HELICOPTER ASSOCIATION INTERNATIONAL
Utilities, Patrol and Construction Working Group

UPAC Safety Guide for Helicopter Operators

Dedicated to the advancement and safety of the civil vertical lift industry

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CHAPTER 1 - INTRODUCTION

The purpose of these guidelines is to offer general information and recommendations to mitigate associated risks: for those individuals and companies involved in utility (power line or pipeline) patrol and inspection (routine or detailed); for those involved in power line construction and related maintenance operations; and to aid in selecting qualified contractors for these operations.

This document reflects procedures generally accepted by aircraft operators involved in supporting the utility and construction industries and should be considered as fundamental to establishing controls to mitigate known hazards to an acceptable risk for the operators, crews, and utility industry. The UPAC guide is to be used, modified, and adapted as necessary to better reflect the individual operator's scope and size of operations, local environmental factors, needs and requirements or to offer additional information that may be incorporated into the operator's existing manuals. This Guide also provides supplemental information regarding the expectations of the HAI, its members, and associates on specific safety recommendations to mitigate risks involving aerial work in the utilities and construction industry. It identifies acceptable methods of implementing the recommendations, although other methods may also be acceptable. It identifies relevant principles and practices by referencing Government and non-Government standards. The discussions on methods and approaches and other information are intended to be useful in understanding and implementing a safety system approach to managing risks.

The use of this Guide will facilitate consistency in implementing the recommendations and help ensure that all of the recommendations are addressed. This Guide will not supersede any government regulations or laws. The word "should" is used throughout this Guide to indicate a recommended practice to implement administrative controls and physical barriers to mitigate known hazards to an acceptable risk. The word "shall" or "must" is used in certain references because it denotes an action(s) that must be performed if a requirement of a government regulation is to be met.

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Those using these guidelines may also refer to the HAI's complete Safety Manual for other guidance.

CHAPTER 2 - BACKGROUND

Section 1- History and Purpose

Helicopters have been in use to support the utility industry since 1947 when the first civilian certified aircraft became available in the United States (US). As the aircraft became more capable and reliable, their use expanded and continues to expand to provide cost effective support. Operators conducting aerial work in support of the utility industry encounter different hazards because of the various types of operational envelopes or flight profiles, terrain, infrastructure, and weather environments. At the same time, aerial work involved with the utility industry exposes aircraft and operators to the same hazards of any aircraft that operates at low altitudes and slow speeds. The first step of a safety system approach to mitigating risk is to define each operational environment and outline the hazards associated with each flight profile. In this Chapter, the UPAC committee identifies the key hazards associated with the operational environment (flight profile) so that owners, managers, pilots and the crews understand these hazards and to develop management controls to mitigate the hazards to an acceptable level of risk.

Although no one has the data for how many hours are flown each year in the world conducting aerial work in support of the utility's industry, it is relatively easy to assume that on any normal workday, thousands of flight hours are accumulated each day. The safety data specific to aerial patrol accident rates per flying hour are also unknown, but we know that between 1979 and May 2007 there were 25 helicopter accidents with 43 fatalities conducting utility work in the US. Generally, we also know from the United State's accidents, that a collision with wires while conducting these operations will result in fatalities and/or serious injuries to the crews and total loss of the aircraft.

Section 2- Defining the Work--Aerial Work Power Line Patrols

Routine power line patrols provide cost effective means of visually inspecting electric utility's structures, conductors, and identifying encroachment of manmade or naturally occurring elements that pose hazards to the reliability of the system. In conducting routine power line patrols it must be clearly understood the aircraft is "flying through" the wire environment, which greatly increases the potential for the aircraft to collide with the infrastructure or terrain. Aerial work like this requires a minimum crew of an observer and a pilot to effectively and safely perform the work. The aircraft may be operated at speeds of 20 to 70 knots of forward speed along the power line right-of-way depending on the type of structures and voltage of the power line (See section 4). Generally, the industry practice is to operate the aircraft slightly above and one to two rotor discs of distance to the side of the power line so that an observer can visually inspect the power line, structures, and right-of-way. By maintaining the appropriate distance and speed, the observer is able to visually inspect the structures, insulators, and conductors. Properly positioned the visual perception is one in which the structures and conductors are passing by the

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observers line of sight at a slow walk allowing the observer time to inspect. However, at 20 knots, the aircraft has a rate of closure of 35.2 feet per second or at 70 knots a rate closure of 123.2 feet per second to an obstacle in its flight path. In order to mitigate the potential risk of collision the crew must identify a potential collision hazard and make corrective actions well in advance, if not, there is very limited action that a pilot can take to avoid a collision. At these rates of closure, it requires the crews to exercise extreme concentration, maintain situational awareness, be knowledgeable of their area of operations, maintain effective communications, and establish clear roles and responsibilities.

Section 2-1- Crew Resource Management (CRM)

CRM encompasses a wide range of knowledge, skills and attitudes including communications, situational awareness, problem solving, decision making, and teamwork; together with all the attendant sub-disciplines which each of these areas entails. CRM can be defined as a management system, which makes optimum use of all available resources - equipment, procedures and people - to promote safety and enhance the efficiency of flight operations.

CRM is concerned not so much with the technical knowledge and skills required to fly and operate an aircraft but rather with the cognitive and interpersonal skills needed to manage the flight within an organized aviation system. In this context, cognitive skills are defined as the mental processes used for gaining and maintaining situational awareness, for solving problems and for making decisions. Interpersonal skills are regarded as communications and a range of behavioral activities associated with teamwork. In aviation, as in other walks of life, these skill areas often overlap with each other, and they also overlap with the required technical skills. Furthermore, they are not confined to multi-crew aircraft, but also relate to single pilot operations, which invariably need to interface with other aircraft and with various ground support agencies in order to complete their missions successfully.

CRM training for crew has been introduced and developed by aviation organizations including major airlines and military aviation worldwide. CRM training is now a mandated requirement for commercial pilots working under most regulatory bodies worldwide, including the FAA (U.S.) and JAA (Europe). Following the lead of the commercial airline industry, the U.S. Department of Defense began formally training its air crews in CRM in the early 1990s. Presently, the U.S. Air Force requires all air crew members to receive annual CRM training, in an effort to reduce to human-error caused mishaps

CRM fosters a climate or culture where the freedom to respectfully question authority is encouraged. However, the primary goal of CRM is not enhanced communication, but rather enhanced situational awareness. It recognizes that a discrepancy between what is happening and what should be happening is often the first indicator that an error is occurring. This is a delicate subject for many organizations, especially ones with traditional hierarchies, so appropriate communication techniques must be taught to supervisors and their subordinates, so that supervisors understand that the questioning of authority need not be threatening, and subordinates understand the correct way to question orders.

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Aerial work, whether it is power line or pipeline patrol, construction or repair work, requires effective communications, due diligence to maintain situational awareness and an understanding that the pilot, observer and/or mission crew are team. They are reliant on each other to effectively communicate observed hazards or safety concerns as they are noted. Each person on-board has a role, responsibility and authority to make the other team member(s) aware of any hazard or safety concern and to effectively communicate that concern to the other team member. Each person on-board should be delegated "stop-work authority" by the operator or owner. It is essential to safety management of risks that if even if one team member has a concern, then work should be stopped, it should be! Evaluate the situation and determine if passive or active safety measures can be instituted to mitigate the hazard or safety concern before initiating work again.

Section 2-2- Identified Hazards

The following hazards were identified that require mitigation to manage the risk to acceptable levels. The controls established to manage these risks are found in Chapter 4 of this Guide.

- Collision with static wires, guy wires or conductors;
- Cantenary or suspension cables
- Collision with structures or towers;
- Controlled flight into terrain
- Engine failure at low altitude
- Settling with Power
- Loss of Tail Rotor Effectiveness
- Tail rotor failure at low altitude
- Bird Strikes
- Loss of situational awareness due to sun, low light, or haze
- Fatigue related stress resulting in "complacency" or "over confidence

Section 3- Defining the Work--Aerial Work Pipeline Patrols

Routine pipeline patrols like power line patrols provide cost effective means of visually inspecting natural gas, oil, and fuel pipelines identifying leakage and encroachment of manmade or naturally occurring elements that pose hazards to the reliability of the distribution system. In recent years, more and more sensors are being tested and developed for installation on aircraft to identify leaks on pipelines that cannot be found using visual methods. This aerial work using sensors may require a mission equipment operator, an observer, and a pilot.

Just as in routine power line patrols, it must be clearly understood an aircraft conducting pipeline patrols is "flying through" the wire environment and at low altitudes which greatly increases the potential for the aircraft to collide with infrastructure or terrain. Generally, the industry practice is to operate the aircraft at speeds of 60 knots of forward speed above or to the side of the pipeline right-of-way at 100 to 500 above the ground level and flown following the ground contour. At 60 knots, the aircraft has a rate of closure of 105 feet per second to an obstacle. The aircraft is above or slightly to one side of the pipeline so that an observer can visually inspect the

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ground above the pipeline for signs of leaks and right-of-way incursions. In order to mitigate the potential risk the crew must identify a potential collision hazard and make corrective actions. At 105 feet per second rate of closure, it requires the pilot and crews to exercise extreme concentration, maintain situational awareness, be knowledgeable of their area of operations, maintain effective communications, and establish clear roles and responsibilities.

Section 3-1 Identified Hazards

The following hazards were identified that require mitigation to manage the risk to acceptable levels. The controls established to manage these risks are found in Chapter 4 of this Guide.

- Collision with static wires, guy wires or conductors;
- Cantenary or suspension cables
- Collision with structures or towers;
- Controlled flight into terrain;
- Engine failure at low altitude;
- Settling with Power;
- Loss of Tail Rotor Effectiveness;
- Tail rotor failure at low altitude;
- Bird Strikes;
- Loss of situational awareness due to sun, low light, or haze; and
- Fatigue related stress resulting in "complacency" or "over confidence"

Section 4- Defining the Work--Aerial Work Detailed Power Line Patrols

Detailed power line patrols are a recent technique implemented by operators. Unlike routine power line patrols the aircraft is "working in the wire environment" and not flying through the environment. In other words, the aircraft while enroute to the job site is flown at an altitude well above obstacles and upon reaching the work site, transitions to hovering flight at the first structure and then maneuvers at or below translational lift to the next structure to be inspected. The mission crew is generally a pilot, front seat observer, and back seat mission crewmember and employs the use of cameras, gyroscopic balanced binoculars, or infrared sensors. Detailed power line patrols require the aircraft to spend extended periods in hovering flight out-of ground effect (OGE) or in slow flight. The aircraft is maneuvered up to the structures at a hover and then both visual observations and sensor recordings are made. The aircraft is then maneuvered to the other side of the structure and up and down the structures to provide a detailed aerial inspection.

Unlike routine power line patrols the aircraft is operated at such slow speeds that a conventional engineering control such as wire strike protection systems offer little to no countermeasure to a wire strike in flight. This is due to the limited momentum because the operations are in hovering or slow flight. In addition, since the aircraft operations are "in the wire environment" and not through it, the greatest hazard is not collision with obstacles, but loss of tail rotor effectiveness (LTE), settling with power, mechanical failures of the aircraft, although collision with obstacles

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remains a hazard. The aircraft are operated at a hover, out-of-ground-effect (OGE), or speeds of 20 knots or less of forward speed, at 100 to 150 above the ground level. The rate of closure is 35 feet per second at 20 knots that allows the pilot and crew ample reaction time to recognize and avert a collision with obstacles. As in routine patrols in order to mitigate the potential risk of collision, a pilot must constantly recognize the position of the aircraft in relation to the infrastructure, surrounding obstacles, relative wind, and available power. The pilot and crews have to maintain situational awareness, be knowledgeable of their area of operations, maintain effective communications, and establish clear roles and responsibilities to mitigate associated hazards

Section 4-1 Identified Hazards

The following hazards were identified that require mitigation to manage the risk to acceptable levels. The controls established to manage these risks are found in Chapter 4 of this Guide.

- Collision with static wires, guy wires or conductors;
- Collision with structures or towers;
- Cantenary or suspension cables
- Controlled flight into terrain
- Engine failure at low altitude
- Settling with Power
- Loss of Tail Rotor Effectiveness
- Tail rotor failure at low altitude
- Bird Strikes
- Loss of situational awareness due to sun, low light, or haze
- Fatigue related stress due to prolonged exposure to stress (Cycles or Turns)

Section 5- Defining the Work--Aerial Work Construction Related Activities

As previously stated, operators conducting aerial work in support of the utility industry encounter different hazards because of the various types of operations and their flight profiles. At the same time, aerial work involved with the utility industry expose aircraft to the same hazards of any aircraft that operates at low altitudes and slow speeds. In this section, the UPAC committee identifies the key hazards associated with the operational environment (flight profile) of operators and crews involved with power line construction or repair. Again, the purpose of this section is so that owners, managers, pilots and crews understand the hazards and to develop management controls to mitigate the hazards to an acceptable level of risk.

It is also important to note that no one has the safety data for how many hours are flown each year in the world conducting external load operations and other flight activities in support of construction operations. However, it is relatively easy to assume that on any normal workday, hundreds of flight hours are accumulated each day in the world. The safety data specific to aerial work in the utility construction and repair industry per flying hour are also unknown, but we know that between 1985 and May 2007 there were nine accidents with 13 fatalities

supporting utility construction in the US. Generally, we also know from these accidents, that a collision with wires, mechanical failures, and falls during these operations will result in fatalities and/or serious injuries to the crews and/or total loss of the aircraft.

1) Transportation of essential crew.

The construction industry relies heavily on helicopters to be able to transport the crew from a staging area at the work site to the structures. If helicopters were not used to transport crews within the work area to the structures, the construction companies or utilities would have to have the crews drive to the structure, climb the structure, conduct the work, descend from the structure and then repeat at the next structure. The ground transportation method has two distinct drawbacks, it is time intensive and requires a great deal of human resources to maintain construction or repair schedules. One method of transporting crews is generally done by having the crew (workers/lineman) board the aircraft, safety themselves to the aircraft then transfer to the structure while the pilot holds the aircraft in a hover at the structure.

When a worker is in position to transfer to a conductor or structure the time the worker is not attached to either the helicopter or structure/conductor shall be kept to a minimum. A break- away device that allows the worker to be attached simultaneously to the helicopter and the structure/conductor may be used until the transfer is complete.

Depending on the type of structure this maneuver has four immediate hazards: (1) main rotor contact with surrounding structure, static wires or conductors, (2) fall hazard during off-loading,
(3) mechanical failure of the helicopter requiring immediate action such as engine failure or tail- rotor failure, and (4) entanglement of the landing gear or aircraft structure with the steel tower components resulting in dynamic role over or loss of control of the aircraft.

The alternate method to landing on the structure or conductor is to carry the worker as an external load and place the individual on the structure using a sling system. This eliminates two of the previously identified hazards main rotor contact with structure and entanglement with structure.

Transfer to or from a helicopter to a conductor or structure by qualified linemen can be accomplished by the use of a platform or using a sling/suspension method to reduce collision or entanglement hazards. Regardless, of which method is used internal, platform, or external load the worker must be attached to the helicopter, platform or sling/suspension device at all times when traveling between the ground and the aerial transfer point or worksite.

2) Transportation of insulators, cross-arms, stringing blocks, steel structure(s), wood pole(s), tools and equipment, etc., using Class B Rotorcraft Load Combinations (US Only).

The helicopter transports the items using a sling system. Generally the sling system can be made up from an appropriate length of non-twist steel cable for non-energized line work or for new construction and ultra-high modulus such as polyester, spectra, technora and other synthetic lines when working near energized lines to maintain obstacle clearance. Caution should always be exercised in selecting the material that makes up the sling to ensure that it does not have a lot of elasticity in the event the sling breaks. Slings with a high elasticity may recoil into the main or tail rotor systems in the event of a break or failure. The sling is attached to the aircraft's cargo hook (belly hook), with a remote cargo hook at the end of the sling with a basket or choker attached to the remote hook. The basket or choker is loaded with blocks, insulators, tools and equipment. Once the workers have been transferred to the structures, the pilot is normally "standing bye" in the staging area (in radio contact with the workers on the structures) for the work to be completed. It is not uncommon for the helicopter to return to the structures several times to resupply tools, material, move hook ladders, and to deliver or remove stringing blocks. After the work has been completed, and the tools or equipment have been removed, the helicopter returns to the structure to move the workers to the next structure to be worked. For new construction, each structure can be visited many times during the initial framing, and directly after the conductors have been pulled and sagged. After the conductors have been sagged, crews can return to the structures to remove the stringing blocks and attach or "clip-in" the conductors to the insulators.

3) Transportation of insulators, stringing blocks, tools and equipment, making repairs, etc., using Class A Rotorcraft Load Combinations (US Only).

   Class A Load combinations (Non-jettisonable work platforms and cargo racks) mounted to helicopters have been used to support workers in performing various work operations in new line construction for years. On higher voltage circuits (230kV and above), additional hardware is required to be installed on bundled conductors to keep the wires separated and prevent chafing. These hardware items are commonly referred to as "spacers." Another application for this class of external load in the construction application is to install aerial warning spheres or devices.
   Both of these tasks have been successful by securing a worker in a seated position on the platform or rack while the pilot hovers the helicopter within the worker's reach of the work location. Other hardware items such as bird diverters, wind dampers, conductor weights, and full tension splices have been installed successfully using this rotorcraft load combination.

   In this process, the aircraft design is altered by installing a "platform" that is approved by the government or in the US by the FAA. In the US, the alteration is approved by either a FAA Supplemental Type Certificate (STC) or using a FAA Field Approval Form 337. The platform and line worker are a rotorcraft Class A load combination. The helicopter load is generally the pilot, worker, and a load of items to be transported. The pilot maneuvers the helicopter within reach of the structure or conductor and then worker sitting on the platform transfers the insulators, stringing blocks, tools and equipment onto the structure or conductor or makes the repairs.

   This method has its hazards as well and the following needs to be considered:

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- The worker must be bonded to the circuit when conducting energized work operations.
- The bonding device will be connected to a common buss on the sling/suspension device seat or tied to the linemen conductive suit.
- The bonding device will allow for breakaway characteristics at the conductor connection.
- Barehanded work methods require the qualified worker to be in contact with, or bonded to, the conductor or energized part and insulated or isolated from conductors or objects at a different potential.
- Care must be taken to ensure the fall arrest system does not compromise the worker's insulated or isolated work positions.
- The pilot must maintain the helicopter's center of gravity (lateral CG) in accordance with the manufacturer's specifications and the government authorization such as in the US any STC or Form 337 limitations during the transfer. The helicopters weight and balance and lateral CG can change as job progresses, e.g. number of workers or different workers on board, burning fuel, loading/unloading material, transferring to or from helicopter to platform, transferring to or from helicopter to structure or conductor)
- The external loads will affect the lateral Center of Gravity (CG) weight and balance of the helicopter in flight.
- An engineered counter-balance system must be used if the transferring weights exceeds the lateral CG limits of the manufactures specifications for the helicopter to ensure stability during transfers.

4) Wire stringing operations using Class C Rotorcraft Load Combinations (US Only).

Wire stringing with helicopters has been effectively performed for many years. This operation requires a sockline to be attached to the helicopter cargo hook while the helicopter pulls the sockline off a reel and into the stringing blocks of the section of line being built. Special "Fly- blocks" are used to allow the rope or cable to enter the block while the helicopter is flown past the structure or pole. Most "Fly-type" blocks come equipped with a guide arm that facilitates the rope or cable to enter the "gate" of the block. This guide arm allows for an easier transition at the structure that can eliminate or reduce the need to stop at the structure to thread the rope or cable into the block.

Structures that are of a "Portal" type construction may require the use of a stringing needle to thread the rope or cable through the portal and into the fly block. Other types of construction that could require this activity are H-frame (middle phase), and the middle phase of larger voltage horizontal phase configurations.

An alternative to the stringing needle method is to use ground crews to pre-thread "pea line" through block in the portal or middle phase. This method does not require the use of a needle however, personnel are required to be staged at each structure to catch and thread the line through the block, then re-attach it to the helicopter cargo hook. The needle method may be more desirable when access to the structures is limited.

Section 5-1 Identified Hazards

The following hazards were identified that require mitigation to manage the risk to acceptable levels. The controls established to manage these risks are found in Chapter 5 of this Guide.

- Collision with static wires, guy wires or conductors;
- Collision with structures or towers;
- Controlled flight into terrain
- Loss of control of aircraft due to exceeding the aircraft's center or gravity limitations
- Engine failure at low altitude
- Settling with Power
- Loss of Tail Rotor Effectiveness
- Tail rotor failure at low altitude
- Bird Strikes
- Loss of situational awareness due to sun, low light, or haze
- Dynamic rollover due to entanglement with structures or tower
- Loss of aircraft control due to longline entanglement
- Failure of belly hook or remote hook to release resulting in settling with power or over-torques, over-speeds, or over-temps
- Fall hazards during transfer of personnel to structures or towers
- Electrical shock
- Puller-tensioner fouling sockline or p-lead resulting in loss of control of the aircraft
- Fatigue related stress due to prolonged exposure to stress (Cycles or Turns)

Section 6 Approach Distances

Operators and workers should ensure they comply with government regulations applicable to worker safety and health.

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CHAPTER 3 - BASIC UTILITY INFRASTRUCTURE

Section 1 Basic Understanding of Utility Infrastructure

This section was developed to provide the operator with basic understanding of typical power grid infrastructures and the types of hazards posed by each. However, it is important to understand a myriad of designs, materials, and line markings are used in the United States, Canada, and other countries. So it is very important that prior to initiating flight operations the operator have a thorough briefing of the design, line markings, and hazards along the right-of-way and have a knowledgeable patrol observer assigned that knows the system.

Alternating Current (AC) power transmission is the transmission of electric power by alternating current. Usually transmission lines use three-phase AC current. The static wires and overhead conductors are not covered by insulation. The conductor material is nearly always an aluminum alloy, consisting of multiple layers of single strands and possibly reinforced with steel strands. Conductor sizes in overhead transmission work range in size from #6 American wire gauge (about 12 square millimeters) to 1,590,000 circular mils area (about 750 square millimeters), with varying resistance and current-carrying capacity. Thicker wires would lead to a relatively small increase in capacity due to the skin effect that causes most of the current to flow close to the surface of the wire. Today, “transmission-level voltages” are usually considered to be 69 kV and above.

