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ADP010763

TITLE: The B-Hunter UAV System

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TITLE: Development and Operation of UAVs for Military and Civil Applications [Developpement et utilisation des avions sans pilote [UAV] pour des applications civiles et militaires]

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The B-HUNTER UAV System

(October 1999)

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Abstract

The purpose of this paper consists to provide a general overview of the B-HUNTER UAV System that has been chosen by the Belgian Army Ground Forces. From year 2001, the B-HUNTER UAV system will replace the Epervier UAV System which was in use in the Belgian Army since more than 20 years.

The B-HUNTER UAV System is derived from the US Short Range HUNTER Tactical UAV that has been developed and qualified according to the most severe NATO requirements by a joint venture composed of Israel Aircraft Industries Ltd. (IAI) and TRW Inc. It has been recently successfully deployed in Kosovo operation with proven operational results that have been reported in profusion of press releases.

This paper will describe the main upgrades at system and subsystem level that will be performed in the frame of the Belgian Contract by the Belgian EAGLE Temporary Association. The B-HUNTER UAV system and subsystem are described.

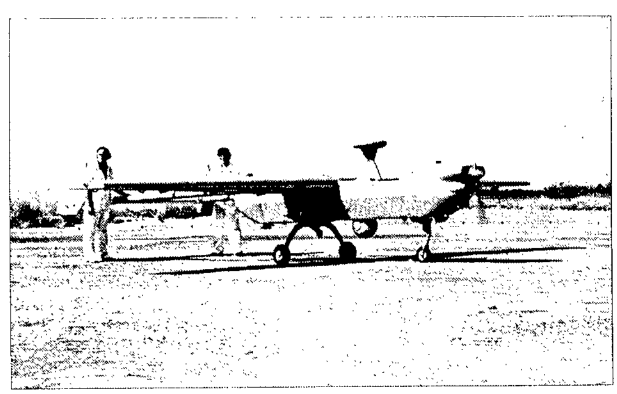
In the course of the B-HUNTER UAV Program, a lot of attention will be paid to the potential integration of the B-HUNTER UAV System in the civil air space. According to the Belgian law, UAV Systems have to comply with the following overall safety objective : "The B-HUNTER UAV System must allow during all its life safely execution of UAV missions above populated areas taking into account Belgian environmental conditions". A short introduction to the activities performed in the frame of the B-HUNTER UAV program with regards to airworthiness issues is presented.

Introduction

1.1. The heritage of the B-HUNTER.

The operational success of the B-HUNTER comes from the heritage of the developments of UAV by the MALAT Division of IAI started from 1974. In 1982, the first SCOUT UAV generation was used in mission in Lebanon by the Israeli ground and airforces. Second IAI-MALAT UAVs generation were deployed during the Gulf War with the US Government PIONEER Systems. These systems have also been extensively used during operations in Bosnia for peace keeping operations. The third generation of IAI-MALAT UAVs include the HUNTER Short Range Tactical UAV, the SEARCHER and other systems that fly today with success in more than 18 countries all over the world.

Seven HUNTER Tactical UAV Systems have been delivered to the US Army in 1995 after an extensive qualification program aimed to efficiently operate the system in all climatic and extreme meteorological conditions. The system as been extensively tested according to MIL-810 standards under the following conditions : altitude, rain, humidity, warm and cold conditions, salt environment, fog, dust and sand, road test , and rail impact.



The propulsion system has been subject to altitude and temperature tests according to FAR 33 standards from the Federal Aviation Regulations (FAR). These US Shrt Range HUNTER Tactical UAV Systems are now used by the military intelligence 15th battalion of the III US Corps and are currently successfully deployed in Kosovo

Paper presented at the RTO AVT Course on "Development and Operation of UAVs for Military and Civil Applications", held in Rhode-Saint-Genèse, Belgium, 13-17 September 1999, and published in RTO EN-9.

operations.

More recently a modernised F-HUNTER UAV System has been purchased by the French ground and airforces. It is currently used with success and has reached the same performances in terms of operational availability than the American system.

After a huge tendering process including extensive flight and ground evaluation tests, the Belgian UAV Contract of the Belgian Army ground forces has been awarded to the EAGLE Temporary Association in December 1998.

It is to be mentioned that three NATO countries have now chosen the HUNTER based UAV system with all the advantages that their choice could bring in terms of international cooperation, life cycle cost monitoring and commonalties for future improvements.

1.2. B-HUNTER UAV System major improvements

Since its original conception, major improvements have continuously been made on the original HUNTER System which is today a proven system in the fields of software, aids to mission planing, use of ground control stations and interface with modern tactical communications.

New improvements of the HUNTER UAV System will be made in the frame the B-HUNTER UAV Program ordered by the Belgian Ground Forces. These include :

- Implementation of a new airborne avionics computer
- Automatic Take-Off and Landing System
- Fourth Generation Ground Control Station with upgraded mission planning and control software
- Integration within the Belgian Army infrastructure (tactical communications, reporting to Intelligence echelon, ...)

While still complying with the environmental requirements, where ever it is possible, it will be called to extensive use of Commercial Of The Shelve (COTS) equipment as well as Non Developmental Items (NDI), in order to reduce the life cycle cost.

These improvements will be performed by the EAGLE Temporary Association constituted under the Belgian law of Israel Aircraft Industries Ltd., SAIT Systems – Brussels, SONACA – Charleroi, THOMSON-CSF Electronics Belgium – Tubize and THOMSON-CSF Systems Belgium – Antwerpen.

B-HUNTER UAV System

Description

2.1. System Overview.

The B-HUNTER UAV System is designed to be utilised in the Belgian Armed Forces for information gathering in threat environments that pose risk to a manned or piloted air mission, or where extended surveillance mission times are required. The system is based on the HUNTER system that has been fielded by the US Ground Forces.

Information is gathered by the system for intelligence, target acquisition, and battle damage assessment. The information is returned to the ground station via a full duplex RF link operating in the C band.

The B-HUNTER UAV System is capable of being operated, maintained, transported and deployed as a self-contained system. Each B-HUNTER System comprises the following:

- 6 B-HUNTER UAVs (including airborne communication and IMINT payload)
- 2 Ground Control Stations (GCS)
- 2 Ground Data Terminals (GDT)
- 1 Lot of Integrated Logistic Support (ILS)
- 1 Lot of Ground Support and Test Equipment (GSTE)

Additionally, a total of five (5) Portable Ruggedized Control Stations (PRCS) and two (2) Operator Proficiency Trainers (OPT) are provided.

Figure 2. depicts the major components and interfaces of the system.

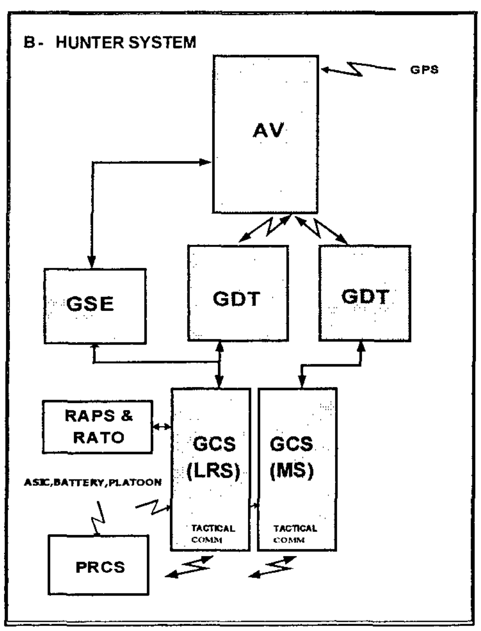


Figure 2. B-HUNTER UAV System Major Components

The UAV is a twin engine, fixed wing configuration. It is either flown remotely from the GCS or autonomously using a predetermined flight plan.

The UAV is capable of carrying a payload to accomplish the system's missions. The payload is a dual sensor configuration using a CCD camera and a FLIR, thus capable of operating in both day and night. The payload provides Real-time video images to the GCS, via the GDT. The video images and target position data from the system may be used directly by commanders at the ground or relayed to external Command-Control-Communication Information systems (C3I).

The flight path for specific missions may be pre-determined by specifying waypoint coordinates on a map displayed by the mission planning computer in the GCS. Using digitized maps, waypoints and flight times are specified to create a flight plan. Payload control commands are determined to carry out the specified mission. The mission, air vehicle and payload commands are downloaded to the air vehicle mission computer during the pre-flight procedure.

