An intermediate level program in the use of helicopters designed for the search and rescue mountaineer who has some experience with helicopters. This program assumes that each student has a detailed understanding of the "Incident Command System" (ICS)
About the Author

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The author of the Mountain Rescue Association’s Helicopters in Mountain Rescue Operations manual and co-author of the Avalanche Rescue Operations manual, Charley has consulted rescuers, mountain guides and climbers throughout the world, from Kazakhstan to Sweden, from Kilimanjaro to Aconcogua. Charley is a frequent speaker at meetings of the Wilderness Medical Society, the Mountain Rescue Association, and the International American Technical Rescue Symposium.
The Mountain Rescue Association (MRA), a volunteer organization dedicated to saving lives through rescue and mountain safety education, has developed this intermediate level “Helicopters in Search and Rescue Operations” program. Although these materials are valuable for individuals, they are largely developed for search and rescue teams. For this reason, this program includes trainers’ materials for rescue team leaders to use when developing team training programs. These additional audio-visual materials are available from the MRA’s Small Stores.

This program is designed for the search and rescue mountaineer who has had little or no experience with helicopters. It is an introductory program, although it is strongly recommended that rescue teams and individual rescue mountaineers review this material frequently.

This program assumes that each student has a cursory understanding of the "Incident Command System (ICS)." For more information on ICS, go to the Federal Emergency Management Agency’s (FEMA) web site, www.fema.gov. Specific information for a self-study course can be found at http://www.fema.gov/emi/is195.htm

At the conclusion of this program, students should be able to:

- Understand basic helicopter design, capabilities and specifications, as well as principles of flight;
- Understand helicopter and heliport management, and;
- Understand helicopter safety precautions and techniques.
This program would not have been possible without the kind assistance of the National Interagency Fire Center as well as a host of helicopter pilots and professionals. Our thanks to all whom offered assistance.

Introduction

As a search and reconnaissance platform coupled with rescue and extrication capabilities, the helicopter is unparalleled in its versatility for emergency and disaster response. Yet, its safety is in direct proportion to the knowledge and skill level of those individuals who manage the helicopter operations in a search or rescue situation. Furthermore, since helicopters can be extremely dangerous, the mission's management must assure safety training of ground personnel. With rotors turning at over 150 M.P.H., the hazard to searchers is very real. In addition, the threat of a helicopter crash poses another danger.

Still, rescue teams must be prepared for the "mass disaster accident" which results in the need for quick mobilization of large-scale rotary wing operations. Imagine a 747 crash in a remote mountain area that results in numerous survivors. While we may assume the chance of survivors is remote, a similar crash in Japan in the early 1980's resulted in over 100 passengers surviving a DC-10 vs. mountain accident. In this case, the rescue team's ability to quickly manage large-scale air operations may be critical to the success of the mission. Certainly other qualified aircraft would be available to assist, however their response time dictates that the initial rescue team members must have a working knowledge of helicopters and the various factors which influence their effective utilization; such as mobilization of air resources and establishment of a heliport. For this reason, large-scale air operations, and the management thereof, are described within this training material.

This Intermediate Level Helicopter Safety program is designed to familiarize the student with helicopter operations in search and rescue (SAR) beyond the standard helicopter safety issues. It is assumed that the student has participated in a basic helicopter safety program. Furthermore, the student should be familiar with the Incident Command System (ICS), although an ICS course is not necessarily a requirement.
Helicopter Management and Safety

Throughout this program, "helicopter management" shall be defined as "the direction, scheduling, coordination and control of helicopter use in accordance with agency policies to ensure maximum efficiency as well as safety in all aspects of the search or rescue operation." The degree of efficiency of a helicopter program depends on the Heliport Managers and key overhead being trained, qualified and having a working knowledge of helicopter safety and operations. A working knowledge of the Incident Command System and its hierarchy is also necessary.

For large-scale air operations within the Incident Command System, the Heliport Manager manages the Heliport. The Heliport Manager reports to the Air Operations Director, who is also responsible for any fixed wing operations. The Air Operations Director reports to the Operations Chief who, in turn, reports to the Incident Commander.

For smaller search and rescue operations in which a very informal, scaled-down Incident Command System is used, the Incident Commander may be responsible for most aspects of the decision-making process with regard to air operations. In so doing, the Incident Commander must take responsibility for air safety concerns. He or she must see that all safety issues are addressed.
Classification of Helicopters - Incident Command System

The Incident Command System has four classifications of helicopters, which loosely correspond to the "Light," "Medium," and "Heavy" classifications used in the past.

