary to apply for a water use permit. This is jurisdiction dependant.

Hazard Description	Suggested Controls
Flooding may affect helipads near river banks or in low valleys. Risk of: ▪ Standing water making landing impossible; ▪ Soft helipad due to water saturation; ▪ Access to helipad may be blocked.	Position in sheltered water. Locate HP's on dry, high ground. Use logs for pad construction.

Wildlife

Personnel on the program must be informed of issues that may arise from encounters with wildlife. For any animal that possesses a risk to personnel, a plan for managing an encounter needs to be communicated to personnel. Specific training for certain types of animal encounters may be required.

Some species of animals and/or fauna encountered during onshore seismic operations are protected under the Species at Risk Act (SARA) - this is Federal Government legislation.

Hunting Season

Identification of species with open hunting season is required in the program planning stage. If possible, timelines for programs should be adjusted to avoid working on a program in an area where there is an active hunting season. If this is not possible, all personnel on the program must be advised on how to associate with hunters if any are encountered on the program. All personnel must wear high visibility clothing. A procedure must be in place for the program and communicated to personnel working on site.

Hazard Description	Suggested Controls
Birds in flight, risk of collision	Avoid positioning helipads near high concentrations of birds Map out locations with high concentrations of birds and make Pilots aware of these locations. Housekeeping: avoid birds of prey or scavengers being attracted to helipads.

Hazard Description	Suggested Controls
Insects ▪ May affect personnel on the ground, but may also get into the helicopter and present a risk to passengers and Pilots inside.	Common protective measures against insects. Avoid cargo being put on bare ground, use elevated platforms

OPERATIONAL HAZARDS & SUGGESTED CONTROLS

Operating Envelope

Hazard Description	Suggested Controls
All helicopters have limits in terms of: ▪ Range; ▪ Capacity; ▪ Lifting; ▪ Altitude Lifting capacity is function of air density, which in turn is influenced by temperature and altitude.	Determine the safe working envelope of the helicopter. Deploy within safe operating envelope of helicopter. Beware of "improvisation" and unplanned, ill-considered use. Develop Manual of Permitted Operations Develop load tables as function of temperature and altitude

Helicopter Integrity

Hazard Description	Suggested Controls
Mechanical Failure	It is self evident that adequate maintenance and repair are essential. Helicopter maintenance as such etc is a specialist and large subject, not addressed here and normally covered in helicopter manuals etc. However, the following must be noted as provisions that must be considered for land helicopter support operations: ▪ Hangar; ▪ Storage of spare parts, some of which may need air-conditioning; ▪ A frame or other lifting device; ▪ Rolling jack to move helicopter Stock of essential spare parts and supply line of these from manufacturer.
Foreign Object Damage (FOD)	Dirt or loose objects may be sucked into the air inlets of the engines or collide with and damage the rotors or other helicopter parts. To avoid FOD: ▪ Housekeeping around landing areas; ▪ Packaging of certain types of cargo (such as cement bags) in sealed plastic bags or containers.

Helicopter Integrity Continued

Hazard Description	Suggested Controls
Mechanical Failure	It is self evident that adequate maintenance and repair are essential. Helicopter maintenance as such etc is a specialist and large subject, not addressed here and normally covered in helicopter manuals etc. However, the following must be noted as provisions that must be considered for land helicopter support operations: ▪ Hangar; ▪ Storage of spare parts, some of which may need air-conditioning; ▪ A frame or other lifting device; ▪ Rolling jack to move helicopter Stock of essential spare parts and supply line of these from manufacturer.
Collision with obstacles: ▪ Higher ground or obstacles near landing point; ▪ Overhead power lines, antennas; ▪ High buildings; ▪ Terrain; ▪ Other helicopter	Mark high points visibly and/or with stroboscope lights. Position landing points on flat ground, without high obstacles nearby, allowing a safe flight path. Provide map of obstacles, such as power lines and antennas, towers etc. Mark power lines with balls. Flight control, notification/coordination with other Helicopter Operators (crop spraying, recreational and other small helicopter, military helicopter and exercises etc.).

Passenger Transport

Hazard Description	Suggested Controls
Passenger transport risks: ▪ Walking into (tail) rotor ▪ Carrying objects that may damage rotors or helicopter' ▪ Boarding or disembarking at wrong moment; ▪ Incorrect behavior inside helicopter; ▪ Entanglement with skids; ▪ Delivery to wrong location, leading to a need for unplanned, extra flights;	Training of all personnel. Pre-flight briefings. Load masters at heliports and inside helicopter.

Internal Cargo Transport

Hazard Description	Suggested Controls
Cargo transport risks: ▪ Poorly secured loads inside helicopter; ▪ Manual lifting and handling; ▪ Damage to cargo due to incorrect handling; ▪ Delivery to wrong location, leading to a need for unplanned, extra flights.	Training. Load masters at heliports and inside helicopter. Colour coding / labels for destination.
Transport of data recorded requires particular attention. Data, be it on paper or some recording medium can easily be damaged beyond repair through rough handling, extreme temperatures or humidity. Data is not only a very valuable cargo, but if lost, the re-acquisition of the data involves further exposure.	Back up data before transport. Separate shipment (and storage) of original and back up data. Waterproof packaging, preferably in floating containers. Only as internal cargo.