Lower voltages such as 46 kV and 33 kV are usually considered “sub-transmission voltages” but are occasionally used on long transmission lines with light loads. Voltages less than 33 kV are usually used for distribution. See photo to the right.

Voltages above 230 kV are considered “extra high voltage” and require different designs compared to equipment used at lower voltages. Overhead transmission lines are un-insulated wire, so design of these lines requires minimum clearances to be observed to maintain safety.(Wikipedia, Electric power transmission, 2007) See photo to the left and on the next page.

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Typical of a wood structure carrying 230kV lines.

Substations: A transmission substation decreases the voltage of electricity coming in allowing it to connect from long distance, high voltage transmission, to local, lower voltage, distribution. It also reroutes power to other transmission lines that serve local markets. The substation may also "reboost" power allowing it to travel greater distances from the power generation source along the high voltage transmission lines.

Section 2 General Hazards

Transmission line inspection patrol hazards vary per location, weather conditions, time of day, etc. The observer, along with the pilot, should be aware of any possible hazards that may come up during the patrol. Some common hazards include:

- Distractions or pre-occupation with other problems or back ground radio chatter/conversations
- Transmission line crossings
- Canerary or suspension wires
- Potential midair collision with other types of patrol aircraft
- Glare from the sun
- Poor weather conditions such as wind, fog, rain, snow, haze, etc.
- Other Low-flying aircraft
- Birds
- Temporary structures such as drill rigs or radio towers
- Radio tower guy wires
- Transmission lines converging at power plants or in deep canyons
- Fatigue (flying too long without a break)
- Breakdown or loss of Crewmember communication
- Congested areas (several transmission lines converging at a substation, several transmission lines running parallel to each other, etc.)
- Unfamiliarity with the transmission lines being patrolled

Section 3 Inspection and Patrols

Aerial patrols are performed on power lines to identify major problems requiring maintenance. Examples of these problems are broken or damaged insulators, structure damage, right-of-way access problems, encroachment problems, weather damage, and emergency outages. Each mile of power line is flown on a periodic basis to identify such problems.

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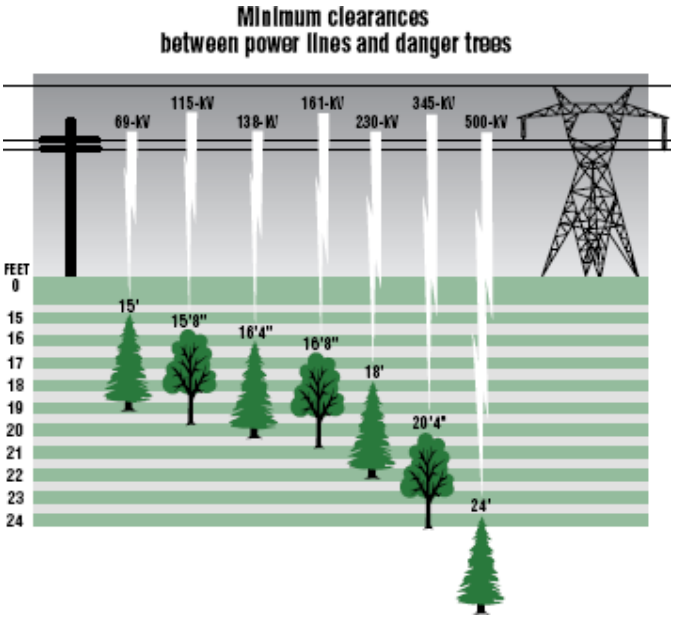
It is important to note that pipelines use aircraft as well to patrol and inspect the systems, which in many cases parallel or cross under many power line right-of-ways. This poses a potential midair collision hazard for aircraft operators, since various utilities more than likely use different aircraft vendors or assets, schedules, and rarely communicates with each other. In addition, there is no industry marking for identifying a pipeline crossing, which may pose a collision hazard for aircraft conducting pipeline patrols.



For power lines in the US, the National Electric Safety Code specifies that power lines be kept specific distances from nearby objects—including trees. The code requires greater clearances for higher voltage lines. For the same safety reasons, transmission line rights of way are wider than for local distribution lines.

The illustration to the right is an example of minimum clearances:
Transmission lines are susceptible to many problems as a result of weather, age, vandalism, etc. Some problems are more serious than others are. Problems should be classified into two categories--primary and secondary.

1. Primary problems are those that may result in an imminent outage or pose a serious threat to the safety and/or welfare of the public. If the damage, in the observer's view, poses a serious threat, the observer should immediately notify the Utility.

Secondary problems are those that may not result in an imminent outage and/or not pose a serious threat to the safety or welfare of the public. These problems can be put on an inspection report to rectify at a later date. The observer must use discretion in classifying problems as primary or secondary. Listed below are problems usually considered as primary or secondary:

Primary problems:

(a) Broken or split cross arms. (May also be secondary)
(b) Downed or loose conductor
(c) Downed or loose static line
(d) Severely damaged conductor
(e) Severely damaged insulators
(f) Foreign material in line (bird nests, wires, shrubs, etc.)
(g) Lines that cross over and under other lines coming into contact with each other because of ice loading, wind damage, etc.

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(h) Severe structure damage
(i) Equipment operation (farm equipment, cranes) under the line not within safe clearances (Note: In cases like these, the helicopter may land so the observer can notify the operator or owner of the hazard.)

Secondary Problems:

(a) Loose X-braces
(b) Structure damage (leaners caused by farm equipment or animals, burnt wood poles, woodpecker damage)
(c) Right-of-way access problems
(d) Right-of-way and/or structure erosion
(e) Loose or damaged guy wires (May also be primary)
(f) Loose or damaged structure ground wires
(g) Loose or damaged dampers
(h) Loose or missing hardware
(i) Missing or faded structure numbers

Many other problems may exist on or around the transmission line. Care should be taken by the aerial observer not to overlook major problems by looking for less significant problems. Smaller, less significant problems will normally be identified during the routine ground patrol of the transmission line. Discussion with line crew supervisors and observers may identify problems other than those listed above and the appropriate responses to them. Again, common sense and care in response to these problems are important.

Emergency Patrols: These patrols normally occur after a circuit has had an operation (or fault). The objective of this type of patrol is to quickly ascertain the cause of the operation, the location of the cause, and access for crews to repair the problem.

Detailed line inspections: These inspections occur for the purpose of identifying everything wrong with a particular circuit. All items of the system are closely viewed in close proximity by the naked eye and with the aid of high-powered gyro-stabilized binoculars. All defects are noted, photographed, and reported in an acceptable format to the utility. Detailed Inspections require that the helicopter be flown at a much slower speed and normally just above conductor height to be able to detect conductor or shield wire damage. Stops at each structure are made to inspect with the binoculars the status and condition of each component. Discrepancies are noted and normally photographs are taken to clarify the reported discrepancy.

Section 4 Power Line Markings

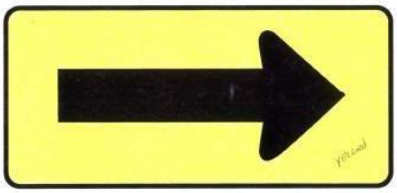
The pilot and observer(s) should always assume the power lines are not marked! The pilot and observer must know or understand the marking system, if any, prior to starting the patrol. Power line markings will vary from utility to utility so it is essential for the pilot and observer to understand the warning sign system. The next few pictures and diagrams depict just one example of how a system could be marked to provide pilots and observers warning of potential collision hazards.

Transmission Line
Warning **X**

SPECIFICATIONS

1. Signs shall be made of No. 18 U.S. gage steel sheet or aluminum. The standard size shall be 24" x 24".
2. Sign face shall be decal reflective sheeting. Sign color shall be engineer grade yellow. "**X**" shall be black.
3. Each sign shall have holes fitted with brass eyelets. Finished holes shall be large enough to take 3/8-inch bolts.

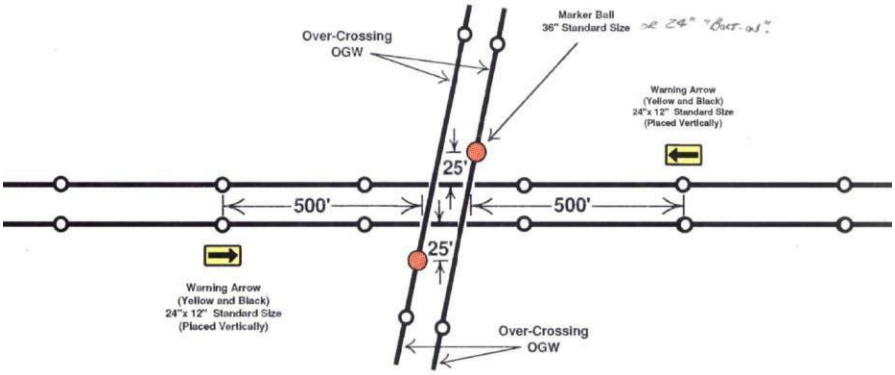
Transmission Line
Warning Arrow



SPECIFICATIONS

1. Signs shall be made of No. 18 U.S. gage steel sheet or aluminum. The standard size shall be 24" x 12."
2. Sign face shall be decal reflective sheeting. Sign color shall be engineer grade yellow. "➡" shall be black.
3. Each sign shall have holes fitted with brass eyelets. Finished holes shall be large enough to take 3/8-inch bolts.

1 MARKER SIGN SYSTEM



Transmission Line Over-Crossing
Marking Diagram

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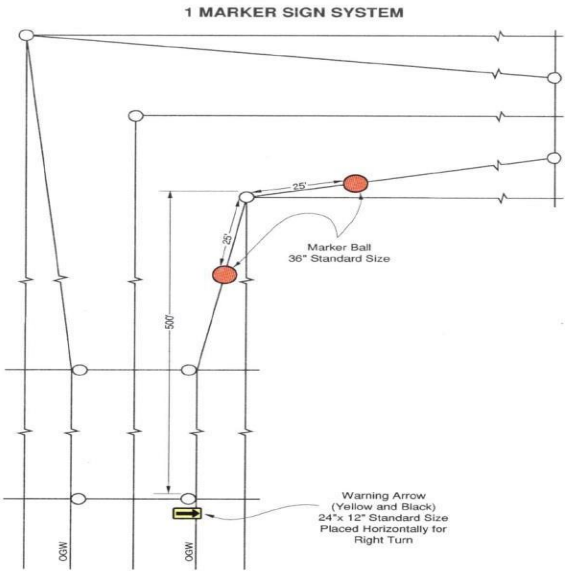
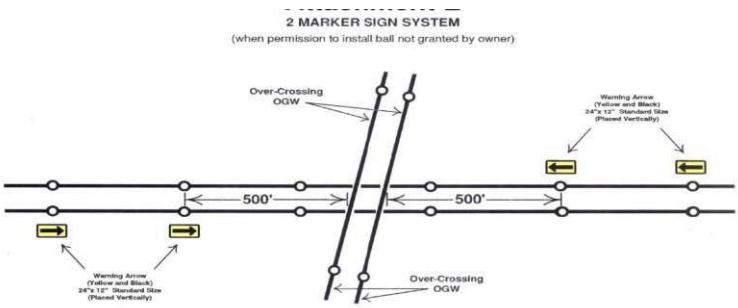


Transmission Line Horizontal Angle
(turns 45° and greater)
Marking Diagram



Transmission Line Over-Crossing
Marking Diagram

Section 5 Pipeline Infrastructure and Marking

Pipeline Right-of-Ways: It is important to note that pipelines use aircraft as well to patrol and inspect the systems, which in many cases parallel or cross under many power line right-of-ways. This poses a potential midair collision hazard for aircraft operators, since various utilities more than likely uses different aircraft vendors or assets, schedules, and rarely communicates with each other. In addition, there is no industry marking for identifying a power line crossing over a pipeline, which poses a collision hazard for aircraft conducting pipeline patrols.

Pipeline Right-of-Ways appear from the air to be large swath and can easily be detected by their marking

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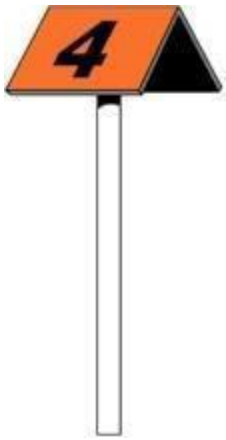
Pipeline Air Mileage Marker



Pipeline Safety Marker

CHAPTER 4 - HELICOPTER PATROL SAFE GUIDELINES

Section 1 Electric Utility Systems and Patrol Procedures

1. General. Develop a working knowledge and a basic understanding of the transmission system facilities is necessary so that the worker understands the reason for work methods employed and to avoid the hazards that are present at the work site. In addition, it provides a pilot and crewmember the ability to forecast where to expect wires rather than total reliance on visual contact with the wire itself. It is important to recognize that electric utility systems are not static, they are dynamic and constantly changing so pilots and crewmen need to maintain vigilance even on systems they may have become familiar.

2. Knowledge of Transmission Facilities

   a. Circuit Voltage: Crews need to know how to identify the circuit being worked and its voltage, by use of various aids such as geographical circuit prints, insulation design, proper marking by circuit signs and/or structure markings.

   b. Minimum Approach Distances: To avoid potential electrical shock, crews should observe minimum approach distances. [U.S. OSHA 1910.269(l) or other regulatory authority, NESC Part 4, IEEE STD 516, etc.]

   c. Structures: The worker needs to have a basic knowledge of various transmission structures including:

      - Lattice types;
      - Steel poles types;
      - Wood pole; and
      - Composite and concrete poles.

   d. Types of Insulators: Pilots and crews need to have knowledge of various types of insulators, including:

      - Ceramic suspension;
      - Ceramic post;
      - Glass; and
      - Non-ceramic (NCI).

   e. In the US, according to the "National Electric Safety Code" higher-voltage lines SHOULD cross over the top of lower-voltage lines. It is an imperative for the

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pilot and crewmembers to know what voltage is being patrolled in order to know what to expect above and below the line.

3. When patrolling an unfamiliar system or for the first time:

   a. Begin with the highest voltage in the system. This provides the ability to observe wire crossings from the top down.

   b. To enhance the quality and safety of the patrol, the pilot or observer must be familiar with the system being patrolled. There should never be a circumstance that a pilot and observer be dispatched to perform a patrol when neither is familiar with the system. Prior to commencing work the pilot and observer must be briefed using maps, system photos, and other information necessary to perform the patrol safely.

   c. The pilot must concentrate on flying the aircraft that includes obstacle avoidance such as identification of wire crossings, antennae, and sensitive areas while providing the observer the best view possible to safely inspect the line. Observer emphasis should focus on developing aerial observation skills and techniques rather than achieving quality, thorough inspection. The pilot and observer should strive to work as a team.

   d. The likelihood of seeing a wire in time to take evasive action is much greater at slower airspeeds. **Keep it slow.**

4. The lower the voltage of the lines being patrolled, the more skills will be required. The greater complexity of the lower-voltage systems increases the patrol workload.

5. Request that the utility provide current circuit maps and information on new lines and construction projects.

6. Work with the utility in the development of a program for marking power lines, wire crossings, and identifying hazards to flight on the mapping resources provide. Remember that electric utilities are not the only organizations that may install wire hazards.

Section 1-1 Understanding Roles and Responsibilities (Power Line Patrols).

1. Operators:

   a. Need to ensure the pilot-in-command is briefed on the customer's request including:

      (i) Proposed patrol routes and type of structures (230 kV, 69 Kv, Oil or Gas Pipeline, etc.)

      (ii) Estimated times,

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(iii) Number of personnel to be carried,

(iv) Any special equipment requirements and weights,

(v) Any other safety related information relevant to the flight.

b. Provide an airworthy aircraft in safe condition and capable of conducting the intended operation.

c. Needs to provide the necessary training or instruction to ensure the pilot-in-command is qualified and proficient in the operations to be conducted.

d. Evaluate and implement a fatigue management system to ensure flight crews are rested.

e. Clearly communicates the conditions that must be met for continued operation and the pilot-in-command is responsible for discontinuing the flight if the conditions cannot be met.

f. Notify the pilot and observer, if possible, that either person has the authority to "call off "the aerial patrol at any time the patrol presents a problem in terms of safety or the effective conduct of the patrol cannot be resolved while conducting the patrol or requires a higher-level personnel involvement.

g. Equip aircraft with "Wire Strike Prevention System" if certified for installation by the government authority for that make and model of aircraft to be used for power line patrol.

2. Pilot-in-command:

a. To pilot the aircraft at all times in a safe manner.

b. Provides a safety briefing before each flight to Crewmembers. The pre-flight briefing shall include the following topics:

(i) Known flight Hazards and forecast weather,

(ii) Coordinates on the planned routes and schedule considering wind conditions, sun, or other factors necessary for the safe completion of the patrol.

(iii) Rotor Blades Clearance precautions

(iv) Smoking Regulations

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(v) Use of Seat Belts and Shoulder Harness

(vi) Passenger Doors used as Emergency Exits

(vii) Location for First Aid/Survival Equipment

(viii) Emergency Procedures - including location and use of Emergency Locator Transmitter, if installed.

(ix) Operation and Location of Fire Extinguisher

c. Complies with the instructions of the patrol observer as long as the instruction is consistent with safe operation of the aircraft and should not distract the observer with an excessive amount of unrelated conversation during the patrol.

d. The depth of coverage of each topic should be appropriate to the degree of experience for each Crewmember. Special concern should be given to discussion of unusual hazards or other than normal conditions. While the pilot is responsible for the initiation of the briefing, Crewmembers are expected to participate as full partners in the review of safety issues.

3. Patrol Observer, Camera or Sensor Equipment Operator.

a. Directs the patrol by establishing priority for the lines to be patrolled and notifying the pilot if:

(i) The aircraft is not properly positioned to safely or effectively view the transmission line.

(ii) The speed of the aircraft is too high for proper patrol. (Appropriate airspeed is determined by existing wind conditions, terrain, and visual perception of the observer.)

(iii) A pass-back is necessary to inspect a specific structure (pull up-circle).

(iv) Communicate with the pilot if at any time, the observer feels a break is needed or at any time, the observer feels uncomfortable.

b. Attends aviation safety training sessions, both initial and recurrent.

c. During pre-flight briefing, provides the pilot with a transmission line update of changes or additions to the transmission line system or hazards that have developed along the route since the last patrol.

d. Complies with the instructions of the pilot-in-command and should not distract

the pilot with an excessive amount of unrelated conversation during the patrol.

e. Conducts him/herself in a safe and responsible manner while in and around the aircraft.

f. Familiarizes him/herself with the transmission lines to be patrolled.

g. Maintains awareness of hazards that exist along the patrol route.

h. Observes and records damage to structures, insulators, hardware, conductors, and other equipment; and observes conditions on or bordering the right-of-ways, including encroachments, dangerous trees, access roads, brush, slides, erosion, etc.

i. When appropriate, inspects questionable situations by requesting to land, if safely possible, and observing from the ground.

j. Analyzes defects observed and determines whether they require routine or emergency maintenance.

k. Makes recommendations to effect immediate repairs to transmission system in emergency situations.

l. Ensures that reports of emergency situations are reported to the Utility, power dispatcher or responsible supervisor.

m. Completes written reports of observations for later transfer to the formal record.

n. Keeps current work sheets for all transmission lines patrolled.

Section 1-2 Pre-flight/Patrol Conduct (Power Line Patrols)

1. The pilot and observer must conduct a preflight briefing prior to each patrol to discuss weather, fuel requirements, route of patrol, known or recently identified obstacles, and noise-sensitive areas. Also, discuss livestock, exotic animals, protected or endangered species, restricted areas, Temporary Flight Restrictions (TFR) or problem landowners.

2. The pilot and observer must work as a team. Prior to each patrol, assess the experience level of the patrol team. Make adjustments as necessary to ensure maximum safety. The pilot must be trained and current in the helicopter being flown and the observer should be experienced with the system being patrolled.

3. The patrol team needs to develop awareness of each member's primary function. It is important that the pilot not become involved in the observer's role.

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4. Review patrol conduct to include terminology and procedures for mandatory call-outs (challenge and response) and emergency communications. Examples of these may be:

    a. CROSSING AHEAD

    b. WIRE

    c. STOP/PROCEED

    d. UP/DOWN

    e. IN/OUT

5. For maximum patrol efficiency, identify the angle, speed, and distance from the wires and structures with the vantage point, and requirements of the observer in mind.

6. Review go/no-go criteria as it applies to the patrol. Examples include such limiting factors as:

    a. Routine patrols in falling precipitation.

    b. Patrolling into a rising or setting sun.

    c. Patrolling in high wind or strong gust spread conditions.

7. The windscreen must be kept clean. Subsequent cleaning should occur as necessary.

8. Develop and use a flight-following or flight-locating procedure. An instrument flight plan may be required to be filed in some countries, if not, a VFR flight plan is recommended.

9. Keep the patrol team size to a minimum. Avoid operations near gross weight or other performance limitations, especially on sub-transmission voltage patrols.

10. Consider the use of personal protective equipment and remote area survival equipment as appropriate.

11. Plan routine patrols to avoid holiday and weekend activities, particularly in noise-sensitive areas. FLY NEIGHBORLY!

12. Knowing the voltage of the circuit you are patrolling and the electrical distance to maintain between the conductors and ground is essential to safe operating practices.

Section 1-3 In-flight

1. Do not become complacent. Look for visual cues (e.g., shiny new hardware, new poles, or road development) that may indicate changes occurring in the system.

2. Do not expect line crossings to be marked. Be alert for other indications of "over" and "under" line crossings.

3. Flight over wires should occur over the top of the structure of the highest-voltage line. This will normally assure passage over the highest wires.

4. Make line crossing and obstruction call-outs MANDATORY.

5. The helicopter should be flown with the skids (wheels) above the highest wire on the structures being patrolled. If descent below the highest wire is required for any reason, speed should be reduced to allow sufficient time to avoid hidden obstacles.

6. The pilot's primary purpose is to fly the helicopter. The pilot should avoid performing the patrol observation function. Teamwork and development of the Cockpit Resource Management concept should be encouraged between pilots and observers at all times.