- A Type I helicopter seats at least 16 people and has a minimum capacity of 5,000 lbs. Both a CH-47 (Chinook) and UH-60 (Blackhawk) are Type I helicopters.
- A Type II helicopter seats at least 10 people and has a minimum capacity of 2,500 lbs. Both an UH1-H and a Bell 212 are Type II helicopters.
- A Type III helicopter seats at least 5 people and has a minimum capacity of 1,200 lbs. Both a 206 and a Hughes 500 are Type III helicopters.
- A Type IV helicopter seats at least 3 people and has a minimum capacity of 600 lbs.

Calling for Helicopters

Since risks are inherent in the utilization of rotary wing aircraft, SAR teams must consider several important factors when determining whether or not to call out these resources. First, the urgency of the mission must be a consideration. Is the use of a helicopter going to improve the victim's condition? If ground teams could transport the victim without worsening any injury, does the benefit outweigh the risk of utilizing a helicopter? Will the use of a helicopter reduce the risk to SAR personnel by limiting the duration of the overall mission?
Second, weather, altitude, terrain and daylight conditions must be considered. Since "ideal flying conditions" vary from helicopter to helicopter, rescue team leadership must be aware of the limitations of any helicopter when calling for these expensive resources.

Third, we must consider the skills of the pilot. Many search and rescue teams have the good fortune of working frequently with the same pilots, such as local television station pilots or trauma center med-evac pilots. In so doing, these SAR teams develop a sense of history of that pilot's abilities in SAR activities and should consider this history when calling for helicopters.

Finally, SAR teams must consider the nature of the task for which the helicopter is to be requested. If, for example, a helicopter is requested to perform spotting during a search operation in fair weather, then the risks may be low. On the other hand, a hoist or suspending line with a live rescuer suspended from the chopper increases the risk exponentially. In the event of any helicopter performance problems, the pilot will often drop the external load to improve the performance of the chopper and save the lives of the others on board.

As much as search and rescue team members must have the physical skills to perform their field duties, the team's leadership must have the wisdom to know when the risks of helicopter use outweigh the benefits. When conditions are not appropriate for flying, only the best Incident Commander will have the courage to choose not to call for the helicopter.

Air Force Rescue Coordination Center (AFRCC)

Civilian SAR teams are fortunate to have at their disposal a multitude of helicopter resources through the United States armed forces. The Air Force Rescue Coordination Center, currently located at Langley Air Force Base in Virginia.

The following was taken from the AFRCC web site: In 1956, the National Search and Rescue Plan was published, establishing a crucial link between military resources and their unique recovery capabilities, and the civilian sector chartered to respond to those in need. This plan established the United States Air Force as the executive agent for inland search and rescue, covering the continental United States, less the major navigable waterways. To provide coordination to meet the growing demand for search and rescue, in 1947 the Air Force established three Rescue Coordination Centers, at Hamilton Air Force Base, California, Lowry Air Force Base, Colorado, and MacDill Air Force Base, Florida.

In 1974, as a result of improved technology and communications capabilities, these three Rescue Coordination Centers were consolidated into the Air Force Rescue Coordination Center at Scott Air Force Base, Illinois. While at Scott, the Air Force Rescue Coordination Center came under the control of several different commands: Military Airlift Command, Twenty-Third Air Force, Aerospace Rescue and Recovery Service, and Air Rescue Service. As budget cuts and agency reorganizations continued in the military, the Air Force Rescue Coordination Center was eventually relocated to Langley Air Force Base, Virginia in 1993, and was aligned under the newly organized Air Combat Command.

Despite military restructuring, the peacetime mission has remained unchanged and vital from 1974 to current day. As of August 2001, over 56,450 search and rescue missions have been performed, resulting in over 12,830 lives saved.
The AFRCC mission is “Continuously building a coordinated search and rescue network ensuring timely, effective lifesaving operations whenever and wherever needed.”

