

4.

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1.0 Persons Affected

This Standard Operating Procedure (SOP) affects:
All Transmission, Operations and Maintenance employees who operate an Unmanned Aerial Vehicle (UAV).

2.0 Purpose

This SOP provides:
A standard procedure for operating a UAV safely.

3.0 Rationale

This SOP ensures the following:

- Supports the safety of our personnel by ensuring that the equipment being used is in safe working order prior to putting the equipment in to service.
- Inspections of SaskPower facilities and equipment to ensure proper working order.

4.0 Scope

In-the-Scope of the Procedure

- The procedure includes:
 - Aerial inspection of switch yards for the following:
 - Buss work
 - Switches for hot spots
 - Connection points for hot spots
 - Transformers for leaks
 - Loose hardware
 - Aerial inspect the lines for the following:
 - Rotten spars
 - Inaccessible structures
 - Loose hardware

Out-of-the-Scope of the Procedure

- The procedure does not include the following:
 - Pre-trip inspection of the machine

5.0 Policies and Regulatory Requirements

This SOP is a result of the following policies, regulations, industry standards, and corporate directives and standards:

Policies:

- Within controlled airspace zone must abide by Air Traffic Control

Regulatory Requirement(s)

- Abide by Transport Canada and Nav Canada Rules and Regulations

Other

- SaskPower Fatigue Standard
- SaskPower Safety and Environment Rulebook

6.0 Roles, Responsibilities and Prerequisites

In-the-Scope of the Procedure Role(s)	Quantity Required	Responsibilities	Prerequisites
SaskPower Employee(s) / Contractor(s)	2	<ol style="list-style-type: none"> 1. Complete inspection of line 2. Complete inspection of switching station(s) 	<ol style="list-style-type: none"> 1. Radio License 2. Standard Flight Operating Certificate from Transport Canada 3. UAV Flight Training

7.0 Tools and Equipment

Tools and Equipment and Quantity Required:

- Base Station (19 inch LED Flatscreen)
- UAV
- Downlink system

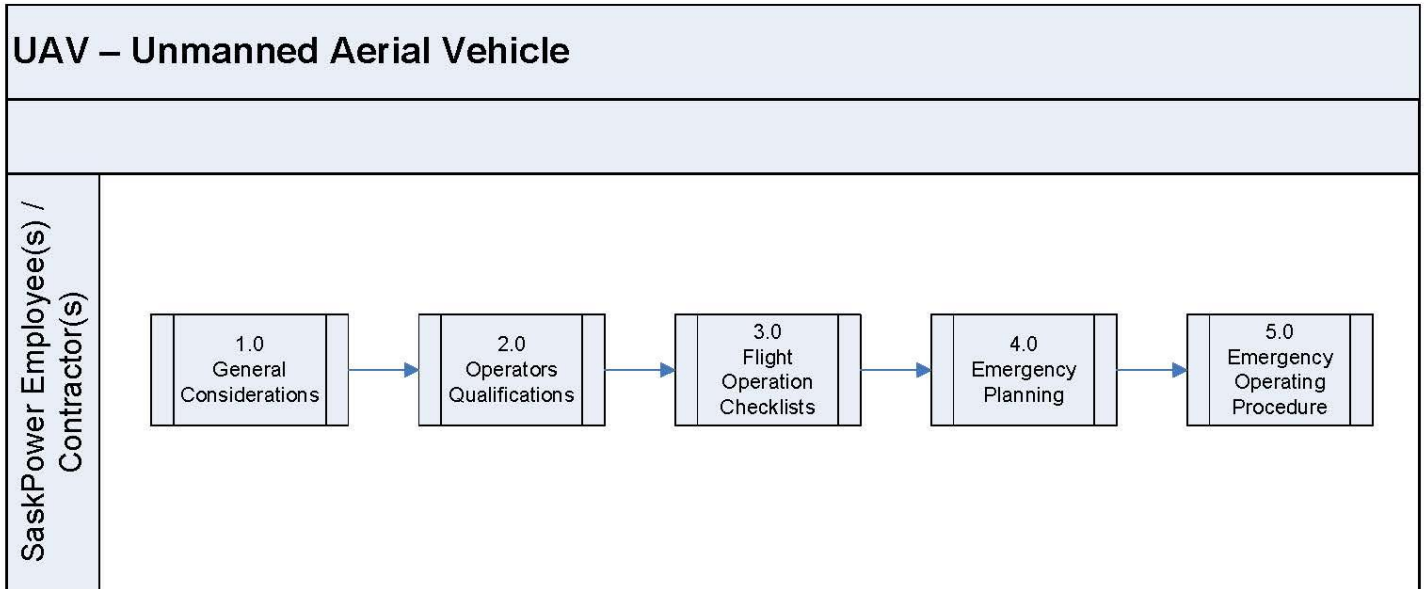
8.0 Planning and Preparation Checklist

Things to Check Before Starting the Procedure:

- Complete Hazard Aspect and Risk Assessment
- Applicable Personal Protective Equipment (PPE) is available and in good condition
- Flight Plan
- Check Weather Conditions (Rain, Snow, Wind)

9.0 Procedure

High Level Flowchart



The Procedure



Introduction

In 2014 SaskPower served almost half a million customers through more than 151,000 kilometres of power lines throughout the province. Our power grid includes three coal-fired, six natural gas-fired, seven hydroelectric, and two wind power facilities, with 230 kV (thousand volts), 138 kV and 72 kV transmission lines, along with numerous distribution stations and sub-stations.

SaskPower has a long history of technological innovation, and the adoption of Unmanned Aerial Vehicles (UAVs) is another example of how we can utilize new technologies to increase both our efficiencies, while enhancing safe operations.

Our UAV operations have brought us into the realm of aviation, and in this field, as in the power production and transmission industry, safety for employees and the general public must be the number one priority in all stages of operations. Incident prevention is much more desirable than conducting clean-up operations and incident reviews after the fact. Training and education as well as commitment to professionally run, well-planned operations are essential elements of safe UAV operations.

While many laws and standards have been established to promote safety, the ultimate responsibility for safe operations lies not with regulatory authorities, but with the individual. All staff involved in UAV operations must learn how to conduct their tasks safely, and apply that knowledge to ensure the safety of themselves, others, and the environment.

Mental Attitude

There is no single element more important in ensuring safe operations than an attitude of "Safety First". This attitude must be taught, practiced and supported by everyone. Strict adherence to the SOPs contained within this document will permit safe, efficient, and economic operations.

Fatigue

Fatigue is one of the most common physiological problems for aviators, and by extension, UAV operators. Fatigue degrades performance so that the operator cannot carry out tasks as reliably and accurately as they should. And fatigue is also an insidious danger: operators are often unaware that their judgement and capabilities are being compromised by the onset of fatigue. Each person should set up several checkpoint areas that will alert them to the onset of fatigue. If any one of these checkpoints is missed or cannot be maintained, it is a clear example that you are becoming fatigued, and should take immediate corrective action.

Some examples include:

- Ensure that all relevant checklist items are completed.
- Keep a working logbook that you annotate the details of each and every project.
- Ensure all crew members watch for telltale signs such as sloppy handling, yawning, etc.

Know the UAV Limitations - and Yours

An experienced pilot will spend sufficient time with a new aircraft becoming familiar with the various aircraft flight characteristics. The same is true for UAV pilots: many hours of practice are needed to gain the "feel" of the UAV in question, which becomes particularly significant when involved in operations where people and/or buildings may be in proximity. As well it is very important not to attempt flights that would exceed your current experience level.

1.0 General Considerations

1.1 Things to Consider

1.1.1 All operators of UAVs shall abide by the following:

- *Be aware of and abide by Transport Canada and NAV CANADA rules and regulations.*
- *Manned aircraft have right-of-way at all times.*
- *Avoid flight over persons or property unless an SFOC for such purposes has been granted.*

- *Do not fly while under the influence of alcohol or drugs.*
- *Aircraft shall remain in line of sight (LOS) at all times.*
- *Optical systems use by pilot is allowed if a designated spotter is used.*
- *Aircraft stability devices and GPS failsafe returns are allowed.*
- *Full autonomous flights are NOT allowed during any operations.*
- *Have a clear understanding of the regulations applicable to the airspace used.*
- *Flight operation will not be undertaken unless the aircraft is airworthy*