External Cargo Operations (nets, slings etc.)

Hazard Description	Suggested Controls
Slings, nets and baskets or bag catchers are often used for external load operations. Failure of such equipment can result in uncontrolled motion/fall of cargo.	Selection of appropriate equipment, regular inspection, color code and tag to facilitate inspection. Training of personnel and load masters: ▪ Do not stand on ropes,; ▪ Do not attach to body or wrap around body parts; ▪ Do not stand under suspended loads; ▪ Careful handling of equipment and slings, avoiding damaging these; ▪ Take suspect or damaged equipment or slings immediately out of service; ▪ Housekeeping.
Operation of external cargo, entails risk of: ▪ Falling cargo; ▪ Slings may get entangled with rotors; ▪ Overloading;	Training Restrict work to qualified, designated personnel. Avoid flying over populated areas etc. Drop long line ahead of landing pad and keep in full sight of Pilot.

Dangerous Goods

Hazard Description	Suggested Controls
IATA lists a vast number of "Dangerous goods" to which restrictions apply. Typical Dangerous goods encountered in land Geophysical operations:	Follow IATA regulations. Training. Load masters at heliports and inside helicopter. Correct packaging.
Explosives: ▪ Premature detonation, especially if detonators close to high explosives; ▪ Detonators may be triggered by radio waves, electrical fields, static electricity; ▪ Loss of external load of explosives: ○ Risk to 3rd parties ○ Risk to reputation ○ Material must be recovered and this can be difficult.	Select suitable products (non-mass detonating detonators, shock proof high explosives etc.): ▪ Carry separately; ▪ Detonators inside closed Faraday cages. ○ Avoid imposing radio silence; ○ Avoid static build up through: detonators as internal cargo or transport in metal baskets etc. ▪ If transported over water or tidal swamps, consider non floating explosives, which will be easier to recover and will not spread in an uncontrolled manner. ▪ Self destructing/decomposing explosives are also preferred.
Batteries	Consider use of sealed batteries. Place in wooden boxes Ensure batteries are kept upright. Preferably transport as external cargo
Small petrol engines. ▪ These often have fixed petrol tank attached to them, which may contain sufficient petrol to cause risk.	Drain petrol tanks of small engines (generators, chain saws) before transport, especially if carried as internal cargo.
Cement: ▪ Cement dust can cause serious and acute damage to engine and moving parts.	Package in strong plastic bags and avoid puncturing of these
Fuels	Transport as external cargo.

Refueling

The difference in electrical potential between separate materials may cause a spark between them. If flammable gases are present they may explode and cause a fire. A metal circuit must be made between tankers and helicopters being refueled, and the equipment must be grounded.

Hazard Description	Suggested Controls
Refueling operations entail the risk of: ▪ Spills; ▪ Fire and explosion; ▪ Fuel contamination (water); ▪ Fuelling helicopter with contaminated fuel.	Sound procedures. Eliminate all ignition sources, no smoking. Use non-sparking equipment and ground metallic nozzles before use. Ground helicopter or at least provide electrical connection between nozzle and helicopter before refueling starts Use fit for purpose fuel containers, hoses and pumps. Spill containment equipment.

Static Electricity

Static electricity is a hazard associated with helicopter sling loads. During helicopter external loading operations, helicopter support personnel may be subjected to shock from this static electricity. Off-loading or hooking up loads should only be done after a helicopter has been electrically grounded.

The following static discharge practices will help reduce the likelihood of Ground Crew personnel receiving a static electrical shock:

- Use a conductor between the helicopter and the ground to discharge the static charge before attempting a sling or rescue hoist pick-up;
- Delay lowering rescue hoist hook until helicopter is over the load to lessen static charge build up. Allow the hook to touch the ground before being loaded and a load grounded before being unhooked;
    - This procedure also applies if for any reason Ground Crew personnel has to contact the load before it has been lowered to the ground, or after it has been lowered to the ground and prior to carrying out the discharge procedure;
- Use ropes (handling lines) in contact with the ground to assist with the maneuvering of a load into position before load landing;
- Avoid grounding through the cargo itself when explosive or flammable cargos are carried.

Hazard Description	Suggested Controls
Helicopters and external cargo will build up significant static electricity charges. Fuelling into tanks can produce static electricity which may then result in sparks, causing fire or explosion.	Touch down helicopter before boarding/disembarking. Allow external cargo to touch the ground before handling it. Specially designed tank inlets. Grounding of nozzles.