Specific Helicopters by Type

Rescue Helicopters

A "rescue helicopter" is defined as a rotary wing aircraft capable of high altitude, warm weather, and out-of-ground effect (OGE) hovers. The aircraft must be capable of landings in rugged terrain using small unimproved helispots. A rescue helicopter would be used to perform rescue operations, possibly at high altitude. The following are some examples of rescue helicopters:

- Aerospatiale Alouette III SA-317B
- Aerospatiale Twin Star AS 355 F1
- Lama SA315
- Boeing Vertol Chinook CH47 C, D or E
- Jolly Green Giant
- Bell 212
- Bell 205 (UH-1H, B, M) - Single-engine Huey
- Bell 412 (UH-1N) - Twin engine Huey
- Bell 214 ST
- Bell 414 ST
- BK 117
- BK 105

Transport Helicopters

A "transport helicopter" is defined as one that is capable of transporting up to 6 search and rescue personnel, including their gear. The aircraft must be capable of high altitude, warm weather flying. A "transport helicopter" must also be capable of landings in moderate terrain using medium- to large-sized improved helispots. A transport helicopter, therefore, is used to transport search and rescue teams to the field in situations where ground transport would be impractical or too time-consuming. The following are some examples of transport helicopters:

- Boeing Vertol Chinook CH47 C, D or E
Not surprisingly, these examples correspond to the three most common helicopters dispatched by the Army when they assist in civilian search and rescue operations.

**Observation Helicopters**

An "observation helicopter" is defined as one with limited seating with limited tactical capabilities at altitudes on hot days. SAR teams during search operations would use an observation helicopter. Examples of observation helicopters include:

- Aerospatiale Alouette III SA-317B
- Aerospatiale A-Star AS 350
- Aerospatiale Twin Star AS 355
- Bell 47 Soloy
- Bell 206-L2
- Bell 206-L3
- Bell 206 III
- Hiller 12E Soloy
- Hughes 500C, D or E
- McDonald Douglas 500D or E

**Med-Evac Helicopters**

A "Med-Evac helicopter" is defined as one that is capable of transporting med-evac personnel as well as at least one supine patient. The aircraft must be capable of high altitude, warm weather flying as well as landings in moderate terrain using small- to medium-sized improved helispots. The following are some examples of med-evac helicopters:

- Aerospatiale Alouette III SA-317B
- Aerospatiale A-Star AS 350
- Aerospatiale Twin Star AS 355
- Bell 205 (UH-1) Huey
- Bell 206 B III
- Bell 206 L-1
- Bell 206 L-3
- Bell 222 UT
- BK-105
- BK-117
- Hughes C, D or E
- McDonald Douglas 500 E
- McDonald Douglas 531 SP
Advanced Helicopter Limitations

Height-Velocity Chart

Each helicopter flight manual contains a "Height-Velocity" chart, which indicates speeds and altitudes to be maintained so that a safe autorotation may be made in the event of a mechanical or electrical failure. At speed/altitude combinations below the curve in the "caution" areas of the chart, the helicopter would be difficult to safely autorotate. For this reason, the Height-Velocity Chart has been given the nickname "Dead-Man's Curve."

Density Altitude

A large number of search and rescue operations requiring helicopters occur at times of high temperature, high humidity, and at high elevations (subsequently low air pressure). Unfortunately, each of these three variables negatively affects the performance of a helicopter.

Density altitude, which is the effect on aircraft by these three variables (temperature, humidity and air pressure), is an important issue that must be considered by the team's leadership. A helicopter cannot work as effectively at higher altitudes as it can at sea level. The effect of increased temperature would be similar to increasing the elevation to which the chopper must now fly. On a hot day, the density altitude at a particular location may be 2,000 or even 3,000 feet higher than the elevation of that location. Increased humidity has an affect, albeit a minor one, on density altitude as well.

In technical terms, therefore, "density altitude" is pressure altitude corrected for temperature and humidity. All three factors (air pressure, temperature and humidity) affect the density altitude in varying degrees. The higher the density altitude, the weaker the helicopter performance. High elevation (e.g. reduced pressure), high temperature and high humidity all contribute to higher density altitudes. Performance is reduced because the thinner air at high-density altitudes reduces blade efficiency. This, in turn, requires additional pitch and power to maintain the same lift capability. The greater pitch angle results in increased drag that
requires additional power. Un-supercharged piston engines and turbines also operate less efficiently in this less dense air.

A high-density altitude can result in loss of engine power, reduced lift and reduced payloads. This would mean that the helicopter would require longer takeoff and landing rolls and would experience a decreased rate of climb. Of the three variables listed above, humidity plays a very minor role in determining density altitude.

Density altitude is one reason why helicopter pilots may prefer to fly in the early morning hours. It also explains why a pilot, whose chopper is full of fuel, may wish to fly with only one passenger at a time. Most importantly, density altitude is the entire reason why consideration of the need for helicopters during search and rescue missions should be made early in the day, since flying conditions may be less than ideal during the afternoon hours.

