HELICOPTER ASSOCIATION OF CANADA

Utility Flight Operations Committee

UFOC Best Practices Safety Guide for Helicopter Operators
18th Revision; 12 July, 2010

The Utility Flight Operations Committee is a forum of professionals dedicated to providing principles to safely operate in the wire and obstruction environment through guidelines for education, training, standards, and existing policies

DISCLAIMER

The UFOC Best Practices Safety Guide document provides guidance to members of the Helicopter Association of Canada (HAC) wishing to establish or adopt these Best Practices Safety Guidelines.

This document is not intended to be all – inclusive, but only a guide.

The Best Practice herein sets out in general principal the actions necessary when conducting operations in the Utility Flight Operations.

Every effort has been made to supply accurate and up to date information, however, the UFOC and the HAC assumes no responsibility for the accuracy, adequacy, or completeness of any information presented within and is not responsible for any errors or omissions, or outcomes obtained from the use of such information. In the event of any conflict, discrepancy, error, or omission between the information presented in this manual and the applicable current provincial and/or federal health and safety regulation, the provisions in the provincial and/or federal regulation will prevail. The members of the UFOC Best Practice Safety Guide, the companies or organizations they represent make no representation, warranty, or guarantee in connection with the publication or the contents of any recommendation, and hereby disclaim liability or responsibility for loss or damage resulting from the use of this document in whole or in part or any violation of statutory or regulatory requirements with which any recommendation may conflict.

The information in this publication is intended as a guide and does not provide the only acceptable method of dealing with the subjects contained herein. It is not a definitive guide to government regulations and does not release users of this document from their responsibilities under applicable legislation.

The UFOC and HAC assume no liability in publishing the UFOC Best Practices Safety Guide. In each case, company or organization personnel should conduct their own due diligence by way of performing specific testing, research, development and implementation of individual methods of controls and should familiarize themselves with all applicable government regulations.

Contents

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 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 the 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 UFOC 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 HAC, 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 implementation of the recommendations and help ensure that all of the recommendations are addressed. This Guide will not supersede any requirements of the Transport Canada, OH&S or any other government, Provincial, or local 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 Transport Canada regulation is to be met.

Additional copies of this Guide or further information can be obtained by contacting the Utility Flight Operations Committee through the Helicopter Association of Canada at 613-213-1110 or www.h-a-c.ca/.

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

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CHAPTER 2 BACKGROUND

Section 2.1 History and Purpose

Helicopters have been in use to support the utility industry since 1947 when the first civilian certified aircraft became available in North America. 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 UFOC 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 industry, it is relatively easy to assume that on any normal workday, hundreds 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 that occurred while conducting utility work in the US. (Transport Canada data to follow) 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 2.2 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 that the aircraft is "flying through" the wire environment, which greatly increases the potential for the aircraft to collide with the infrastructure or terrain. This aerial work requires a minimum crew of an observer and a pilot to effectively and safely perform the work. The aircraft may potentially 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 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 of closure of 123.2 feet per second to an obstacle in its flight path. In order to mitigate the potential risk of a collision the crew should identify all 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, crews are required to exercise extreme concentration, maintain situational awareness, be knowledgeable of their area of operations, maintain effective communications, and establish clear roles and responsibilities. Tools to mitigate these hazards include: high recon, hazard mapping, markers, and patrolling away from the hazard (if possible).

Section 2.3 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;
- Catenaries 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 2.4 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. It then maneuvers at or below translational lift to the next structure to be inspected. The mission crew is generally a pilot, a front seat observer, and a 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 conventional engineering controls, 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, and mechanical failures of the aircraft, although collision with obstacles 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 ft above the ground level. The rate of closure is 35 feet per second at 20 knots, which 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 2.5 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;
- Catenaries 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 2.6 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 UFOC 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 to give owners, managers, pilots and crews an understanding of 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 9 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.

Section 2.7 Transportation of essential crew.

The construction industry relies heavily on helicopters to be able to transport the workers from a staging area at the work site to the structures. The preferred method is to deliver the crew and land off corridor in a safe landing site. Another method is to deliver the crew by landing - possibly under the conductors - on the Right-of-Way (ROW). A third method of transporting crews is 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 (Entering or Leaving a Helicopter in Flight: CAR 702.19). It is recommended that an approved breakaway device that allows the worker to be attached simultaneously to the helicopter and the structure/conductor may be used until the transfer is complete. At no time should the lineman be attached to the structure and the helicopter at the same time without an approved breakaway device.

Depending on the type of structure this maneuver has four immediate hazards:

a. main rotor contact with surrounding structure, static wires or conductors;

b. fall hazard during off-loading;

c. mechanical failure of the helicopter requiring immediate action such as engine failure or tail-rotor failure

d. entanglement of the landing gear or aircraft structure with the steel tower components resulting in dynamic roll over or loss of control of the aircraft.

An 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 hoist. 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 may be accomplished by the use of a platform or hoist method to reduce collision or entanglement hazards. Regardless of which method is used the worker shall be attached to the helicopter, platform or hoist at all times when traveling between the ground and the aerial transfer point or worksite.

