

# Appendix 11 Aerial pipeline inspection

## **A11.1 General**

In most countries periodic inspections of product pipelines are required by national legislation, although the owner will usually wish to carry out inspections regardless of legislation. As well as checking for any signs of a leak from or damage to a pipeline, the inspection is to check that there is no danger to the integrity of the line from nearby construction or drainage work. The use of helicopters or fixed-wing aircraft is often the most effective way of achieving the task. Additional hazards are introduced by the need to operate at an altitude which is lower than normal operations. These hazards can be managed by complying with the following guidance.

## **A11.2 General guidelines**

- a) Weather.
  - i) All aerial survey/pipeline patrol operations should be conducted under Day Visual Flight Rules (VFR) conditions.
  - ii) Minimum weather for Day VFR of 1000-foot ceilings and 3 miles visibility.
- b) Oil spill surveillance and other aerial surveillance operations using specialized IR/UV cameras may be conducted at night if all requirements for night flight (Appendix 5) are met.
- c) Operations should be conducted at no less than the minimum safe altitude stipulated by regulation or authorized by the local regulatory authority (see item 11 below).
- d) Helicopters, when used, should not be operated within the avoid area of the height/velocity curve, as published in the helicopter's approved flight manual, except during landing and takeoff.

## **A11.3 Single-engine aircraft**

The use of a single-engine aircraft may offer some advantages for maneuverability and visibility. There are conditions that should be considered when making the decision on whether a single engine aircraft would offer an acceptable risk. Those conditions are generally: environment, terrain, the availability of a safe landing area along the route to be flown and ready access to professional search and rescue support (See Appendix 6 - weather planning document). When operating with a single engine aircraft the following provisions must be in place and monitored for compliance:

- a) The terrain must be such that a safe forced landing may be achieved in the event of a power failure, which means that there should be a potential for limited damage to the aircraft and injury to occupants.
- b) Flights should be conducted at not less than 500 feet AGL cruising altitude and at a speed and height combination such that, in the event of a power failure, a safe forced landing can be made.

An altitude exception is made where an appropriate approved low level waiver is in place and the pilot has read and signed the waiver which is carried in the aircraft.

## A11.4 Aircraft configuration

For long-term pipeline patrol operations, the aircraft should be at a minimum equipped as follows:

- a) Equipped for IFR Flight
- b) One VHF Transceiver
- c) GPS (IFR TSO preferred)
- d) Mode C or Mode S Transponder (or Equivalent)
- e) Crew Headsets
- f) ELT with TSO 126 or equivalent, 406mhz is preferred.
- g) Ground Proximity Warning System (GPWS, EGPWS, TAWS).
- f) Radar Altimeter (Radalt) with audio and visual alert or Automatic Voice Alerting Device (AVAD), where available for the aircraft model to ensure that the selected height AGL is maintained.
- g) Collision avoidance systems with active transponder interrogation, providing verbal and/or visual positional data on the target aircraft in high density areas or where other low level traffic may present a hazard.
- g) Automated engine monitoring systems for all single-engine aircraft. (Engine condition monitoring per FAA AC 20-105b is acceptable.)
- i.) Landing lights converted to pulse light configuration (for airplanes wing tip pulse lights) in high-density areas. High Intensity Strobe Lights (HISL)/pulse or forward recognition lights should be fitted to the aircraft.
- j) Climate controlled cabin for all operations in temperatures below 15°C and for long-term operations where temperatures are routinely above 32°C.
- k) For extended over water flights, One life raft with the ability to attach to the aircraft via a lanyard and life jackets with attached signal devices and water activated lights.
- l) Survival Kits should be appropriate for the environment being flown and should include a portable emergency beacon/radio.
- m) The aircraft should be painted in a high visibility paint scheme with appropriate markings and the operator should be encouraged to fit High Visibility Blades for helicopters if approved for the model.
- n) First Aid Kit and Fire Extinguisher (Pressure Gauge Preferred)
- o) Upper Torso Restraint if an approved modification for the aircraft exists.
- p) Carbon Monoxide Detector in the cockpit (visual or Electronic) on piston aircraft.