**Loss of Tail Rotor Effectiveness**

The pilot controls the helicopter's tail rotor with pedals operated by his/her feet. When the anti-torque provided by the tail rotor is insufficient to counteract the torque of the main rotor, the ship experiences the condition called "loss of tail rotor effectiveness." The helicopter will begin a spin, albeit potentially a slow one. This is a dangerous condition. It is more common in situations of high altitude, high temperature and/or heavy loads.

**Helicopter Loading**

**Center of-Gravity Effects**

Consideration of center-of-gravity (CG) limitations is important in the loading of all aircraft, but is particularly important and critical in helicopters. In fixed-wing aircraft, the load is balanced over a horizontal wing area and has a comparatively wide range. In a helicopter, however, it is carried under a single point, like a pendulum. Therefore, very little "out of CG" loading can greatly affect the controllability of the helicopter.

<table>
<thead>
<tr>
<th>Center of Gravity</th>
<th>Normal</th>
<th>Excessive loading forward of center of gravity</th>
<th>Excessive loading rear of center of gravity</th>
</tr>
</thead>
</table>

- 9 -
Center-of-gravity effects are one of the most significant reasons that one-skid offloads should be performed with precision, by rescuers familiar with this procedure, and only when absolutely necessary.

<table>
<thead>
<tr>
<th>CENTER OF GRAVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal lateral distribution of cargo</td>
</tr>
<tr>
<td>Improper load distribution</td>
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It is also important to properly secure all materials loaded on or in a helicopter.

**Helicopter Size Classification**

There are three size classifications with regard to helicopters. These classifications are based in accordance with their maximum available standard passenger classification. The three classes are as follows:

- **Light**: 0 to 6,000 pounds (typically 1 to 7 places)
- **Medium**: 6,001 to 12,500 pounds (typically 8 to 16 places)
- **Heavy**: 12,501 pounds and higher (typically 17 places or more)
Helicopter Performance Capabilities and Specifications

In order to complete the mission safely and successfully, a helicopter must be capable of the performance required. Weight-lifting capacity, hover ceiling, airspeed and fuel requirements need to be considered by the SAR team leadership in selecting the proper aircraft.

Capabilities and Specifications Definitions

The definitions listed below are helpful in understanding the technical specifications of helicopters. Remember that these specifications are generally for a "standard day" (altitude = sea level; temperature = 59 degrees Fahrenheit).

Hover In Ground Effect (HIGE)

HIGE is normally effective up to a height equal to the radius of the main rotor(s). This is measured from the plane of the main rotor blades to the ground.

Hover Out of Ground Effect (HOGE)

HOGE occurs when the helicopter is hovering out of ground effect.

Aircraft Seating or "Place"

This is the total number of occupants, including pilots and passengers.

Gross Weight

"Gross Weight" is the maximum certified weight in pounds. Some models have higher or lower weights for jettisonable external loads. If no number appears in the external weight block, the weight is the same as internal.

Useful Load

This number, in pounds, is established by subtracting the average equipped weight of the helicopter from the gross weight.
Payload

Payload is established by subtracting the equipped weight of the helicopter from the computed gross weight for a calm day at 5,000 feet pressure altitude, 80 degrees Fahrenheit, 7,400 feet density altitude, 2 hours of fuel and a pilot. Pilots and crew use charts or "tabulated data" which provides payload data for a variety of temperatures and pressure altitudes.

Ceilings

These are in and out of ground effect hovering ceilings, computed at maximum gross weight in a standard atmosphere and calm air. This value is "density altitude."

Cruise Speed

Cruise speed is the helicopter's airspeed, in knots, equivalent to 80% of Vne at 5,000 feet and at 80 degrees Fahrenheit.

Fuel Consumption and Fuel Capacity

Fuel consumption, given in pounds per hours, is computed for 5,000 feet pressure altitude at 80 degrees Fahrenheit. Fuel capacity is computed using a measured amount of fuel burned in a known amount of time.

Helicopter Landing and Takeoff Areas

Probably the most important aspect in planning for helicopter operations is the selection of heliports and helispots for the helicopters. The Air Operations Director and/or Heliport Manager may have at their disposal the finest helicopter on the commercial market, a good crew, and the best helicopter accessories available. Still, they may need a network of heliports and helispots to fully utilize the machines. The types of activity and the volume of traffic will affect selection and development of these sites. The site should lend itself to economical development, to a size that will accommodate the type of helicopters used and the volume of traffic expected.
Landing and Takeoff Areas Definitions

Permanent Heliport

A permanent heliport is a permanent facility for helicopter operations. It is usually the "home base" of assigned helicopters and personnel. It should be large enough to accommodate at least two medium-class helicopters, have adequate fueling facilities, a reliable wind indicator, signs, fire extinguishers, paved pads, vehicle parking areas, and reliable telephone and/or radio communications. A heliport is located in the vicinity of the command post.