Section 2.8 Transportation of Class B Rotorcraft Load Combinations.

The helicopter transports the items using a sling system generally made up of an appropriate length of approved long line to maintain obstacle clearance attached to the aircraft's cargo hook (belly hook), a remote cargo hook at the end of the long line and a basket or choker (sling) attached to the remote hook. Once the workers have been transferred to the structures, the pilot is normally "standing by" 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.

Section 2.9 Transportation of Class A Rotorcraft Load Combinations.

Class A Load combinations (Non-jettisonable work platforms) mounted to helicopters has 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 STC (Supplemental Type Certificate) and approved by the Transport Canada. 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:

- 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 platform and tied to the linemen conductive suit.
- The bonding device will allow for breakaway characteristics at the conductor connection.
- Barehand 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 STC 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.
- Hovering in close proximity to the structure or conductors.

Section 2.10 Wire stringing operations using Class C Rotorcraft Load Combinations.

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 2.11 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 of aircraft's center of 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 2.12 Approach Distances

Operators and workers should ensure that they comply with provincial/territorial regulations governing worker safety and health and minimum approach distances. Re-determination of these distances is currently in progress.

CHAPTER 3 BASIC UTILITY INFRASTRUCTURE

Section 3.1 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 there are a myriad of designs, materials, and line markings 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 uninsulated 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.

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 "re-boost" power allowing it to travel greater distances from the power generation source along the high voltage transmission lines.

Section 3.2 General Hazards

Hazards to transmission line inspection patrol 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 background radio chatter/conversations
- Transmission line crossings
- Catenaries 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

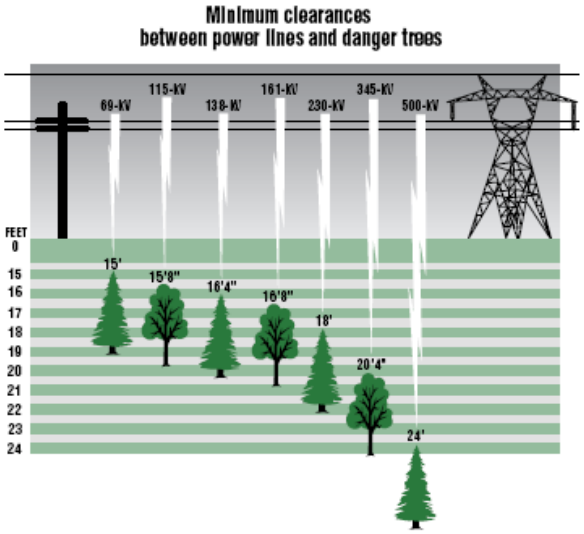
Section 3.3 Inspection and Patrols

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.

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 and power line patrols. Collision avoidance systems can enhance safety in these situations. It is recommended that utilities with parallel or crossing, interconnected systems and ROWs be notified of patrols.

Regulations specify 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. 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.

2. 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 crossarms. (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.
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 (leaner's 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.

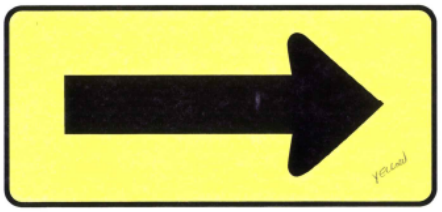
Emergency Patrols: These patrols normally occur after a circuit has had an operation (or fault). The objective of this type of patrol is to quickly ascertain the cause of the operation, the location of the cause, and access for crews to repair the problem.

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 3.4 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 Arrow



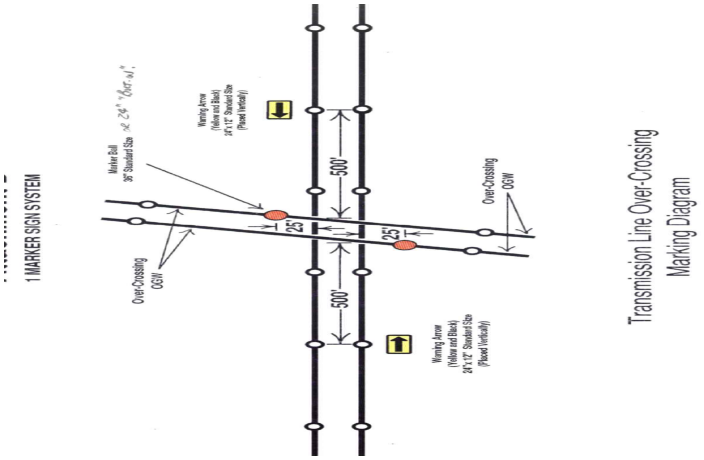
SPECIFICATIONS

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.