## **A11.5 Aircraft maintenance for long-term operations**

### **1. Maintenance of Pipeline Aircraft**

This section provides maintenance guidance for company owned or contracted aircraft. Its goal is to provide for the repair, maintenance, overhaul and modification of company owned or contracted aircraft and associated components in accordance with the objectives of maintaining safety; meeting airworthiness standards; and achieving maximum schedule reliability.

### **2. Responsibilities of the pilot / operator**

The Pilot / Operator is responsible for the planning and control of all maintenance, liaison with the civil aviation authority on maintenance topics, and liaison with all Persons or Approved Maintenance Organizations (AMOs) performing maintenance on the operator's aircraft. They shall have access to all applicable technical and regulatory publications necessary to perform these duties, and shall ensure that those publications are kept up to date. The Pilot / Operator shall remove from service any aircraft that are unsafe, or that do not comply with the regulatory requirements of the local civil aviation authority or this Manual.

### **3. Maintenance Schedules**

All aircraft shall be maintained in accordance with the manufacturers approved maintenance schedule. Copies of the maintenance schedule are included in the Aircraft Maintenance Manual. This maintenance will include Annual, 100 Hour and CAP (Continued Airworthiness Program) recommended inspections, where available. All mandatory and recommended Bulletins will be completed within the time limit stated in the bulletin. Optional bulletins are at the discretion of the company. The operator will adhere to manufacturer's TBO recommendations and transponder and altitude reporting checks will be performed every two years in accordance with local regulations. Engine oil changes will be completed in accordance with manufacturer's recommendations and the use of an oil analysis program is recommended.

### **4. Aircraft Special Inspections**

During operations, an aircraft may be subject to speeds or other conditions that exceed normal operating limitations: severe turbulence, exceeding airspeed limitations, abnormal maneuvers, hard landing, over weight landing, or lightning strike. The engines may be subject to foreign object damage or over speed conditions. If any of these conditions occur, the aircraft will be restricted from normal flight until a special inspection, as recommended by the manufacturer, is carried out by a licensed engineer.

### **5. Magnetic Direction Indicators**

The compensated installation may not have a deviation, in flight, greater than 10 degrees on any heading. A placard meeting the above requirements must be installed on or near the magnetic direction indicator. The placard must state whether calibration was made with the radio or air conditioner on or off. Each calibration reading must fall within 45-degree increments. Verification of the magnetic direction indicator is to take place every 24 calendar months or sooner if mandated by the appropriate regulatory authority.

### **6. Elementary Work & Servicing**

No person shall perform any elementary work or servicing (Oil Changes, Light Bulb replacement, etc.) without first being trained and authorized by an appropriately rated engineer trained in the task to be accomplished. This training will be documented and included in the person's company

training file. Elementary work and servicing shall be performed in accordance with the methods and procedures recommended by the aircraft or engine manufacturer.

#### 7. Airworthiness Directives

The person returning the aircraft to service after any scheduled inspection shall review all new and revised airworthiness directives upon receipt, to determine if they are applicable. They shall enter details of all applicable airworthiness directives, and details of all directives pertaining to the aircraft make and model, in the appropriate airframe, engine, or component technical record. The person returning the aircraft to service shall determine the date, air time or operating cycles, when the actions specified in the directive must be taken. If the required actions are due before the next scheduled maintenance activity they shall make the necessary entries in the log in accordance with the local regulations.