Helibase

A helibase is a secondary base to be activated intermittently as the need arises. The helibase should contain most of the facilities required for a permanent heliport. A helibase can be established for special projects. In an extremely large operation, there may be two or more helibases. Facilities should include parking areas for refueling and maintenance trucks, rest areas for pilots and crews, and adequate communications with the command post.

Helispot

A helispot is a natural or improved takeoff and landing area intended for temporary or occasional helicopter use in the field. It may or may not have road access. In many cases, helispots do not meet the basic requirements of a heliport and, therefore, should not be declared formally or referred to as heliports.

A two-way helispot (pictured below) is ideal because it gives the pilot the option of flying into the wind during landings and takeoffs. Remember that a helicopter pilot will prefer to land and takeoff into the wind.

![Two-Way Helispot Diagram]

It is important to maintain safety precautions around all helispots. A safety circle (described below) of 90 feet or greater is important, as is a 20-foot landing area (or "touchdown pad"). In addition, trees and other natural or man-made obstructions should be low enough to allow for a 20° angle of approach or departure.
In some cases, one-way helispots may be the only option. In this case, the same safety circle, touchdown pad and approach/departure angle should be maintained.

Off-Site Landing Area

This is an unimproved area used only one time and at the discretion of the pilot.

Major Elements of a Heliport/Helispot

Landing and Takeoff Area

This is the specific area in which the helicopter actually lands and takes off, including the touchdown pad and safety circle. A "landing and takeoff area" exists in virtually every landing zone, whether it is at a heliport, helibase or helispot.
**Safety Circle**

This is a safety zone that provides an obstruction-free area on all sides of the landing and takeoff area.

**Touchdown Pad**

A touchdown pad is that part of the landing and takeoff area where it is preferred that the helicopter land.

**Approach/Departure Path (Flight Path)**

This is a clear path selected for flight extending upward and outward, in both directions, from the touchdown pad and safety circle. At higher density altitudes, this path must be extended to allow for takeoff in situations where reduced lift is available.

All landing zones should always be located in such a manner that landings and takeoffs may be made into the prevailing winds. Avoid, if at all possible, one-way helispots (those which only allow for approach from one direction), especially at higher altitudes. Furthermore, slopes should be avoided at all costs.

Water provides a poor ground effect base for hovering. River currents move the ground cushion and can result in pilot disorientation. Furthermore, if a helicopter must take off over water from a helispot on shore, the ship may need at least 300 feet of water over which to gain flying speed.

Beware of dead air holes in canyon bottoms and consider that the canyon does not have downdrafts from neighboring ridges. If the canyon is deep, the helicopter will need a long forward run to pull out or a wide enough area in which to circle to gain elevation.

Like water, meadows with high grass will tend to dissipate helicopter ground cushion. High grass may also hide rocks, logs and swampy areas. Furthermore, dry grass can be a serious fire hazard.

Ice locations for landing zones should be avoided at all costs. If an icy landing zone (LZ) must be used, those with a greater than 10% slope should be avoided. Under cases, a pilot may not be able to judge the percent of slope and iciness of the LZ. If an icy LZ is chosen, rescuers must stay well clear of the helicopter during landings and takeoffs, since torque may cause the tail rotor to swing around.

If the aircraft is ever parked on a snowy/icy surface for an extended period, the skids may freeze to the surface of the snow/ice. This is a dangerous situation, as it can lead to dynamic rollover of the helicopter during takeoff.
Rescuers must keep landing zones clear of personnel and equipment at all times. In addition, rescuers should keep at least 100 feet away from helicopters except when loading.

Helicopter Evacuations

Helicopters can make pickups in three ways
1. by landing at a LZ
2. by making a hovering or one-skid recovery, or
3. by using an external load operation (hoists, short-hauls)

The last two are hazardous, even under optimal conditions. In conditions of mountainous terrain, evacuations should be by landing if at all possible, even if this means a trail carry of the victim by ground crews to a nearby LZ. In many mountainous rescue situations, there is plenty of time to locate or construct a safe helispot rather than try hovering or one-skid recoveries.