7. As new obstacles are encountered during a patrol, note the location on a chart or map for post-flight debriefing and future reference.

8. Flight into a low (rising or setting) sun or haze may reduce the visibility of wires due to reflection and glare. Consideration should be given to this condition especially when patrolling an unfamiliar system.

9. When terrain conditions warrant, consideration should be given to conducting the patrol on the downhill side of the wires. Evaluate wind speed and direction, attempting to patrol into the wind, if possible.

10. Avoid judging distance from a wire, particularly stranded wire, based on visual reference to the wire only. The potential for illusions and misjudgment is high, especially in low-light conditions.

11. Hovering and slow flight performance factors (Loss of Tail Rotor Effectiveness and Settling with Power) must be considered when patrol requirements dictate close observation of the system. Special care should be given to "FLY NEIGHBORLY" practices.

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Section 1-4 Post-flight Debriefing

Upon completion of each patrol, the flight team should review the patrol just performed and document any new information/obstacles that may be important for future reference.

Section 2 Pipeline System Patrol Procedures

1. Develop a working knowledge of how the pipeline system is constructed and markings. This will provide the ability to forecast where to expect wire crossings and other flight hazards rather than total reliance on visual contact with them.

2. When patrolling an unfamiliar pipeline system or for the first time:

    a. Consider conducting a high reconnaissance of a patrol segment. This provides the ability to observe wire crossings and other hazards from the top down.

    b. To enhance the quality and safety of the patrol, either the pilot, camera or sensor operator or observer must be familiar with the system being patrolled. If this is not possible, then prior to commencing work the pilot and crew (observer and camera or sensor operator) need to be briefed using maps, system photos, and other information necessary to perform the patrol safely.

    c. The pilot must concentrate on flying the aircraft that includes obstacle avoidance such as identification of wire crossings, antennae, and sensitive areas while providing the observer the best view possible to safely inspect the pipeline and right of way. Observer emphasis should focus on developing aerial observation skills and techniques to provide a thorough inspection. The pilot and observer should strive to work as a team.

    d. The likelihood of seeing a wire in time to take evasive action is much greater at lower airspeeds. **Keep it slow.**

3. Contour following flights at lower altitudes for sensor use and/or patrolling pipelines with smaller right of ways will require more skill. The higher likelihood of flying though the wire environment increases the patrol workload. This is especially true in hilly or mountainous terrain where wires may be suspended across valleys on the intended flight path.

4. The pipeline company shall provide current system maps and/or information of new pipelines and construction projects. Digital mapping that can be displayed for the flight crew is preferred. However, digital mapping displays may also introduce a human factor element that may distract the pilot's attention during flight.

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5. Work with the pipeline company in the development of a program for marking power lines, wire crossings, and identifying hazards to flight on the mapping resources provide. Remember that electric utilities are not the only organizations that may install wire hazards.

Section 2-1. Roles and Responsibilities

1. Operators:

   a. Need to ensure the pilot-in-command is briefed on the customer's request including:

      (i) Proposed patrol routes and type of equipment on-board (sensor or camera) and equipment limitations

      (ii) Estimated times,

      (iii) Number of personnel to be on-board,

      (iv) Any special equipment requirements and weights,

      (v) Any other safety related information relevant to the flight.

   b. Provide an airworthy aircraft in safe condition and capable of conducting the intended operation.

   c. Provide the necessary training or instruction to ensure the pilot-in-command is qualified and proficient in the operations to be conducted.

   d. Evaluate and implement a fatigue management system to ensure flight crews are rested.

   e. Clearly communicates the conditions that need to be met for continued operation and the pilot-in-command is responsible for discontinuing the flight if the conditions cannot be met.

   f. Notify the pilot and observer, if possible, that either person has the authority to call off the aerial patrol at any time the patrol presents a problem in terms of safety or the effective conduct of the patrol that cannot be resolved while conducting the patrol or requires a higher-level personnel involvement.

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g. Equip aircraft with "Wire Strike Prevention System" if certified for installation by the government for that make and model of aircraft to be used for power line patrol.

2. Pilot-in-command:

a. To pilot the aircraft at all times in a safe manner.

b. Provides a safety briefing before each flight to Crewmembers. The pre-flight briefing shall include the following topics:

(i) Known flight Hazards and forecast weather,

(ii) Coordinates on the planned routes and schedule considering wind conditions, sun, or other factors necessary for the safe completion of the patrol.

(iii) Rotor Blades Clearance precautions

(iv) Smoking Regulations

(v) Use of Seat Belts and Shoulder Harness

(vi) Passenger Doors used as Emergency Exits

(vii) Location for First Aid/Survival Equipment

(viii) Emergency Procedures - including the location and use of Emergency Transmitter Locator, if installed.

(ix) Operation and Location of Fire Extinguisher

(x) Required PPE for the flight such as fire retardant flight suits, helmets, etc.

c. Complies with the instructions of the patrol observer, camera/sensor operator, as long as the instruction is consistent with safe operation of the aircraft, and should not distract the observer with an excessive amount of unrelated conversation during the patrol.

d. The depth of coverage of each topic should be appropriate to the degree of experience for each Crewmember. Special concern should be given to discussion of unusual hazards or other than normal conditions. While the pilot is responsible for the initiation of the briefing, Crewmembers are expected to participate as full partners in the review of safety issues.

3. Patrol Observer, Camera or Sensor Equipment Operator.

4.

a. Directs the patrol by establishing priority for the lines to be patrolled and notifying the pilot if:

(i) The aircraft is not properly positioned to safely or effectively view the transmission line.

(ii) The speed of the aircraft is too high for proper patrol. (Appropriate airspeed is determined by existing wind conditions, terrain, and visual perception of the observer.)

(iii) A pass-back is necessary to inspect a specific structure (pull up-circle).

(iv) Communicate with the pilot if at any time, the observer feels a break is needed or at any time, the observer feels uncomfortable.

b. Attends aviation safety training sessions, both initial and recurrent.

c. During pre-flight briefing, provides the pilot with a transmission line update of changes or additions to the transmission line system or hazards that have developed along the route since the last patrol.

d. Complies with the instructions of the pilot-in-command and should not distract the pilot with an excessive amount of unrelated conversation during the patrol.

e. Conducts him/herself in a safe and responsible manner while in and around the aircraft.

f. Familiarizes him/herself with the transmission lines to be patrolled.

g. Maintains awareness of hazards that exist along the patrol route.

h. Observes and records damage to structures, insulators, hardware, conductors, and other equipment; and observes conditions on or bordering the right-of-ways, including encroachments, dangerous trees, access roads, brush, slides, erosion, etc.

i. When appropriate, inspects questionable situations by requesting to land, if safely possible, and observing from the ground.

j. Analyzes defects observed and determines whether they require routine or emergency maintenance.

k. Makes recommendations to effect immediate repairs to transmission system in emergency situations.

l. Ensures that reports of emergency situations are reported to the Utility, power

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dispatcher or responsible supervisor.

m. Completes written reports of observations for later transfer to the formal record.

n. Keeps current work sheets for all transmission lines patrolled.

Section 2-2 Pre-flight/Patrol Conduct (Power Line Patrols)

1. The pilot and observer must conduct a preflight briefing prior to each patrol to discuss weather, fuel requirements, route of patrol, known or recently identified obstacles, and noise-sensitive areas. Also, discuss livestock, exotic animals, protected or endangered species, restricted areas, Temporary Flight Restrictions (TFR) or problem landowners.

2. The pilot and observer must work as a team. Prior to each patrol, assess the experience level of the patrol team. Make adjustments as necessary to ensure maximum safety. The pilot must be trained and current in the helicopter being flown and the observer should be experienced with the system being patrolled.

3. The patrol team needs to develop awareness of each member's primary function. It is important that the pilot not become involved in the observer's role.

4. Review patrol conduct to include terminology and procedures for mandatory call-outs (challenge and response) and emergency communications. Examples of these may be:

    a. CROSSING AHEAD

    b. WIRE

    c. STOP/PROCEED

    d. UP/DOWN

    e. IN/OUT

5. For maximum patrol efficiency, identify the angle, speed, and distance from the wires and structures with the vantage point, and requirements of the observer in mind.

6. Review go/no-go criteria as it applies to the patrol. Examples include such limiting factors as:

    a. Routine patrols in falling precipitation.

    b. Patrolling into a rising or setting sun.

    c. Patrolling in high wind or strong gust spread conditions.

7. The windscreen must be kept clean. Subsequent cleaning should occur as necessary.

8. Develop and use a flight-following or flight-locating procedure. An instrument flight plan may be required to be filed in some countries, if not, a VFR flight plan is recommended.

9. Keep the patrol team size to a minimum. Avoid operations near gross weight or other performance limitations, especially on sub-transmission voltage patrols.

10. Consider the use of personal protective equipment and remote area survival equipment as appropriate.

11. Plan routine patrols to avoid holiday and weekend activities, particularly in noise-sensitive areas. FLY NEIGHBORLY!

12. Knowing the voltage of the circuit you are patrolling and the electrical distance to maintain between the conductors and ground is essential to safe operating practices.

Section 2-3 In-flight

1. Do not become complacent. Look for visual cues (e.g., shiny new hardware, new poles, or road development) that may indicate changes occurring in the system.

2. Do not expect line crossings to be marked. Be alert for other indications of "over" and "under" line crossings.

3. Flight over wires should occur over the top of the structure of the highest-voltage line. This will normally assure passage over the highest wires.

4. Make line crossing and obstruction call-outs MANDATORY.

5. The helicopter should be flown with the skids (wheels) above the highest wire on the structures being patrolled. If descent below the highest wire is required for any reason, speed should be reduced to allow sufficient time to avoid hidden obstacles.

6. The pilot's primary purpose is to fly the helicopter. The pilot should avoid performing the patrol observation function. Teamwork and development of the Cockpit Resource Management concept should be encouraged between pilots and observers at all times.

7. As new obstacles are encountered during a patrol, note the location on a chart or map for post-flight debriefing and future reference.

8. Flight into a low (rising or setting) sun or haze may reduce the visibility of wires due to reflection and glare. Consideration should be given to this condition especially when patrolling an unfamiliar system.

9. When terrain conditions warrant, consideration should be given to conducting the patrol on the downhill side of the wires. Evaluate wind speed and direction, attempting to patrol into the wind, if possible.

10. Avoid judging distance from a wire, particularly stranded wire, based on visual reference to the wire only. The potential for illusions and misjudgment is high, especially in low-light conditions.

11. Hovering and slow flight performance factors (Loss of Tail Rotor Effectiveness and Settling with Power) must be considered when patrol requirements dictate close observation of the system. Special care should be given to "FLY NEIGHBORLY" practices.

Section 2-4 Post-flight Debriefing

Upon completion of each patrol, the flight team should review the patrol just performed and document any new information/obstacles that may be important for future reference.

CHAPTER 5 - POWER LINE CONSTRUCTION AND MAINTENANCE

Section 1 Preflight Operational and Safety Meeting (Job Briefing)

1. General: It is essential that the operators and crews involved in or supporting the construction industry, depending on their assignment, have a basic understanding of electrical theory in order to understand the purpose of the equipment on which work is being performed, as well as understanding the hazards of the work. The topics that pilots and operators should understand in enough detail to understand the potential hazards are as follows:

    - Step and touch potential and grounding and bonding.
    - Circuit Theory: Electrical Flow Grounding: Must understand the basics about concepts of grounding as it relates to circuits, equipment and worker protection.
    - Fault Theory, Relaying, Breakers and Reclosing: Have a basic understanding of faults and how they are cleared. Understand that circuits may be reclosed automatically or by operator control.
    - Induction: Must understand the basics principles of induction and possible hazardous effects from both electric and magnetic fields.
    - Testing for Potential: Use appropriate test equipment that is commercially available equipped with a voltage indicator that, if necessary, is shielded from induction. Therefore, it is essential for workers who come in contact with the lines, poles, and structures to know the proper procedures for bonding.

Section 1-1 Roles and Responsibilities.

1. Operators:

    a. Need to ensure the pilot-in-command is briefed on the customer's request including:

        (i) Area of operations,

        (ii) Class of external load operations to be conducted,

        (iii) Any special equipment requirements and weights,

        (iv) Any other safety related information relevant to the flight.

    b. Provide an airworthy aircraft in safe condition and capable of conducting the intended operation.

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c. Provide the necessary training or instruction to ensure the pilot-in-command is qualified and proficient in the operations to be conducted.

d. Evaluate and implement a fatigue management system to ensure flight crews are rested.

e. Clearly communicates the conditions that need to be met for continued operation and the pilot-in-command is responsible for discontinuing the flight if the conditions cannot be met.

f. Notify the pilot and customer, if possible, that the pilot and customer have the authority to call off the aerial work at any time the safety concerns or hazards present a problem in terms of safety or the effective conduct of the aerial work that cannot be resolved while conducting flight operations or requires a higher-level personnel involvement.

2. Pilot-in-command:

a. To pilot the aircraft at all times in a safe manner.

b. Provides a safety briefing before each flight to Crewmembers. The pre-flight briefing shall include the following topics:

(i) Known flight Hazards and forecast weather,

(ii) Coordinates on the planned routes and schedule considering wind conditions, sun, or other factors necessary for the safe completion of the patrol.

(iii) Rotor Blades Clearance precautions

(iv) Smoking Regulations

(v) Use of Seat Belts and Shoulder Harness

(vi) Passenger Doors used as Emergency Exits

(vii) Location for First Aid/Survival Equipment

(viii) Emergency Procedures - including the location and use of Emergency Transmitter Locator, if installed.

(ix) Operation and Location of Fire Extinguisher

(x) Required PPE for the flight such as fire retardant flight suits, helmets, etc.

c. Complies with the instructions of the customer, as long as the instruction is consistent with safe operation of the aircraft.

d. The depth of coverage of each topic should be appropriate to the degree of experience for each worker involved in the operation. Special concern should be given to discussion of unusual hazards or other than normal conditions. While the pilot is responsible for the initiation of the briefing, workers are expected to participate as full partners in the review of safety issues.

3. During the Job briefing, all aspects relating to the operation are discussed, including each individual's responsibility, safety issues, emergency procedures, hazards, personal protective equipment (PPE), and the status of the energy source controls. It is important that the pilot-in-command (PIC) ensures that all persons working with the helicopter fully comprehend their functions and responsibilities.

a. Crewmember's Responsibilities: All crewmembers are responsible for participating in the job briefing and to know and understand their assignment for the work being performed, and notify the person in charge if they are not. Other duties include, but not limited to, inspecting and verifying all equipment, tools and fall protection equipment are in good working order.

b. Job Briefing: Prior to the beginning of each job, a job briefing will be performed at the jobsite. The job briefing shall include, but not limited to, the information on the following:

(i) Work to be performed;
(ii) Work practices/rules to be used;
(iii) Jobsite hazards – task specific hazards
(iv) Work area limits
(v) Emergency action plan,
(vi) Personal protective equipment (PPE)
(vii) Crewmembers responsibilities.
(viii) Voltage of line being worked
(ix) Minimum approach distance (MAD) as defined by OSHA or regulatory authority that must be maintained
(x) Rigging loads that will be encountered
(xi) Site safety, public safety, isolation
(xii) Safety observer trained and proficient in the work being performed with the right to stop any job when an unsafe act is observed
(xiii) Identity of worksite hazards
(xiv) Rescue techniques
(xv) CPR/First Aid
(xvi) Automatic External Defibrillators (AEDs)
(xvii) Need for job briefing documentation
(xviii) If at any time during the job unforeseen changes occur to the job plan that will

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significantly change the scope of the original briefing, a new briefing shall be conducted to include the change in the job procedure. [U. S. reference OSHA 1910.269 paragraph c]

4. To supplement mandatory crew briefing and preflight checklists, the following items need to be considered and discussed, as appropriate, in the pilot's portion of the tailboard:

   a. Assure that each person understands his or her job responsibility, i.e. lineman, hook-up man, signalman, fuel truck driver, etc.

   b. Personal safety equipment, i.e. hard-hats, chin straps, goggles, gloves, safety belts, clothing, hearing protection, fall protection, etc.

   c. Rotor blades and other helicopter hazards, i.e. effect of irregular terrain on rotor clearances, tail rotor "invisibility", etc.

   d. Helicopter emergency procedures.

   e. Engine failure and flight path.

   f. Ground crew escape routes.

   g. Jettison of external loads.

   h. Unusual aircraft noise alerts.

   i. Unusual smoke or oil and fuel leaks.

   j. Immediate communication of any safety hazard.

   k. Communications.

      (i) Radio frequencies, call signs, phraseology, limit use, radio failure procedure.
      (ii) Hand signals, designated signalman visible to pilot, high visibility clothing (vests).
      (iii) Head signals when hands are being used to maneuver the load.

   l. Flight hazards. Adjacent lines, guy wires, required visibility markings, etc.

   m. Staging areas.

      (i) Clear of loose debris that could be affected by rotor wash.
      (ii) Clear of non-essential personnel and unnecessary obstructions.
      (iii) Dust control issues (wet down area, if needed).

   n. External Helicopter cargo loads.

      (i) Long objects (carried horizontal, below the waist).

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(ii) No throwing of objects.
(iii) Cargo loading, unloading, restraints, etc.

o. Personnel Transport Operations.

(i) Helicopter door operation, ingress, egress, etc.
(ii) Use and operation of seat belts and shoulder harness.
(iii) Headsets/communications, including the use and operation of headsets, helmets and communication switches, cords, etc.
(iv) Signals and instructions from pilot.
(v) No chasing loose or blowing items.
(vi) Stepping on skids to avoid foot injury (skid movement).
(vii) Doors-off flight: Security of cargo, mission equipment and unoccupied seats
(viii) Seat belt security.

p. Suspended Loads, if personnel are transported as an external load they must be essential to or directly related to the operation in order to be transported in the US, without complying with the provisions of Class D Rotorcraft Load Combinations under 14 CFR Part 133.

(i) Static and induced electrical discharge hazards.
(ii) Grounding and insulating devices.
(iii) Rigging – Security, condition, appropriateness to include rated for the loads being carried.
(iv) Aerodynamic factors and weight of load.
(v) Communications
(vi) Emergency situations and actions.

q. Special Landings.

(i) Toe-in and partial touchdown landings
(ii) Tower landings.

r. Emergency Equipment

(i) Location and use of first aid kit.
(ii) Location and use of the survival kit.
(iii) Location, type and use of the fire extinguisher(s).
(iv) Location and use of the Bloodborne pathogen kit.

s. Flight Paths.

(i) Procedure changes due to weather conditions (wind shift, etc.).
(ii) Flagman/Control of ground traffic under flight path.

t. Coordination of multiple aircraft.

(i) Pilot briefing.
(ii) Ground crew coordination

u. Discussion of livestock, exotic animals, protected or endangered species, restricted areas, TFRs, or problem landowners.

Section 2 Communications

1. When possible, radio communications must be established between the ground crew and the helicopter pilot.

   a. If possible, a backup frequency should be established.

   b. Identify each person that has a radio with a name or call sign.

   c. Pilot should make a radio check with each person prior to the first flight.

   d. Prior to first flight, pilot and ground crew should establish "lost communication" procedures.

2. The same terminology should be used throughout the flight. Radio communications should be done concisely and should be kept to a minimum.

3. Establish hand signals prior to the flight. The signalmen should be distinguishable from other ground personnel and visible to the pilot.

4. When talking to the pilot, the radioman should give the pilot specific distances, i.e., "6 inches up", "20 feet forward", etc.

Section 3 Crew Support Operations

Due to the unique aspects of the utility industry, more in-depth briefings are sometimes needed to optimize safety of all personnel involved. The government regulations dictate that the pilot has overall charge of the safe operation of the helicopter.. As such, he is required to brief all pertinent personnel on the procedures to be followed in each specific instance, including all safety and emergency procedures.

1. Personnel.

   a. Personnel riding in the helicopter must receive instruction on the use of door handles, headsets, and seat belt/restraint systems, as well as the requirements for the use of restraint systems.

   b. Personnel must receive instruction on the safest routes for approach to and departure from the aircraft, including any special consideration for the type of helicopter or terrain specific to the operations area.

   c. Personnel must receive permission from the pilot prior to approaching or exiting the aircraft. All persons must remain secured in the aircraft until clearance to exit has been given by the pilot.

2. Cargo/Equipment.

   a. All materials and equipment loaded in the aircraft must be secured for flight.

   b. Long objects, such as shovels and hot sticks, shall be carried horizontally, below the waist, to avoid contact with the main rotor blades.

   c. The pilot will ensure that all loads are safely secured to the helicopter, or in cargo racks, and properly loaded with regard to weight and balance.

   d. Never throw anything while loading or unloading the helicopter. Thrown items may contact and damage the rotor blades and may cause injury to ground personnel.

   e. Secure loose objects around the helicopter. Rotorwash can cause these items to contact the rotor blades or personnel in the immediate area. Do not chase items that may blow away.

3. Operations.

   a. When operating on irregular surfaces, e.g. sloped, rotor blade or terrain clearance may be reduced and the danger of walking into the rotor system is increased.

   b. On rocky or uneven terrain, the skids may move, resulting in potential foot injuries. Therefore, to avoid injury, when loading or unloading the helicopter, step or stand directly on the skid and not immediately near or outside of it.

   c. Only specially trained crews should be utilized to load, unload, enter, or exit the helicopter while in hovering flight or when landing gear is only in partial contact with the surface.

4. Transferring linemen from helicopter to tower (tower drop off)

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a. The helicopter should be loaded to allow it to be hovered out of ground effect with sufficient reserve power available.

b. The helicopter should be positioned so that in the event of an engine failure, it can perform a power off landing clear of structures and wires.

c. The helicopter should be positioned adjacent to the structure and at a position that will allow the lineman to connect a safety lanyard to the structure. The connection on the structure must be able to support the shock load of 5000 pounds REF. OSHA 1926 sub part M a fall of the lineman into his harness.

d. The helicopter should not land on the structure unless it is approved by the utilities' engineering and risk management departments.

e. The pilot and lineman should have radio communication so they can talk to each other at all times.

f. The pilot and lineman should have been trained in this type of helicopter operations and have completed an internship with the helicopter operator.

g. Linemen should not be hard safetied to both the structure and the helicopter at the same time, unless a "break away device" is in use.