#### 8. Deferred Rectification of Defects

All defects shall be cleared before further flight of the aircraft, except as provided in this section. Where permitted by regulatory provisions as applicable, aircraft having outstanding defects may be operated subject to the following procedures:

- a. Where a Minimum Equipment List (MEL) has been approved and the list includes limits on the amount of time equipment may be inoperative, those limits apply.
- b. Where the MEL does not specify time limits, the aircraft may be operated following discovery of a defect. This provision is conditional to the following procedure:
  1. The pilot reports and coordinates the defect deferral with the Director of Maintenance or equivalent who will coordinate the authorization of the deferral;
  2. The defect shall be recorded in the aircraft discrepancy log.
  3. The discrepancy log entry shall specify the reason for the deferral and the latest date by which the defect must be corrected.
  4. The inoperative item is isolated and placarded "Inoperative" adjacent to the control.

#### 9. Aircraft Weight & Balance Control

Each aircraft shall have a current weight and balance report with an up-to-date equipment list. Using this information, the center of gravity location and operational empty weight (OEW) shall be calculated using actual occupant and cargo weights.

#### 10. Maintenance Arrangements

All aircraft maintenance shall be performed by the company's own authorized qualified maintenance technician, or an approved maintenance organization (AMO) holding proper license/ratings and training for the scope of the work to be undertaken.

#### 11. Aircraft Defects

The Certificate of Airworthiness of an aircraft is not in force if the aircraft has any malfunction or defect, unless the details of the malfunction or defect are recorded in the discrepancy log and unmistakable warning is given at the flight station by removing, placarding or tagging the affected item. In the case of deferred defects, the PIC shall assure him/her self that the affected equipment will still allow the flight to be conducted safely.

## **A11.6 General pilot and/or observer requirements**

The need for a qualified pilot and/or observer is extremely important and the following should be considered when selecting pilots and/or observers for a pipeline contract:

- a) The basic operation of pipeline patrol requires a division of attention between flying the aircraft, looking for traffic and observing the pipeline right of way.
- b) Patrol pilots may fly long hours often as a single pilot. The pilot should have a history of following all rules, and be self-motivated.
- c) Pilots must have a strong working knowledge of route terrain, and have a good understanding of local weather conditions and potential migratory bird activity.
- d) Each Operator should establish the procedures to be used by the aircrew in the performance of their duties to include but not limited to cockpit procedures and crew responsibilities.
- e) Each Operator should establish a 'sterile cockpit' rule covering as a minimum: key altitudes/ flight phases, restriction of unnecessary conversation and paperwork.
- f) Aircraft operators should ensure that PIC and observer candidates meet applicable certification, minimum experience levels and undergo initial and recurrent training.
- g) Annual ADM / CRM Training should be completed by ALL crewmembers.

## **A11.7 Pipeline patrol specific pilot role experience**

In addition to experience requirements contained in Appendix 5 the following requirements are recommended for all aircrew:

- a) Successful completion of a pipeline route check for the route to be flown (unless for a newly established route).
- b) Basic instrument experience.
- c) 50 hours in command patrol survey time in the previous six months.
- d) 10 hours on the contract aircraft type conducting pipeline operations within the preceding 90 days, or successful completion of a pipeline line check within the preceding 90 days.
- e) DOT Operator Qualification Program completed and current.
- f) Enrolled in an operator approved Drug and Alcohol program if allowed by local regulations.
- g) For helicopter Operations, see Helicopter recent Role Experience.

<b>Requirements</b>	<b>PIC</b>
<b>Airman Certificates &amp; Ratings</b>	
Commercial Pilot Certificate	Minimum
Instrument Rating or an Airline Transport Pilot Certificate	
Appropriate Category Rating	
Appropriate Class Rating	
Valid Second Class Medical Certificate	
<b>Flight Time (2)</b>	
1500 Hours Total Flight Time	Minimum
500 Hours Cross Country Flight Time	
25 Hours of Night Flight	
25 Hours in Make and Model	
50 Hours Aerial Patrol Experience	
<b>Programs</b>	
DOT Operator Qualification Program Completed (If applicable)	Minimum
Enrolled in operator approved Drug & Alcohol Program	
<b>Training</b>	
Annual Recurrent Flight Training (1)	Minimum
Annual Recurrent Ground Training and Testing	
Annual ADM / CRM Training	
IIMC/ Emergency Training	
Annual Maintenance Training	
Annual Flight / Line Check (1)	
Annual Simulator / IFR Training	Highly Recommended