Any of the pre-programmed flight commands, stored in the UAV mission computer, may be overridden or changed by the air vehicle operator at the ground control station during flight. New waypoints may be specified and Real-time operation of the payload can be provided by the payload operator.

The UAV takeoff is either a conventional runway takeoff or by launching, using a RATO launcher. Both methods use the ATLS to accomplish an automatic process. The UAV is automatically landed by the Automatic Take-Off and Landing System (ATLS). In case of an emergency, the recovery is by using a parachute.

The B-HUNTER UAV System is capable of deployment in two sites:

- Launch and Recovery Site (LRS) – Figure 3.
- Mission Control Site (MCS) – Figure 4.

The sites may be at a distance limited by the Belgian tactical communication range.

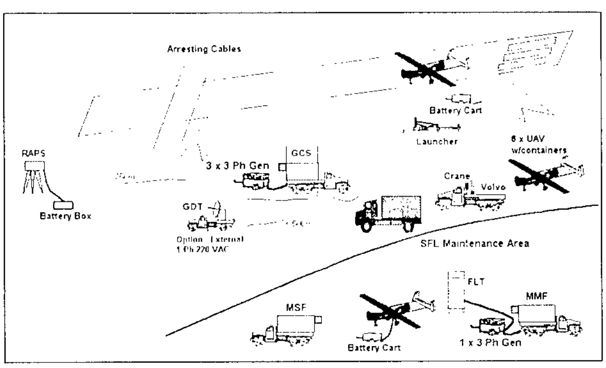


Figure 3. : Launch and Recovery Site

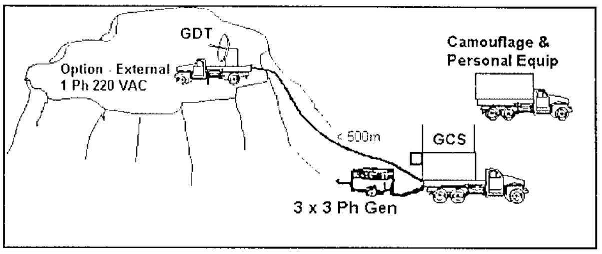


Figure 4. Mission Control Site

The B-HUNTER UAV system will meet the requirements concerning Security, Hygiene, Embellishment and the legislation concerning the Environment, as apply to military equipment and foreseen in the RFP and the proposal.

2.2. Missions

The UAV System will be capable of fulfilling the following missions :

- Imagery Intelligence (IMINT) Combat Information with day/night capability
- Damage Assessment with a day/night capacity
- Target Acquisition
- Artillery Adjustment

The main tasks of the IMINT combat information for the division consist of locating the reserves, the headquarters and the artillery positions of the enemy through the interpretation of images. The UAV System will also have the capability of performing the following tasks :

- Gathering information about certain parts of the terrain
- Gathering information about infrastructure having military importance
- Localization and attitude of enemy units
- Confirming information gathered by other means
- Directing the search for other means of information
- Delivery of proof through images
- Zone surveillance
- Border surveillance
- Control of disarmament agreements
- Following movements of troops and refuges
- Escorting of columns

In the Damage Assessment mission, the UAV System will supply continuous and reliable information to the division level relating to the results of the fire support.

For Target Acquisition missions, the UAV System will provide continuous and reliable information to the division level relating to the detection and the acquisition of possible targets for support in depth, in order to make accurate localization of enemy command posts, liaison centres, logistic installations, rocket launching ramps, AA and AT units and reserves.

For Artillery Adjustment missions, the UAV System will provide reliable information to the fire control centre of the supported field artillery unit relating to the distance (in meters) between the effect of one artillery shot and the target.

2.3. Operators and Tasks

The main operational tasks are :

- Mission Commander
- Mission Planner
- Pilot Navigator
- Real Time Observer
- Off Line Analyst
- Field Operators

Each one of these main tasks comprises either real-time tasks or off-line tasks; the real time tasks are the Pilot Navigator and the Real Time Observer tasks, the off-line tasks are the Mission Planner and the Off Line Analyst tasks, while the Mission Commander tasks are divided into real-time tasks and off -line tasks. Three operators will manage the tasks as follows:

- Operator No. 1 - Mission Commander, Planner and Off Line Analyst
- Operator No. 2 - Pilot Navigator
- Operator No. 3 - Real Time Observer
- Operator No. 4. – Field Operators

The Mission Commander, Planner and Offline Analyst will have the following capabilities :

a) Functions Commander:
  - Receive in the GCS the alphanumeric Operation Order (OO) containing the necessary data
  - Evaluate in the GCS the tactical situation through a Tac Sit overlay received in the framework of the operation order (threat, meteo. data, etc.)
  - Monitor the execution of the flight mission and take the necessary action in case of an emergency situation.
  - Inform the responsible operators of the UAV System and its higher echelon concerning the conduct of the flight mission so that the necessary measures can be taken to adjust the mission, to correct the execution of future missions and/or to analyze eventual human errors and/or failures of the material during the executed mission.

b) Planner Functions :
  - Make a correct plan of the flight mission, including overlay updates, route planning and route analysis (this function can also be performed by the Pilot Navigator)

c) Off-line Analysis Functions:
  - View real-time video
  - Capture still images
  - Visualize and interpret the already captured images (analog video from playback and stills) of an earlier or an ongoing mission
  - Transmit the relevant information (intrep, overlays, still images) from the captured images to the higher echelon Branch 2.

Figure 5. : GCS operations

The Pilot Navigator has the capabilities required to execute and follow up the flight mission, including:

- Perform self test of his console and the GDT
- Perform Pre-set procedure of the flight associated data
- Update Overlay data
- Plan flight routes, analyze them and load to the UAV
- Monitor the UAV launch, and systems during flight
- Select the flight modes and steer the UAV
- Operate the UAV sub-systems
- Perform emergency procedures

The Real Time Observer will have the capabilities required to execute and follow up the flight mission, including:

- Perform self test of his console
- Visualize real time images coming from the IMINT payload
- Control all IMINT payload functions and operational modes
- Monitor payload status
- Annotate images for later analysis by the Off-Line Analyst (this capability is also available for the Off-Line Analyst)
- Annotate items of interest on the image for later analysis by the Off-Line Analyst (this capability can also be performed by the Off-Line Analyst)
- Steer the UAV

The Field Operators in the LRS Site are responsible for testing of the UAV, preparing it for launch, setting up the Auto-land sensor, post flight activities and other activities concerning the operation of the UAV and the security of its operation.

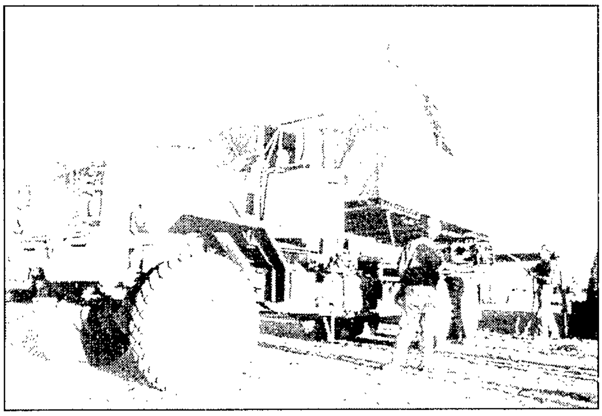


Figure 6. : Field Operations

2.4. Modular Optronic Stabilized Payload (MOSP)

The MOSP is a IAI-TAMAM stabilized passive electro-optical system, variable line of sight, designed to provide the observer with the capability for acquiring and tracking targets under day and night conditions.

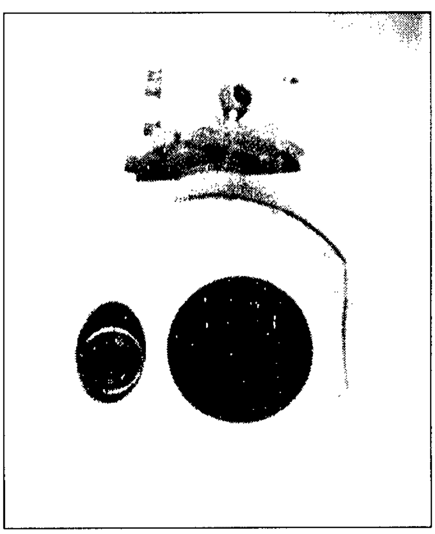


Figure 7. : Field Operations

The MOSP payload:

- Enables the operator to acquire targets during day and night engagements.
- Provides the capability to track targets either manually by using a joystick or automatically by using the TV tracker with either Camera Lens Assembly (CLA) or Forward Looking Infra Red (FLIR) sensor as image source.
- Provides the capability to select between the CLA image and the FLIR image.
- Provides Line of Sight (LOS) direction (bearing and depression) in reference to the UAV axes.