ANNEX C - HAC CLASS D EXTERNAL LOADS TRAINING GUIDELINES

This document outlines industry training guidelines serving as support for Operations Specifications allowing carriage of Class D external loads. Since operational parameters involving Class D loads vary considerably from one operation to another, these guidelines do not purport to be complete nor are they universally applicable. Individual operators remains responsible for tailoring their company policies and training methodology used to achieve these training objectives, to the experience and aptitude of individual Pilots, the type of equipment operated, the prevailing geographical and climatic conditions of the local operational environment and other particulars, proper to each operator and/or the local training environment.

Ground Training: (as applicable)

A. General

- Rescue philosophy and risk assessment techniques;
- Agreements between operator and any emergency response user organizations;
- Crew responsibilities and coordination with ground/rescue crew;
- Mission briefings;
- Rescue planning and contingency plans;
- Helicopter safety briefings specific to Class D loads;
- Dispatch of flights,
- Weather and winds limitations;
- Crew qualifications and certification.

B. Documentation and Performance

- Operations certificate / ops spec.;
- Airworthiness approvals;
- Flight manual and supplements:
  - Limitations;
  - Performance;
  - One engine inoperative;
  - Hover out of ground effect (HOGE);
  - Rate of climb;
  - Height/velocity chart.
- Weight and balance calculations:
  - Most forward, most aft., lateral limits;

- Critical loading, load limitations.

- Helicopter performance safety margins:
  - Power reserves, Weight-Altitude-Temp, Density Altitude;
  - Fuel management;
  - Pre-flight procedures and inspections;
  - Helicopter;
  - Equipment;
  - Crew certification and qualification;
  - Service user training requirements;
  - Minimum crew experience and qualifications

C. Communications

- Intercom and radio checks;
- Portable and hand held radio checks;
- Standard phraseology:
  - Strength and readability;
- Hand signals;
- Emergency communications:
  - Com failure procedures before, during and after rescue ops.

D. Equipment

- Airworthiness approvals;
- Rescue equipment:
  - Weight limitations;
  - Loading, weight &balance;
  - Emergency exit access;
  - Essential equipment only;
  - Extended stay equipment;
  - Equipment to deal with alternate extraction (e.g. skis, toboggan).

- Personal Protective Equipment:
  - Helmets with communication wiring;
  - Gloves, goggles, boots;
- Vertical reference doors and windows;
- Mirrors;
- Ropes, lanyards, swivel, weight;
- Bavarian rescue seat, Bauman bag, Billy Pugh net, climbing harnesses;
- Hoists and cable cutters;
- Hooks and hook release

E. Normal Rescue Procedures

- Reconnaissance of staging area and rescue site:
  - Obstacles, minimum clearances horizontal and vertical;
  - Wind speed and direction;
  - Approach and departure path;
  - Debris;
  - Size;
  - Ground access and departure;
  - Bystander control.
- Power check, power and fuel reserves
- Equipment and personnel deployment;
- Toe-in, I.G.E./O.G.E. hover exit;
- Order of drop at rescue site;
- Equipment set up;
- Rescuer and patient pick up;
- Vertical vs. horizontal reference;
- Flight limitations (e.g. airspeed, hook weight, min and max hover height);
- Load spin control

- V.N.E.;
- Rescuer and patient drop off;
- Sloping terrain;
- Snow covered terrain;
- Glacier ops;
- Avalanche debris;
- Toe-in landings;
- Static discharge;
- Untrained personnel i.e. Police, Medical