2.0 Operators Qualifications

2.1 Qualifications for the Operator(s)

2.1.1 The Operator(s) shall have the following qualifications:

- *Prior to participating in commercial operations in sparsely populated areas or in Class G airspace UAV operators must have a flight time of not less than 10 hours, with a proficiency check performed by an experienced UAV operator*
- *For all other operations in populated areas and Class C through Class F airspace UAV operators must have a total flight time of not less than 20 hours*
- *For operations at controlled and uncontrolled aerodromes the crew must include a member conversant with proper R/T procedures e.g. pilot, ATC staff, local facility operator*

2.2 Flight Duty Time Limitations and Rest Periods

2.2.1 All crew members shall abide by the following:

- *All crew members shall be responsible for recording their duty times, and shall be limited to a 14 hour duty day, with a minimum rest period of 8 consecutive hours of sleep in suitable accommodation, time to travel to and from that accommodation and time for personal hygiene and meals*

2.3 Selection of UAV Type

2.3.1 The Operators shall consider the following:

- *Aircraft is large enough to be seen in all flight operations*
- *Aircraft is small enough to operate within the specific landing zone for the project at hand*
- *Aircraft coloration and lighting makes its orientation visible at all times*
- *Aircraft is built to carry the added weight of photography equipment intended for use*
- *Aircraft is capable of the increased load factors in-flight*

- *Aircraft are test flown and deemed airworthy before being put in service*
- *Aircraft final test flights to include all photo equipment installed*

2.4 Site Assessment

2.4.1 Operator(s) shall use the following form to complete the site assessment:

- *Prior to each flight the Hazard, Aspect and Risk Assessment shall be completed*

3.0 Flight Operation Checklists

3.1 Communications

3.1.1 All Operator(s) of UAVs shall abide by the following:

- *Check proper operation of communications between pilot and spotter if remote unit required*
- *Check for proper operation of primary and backup VHF/UHF handheld unit by checking with ground at a controlled airport*

3.2 Pre-Flight

3.2.1 All Operator(s) of UAVs shall abide by the following:

- *All personnel to wear certified Personal Protective Equipment (PPE) as required*
- *Turn cell phones to airplane mode*
- *Before the first flight of the day, verify all transmitter, on-board aircraft, and camera batteries are fully charged*
- *Check all control surfaces for signs of damage, loose hinges, and overall condition*
- *Check the control linkages are secured and the condition of the control mounts and brackets*
- *Check the rotors to make sure they are in good structural condition and properly secured and aligned to the airframe*
- *Check the propulsion and mounting systems to make sure they are firmly attached to the airframe*
- *Check the propeller or rotor blades for chips, cracks, looseness and any deformation*
- *Check the landing gear for damage and for secure attachment and proper operation*
- *Check that the servos are firmly attached to the airframe and all receiver connections are secure*
- *Check all electrical connections making sure they are plugged in and secured to the airframe*

- *Check that the photography equipment and mounting system are secure and operational*
- *Perform an overall visual check of the UAV prior to arming any power systems*
- *Repair or replace any part found to be not airworthy in the pre-flight prior to take-off*
- *Perform assessment of operational area to identify hazards that may interfere with operation*
- *Determine if barriers or crowd control personnel are needed to protect public from harm*
- *Install barriers and/or assign duties to crowd control personnel as needed*
- *Confirm on-screen home position corresponds to site location*
- *Landing gear grommets in proper position*
- *Battery straps secure*
- *Camera battery, SD card and ensure focus manual to infinity (remember lens focus can go beyond infinity)*
- *Check lens is clean*
- *Controllers:*
 - *switches in proper position for initiation (*throttle minimum*)*
 - *antennas should be angled forward (never hold antenna)*
- *Cell phones in aircraft mode before GPS initialization*

3.3 Control Systems Check

3.3.1 The Operator(s) shall abide by the following:

- *Make every effort to assure that no one in the area is using your radio's frequency before turning on your transmitter*
- *Make sure that all of your body parts, clothing, other obstructions, and bystanders are well away from any propeller or rotor and its arc before turning power on to any systems*
- *Make sure the aircraft is secure and will not move if the motors were suddenly powered up*
- *Announce out loud - "CLEAR VEHICLE"*
- *Turn on the transmitter. If it displays information such as aircraft memory and battery voltage, be sure these numbers are correct*
- *Make sure that the throttle stick on the transmitter is in the power off position*
- *Connect the battery and/or turn on the power switch to the UAV*