Its main technical performance allow to the following :

- Video tracker
- FLIR and CCD sensor capabilities
  - Detection (NFOW) : > 7.5 km
  - Detection (WFOW) : >5 km
  - Recognition : > 2.5 km
  - Identification : > 1.5 km

2.5. Data-link

The B-HUNTER UAV System employs primary and secondary (back-up) uplink communication channels and one downlink (wideband). The same frame format is used by the primary and backup channel, through each of the operational phases described below. The UAV employs an emergency logic in which the functional uplink replaces the malfunction uplink, as the active controlling channel, in case of UAV control channel failure (either primary or backup).This logic is implemented through all operational phases of the UAV.

a. <u>Operational Modes (Takeoff / Landing / Mission)</u>

The UAV communication system operates via the GDT and the ADT. During the Takeoff/Landing phase, omni antennas are used in both the UAV and GDT, while in the Mission phase, the GDT and/or UAV use directional antenna. The onboard transmitter and receiver are controlled by the DCPA

b. <u>Uplink Backup Operation</u>

Both primary and backup channels are suitable to serve as the UAV sole controlling channel (distance dependent). Normally, both uplinks are continuously transmitted by the GDT and received by the UAV, constituting a "Hot Backup Logic" within the UAV. The functional uplink channels immediately replaces the malfunction uplink, as the active controlling channel, without the need for re-synchronization. This backup operation automatically occurs in case of malfunction in the controlling channel.

c. <u>UAV Hand-over</u>

In this phase, UAV control is transferred between the GCS of the MCS and the GCS of the LRS and vice versa. This process is performed while both stations receive downlink channel (via the UAV omni antenna). At a start of a mission the GCS of the LRS controls the UAV via the primary channel and the GCS of the MCS communicates with the UAV via the backup channel. The process starts when the GCS of the MCS requests the UAV to grant control via the backup channel. The process is accomplished when the GCS of the LRS approves the request. Both uplink channels, primary (UPL_1) and backup (UPL_2) are used for this Hand-over to assure continuous control during the change over.

d. Operator Initiated Change-Over
The operator can change, upon request, the controlling channel of the UAV from the primary channel to the backup and vice versa. This process is implemented simply by using the same logic of UAV hand-over in the frame work of one station.

2.6. Real Time Information and Command of the UAV

The B-HUNTER UAV system transmits the video from the payload in real time to the GCS. The operators in the GCS receive the video in real time. The UAV also transmits status information, concerning the flight and the payload, to the GCS in real time. The video and UAV status information are available whenever the UAV is within operating range of the GDT.

The mission console displays the video and the status information in real time to the operators. The mission console derives additional information from the down link data reported by the UAV.

The GCS enables the operators to command and control the IMINT payload and the flight of the UAV in real time as long as the UAV is within the operating range of the GDT.

The GCS can handle two UAVs : one "on duty" and one "inbound" or "outbound" under autonomous programmed flight.

2.7. Automatic Takeoff and Landing (ATLS)

The UAV System is equipped with an Automatic Takeoff and Landing System (ATLS). The ATLS supports automatic rocket launching, automatic runway takeoff and automatic landing. The ATLS process is controlled and monitored from the GCS by the Pilot Navigator (PN). The UAV is capable of taking off from a straight and level unprepared terrain area of 25x300 meters maximum. A Rocket Assisted Take-Off (RATO) launching – zero length launching - is used for takeoff whenever the takeoff area is smaller.

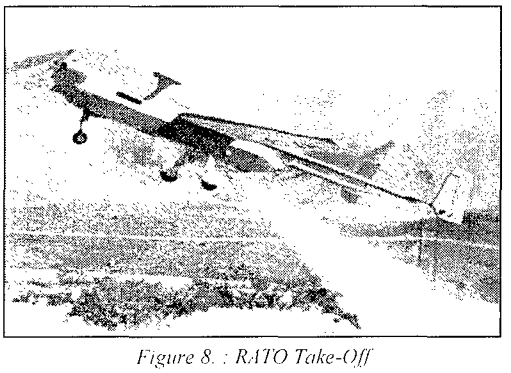


Figure 8. : RATO Take-Off

The UAV is capable of landing on a straight and level terrain area of 25x300 meters maximum. The surface at the two ends of the runway should be free of obstacles higher than 10 meters, at a distance of 200 meters from each end of the runway. The runway should maintain an appropriate leveling to support RAPS tracking capability.

The ATLS uses a Range Automatic Positioning Sensor (RAPS) to measure the UAV spatial location through a LASER retro reflector mounted on the UAV wing leading edge. The location data is provided to the GCS, through fiber optics cables. The OPBY at the GCS performs the Automatic Takeoff/ Landing (ATOL) geometric calculations and prepares the data for transmittal to the UAV where the DCPA performs the ATOL control laws and algorithms.

2.8. Emergency Recovery

The UAV is equipped with an Emergency Recovery System (ERS) based on a Flight Termination System (FTS). In the event of system failure which would preclude a normal recovery, the Flight Termination System (FTS) is activated. The FTS is activated by a manual command from the GCS or automatically in the event of loss of communication or total failure of the DCPA.

The DCPA is capable of initiating the emergency recovery process according to operator's command received through the ADT, or as part of the Loss-of-Link flight plan, independently, in the event of loss of communication. The Flight Terminal Logic (FTL) unit is capable of initiating the emergency recovery process in the event of a total failure of the DCPA itself. The FTL activates the FTS which performs: UAV payload Lift-up to safety position (Lift-UP command); Cuts UAV engines (FWD and AFT Engine Cut Command) and releases the parachute (Shoot Parachute).

2.9. System Built In Test (BIT)

The B-HUNTER UAV system is provided with BIT capability to decrease the time required for checkouts or fault isolation, and to provide status monitoring. The UAV, GCS, GDT and the MOSP are provided with BIT to detect failures and isolate the failures to the LRU level. The BIT is used to ascertain mission readiness status and to indicate which equipment is malfunctioning.

BIT features are provided in the electronic LRUs/DUs. The BIT operates in three modes: Power Up BIT, Initiated BIT and Periodic BIT.

Power Up BIT is initiated as power is applied to the system/subsystem, and is capable of system/subsystem checkout and fault isolation to an LRU. Go/No-Go indication shall be displayed and the failure log shall be updated. Failure data is stored in the Non Volatile Memory (NVM) of the end item computer. Power Up also checks circuitry that cannot be tested during operation without interfering with normal system operation.

Initiated BIT is activated by the operator. The operator is guided by the BIT menus displayed on the GCS or the Flight Line Tester screens to check the functions that can be tested off-line only due to interference with the system operation and to perform functional tests after maintenance or during preflight or pre-operational tests. This mode is also used to display failure data. Failure data is stored in the NVM of the end item computer.

Periodic BIT is performed automatically, without interference to the system normal operation after initialization, as a background task of the system's normal operation. Periodic BIT detects and isolates failures that occur during system operation. Safety critical and mission critical failures are automatically displayed to the operator during system operation. Failure data is stored in the NVM of the end item computer.

2.10. Tactical Communications Network

The following tactical communication networks are realised in the UAV Platoon :

- Battery Technical Net
- Platoon Command Net
- Higher Echelon Intelligence Net

Figure 9. depicts the integration of the UAV system within the three tactical communication networks.

The Battery Technical Network is used to transmit the UAV operation orders from the Battery Commander to the UAV Platoons. In addition, it also enables transmission of tactical overlays from the Battery Commander. It is composed of QUICK DATA VHF BAMS radios for the Battery Commander and the three GCS Mission Commanders. The transmission includes the following :

a) Operational Orders (OO)
b) UAV RECCE Request
c) Warning Order
d) Movement Order
e) Free Text
f) Overlays for tactical maps.

Each VHF BAMS radio in this network is functionally connected with the respective mission console of the Mission Commander in the GCS and the PRCS of the Battery Commander.