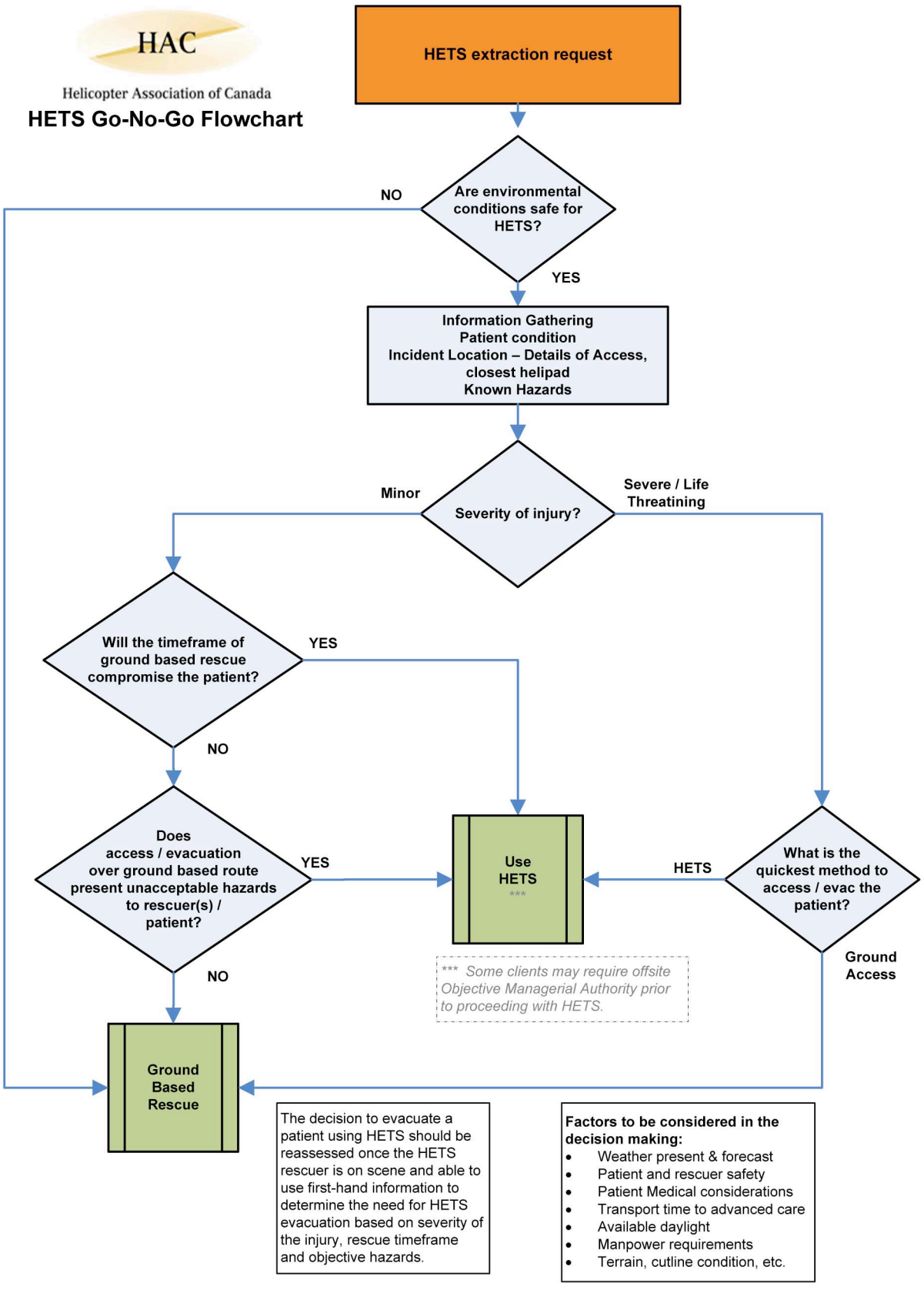
F. Emergency Procedures

- Conditions to continue, suspend or terminate operations;
- Standard communications and notification of emergencies and malfunctions;
- Equipment and load jettisoning;
- Communications failure - hand signals;
- Line snag;
- Skygenie, rope, fittings and other equipment failures;
- Hoist / hook failures;
- Malfunctions - chip lights – hydraulics;
- Emergencies - engine failures - emergency descents

Flight Training: (as applicable)

- Duration of initial and recurrent flight training shall be subject to candidates reaching acceptable levels of competency;
- Equipment Setup and function checks:
  - Hook release normal and emergency.
- Crew co-ordination;
  - Communications / information flow;
  - Hand signals

- Power Checks;
- Hover exit, toe-in;
- Vertical and standard reference ops;
- Main and Tail Rotor clearances;
- Altitude control, min and max hover height (rope length), Yaw control;
- Pick-up, departure, approach and delivery of Class D loads;
- Simulated emergencies appropriate to type
    - Load jettisoning;
    - No live loads during emergency procedures training;
    - i.e. hydraulics failure, engine fail
- Service user training requirements
    - i.e. reference to Parks Canada, Alberta Environment, A.R.A. training.


HAC
Helicopter Association of Canada
HETS Go-No-Go Flowchart
HETS extraction request
Are environmental conditions safe for HETS?
NO
YES
Information Gathering
Patient condition
Incident Location – Details of Access, closest helipad
Known Hazards
Severity of injury?
Minor
Severe / Life Threatining
Will the timeframe of ground based rescue compromise the patient?
YES
NO
Does access / evacuation over ground based route present unacceptable hazards to rescuer(s) / patient?
YES
NO
Use HETS
***
What is the quickest method to access / evac the patient?
HETS
Ground Access
*** Some clients may require offsite Objective Managerial Authority prior to proceeding with HETS.
Ground Based Rescue
The decision to evacuate a patient using HETS should be reassessed once the HETS rescuer is on scene and able to use first-hand information to determine the need for HETS evacuation based on severity of the injury, rescue timeframe and objective hazards.
Factors to be considered in the decision making:
Weather present & forecast
Patient and rescuer safety
Patient Medical considerations
Transport time to advanced care
Available daylight
Manpower requirements
Terrain, cutline condition, etc.
Revision 1 - Oct 2, 2009

ANNEX D - HAC MOUNTAIN FLYING TRAINING GUIDELINES

The following are HAC recommended guidelines for Mountain Flying Training. Since operational parameters of mountain flying vary considerably from one operation to another, these guidelines do not purport to be complete nor are they universally applicable.