**Landing Recoveries**

Hazards exist even in relatively safe conditions of a landing recovery whereby the helicopter will normally come to full rotor stop. The victim should be briefed regarding helicopter safety, including a warning to stay away from the rear of the helicopter, especially the tail rotor, at all times. Even if the helicopter is fully without power, rescuers should escort any walking victim to the helicopter and assure that they are secured in their seat with their full seat belt, including chest harness.

The rescuer should anticipate that the helicopter flight will make the victim nauseous, and should be prepared for the possibility that the victim may vomit during the transport.

**Hovering and One-Skid Recoveries**

In certain situation, pilots and rescuers may choose to perform a hovering or one-skid recovery of a rescue victim. In this case, serious medical complications are likely present, which warrants the more hazardous recovery.

Medical problems of a victim can be compromised during hovering or one-skid recoveries, due to fear, uncertainty and anxiety. Rescuers should advise the victim what will happen prior to the actual helicopter pickup. They must be certain that the victim is capable of withstanding the strain of the recovery procedures, which will include a very loud noise combined with high rotor wash and dangerous conditions.

If rescuers do not have communications with the pilot and the rescuer will not accompany the victim on board the chopper, a tag should be attached to the victim stating the medical condition and treatment given as well as where s/he is to be taken.

The factors to be taken into account in selecting a site for a hovering recovery are generally the same as those for selecting a helispot. In these conditions, a smaller ground area, rougher terrain and steeper slope are permissible. On the other hand, it is extremely important that there be plenty of room for both the main rotor and the tail rotor boom, since the pilot may have to turn the helicopter in the event changes in wind direction. An experienced hand signaler, one that the pilot knows is competent, should be at the site and all ground personnel should be within the pilot's view, if at all possible. In the case of one-skid recoveries on rock outcrops, this may be impractical.

**External Loads (Suspended/Retractable Recoveries)**

Other techniques are available for helicopter evacuations using “external loads.” These include:
- Suspended Sling (Horse Collar)
- Suspended Litter
- Suspended Billy Pugh Net (a.k.a. Cargo Net)
- Retractable Hoist cable

In the case of the suspended extrications, the helicopter hovers above the victim, who is secured to the line by ground personnel. When the victim is secured, the helicopter gains altitude, lifting the victim off the ground. Since the victim is suspended, the helicopter simply transports the victim to a predetermined area where other ground personnel will disconnect the victim from the system once the victim is on the ground.

Conversely, with retractable operations, the helicopter pilot or crew is capable of pulling the hoist line into the chopper while it is airborne.

In either case, a ground rescuer who is familiar with helicopter hand signals should be used. This is especially important in these types of operations, since the pilot is often unable to see below the helicopter to know when the victim is secured.

The use of a sling is difficult, to say the least, even if the victim is assisted by a trained ground crew. Imagine yourself hanging 100 feet below a helicopter as it lifts you off the ground and quickly departs the area.

Use of a litter for suspended recoveries is preferred, particularly when the victim is injured. One simple reason is that the victim cannot look down to see how high they are above the ground or how quickly they are traveling, which would increase anxiety. The excitement of a sling may increase shock or heart problems and may further damage injuries to the chest, shoulders or arms.

In the case of any suspended or hoist recovery, the downwash from the rotor combined with natural winding in the cable may result in the load spinning, sometimes uncontrollably, while suspended beneath the helicopter. For this reason, any rescuer who straddles the litter must be carefully secured to the system and must plan for a high rate of spin that might result in a centrifugal force that throws them off the litter. A tag line should be used for any hoist operation involving a litter. Additionally, a Stokes litter is preferred over a Thompson litter. A Thompson litter, with its solid structure, acts as an air foil and can easily spin uncontrollably.

Helicopters with hoist mechanisms are not common and some of these have very limited operational ceilings for mountain work. The upcoming “Advanced Level” of this program will further describe external loads.
Heliport Safety Operations

The following guidelines must be enforced at the heliport:

First, there should be NO SMOKING within 200 feet of all helicopters. Mission management should strongly consider having fire equipment (e.g. fully equipped pumpers) at the scene of the heliport during all hours of operation.

The following procedures should be observed when refueling helicopters at landing areas:

- Helicopter engines will be shut off and rotor blades fully stopped (aircraft equipped with closed-circuit fueling systems need not shut down).
- There will be no passengers aboard the choppers while refueling.
- Both helicopters and fuel containers must be grounded.
- Fire extinguishers will be on hand.