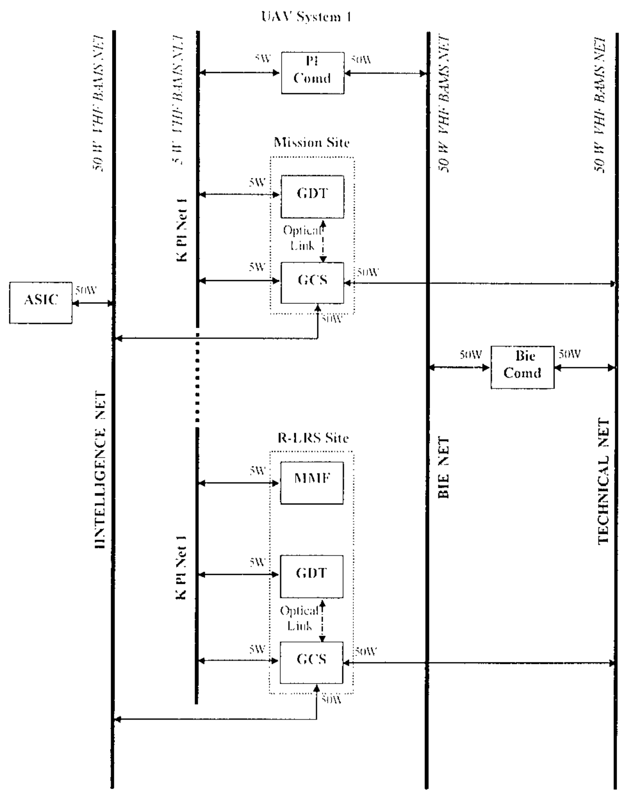


Figure 9 : Integration of TACOM Radio Networks within the UAV System

The Platoon Command Network is used to manage the UAV System. It is composed of a network of VHF BAMS radios for the ground elements (GCS, GDT, LRS) of each platoon and the S&TE for Single Field Level (SFL) Level maintenance. The VHF BAMS radios of this network are integrated in the corresponding elements of the UAV System. For each Platoon, the VHF BAMS radios connect, as a backup means, all of its elements and the S&TE level B3, by voice communication.

The Higher Echelon Intelligence Network is used to transmit the Intelligence data of the various UAV Platoons to the division ASIC, including fixed (still) images with overlaid data. It is composed of a network of VHF BAMS radios connecting the Division ASIC with the offline analysis in each GCS. The system transmits information obtained from the payload to the ASIC by the Intelligence network :

a) Intelligence Reports (INTREP) with text and numeric data. This information includes date and time, identification of target, coordinates of target.
b) Overlays of digital maps with graphical and alphanumeric (label) data
c) Single frame images from the IMINT payload. Each image is annotated with system data, and marked up with symbols and text. The images will be transmitted in JPEG format.

Each VHF BAMS radio of this network is functionally connected to the respective GCS (Mission console with the Off Line Analyst function) and the PRCS of the division ASIC.

The UAV System has also the capability to realise communications between its elements and to external authorities via telephone voice communications. Three field telephones are supplied for each system which interconnects with the intercom system.

There is also the possibility, as growth potential to integrate the UAV System in a Air Traffic Control (ATC) Network and in a Chase Heli Network.

2.11. System Performance

Operational Range

The operational range of the air vehicle, when there is a clear line of sight between the Ground Data Terminal (GDT) and the air vehicle, is 100 km.

Endurance

The Endurance as related to the flight profile is 10 hours (including reserve time of 30 minutes) with maximum fuel (takeoff weight 1600 lb). The UAV maximum loiter time above target (at 100 km range and same flight profile) is 7 hours.

Target Localization

When the UAV is at an altitude of 1000 m and at a slant range of 1500 m from the target, it measures the coordinates of the target in the UTM system relative to WGS 84 with an accuracy of 81 meters CEP. When the UAV is at an altitude of 1000 m and at a slant range 2500 m from the target, it measures the coordinates of the target in the UTM system relative to WGS 84 with an accuracy of 148 meters CEP.

UAV Localization

The UAV system uses the GPS receiver, located on board the UAV, as the primary method for UAV localization. As a secondary method, the UAV system tracks the air vehicle and provides its distance and azimuth measurements, in relation to the GDT location, to the operators. The distance accuracy in this method is 200 meters. It is possible to calibrate the distance and azimuth information in flight, or on the ground, by using the information provided by the UAV on-board GPS and the known location of the GDT.

Redundancy

The UAV avionics, the GCS and the Data Link have redundant hardware in cases where a component is critical for safety of the UAV. If a redundant item fails, the system can continue safe operation by using the spare hardware.

The system also has backup modes of operation that allow it to continue to operate in a degraded fashion following a non-critical item failure.

Autonomous Flight

The UAV is capable of performing pre-programmed mission profiles independent of GCS navigational guidance. The autonomous navigation is the normal navigation method during the flight. The pre-planned mission consists of a series of commands stored in DCPA to be executed in sequence when the UAV is operating under pre-programmed control. Each command in this series is defined as a waypoint and the mission planning is the end result of the series of commands. The commands include: UAV guidance, payload operation, communication control, etc. During operation, the way points serve as a destination for the UAV navigation system for the duration of that command. During autonomous flight, the GCS is constantly monitoring the down link received from the UAV.

Mission Continuity

The B-HUNTER UAV System can operate during 30 consecutive 24 hour days following user operational profile.

Data Link Performance

A communication range of downlink channel of at least 100 km between the GDT and the UAV in Line Of Sight (LOS) condition. Fail safe architecture is established in the ADT and the GDT by separating the Primary and the Backup terminals by means of function, power supply and communication with the DCPA/GCS.

The GDT is constantly transmitting via two up-link channels, each capable of serving as the UAV controlling channel. The UAV DCPA receives both the primary and the back-up channels and uses the functional channel by a "Hot Backup Logic".

The downlink contains either analog video or a digital compressed video signal as selected by the operator. In-flight selection of 7 pre-set frequencies (for each uplink or downlink link).

Co-existence of 3 UAVs controlled by their respective GDT is maintained by using adequate frequency separation among the uplink, downlink and back up channels, within the area of 70 km x 35 km and minimum separation of 300 meters between UAVs.

Inherent Availability

The inherent availability for the UAV System is calculated as 97.5 %.

Operational Availability
The operational availability for the UAV system is calculated as 71.6%.

2.12. System Deployment

The UAV System is deployed in two sites as depicted in Figure 3 and Figure 4. Figure 10. depicts the UAV System mobilization to the deployment sites.

Launch and Recovery Site includes:

- Six UAVs in containers
- One GCS
- One GDT
- Six IMINT payloads
- One Mobile Maintenance Facility (workshop, tent, storage space) with the associated Single Field Level support equipment and spare parts
- One RATO Launcher
- Take-off / landing area
- RAPS Sensor
- One Flight Line Tester
- Power supply generators, 3 12.5KVA (x4) - Government Furnished Equipment (GFE)
- Ground Support and Test Equipment.

Mission Control Site includes:

- One GCS
- Power supply generator, 12.5 KVA (x3) - Government Furnished Equipment
- One GDT (at up to 500 meters distance from the GCS)
- Ground Support and Test Equipment.

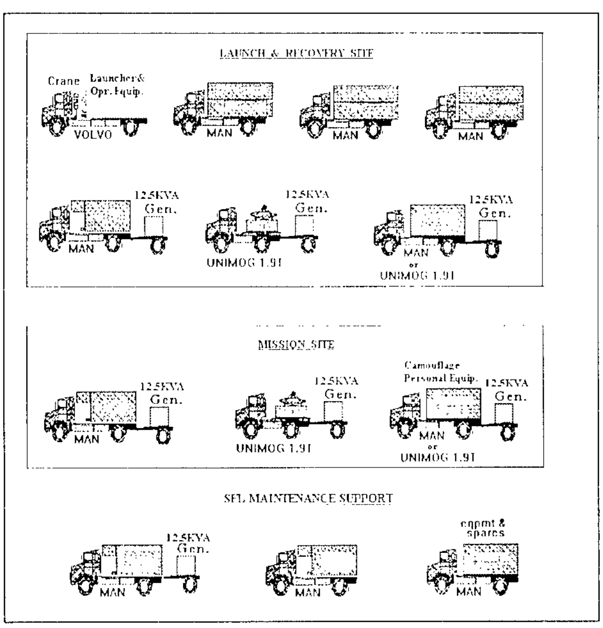


Figure 10. : Load Out Plan

The UAV system will be integrated with vehicles to provide it with autonomous mobility. The vehicles and integration will meet the "all roads" requirement in the foreseen theatres.