Individual Helicopter Operators are responsible for:

- Tailoring their company policies and training methodology used to achieve these training objectives;
- The experience and aptitude of individual Pilots;
- The type of equipment operated;
- The prevailing geographical and climatic conditions of the local operational environment and other particulars, proper to each Helicopter Operator and/or the local training environment.

The ensuing training program may be incorporated into the Helicopter Operators operations manual. To facilitate field verification of Pilot competency, the chief Pilot or their delegate, may wish to certify initial and recurrent Mountain Flying Training in the Pilot's log book.

Mountain Flying Initial Training Criteria

Ground School should address:

- Topography and formations;
- Weather and wind;
- Density altitude vs helicopter performance**;**
- Reconnaissance, approach and departure techniques (side hill pads, mountain top sites and operations from ridges)**;**
- Hazards and illusions
- Physiological and psychological factors

Flying training should assure competency in:*

- Emergency procedures;
- Precision handling techniques;
- Confined area operations;
- Illusion recognition techniques;
- Reconnaissance, approach and departure techniques (side hill pads, mountain top sites and operations from ridges);
- Slinging operations;

- Wind effects;
- Snow operations;
- Contour flying;
- Density altitude vs helicopter performance;
- Hazards and illusions;
- Physiological and psychological factors

Mountain Flying Recurrent Training Criteria

Recurrent Ground School should review:

- Density altitude vs helicopter performance**;**
- Reconnaissance, approach and departure techniques (side hill pads, mountain top sites and operations from ridges)**;**
- Hazards and illusions**;**
- Physiological and psychological factors.

Recurrent flying training should assure continued competency in:

- Emergency procedures;
- Confined area operations;
- Reconnaissance, approach and departure techniques (side hill pads, mountain top sites, and operations from ridges).

** HAC opposes the imposition an arbitrary minimum number of hours to be flown in the process of reaching a specific standard of competency. However, certain customers insist on such arbitrary constraints: for example, the British Columbia Government Forest Service requires a minimum of 20 hours initial Mountain Flying Training.*

ANNEX E – FATIGUE MANAGEMENT PROGRAMS

As per Transport Canada:
http://www.tc.gc.ca/civilaviation/managementservices/referencecentre/documents/sur/pdf/sur-007e.pdf

A documented plan should be implemented for a Fatigue Management Plan (FMP) by the Helicopter Operator. Due to the nature of land seismic and heli-rig flying, specifically heli-portable operations, Pilot workload is high. To adequately address fatigue issues of repetitive lifting operations and multiple landings, it is important that all operators identify areas where crew may need additional guidance to insure adequate rest and thus mitigate against acute and chronic fatigue arising from these types of activities.

A fatigue management plan will help to address these concerns as they relate to the operators specific Pilots and engineers. The operator will identify areas where controls need to be implemented or a variance granted to better suit a particular program, or geographic area, thus allowing greater operational flexibility while still maintaining safety sensitive issues that arise from flight duty/workload and their effects on fatigue. It should be submitted to the Aviation Advisors during operational planning. This plan should include all air crew (both Pilots and engineers) and any safety sensitive support crews (fuel truck drivers, loadmasters, etc.)

Fatigue can be defined as increasing difficulty in performing physical or mental activities. Signs of fatigue include tiredness even after sleep, psychological disturbances, loss of energy and inability to concentrate. Fatigue can lead to incidents because Pilots and engineers may not be alert and may be less able to respond to changing circumstances. As well as these immediate problems, fatigue can lead to long term health problems.

Acute fatigue is caused by immediate episodes of sleep deprivation, i.e. because of long periods of wakefulness from excessively long shifts which can compound into chronic fatigue (daily, weekly, monthly and in extreme cases annually) without adequate daytime rest.

Ongoing sleep disruption can lead to sleep debt and chronic sleep deprivation, placing individuals in a state of increased risk to themselves, their passengers and the general public. It results in:

- Unpleasant muscular weariness;
- Tiredness in everyday activities; and
- Reduced coordination and alertness.

If sleep deprivation continues, work performance can deteriorate even further (Chronic fatigue). As a number of helicopter accidents are directly related to human performance issues, establishing an effective fatigue management plan should be a priority.

Causes of fatigue can result from features of the work and workplace and from features of a Pilots/engineers life outside work. Levels of work-related fatigue are similar for different individuals performing the same tasks. Work-related fatigue can and should be measured and managed at an organizational level. Non-work related causes vary considerably between individuals. Nonworking related fatigue is best managed at an individual level. This is where training and education programs should be considered by the Helicopter Operator to further allow personnel to recognize individual symptoms and areas that may contribute to either acute or chronic fatigue outside the work place.

Fatigue management programs should aim to achieve the following:

- Reduce fatigue and improve the on-duty alertness of Pilots, engineers and other safety sensitive positions;
- Reflect the nature of the operations conducted by the company including anticipated and existing conditions.