(1) Six months between Recurrent Flight Training and Flight / Line Check

(2) Predicated on single engine airplane for Aerial Observation

## **Pipeline patrol specific observer role experience**

In addition to experience requirements contained in this appendix, the following requirements are recommended for all aircrew:

- a) Successful completion of a pipeline observer training program. .
- b) DOT Operator Qualification Program completed and current.
- c) Enrolled in an operator approved Drug and Alcohol program.

## **A11.8 Pilot flight & duty time**

The pilot flight and duty time limitations described in Section 5.6 of this guide should be applied.

## **A11.9 Collision avoidance**

There is an increased likelihood of traffic conflicts with military low-level traffic; power line inspection flights; aerial work and private flying activity, often beneath ATC radio coverage. The following measures have been shown to alleviate the hazards:

- a) Collision avoidance equipment described in the 'aircraft configuration' section above.
- b) An optimum operating height should be maintained at 500 feet AGL or higher. An exception is granted when an appropriate approved low level waiver is in place and the pilot has read and signed the waiver which is carried in the aircraft.
- c) Every effort must be made to co-ordinate with other airspace users through a notification system.

SSR Transponders should always be turned on even if operating outside controlled airspace or in remote areas. Other aircraft which may be operating in the low level environment are typically equipped with collision avoidance equipment that relies on detecting transponder signals from potentially conflicting aircraft.

## **A11.10 Passengers – crew members**

Passengers should normally not be carried during aerial surveillance operations, unless they are performing work related to the flight. In such cases they should be considered 'crew members', if not in contravention to local regulations. In Addition to the normal passenger briefing described in Section\*(9.5), persons acting as crew members will be briefed on their responsibilities by the pilot to include;

- (1) Primary responsibility of the crewmember is to act as an observer.
- (2) Route of flight
- (3) Map briefing pointing out all known hazards.
- (4) Weather enroute and at destination
- (5) Altitudes
- (6) Emergency procedures
- (7) Other duty assigned by the PIC.

It is recommended that for long-term pipeline patrol operations using single pilot aircraft, where daily flight times exceed 2 hours, a dedicated observer is onboard the flights. A dedicated observer should also be used when times are less than 2 hours if a portion of the patrol includes flight over or near large cities, and/or includes flight in congested airspace. These observers should receive appropriate initial and recurrent training following a written curriculum with appropriate testing. Recommended subjects include duties, responsibilities, observation techniques, and radio procedures.

### **A11.11 Exemptions/Low Altitude Waivers**

In most countries pipeline inspections occur below normal minimum operating altitudes, especially in the case of helicopters, and it will be necessary for the operator to obtain an exemption from the regulatory authority to conduct low-level operations. If exemptions are not in place then the client and operator may be subject to liability in the event of an accident or complaint regarding aircraft noise.

### **A11.12 Inadvertent entry into Instrument Meteorological Conditions**

Pilots may have limited experience in flying under IFR. It is therefore recommended, where allowed by local authority, that procedures following inadvertent cloud entry should be included in the Operations Manual and practiced during pilots' base checks.

### **A11.13 Flight following**

It is likely that pipeline inspection aircraft will be below radio coverage for a significant proportion of the time. Special procedures should therefore be in place to ensure that position reporting is achieved. This may involve the use of HF to base, periodic climbs to a higher altitude to achieve VHF contact or the use of VHF FM or mobile phone to speak to pumping or service stations along the route or installation of automated satellite flight following systems. Emergency response procedures should be tested periodically to ensure that flight following arrangements are effective in the event of an overdue radio call or missing aircraft. The use of advanced satellite flight following technology that would allow the tracking of flights at a base station is highly recommended.