The crew for the deployment and the operation of a UAV system consists of 13 persons, 9 for the LRS and 4 for the MCS. Operation of the system, once it has been deployed, requires a crew of at most 6 persons. Refer to the ILSP for minimum training required to operate the system with maximum safety. Deployment and Teardown Times are :

- Deployment time for the MCS (GCS site) is 44 minutes.
- Teardown time for the MCS is 25 minutes.
- Deployment time for the LRS is 90 minutes.
- Teardown time for the LRS is 52 minutes.

The UAV System is capable of being transported by aircraft, type C5, C141 or ANTONOV. Transportation of the system while the elements are mounted on their respective road vehicles is possible up to the maximum height limit of the respective transport aircraft. Transport by Belgian C130 Hercules aircraft without road vehicles.

The components of the UAV system and their associated vehicles may be transportable by rail. All components and vehicles can be loaded into the railway carriages.

Major B-HUNTER UAV Subsystems Elements

3.1. B-HUNTER major subsystems

The B-HUNTER System includes the following major components:

a. Air Vehicle (AV)
b. Payload (MOSP)
c. Portable Ruggedized Control Station (PRCS)
d. Ground Control Station (GCS)
e. Ground Data Terminal (GDT)
f. Ground Support Equipment (GSE)

3.2. Unmanned Air Vehicle (UAV)

The air vehicle (Figure 11) is the remotely-controlled airborne platform of the System. It is a twin engine high wing aircraft. An operational UAV System consists of 6 UAVs. The major groups of equipment which comprise the AV are :

- Airframe
- Propulsion and fuel system
- Electrical Power system

- Digital Central Processing Assembly (DCPA)
- Sensors
- Electromechanical Units
- Airborne Data Terminal (ADT)
- Air Traffic Control (ATC) Transponder (IFF Transponder)
- Flight Termination System

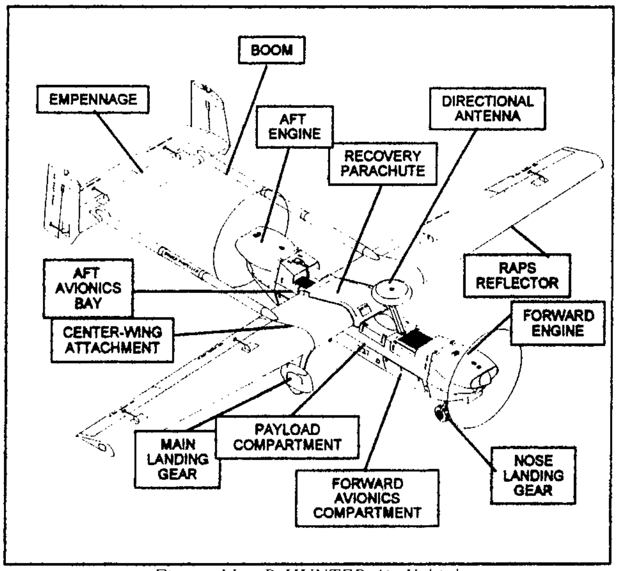


Figure 11. : B-HUNTER Air Vehicle

Airframe

The airframe houses, and supports all airborne equipment within an aerodynamic shape that provides lift and control surfaces. The airframe has a fixed wing and is constructed of lightweight composite materials which allows ease of repair. The airframe consists of the structural elements including fuselage, wing and empennage assemblies required to carry UAV equipment and the payload. The airframe includes a fixed landing gear, an arresting hook and a payload lift.
The UAV is designed to be capable of packaging in the UAV storage/shipping container.
The UAV airframe can be disassembled (fuselage, wing, boom, tail, etc) for storage and transportation in the UAV container.

Propulsion and Fuel System

The AV is powered by two engines. The forward engine drives a two blade tractor propeller and the rear engine drives a two blade pusher propeller. The propellers are two blades laminated wood propellers equipped with Estane leading edge protection. The propellers comply with the requirements of FAR part 35.
The fuel is stored in the integral tank of the center wing and the fuselage and is pumped by the membrane pumps of the carburetors.

Electrical System

The AV electrical power system generates, distributes and controls the required electrical power for the various electrically operated UAV component items including the Payload and the ADT.
For Ground Operation, the UAV is equipped with an electrical power connector enabling the connection of all 28V buses and all DC/DC converter inputs to a 28VDC external (ground) power source.
The UAV is equipped with an emergency battery which supplies critical loads through the 28V battery bus in case of a failure in the generator. The battery supplies the flight critical consumers. The emergency battery is a sealed Ni-Cd battery which is connected in parallel to the generator.
The UAV is equipped with aircraft standard position-lights and a strobe-light.

Digital Central Processing Assembly (DCPA)

The Avionics in the UAV is controlled by the DCPA. The DCPA receives commands from the GCS through the communication system, or uses the stored mission program. The DCPA provides flying qualities that match the specified requirements in all the flight modes. The DCPA is capable of detecting failures of sensor, computer and actuator and has the ability to backup each faulty item. The DCPA status and flight parameters are transmitted to the GCS. The DCPA provides all the required facilities for control and operation of the AV. It manages the important UAV subsystems including the MOSP and the ADT. The DCPA consists of two identical digital computers (AVC1 and AVC2). The two digital computers are connected to each other via a RS-422 digital data link (Cross Channel Data Link). Both computers include software and hardware modules, and I/O cards. During normal operation AVC-1 is the active computer, while AVC-2 is in stand-by mode. All the inputs and most of the outputs are connected to both computers, but only the active computer outputs are actually issued. In the event of a failure in the AVC-1, the AVC-2 becomes the active computer and takes control of all the common outputs, providing a full back-up for the related functions.

Sensors

The AV is equipped with the following sensors:

- Air Data Unit (ADU) includes the airspeed transducer and the altitude transducer
- (pitot system).
- One Vertical Gyro Unit (VGU) providing pitch and roll attitude information for flight control system and for attitude display.
- One Sensor Block containing triple axis rate gyros and accelerometers providing angular velocities and accelerations to back up the flight control system in case of VGU failure.
- The UAV is designed with provisions for replacement of the VGU and sensor block with two Fiber Optic Gyro (FOG) based Directional Measurement Units (DMU). The DMUs provide

redundant pitch and roll attitude as well as three axes rate and acceleration.

- Three axes Flux Valve Unit (FVU).
- Global Position Sensor (GPS) and Antenna.
- Engine Temperature Sensor (ETS) inserted in the engine head.
- Fuel Level Sensor (FLS) inserted in the fuel tank.
- Two accelerometers (X and Y axes) provide the decision to enter to the
- Emergency mode.

Electromechanical Assemblies

The following electromechanical assemblies are installed:

- 6 flight control servo actuators (aileron, rudder, elevator).
- 2 throttle servo actuators (FWD, AFT).
- 2 flap servo actuators.
- Nose wheel steering servo actuator.
- Payload lift actuator.

Airborne Data Terminal (ADT)

Commands, Video images and reports are transferred in real time from and to the GCS/GDT by the airborne section of the communication system, the ADT. The ADT is divided into three major assemblies: the primary ADT receiver; the Backup ADT receiver; and the antenna group - provided as part of the UAV airframe.

Air Traffic Control (ATC) Transponder

The UAV is equipped with an IFF Transponder, capable of operating at 1, 2, 3/A, C, S, 4 and TEST modes. The IDENT and emergency reply codes are in accordance with NATO STANAG 4193 rules. The transponder is controllable by the Pilot Navigator.

Flight Termination System

The UAV is equipped with a Flight Termination System (FTS). In the event of system failure which would preclude a normal recovery, the Flight Termination System (FTS) is activated using a parachute. The FTS is activated by a manual command from the GCS or automatically in the event of loss of link and total DCPA failure. The parachute pack is installed in the parachute compartment in the forward upper section of the UAV. The DCPA is capable of initiating the emergency recovery process according to the operator command received through the ADT, or as part of the Loss-of-Link flight plan, or independently, in the event of system failure. The Flight Terminal Logic (FTL) unit is capable of initiating the emergency recovery process in the event of a system failure that results in total failure of the DCPA itself, or according to a flight termination command received from the Flight Termination Receiver (separately from the normal GDT-ADT data link).. The FTL activates the FTS which performs: UAV payload Lift-up to safety position (Lift-UP command); Cuts UAV engines (FWD and AFT Engine Cut Command) and releases the parachute (Shoot Parachute).