ANNEX E – FATIGUE MANAGEMENT PROGRAMS

Program Development - Primary Steps

Create a Fatigue Management development committee, which should include Pilots/engineers and management. Helicopter Operators should ensure that Pilots and engineers are consulted in the development and implementation of fatigue management programs, including the making of changes to such programs.

The Fatigue Management Plan should address the following:

- The time of day that work takes place;
- Stress;
- Circadian rhythms;
- Sleep debt;
- Corporate culture;
- Job requirements;
- PPE or lack of (adequate hearing protection, comfortable seating, etc.);
- Exposure;
- Individual Health;
- Nutrition;
- Hydration;
- Life style choices;
- Physical and mental activity;
- The length of time spent at work and in work related duties;
- The type and duration of a work task and the environment in which it is performed (long line operations require intense levels of concentration for short periods of time);
- The quantity and quality of rest obtained prior to and after a work period;
- Activities outside of work, such as second jobs and family commitments and life style;
- Individual factors such as sleeping disorders.

Define program objectives.

Conduct a needs assessment.

ANNEX E – FATIGUE MANAGEMENT PROGRAMS

Program Development - Core Components

Pre approve tentative schedules to meet operational, environmental, and travel considerations.

Provide core training as outlined above to all personnel involved or affected by these types of operations.

Include a fatigue component in incident investigation procedures

Program Development - Company Specific Component

Build a program outline that reflects the above initiatives that are within the control of the Helicopter Operator its clients and contractors.

Implement controls and counter measures to control identified fatigue risk factors that would be under the control of the Helicopter Operator, its clients and contractors.

Implement Fatigue Management Program.

In consultation with the client Aviation Advisor and Helicopter Operator.

Evaluate Fatigue management Program.

Plan should be routinely evaluated against current operational needs, personnel changes, environmental changes, or significant changes in normal operations.

Fatigue management Helicopter Operator training programs should consider, but not be limited to, the following:

- The risks associated with this particular form of flying;
- Pilot/Engineer work scheduling practices, including relief arrangements to cover absences;
- Training specific to sleep and its effect on fatigue including nutrition, lifestyle choices, etc.;
- On-the-job alertness strategies;
- Rest environments provided by the employer (i.e. sleeping facilities);
- Work environments, (environmental conditions hot and high, heat, or excessive cold and effects on performance in the cockpit or maintenance facility or lack thereof);
- Working under unusual, unpredictable or emergency operating conditions. Working outside of normal flight regimes, operational pressures i.e. weather, environmental constraints, client pressures etc.

The FMP should include the above as minimum initiatives throughout the plan. It should combine and utilize appropriate scheduling of crews as well as implementation of fatigue reducing factors such as job site climate controlled rest facilities, adequately equipped helicopter that enhance Pilot comfort and reduce workload to mitigate the associated risks of fatigue.

GLOSSARY

6-S PROCEDURE

Features of landing area: Size, Shape, Surrounds, Surface, Slope, Sun and Stinger-placement.

AVIATION ADVISOR

Person who acts on the Prime Contractor's behalf to improve aviation safety.

BAG RUNNER

Person who attaches a seismic bag to a remote hook or carousel when the equipment is being retrieved.

BEAR PAWS

Additional equipment attached to the rear area of the helicopter landing skids. Bear Paws help prevent these skids from sinking into the ground.

BROWNOUT

Environmental conditions where airborne (usually from rotor wash) dust/debris prevents the Pilot from seeing the ground clearly.

CAROUSEL

Device that attaches to the bottom of a long line that contains multiple remote hooks; each hook can be controlled independently by the Pilot.

CLASS D

Type of external-load operations where living humans are carried.

CLIENT

The Client on a seismic program is the Prime Contractor unless that responsibility has been specifically assigned to another party **by written agreement** and has taken steps to ensure that the party is capable of fulfilling all the duties and responsibilities required of a Prime Contractor. When a program has more than one Client, the Client who is assigned as the operator has the responsibility of Prime Contractor. Generally this is the licensee of the program.

CONFINED AREA OPERATIONS

Type of landing area where the Pilot must avoid obstacles during the landing process.

COORDINATOR

The coordinator is responsible for the management of resources in staging, the equipment plan on the program, and the flight plans for the helicopter. Coordinators assist the observer and party manager in writing the daily operations plan.

The coordinator is also the assigned flight controller for the helicopter. As flight controller, the coordinator directs helicopter missions and controls the movement of equipment and personnel around the program. On small programs one of the observers may assume these responsibilities.

CREW RESOURCE MANAGEMENT

Process of utilizing multiple people to operate the helicopter safely and efficiently.

DAY VISUAL FLIGHT REGULATIONS (VFR)

Environmental conditions with sufficient daylight and visibility to use visual reference for safe flight; see Transport Canada's Airman's Information Manual section GEN 1.6 for definition of Day (generally 30 minutes before sunrise to 30 min after sunset); see Transport Canada's Airman's Information Manual RAC 2.7.3 for VFR weather minima.