Section 4 Rigging

The pilot is responsible for the integrity of the rigging for any external load and must ensure safe delivery of the cargo by continuously inspecting and monitoring the security of the rigging throughout the operation.

1. Prior to operations, the pilot should check the condition and application of all rigging gear to ensure serviceability.

2. All electrically operated remote hooks or other such items must be checked before operations commence. Ref. In the US, 14 CFR part 91.213.

3. Prior to commencing operations, determine the complete rigging requirements including slings and taglines:

    a. Are nets required?

    b. Should a spreader bar be used?

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c. What materials or types of slings should be used?

d. What is the size and weight of the load?

e. What length of sling, type of hook or hooks, and or other rigging should be considered?

f. What is the working load rating for the ropes, slings or cable being used?

4. Be aware that nylon rigging materials have certain properties that must be considered when developing an operational plan. Nylon has elastic properties and, if failure occurs, may snap back into the aircraft. Connecting nylon to itself should be avoided due to possible friction heating causing a failure.

5. Taglines should be of such a length and weighted with non-conductive material or secured so that they cannot fly up into the rotor systems.

6. Load rigging methods can have a broad impact on the Center of Gravity and flight dynamics of the load.

7. Hand braided loops or splices and cable clamps should be avoided in metallic rope. Use swaged loops or pressed sleeves for splices, etc.

8. Swivels should be used whenever circumstances dictate.

9. Determine the best method for attaching sock lines wire, or bull-ropes to the side puller, cargo hook, or pulling weight.

10. Consider the use of highly visible color on slings, rigging, and the lead section of sock line.

Section 4-1 Sling System/Vertical Suspension

The sling system is a vertical system suspended from the helicopter cargo hook. The Sling system will comply with all government regulations or requirements, for the US must comply with the 14 CFR parts 27, 29, and 133.

1. External Load: Class B (US Only) rotorcraft load combination allows for the carriage of persons who are essential to or directly connected with the external load operations or cargo on a sling/suspension system under the helicopter.

   a. The rotorcraft used must have been type certificated under the government's regulations (i.e., US FAA 14 CFR parts 27 or 29), for its operating weight.

   b. The rotorcraft should be equipped for direct radio intercommunication between the

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pilot and the suspended linemen.

c. The external load attachment means must be FAA-approved (USA only) or meet government certification requirements.

d. The attachment of the slings/suspension system to the helicopter should include two independent releasable systems, attached at two separate locations.

e. The sling system will be designed, built, tested, fitted and approved by the government or in the US by the OSHA. (In the US the FAA does not certify the sling system below the aircraft's attachment means, but the slings, cables, nest etc. are regulated thru OSHA.

f. An electrical test shall be performed on the suspension insulating system prior to the start of the job and/or when conditions change.

g. Bonding devices must be engineered to protect lineman from charging current and be suitable to transfer. The bonding device will be connected with common buss on the suspension system seat or tied to the linemen conductive suit. The bonding device should allow for breakaway characteristics at the conductor connection.

Section 4-2 Other construction operations using Class "A" Rotorcraft Load Combinations

1. If a platform system is used to transport crews or where a crewmember performs work from, the platform system must comply with all government regulations or requirements and for the US must comply with the FAR Part 133 Class A - External Load.

   a. The platform shall be rigidly attached to the helicopter airframe.

   b. The platform must be:

      i. Designed and engineered by a competent person and approved by the government or in the US by the FAA.

      ii. Structurally sound [Meet the government's regulation's for airworthiness] and:

         (1) Suitable for operation in an electrical environment, electrically tested for low resistance (1 ohm),

         (2) Tested to be free from corona discharge points,

         (3) Bonded together and then bonded to the helicopter's frame (common

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ground buss).

(4) The platform must be designed and mounted so that it is meets the aircraft certification requirements of the government or in the US 14 CFR Parts 21, 27 and 29. That include:

- Flight and hovering capabilities of the helicopter must not be adversely affected by the design of the platform.
- The platform must not affect the auto rotation and emergency capabilities of the helicopter.
- The platform and loads will affect the lateral & longitudinal CG weight and balance of the helicopter in flight. An engineered counter-balance system must be used if the platform exceeds the lateral CG limits of the manufactures specifications for the helicopter this will ensure stability.
- Provisions will be made for the attachment of the lanyard for the lineman's safety harness to the helicopter frame.
- Provision will be made for the bonding of the crew's conductive suits and bonding system to the platform.
- Bonding devices must be engineered to protect lineman from charging current and be suitable to transfer a minimum of 400 amps charging current to the helicopter. The device will be connected with a bolted connection to a common buss that allows for breakaway characteristics at the conductor connection.
- The platform design should take into consideration lineman and pilot safety in the case of a hard landing.

iii. The platform must be approved in accordance with the government's regulations and requirements and for the US means a Supplemental Type Certificate (STC) from the FAA or FAA approved Form 337.

iv. In the US the STC or Form 337 Rotorcraft Flight Manual supplements shall be present in the rotorcraft flight manual.

v. If the platform has been modified from the original STC or Form 337 alteration, then subsequent government or for the US, FAA approval by STC or Form 337 and the Flight Manual supplement shall be present in the Rotorcraft Flight Manual.

vi. Any special instructions such as placards shall be placed where required by the STC or From 337.

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vii. Installation and removal procedures approved by the government or FAA require demonstration of proficiency. Each installation and/or removal of a restricted category platform must be recorded in the rotorcraft logbook in the US that meets 14 CFR parts 43.9, 91.403, and 91.417.

Section 5 Suspended Loads (Jettisonable) FAR External Load Part 133 Class B

The pilot is responsible for the safe conclusion of an external load operation. To accomplish this, the pilot must operate within the limitations of the aircraft and ensure the safety of the aircraft, the crew, the cargo, and persons or property on the surface.

1. Determine the needs of the operation: a visual survey of the work area should be made. If an extra person is on board is he/she essential to or associated with the operation? (provide crewmember briefings as necessary). Is the use of a long line required? Can the needs of the operation be met with short straps? Is non-conductive material required?

2. Consider the use of a cargo mirror. A physical view of the hook and/or load enhances the safety of the external load operation.

3. Ascertain the power available and the fuel required for the operation. Ensure that the power and fuel available meets the needs of the operation.

4. Ensure that when the sling is attached to the aircraft's cargo hook that the line is freely suspended and not entangled in the landing gear, etc. Develop a procedure to ensure the pilot's knowledge of line attachment during the take-off process.

5. Once the cargo is hooked, ensure that the lift proceeds smoothly. Ground observers should inform the pilot of any unusual circumstances noted; pilot control input should be smooth to minimize cargo oscillations.

6. Transition to forward flight should occur with a smooth increase in speed until cruise is reached. Remember, the size, density and shape of a load will determine its specific cruise speed. Maintain awareness of the load's flight characteristics. If oscillation occurs, place the aircraft over the center of the load or reduce airspeed to aid recovery.

7. Avoid a flight path that creates a hazard to anything on the surface.

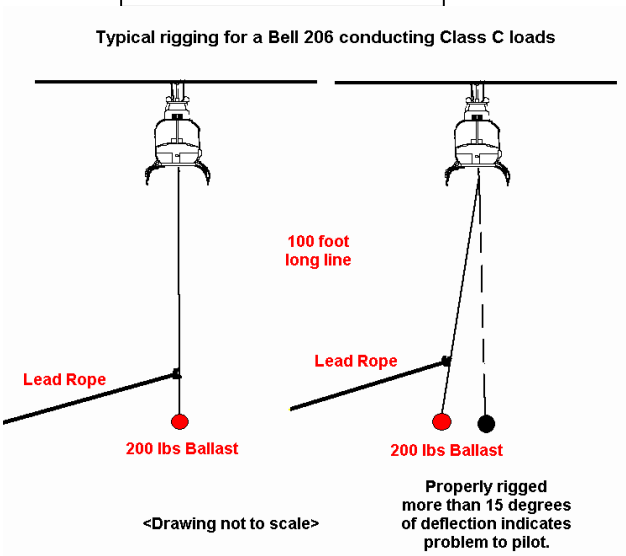
8. At destination, a coordinated transition into hovering flight is necessary, ensuring the load is stable before setting it down. After determining the load is properly positioned, it can be released.

9. Once the load is released, it is necessary to determine that the hook is clear before continuing with the operation.

Section 6 Line Stringing

Due to the widely varying requirements of line stringing and wire pulling operations, it is difficult to offer standard operating procedures that apply equally well in all situations. Therefore, each mission must be thoroughly evaluated as to the best means of conducting that operation. Safety is the uppermost concern and may, at times, dictate that expediency must suffer during certain segments of an operation. Each pilot should be highly experienced in external load operations prior to attempting to perform line stringing operations. The pilot should also receive "hands-on" training in preparation to accomplish these operations in the safest, most efficient manner possible.

Typical Aircraft using ballast pull wire



Typical Aircraft using side puller.

To aid operators in establishing safe conduct procedures for any specific line stringing or wire pulling operation, it is important to bear in mind the following items:

1. The pilot should ensure that all tensioning and reel equipment have properly functioning brake systems and be designed or adapted for helicopter wire string operations.

2. The pilot should perform a ground and flight evaluation or inspection prior to initiating work. The evaluation should include:

   a. The set-up of the tower mounted blocks/rollers/dollies,

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b. The length of the lead rope to determine clearances in most cases,
c. Inspect the "keepers" and dollies.

3. Consideration should be given to fuel load prior to beginning a pull so as not to uncover fuel sumps (unport) due to the roll angle of the helicopter (Side pulling aircraft only).

4. When using an aircraft installed with a side puller use a break-away link between the helicopter and the pulled line to insure that:

   a. In the event of line breakage, all lines are propelled away from the helicopter.

   b. In the event the line becomes jammed and high tensional forces are encountered, jettison the load so that the airframe will not be over stressed.

5. The appropriate use of a swivel in order to keep the line from twisting.

6. Precautions should be taken to assure that rope slings or steel cables do not twist around the remote cargo hook jaws, thus preventing a clean release when the remote hook is opened.

7. The pilot should ensure that guards are placed to preclude vehicular traffic from coming into contact with a moving sock line. Any movement over a sock line must be done with prior coordination and knowledge of the pilot.

8. During the pull, pilots should be aware of any and all inactive sock lines in the vicinity of the aircraft. No sag changes are made to those lines until the pull is completed or the pilot is properly notified.

9. It should be the pilot's decision as to the order in which lines are pulled to ensure the tailrotors and main rotors remain clear of the lines behind and above the helicopter.

10. The pilot should exercise extreme caution when hooking up to the line at the base of a tower that already is threaded. The use of a long line should be considered if a tower base hook up is required.

11. No person should be allowed under the helicopter or sock line during the course of a pull. The possibility of swivels or the sock line dropping and running back could injure ground personnel.

12. The pilot should always pull a sock line sideways (perpendicular to the line being constructed) to enable viewing behind and forward on line simultaneously.

13. When a conductor or metal cable is being pulled, it should be treated as if it is energized until properly grounded and caught off.

CHAPTER 6 - SAFETY GUIDE FOR UTILITIES IN EVALUATING AND SELECTING QUALIFIED HELICOPTER CONTRACTORS

Section 1 Overview

This document is a safety guideline and is intended to give utilities guidance in the areas they need to consider when selecting helicopter contractors for the performance of energized and non-energized Line Work, as well as Patrol, Construction, Maintenance, Inspection and other helicopter related support functions. These recommendations provide one method of addressing the risks associated with the listed operations, but are not the only means available. These recommendations are based on best existing industry practices to date for the operator or a utility to use for managing the associated risks with these operations.

It is suggested that when a utility company is considering contracting for services that one or more qualified persons be assigned to perform a qualification check leading to the recommendation of a qualified contractor. Utilities may wish to pre-qualify the selection of the contractor with an expression of interest qualifier as shown in Part. 1. Upon receipt of the expression of interest form and verification of qualifications, the utility should prepare a detailed specification of the work to be done. This should include minimum qualifications of all personnel, details of work required, requirements for insurance, accident history, and references. Once a contractor has been selected, the contractor should be inspected periodically for compliance with the specifications as well as overall operation. Part 2 provides a sample audit sheet that the utility company could use along with the specifications to evaluate the contractor's performance.

The contractor is required to perform and document a Job Hazard Analysis (JHA) and a pre-job briefing, and make these documents available to the utility. In Chapter 7 the UPAC provides some examples of sample of a JHAs and a sample of a pre-job brief form.

The utility company may keep a current list of all qualified contractors.

This safety guide is to be used as an aid in qualifying contractors for any helicopter support service to include, but not limited to the following activities:

- Routine Aerial Patrols
- Detailed Aerial Inspections
- Electric Component repairs, modifications, or replacements
- Installation/Construction of new lines, equipment or components
- Aerial Photography/Video/Infrared inspections/mapping
- Aerial Reconnaissance

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NOTE: Transportation of personnel, for other than those duties listed above, does not require the specialized skills involved in low level utility helicopter applications and are not addressed in this safety guide. Appropriate certification, however, is required.

This guide may be used in conjunction with other specifications provided by the utility that are applicable to the specific operation that is to be performed by the contractor.

This guide includes four (4) parts:

Part 1	Contractor Qualifications
Part 2	Helicopter Contractor/Operator Questionnaire
Part 3	Utility Company Helicopter Contractor Inspection Checklist
Part 4	Draft Letter Format

It is suggested that when a utility company decides to contract for helicopter services, one or two qualified aviation persons be assigned to perform the safety qualification checks leading to the recommendation of a qualified contractor. If the utility does not have qualified aviation personnel, then it should hire qualified aviation safety consultants familiar in utility operations, safety, and airworthiness programs (It is recommended that Parts 2 and 3 be used in the evaluation.)

Following the qualification of their personnel, the utility company should send out a letter (such as the sample letter in Part 4) and (Part 1) Contractors qualifications and questionnaire (Part 2), to contractors that are interested in the work. Allow sufficient time (30 days) for the helicopter contractors to return the questionnaire. If the returned questionnaires meet with approval, the next step is to schedule a safety assessment using Parts 2 and 3 as a guide.

A utility company should keep a list of all qualified contractors. By being able to call pre-qualified contractors, a utility can be reasonably assured the company and all personnel using the helicopter operator are using qualified personnel and appropriate equipment for the work.

If the contractor(s) meet the qualifications, specifications for the proposed work should be prepared, along with an invitation to bid on those specifications.

Parts 2 & 3 should be utilized for follow-up qualification checks every year, along with unannounced visits. This will reasonably assure the utility company that their respective contractors are still qualified under this safety program and guide.

This document is primarily concerned with qualifying safe and effective contractors to provide service to utility companies. However, since a major part of any safety system approach is to

ensure personnel involved with these operations have the knowledge commensurate with their duties, it is highly recommended that utility company personnel flying in the low-level wire environment, such as line patrol, infrared surveys or other low-level reconnaissance/survey activities, also be trained in the dynamics of the electric grid system. The HAI/UPAC Committee Wire Strike Avoidance Course, or a course similar to it, is recommended for both the contractor and utility company personnel.

Part 1 Contractor's Qualifications

Contractor's Qualifications. Any contractor to be used by the utility company for performing the services designated in this safety guide should possess the minimum qualifications and experience specified in this guide, in addition to all standards and requirements specified in the appropriate aviation regulations.

Operating Certificate(s): The helicopter contractor/operator should hold all necessary current and valid operating certificate(s) as a rotorcraft operator, issued by the appropriate government aviation regulating agency, with authorization for appropriate load classes they will be expected to carry.

Supplemental Type Certificates or Appropriate Field Approval: The contractor should hold a current and valid Supplemental Type Certificate of Field Approval issued by the appropriate government agency, when required, for any attachment of modifications that are made to the contractor's helicopter(s), to be used in performing specialized helicopter power line maintenance or other service for the utility company.

Airman Certification. All pilots, including back-up pilots, that will be performing the specified services must, as a minimum, a valid commercial helicopter license with the appropriate ratings for the work to be performed.

Flight experience is critical to flight safety. All pilots should have accumulated sufficient flight hours and completed the applicable necessary training to satisfy the requirements of the insurance underwriters and the utility company. A minimum of 250 hours of time in the type, make, and model is also recommended. The most important aspect to pilot experience is recency of operations, proficiency within the preceding 6 months and the previous training.

Much more important, however, in low-level utility operations, is the experience of operating in the low-level wire environment and the familiarity of the electric grid system dynamics. It is recommended that a minimum of three years cumulative operating experience in the low-level wire environment be required of each pilot that is to perform low-level operations or completion of a comprehensive training program designed and taught by personnel qualified and experienced in utility company patrol, construction and repair procedures. In addition, in the US there is also OSHA requirements for being a "qualified person" for workers to be within the minimum approach distance.

Since the degree of' skill to operate safely in the 69KV and lower voltages is greater than higher

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voltages, the pilot qualifications, listed in section 8 of the Helicopter Contractor Questionnaire, should include a break down of the time flown by voltage classification in patrolling, inspecting, repairing etc.

Helicopters: The contractor should provide helicopters that are appropriately certified, maintained and safe for the intended operation. Each helicopter should be equipped with the appropriate operable radio equipment and intercom system. Turbine powered helicopters are recommended because of reliability and reduced pilot work load.

Contractor Personnel: All contractor personnel involved with the on site work operation should be properly trained, qualified and certified by the contractor for the operations to be performed. If specialized (energized line work) work is to be performed, the pilot and crew member should be trained in the specialized procedures and practices as appropriate such as OSHA for US operations.

Safety Management System or Program: It is recommended that the contractor have an established safety management system or safety program in effect that incorporates principles of a safety management system, work and safety rules for employees, which are appropriate to their work duties and comply with appropriate civil government regulations. The safety management system program should, at minimum, include the recommendations found in this guide and ICAO Safety Management Manual (Doc 9859), or FAA Advisory Circular A-120, or the International Helicopter Safety Team's Safety Management System Tool kit. In addition, the operator should participate in the HAI Platinum Certification program.

Personal Protective Equipment: The contractor's personnel should have and use the personal protective equipment appropriate to their work duties. The following items are basic personal protective equipment (PPE) requirements for line work. Refer to governmental regulations and consensus standards for basic training, use, testing, care and maintenance of PPE. [In the US refer to OSHA 1910 Subpart I, 1926, Subpart E, ASTM F18 Standards.]

- Head protection
- Eye/Face protection
- Work gloves
- Hearing protection
- Respirators
- Clothing [OSHA 1910.269(1), ASTM F18]
    - Flame Resistant
    - Conductive
    - Rainwear
- Insulated Personal Protective Equipment
- Rubber gloves and sleeves
- Leather protectors for rubber insulating gloves and mittens

- Dielectric overshoes and insulated footwear

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- Conductive footwear

Compliance with Governmental Regulations: All flight and ground operations, including helicopter maintenance, should be performed in accordance with the applicable government's regulations. Nothing in this safety guide should be construed or applied to contravene applicable government regulations.

Insurance: The Contractor should have in full force and affect the insurance specified by the utility company. The following coverage is suggested as a minimum:

- Comprehensive Aviation Liability
- Comprehensive Legal Liability (as required)
- Automobile Liability (as needed)
- Workers Compensation (as required)

The contractor should provide a certificate of insurance in the amounts specified by the utility, name the utility as an additional insured and provide that the contractor or insurance company notify the utility in writing ten (10) days in advance of any cancellation.

On the next pages are sample Operator Questionnaires that may be used as guide to receive information about perspective operators prior to award of any contracts.

Part 2 Helicopter Contractor/ Operator Questionnaire

Section 1: Background								
Company:								
Mailing Address:								
Phone:		Fax:						
After Hours Phone:		Email:						
Key Person for Helicopter Requests:								
Senior Officer:								
Does your company qualify as a woman/minority owned business?				Yes		No		
Section 2: Current Operating Certificates								
Part 135 (USA operations) and only required for certain personnel transport flights and use requirements established by other countries)				Yes		No		
If yes, certificate #:		Issue Date:						
Part 133 (USA operations) and only required for certain external load operations and use requirements established by other countries)				Yes		No		
If yes, certificate #:		Issue Date:						
Section 3: Insurance (Provide copy of Insurance Certificate or Provide name of insurer)								
Section 4: Helicopters Available (Provide List of Available Helicopters)								

Make	**Model**	**Registration #**	**Number of Seats**	**External Load Capacity**

Section 5: Flight Services Available					
Line Patrol		Construction		Photo/Video	
Executive		Externals		Infrared	
Crew Support		Pole Set		Land Survey	

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Recon		Snow Survey		Line Stringing	
IFR		Other			

Section 6: Company Flight Hours							
Last 30 Days		Last 90 Days		Last 12 Months			
Section 7: Safety							
Has the company received a safety audit or inspection?			Yes		No		
Company OSHA Rate							
Company Accident History and Rate							
Agency/Company conducting the audit/inspection?							
Most recent audit or inspection date:							
Has the company established a formal safety program?			Yes		No		
Section 8: Pilot/Crew Qualifications							
Attach a list of qualified pilots who will fly for the utility company. Include the following information:							
Name.		Type license and number.					
Address.		Type of Physical Class I or II					
Phone Number(s).		Date of last flight physical.					
Total helicopter flight hours.							
Helicopter flight hours last 30 days.		Helicopter flight hours last 90 days.					
Total hours in support of utility industry: patrol, construction, line stringing, crew support, live-line, external loads							
Total number of accidents or incidents.							
Experience on specific voltages to be worked on or to be patrolled: 69KV and below and above 69KV. Employee Qualifications (Linemen)							
Names of utilities for which the pilot has previously worked, and the name of the person to whom he reported.							
Specific training received that would promote or enhance safe operations in the wire environment; include locations, dates and instructor's name.							
Section 9: Maintenance							
Attach a list showing name, address and phone number of support facility, which maintains helicopters, listed in Section 4.							
Section 10: References							

The contractor should furnish: Names, addresses and phone numbers of utility companies they have worked for in the last 24 months.