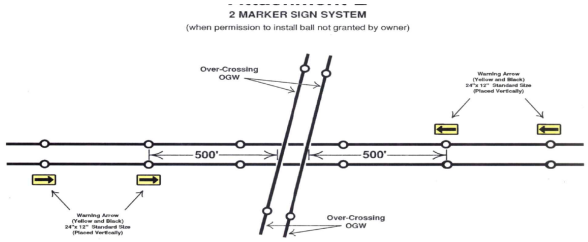
Transmission Line
Warning **X**

SPECIFICATIONS

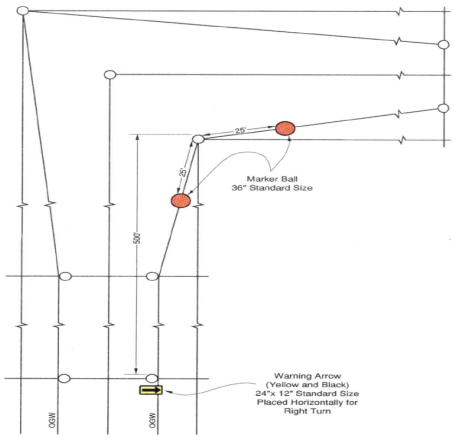
1. Signs shall be made of No. 18 U.S. gage steel sheet or aluminum. The standard size shall be 24" x 24".
2. Sign face shall be decal reflective sheeting. Sign color shall be engineer grade yellow. "**X**" shall be black.
3. Each sign shall have holes fitted with brass eyelets. Finished holes shall be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



Transmission Line Over-Crossing
Marking Diagram



Transmission Line Over-Crossing
Marking Diagram



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

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CHAPTER 4 HELICOPTER PATROL SAFE GUIDELINES

Section 4.1 Electric Utility Systems and Patrol Procedures

1. General

Developing 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 with.

2. Knowledge of Transmission Facilities

a. Be aware of rules and regulations associated with working in close proximity to energized lines. See IEEE Std 516 (expected to be revised 2009) for more information. See Chapter 3, Section 7, Influence of a Floating Object in the Air Gap.

b. 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.

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

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

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

- Ceramic suspension
- Ceramic Dead-end
- Ceramic post
- Glass
- Non-ceramic (NCI)

e. Higher-voltage lines SHOULD cross over the top of lower-voltage lines. It is an imperative for the pilot and crewmembers to know what voltage is being patrolled in order to know what to expect above and below the line. Hazard identification maps should be consulted prior to and during patrol, as well as high recon procedures and hazard markings.

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. 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 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 provided. Remember that electric utilities are not the only organizations that may install wire hazards.

Section 4.2 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 flight times,
      (iii) Number of personnel to be carried,
      (iv) Any special equipment requirements and weights,
      (v) Any other safety related information relevant to the flight such as hazard mapping, plan and profile drawings and elevations ASL.

   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. Assign flight crews that are rested .

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

f. Equipping aircraft with "Wire Strike Prevention System" may be a consideration for performing power line patrols.

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 use of ELT
(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. Recommended: Wire Environment Situational Awareness Training.

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 reports of observations for later transfer to the formal record.

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

Section 4.3 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, elevations ASL, 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 must 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 focused on the observer's role.

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

    a. CROSSING AHEAD
    b. HAZARD AHEAD (line angle, com tower, etc)
    c. WIRE
    d. STOP/PROCEED
    e. UP/DOWN
    f. 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.

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 NEIGHBOURLY!

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 4.4 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, haze, snow, smoke or glare 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 NEIGHBOURLY" practices.

Section 4.5 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.

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CHAPTER 5 POWER LINE CONSTRUCTION AND MAINTENANCE

Section 5.1 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.

2. 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 are not limited to, inspecting and verifying all equipment, tools and fall protection equipment are in good working order.

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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 be 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 Government or Utility 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 change the scope of the original briefing, a new briefing shall be conducted to include the change in the job procedure.

3. 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 their 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, fuel shut off, and remote ELT switch location.

e. Engine failure and flight path.

f. Ground crew escape routes.

g. Jettison of external loads.

h. Unusual aircraft noise and warning sirens.

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 procedures.

(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).
(iv) Ensure that staging area is of an appropriate size.

n. External Helicopter cargo loads.

(i) Long objects (carried horizontal, below the waist).
(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; avoid loose clothing and ball caps.
(vi) Stepping on skids to avoid foot injury (skid movement).
(vii) Doors-off flight: Security of cargo, mission equipment and un-occupied seats
(viii) Seat belt security.

p. Suspended Loads

(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, including escape routes.

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q. Special Landings (need to be accompanied by appropriate training).

(i) Toe-in and partial touchdown landings.
(ii) Structure landings.
(iii) Catenary 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).

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, TFR's, or problem landowners.

Section 5.2 Communications

1. 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. (refer to appendix for hand signal suggestions).

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 5.3 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. Transport Canada 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 hazards and procedures to be followed in each specific instance, including all safety and emergency procedures.

1. Crew Briefing.

    e. 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.

    f. 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.

    g. 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 in 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)

   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 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, a fall of the lineman into his harness. REF. OH&S.

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

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

   e. The pilot and lineman must have been trained in this type of helicopter operations.

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

   g. Access a side of the structure that will provide a more suitable landing site in the event of an emergency.

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Section 5.4 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.

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?

   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. Is the safest means of loading being used?

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

h. If non-standard sling devices are used, they must be engineered and visibly tagged as such.