In addition to the above comments it must be clear that the contracting OGP Member Company is responsible for flight following, and must either have the capability to perform this or have it as a contract requirement.

This section provides a guideline for a manual flight following system to augment a real-time satellite tracking system or to provide sufficient flight following capability in the event an operator does not utilize satellite tracking.

The purpose of a flight following system is to keep the operator aware of the position and status of each aircraft and its crew as well as to provide an overdue aircraft alert and trigger the Emergency Response Plan should an aircraft become overdue. In addition, last known position, fuel status, persons on-board and projected flight path information can be provided to search and rescue authorities should their services be required.

It is preferred that each patrol operator employ a monitored real-time satellite tracking system on each aircraft deployed for aerial patrol, however there may be several reasons for utilizing this manual system such as when the satellite system being inoperative or removed for service. Operators who are on short-term contracts (less than 12 months) should utilize a positive flight following system, which would include a manual system to provide operational capability and a positive flight following system should be included in each operator's operation manual. Each operator for each flight will determine the length of time between air-to-ground communications and the subsequent actions if an aircraft becomes overdue. It is recommended that this length of time be at a minimum of every 30 minutes for air to ground communication and if in contact with ATC, a positive position report is provided.

**Responsibilities:**

**Operator** - The Operator is responsible for maintaining an accurate and timely awareness of the location and status of each aircraft and crew. This status must be maintained by a person or facility not engaged in flight activities and will usually be a ground based dispatcher or flight following administrator (FFA). The status of each flight shall be maintained on a written or computerized Daily Flight Following Log which will be updated in real-time as new information is received.

**Pilot** - The pilot is responsible for reporting all required information to the Operator/FFA in a timely manner. This will usually be accomplished by way of cell phone, two-way pagers etc. These reports will generally be made prior to each take-off, upon each landing or should an event necessitate a change to the flight path, destination, estimated time of arrival (ETA) or aircraft status.

**Recommended Procedures for Pilot/Observer -**

1. Contact the FFA with a request to utilize Automated Flight Following (AFF) via satellite or Positive / Manual Flight Following (preferably via phone or email prior to flight).
2. Provide the FFA with appropriate flight information. (See below)

Note: If AFF satellite availability is lost at the FFA office, or the signal is lost during the flight, flight following will revert to 30 minute radio check-in procedures.

Flight Following Administrator (FFA) - The FFA will log all calls from the pilots as they are received and maintain the log in a timely and accurate way such that the location and status of each flight is available to the operator. The FFA will also have a method of alerting the pilot if an ETA is exceeded or should they become distracted by other duties.

The FFA is also responsible for alerting the appropriate operator personnel when an aircraft exceeds its ETA and is considered "overdue." The FFA may also initiate the "overdue aircraft" procedure from the Emergency Response Plan.

If the FFA must leave their duty station (end of shift/lunch) they are responsible to insure that their duties are transferred to another trained FFA and that there are no gaps in the flight following coverage.

**Recommended Procedures for FFA -**

1. When AFF is requested, ensure AFF program access is available and request standard flight information from the pilot/Chief of Party (COP). Document using existing FFA forms and logs.
2. Provide pilot/observer with appropriate frequencies to monitor during the Flight. (FFA frequency, national flight following, etc.) Ensure these frequencies are monitored during duration of flight.
3. Originating FFA center will communicate with destination FFA center as to whom will track on AFF.
4. If flight following will be handed off to another FFA office during the flight, brief this with the pilot/observer, providing the frequency change, call sign, and other appropriate information.
5. Brief with the pilot/observer on the radio calls that are expected and the expected responses.