Signature (Contractor/ Representative) Date

Typed or Printed Signature

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Part 3 Utility Company Helicopter Contractor Checklist

Operator:			
Inspection performed by:			
Date:		Report Number:	

	Satisfactory/Yes	Unsatisfactory/No	N/A
1.Facility			
Appearance/Housekeeping	_____	_____	__
2. Verify Necessary Certificates			
Per Government agency	_____	_____	__
133 (US Operators only)	_____	_____	__
3. Verify Necessary Manuals			
Operations	_____	_____	__
External Load	_____	_____	__
Safety	_____	_____	__
Other	_____	_____	__
4. Aircraft			
Appearance	_____	_____	__
Radios and Intercom	_____	_____	__
Mission Equipment	_____	_____	__
5. Records			
Pilots/Crew:			
Correspond to Questionnaire	_____	_____	__
Verify Licenses	_____	_____	__
Verify Medical Certificate	_____	_____	__

Verify Experience	_	_____	_____
Verify Flight Time	_	_____	_____
Verify Accident Record	_	_____	_____
Verify Training	_	_____	_____
Live-Line Certification	_	_____	_____
Aircraft:			
Registration Numbers	_	_____	_____
Insurance	_	_____	_____
Maintenance Records	_	_____	_____
Airworthiness Certificate	_	_____	_____
Registration Certificate	_	_____	_____
FCC Permit	_	_____	_____
STC's or 337's (Per government regulation)	_	_____	_____
Maintenance:			
Facility, Appearance	_	_____	_____
Appropriate Certificates	_	_____	_____
Personnel Licenses	_	_____	_____
Personnel Training	_	_____	_____
Maintenance & Parts	_	_____	_____
Books			
Support Equipment:			
Vehicles for Field	_	_____	_____
Support			
Fueling Off-Field	_	_____	_____
Mission Equipment	_	_____	_____

Part 4 Draft Letter Format

Dear (Helicopter Company):

The (Utility Company) is currently seeking bidders to update current bid lists of qualified helicopter contractors.

We anticipate the work to include; (specify service(s) required i.e., line patrol, reconnaissance, photography, passenger transport, line stringing, construction, maintenance, disaster response etc.).

If you are interested in becoming a qualified contractor for (Utility Company Name), please review the attached Helicopter Contractor Evaluation and Selection Guide. Complete the accompanying questionnaire and return it in the enclosed envelope by (Date).

This requirement applies to operators who are currently on our approved contractor list, have a current purchase order, or those who wish to be considered.

After we have reviewed your completed questionnaire, we will contact you to discuss any questions we may have and arrange for an inspection of your records, equipment and personnel. After the inspection is complete, we will make the determination of approved contractor(s) that meet our needs.

If you have any questions, please contact (Contact person's name), at (Telephone number).

Sincerely,

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CHAPTER 7 - SAFETY WORKSHEETS, JOB HAZARD ANALYSIS EXAMPLES, ETC.

Section 1 Job Hazard Analysis

The following Risk Matrix was used to assign a probability and severity level to each of the identified hazards. The Probability and Severity level for each hazard are listed. Administrative and Physical barriers were used to mitigate the associated risks to an acceptable level.

Severity

Mishap severity is an assessment of the consequences of the most credible mishap that could be caused by a specific hazard. Mishap severity category is a categorization that provides a qualitative or quantitative measure of the most reasonable credible mishap outcome, resulting from personnel error, environmental conditions, design inadequacies, procedural deficiencies, or system, subsystem, or component failure or malfunction. Mishap severity categories are shown in Table 1 below.

TABLE 1	
Description	Environmental, Safety, and Health Result Criteria
Catastrophic	Death, permanent total disability, total loss of equipment/aircraft or irreversible severe environmental damage that violates law or regulation.
Critical	Permanent partial disability, injuries or occupational illness that may result in hospitalization, extensive damage but not a total loss of equipment/aircraft, or reversible environmental damage causing a violation of law or regulation.
Marginal	Injury or occupational illness resulting in one or more lost work days(s), minor damage to equipment/aircraft exceeding $10K but less than $200K, or mitigatible environmental damage without violation of law or regulation where restoration activities can be accomplished.
Negligible	Injury or illness not resulting in a lost workday, slight damage to equipment/aircraft exceeding $2K but less than $10K, or minimal environmental damage not violating law or regulation.

Probability

Mishap probability is the aggregate probability that a mishap will occur during the planned life expectancy of the system. It can be described in terms of potential occurrences per unit of time, events, population, items, or activity. Assigning a quantitative mishap probability to a potential design or procedural hazard is generally not possible early in the design process. At that stage, a qualitative mishap probability may be derived from research, analysis, and evaluation of historical safety data from similar systems. Supporting rationale for assigning a mishap probability is documented in hazard analysis reports. Mishap probability levels are a categorization that provides a qualitative or quantitative measure of the most reasonable likelihood of occurrence of a mishap resulting from personnel error, environmental conditions, design inadequacies, procedural deficiencies, or system, subsystem or component failure or malfunction. Qualitative mishap probability levels are shown in Table 2 on the next page.

Table 2	
Description	**Probability**
Frequent	**Likely to occur during the life of the product with a probability of occurrence of approximately 10^{-3} per flight hour. (1 in every 1,000 operations)**
Likely	**Likely to occur during the life of the product with a probability of occurrence of approximately 10^{-4} per flight hour. (1 in every 10,000 operations)**
Occasional	**Likely to occur during the life of the product with a probability of occurrence of approximately 10^{-5} per flight hour. (1 in every 100,000 operations)**
Remote	**Likely to occur during the life of the product with a probability of occurrence of approximately 10^{-6} per flight hour. (1 in every 1,000,000 operations)**
Improbable	**Likely to occur during the life of the product with a probability of occurrence of approximately 10^{-7} per flight hour. (1 in every 10,000,000 operations)**

Section 2 Mishap Risk Assessment

Mishap risk assessment is the process of characterizing hazards within risk areas and critical technical processes, analyzing them for their potential mishap severity and probability of occurrence, and prioritizing them for risk mitigation actions. Mishap risk classification by severity and probability can be determined by using a mishap risk assessment matrix. This

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assessment allows a mishap risk assessment code to be assigned to a hazard based on its severity probability. The risk assessment code is then used to rank different hazards according to their associated risk levels. The mishap risk assessment matrix is shown in Table 3 on the next page.

Mishap Risk Assessment Codes TABLE 3

PROBABILITY	SEVERITY			
	Catastrophic	Critical	Marginal	Negligible
Frequent	1	3	7	13
Likely	2	5	9	16
Occasional	4	6	11	18
Remote	8	10	14	19
Improbable	12	15	17	20

Section 3 Mishap Risk Categories

Mishap risk assessment codes are used to group individual hazards into mishap risk categories. The identified hazards associated with an aviation event or project each receives a RAC. The RAC representing the greatest risk (lowest RAC number) determines the overall event/project RAC. Table 4 includes a listing of mishap risk categories and the associated risk assessment codes. The event/project RAC is used in Table 4 to determine the Mishap Risk Category for the event or project. Mishap risk categories are used to identify the highest signature authority required for approval of an aviation event or project. Additionally, the UPAC JHA Preparer, Company Aviation Safety Officer, Director of Operations, and Manager are required to review and approve all JHA regardless of mishap risk acceptance level or risk category.

UPAC recommends that mishap risk assessment codes 1 through 5 constitute High risk, 6 through 9 constitute Serious risk, 10 through 17 Medium risk and 18 through 20 Low risk. The event/project risk assessor may at his/her discretion elevate the mishap risk category by one level in the absence of predicted levels of performance.

Mishap Risk Risk

Mishap Risk Assessment Code	Mishap Risk Category	Mishap Risk Acceptance Level
1 – 5	High	Owner
6 – 9	Serious	GM
10 – 17	Medium	DO
18– 20	Low	Chief Pilot/Pilot

TABLE 4 Categories and Mishap Acceptance Levels

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NOTE 1: The initial risk assessment should be performed by an Aviation Safety Officer (ASO) or other qualified personnel designated by the owner or manager.

NOTE 2: The Aviation Safety Officers should have safety oversight of all aviation operations. An ASO will perform an advisory review and provide comments for all work processes that have a mishap risk assessment code < 12. If the ASO advisory review results in a mishap risk acceptance code different than previously determined, the more severe mishap risk acceptance code will be used to determine mishap risk category and corresponding mishap risk acceptance level.

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Section 4 Class A and B Rotorcraft Load Combinations Job Hazard Analysis

For use by operators and companies involved with Rotorcraft Class A or B external load operations that will require operation of rotary-wing aircraft within the power line right-of-way.

JOB/WORK DEFINITION: Class A or B Rotorcraft Load Combinations					
Start Date:	**Customer:**			**Location/Destination:**	
Customer Requirements:					
Haz Mat Involved:	Yes:		No:		Provide Description of Haz Mat/DG:

Pre-Mission Work Package				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
Un-qualified operator or inadequate aircraft selected for operation.	2 High	All Commercial Aviation Service vendors should be assessed by a qualified official(s) prior to any flight operations and thereafter every two years, if a continuing need exists.	18	Low
Staging area inadequate for operation.	3 High	Staging area(s) will be established that will accommodate helicopter, support trucks, crews, and any other project equipment, without causing undue hazard to equipment and personnel. Final Approach and Take-Off Area (FATO): Length, width and diameter should be no less than: 1.5 X overall length of helicopter to be used plus a safety boundary of 12 feet. No wire or obstacle hazards should be located near approach or departure paths of staging area.	18	Low

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Pre-Mission Work Package				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
Aircraft takeoff and landing capability	5 High	No operation will be planned that exceeds the maximum gross weight of the aircraft given the density altitude of the planned departure, work site, and landing area. During pre-mission planning calculations will be made using the cargo load weight(s), A/C equipped weight, and average density altitude to ensure operation is within the capabilities of the FAA approved RFM.	19	Low
Inadequate equipment to accomplish the planned work.	5 High	The assigned aircraft will be capable of conducting the operation and rigging, longline(s), remote hook(s), and other special equipment will be on-hand and adequate for operations prior to commencing work. Equipment (longline) will be long enough to maintain 15'- 25' Obstacle clearance	19	Low
Crew Fatigue and Stress	6 Medium	Customer will be informed that pilot(s) will work no more than 14-hour duty day including transportation to and from work site. Maximum flight time will depend on cycles per flight hour (1 to 20 loads per flight hour = 8 flight hours max; 20 to 30 loads per flight hour= 6 flight hours max; 30 loads to 50 loads per flight hour= 5 flight hours max) Combined flight time will not exceed 8 flights per duty period	18	Low
Inadequate training or proficiency of the crews involved.	2 High	The assigned pilot will be current for the type of operation being conducted and qualified in the make and model of aircraft. Adequate ground crew will be available to accomplish the tasks to complete the work, which are trained and current for the planned operation.	18	Low

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	AVIATION JOB HAZARD ANALYSIS		
Activity Description:			Routing:
Activity Location:		Date of Activity:	
JHA Prepared by:		Date:	
Joint JHA considered?		(Yes, if more than one discipline is involved)	
Are written procedures required?		If so, attach copy.	
PERSONNEL INVOLVED (include engineers, other crafts, and other agencies)			JHA Review

WORK CREW				***OTHER PERSONNEL***	
Name	Init.	Name	Init.	Name	Init.

LIST OF SPECIAL EQUIPMENT AND TOOLS:

SPECIAL INSTRUCTIONS OR LIMITATIONS: Consider: (1) Energized equipment (2) Experience of work crew (3) Engineering expertise available (4) Clearances and grounding requirements (5) Emergency capabilities such as CPR, First Aid (6) List applicable sections of such standards as PSSM, PSOM.

a) LIST OF IDENTIFIED HAZARDS AND HOW TO MINIMIZE OR ELIMINATE THEM

ACTIVITY	IDENTIFIED HAZARDS	CORRECTIVE ACTION
Pre-mission Planning	**See Attachment 1**	**See Attachment 1**
Flight Operations	**See Attachment 2**	**See Attachment 2**

Prior to Starting Work at the Job Site

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Hazard Identification	RAC With No Controls	Administrative Controls (Risk Mitigation)	RAC Controls Established	TOTAL RAC
Un-qualified operator or inadequate aircraft selected for operation.	2 High	(Insert Organization's Name) verifies the CAS vendor is accepted for use prior to initiation of flight operations. (Insert Organization's Name) verifies CAS operator has the FAA Approved External Load Operations Manual in aircraft and aircraft in use is listed and placarded for operations.	18	Low
Inadequate training or proficiency of the crews involved.	3 High	(Insert Organization's Name) will validate the assigned pilot is current and proficient (Log book or Training records) for the type of operation being conducted and qualified in the make and model of aircraft. Pilot in command (PIC) ensures adequate ground crews are available to accomplish the tasks to complete the work and are trained and current for the planned operation.	18	Low
Staging area inadequate for operation.	5 High	Perform recon of staging area(s) to ensure it will accommodate helicopter, support trucks, crews, and any other project equipment. Final Approach and Take-Off Area (FATO): Length, width and diameter should be no less than: 1.5 X overall length of helicopter to be used plus a safety boundary of 12 feet. No wire or obstacle hazards should be located near approach or departure paths of staging area.	19	Low
Aircraft takeoff and landing capability	5 High	Pilot will complete weight and balance calculation considering current density altitude, actual cargo load weight(s), and aircraft (A/C) equipped weight to ensure A/C can be operated within the capabilities of the FAA approved Rotorcraft Flight Manual.	19	Low

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Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls** **(Risk Mitigation)**	**RAC Controls Established**	**TOTAL** **RAC**
Inadequate equipment to accomplish the planned work.	5 High	Pilot ensure adequate aircraft, rigging, long line(s), remote hook(s), and other special equipment are on-hand prior to commencing work. Equipment (longline) will be long enough to maintain 15- 25' Obstacle clearance	19	Medium
Crew Fatigue and Stress	6 Medium	Customer will be informed that pilot(s) will work no more than 14 hour duty day including transportation to and from work site. Maximum flight time will depend on cycles per flight hour (1 to 20 loads per flight hour = 8 flight hours max; 20 to 30 loads per flight hour= 6 flight hours max; 30 loads to 50 loads per flight hour= 5 flight hours max) Combined flight time will not exceed 8 flights per duty period	18	Low
Inadequate communications	5 High	PIC will ensure adequate communication systems (air-to-ground, ground-to-air, and to dispatch) are available and tested prior to operation. Any malfunction affecting the reliability and effectiveness of communications requires a STOP WORK until resolved	18	Low
Collisions with obstacles or hazards to flight	4 High	PIC will review maps and/or perform area recon above 500' AGL to identify all obstacles and hazards to flight. Adjust route of flight or longline lengths to avoid hazards.	14	Medium
Fuel starvation	8 Serious	Aircraft will be operated at all times with no less than 20 minutes of fuel reserve based on average Fuel Burn Rate for the aircraft in use.	12	Medium

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Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls** **(Risk Mitigation)**	**RAC Controls Established**	**TOTAL** **RAC**
Wire strike potential	1 High	Wire strike prevention kit installed on aircraft, if FAA approved for the model of aircraft. Note: If work involves landing crews on the infrastructure, then Wire Strike kits will pose a greater hazard to operations. In these cases rely on an area map or pilot recon completed and to establish route and altitudes for flight path to avoid static wires, conductors, etc.	11	Medium
Aircraft Mechanical Failures	8 Serious	The pilot will ensure all maintenance discrepancies are corrected prior to flight and the aircraft is airworthy and in safe condition for flight or inoperable equipment is deferred I/A/W FAA approved Minimum equipment List.	12	Medium
Engine Failure	8 Serious	The pilot will ensure all maintenance discrepancies are corrected prior to flight and maintenance is accomplished I/A/W the manufacturer's maintenance program, including compliance to airworthiness directives and retirement life schedules. Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew.	12	Medium
Tail Rotor Failure	8 Serious	The pilot will ensure all maintenance discrepancies are corrected prior to flight and maintenance is accomplished I/A/W the manufacturer's maintenance program, including compliance to airworthiness directives and retirement life schedules. Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew.	12	Medium

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Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
Hydraulic Control Failure	14 Medium	The pilot will ensure all maintenance discrepancies are corrected prior to flight and maintenance is accomplished I/A/W the manufacturer's maintenance program, including compliance to airworthiness directives and retirement life schedules. Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew.	19	Low
Remote Hook will not release load.	5 High	Pilot will prior to flight ensure the remote hook electrical connections to the airframe, long line, and remote hook are properly secured using electrical tape or other acceptable method. The pilot will brief ground crews prior to start of the job on the following: 1) methods of manually releasing the load from the remote cargo hook; 2) pilot will return to pick-up point to correct malfunction; or 3) in an emergency, the pilot will jettison the load from the "belly hook.	15	Medium

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Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls** **(Risk Mitigation)**	**RAC Controls Established**	**TOTAL** **RAC**
Long line snags on ground, trees or structures resulting in potential dynamic rollover.	5 High	Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew in the event of this emergency Prior to start, the pilot will visually check to verify if the long line is attached to the aircraft's belly hook and properly secured. If so, the pilot will verify the long line is extended out from the belly hook along the center-line of the aircraft to a point forward of the nose of the aircraft where the pilot while seated can visually observe the long line. The pilot will ensure the long line does not cross over any part of the landing gear. The pilot will use a vertical assent maintaining eye contact with the long line until clear of the landing zone or drop zone. The pilot will jettison the long line from the aircraft's "belly hook," if it becomes entangled.	10	Medium
Aircraft's "belly hook" fails to release electrically.	8 Serious	Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew in the event of this emergency. Pilot will jettison the load using the manual release.	19	Low
Loss of Control due to gusty winds.	4 High	Flight operations will cease when the maximum wind gust is in excess of 20 knots or a gust spread of 10 knots exists from the prevailing wind, or at the pilot's discretion.	12	Medium

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Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls** **(Risk Mitigation)**	**RAC Controls Established**	**TOTAL** **RAC**
Loss of tail rotor effectiveness (LTE)	5 High	Pilot will ensure aircraft is operated on approach, landing, and departure into the prevailing wind or within the wind azimuth established in the RFM. Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew.	15	Medium
Inadvertent IMC	4 High	External load flight operations will cease when the ceiling is less than 500 feet and visibility is less than 1/2 mile.	14	Medium
Aircraft penetrates building or structure during an emergency.	12 Medium	The pilot will ensure the aircraft is operated at an altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.	20	Low

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Section 5 Job Hazard Analysis for use on Class C Rotorcraft Load Combinations

For use by operators and companies involved with Rotorcraft Class C external load operations that will require operation of rotary-wing aircraft within the power line right-of-way.

JOB/WORK DEFINITION: Class C Rotorcraft Load Combinations				
Start Date:	**Customer:**	**Location/Destination:**		
Customer Requirements:				
Pre-Mission Work Package				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
Un-qualified operator or inadequate aircraft selected for operation.	2 High	All Commercial Aviation Service vendors should be assessed by a qualified official(s) prior to any flight operations and thereafter every two years, if a continuing need exists.	18	Low
Inadequate training or proficiency of the crews involved.	3 High	The assigned pilot will be current for the type of operation being conducted and qualified in the make and model of aircraft. Adequate ground crew will be available to accomplish the tasks to complete the work, which are trained and current for the planned operation.	18	Low
Staging area inadequate for operation.	5 High	Staging area(s) will be established that will accommodate helicopter, support trucks, crews, and any other project equipment, without causing undue hazard to equipment and personnel. Final Approach and Take-Off Area (FATO): Length, width and diameter should be no less than: 1.5 X overall length of helicopter to be used plus a safety boundary of 12 feet. No wire or obstacle hazards should be located near approach or departure paths of staging area.	19	Low

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Hazard Identification	RAC With No Controls	Administrative Controls (Risk Mitigation)	RAC Controls Established	TOTAL RAC
Aircraft takeoff and landing capability	5 High	No operation will be planned that exceeds the maximum gross weight of the aircraft given the density altitude of the planned departure, work site, and landing area. During pre-mission planning calculations will be made using the cargo load weight(s), A/C equipped weight, and average density altitude to ensure operation is within the capabilities of the FAA approved RFM.	19	Low
Inadequate equipment to accomplish the planned work.	5 High	The assigned aircraft will be capable of conducting the operation and rigging, longline(s), remote hook(s), bull rope, sockline, and other special equipment will be on-hand prior to commencing work. The Bell series aircraft's external load rigging will include adequate ballast to ensure full maneuverability of the aircraft.	19	Low
Inadequate puller-tensioner equipment.	3 High	The planning will include utilization of a puller-tensioner that is able to provide the equipment operator reliable braking and control during the pulls.	14	Medium
Crew Fatigue and Stress	6 Medium	Customer will be informed that pilot(s) will work no more than 14 hour duty day including transportation to and from work site. Combined flight time will not exceed 8 flights per duty period	18	Low
Cable or sockline snags during operation.	3 High	The puller-tensioner will be in the freewheel mode during all Class C loads and the operator must have clear unobstructed view of the cable or sockline dispensing from the top of the reel. The sockline used will be of a design and diameter that is not prone to snagging. (Avoid the use of 7/16" Spectron 12 line.)	13	Medium

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Inadequate aircraft communications	5 High	PIC will ensure adequate communication systems (air-to-ground, ground-to-air, and to crew) are available and tested prior to operation. Any malfunction affecting the reliability and effectiveness of communications requires a STOP WORK until resolved	18	Low
Hazard Identification	**RAC With No Controls**	**Administrative Controls** **(Risk Mitigation)**	**RAC Controls Established**	**TOTAL** **RAC**
Inadequate ground communications with equipment operator.	5 High	Adequate communication systems to include a hands free ability for the puller-tensioner equipment operator will be available and operable.	15	Medium
Fuel starvation.	4 High	Adequate preparation and planning will be made to accommodate refueling operations. No Class B or C load operations will be planned or conducted with less than 20 minutes reserve fuel on-board the aircraft considering the normal fuel consumption rate.	15	Medium
Loss of Control due to gusty winds.	4 High	No operation will be planned that allows external load operations to start or continue when the maximum gust is in excess of 20 knots or a gust spread of 10 knots exists from the prevailing wind.	12	Medium
Inadvertent IMC	4 High	No external load operation will be planned when the ceiling and visibility are less than 500 feet and 1/2 mile.	14	Medium

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	AVIATION JOB HAZARD ANALYSIS				
Activity Description:					Routing:
Activity Location:			Date of Activity:		
JHA Prepared by:			Date:		
Joint JHA considered?		(Yes, if more than one discipline is involved)			
Are written procedures required?		If so, attach copy.			
PERSONNEL INVOLVED (include engineers, other crafts, and other agencies)					JHA Review

WORK CREW				***OTHER PERSONNEL***	
Name	Init.	Name	Init.	Name	Init.