Wind direction should be indicated by use of a windsock, flagging or streamers. Heliport landing zones, particularly refueling areas, should be dust-proofed by wetting down or by other means to prevent damage by dust and other foreign objects. LZ's should be kept clear of light, loose objects and unauthorized personnel. Ground vehicles near helicopters should not be moved until the chopper rotors have come to full stop. Helicopters with wheels must be chocked after landing, and parking brakes must be set.

One-wheel or one-skid landings should not be performed in the heliport. When helicopter accessories such as sling loads are being used, unauthorized personnel should never be standing directly beneath any portion of the helicopter or equipment. Finally, takeoff and landing areas must be clear of other aircraft, personnel and vehicles.
Heliport Equipment

The following equipment should be available at the heliport:

- Fire extinguisher (200 pounds at each permanent base heliport - 20 pounds per helicopter.)
- Protective clothing
- Crash rescue equipment for entry and extrication.
- Crash evacuation kit including stokes litter and appropriate first aid equipment.
- Water for refuelers doused in jet fuel - possibly a spare set of overalls

Furthermore, the Incident Commander, Operations Chief and/or Heliport Manager must know how to mobilize specialized crash/fire rescue units---their locations, phone numbers and call-out procedures. Specialized medical facilities available including burn and head injury treatment facilities including their locations and phone numbers should be known as well. Medical transportation methods must be available, including trauma center helicopters.

In-flight Emergencies

In the event of in-flight emergencies, the following procedures must be observed:

- Notify base of emergency and location, regardless of how minor the emergency may appear.
- Assure that seat belts are snug.
- Secure protective equipment, including helmet and clothing.
- Keep hands and feet clear of controls.
- Secure any loose gear.
- Check emergency exits and operation
- Observe the following crash landing seating positions
  - For passengers facing forward or sideways with seat belt only: lean forward, tuck head between knees and place arms around knees.
  - For passengers facing forward with seat belt and shoulder harness: lean back all the way and tighten all straps.
  - For passengers facing to rear with seat belt and/or shoulder harness: lean back all the way and tighten all straps.
• Exiting: Wait until all motion stops unless there is a fire or unless instructed to do otherwise by the pilot.

Helicopter and Heliport Management

Introduction

Management of helicopters in any search or rescue operation is a challenging job. The speed (or short round-trip times) in which helicopter missions are accomplished represents the primary challenge. To take advantage of this speed, the Heliport Manager must anticipate expected needs.

The success of efficient helicopter management depends on trained and qualified managers and key mission overhead that have working knowledge of helicopter use.

Helicopter Management Defined

Once again, "helicopter management" is "the direction, scheduling, coordination and control of helicopter use in accordance with agency policies to ensure maximum efficiency as well as safety in all aspects of the search or rescue operation."

Recommended Procedures

Managers should be required at each heliport that is used as an operating base. An individual trained in basic helicopter use should be stationed at each heliport or helispot during operations to load, unload and enforce safety procedures. An adequate ground crew should be provided to perform work in support of the aircraft.

Any time a helicopter is dispatched on a mission, consideration should be given to sending a rescuer, including the Incident Commander if an aerial view of the area is required.

It is the responsibility of the Incident Commander or Air Operations Director to place trained and qualified people in helicopter management.

Since search and rescue teams often request the assistance of media helicopters, the Heliport Manager should recognize that press releases and/or media interviews are the responsibility of
the Sheriff, Incident Commander, and Operations Chief or assigned Public Information Officer. Furthermore, interviews with search team members and/or subjects or family should be discouraged until the Sheriff, Incident Commander and/or Public Information Officer has received authorization.

Should trauma center helicopters arrive at a heliport or at the command post en route to a rescue scene, the Heliport Manager or Incident Commander must assure that the flight nurse is able to quickly contact field medical personnel for a briefing on the rescue and/or patient's status.

**Locating the Base Heliport**

Normal guidelines should be observed for helicopter landing and takeoff areas. The best heliports are located on exposed knobs, including a spot where a drop-off is possible for takeoffs. The higher the elevation, the more important the drop-off becomes. With a drop-off, the helicopter may use less power, carry a larger payload and have a greater safety margin.

Location of the heliport should always be a prime consideration. Consider the location relative to the command post. If possible, the heliport should be within walking distance of the command post, but not located so close that dust and dirt would affect base operations and create noise.

The heliport should be large enough to accommodate all helicopters presently working on the mission. Plan for growth potential. The heliport must be accessible by road, preferably one other than the main road to the command post.

The heliport should have access to water, if possible.