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. If pre-formed loops are used as part of the rigging, ensure that they been checked for serviceability.

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 5.4.1 Class D Emergency Rescue

1. "Helicopter Class D external load" - means an external load with a person carried externally or any external load, other than a Class A, B or C external load.

2. To be determined.

Section 5.4.2 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 and all associated components, must comply with all Transport Canada requirements.

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

b. The platform must be:

(i) Designed and engineered by a competent person and approved by Transport Canada.

(ii) Structurally sound [Meet the Transport Canada's airworthiness requirements] and:

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

(2) Be free from corona discharge points.

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

(4) The designs should 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.
- Electronic fuel management systems have not been tested in the energized environment.

(iii) The STC Rotorcraft Flight Manual supplements shall be present in the rotorcraft flight manual.

(iv) If the platform has been modified from the original STC alteration, then subsequent Transport Canada approval may be required.

(v) Any special instructions such as placards shall be placed where required by the STC.

(vi) Installation and removal procedures as per STC and drawings. Each installation and/or removal of a restricted category platform must be recorded in the rotorcraft logbook.

Section 5.5 Suspended Loads (Jettisonable) 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 lanyards? Is non-conductive material required?

2. Consider the use of a cargo mirror. A physical view (vertical reference) 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.

5. When using electric long lines, ensure the correct operation of the remote hook.

6. 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.

7. Maintain awareness of the load's flight characteristics. Varying sizes, weights, and configurations of loads will have significant differences in flight characteristics, including the potential of erratic behaviour. If oscillation occurs, place the aircraft over the center of the load or reduce airspeed to aid recovery.

8. Avoid a flight path that creates a hazard to anything on the surface. A preview of the flight corridor may be required.

9. 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.

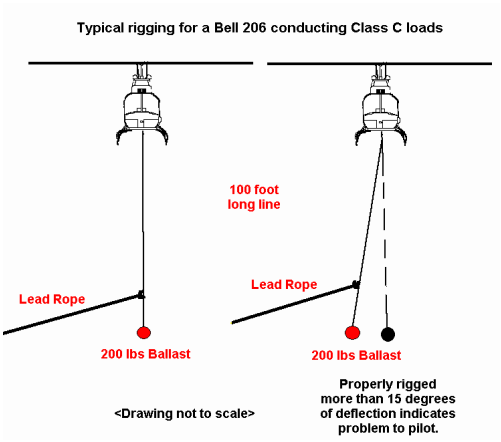
10. Once the load is released, it is necessary to determine that the hook is clear before continuing with the operation.

Section 5.6 Long Line Maintenance and Inspection

Section 5.6 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. All tensioning and reel equipment must have properly functioning brake systems and be designed or adapted for helicopter wire string operations.

2. 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.

3. 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.

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

5. Precautions must 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.

6. The crew must ensure that guards (rider poles) 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.

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

8. It is the pilot's decision as to the order in which lines are pulled to ensure the tail rotors and main rotors remain clear of the lines behind and above the helicopter.

9. The pilot must 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.

10. No person will 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.

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

12. When pulling, ensure that the payout of rope is in a freewheeling assembly controlled by brakes.

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

Section 6.1 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 UFOC provides some examples of samples of a JHA 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

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 persons 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 that fly 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. A 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: The contractor should hold a current and valid Supplemental Type Certificate issued by Transport Canada, 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 services for the utility company.

Airman Certification: All pilots, including back-up pilots, that will be performing the specified services must, as a minimum, hold a valid commercial helicopter license with the appropriate endorsements 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 utility company. A minimum number of hours of time in the type, make, and model, or sign-off from the helicopter operator as being qualified and competent, is recommended as determined by the utility. The most important aspect to pilot experience is recent demonstrated proficiency and 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 each pilot who is to perform low-level operations complete a comprehensive training program designed and taught by personnel qualified and experienced in utility company patrol, construction and repair procedures. In the absence of formalized training, documented sign-off of demonstrated proficiency is required. This should be supplemented by specialized training specific to the task.

Helicopters: The contractor must provide helicopters that are appropriately certified, maintained and safe for the intended operation. Each helicopter should be equipped with the appropriate operable radio equipment (appropriate required frequencies).

Contractor Personnel: All contractor personnel involved with the on site work operation must 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 must be trained in the specialized procedures and practices as appropriate.

Safety Management System (SMS): It is recommended that contractors have an established SMS in effect that incorporates hazard identification and work and safety rules for employees

which are appropriate to their work duties and comply with appropriate Transport Canada or civil governmental regulations.

Personal Protective Equipment (PPE): The contractor's personnel must have and use the PPE appropriate to their work duties. The following items are basic PPE requirements for line work. Refer to governmental regulations and consensus standards for basic training, use, testing, care and maintenance of PPE required by the utility.

- Head protection (approved flight helmets recommended for flight crew)
- Eye/Face protection
- Work gloves
- Hearing protection
- Clothing
- Other appropriate PPE for specified tasks

Compliance with Governmental Regulations: All flight and ground operations, including helicopter maintenance, must be performed in accordance with the applicable Transport Canada regulations. Nothing in this safety guide should be construed or applied to contravene applicable Transport Canada 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:							
Section 2: Current Operating Certificates							
702 CAR				Yes		No	
If yes, certificate #:		Issue Date:					
703 CAR				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			
Recon		Snow Survey		Line Stringing			
IFR		Hover Exit		Other			

Helicopter Contractor/ Operator Questionnaire, Continued.