LIST OF SPECIAL EQUIPMENT AND TOOLS:

SPECIAL INSTRUCTIONS OR LIMITATIONS: Consider: (1) Energized equipment (2) Experience of work crew (3) Engineering expertise available (4) Clearances and grounding requirements (5) Emergency capabilities such as CPR, First Aid (6) List applicable sections of such standards as PSSM, PSOM.

LIST OF IDENTIFIED HAZARDS AND HOW TO MINIMIZE OR ELIMINATE THEM

ACTIVITY	IDENTIFIED HAZARDS	CORRECTIVE ACTION
Pre-mission Planning	**See Attachment 1**	**See Attachment 1**
Flight Operations	**See Attachment 2**	**See Attachment 2**

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Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls** **(Risk Mitigation)**	**RAC Controls Established**	**TOTAL** **RAC**
Un-qualified operator or inadequate aircraft selected for operation.	2 High	(Insert Organization's Name) verifies the vendor is accepted for use prior to initiation of flight operations. (Insert Organization's Name) verifies operator has the FAA Approved External Load Operations Manual in aircraft and aircraft in use is listed and placarded for operations.	18	Low
Inadequate training or proficiency of the crews involved.	3 High	(Insert Organization's Name) will validate the assigned pilot is current and proficient (Log book or Training records) for the type of operation being conducted and qualified in the make and model of aircraft. Pilot in command (PIC) ensures adequate ground crews are available to accomplish the tasks to complete the work and are trained and current for the planned operation.	18	Low
Staging area inadequate for operation.	5 High	Perform recon of staging area(s) to ensure it will accommodate helicopter, support trucks, crews, and any other project equipment. Final Approach and Take-Off Area (FATO): Length, width and diameter should be no less than: 1.5 X overall length of helicopter to be used plus a safety boundary of 12 feet.	19	Low
Aircraft takeoff and landing capability	5 High	Pilot will complete weight and balance calculation considering current density altitude, actual cargo load weight(s), and aircraft (A/C) equipped weight to ensure A/C can be operated within the capabilities of the FAA approved Rotorcraft Flight Manual.	19	Low
Inadequate equipment to accomplish the planned work.	5 High	The assigned aircraft will be capable of conducting the operation and the rigging, longline(s), remote hook(s), bull rope, sockline, and other special equipment will be on-hand in serviceable condition prior to commencing work. The Bell series aircraft's external load rigging will include adequate ballast to ensure full maneuverability of the aircraft.	19	Low

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Hazard Identification	RAC With No Controls	Administrative Controls (Risk Mitigation)	RAC Controls Established	TOTAL RAC
Inadequate puller-tensioner equipment.	3 High	Prior to initiation of the work the PIC will verify the operator of the puller-tensioner can provide reliable braking and control during the Class C operation.	14	Medium
Cable or sockline snags during operation.	3 High	The Pilot and Job Foreman will verify the puller-tensioner is in the freewheel mode and the operator has clear unobstructed view of the cable or sockline dispensing from the top of the reel. Check level-wind is in use or not. (preferred method--freewheel payout is without the sockline or cable passing thru level-wind) Pilot and Job Foreman will verify the sockline used is not 7/16" Spectron 12 line. If the work requires pulling sockline or cable over energized lines, then refer to company procedures to mitigate hazards.	13	Medium
Crew Fatigue and Stress	6 Medium	Customer will be informed that pilot(s) will work no more than 14 hour duty day including transportation to and from work site. Maximum flight time will depend on cycles per flight hour (1 to 20 loads per flight hour = 8 flight hours max; 20 to 30 loads per flight hour= 6 flight hours max; 30 loads to 50 loads per flight hour= 5 flight hours max) Combined flight time will not exceed 8 flights per duty period	18	Low
Inadequate communications	5 High	PIC will ensure adequate communication systems (air-to-ground, ground-to-air, and to dispatch) are available and tested prior to operation. Any malfunction affecting the reliability and effectiveness of communications requires a STOP WORK until resolved	18	Low

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Hazard Identification	RAC With No Controls	Administrative Controls (Risk Mitigation)	RAC Controls Established	TOTAL RAC
Collisions with obstacles or hazards to flight	4 High	PIC will review maps and/or perform area recon above 500' AGL to identify all obstacles and hazards to flight. Adjust route of flight or longline lengths to avoid hazards.	14	Medium
Fuel starvation	8 Serious	Aircraft will be operated at all times with no less than 20 minutes of fuel reserve based on average Fuel Burn Rate for the aircraft in use.	12	Medium
Wire strike potential	1 High	Wire strike prevention kit installed on aircraft, if FAA approved for the model of aircraft. Note: If work involves landing crews on the infrastructure, then Wire Strike kits will pose a greater hazard to operations. In these cases rely on an area map or pilot recon completed and to establish route and altitudes for flight path to avoid static wires, conductors, etc.	11	Medium
Aircraft Mechanical Failures	8 Serious	The pilot will ensure all maintenance discrepancies are corrected prior to flight and the aircraft is airworthy and in safe condition for flight or inoperable equipment is deferred I/A/W FAA approved Minimum equipment List.	12	Medium
Engine Failure	8 Serious	The pilot will ensure all maintenance discrepancies are corrected prior to flight and maintenance is accomplished I/A/W the manufacturer's maintenance program, including compliance to airworthiness directives and retirement life schedules. Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew.	12	Medium

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Tail Rotor Failure	8 Serious	The pilot will ensure all maintenance discrepancies are corrected prior to flight and maintenance is accomplished I/A/W the manufacturer's maintenance program, including compliance to airworthiness directives and retirement life schedules. Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew.	12	Medium

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Hazard Identification	RAC With No Controls	Administrative Controls (Risk Mitigation)	RAC Controls Established	TOTAL RAC
Hydraulic Control Failure	14 Serious	The pilot will ensure all maintenance discrepancies are corrected prior to flight and maintenance is accomplished I/A/W the manufacturer's maintenance program, including compliance to airworthiness directives and retirement life schedules. Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew.	19	Low
Remote Hook will not release load.	5 High	Pilot will prior to flight ensure the remote hook electrical connections to the airframe, long line, and remote hook are properly secured using electrical tape or other acceptable method. The pilot will brief ground crews prior to start of the job on the following: 1) methods of manually releasing the load from the remote cargo hook; 2) pilot will return to pick-up point to correct malfunction; or 3) in an emergency, the pilot will jettison the load from the "belly hook.	15	Medium

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Hazard Identification	RAC With No Controls	Administrative Controls (Risk Mitigation)	RAC Controls Established	TOTAL RAC
Sock line snags on structures resulting in dynamic rollover.	3 High	Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew in the event of this emergency Prior to start, the pilot will visually check to verify if the long line is attached to the aircraft's belly hook and properly secured. If so, the pilot will verify the long line is extended out from the belly hook along the center-line of the aircraft to a point forward of the nose of the aircraft where the pilot while seated can visually observe the long line. The pilot will ensure the long line does not cross over any part of the landing gear. The pilot will use a vertical assent maintaining eye contact with the long line until clear of the landing zone or drop zone. The pilot will jettison the long line from the aircraft's "belly hook," if it becomes entangled.	13	Medium
Aircraft's "belly hook" fails to release electrically.	8 Serious	Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew in the event of this emergency. Pilot will jettison the load using the manual release.	19	Low
Loss of Control due to gusty winds.	4 High	Flight operations will cease when the maximum wind gust is in excess of 20 knots or a gust spread of 10 knots exists from the prevailing wind, or at the pilot's discretion.	12	Medium

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Hazard Identification	RAC With No Controls	Administrative Controls (Risk Mitigation)	RAC Controls Established	TOTAL RAC
Loss of tail rotor effectiveness (LTE)	5 High	Pilot will ensure aircraft is operated on approach, landing, and departure into the prevailing wind or within the wind azimuth established in the RFM. Pilot will brief ground crews prior to start of the job on the emergency procedures, communications, and actions to be taken by the ground crew.	15	Medium
Inadvertent IMC	4 High	External load flight operations will cease when the ceiling is less than 500 feet and visibility is less than 1/2 mile.	14	Medium
Aircraft penetrates building or structure during an emergency.	12 Medium	The pilot will ensure the aircraft is operated at an altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.	20	Low

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Section 6 Sample Job Briefing

JOB BRIEFING

The employee in charge of each job shall ensure that a job briefing is conducted with employees involved in the work before a job is started and any time significant changes, which might affect the safety of the job, occur during the course of the work. The briefing shall cover at least the following subjects.

1. **Identify The Person-In-Charge For the Job**

2. **Hazards Associated With The Job**

    - What are the risks associated with this job?
    - What can go wrong?
    - What actions can be taken now to minimize those risks?

3. **Work Procedures Involved In The Job**

    - What are we going to do? How? Where? Who? When?
    - Are there tools, materials, machine equipment or work processes not used by the employees during the last 12 months? If so, the applicable safe work practices and processes must be reviewed. Also, make certain all employees have had the appropriate initial training.

4. **Special Precautions**

    - Are all employees physically able to perform the scheduled work?
    - Are all employees in good health today?
    - Have all applicable emergency procedures been reviewed?

5. **Energy Source Controls**

    - Have all potential sources of energy in the work zone been identified?

        Electrical *Chemical *Mechanical *Stored Energy *Other

    - Have proper clearances been obtained and verified?
    - Have proper right-of-ways been obtained?

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6. Personal Protective Equipment (PPE)

- Are all tools and equipment in safe, usable condition?
- Has equipment that requires it been properly tested and/or calibrated?
- What PPE is required for the job?
- Is all required PPE available, clean and in good repair?

Section 7 Pre-work Determinations

Determination of Existing Conditions

Before work on or near electric lines or equipment is started, a determination of existing conditions related to the safety of the work to be performed shall be made. Such conditions include, but are not limited to the following:

1. Nominal voltages of lines and equipment

2. The presence of hazardous induced voltages

3. The presence and condition of protective grounds

4. The presence and condition of equipment grounding conductors

5. The condition of poles

6. Environmental conditions relative to safety

7. The locations of circuits and equipment, including power and communication lines and fire protective signaling circuits

8. Any other conditions or circumstances which may affect job safety

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Section 8 Helicopter Emergency Medical Response Planning

This guidance is to assure that proper planning and preparation is made in the event of a medical emergency in the course of constructing, patrolling or maintaining power lines.

In the event of a medical emergency in the field it is crucial to immediately notify trained, qualified medical personnel to respond to the scene.

Liabilities associated with medical evacuation are such, that unless adequate planning and preparations are made prior to starting the job, the pressure to rely on the on-site helicopter, flight and ground crews may introduce human factor errors that may lead to further injury of the patient. Therefore, proper pre-job planning should include consideration of each of these items:

The development of a site-specific emergency response plan.

Is the onsite helicopter properly configured or capable of conducting a medical evacuation?

Is the onsite flight or ground crew properly trained to assess the nature or extent of trauma or to determine if the helicopter is adequate to accomplish an emergency medical evacuation?

Review the local Good Samaritan Laws to determine what restrictions there are when treating an injured person.

Contact the local law enforcement agency(s), fire, rescue, medical, etc., depending on jurisdiction. When working over water contact the appropriate boating Safety Unit or Coast Guard to inform them of the work location, possible landing zones and a description of the work to be performed.

Once an emergency plan is developed, it should be widely disseminated to the appropriate supervisors and flight crew and should be included in the daily “safety briefing” (Tail board, tail gate, etc.)

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CHAPTER 8 - HELICOPTER CLASS B HUMAN EXTERNAL CARGO (HEC)

Section 1 General Information

a) Purpose

The information contained herein is intended to provide information and suggested "best practices" for helicopter operators and utilities when developing, maintaining and/or training for their respective Class B HEC programs. The document sets out general principles for conducting Class B Human External Cargo (HEC) loads which, being general in nature, are not intended to define a legal standard of care. This document is not, and is not intended to be, all inclusive of every aspect of CLASS B HEC safety. The information contained in this document is not intended to take the place of approved helicopter flight manuals, operational manuals, Part 135 operations specifications, site-specific safety plans, or regulations issued by a controlling agency such as the Federal Aviation Administration or the Occupational Safety & Health Administration. In the event of any conflict, the aforementioned authorities should control over this document.

Persons may use the information contained in this document to make informed decisions, but should use their own independent judgment appropriate for a given situation. The ultimate judgment regarding safe operations should be made in consideration of all circumstances relevant to the specific situation.

b) Definitions

- Secondary Safety
    - A device, such as a Personal Safety Device (PSD) or approved secondary hook installation is intended to protect the external crewmember from an inadvertent release from the aircraft's primary attachment means.
- Sufficient Experience
    - Means sufficient training, knowledge, skills, proficiency and experience to recognize foreseeable hazards and to take appropriate mitigation measures to manage and minimize risks.

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- Safety Management System (SMS)
    - SMS can be defined as a coordinated, comprehensive set of processes designed to direct and control resources to optimally manage safety. SMS takes unrelated processes and builds them into one coherent structure to achieve a higher level of safety performance, making safety management an integral part of overall risk management. SMS is based on leadership and accountability. It requires proactive hazard identification, risk management, information control, auditing and training. It also includes incident and accident investigation and analysis.

- Personal Safety Device (PSD)
    - A PSD, also known as a belly band system, or emergency anchor, is used in helicopter external-load operations involving CLASS B HEC. This type of PSD is typically a strap that extends through the aft cabin doors around the helicopter's flooring and belly. It hangs beneath the helicopter between the landing gear and is to serve as a secondary safety means of attachment for the external crewmember. The PSD is intended to improve human external cargo (CLASS B HEC) safety by reducing the chance of an accidental cargo discharge in case the primary attaching means or release system fails.

- Crewmember
    - Individual that has completed the appropriate training and has demonstrated understanding and proficiency in general helicopter safety and CLASS B HEC operations; and performs an essential function in connection with the external-load operation; or is necessary to accomplish the work activity directly associated with that operation.

- Competent Person
    - Is one who, by way of training and/or experience, is capable of identifying existing and predictable hazards relating to the specific operation in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to a person, and who has the authority to take prompt corrective measures to eliminate them.

- Primary Attachment Means
    - Is the point at which the external load is connected to the helicopter (FAA approved Cargo Hook)

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Section 2 Task Summary

2-1 Description

The helicopter short-haul technique was originally researched and developed by Swiss Air Rescue (REGA) in 1966. Class B HEC gained popularity in Europe prior to 1970 as an effective rescue technique in mountainous areas. In 1970, National Parks Canada incorporated class B HEC (slinging) into their search and rescue program, where it is continues to be widely used.

In the early 1980's, Class B HEC was adopted and modified by a various agencies as well as the utility industry for use in a variety of missions and tasks. Helicopter shorthaul continues to be an effective tool in meeting safe and efficient operational objectives within these programs. The regulation, 14 CFR Part 133.35, allows a person to be carried during rotorcraft external-load operations when that person:

(1) Is a flight crew member;
(2) Is a flight crewmember trainee;
(3) Performs an essential function in connection with the external-load operation;
(4) Is necessary to accomplish the work activity directly associated with that operation.

2-2 Application

CLASS B HEC has become an essential tool within the power utility industry and has proven to be a safe and efficient means of conducting numerous tasks. Pilots and operators should conduct a thorough safety analysis of any proposed CLASS B HEC operation to ensure that the use of class B HEC is appropriate to the mission and that a proper hazard analysis has been conducted.

Some examples of CLASS B HEC tasks that have proven to be safe and efficient are:

- Operations utilizing a Bosun's Chair or Air-Chair o
  Marker Ball installation
  o Installation or removal of armor rod
  o Installation of Travelers

- Placement of crewmembers at an elevated position
  o Structure
  o Baker Boards

Section 3 Recommended Minimum Standards

The standards set forth herein are intended as guidelines to reflect "best practices" within the utility and helicopter industry. Each operator should ensure that each pilot and crew member has a complete understanding of their roles and responsibilities, willingness to perform the work and

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has demonstrated a satisfactory level of knowledge and proficiency within the particular task.

3-1 Helicopter Operator Qualifications

Helicopter operators involved in CLASS B HEC operations should understand the increased responsibility involved in conducting such operations. In addition to an operator's basic requirements under FAR Part 133 for class B external load operations, an operator should develop additional written training and procedural guides in order to establish specific company policy and procedures as they pertain to CLASS B HEC.

These additional policies and procedures should include, but not limited to:

- CLASS B HEC Operations
- CLASS B HEC Training
- Safety Management System (SMS) which has been customized to the specific operator
- Crew Resource Management (CRM) Policies, procedures and training
- Written Roles and Responsibilities for each functional position in the operation
    - o Pilot
    - o Mechanic
    - o Ground Support
    - o Linemen
    - o Crewmembers

Additionally, any operator conducting CLASS B HEC operations within the power utility industry should have sufficient experience and understanding of the inherent risks associated with power line construction, maintenance and general operations within the wire environment.

3-1.1 Drugs & Alcohol

Operators should take all reasonable measures to provide a drug and alcohol free workplace. The operator should have in place and ensure that all employees comply with a substance abuse and drug and alcohol policy that includes pre-employment testing, reasonable suspicion testing, post-incident testing, and otherwise meets or exceeds the requirements of all applicable federal, state and/or local statutes and regulations.

3-1.2 Personnel Qualifications

CLASS B HEC operations demand a high level of willingness, commitment, skill, communication and coordination on the part of the pilot in command as well as the crewmembers working on and around the aircraft. Operators and utilities should have written minimum standards that apply toward those individuals seeking to conduct CLASS B HEC operations. Operators should develop and employ methods of demonstration and testing which are designed to verify that an individual has sufficient experience and is able to conduct the task safely. Additionally, operators should establish minimum experience and proficiency criteria in

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order to ensure that each person involved in CLASS B HEC has sufficient experience and proficiency within aircraft operations of similar scope as well as the proper attitude toward safety standards and procedures. The minimum qualifications outlined herein are intended to help identify those individuals with sufficient past experience and that an operator may consider a candidate for the continued CLASS B HEC training outlined within Section C-2.

3-1.3 Pilot Qualifications

Helicopter pilots selected to perform CLASS B HEC operations should have past experience within the power utility industry and be trained for safe operations within the wire environment. Operators should establish minimum sufficient experience levels to serve as a basic qualification threshold. One consideration of such minimum experience may be;

- 2000 hours as pilot in command in helicopters
- 500 hours of vertical reference long line experience
- 200 hours as pilot in command in specific type of the helicopter to be used in the CLASS B HEC operation
- 200 hours as pilot in command conducting precision vertical reference, long line operations
- Knowledge of the electrical hazards and "hands on" work to be conducted
- Fitness for duty and physical or psychological limitations
- Communications limitations
- Attitude and aptitude
- Flight operation hazards within the wire environment

3-1.4 Crewmember Qualifications

Not all crewmembers will be comfortable with or qualified to perform CLASS B HEC work. All crewmembers should be selected for CLASS B HEC work on a voluntary basis. Crewmembers selected should be qualified for CLASS B HEC operations based on:

- Experience level
- Knowledge of aircraft limitations including weight limitations for power margins
- Knowledge of the "hands on" work to be conducted
- Fitness for duty and physical or psychological limitations
- Communications limitations
- Attitude and aptitude

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3-2 Training

Thorough training of both pilots and crew members is critical to safely conducting CLASS B HEC operations. The following topics should be developed and integrated into a company's CLASS B HEC training program.

- General Helicopter Safety Training
- Regulations
  - Each pilot and crewmember should be aware of the applicable regulations pertaining to CLASS B HEC operations
- Company specific requirements and limitations

3-2.1 Pilot Training

Helicopter operators should select only those pilots that have demonstrated a sufficient level of experience, skill and ability within class B vertical reference operations. CLASS B HEC pilot training should be conducted by an operator's chief pilot or the chief pilot's qualified designee. Pilot training should be conducted and documented in accordance with the operator's CLASS B HEC training program and should contain, but is not limited to, the following minimum curriculum:

- Knowledge and skill training in accordance with 14 CFR 133.37
- Demonstrated proficiency with precision vertical reference load placement
- Proper load configuration, use and application of CLASS B HEC
- Installation, inspection and operation of secondary safety device(s)
- Acceptance or rejection criteria of HEC long lines, chairs and/ or harnesses
- Risk Analysis and mitigation
- Crew Resource Management (CRM)
- Communication
- Normal /abnormal and emergency procedures pertinent to CLASS B HEC operations
- Electrical wire environment hazards
- Fuel management

3-2.3 Crewmember Training

Crewmembers working on or around the helicopter should be trained by a competent person in the following areas:

- Task specific operations
- Equipment, inspections, acceptance or rejection criteria of HEC long lines, chairs and/ or harnesses
- Risk analysis and mitigation
- Crew Resource Management (CRM)
- Communication

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    - Emergency procedures pertinent to CLASS B HEC operations
    - Ground
    - Flight
- Mock up training and review of:
    - Rigging inspection, acceptance or rejection criteria of equipment
    - Communication procedures
    - Simulation of task (both crew and pilot tasks)
- Documented completed proficiency on all of the above

Each company or utility is responsible to ensure that the individuals providing crewmember training have sufficient experience with CLASS B HEC operations, safe rigging, and fall protection. Additionally, competent instructors should have working knowledge and understanding of the particular risks associated with the specific project being conducted.

3-2.3 Recurrent Training

Both pilots and crew members should receive recurrent CLASS B HEC training at intervals which should not exceed twelve months. Additional training should be conducted and documented for each new project or when the mission profile is significantly modified.

3-2.4 Recency Experience

Each operator should have a recency experience program that is designed to ensure each pilot and crewmember is prepared to perform CLASS B HEC safely and has conducted CLASS B HEC or equivalent precision operations within a 45 day period of time. An individual's recency experience should be within the specific companies operations and should not carry over from outside experience.