**Activating the Base of Operations**

When activating the Heliport, several important issues must be considered. First, personnel should restrict travel on the heliport using barriers, cones, flagging, etc. Access control for official vehicles and personnel should be provided. Warning and directional signals must be provided as necessary. These include "NO SMOKING" signs at fuel storage areas around heliport as well as directional signs pointing the way to the heliport and the command post.

A windsock or flagging (if windsock is not available) must be installed as well. Wind indicators must not be in any takeoff or landing path. Wind indicators should be posted where pilots can clearly see them. Wherever possible, use a smooth surface pole so that wind indicators will not "hang-up" while wind or rotor wash is blowing.

Fuel and Oil considerations must be made as well. The Heliport Manager must maintain adequate supplies of jet fuel and oil. All drums should be stored 100 feet from the landing area. Shade and air circulation must be provided. Finally, fuel trucks should be on the landing and takeoff area only during refueling, and then moved away.

It is essential that communications issues be addressed. First, telephone communications with the command post may be useful. Radio communications between aircraft, managers and the command post are essential for efficient use. Pilots should be briefed on the appropriate
frequencies for all communications. Finally, all helicopters must be equipped with radios/frequencies essential to the mission.

Trash cans for paper, oily rags, and oil cans etc. may be useful. If the mission is anticipated to be a long one, a portable generator or other source of electricity is necessary to provide lights. Water or dust abatement liquids should be used to maintain a dust-proof environment for the heliport. Finally, a vehicle to take rescuers, pilots and key overhead to and from the command post would be advisable.

Managing the Heliport

Duties of the Heliport Manager

The following duties are the responsibility of the Heliport Manager:

First, s/he requests ground operations crew through the Operations Chief. S/he also supervises construction of the heliport and helispots. The Heliport Manager must also order necessary facilities and equipment from the Operations Chief for safe efficient heliport operation. Supervises installation and placement of facilities

The Heliport Manager must obtain data on each aircraft operating on the heliport, including:

- Type
- Owner and pilot(s)
- Estimated time of travel
- Limitations on normal use
- Hours flown

S/he must also secure a priority list of air missions and schedules flights, as directed by the Operations Chief and/or Incident Commander. In addition, the heliport manager supervises and clears all missions approved by the project manager (Assignments should be made the previous night, during the evening planning session). Maps showing mission area, hazard areas, heliports, etc. must be furnished to helicopter support crews and pilots.
The Heliport Manager must brief pilots, helicopter support crews and other personnel on the following:

- Type of mission to be flown
- Landing and takeoff areas (helispots) to be used and their numbers
- Weather conditions
- Hazards, such as power lines
- Safety and emergency procedures
- Other aircraft activities
- Established flight patterns at all landing areas
- Communications protocol and frequencies

Aided by the ground crew, s/he must instruct all personnel in helicopter safety. Emphasis is placed on safety training in approaching, entering, riding and exiting the helicopter. The Heliport Manager must also assure that personnel and freight are loaded at the heliport and unloaded at the field helispot safely.

Flight operations must be ceased during periods of high wind and poor visibility.

Operational concerns must also be addressed. The Heliport manager must receive overhead, crews and supplies arriving at the heliport and verify arrangements for transportation to assigned destinations. S/he must also record ETA's on all assigned helicopters. Remember that the Heliport Manager works closely with the dispatcher and timekeeper. By recording ETA's, better helicopter management is realized and immediate search can be initiated for overdue or lost helicopters (A missed radio check-in during a 1988 Alpine Rescue Team search was the primary reason for a quick spotting of the downed aircraft with one survivor on board).

Arrangements to protect helicopters at night must be made.

**Duties of the Heliport Crew**

The Heliport Crew must construct and equip the heliport as directed by the Heliport Manager. They must maintain the heliport including dust abatement. They must also assist in supervising loading and unloading of personnel. It is best to escort personnel to and from the helicopters. Ground crewmen also carry tools and equipment for passengers and check belts before takeoff.
Conclusion

The key to effective utilization of any resource in search and rescue operations lies in the following factors:

- Early identification of the requirements
- Effective mobilization of the required resources
- Efficient management of the resources at the scene
- Accountability for resource utilization

With helicopter resource management, additional concerns are vital to the success of the operation. These are:

- Assurance that safety considerations are not only met, but exceeded
- A complete risk-benefit analysis is performed prior to the utilization of any aircraft

With proper management of airborne resources, search and rescue teams can accomplish more than is possible with simply ground-based resources.

Once again, "helicopter management" is "the direction, scheduling, coordination and control of helicopter use in accordance with agency policies to ensure maximum efficiency as well as safety in all aspects of the search or rescue operation."
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