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 WCB/ WorkSafe Compliant and Clearance Letter				
Company Accident/Incident Reporting System				
Agency/Company conducting the audit/inspection?				
Most recent audit or inspection date:				
Has the company established an SMS?	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.	Current Medical:
Phone Number(s).	Date of last medical:
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.	
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

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			
Operating Certificate	_____	_____	_____
Certificate of Air Worthiness			
Certificate of Registration	_____	_____	_____
3. Verify Necessary Manuals			
Operations	_____	_____	_____
Safety (SMS)	_____	_____	_____
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	_____	_____	_____
Radio License	_____	_____	_____
STC's	_____	_____	_____
Maintenance:			
Facility, Appearance	_____	_____	_____
AMO License	_____	_____	_____
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,

CHAPTER 7 SAFETY GUIDE FOR UTILITIES DEVELOPING AND PERFORMING UTILITY FLIGHT OPERATIONS

Section 7.1 Introduction

This safety guide is intended as an aid to utilities in developing and/or performing utility flight operations, and to helicopter contractors for evaluating the knowledge and competency of a utility considering the use of a helicopter for power line maintenance and construction work. It applies to utilities that undertake their own utility flight operations, but may be used as a source of reference for either a utility or a helicopter service provider, to qualify prime contractors

Utilities are ultimately responsible and accountable for these operations and need to be cognizant of their role in the implementation of any activities that involve the use of a helicopter. These guidelines may provide a framework for discussion to assist in managing associated risks and liabilities.

This guideline also recognizes that successful utility flight operations are a collaborative effort between the power line company and the helicopter contractor, and it is essential that utilities work closely with helicopter contractors in developing policies and procedures related to their application.

Implementation of utility flight operations require that owners and operators of power line facilities take into account some key considerations:

- Clearly defined goals and objectives,
- Policies and procedures to support goals and objectives,
- Capabilities and limitations of the aircraft,
- Safety, and
- Training

Section 7.2 Utility Responsibilities

Prior to engaging in any kind of flight related operations, utilities must address a few primary concerns. The first is to complete a detailed risk assessment of the work to be performed and identify all known hazards and develop controls to eliminate them or reduce the impacts to acceptable levels. To do this, it is necessary for the utility to consult with helicopter operators to identify and understand the associated hazards specific to helicopters, and understand the industry related controls that have been developed. These need to be incorporated with the hazards associated with working in the power line environment so that a comprehensive assessment can be performed. When complete, it is a requirement to inform potential helicopter operators of these hazards and the controls that are in place. This information can then be used by prospective helicopter service providers to determine if they are qualified to do the work, have the required aircraft, and meet any other qualification criteria.

Due to the inherent risk associated with utility flight operations, the power line company is responsible to develop very clear and specific pre-qualification criteria supported by an audit

process. Qualification specifications must address level of risk and be consistent with legal and other requirements. Audits are essential to ensure compliance with all qualification criteria. Failure to comply must enforce corrective action, and failing that, disqualification.

It is also incumbent on the utility to identify training requirements, and ensure it is made available.

Section 7.3 Utility Flight Operation Considerations

The use of and the need for helicopters in the maintenance and construction of power line facilities is determined by the utility, and whether services are provided by an external contractor, or are undertaken by utility owned aircraft, the following considerations need to be taken into account:

Section 7.3.1 Goals and Objectives

Implementation of utility flight operations requires alignment with corporate goals around effective management. Considerations might include:

1. **Cost / cost benefit analysis**: in isolation, helicopter costs alone can be perceived as prohibitive and are only one of many considerations for a decision about the use of helicopter of power line maintenance. Other cost benefits are:

    a. Scope of work: What type of work needs to be done, and does the use of a helicopter provide value? It is necessary to evaluate and compare all associated costs of conventional methods against aerial methods, to determine the value and feasibility of considering utility flight operations. All things being equal, there is additional pragmatic value for use of a helicopter.
    b. Time: more work can be accomplished in less time, facilitating optimization of human and financial resources.
    c. Access: significant cost savings can be achieved if facilities cross privately owned land – no damage caused by vehicles.
    d. Regulatory compliance: introduction of new regulations are resulting in additional costs due to changes in work practices. There are situations when costs can be reduced by use of a helicopter.
    e. Resource management: labor and financial resources are often limited; use of helicopters provides opportunities for more effective and optimal use of available resources.
    f. Environment: several factors need to be taken into consideration; i.e., weather, terrain, impact on public.
    g. Expanded opportunities: restrictions that may be the result of access (crops, sensitive ecosystems, etc.) can be reduced and/or better managed.
    h. Experience / reputation of helicopter operator: this is a critical consideration. Use of the "SAFETY GUIDE FOR UTILITIES IN EVALUATINIG AND SELECTING QUALIFIED HELICOPTER CONTRACTORS" provide guidelines to evaluate qualified contractors, and should be used in conjunction with tariff rates. Lowest price is not always the best value.

i. Contractual obligations: terms within contracts between the utility and the helicopter operator may have an impact on the type of operations considered. (e.g. Guaranteed minimums)

2. **Risk**: there may be additional and inherent risk associated with the use of helicopters. While this risk can be managed by procedures, consideration of whether to accept any potential risk is a corporate decision.