3-3 Project Planning

Prior to any class B HEC operation, the helicopter operator should conduct an assessment of the proposed operations to determine the overall feasibility and associated risk of the proposed task. Consideration should be given to the following minimum categories

- Type of work to be done
  o Energized / De-energized
- Hazard identification and mitigation
- Use of CLASS B HEC as opposed to alternate methods
- Aircraft, equipment and personnel required to complete the work
- Structure design, and dimensions, age and condition
- Landing Zone Placement as close to work site as possible □ Minimum Approach Distance (MAD)
- Consideration of a crewmember's exposure to:
  o Suspension in a harness

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- o Wind and extreme temperatures
- o CLASS B HEC in the wire environment
- Pilot fatigue due to vertical reference positioning

3-4 Pre-work Briefing / Training

A pre-work briefing should be attended by all persons associated with the project and is intended to convey all critical information related to the work task. This briefing should focus on the project's broad scope and provide specific training related to:

- All items contained in the project planning
- Site Specific Safety Plan
- Electrical Clearances
- Job Hazard Analysis (JHA)

3-4.1 Daily Tailboard Briefing

The daily tailboard should be attended by all persons involved in the work task for that particular day. The briefing should cover the previous day's events along with any observations, concerns and newly identified risks or hazards. Additionally, this briefing should cover:

- Defining the core operational and individual tasks for the day
- Identify specific hazards
- Discuss hazard and risk mitigation
- Communication Issues
- Weather conditions and forecasts
  - o Wind gusts, lightning or other weather factors that could increase risk
- Minimum Approach Distance
- Any revisions to the site specific safety plan
- Universal "stop work" authority
- Pre-work reconnaissance flight
- PPE appropriate for the task
- Review key points of the Emergency Action Plan
- Daily allowable load calculation

An additional tailboard briefing should be conducted upon any significant change in the daily operations or request for a new task which was not covered by the daily tailboard

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Section 4 Recommended Procedures

4-1 Personal Protective Equipment (PPE)

Personal protective equipment (PPE) should be worn by all personnel conducting CLASS B HEC operations. PPE for electrical workers (crewmembers) should comply with Title 29 of the Code of Federal Regulations (CFR), Part 1910 /1926, and equivalent regulations in states with OSHA-approved plans.

PPE should consist of the following as required:

- Head protection (Helmet or hard hat with three point chin strap)
- Eye protection (Goggles or helmet visor)
- Hearing protection
- Cotton, Flash Resistant (FR) or conductive clothing
- Gloves (Leather or Nomex)
- Boots (Should provide adequate foot and ankle protection)
- Class III Full body harness
- Safety lanyard with fall arrest
- Emergency floatation device

4-2.1 Equipment Inspections

A visual inspection of all rigging components of the CLASS B HEC system should be conducted daily prior to any CLASS B HEC operations. Equipment should be closely inspected for any signs of damage or wear that would deem a particular piece of equipment unserviceable. Additionally, periodic inspections should be conducted in accordance with the equipment manufacturer's directives and instructions for continued serviceability. Any component that has any evidence of damage or excessive wear should be immediately taken out of service and replaced.

4-2.2 Secondary Safety Device

A Secondary Safety Device or Personal Safety Device (PSD) should be used to prevent the inadvertent release of the Crewmember. Any secondary safety device shall have the ability to allow the pilot or qualified crew member to jettison the load. The purpose and discussion of the use of a PSD is covered by Federal Aviation Administration InFO letter 12015, dated 9/10/2012.

4-2.3 CLASS B HEC Lines

Lines used for CLASS B HEC require meticulous selection, care, inspection and storage. All lines used for CLASS B HEC should:

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- Be spliced by a certified individual or entity using the manufacturers guidelines
- Be serial numbered and traceable
- Be labeled with a WLL (Working load limit)
- Have a Minimum Break Strength 10 times the working load limit.
- Be nonmetallic
- Be Non-rotational
- Be sufficiently weighted to prevent the empty line from making contact with the tail rotor

Ropes equipped with any type of conductive cable or extension cord should not be used for CLASS B HEC operations.

Note: Contaminates and/or moisture on the CLASS B HEC line can increase the risk of conductivity.

4-2.4 Harnesses

Harnesses used for CLASS B HEC should be class 3, Full body style harnesses with a D-ring for hookup, a dorsal D-ring for fall protection and other hookup provisions as necessary. For longer flights (usually more than 15 minutes), a harness with an integrated seat should be used to prevent adverse health consequences such as suspension trauma. Orthostatic intolerance and other suspension trauma can occur when suspended for long periods of time and should be addressed with proper harness selection and fit.

Newer, specially designed ergonomic harnesses, or harnesses with integrated seats which reduces suspension trauma.

4-2.5 A-Frame and Carabiner Attachments

If an A Frame and carabiner is utilized to connect the CLASS B HEC line with the crew member's harness, the A-Frame or attachment device should be ANSI Z359 rated with a dual action release gate.

4-3 Aircraft

Single or twin engine helicopters that are authorized under an operator's 133 ops specs, may be used to perform Class B HEC. The following aircraft related minimums should be observed when conducting Class B HEC.

- Aircraft performing HEC must have sufficient power available to hover out of ground effect at all times during the flight.
- Aircraft must have power available verified each day through a documented power assurance check.
- Under the conditions which an aircraft's allowable gross weight with a jettisonable load is greater than the internal gross weight limitation, the internal load limit should

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not be exceeded when performing Class B HEC. This is intended to provide an added margin of aircraft performance safety.

4-4 Aircraft Maintenance

Aircraft used for Class B HEC should be meticulously maintained in accordance with 14 CFR Parts 91 and 43 as well as the manufacturers or operator's FAA approved maintenance program. Operators should ensure that aircraft are being inspected daily in accordance with the manufacture's preflight procedures.

4-5 Aircraft Fuel Management

Each operator conducting CLASS B HEC should develop and maintain a system which is designed to ensure that fuel quality checks are being conducted prior to each daily operation and that fuel quantity onboard the aircraft is continually monitored by a method involving the pilot and fueling personnel.

4-5.1 Daily Fuel Quality Inspection

Daily quality inspections should be conducted in accordance with sections 9-3 of this guide and should be documented and signed off by a qualified person who is properly trained in fuel testing procedures.

4-5.2 Fuel Quantity Monitoring

A fuel quantity monitoring system should be utilized to provide the pilot with assistance in tracking fuel quantity/ flight time. The system should enable a designated competent person to track and log the quantity of fuel transferred into the aircraft and calculate a corresponding time in which to communicate with the pilot when fuel levels may be low. At no time should an aircraft land with less than 20 minutes of fuel remaining. The fueling person should be in radio communication with the pilot, tracking the duration of the operation, and assist the pilot in warning them of a possible low fuel condition.

4-6 Landing Zones / Base of Operation

Landing Zones or CLASS B HEC base of operations should be located as close to the work area as practicable in order to limit the crew's time in suspension under the helicopter.

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4-7 Operational Safety Considerations

- Each aircraft used for CLASS B HEC operations should be subject to daily engine power assurance checks and trend monitoring.
- No Green on Green
  - When selecting crewmembers for Class B HEC, care should be given to ensure that those individuals with the least experience and knowledge, be paired with qualified crewmembers experienced in Class B HEC operations.
- Transfers of crewmembers to and from structures should be limited to two persons on the line at any given time.

4-8 Communications

Prior to any CLASS B HEC operation, it is essential that all crew members and the pilot have established a clear method of communication. This may consist of head or hand signals and/or two way radio or Bluetooth connection. Communications should be tested prior to each daily operation and should there be any type of communication failure or confusion, operations should be stopped until clear communications are restored.

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CHAPTER 9 - HELICOPTER RAPID REFUELING PROCEDURES

Section 1 Background

These Helicopter Rapid Refueling (HRR) guidelines are established to acknowledge the generally accepted practices and procedures utilized by operators to refuel helicopters with the engine(s) running and the blades turning. It can also be used as a training aid to create HRR procedures and to dispel any misconceptions that may exist about this process. Helicopter Rapid Refueling is a procedure safely employed by operators world-wide every day.

This document is intended to provide guidance for kerosene-type turbine fuels only classified as combustible liquids with a flashpoint above 38˚ C (100˚F).

Section 2 Definitions

1. ANSI Z-87.1 – American National Standards Institute: American National Standard for occupational and educational eye and face protection. This standard sets forth criteria related to the general requirements, testing, permanent marking, selection, care, and use of protectors to minimize the occurrence and severity or prevention of injuries from such hazards as impact, non-ionizing radiation and chemical exposures in occupational and educational environments including, but not limited to, machinery operations, material welding and cutting, chemical handling, and assembly operations.
2. BC fire extinguishers – Fire extinguishers that are capable of extinguishing Class B & C fires: Class B fires – A fire in Flammable liquids, combustible liquids, petroleum greases, tars, oil-based paints, solvents, lacquers, alcohols, and flammable gases. Class C fires – A fire that involves energized electrical equipment where the electrical non-conductivity of the extinguishing media is of importance.
3. Bladders – A collapsible container used to store, transport or dispense aircraft fuel.
4. Closed Circuit Refueling – is a system of refueling aircraft in which the fuel nozzle mates with and locks into the aircraft fuel port.

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5. Contamination – Any foreign substance not part of the chemical composition of aircraft fuel such as water, dirt, algae, or any foreign object or material.
6. Drum – A cylindrical steel or plastic-type container with flat ends usually 55 gallons in size. These containers normally have two openings (bungs) on one end of the container. One for extracting or filling, the other for venting.
7. EH rated safety toe work boots – Boots or shoes with Electrical Hazard Protection that meet ANSI Z41 PT99 standards to provide protection from open circuits. The soles of Electrical Hazard Safety boots or shoes provide a safety barrier to protect employees from open electrical currents up to 600 volts.
8. Electrical bond – means the practice of intentionally electrically connecting non-current carrying metallic items as protection from electric shock.
9. Electrical potential – means the difference in electrical charge between two points expressed in volts.
10. Electrostatic charge – is the electrical charge at rest on the surface of an insulated body.
11. 11.Flame Resistant clothing – is clothing designed to protect persons exposed to flame or flash hazards in the workplace. It is also known as "FR" clothing.
12. Flash hazard – is a dangerous condition associated with the release of energy caused by an arc. (2004 NFPA 70E)
13. Fueler – For the purpose of this document is the properly trained individual who dispenses the fuel into the aircraft from the fuel source.
14. GPM – Abbreviation meaning "Gallons Per Minute".
15. Open port – is a system of refueling an aircraft in which the fuel port is open to the atmosphere.
16. Operator – Any entity that has the operational control to initiate, conduct or terminate a flight, and in regards to this document – a helicopter.
17. Portable containers – are moveable containers or any container not permanently affixed used to transport or transfer fuel into or from an aircraft.
18. PPM – Abbreviation meaning "Parts Per Million".
19. Spills – A reference to an inadvertent release of petroleum products into the environment.
20. Tank vehicles – A vehicle having a cargo tank (tank truck, tank full trailer, tank semi- trailer) designed for or used in the transportation and transfer of fuel into or from an aircraft. (2012 NFPA 407)

Section 3 Procedures

The procedural guide is a list of items that are recommended to be included in a Helicopter Rapid

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Refueling procedure.

1. Inspection of fuels (applicable to all fueling operations): The first step to a safe Rapid Refueling operation is to confirm the integrity of the fuel that is to be dispensed. This includes the vendors who are selling the fuel, and the end user who will be rapid refueling their aircraft with this product.
2. It is recommended that fuel is purchased only from vendors that have fuel handling policies and procedures in place that prevent contamination of the product.
3. For tank vehicles – Fuel should be inspected at a minimum prior to moving the vehicle that will be dispensing the fuel at the beginning of the work day. If the vehicle has been loaded at the beginning of the work day, the fuel should be allowed to settle in the containers before sampling. A general guide to follow would be to allow the fuel to settle for 1 hour per every tank-foot of depth prior to sampling.
4. For drums or other portable containers – Fuel should be inspected prior to dispensing from the container. Methods of inspecting fuel –
    a) By viewing a sample taken from the lowest point of the vehicle, or container.
    b) By looking inside each container,
    c) Using water-detecting paste – that changes color when water is present in the fuel, or
    d) A fuel quality test kit that detects solids & water in suspension in ppm. NOTE: This method does not require the settling times required of other inspection methods.
5. Elimination of fuel contaminants: Some contaminants can be eliminated from fuel by simply sumping the contamination out of the container. Others may require additional filtration. It is recommended that all fuel be filtered from the supplier to the vendor, from the vendor to the operator, and from the operator to the helicopter. As a last stage barrier, a spring-loaded cap over the dispensing nozzle will prevent contaminants from entering the nozzle which will be inside the helicopter fuel filler port when dispensing fuel.
6. Containers or tanks should keep their filler caps closed at all times, except during filling, or changing tanks (in multi-tank systems). It is also recommended NOT to fill tanks or service aircraft during periods of precipitation. If it becomes necessary to service a tank or aircraft during periods of precipitation, extreme caution must be observed to prevent foreign matter from entering the filler port of the tank or

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Section 3 Procedures

The procedural guide is a list of items that are recommended to be included in a Helicopter Rapid Refueling procedure.

1. Inspection of fuels (applicable to all fueling operations): The first step to a safe Rapid Refueling operation is to confirm the integrity of the fuel that is to be dispensed. This includes the vendors who are selling the fuel, and the end user who will be rapid refueling their aircraft with this product.
2. It is recommended that fuel is purchased only from vendors that have fuel handling policies and procedures in place that prevent contamination of the product.
3. For tank vehicles – Fuel should be inspected at a minimum prior to moving the vehicle that will be dispensing the fuel at the beginning of the work day. If the vehicle has been loaded at the beginning of the work day, the fuel should be allowed to settle in the containers before sampling. A general guide to follow would be to allow the fuel to settle for 1 hour per every tank-foot of depth prior to sampling.
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    a) By viewing a sample taken from the lowest point of the vehicle, or container.
    b) By looking inside each container,
    c) Using water-detecting paste – that changes color when water is present in the fuel, or
    d) A fuel quality test kit that detects solids & water in suspension in ppm. NOTE: This method does not require the settling times required of other inspection methods.
5. Elimination of fuel contaminants: Some contaminants can be eliminated from fuel by simply sumping the contamination out of the container. Others may require additional filtration. It is recommended that all fuel be filtered from the supplier to the vendor, from the vendor to the operator, and from the operator to the helicopter. As a last stage barrier, a spring-loaded cap over the dispensing nozzle will prevent contaminants from entering the nozzle which will be inside the helicopter fuel filler port when dispensing fuel.

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6. Containers or tanks should keep their filler caps closed at all times, except during filling, or changing tanks (in multi-tank systems). It is also recommended NOT to fill tanks or service aircraft during periods of precipitation. If it becomes necessary to service a tank or aircraft during periods of precipitation, extreme caution must be observed to prevent foreign matter from entering the filler port of the tank or aircraft. Some operators may use rain gutters over their aircraft fuel ports that prevent water from dripping into the filler neck.

7. Dispensing: It is recommended that a rapid refueling dispensing procedure (open port) include provisions for the following:

    a) The location of the refueling area should be appropriate for the operation and based on following considerations: Safety of Personnel, Property, environmental, and any other job-specific requirements.

    b) The helicopter should be at flat pitch and the engine at ground idle.

    c) A pilot at the controls.

    d) The dispensing vehicle should be a safe distance away from and outside the arc of the rotating main rotor blades.

    e) The helicopter will be absent of any passengers.

    f) Communications between the fueler and the pilot has occurred so the fueler knows the correct amount of fuel to dispense.

    g) Before fueling, the aircraft must be bonded to the fuel source to equalize the static electricity between the fuel source and the aircraft.

    h) Upon completion of servicing the helicopter with fuel, and prior to turning away from the helicopter, the fueler will re-install the fuel cap on the helicopter.

    i) The fueler will then remove the bonding cable from the helicopter, return the bond(s) and fuel nozzle back to the re-fueling system, confirm that the bond(s) and hose are clear of the aircraft, and re-check that the fuel cap is installed.

    j) The passengers (if any) will board the helicopter with the assistance of the fueler and/or ground crew, and the fueler/ground crew will confirm that all seat belts and doors are secured.

    k) The fueler will signal or via radio communication inform the pilot from the front of the aircraft that he is clear to depart.

    l) At the end of this process and after the helicopter has departed, the fueler should perform a post service inspection of the system to insure that all pumps and valves are off, and for evidence of leaks or spillage.

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8. Personal Protective Equipment (PPE): Operators performing Helicopter Rapid Refueling operations should provide PPE for all exposed individuals.

    a) At a minimum, protection should be provided for splash (bodily contact), high noise levels and flash hazards. Protection for these hazards has been known to include:

        i. Flame Resistant clothing (FR), all cotton or wool clothing, long sleeve shirts with sleeves down, long-legged trousers, cotton or wool undergarments.

        ii. Leather or petroleum resistant gloves.

        iii. ANSI Z-87.1 Safety glasses, Safety-rated prescription eye glasses with side protectors, or goggles. If a flight helmet is used, the visor must be lowered, or the eye safety listed prior must be worn with the flight helmet.

        iv. If a hard hat is worn, a chin strap must be installed and used.

        v. Many electric utility job sites require EH rated safety toe work boots, or shoes. It is recommended that, at a minimum, leather work boots with petroleum resistant soles be used during this operation.

        vi. Hearing protection (ear plugs, muffs, or flight helmet).

9. Fire protection: Rapid Refueling at unimproved remote sites can provide opportunity for fires to ignite. Sources for ignition can be the helicopter exhaust, and or the idling refueling vehicle exhaust. It is recommended that no smoking or spark producing activity be within fifty feet of the rapid refueling operation. It is also recommended to have available to the fueler an appropriately rated BC fire extinguisher(s). A cockpit fire extinguisher should also be available to the pilot.

10. Personnel not involved: Personnel not involved should be escorted at least fifty feet away from the operation prior to commencing Helicopter Rapid Refueling. No boarding or unloading should be allowed during Rapid Refueling operations.

11. Spills: A spill kit should be present and available during Helicopter Rapid Refueling operations. Precautions must be taken to eliminate and prevent spills, such as:

    a) Holding the fuel nozzle upright enroute to the helicopter with the nozzle cap in place, and

    b) Maintaining vigilance to the rate of flow and the visible fuel level.

    c) A spill response action plan should be in place and known by all persons involved with Helicopter Rapid Refueling operations. Items of this plan should include:

        i. Precautions to take to prevent spills,

        ii. The location and use of the spill kit,

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iii. What to do in the event of a spill, and

iv. Who to notify in the event of a spill.

12. Drums: Helicopter Rapid Refueling from drums should only be accomplished during an emergency or under very controlled conditions in accordance with applicable regulations, or company procedures. See attached list of reference documents for additional guidance on refueling from drums.

13. Vehicles: Vehicles used to transport and dispense turbine fuel should comply with the applicable Motor Vehicle Safety Regulations, and state or local ordinances. Persons operating the vehicle should be licensed and properly endorsed for the vehicle configuration. The size and type of containers used to hold the fuel will determine if placarding is required.

14. Closed circuit: Closed circuit fueling is an alternate system of refueling in which the nozzle mates, seals and locks with the fuel filler port. Closed Circuit Refueling (CCR) systems are similar to open-port (gravity-fed) systems with the following differences:

    a) The CCR nozzle: Several different types of nozzles exist for CCR. They are comprised of a cam-lock coupler, and a valve that remains closed so that fuel cannot flow unless the nozzle is mated to the port. The CCR nozzle can be operated at greater flow rates than open port type nozzles.

    b) The CCR filler port: This port is built into the aircraft. It includes a float-operated valve that controls the flow of fuel into the tank(s). The valve is set to close at a certain fuel level. The valve closes automatically if the flow rate exceeds the aircraft's maximum rate of flow. The device that mates to the CCR nozzle is recessed inside the receiver. On some filler ports, a bypass opening covered by a sliding panel positioned inside the receiver in the space between the outside dust plug and the mating device. When this panel is slid aside, an opening is exposed that will allow for gravity (open port) fueling. Another variation of this feature involves the CCR filler port mounted on a hinged panel that swings inward when unlatched to allow access for open-port type fueling.

    c) Fuel pump system: The fuel pump is normally rated for greater flow rates (GPM) than the open port type systems.

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d) Bonding: An electrostatic charge may accumulate on the surface of the aircraft or fueling vehicle when conditions are favorable. Ensuring that the helicopter is bonded to the fueling equipment so that the two cannot have a difference in electrical potential can eliminate the hazard of sparking. Prior to Helicopter Rapid Refueling operations, verify that the refueling system is electrically bonded together. The system should have bonding wires and clamps adequate to facilitate prompt, definite electrical connection between the refueling equipment, and the helicopter. Before the helicopter's fuel cap is opened, bond the helicopter and fueling equipment by connecting a bonding wire between designated points on clean, unpainted metal surfaces of both the aircraft and the fueling equipment. If so equipped, also prior to opening the fuel cap, ensure the fuel nozzle is bonded to the helicopter. The bonding connections should remain in place until the nozzle and hose has been removed and the filler cap replaced.

Section 4 Refueling System Considerations

Many different kinds of refueling systems are used for HRR operations. They vary in size and design from 55 gallon drums to multi-thousand gallon vehicles, tanks, or bladders. ALL systems either purchased or fabricated should conform to the applicable regulations and guidelines for vehicles, tanks, bladders, fuel pumps, hoses, nozzles, and filtration systems.

Section 5 Training

All personnel who are involved with HRR operations should be trained in the safe techniques and procedures prior to conducting these operations. Persons involved with HRR operations should be trained initially upon their hiring, and subsequently on or before their anniversary of the initial training. Training topics should include at a minimum:

1. Characteristics and health hazards of kerosene-type turbine fuel,
2. PPE to be used,
3. Fuel quality control procedures,
4. Operation of fuel vehicles and fuel systems,
5. Refueling area selection and set-up,
6. HRR refueling procedures,
7. Bonding of the aircraft to the fuel dispensing equipment,
8. Avoidance of Rotor Blades,
9. Communications,
10. Fuel Spills,
11. Personal Injury response and emergency planning (including First Aid kit locations, AEDs, etc.),
12. Any applicable licensing, permitting, endorsements and certifications should be reviewed for compliance and

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13. Passenger disembarkation and embarkation procedures to include seat belts and door security.

The initial and subsequent (re-current) training should be recorded and maintained in the employee's training file.