6. Check the Automatic Flight Following system to ensure that the icon for the aircraft is shown.
7. Shortly after take off, the pilot/observer will call via radio stating “(Registration or Flight Number xxxx off (airport name) AFF”. Check the aircraft Icon color and verify the time and date. Respond to the radio call, stating “Registration or flight number xxxx, (FFA call sign) AFF”.
8. Keep the AFF system running and monitored on a computer during the entire flight.
9. Set a 30 minute timer, and check the flight progress as appropriate during the flight. Document the positions using existing forms and logs.
10. If the signal has been lost (for example - the aircraft icon turns RED). Immediately attempt contact with the aircraft via radio and follow normal lost communication, procedures as appropriate (to be defined).
11. If radio contact is made after a lost signal, flight may continue utilizing 30 minute radio check-ins for flight following.
12. In the event that the FFA tracking an aircraft on AFF loses the internet connection (on the ground), immediately attempt contact with the aircraft via radio. If unable to rely on the 30 minute radio check-ins then flight following will fall back on FAA flight plan.
13. Flight following hand offs must be coordinated when using AFF and Manual / Positive Flight Following. Coordinate with the affected FFA staff and agree on who will be responsible for flight following, how it will be accomplished (AFF and/or radio check-ins), frequencies the aircraft should monitor, and if frequency changes are required, when and where they should be made.
14. Ensure that the pilots/observers are briefed on any hand offs anticipated (call signs, frequencies and when to switch) and if a combination of satellite AFF and radio check-ins will be required (when and where).

**Recommended Flight Following Calls -  
Take-Off**

At a minimum the FFA will have the following information prior to each take-off:

1. Aircraft Identification
2. Point of Departure
3. Departure Time
4. Hours of Fuel on Board
5. Route of Flight (Patrol Route)
6. Intended Destination
7. Estimated Time of Arrival/Time in Route
8. Name(s) and emergency contact information of any passengers (non-crew)

## **Landing**

As soon as practical upon landing the pilot will report the following information to the FFA:

1. Point of Landing

## **Exceptional Reports**

In addition to the above routine reports, the pilot will report any of the following to the FFA in a timely manner:

1. Change in ETA by more than 30 minutes
2. Change in Route of Flight
3. Change in Aircraft Status

**Overdue Aircraft** - An aircraft will be considered overdue if the pilot has not reported landing at the Estimated Time of Arrival (ETA). One minute after the ETA, the steps below would be initiated. If an aircraft is overdue the FFA will report this to the appropriate Operator Personnel and/or take the following actions, for example, but not limited to:

1. Call the crew mobile phones. Most overdue aircraft are the result of pilots failing to report immediately upon landing so a phone call will eliminate this possibility.
2. Call the ATC tower at the destination and alternate airports to see if they have had contact with the aircraft.
3. Call the FBO at the destination to see if they have refueled or had contact with the aircraft/crew.
4. Implement Emergency Response Plan.

**Securing Flight Operations** - An FFA must remain on duty until all flight crews have landed and reported that they are complete for the day.

## **A11.14 Flights over urban areas**

Pipelines running through urban areas should wherever possible be inspected from the ground. Where aerial inspection is essential it should be conducted at a minimum altitude approved by local civil aviation authorities.

When operating single-engine aircraft, or multi-engine aircraft unable to sustain flight on one engine, pilots will select a flight path that provides a safe emergency landing area, avoids damage to third parties or facilities on the ground and that provides an opportunity for a safe emergency landing.

Operators will designate the preferred flight-path to be used if flights are conducted routinely over the same congested area.

## **A11.15 Landings and low altitude inspections en-route (helicopters only)**

During the flight the observer will take a note of construction work, or any other activity near the pipeline which could affect its integrity and will report events to the pipeline owner to follow up on the ground. However, if the observer judges that urgent action is required (for example, a trench converging on the pipeline) the observer may request the pilot to land nearby so that he can talk to persons on-site.

The operator should therefore have a section in his Operations Manual for unplanned landings or low altitude inspections to include guidance on the justification for such a landing, landing site selection, informing base or ATC of the intention to land, and recording the event. Pilot training and line-checking should include unplanned landing procedures.