3. **Public perception**: general public may not be in a position to understand the value of using a helicopter for power line work. Circumstances may be that negative public perception may limit or prohibit use of a helicopter. Again, special care should be given to "FLY NEIGHBORLY" practices.

4. **Effectiveness**: utility flight operations need to satisfy scrutiny of both the corporation and external stakeholders as being both responsible and effective practices that support goals and objectives.

5. **Regulatory constraints**: situations exist that prohibit low level flight operations, and these need to be considered when planning and executing utility flight operations.

Section 7.3.2 Policies and Procedures

Policies and procedures provide the necessary direction and structure of utility flight operations. Both must be documented and readily accessible as a reference for job planning.

1. **Policies** are the guiding principles and define such items as:

   a. **Philosophy**: conditions and circumstances under which helicopter procedures will be applied.
   b. **Roles and accountabilities**: who is responsible for what, and what accountabilities lay with each role. In the case of utility flight operations, there may be joint leadership roles – one for non-flight operations, and one for in-flight activities.
   c. **Safety**: identifies necessary training and qualifications of workers, certification of tools and equipment, conditions of application, and limitations, and so on.
   d. **Compliance to regulations**: identifies all necessary regulations, and ensures that they are complied to.
   e. **Competency**: this applies to all parties engaged in utility flight operations, both from the utility perspective and the contractor / pilot point of view. Needs to consider education, willingness, and capability of the individuals. Policies need to provide the latitude for both the employee and the contractor to have a final say about competency.
   f. **Training**: policies need to identify training requirements, when a person is deemed as qualified, and need and frequency of recurrent training.

2. **Procedures**: the "modus operandi" or how the job will be completed. There are two distinct levels of procedures to be considered and all should be documented and approved:

   a. **General**: within the SAFETY GUIDE are high level procedures based on generally accepted best practices within the industry, and are fundamental in nature. The purpose of them is to provide a framework of conversation to develop more detailed procedures.

   b. **Operating procedures**: these are detailed and very specific to the task at hand. They identify resources, tools and step-by-step procedures as to how a task or series of tasks will be completed. Procedures address not only the specific tasks, but mitigate any condition or hazard that may be identified during pre-job planning. Procedures should be strictly adhered to unless a change arises that necessitates reviewing and changing the procedure to address the change. At this time, activities should be terminated, and only recommenced once the new procedure is discussed, approved and documented.

Section 7.3.3 Capabilities and Limitations of Aircraft

A utility considering the use of a helicopter needs to develop a good working knowledge of the capabilities and limitations of the aircraft as it ultimately determines the type of work to be considered, the cost of doing it, and the proper selection of approved contractors. Key considerations are:

- **Application**: what is it that you want to do with a helicopter? Applications can be very diverse, but may be limited by availability and budget. Consider the use of a helicopter for those tasks that provide the greatest value – look for alternate methods to do the rest.
- **Size of helicopter**: size can impose several restrictions, operationally and financially. Evaluate needs and select an aircraft that satisfies the majority of your needs
- **Environment (physical)**: utility flight operations are significantly impacted by weather conditions. Schedules for work need to accommodate the variable nature imposed by weather. When developing plans for utility flight operations, it is important to consider seasonal weather patterns, and schedule work accordingly.
- **Environment (operating)**: altitude and location impact not only the size of aircraft, but may also have an effect on what work can be done, how it will be done, and when it can be done.

Operators and manufacturers are an excellent resource to use to make such decisions

Section 7.3.4 Safety

Safety is of paramount importance, and is the central theme in all utility flight operations. By nature, there is inherent danger when engaged in power line activities; therefore, all aspects of planning need to be a collaborative effort between the utility and the helicopter contractor, procedures should be documented, thoroughly discussed and understood, and unanimously

agreed upon. An effective Safety Management System supports this effort to manage associated risks by:

- facilitating the identification of hazards and conditions that negatively impact operations, and then implementing / modifying procedures to mitigate these to acceptable and manageable levels. This can be accomplished through a structured safe work planning process.
- having an incident reporting process that addresses effective reporting of incidents in a timely manner, should they occur,
- investigating incidents with a focuses on identifying root causes, rather than blame, and
- having a process that takes the findings of an incident investigation and promoting continuous improvement to existing policies.

Section 7.3.5 Training

Utility flight operations represent an alliance between power line maintenance practices and helicopter flight procedures. At a high level, the SAFETY GUIDE documents common helicopter / utility activities, and provides guidelines for qualifying for helicopter contractors. Reciprocally, utilities need to be diligent about providing training and qualifying employees for these operations. Utilities should be able to provide documentation supporting qualification of employees.