DENSITY ALTITUDE

Altitude above sea level which takes into consideration the effects of temperature and ambient pressure on true altitude.

DROP ZONE

A cleared or open area where the equipment (e.g. drill, compressor, seismic bag) is placed by the helicopter.

DUTY DAY

Period from when a Pilot first begins daily flight duties (may include travel) to when the last duties are complete.

ESSENTIAL CREW

Pilots, AME's, qualified flight navigators and cabin attendants who are required by local regulation or Helicopter Operator.

FINAL APPROACH AND TAKEOFF

Area surrounding a takeoff or landing point that usually includes air space around flight paths for final approach and takeoff phases of flight.

FIRST LIMIT INDICATOR

A device to show when a first, among several possible, helicopter limitation is reached.

FLIGHT SIMULATOR / FLIGHT TRAINING DEVICES

Ground based device that utilizes computer simulation for training Pilots outside actual helicopter flying, classified according to different levels of fidelity.

GROUND EFFECT

Term to describe the improved performance of a helicopter when it hovers close to the ground.

HAZARD MAP

A tool to be utilized and continually updated over the duration of a seismic program. The purpose of a Hazard Map is to give a visual reference identifying all program related hazards, as well as the hazard location on the program. Minimum information required on a Hazard Map:

- Approved LZ locations, both natural clearings and cut locations;
- LZ numbering system with pad identifier (including latitude and longitude reference) for all approved LZ locations;
- Location of base camp and staging areas if applicable;
- Location of Muster Areas;
- Location of STARS registered heli-pad (including latitude and longitude reference);
- Access roads;
- All identified and registered hazards;
- Terrain Assessments;
- Creek/Water Crossings.

HELICOPTER OPERATOR

The corporate entity who holds an air operator certificate issued under Part VII of CARs. The Helicopter Operator is responsible for all helicopter operations within the scope of the service contract.

HOSTILE ENVIRONMENT

The ICAO defines a Hostile Environment as an environment in which:

- A safe forced landing cannot be accomplished because the surface is inadequate (Inadequate surface would include moderate & steep slopes and Trees); or
- The helicopter occupants cannot be adequately protected from the elements; or
- Search and rescue response capability is not provided consistent with anticipated exposure; or
- There is an unacceptable risk of endangering persons or property on the ground.

HOVER EXIT

Event when passengers get on or off the helicopter while it is hovering.

HOVER OUT OF GROUND EFFECT (HOGE) PERFORMANCE:

In calculating HOGE or OEI, planned performance should be based on zero wind conditions, ambient temperature, based on the seasonal average for the area, and density altitude for the lowest level – mid Level- and highest level of the intended job sites. Account should be taken of the additional power required to transition to forward flight over and above that required to hover OGE.

INSTRUMENT METEOROLOGICAL CONDITIONS

Environmental conditions without visibility. To use visual reference for safe flight; see Transport Canada's Airman's Information Manual RAC 2.7.3 for VFR weather minima- Instrument Flight conditions are less than VFR minima.

LINE ORIENTED FLIGHT TRAINING (LOFT)

Flight training while the helicopter is working, similar to on-the-job-training.

LONG LINE

Line or cable, usually 30-70m in length, used to connect the helicopter to the external load.

MANAGEMENT OF CHANGE

Systematic process of anticipating and mitigating risk caused by a change in operations.

NON-HOSTILE ENVIRONMENT

An environment in which a successful emergency landing can be reasonably assured, the occupants of the helicopter can be adequately protected from the elements, and search and rescue response/capability can be provided consistent with the anticipated exposure.

ONSHORE SEISMIC OPERATIONS

The measurement or investigation, by indirect methods, of the subsurface of the earth for the purpose of locating oil, gas or minerals or of determining the nature of the subsurface conditions and includes activities related to scouting, field tests of energy sources, calibration of instruments, cable ballasting, surveying, line clearing and preparation, drilling, blasting, operating vibrator equipment, recording results and clean-up or reclamation of the site.

PILOT COMPETENCY CHECK (PCC)

Flight and ground exam by Helicopter Operator employee to ensure candidate performs to standards defined by Helicopter Operator.

PILOT IN COMMAND (PIC)

The Pilot responsible for the safe operation of the helicopter, also known as the Helicopter Commander.

PILOT PROFICIENCY CHECK (PPC)

Flight and ground exam by Transport Canada employee, or person representing Transport Canada to ensure candidate performs to standards defined by Transport Canada.

PRIME CONTRACTOR

When more than one employer is working at the same job site, one party must have overall responsibility for health, safety and coordination of all onsite employers to carry out the planned work.

The Prime Contractor is responsible for ensuring that the Occupational Health and Safety Act and Regulations are complied with at the job site. In most situations, the Prime Contractor will meet these responsibilities through the development of a safety management system that will ensure compliance from all contractors and sub-contractors onsite.

Typically the Client is the Prime Contractor unless that responsibility has been assigned to another capable party **in writing.**

RECORDING CREW MANAGER (RCM)

Person in charge of the Seismic Recording Crew, also known as the Party Manager.