Section 6 References:

1. NFPA 407,
2. FAA – SAFO 10020,
3. California code of regulations: Title 8, Section 1905,
4. AC 91-32B (Helicopter safety)
5. AC 91-42D (Rotors)
6. 8900.1 Change 0, Vol. 2, Chapter 2, Section 5.
7. 8900.1 Change 0, Vol. 6, Chapter 11, Section 21,
8. CASA Part 20, Section 20.10 (Australia),
9. Safe Work Practices for Helicopter Operations in the Forest Industry (Canada)
10. NATA – Refueling and quality control procedures for airport service and support operations
11. Airman's Information Manual 10-2-1 m.
12. TC – AIR 1.3 (Canadian AIM)
13. TP 2228E-13 (Fuel drum etiquette safety letter – Canada)
14. 49 CFR 173.150
15. CASA AC-91-365(0) (Australia)
16. MSDS Sheets
17. FM 10-67-1 Chapter14
18. Department of Interior – OAS – Aviation fuel handling handbook 19. OSHA regulations – §1910.183, §1926.152, §1926.155, §1926.551

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CHAPTER 10 - HUMAN PERFORMANCE IMPROVEMENT

Human Performance Improvement (HPI) is a system of education, methods, and controls designed to eliminate latent and active organizational weaknesses, identify areas of improvement, and increase performance and efficiencies. It can be defined as a set of principles and elements that work together to replicate intended, consistent outcomes. The principles of HPI are centered around an individual's inherent tendency to make mistakes. The goal, then, is for individuals and organizations to understand when and where an individual could err and to use knowledgeable sources to employ error prevention methods.

HPI is not a new concept. Some organizations may have learned or may teach the principles and definitions in a different way. In fact, many find that HPI and other systems, such as crew resource management (CRM), have overlapping themes. The notions and training of HPI have been introduced by the US Department of Energy (DOE), the aviation industry, and numerous private and commercial corporations for years. Additionally, various safety and performance training companies have developed their own HPI training curricula based on principles introduced by DOE and research produced by HPI scholars.

HPI Principles

Over the years, HPI definitions have been adjusted to fit different industries and institutions, but the underlying principles (Table 1) have remained consistent.

Table 1. Principles of HPI

People are fallible, and even the best will make mistakes.
Individuals react to situations instinctively and predictably.
An individual's performance is based on awareness, reinforcement, and self-motivation.
Errors are predictable and preventable when individuals or an organization recognize error traps.
Individuals can prevent unplanned events by understanding causes and applying lessons learned.
Consistent methods produce consistent outcomes.
Organizational values influence individual behavior.

Individual performance is based on the individual's relationship to the work environment, organization, equipment, and processes around him or her. The individual must understand that, because of human nature, there is always risk for error. The level of risk for the individual is based on his or her experience with the specific task in the environment and at the exact time it will be performed.

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HPI Terms

Table 2 lists common HPI terms and their role in performance. Through hazard analysis, task awareness, and informed decision making, the individual can improve his or her abilities to perform the intended action at the task and step level, reducing the probability for error.

Table 2. HPI Terms

Individual	The person responsible for performing the action.
Organization	The group for which the individual is performing the task, or that could impact the individual performing the task. Often, this is the crewmembers immediately around the individual.
Traps	A task, or characteristic of a task or individual, that increases the chances for error during an action. Common error traps include stress, multitasking, time pressure, poor communications, poor procedures, overconfidence, first-time task, distractions, first-day back, and shift work.
Triggers	Actions or reactions by an individual. These are observable and often referred to as a gut feeling. They give the individual or organization a chance to respond before an event can occur.
Tools	Methods used at the individual level that reduce the probability of error.
Error	An action or lack of action that results in an unintended outcome or undesirable condition.
Event	The consequence of an error, a set of errors, or a set of conditions.

Modes of Performance

An individual makes decisions based on his or her familiarity with a task and the tools used to perform that task at the time it is to be performed. Throughout the day, our mind goes in and out of three different modes of performance that are based on the individual and the task at the time it is performed. The modes are skill-based, rule-based, and knowledge-based.

Each performance mode either increases or decreases the chance for error. An individual who understands which mode he or she is working in is more likely to prevent an error because he or she can more easily recognize triggers and error traps.

- An individual is operating in *skill-based mode* when performing a task with few steps in a familiar environment. The task is performed with little thought and often out of habit.
- Individuals operating in *rule-based mode* are less familiar with a task but know they have access to rules or procedures to follow, such as technical specifications, operator manuals, checklists, or a subject-matter expert such as a supervisor or person in charge.

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- An individual operating in *knowledge-based mode* has the greatest chance for error. In this mode, the individual is unfamiliar with a situation, unaware of the proper procedures, or unsure of what to do without guessing.

The least chance for error exists while an individual is operating in skill-based mode. However, individuals cannot always be in skill-based mode. Realistically, individuals are more likely to be operating in rule-based mode where they are following a set of procedures. The knowledge-based mode is not a mode in which individuals should work. Rather, operating in the knowledge-based mode should act as a warning signal, indicating mistakes are more likely to occur. The individual should verify any gut feelings by asking questions, confirming that information is correct, and double-checking the planned action before performing it by using HPI tools.

Lapses in decision-making are possible, even in rule-based mode, because the individual and members of the organization are human. These lapses threaten the consistency of methods and therefore threaten the consistency of outcome. Examples of lapses might include recalling a procedure from memory, leaving out a planned item in a series of tasks, or performing a series of tasks in an incorrect sequence.

HPI Tools

HPI tools, as noted earlier, are intended to make sure the individual is self-aware of these potential risks and understands the necessary, effective mitigation methods. Table 3 describes HPI tools that are commonly used in UPAC activities.

Table 3. HPI Tools

Pre-Job Walkaround	Review the work location and associated paperwork to ensure existing environment conditions are error free.
Tailboards / THA	Perform pre-job briefing. Tailboard should include the person in charge, all involved crewmembers, and organizational members as needed. A good pre-job briefing involves a discussion about possible traps, triggers, and HPI tools to be used as mitigation measures.
Verbalize, Point, and Touch	Verbalize intended action. Point to equipment to be operated. Engage equipment to be operated.
Self-Check	Pause and double-check before performing an action. Focus attention, verify the action, anticipate planned results, and apply questioning attitude. Verify result happened as planned.
Peer-Check	Have a second knowledgeable crewmember verify that the planned action is correct before the action is performed.
Three-Way Communication	Initiate a verbal communication. The receiver shall acknowledge the communication by repeating it back either verbatim or paraphrased. Then, acknowledge the repeat back. Ensure no question goes unanswered. A common example of three-way communication is use of a challenge and response when running a system checklist.

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Situational Awareness	Pay attention to your surroundings to understand any changes to the work environment while a task is being performed.
Questioning Attitude	Maintain a healthy sense of uneasiness in order to recognize hazards or error-likely situations that could cause an unplanned event.
Stop Work Authority	Stop work to regroup if there is uncertainty or confusion about a task or action about to be performed. Seek further information from a subject-matter expert, task-related documents, or process controls.

Encouraging Desired Behaviors

As previously stated, operating in a knowledge-based mode indicates an individual's need for more information from an additional knowledge source in order to perform a planned action safely, correctly, and completely. Triggers that indicate an individual is in knowledge-based mode generally include phrases that express doubt:

- I believe.
- I think I can.
- I'm pretty certain.
- I hope.

Triggers should be recognizable by the individual as well as the crewmembers in the organization. They are called triggers because they should elicit a response. Observing them should lead the organization or crew to initiate stop-work authority so that crewmembers can confirm their understanding together. This ensures everyone involved understands and agrees upon a plan of action before continuing with the task.

The impact of other crewmembers and the rest of the organization in relationship to the individual is vital for consistent performance and improving inefficiencies. The behavior of an individual is reinforced by the consequences he or she experiences when the behavior occurs. A positive consequence reinforces repeated behavior. However, this cause-and-effect process happens even if the process to achieve the consequence is unsafe or incorrect.

Therefore, an organization must encourage the correct, desired behaviors and discourage unsafe, undesired behaviors, even if they result in the desired outcome. When individuals are aware of the correct procedures that lead to the desired outcomes and are encouraged by the organization to continue those correct procedures or fix any unsafe or incorrect habits, the organization achieves consistent methods, and thus, consistent outcomes.

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Ensuring a Successful HPI Program

The following are several recommended action items that should help ensure the success of your HPI program:

- Train personnel on human performance principles. Encourage the correct, desired behaviors. Discourage unsafe, undesired behaviors, even if they result in the desired outcome.
- Develop a "Just Culture" through the implementation of an accountability program that promotes adherence to established best safety practices and acknowledges the correct, desired behavior.
- Minimize the adverse effects of time pressure to the extent possible by:
  - Setting attainable performance goals
  - Encouraging personnel to work efficiently rather than fast
  - Never pressuring a pilot to fly when he/she feels it is unsafe.
- Enhance effective communication through:
  - Three-way communication
  - Detailed tailboards
  - Encourage everyone to have a questioning attitude
  - Reliable intercom/radio communications appropriate to the work being performed
  - Training on crew resource management.
- Educate personnel in identifying each critical step and understanding that once that step is taken, the result of the action is uncontrolled. Before taking a critical step, utilize self-check and peer check to make sure the outcome is as planned without incident.
- Educate staff on the importance of focus. Establish and implement a policy whereby no one works while distracted a personal electronic device. Limit the use of devices such as cell phones, smart watches, tablets, etc., in, and while working around, aircraft. Minimize the possibilities for interruptions by, for example, creating a policy for what happens when interrupted during a critical phase such as preflight.
- Train personnel on their obligation regarding each person's universal stop-work authority. Emphasize that each person has the right or authority to stop work as well as the obligation to act to prevent injury or damage.

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HPI in UPAC Activities

HPI is a valuable system that works together with existing programs to sustain cohesive safety and performance values across organizations by developing a systematic approach to decision-making, self-awareness, and communication among multiple perspectives. It proactively prevents unwanted outcomes caused by human error.

Aerial work requires foresight in planning and performance, consistency in methods, and accurate decision-making skills to effectively communicate, process, and react to situations. Error reduction is an effective approach to ensuring consistency. By utilizing HPI to recognize that humans are inherently fallible and to understand error traps, individuals and organizations can predict, manage, and prevent error-likely situations. In this industry, that means reducing equipment damage, damage to the electrical grid, injury, and even death.

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GLOSSARY (ENDNOTES)

1. **Airworthy** – In the United States means the product (aircraft, engine, propeller, etc.) conforms to its type certificate (TC), is configured with the components installed as described in the drawings, specifications, and other data that are part of the TC, which includes any Supplemental Type Certificates (STC), Airworthiness Directives (AD), and field approved alterations incorporated into the product; and the product is in a condition for safe for its intended operation. [Ref. FAA Order 8130.2F]

2. **Aerial Work** – In the United States and for this guide means those commercial aviation activities that include aerial photography or survey; helicopter operations in construction or repair work (but it does apply to transportation to and from the site of operations); external load operations governed by 14 CFR part 133; and power line or pipeline patrol. [Ref. 14 CFR § 119.1 (c) and (d)]

3. **Barehanded (work/technique)** – a work method performed on energized electrical facilities using an isolated or insulated platform. Worker is protected from adverse electrical effects through the use of specially designed conductive suit.

4. **Bonding** – a method of physically inter-connecting conductive parts to maintain a common potential. The objective of bonding is to avoid harmful shock currents by minimizing any potential difference across the worker's body.

5. **Bonding Device** – an engineered and rated device consisting of clamps and rated conductor designed to facilitate the inter-connection of conductive components so they remain at the same potential.

6. **Breakaway Device/Break-Away Link** - A small section of line or fabricated metal in between the aircraft and the sock line manufactured with a pre-determined breakage point to prevent over stressing the airframe. A Break-Away device may also be employed between a crewmember's safety harness and the aircraft attachment means as a safety device when transferring personnel to structures or conductors. Also known as a "Weak Link"

7. **Bull-Rope** - A rope, used for various reasons, between the sock line and the helicopter.

8. **Catenary** - That part of the overhead cable, which hangs between the supporting masts or two points and from which the dropper wires are hung to suspend conduit.

9. **Cargo** - Bulk Load or Payload, i.e. work box, traveler set, etc., to be carried on board or externally by aircraft.

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10. **Choker** - a short length of rope or cable, that fastens closely around a cargo load or pole as part of the external load rigging.

11. **Government agency** - the government agency within a country that regulates and oversees the use of air space and aviation activities within that country.

12. **Class A Rotorcraft Load Combination** – In the US this means a load in which the external load cannot move freely, cannot be jettisoned, and does not extend below the landing gear.

13. **Class B Rotorcraft Load Combination** - In the US this means a load in which the external load is jettisonable and is lifted free of land or water during the rotorcraft operation.

14. **Class C Rotorcraft Load Combination** - In the US this means a load in which the external load is jettisonable and remains in contact with land or water during the rotorcraft operation.

15. **Class D Rotorcraft Load Combination** - In the US this means a load in which the external-load is other than a Class A, B, or C and has been specifically approved by the Administrator for that operation.

16. **Conductor** - A wire or combination of wires not insulated from one another, suitable for carrying electric current.

17. **Conductive Suit** – A suit worn by pilots and crews that is made of material that has the ability to conduct electric current that has the ratio of current passing through a material to the potential difference at its ends.

18. **Corona Discharge Points** – these are locations on objects energized at high voltages where sharp corners create an electrical discharge brought on by the ionization of the air around this point (electrode). The ionized air around this point will reach a higher potential and create a potential gradient, and when it reaches a certain level, it will discharge to an area of lower voltage. This discharge manifests itself as a UV arc that can cause a breakdown in the insulting value of the surrounding air.

19. **Crewmember** – In the US and for the purposes of this guide means a person on-board an aircraft that is essential to or directly related to the operation of the aircraft or performs an essential function in connection with the external-load operation; or is necessary to accomplish the work activity directly associated with that operation.

20. **Detailed Power Line Patrol** – For the purposes of this guide means a comprehensive inspection by air of power line or pipeline infrastructure including conductors, static wires, poles, metal structures, insulators, spacers, cross-arms, substations, pipes, etc., using close visual or infrared examination.

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21. **Distribution System** - Circuitry involving high-voltage switchgear, step-down transformers, voltage dividers, transmission lines, and related equipment used to receive high-voltage electricity from a primary source and redistribute it at lower voltages.

22. **External Load Attachment Means** – In the US means the structural components used to attach an external load to an aircraft, including external-load containers, the backup structure at the attachment points, and any quick-release device used to jettison the external load. The external load attachment means is certified in the US under the provisions of 14 CFR parts 27 and 29 and do not include rigging or any other sling system attached to it, commonly referred to as the "belly hook."

23. **Fatigue** - means a state of diminished physical and/or mental efficiency.

24. **Form 337** – In the US means the Federal Aviation Administration (FAA) form used by maintenance technicians or Repair Stations to report major repairs or alterations on aircraft, engines, appliances, or propellers.

25. **Field Approval** – In the US means to approve technical data used to accomplish a major repair or major alteration by the FAA. It is an approval by the FAA Administrator, through an authorized Aviation Safety Inspector (airworthiness), of technical data and/or installations used to accomplish a major repair or major alteration. Technical data so approved becomes "technical data approved by the Administrator." This type of approval may be accomplished for one-time approval.

26. **Flight Profiles** – means the representative side view of the aircraft's flight path or pattern.

27. **Fly Type Blocks** – specially designed conductor stringing blocks that facilitate the installation of conductor stringing accessories (ropes / cables) into these blocks using a helicopter.

28. **Grounding** – is a method of connecting an isolated conductor to some type of connection to ground and the phases together in order to trip the circuit as quickly as possible and minimize the length of time there is a voltage rise on the circuit

29. **H-Frame** – a type of power line structure consisting of two poles spaced at a pre-determined location and bridged at the top with some type of crossarm to support conductors

30. **Hazard** – means a possible source of danger or circumstance that increases the likelihood or probable severity of a loss, injury, or death.

31. **Hot Stick** - Long non-conductive, rated and tested stick-like tool used on energized lines.

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32. **Induced Electrical Discharge** Hazard (Induced discharge) - is a voltage that can be imposed on a power line due to lightning, wind, and close proximity to an adjacent power line or by magnetic coupling resulting from the paralleling of two or more circuits.

33. **Lineman** – a person trained to perform maintenance activities on power line facilities

34. **Load -** Cargo, accessories, and associated rigging hardware connected to the helicopter.

35. **Loss Of Tail Rotor Effectiveness** (**LTE)** – means a critical, low-speed aerodynamic flight characteristic, which can result in an uncommanded rapid yaw rate, which does not subside of its own accord and, if not corrected, can result in the loss of aircraft control. LTE is not related to a maintenance malfunction and may occur in varying degrees in all single main rotor helicopters at airspeeds less than 30 knots and is not necessarily the result of a control margin deficiency.

36. **Minimum Approach Distance** – In the United States means the minimum distance an employee can bring himself or any conducting object to exposed and energized or ungrounded electrical parts without any kind of controls or barriers.

37. **Observer** – means a crewmember onboard an aircraft to inspect and record power line or pipeline deficiencies during flight while on aerial patrol.

38. **Operational Envelopes** – means the design basis or standards that limits an aircraft, engine, appliance or product to specified performance parameters to ensure safety during operation. May also refer to the capabilities of a design in terms of speed and altitude and can also refer to other measurements such as maneuverability.

39. **Occupational Safety And Health Civil Authority** – means the government entity that promulgates regulations and standards and oversees worker protection and health in industry. In the US the Occupational, Safety and Health Administration (OSHA) carries out these responsibilities.

40. **Personal Protective Equipment** – any kind of clothing or equipment designed, tested, and certified to protect a worker from inherent workplace hazardous conditions.

41. **Platform System** – an engineered, tested and approved platform that can be attached to specified types of helicopters to allow access to structures and conductors for a qualified lineman.

42. **Portal Type Construction** – a type of power line structure where conductors pass through a "window" surrounded by structural material of the structure.

43. **Pre-formed Loop -** Pre-formed quick attachment cable. Also known as a twist form loop.

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44. **Puller Tensioner** – a specialized piece of equipment used for stringing conductors / cables / rope that is designed to control the rate of speed at which a conductor / cable is paid out / pulled back, and to maintain the necessary tension on the conductor / cable to prevent damage resulting from contact with the ground and other obstacles.

45. **Qualified Worker** – a person adequately qualified, suitably trained and with sufficient experience to safely perform work with only a minimal degree of supervision.

46. **Remote Cargo Hook Remote Hook** - A cargo hook at the end of a long line attached to the aircraft's belly hook with pilot-controlled electric release capability and a manual release capability activated by a ground crewmember or worker.

47. **Rigging** - The system of equipment used to secure cargo for carriage, e.g. straps, cables, clevises, shackles, spreader bars, hooks, etc.

48. **Rotorcraft Load Combination Flight Manual** - In the US means the FAA approved manual that sets forth the Operating limitations, procedures (normal and emergency), performance, and other information established under this subpart; the class of rotorcraft-load combinations for which the airworthiness of the rotorcraft has been demonstrated in accordance with §§133.41 and 133.43; and in the information section of the Rotorcraft-Load Combination Flight Manual—(1) Information on any peculiarities discovered when operating particular rotorcraft-load combinations; (2) Precautionary advice regarding static electricity discharges for Class B, Class C, and Class D rotorcraft-load combinations; and (3) Any other information essential for safe operation with external loads.

49. **Routine Power Line Patrol** - For the purposes of this guide means the inspection by air of power line infrastructure including conductors, static wires, poles, metal structures, insulators, spacers, cross-arms, substations, pipes, etc., by visual examination.

50. **Safety (management) System** – means a documented process for managing risks that integrates operations and technical systems with the management of financial and human resources to ensure aviation safety or the safety of the public.

51. **Sag** - The amount of tension on the line along a power line. The distance below a horizontal line between structures that the line bows.

52. **Settling With Power (Vortex ring state)** - describes an aerodynamic condition where a helicopter may be in a vertical descent with up to maximum power applied, and little or no cyclic authority. The term "settling with power" comes from the fact that helicopter keeps settling even though full engine power is applied.

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53. **Side Puller** - A type of cargo hook attached to the side of a helicopter enabling line stringing to be performed sideways by aircraft that have a non-floating transmission.

54. **Signalman** - Designated individual responsible for communication between the ground crew and pilot.

55. **Situational Awareness** - is the accurate perception and understanding of all the factors and conditions within the four fundamental risk elements (the pilot, the aircraft, the environment, and the type of operation that comprise any given aviation situation) that affect safety before, during, and after the flight.

56. **Sling System Sling** - That part of external load rigging, that may include a remote cargo hook or suspension system that is composed of cables or straps that provide for obstacle clearance, allows the cargo to swing about the aircraft's external load attachment means (belly hook).

57. **Sock Line** - Pull line between the helicopter and conductor. First line pulled through in a stringing operation. Also known as Finger Line or Lead Line.

58. **Spreader Bar** - That part of external load rigging that is composed of cables, hooks, and bars arranged in such a fashion as to set the hooks in specific locations without causing stress to the cargo.

59. **Static Electrical Discharge Hazard (Static discharge)** - Electrical charge created by meteorological conditions effects on the rotor system.

60. **String Blocks** – specially designed, metal alloy wheels and supporting framework installed on power line structures at the ends of insulators strings or attached to the structure to allow the free movement of conductors being strung on the structures.

61. **Sub-Transmission Voltages** – power lines with phase to phase voltages between 34 kV and 161 kV.

62. **Suspension System** – See sling system

63. **Tagline** - Used to control a suspended load from the ground by ground personnel.

64. **Tailboard** - A term used by electrical workers to describe the crew briefing conducted prior to the beginning of a job. The tailboard is mandatory and must be attended by all workers, including the helicopter crew. Sometimes called "Tailgate".

65. **Tension Dolly** - Tensioner for braking system

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66. **Wire Stringing** – the physical act of pulling conductors out along a length of line, and the placement of these wires on the structures in stringing blocks so it can be pulled to its designed sag to be secured in their final position.

67. **Wire Environment** – airspace below 300’ AGL, airspace located between ridge tops, and/or airspace that is unfamiliar to the flight crew should be considered as the Wire and Obstruction Environment.

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