- *Follow the recommended range test procedures as outlined in your radio transmitter/receiver owner's manual*
- *Check for proper operation of control surfaces*
- *Check that all servos are steady and not chattering or making any other abnormal noise when in operation or idle*
- *Check the motor/engine for proper operation*
- *Check that the motor stops completely when the throttle stick is at the off position*
- *Check that photo/video equipment power is on. Check to make sure the triggering device is working correctly*

3.4 Before Take-Off

3.4.1 The Operator(s) shall abide by the following:

- *Confirm transmitter antenna is fully extended and in correct position*
- *Confirm transmitter trim settings in proper position*
- *Confirm receiver antenna is fully extended*
- *Check that the take-off area is clear of obstructions and people*
- *Double check weather conditions and review potential emergency landing areas*
- *Set flight timer alarm and or other alarm systems*
- *Announce out loud - "TAKE OFF"*
- *Launch aircraft*

3.5 In-Flight

3.5.1 The Operator(s) shall abide by the following:

- *Climb to a safe altitude away from potential hazards and check control systems. Reset trims if necessary*
- *Keep aircraft at a safe operating distance from people and buildings*
- *If aircraft must be flown over buildings or people, maintain a safe altitude for recovery & make every effort to minimize that time*
- *Continually scan the flight and ground areas for potential hazards*
- *A spotter must be used at all times during operation of the UAV. The Spotter's responsibilities include:*
 - scanning for possible hazards in the air and on the ground
 - helpful in lining up particular shots by directing the best place and angle in the sky to photograph the target on the ground
 - ensuring interested bystanders are kept a safe distance from the operation

3.6 Landing

3.6.1 The Operator(s) shall abide by the following:

- *Check the control systems and set the trims that if necessary, an emergency abort landing can be made*
- *Scan landing area for potential obstruction hazards and recheck weather conditions*
- *Announce out loud - "LANDING"*
- *Always be prepared to go around*
- *Carefully land the aircraft away from obstructions and people*

3.7 Post-Flight

3.7.1 The Operator(s) shall abide by the following:

- *Turn the power off to the UAV and/or disconnect the batteries*
- *Turn off the transmitter*
- *Turn the power off to the photo equipment*
- *Visually check aircraft for signs of damage and/or excessive wear*
- *Secure the aircraft*

3.8 Maintenance and Log Books

3.8.1 The Operator(s) shall abide by the following:

- *Any damage or worn out parts need to be replaced or repaired before the next flight occurs*
- *Log books are not only used to log aircraft flight times with a running total, but to record all maintained, i.e. component installation, repairs, and replacement*
- *Each UAV should have an identifying number that can be connected to the aircraft and corresponding aircraft log book*
- *The logbook should be kept with the UAV*
- *All repaired UAVs shall be tested, deemed airworthy, and so noted in the maintenance logbook before resumption of duties*
- *Pilots must keep personal flight log books up to date*

4.0 Emergency Planning

4.1 Prior to Operations

4.1.1 The Operator(s) shall abide by the following:

- *Completed Hazard, Aspect and Risk Assessment Form*

- *Ensure there are independent primary and backup communications services with those agencies defined on the Hazard, Aspect and Risk Form*
- *Communicate the plan where applicable to the property owner, airport/aerodrome manager or air traffic service provider*
- *Ensure that all persons associated with the operation who may be required to respond to an emergency situation are briefed in advance of the operation*

4.2 During Operations

4.2.1 The Operator(s) shall abide by the following:

- *Ensure a well-equipped medical kit is available on-site*
- *Have local law enforcement and/or local supervisory personnel on-site if required to ensure the safety and orderly conduct of persons attending the flight*
- *In the event of an aircraft emergency, establish that there is no immediate risk to life, then implement procedures for flight termination*