3.3. Multi Mission Optronic Payload (MOSP)

The Multi-Mission Optronic Stabilized Payload (MOSP) is a Day/Night stabilized passive electro-optical system designed to provide the observer with the capability to detect, recognize and acquire tactical targets under day and night conditions. A complete UAV- System includes 6 MOSP.

The payload is installed onboard the UAV and is controlled by an observer in the Ground Control Station.

The MOSP:

- Enables the operator to acquire targets during day and night engagements using two fields of view – Narrow (NFOW) and Wide (WFOV).
- Provides the capability to track targets either manually by using a joystick or automatically by using the TV tracker with either Camera Lens Assembly (CLA) or Forward Looking Infra Red (FLIR) sensor as image source.
- Provides the capability to select between the CLA image and the FLIR image.
- Provides Line of Sight (LOS) direction (bearing and depression) in reference to the UAV axes.

The MOSP is composed of:

- Stabilized Gimbals Assembly (SGA) containing Stabilized Platform Assembly (SPA) and Payload Control and Logic (PCL)
- Forward Looking Infrared (FLIR) containing 2nd generation 8-12µ Thermal Sensor Unit (TSU) and FLIR Electronic Box (FEB).
- Camera Lens Assembly (CLA) containing TV camera and 20mm-280mm continuous zoom lens.
- Tracker contained in PCL.

3.4. Ground Control Station (GCS)

The GCS is a shelter type control station mounted on a 4-ton MAN vehicle. The shelter configuration is capable of supporting electronic equipment installations and protection of the operators in the specified environment. Two identical GCS are provided with each UAV System, where one unit is employed at the launch and recovery site and is used for the pre-flight, take-off and landing, while the other is used for the mission planning, mission control and observation.

Shelter

The shelter is S 280 type shelter with consoles for 3 operators. The shelter is transportable by a MAN 4T.

The shelter is air conditioned. The shelter provides all necessary electrical and mechanical interfaces for the

BAMS tactical communication equipment.

Operators' Consoles – OPBY-R/L, CMBY

The GCS uses a generic console as a building block. The generic console has all the hardware and all the software needed to control the UAV, its payload and also the datalink. The GCS has two generic consoles each of which may be configured to perform all the mission and flight critical functions. If mission critical hardware fails in one generic console, it is possible to reconfigure the system so that the second generic console takes over the functions of the failed hardware. A third console contains hardware that is not critical for the safety of the UAV or for its mission. The GCS configuration includes three operators' consoles as depicted Figure 12.

Generic console	Commander console	Generic console
OPBY- L	CMBY	OPBY- R
=	=	=
Real Time Observer -or- Pilot Navigator + Mission Planner	Mission Commander + Mission Planner + Off Line Analyst	Pilot Navigator + Mission Planner -or- Real Time Observer

Figure 12. : S 280 Shelter, Mission Console Assignment

An operator will be stationed at each console, i.e. 3 operators.

The functions for the left generic console and the right generic console are software assigned.

In a typical configuration, the generic console on the right will assume the functions of Mission Planner + Pilot Navigator and the generic console on the left will assume the functions of the Real Time Observer. The functions of the Mission Commander + Mission Planner + Off Line Analyst are assigned to the central console. The generic consoles are symmetric, so their functions can be exchanged between left and right. The functions of the Mission Commander and of the Off-Line Analyst may also be available at any of the other consoles.

Instructor Bay (INBY)

The INBY bay contains the necessary instrumentation for connection to and switching of the up-link and down-link data between the operators bay via the TLM-SW. The bay is also used to host two 50W BAMS radios see GCS SSDD.

Supplies Bay (SBY)

The SBY bay is the electrical power center for the GCS. It hosts the 230 VAC to 28 VDC power converters, a battery pack, five UPS for all bays and the electrical control panel.

Operator Proficiency Simulator (OPT)

The Operator Procedure Trainer (OPT) consists of a commercial Personal Computer and interface components. When connected to the GCS it enables the operators to perform their respective functions as if an AV was in flight. The OPT also simulates the function of the GDT. The three consoles of the GCS send commands to the OPT (as if it were an AV) and receives the appropriate responses (data, status and video). Thus, the operator is able to operate the system, in all the modes of operation that are pertinent to an AV in flight. Delivery of an OPT can significantly reduce the risks associated to human errors by appropriate training of all the mission operators involved in a UAV battalion.

TACOM

The GCS includes a full duplex intercom system, based on SOTAS system, for voice communication among the operators.

3.5. Ground Data Terminal (GDT)

A complete UAV- System consists of 2 GDTs (Figure 13), each connected to an GCS. The GDT is mounted on a UNIMOG and integrated with a vehicle mounted DC Generator (Figure 14).

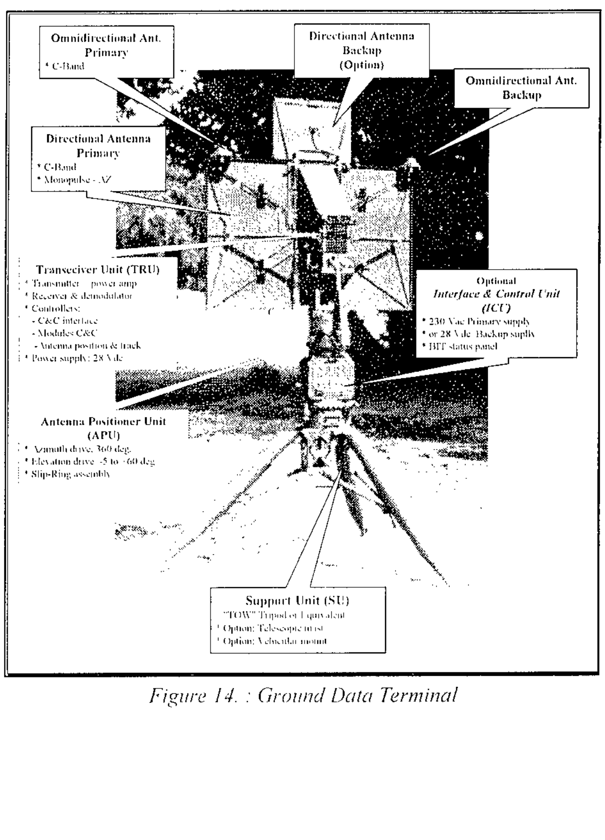


Figure 14. : Ground Data Terminal

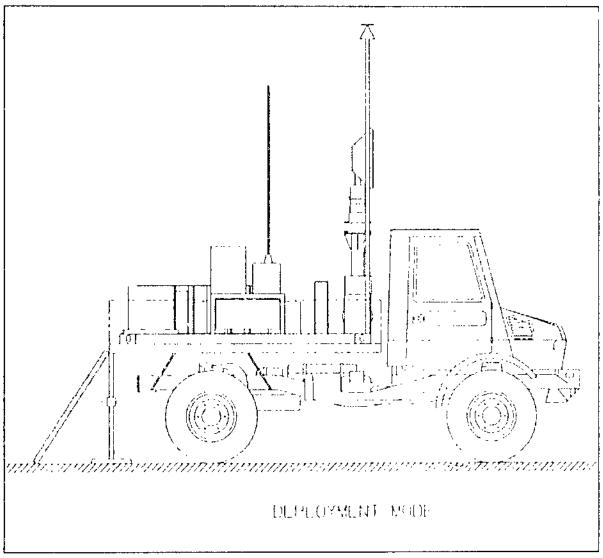


Figure 15 : GDT on UNIMOG Truck (Deployment mode)

The communication between the Ground Control Station (GCS) and the UAV flows via the Ground Datalink Terminal (GDT) and the Airborne Datalink Terminal (ADT). It is designed to provide full duplex communication link between the UAV and the GCS. The GDT transmits to the ADT two uplink channels and receives from it a single downlink channel. The uplink channel includes the real time command and the control message. The downlink channel includes real time video and telemetry.