In consideration of this, a utility needs to evaluate:

- **Minimum requirements**: all personnel must be familiar with safety practices for working around a helicopter. This would include hazards associated with the rotor systems, basic operation of doors, seat belts and communications, understanding other hazards associated with working with a helicopters (noise, flying debris, etc.), and emergency response procedures.
- **Competency of Personnel**: while there are a variety of best practices related to utility flight operations, circumstances are such that new practices and procedures will be developed, making it difficult to develop determine competency levels. Training should build on industry best practices and be modified to address change as it arises. Utilities need to develop training programs that address their needs, and to document what training has taken place. Involving the aircraft operator in developing training programs will provide an additional comfort zone for all.
- **Working in the Wire Environment**: by nature, utility flight operations involve working in close proximity to wires and other low level flight risks. Utilities should provide formal instructions at a minimum to its own employees, and where possible, to the helicopter contractor. Enrolling in and participating in courses focusing on low level operations is highly recommended prior to commencing such activities.
- **Specialized training needs**: practices associated with many utility flight operations are the result of "trial and error". Procedures are often products of need and innovation, and this requires due diligence on behalf of both the utility and the helicopter operator. In situations such as these, training is defined by the type of work to be performed, and the complexity of the task. Special skills are required to operate safely in the wire

environment, and training needs to focus on developing this expertise, both form the perspective of the utility and the contractor.
- All training should be supported by documentation.

Summary

Never before in history has the utility industry been more dynamic and unpredictable. There is growing concern about the lack of capital investment in the power grid over the past few decades, but as utilities move to upgrade existing infrastructure, they are experiencing resistance from a variety of land use stakeholders about the addition of new facilities. To meet these challenges, use of helicopters may provide utilities with new and innovative opportunities to effectively operate and maintain both new and existing facilities, however, success will depend on their diligence around the safe management of their utility flight operations.

CHAPTER 8 SAFETY WORKSHEETS, JOB HAZARD ANALYSIS EXAMPLES, ETC.

Section 8.1 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.

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 8.2 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 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.

TABLE 3 Mishap Risk Assessment Codes

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 8.3 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 UFOC 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.

UFOC 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.

TABLE 4 Mishap Risk Categories and Mishap Risk Acceptance Levels

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

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

NOTE 2: The Company Aviation Safety Officers should have safety oversight of all aviation operations. A CASO will perform an advisory review and provide comments for all work processes that have a mishap risk assessment code < 12. If the CASO 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.

Section8.4 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

Pre-Mission Work Package				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
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
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 Transport Canada 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

Pre-Mission Work Package				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
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

	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) Responsible Job Supervisor:						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

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 CAS vendor is accepted for use prior to initiation of flight operations. (Insert Organization's Name) verifies CAS operator has Transport Canada 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

Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
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 Transport Canada approved Rotorcraft Flight Manual.	19	Low
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

Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
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
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

Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
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
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

Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
Remote Hook will not release load.	5 High	Pilot will, prior to fligh,t 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
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

Prior to Starting Work at the Job Site				
Hazard Identification	**RAC With No Controls**	**Administrative Controls (Risk Mitigation)**	**RAC Controls Established**	**TOTAL RAC**
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
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

Section 8.5 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

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 Transport Canada 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 long line 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
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

	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

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 Transport Canada 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 Transport Canada 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

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

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 Transport Canada 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 per Transport Canada regulations, 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 in accordance with 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 in accordance with Transport Canada regulations and 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

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 in accordance with Transport Canada regulations and 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

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

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

Section 8.6 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

    a. What are the risks associated with this job?

    b. What can go wrong?

    c. What actions can be taken now to minimize those risks?

3. Work Procedures Involved In The Job

    a. What are we going to do? How? Where? Who? When?

    b. 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

    a. Are all employees physically able to perform the scheduled work?

    b. Are all employees in good health today?

    c. Have all applicable emergency procedures been reviewed?

5. Energy Source Controls

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

        (i) Electrical
        (ii) Chemical
        (iii) Mechanical
        (iv) Stored Energy
        (v) Other

    b. Have proper clearances been obtained and verified?

c. Have proper right-of-ways been obtained?

6. Personal Protective Equipment (PPE)

a. Are all tools and equipment in safe, usable condition?

b. Has equipment that requires it been properly tested and/or calibrated?

c. What PPE is required for the job?

d. Is all required PPE available, clean and in good repair?

Section 8.7 Pre-work Determinations

1. 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:

    a. Nominal voltages of lines and equipment

    b. The presence of hazardous induced voltages

    c. The presence and condition of protective grounds

    d. The presence and condition of equipment grounding conductors

    e. The condition of poles

    f. Environmental conditions relative to safety

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

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

Section 8.8 Helicopter Emergency Medical Response Planning

1. 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.

2. 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.

3. 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:

    a. The development of a site-specific emergency response plan.

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

    c. 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?

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

    e. 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.

4. 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.).