5.0 Emergency Operating Procedure

5.1 Launch

5.1.1 The Operator(s) shall abide by the following:

- *If any flight irregularities are noticed, abort immediately*

5.2 Partial Loss of Power in Flight

5.2.1 The Operator(s) shall abide by the following:

- *Land immediately if possible*
- *If there are persons or buildings that may conflict, attempt to fly the UAV to a safe area before landing*

5.3 Erratic Flight Path

5.3.1 The Operator(s) shall abide by the following:

- *Land immediately if possible*
- *If there are persons or buildings that may conflict, attempt to fly the UAV to a safe area before landing*

5.4 Loss of Control Link

5.4.1 The Operator(s) shall abide by the following:

- *Check all switches in normal positions*
- *Check power level of control unit and change for full charged batteries if required*

5.5 Low Battery

5.5.1 The Operator(s) shall abide by the following:

- *Land ASAP in a safe area*

5.6 Loss of Visual Contact

5.6.1 The Operator(s) shall abide by the following:

- *Initiate pre-programmed return to base program*

5.7 Detection of Signal Interference

5.7.1 The Operator(s) shall abide by the following:

- *Change to different control channel*

5.8 Crew Responsibilities

5.8.1 The crew shall abide by the following:

- *In the event of an emergency situation, the following crew duties apply:*
- *Pilot - continues to focus on flying the UAV*
- *Spotter and Security Personnel - keep the area secure and free from onlookers*
- *Ground Supervisor - contact the appropriate emergency and controlling authorities as required*

5.9 Site Surveys

5.9.1 The Operator shall abide by the following:

- *When conducting surveys of any electrical structures (power lines, switching stations, substations, etc), be aware of the potential danger to both equipment and personnel from the high voltages present*
- *During a survey, if incidental contact should occur between the UAV and any electrical structure and no visible damage has occurred, immediately land the unit and check for potential damage. As well check the electrical structure to ensure no damage has occurred*
- *Should there be an event in which the UAV becomes entangled or hung up in any electrical facility, immediately power down the unit using the remote control. Do not attempt to remove it from the facility. Under no circumstances would we attempt to remove it from the energized facility. After ensuring a safe work zone, call your immediate supervisor and a plan for retrieval will be developed.*

5.10 NAV CANADA Rogue UAV Procedures

5.10.1 The Operator(s) shall abide by the following:

- *In the event of any uncontrolled flight either vertically or horizontally, the following rogue procedures apply.*

- *Within the Winnipeg Flight Information Region (FIR) contact the Winnipeg Area Control Centre Duty Shift Manager at (204) 983-8338 as soon as possible*
- *Within the Edmonton FIR contact the Edmonton Area Control Centre Shift Manager at 780.890.8397*
- *For operations within a control zone that has a Control Tower, contact that tower. For operations within a control zone that has a Flight Service Station (FSS) Tower, contact that FSS. For operations outside controlled airspace contact the appropriate Area Control Centre and the appropriate Flight Information Centre (Winnipeg - 1.866.541.4103, Edmonton - 1.866.541.4102)*
- *When you call, the ACC Shift Manager and Control Tower staff will be looking for information such as the UAV's last known position, altitude, direction of flight, service ceiling, range, type (fixed wing or rotary) and colour/markings*

10.0 Acronyms, Definitions and Symbols

Acronyms and Abbreviations

ATC - Air Traffic Control

GPS - Global Positioning System

LOS - Line of Sight

R/T Procedures - Radiotelephony Procedures

SFOC - Special Flight Operating Certificate

UAV - Unmanned Aerial Vehicle

VHF/UHF handheld unit -

Definitions

R/T Procedures - Radiotelephony procedures that must be followed when talking to the Airport towers during operation within their controlled Airspace.

Symbols

N/A

UAV - Unmanned Aerial Vehicle

11.0 SOP Components

The following is a list of components for this SOP which can be accessed through the SOP System:

SOP Component Name	SOP Component Type	SOP Component Description	Location of SOP Component
UAV - Unmanned Aerial Vehicle Flowchart	Flowchart	High to midlevel flowchart.	SOP Online - SOP Bundle - UAV - Unmanned Aerial Vehicle SOP

12.0 SOP Owner

SOP Owner

Manager, Construction/Maintenance North

13.0 References

References	Location of Resource
N/A	