The functions of the GDT are as follows:

- Receiving the uplink message and the ground Datalink control from the GCS via RS422 protocol.
- Transmission of real time primary command uplink (UPL-1) to the UAV via the radio link.
- Transmission of real time secondary command UPL-2 to the UAV via the radio link.
- Receiving real time down link (DNL) information (video and telemetry) from the UAV via the radio link.
- Transmitting the downlink message (video and TM) and Datalink status to the GCS via RS422 (TM) and CCIR format (VIDEO).
- Tracking the UAV transmitted RF signals.
- Measure the azimuth and range from the GDT to the UAV.
- Execute the Built In Test function.

The GDT major elements are:

a. Antenna System
   - Directional Antenna (C band) (for UPL & DNL)
   - Omni directional Antenna (C band) (for UPL & DNL)
   - Omni directional (UHF) (for backup UPL only)

b. Transceiver Unit (C band)
c. Directional Antenna Positioner
d. Backup Transmitter (UHF)
e. Digital Video Expansion Unit
f. Equipment Box
g. Power Supply Unit
h. Generator

3.6. Portable Ruggedized Control Station (PRCS)

The PRCS is a computer station for on-line mission management (planning, ordering, reporting, overlays sending and receiving) remotely from the GCS. It provides a computer terminal for communication with the GCS via the Battery technical net and the Intelligence net radio networks, using the QUICK DATA BAMS 50W radio.

The PRCS is used by the Battery Commander to transmit Operational Orders (OO) to 3 operational GCS of his Battery. The PRCS is used by the ASIC to receive and exploit information from 3 operational GCSs in the Battery. The PRCS is based on a workstation, using UNIX as the operating system, and on a subset of the GCS software for mission planning. The PRCS software uses the same resources used by the GCS software for mission planning. The PRCS can be carried by one person.

3.7. Ground Support Equipment (GSE)

Launcher

The B-HUNTER uses a specifically designed HUNTER launcher for RATO take-off.

RAPS (Figure 16)

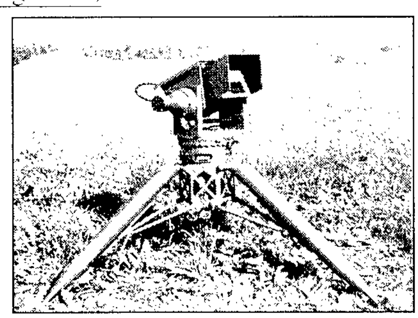


Figure 16 : Range Automatic Positioning Sensor

The ground portion of the RAPS consists of the following elements:

- Tripod - serves as a basis for the sensor platform
- Sensor Platform with Transportation Case - Contains Actuator Motors, Position Sensors, Gears and Sensing Head
- The CORA Sensing Head - Consists of Laser Diode Emitter, Distance Sensor, Angle Sensor, and TV

camera

- Electronic Unit with Transportation Case - Encompasses Compact electronic cabinet with embedded computer and interface electronics for actuators and sensors
- Battery Pack - provides electrical energy to RAPS

The airborne portion of the RAPS consists of a retroreflector, mounted in the UAV wing leading edge and used to reflect the laser beam to the RAPS ground portion.

Other Ground Support Equipment

The B-HUNTER UAV Single Field Level of maintenance concept consists of the following (see also Figure 10) per B-HUNTER UAV System :

a) GFE Supplied Volvo 10T with 10T Crane for
   - Launcher
   - Support Equipment
b) 3 GFE MAN 5T Trucks, each capable of transporting 2 UAV Containers
c) LRS : One GFE Truck for GSTE and operational equipment incl. Flight Line Tester
d) MCS : One GFE Truck for personnel and camouflage equipment
e) Mobile and Maintenance Facility
   - One Mobile Workshop :
     - S280 Shelter on GFE MAN 5TTruck
     - Maintenance Tent
     - PC and GSTE
   - One Mobile Storage Facility for :
     - Support Equipment
     - Spare parts
   - One GFE Cargo truck for GSTE and Spare parts

Airworthiness Certification Process

4.1. Introduction

The worldwide UAV community faces today to the civil airspace management and regulations organization demands to be able to make fly their Air Vehicles in the civil air space, over populated areas. Flying UAVs is in most of the case still restricted over dedicated areas which belong to military organisations. Deployment of UAV systems in the civil airspace over populated areas is one of the major challenges UAV manufacturers will have to comply in the very future.

By reaching this goal, there is no doubt that this will allow not only military users to extend the range of their systems, but also will significantly increase the potentialities of UAV systems to perform safely civil applications which today cannot be achieved mainly because restrictions are still imposed to deploy safely UAVs above populated areas.

Definition of UAV Systems certification rules by international regulation authorities and compliance of UAV Systems to these rules is a major objective of the next century, should all the UAV users and manufacturers want to extend the application range and the market of future UAV Systems.

4.2. The B-HUNTER UAV System Certification Process.

The B-HUNTER UAV System airworthiness can today hopefully count on the fact that the HUNTER UAV System accumulates an experience of more than ten thousand (10.000) flight hours which are the combined result of a two engines concept which has undergone extensive endurance tests according to the FAR 33 standard, of built in redundancies included in all safety critical items of the system, of an emergency parachute tested and approved. The Air Traffic Control (ATC) mode ¾ IFF and the anti-collision strobe lights allow already the HUNTER System to be integrated in the US civil air space.

During all stages of its customisation to the Belgian Ground Forces needs, the B-HUNTER UAV System will follow an extensive Airworthiness Certification process in order to comply with an overall safety objective consisting of the following : “The B-HUNTER UAV System must allow during all its life safely execution of UAV missions above populated areas taking into account Belgian environmental conditions”.

The goals of the airworthiness activities to be held in the course of the B-HUNTER Program are the granting of two certificates required by the Belgian law which defines the legal airworthiness requirements to which UAV systems have to comply :

a) the Airworthiness Type Certificate
b) the Individual Airworthiness Certificates which shall include
   - the initial Individual Airworthiness Certificate
   - the Maintaining of the Aptitude to fly

4.3. Airworthiness Type Certification

The following steps are to take place towards the granting of Type Airworthiness Certificates according to the following logic structure:

1. Definition of certification basis composition containing the following elements :
   1) System Safety Program Plan (SSPP)
   2) Tailored JAR-VLA compliance elements

3) Specific Requirements
4) Relation with logistics support.

2. Definition of methods and levels of verification as well as verification procedures for all elements of the certification basis
3. Execution of the verification plan related to the basis of certification (including analyses and tests reports)
4. Compilation of the final Certification File including all elements as defined in paragraph 11.2.5.
5. Presentation of the Certification File and the airworthiness type certificate for approval by BMOD certification authority (GST).

These activities will be executed in close coordination with other Program engineering activities in order to :

- Reach the Overall System Safety Objective for the B-HUNTER UAV System
- Establish accordingly the Final Certification File that will serve as a justification for the granting of the Airworthiness Type Certificate.

A. Certification basis

System Safety Program activities

Those activities are related to the risk analysis are detailed in a System Safety Program Plan based on the Contract requirements and on required MIL STD 882C tasks. Specific Safety Analyses outputs are :

- System Hazard Analysis and Sub System Hazard Analysis (SHA & SSHA)
- Operational Support Hazard Analysis (OSHA)
- Safety Assessment Report (SAR)

The hazard probability is a qualitative expression of the probable occurrence of the identified hazards during the planned life expectancy of the system in accordance with MIL-STD-882C, paragraph 4.5.2.

The application for B-HUNTER program is presented in Table 1, below.

DESCRIPTION	LEVEL	SPECIFIC INDIVIDUAL ITEM	FLEET OR INVENTORY
FREQUENT	A	Likely to occur frequently.	Continuously experienced.
PROBABLE	B	Will occur several times in life of an item.	Will occur frequently.
OCCASIONAL	C	Likely to occur sometime in life of the item.	Will occur several times.
REMOTE	D	Unlikely, but possible to occur in life of the item	Unlikely, but can reasonably be expected to occur
IMPROBABLE	E	So unlikely, it can be assumed occurrence may not be experienced.	Unlikely to occur, but possible.

Table 1 : Hazard Probability

The hazard severity categories are tailored as per MIL-STD-882C requirements. The application for B-HUNTER program is presented in Table 2 below.