GLOSSARY (ENDNOTES)

Airworthy	In Canada 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.
Aerial Work	In Canada 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.
Barehand	Work/technique performed by touching an uninsulated energized or de-energized electrical part with the bare hand.
Bonding Device	Means a bare or insulated conductor used to ensure the required electrical conductivity between metal parts required to be electrically connected.
Breakaway Device	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 crewmembers safety harness and the aircraft attachment means as a safety device when transferring personnel to structures or conductors. Also known as a "Weak Link" (there are products commercially available)
Break-Away Link	See "Breakaway Device
Bull-rope	A rope, used for various reasons, between the sock line and the helicopter.
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.
Cargo	Bulk Load or Payload, i.e. work box, traveler set, etc., to be carried on board or externally by aircraft.
Choker	A short length of rope or cable, that fastens closely around a cargo load or pole as part of the external load rigging.
Civil Aviation Authority	The government agency within a country that regulates and oversees the use of air space and aviation activities within that country.
Class A Rotorcraft Load	External load fixed to the rotorcraft, cannot be jettisoned, and does not extend below the landing gear, used to transport cargo
Class B Rotorcraft Load	External load suspended from the rotorcraft, which can be jettisoned, and is transported free of land or water during

	rotorcraft operations
Class C Rotorcraft Load	External load suspended from the rotorcraft, which can be jettisoned, but remains in contact with land or water during rotorcraft operation
Class D Rotorcraft Load	External load suspended from the rotorcraft for the carriage of persons
Conductor	A wire or combination of wires not insulated from one another, suitable for carrying electric current.
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.
Corona Discharge Points	Partial breakdown of the air occurs as a Corona Discharge on high voltage conductors at points with the highest electrical stress.
Crewmember	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.
Detailed Power Line Patrol	For the purposes of this guide means the inspection by air of power line or pipeline infrastructure including conductors, static wires, poles, metal structures, insulators, spacers, cross-arms, substations, pipes, etc., by close visual or infrared examination.
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.
External Load Attachment Means	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 do not include rigging or any other sling system attached to it, commonly referred to as the "belly hook."
Fatigue	Means a state of diminished physical and/or mental efficiency.
Field Approval	Means to approve technical data used to accomplish a major repair or major alteration clearly set out by Transport Canada. It is an approval by Transport Canada, 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.
Flight Profiles	Means the representative side view of the aircraft's flight path

	or pattern.
Fly Type Blocks	A large wheel type of single pulley, usually with an attached fly arm to assist in catching the Fly rope, that is connected to the end of the structure arm when stringing using a helicopter
H-Frame	A two pole structure (can be wood or steel) that has a crossarm attached horizontally, close to the top of the structure. The completed structure looks somewhat like the letter "H"
Hazard	A possible source of danger or circumstance that increases the likelihood or probable severity of a loss, injury, or death.
Hot Stick	Long non-conductive stick-like tool used on energized lines.
Induced Electrical Discharge Hazard (Induced discharge)	Alternating current generated by energized electrical systems.
Lineman	A person who installs and maintains electrical, telephone, and/or telegraph lines
Load	Cargo, accessories, and associated rigging hardware connected to the helicopter.
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.
Limits of Approach	The closest distance an employee (qualified worker) is permitted to approach an energized or a grounded object.
Observer	A crewmember onboard an aircraft to inspect and record power line or pipeline deficiencies during flight while on aerial patrol.
Operational Envelopes	The design basis or standards that limit 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.
Occupational Safety And Health Civil Authority	The government entity that promulgates regulations and standards and oversees worker protection and health in industry.
Personal Protective Equipment (PPE)	Refers to protective clothing, helmets, goggles, or, or other garment designed to protect the wearer's body or clothing from injury by electrical hazards, heat, chemicals, and infection, for job-related occupational safety and health purposes
Platform System	A certified and approved attached aerial device, attached to a helicopter to allow enplaning and deplaning or hands on work from the device directly to a structure or element of the line.
Pre-formed Loop	Pre-formed quick attachment cable. Also known as a twist form loop.

Puller Tensioner	A device that applies a force to an object to maintain it in tension. Often the amount of force is adjustable. In line applications it applies tension to line or rope that is being strung.
Qualified Worker	A qualified person is "one who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved."
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.
Rigging	The system of equipment used to secure cargo for carriage, e.g. straps, cables, clevises, shackles, spreader bars, hooks, etc.
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.
Safety (management) System	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.
Sag	The amount of tension on the line along a power line. The distance below a horizontal line between structures that the line bows.
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.
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.
Signalman	Designated individual responsible for communication between the ground crew and pilot.
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.
Swing System Sling	That part of external load rigging that may include a remote cargo hook and 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).
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.
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.
Static Electrical Discharge Hazard (Static discharge)	Electrical charge created by meteorological conditions effects on the rotor system.
Sub-Transmission Voltages	Generally considered to be 44kv voltage and below.
Suspension System	See sling system
Tagline	Used to control a suspended load from the ground by ground personnel.
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”.
Tension Dolly	Tensioner for braking system
Wire Stringing	An application were old wire is replaced by new wire, often buy using a helicopter to string the first rope string and/or by using the existing old wire to pull in the new wire.
Wire Environment	Any operating area where any type of wire may exist

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