SAFE FORCED LANDING

According to the ICAO - an unavoidable landing or ditching with a reasonable expectancy of no injury to persons in the helicopter or on the surface.

SEISMIC CONTRACTOR

The corporate entity who has entered into an agreement with the Client to conduct the onshore seismic operations (typically a Data Acquisition company) within the scope of the service contract.

SEISMIC FIELD OPERATIONS SUPERVISOR (SFOS)

Any person assigned to direct and/or instruct, or has influence over, personnel engaged in a seismic exploration program, or one or more program phases. The SFOS is accountable for the performance and progress of work within the scope of their assigned authority and responsibilities. Responsibilities for a given supervisor will vary depending on the nature of the program, the scope of assigned duties or the supervisors experience level.

TEST LOAD

A load which gets the helicopter within 20% of the Max Hover Out of Ground Effect (HOGE).

TOE-IN

Event when passengers get on or off the helicopter, while the helicopter operates at hover power, and only parts of the skids are in contact with the landing area.

TRANSLATIONAL LIFT

Increased (compared to slower flight) lift caused by the helicopter flying through the air; this can be caused by strong wind when the helicopter is hovering.

TYPE 10 MAGAZINE (FLY MAG)

Magazines built to this standard are authorized for special applications such as heliportable magazines for onshore seismic operations. They are used in isolated areas and are suitable for short term storage of either blasting explosives and detonating cords, or detonators.

Maximum quantities that may be stored in a Type 10 magazine shall not exceed 25kg (one case) of blasting explosives and 600m of detonating cord (two spools), or one case of detonators as packaged by the manufacturer and approved by the competent authority or 100 detonators, whichever is less.

When not in use as a magazine, Type 10 magazines may be used as transportation containers or as day boxes providing the use of day boxes for industrial explosives falls under provincial jurisdiction.

Type 10 magazines when, airlifted to remote regions, must be secured by means of a hardened steel chain or substantial wire cable with a high-security padlock.

VERTICAL REFERENCE

Method for a Pilot to be oriented while looking down and not seeing a horizontal reference. Commonly used when using a long line to move people and material.

WHITEOUT

Environmental conditions where airborne (usually from rotor wash) snow/ice prevents the Pilot from seeing the ground clearly; also a condition where snow/ice on the ground blending with overcast weather causes the Pilot to lose reference with the ground and, consequently, situational awareness.

ACRONYMS

AFF	Automatic Flight Following
AGL	Above Ground Level
AME	Aircraft Maintenance Engineer
APU	Auxiliary Power Unit
ASL	Above Sea Level
ATC	Air Traffic Control
CAGC	Canadian Association of Geophysical Contractors
CAPP	Canadian Association of Petroleum Producers
CARs	Canadian Aviation Regulations
CFIT	Controlled Flight Into Terrain
CRM	Crew Resource Management
CSA	Canadian Standards Association
DME	Distance Measuring Equipment
DZ	Drop Zone
ELT	Emergency Locator Transmitter
EPIRB	Emergency Position Indicating Radio Beacon
EVMS	Engine Vibration Monitoring System
FATO	Final Approach and Take-Off
FMP	Fatigue Management Plan
FOD	Foreign Object Damage
FTD	Flight Training Device
GPS	Global Positioning System
HAC	Helicopter Association of Canada
HAZMAT	Hazardous Material(s)
HETS	Helicopter External Transport System
HOGE	Hover Out of Ground Effect
HUMS	Health and Usage Monitoring System

ACRONYMS

IATA	International Air Transport Association
ICAO	International Civilian Aviation Organization
IHST	International Helicopter Safety Team
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
JAA	Joint Aviation Authorities
LOFT	Line Oriented Flight Training
LZ	Landing Zone
MDS	Minimum Departure Standard
MEL	Minimum Equipment List
MOC	Management of Change
MOU	Memorandum of Understanding
NAVAID	Navigation Aid
NDB	Non-Directional Beacon
OAT	Outside Air Temperature
OEI	One Engine Inoperative
OGC	Oil and Gas Committee
OGP	International Association of Oil and Gas Producers
OSR	Onsite Representative
PASS	Pull. Aim. Squeeze. Sweep.
PCC	Pilot Competency Check
PDM	Pilot Decision Making
PIC	Pilot in Command
PPC	Pilot Proficiency Check
PPE	Personal Protective Equipment
QA	Quality Assurance
RCM	Recording Crew Manager

ACRONYMS

RFM	Rotorcraft Flight Manual
SAR	Search and Rescue
SARP	Standards and Recommended Practices
SARSAT	Search and rescue Satellite-Aided Tracking
SMS	Safety Management System(s)
SOP	Standard Operating Procedure
UV	Ultra Violet
VFR	Visual Flight Regulations
VHF	Very High Frequency
VNE	Never Exceed Speed
VOR	Very High Frequency Omni-directional Range