DESCRIPTION	*Category*	*Software Safety Criticality (see 3.4)*	MISHAP DEFINITION
POTENTIALLY CATASTROPHIC	I	*Critical*	Uncontrolled UAV landing or crash
CRITICAL	*II*		Failure conditions which would reduce the capability of the UAV to cope with adverse operating conditions to the extent that there would be a large reduction in safety margins or functional capabilities, or cause severe injuries.
MARGINAL	*III*	*Non Critical*	Failure conditions which would reduce the capability of the UAV to cope with adverse operating conditions to the extent that there would be a significant reduction in safety margins or functional capabilities, or cause system damage and possible minor injuries.
NEGLIGIBLE	*IV*		Failure conditions which would not significantly reduce UAV safety, and which may lead to a slight reduction in safety margins or functional capabilities, or cause less than minor injuries.

Table 2 : Hazard Severity

Software components are classified as:

(a) Safety Critical Software, i.e. software whose anomalous behavior as shown by functional hazard assessment would cause or contribute to a failure condition of category I or II as defined in Table 2.
(b) Non Safety Critical Software i.e. software whose anomalous behavior as shown by functional hazard assessment would cause or contribute to a failure condition of category III or IV as defined in Table 2.

Acceptable risk levels can be deducted from the matrix, presented in Table 3, as per MIL-STD-882, which depicts the risk levels (index), as a function of hazard probability and severity class and the requested actions for each risk category (Table 4).

HAZARD PROBABILITY	HAZARD LEVEL			
	I *Potentially* Catastrophic	II Critical	III Marginal	IV Negligib
A-Frequent	IA (1)	2A (3)	3A (7)	4A (13)
B-Probable	IB (2)	2B (5)	3B (9)	4B (16)
C-Occasional	IC (4)	2C (6)	3C (11)	4C (18)
D-Remote	ID (8)	2D (10)	3D (14)	4D (19)
E-Improbable	IE (12)	2E (15)	3E (17)	4E (20)

Table 3 : Acceptable Risks Level

HAZARD RISK INDEX	ACTION REQUESTED
1-3	High Risk – Unacceptable
4-6	Medium Risk - Undesirable (Managing Activity decision required)
7-17	Moderate Risk – Acceptable with Managing Activity review
18-20	Low Risk – Acceptable without review

Table 4 : Risks Level Management

Risk level Management is the basis of all the safety assessment activities to be performed in the frame of the B-HUNTER UAV Program which are depicted in Figure 17 here under which provides interrelationship between engineering activities and Integrated Logistics Support Activities with the safety analysis tasks to be performed in the frame of the B-HUNTER UAV Program :

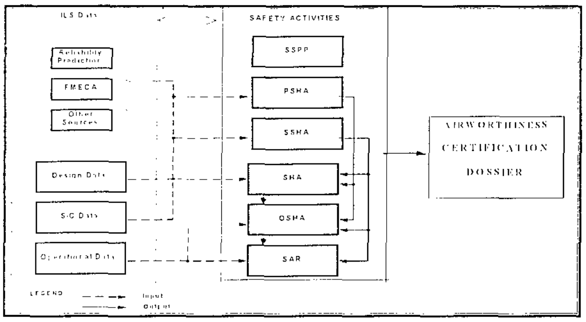


Figure 17. : Safety Activities Interrelationship

Presentation of a Tailored JAR-VLA

There currently don't exist any Joint Air Regulations related to UAV Systems. During the course of the B-HUNTER UAV Program, a tailoring of the existing Joint Air Regulations for Very Light Aircrafts (JAR VLA) will be made more specifically with regard to the B-HUNTER UAV System. Identification of the B-HUNTER UAV System compliance to the JAR VLA requirements is performed.

Specific Requirements

Attention will be paid in the frame of the airworthiness type certification to the following items :

(1) Fail safe design
(2) Built in Test
(3) Software
(4) Flight Management System
(5) Electrical System
(6) Communications/Datalink
(7) Navigation System
(8) Propulsion System
(9) Ground Control Station (GCS)
(10) Flight Recovery and Termination System
(11) UAV air vehicle

Impact on logistic support

The Contractor will also execute the activities foreseen in view of the functional, technical and logistics requirements of the Contract which are related to Airworthiness Type Certification.

B. Airworthiness Verification Activities

Verification methods and levels as specifically related to Airworthiness requirements will be reviewed and will be included in the overall Program Verification Plan.

Specifically required airworthiness procedures will be identified with regards to related to airworthiness requirements and will be integrated within the verification procedures and activities taking place in the frame of compliance demonstration with the functional, technical and logistics requirements of the Contract.

Analyses, demonstration, tests or inspection on all airworthiness related items will be performed according to an Airworthiness Verification Plan.

Credit will be taken from the existing data and emphasis will be put on the specific adaptations from the HUNTER Baseline configurations to the B-HUNTER UAV System. Credit from existing data supposes that the configuration items to which similarity is referred are equivalent to the one of the B-HUNTER Contract;

C. Final Certification File

A final Certification File will be subsequently established. Upon this basis, the Airworthiness Type Certificate will be granted by which it is attested that the B-HUNTER UAV System in its final configuration satisfies the above mentioned Overall Safety Objective.

The final Certification File shall be fully adapted to the B-HUNTER UAV System and shall include the following information :

(1) An identification and reference to the B-HUNTER UAV System configuration.
(2) The certification basis containing compliance statement, and summary of related compliance demonstration related to airworthiness requirements namely :
    - System Safety Program requirements
    - Tailored JAR/VLA
    - Demonstration of B-HUNTER UAV System Compliance to airworthiness requirements
    - Operational, Technical and Logistical requirements shall also be taken into account.
(3) Verification levels and methods used to prove compliance to the contract requirements related to airworthiness
(4) Reference to the corresponding substantiation data (test results and analyses)
(5) Airworthiness Type Certificate attesting that the B-HUNTER UAV System, in its final configuration satisfies with the Overall System Safety Objective with :
    - Reference to the B-HUNTER UAV System configuration, with mention of the limitations of its performances and characteristics;
    - Mention of the conditions or restrictions relative to the deployment of the B-HUNTER UAV System;
    - Reference to the procedures which permit to cope with these limitations or restrictions;

- Reference to the requirements (certification basis) which constitute a sufficient basis for system airworthiness.

4.4. Initial Individual Airworthiness Certificates

Individual Airworthiness Certification will be based upon Quality Control / Conformity Inspection activities to ensure that each individual system has been built in accordance with the Technical Definition Dossier and upon Acceptance Tests.

In order to demonstrate that each individual air vehicle and the associated UAV system satisfy the requirements concerning official initial individual certification, necessary test and analyses, including flight tests are to be made before delivery.

After these initial individual test, an individual certification file shall be drawn up and shall be delivered along with the relevant system and UAV air vehicle.

4.5. Preservation of Flight Capability

Preservation of flight capability means that periodically (every fifty flight hours) the individual airworthiness certificate has to be renewed by the Ground Forces.

The following requirements have to be fulfilled for preservation of flight capability :

(1) User regulations, the content of which has been determined, have to be formulated for the UAV system.

(2) Maintenance and support regulations must be defined.

(3) The requirements concerning the qualification of the personnel responsible for the operation and the maintenance of the UAV system are to be met. This applies to the establishment of the responsibilities and the correct filling in of the necessary certificates.

(4) Control Systems must be defined to make possible the control of the following:

- Compliance with the user's regulations
- Compliance with the maintenance and supply regulations
- The application of an updating system for maintenance and supply documents
- The description of every alteration and its approval by the personnel of the Ground Forces responsible for the management of the definition file
- The inclusion of these alterations in the definition file and in the maintenance and supply documents
- Compliance with the requirements concerning the qualification of the personnel

Conclusions

This paper has presented the B-HUNTER UAV System that will be delivered to the Belgian Army Ground Forces from year 2001, and the main adaptations or customisations that will be done with regards to the US HUNTER Short Range Tactical UAV or to the F-HUNTER UAV System. An overview of the B-HUNTER main subsystem has been described together with its performances.

Airworthiness Certification is a Belgian legal condition before to be authorised to fly in Belgium over populated areas and is consequently an essential part of the Program. The airworthiness certification process which has to conclude to a final safety assessment has been detailed. The activities performed in the frame of the B-HUNTER UAV program will contribute to the execution in safety conditions of the Belgian Ground Forces missions in the frame of their participation to future NATO peace keeping missions, and, why not, of future civil missions in Belgium in a UAV controlled Air Space Management.