CHAPTER 6

JOINT TACTICAL-UAV

The JT-UAV provides the commander with an asset capable of performing varied missions over a hostile environment without risking capture, injury, or loss of personnel. The system currently provides NRT day or night passive IMINT via video output to any RVT, GCS, LRS and MPS (with either net connection to a GCS or its own antenna). Included on the video display among other data, is a coordinate of the target, and a north arrow. Future upgrades may include communications relay, meteorological information, mine and NBC detection, EW, moving target indicator (MTI), SIGINT, psychological operations (PSYOP), resupply, and laser range finder and designator.

The JT-UAV will penetrate into enemy airspace out to a range of 200 km, with a relay AV, during both day and night operations, and conduct any of the missions listed in Chapter 2. The tactical situation will dictate sensor employment and flight profile. An example of JT-UAV employment is shown in Figure 1-2.

ORGANIZATIONAL STRUCTURE

Air reconnaissance companies will be organic to the MI brigade AEB at theater and corps. An air reconnaissance company has a company HQ element, two ground control and operations platoons, and a L/R and service platoon (see Figure 6-1). The company HQ will normally locate in the corps rear area adjacent to the company L/R and maintenance site.

Air reconnaissance platoons are organic to the GS company of the heavy, airborne, air assault division MI battalions, and heavy armored cavalry regiments (ACRs). An air reconnaissance platoon has a platoon HQ element, two ground control and operations sections, and a L/R and service section (see Figure 6-2). The HQ element provides for the staffing and C^2 of assigned or attached elements and will normally locate in the division rear area adjacent to the platoon's L/R and maintenance site

The ground control and operations sections provide for JT-UAV AV control and mission payload operations support to selected tactical operations centers (TOCs), FSEs, and other HQ. In addition, they provide C^2 and liaison with supported units and resupply functions.

The L/R and service elements launch and recover all JT-UAV flights and provide the organizational maintenance support described in Chapter 5. They also provide technical supply, quality assurance actions, and petroleum, oil, and lubricants (POL) receipt and delivery services. A UAV slice to brigade may be comprised of one or more GCS and support elements.

EQUIPMENT

The JT-UAV is a robust system designed to provide optimum flexibility. The system possesses redundant backups to all critical shelter and UAV components. See Figures 6-3 and 6-4 for a listing of system components and quantities authorized for one baseline system.

JT-UAV AV:
The AV is a graphite-epoxy composite designed to reduce detection and weight, and withstand the stress of repetitive operations in a battlefield environment. The UAV will normally fly missions of 8+ hours in duration. Specifications include—

- Maximum gross takeoff weight is 1,600 pounds.
- Maximum fuel capacity is 49.4 gallons.
- Climb rate is approximately 750 feet per minute in standard atmosphere with mission equipment onboard.
- Service ceiling is approximately 15,000 feet above MSL.
- Fully assembled dimensions are 22.63 feet long x 29.19 feet (wing-span) x 5.57 feet high (see Figure 6-5).

The wings, tail booms, and tail are removed and all UAV components are stored in a shipping container for transport. Figures 6-6 through 6-10 show the JT-UAV in disassembly, shipping, storage, loading, and transportation features.

Fig 6-3 (full)

Fig 6-4 (full)

Fig 6-6 (full)

JT-UAV Container:

The container's dimensions are 17.34 feet long x 7.25 feet wide x 4.27 feet high, and designed for crane lift and stow. One 5-ton truck can transport two container-stored UAVs.

JT-UAV Power Plant:

The JT-UAV is powered by two modified 75 horsepower Moto Guzzi, fuel injected, air cooled, two cylinder, four-stroke engines, mounted fore and aft on the fuselage in a push-pull arrangement. The engine assembly includes exhaust mufflers, two fuel pumps, and two generators (either of which can sustain both engines with fuel and power). The power plant has an alternator capable of supplying all electrical needs for flight, and a 12-volt battery for each engine to enable emergency airborne starts.

JT-UAV Avionics Data Control Group:

The internal avionics installed include the digital central processor assembly (DCPA), an auto operator, flight control, navigation control, an IFF transponder, and the air data terminal (ADT).

The DCPA controls and monitors the operation of the UAV, air-to-ground communications, and message traffic between the UAV and the GCS. The DCPA has separate computerized flight control and mission system processors and processor power supplies. Either permits mission completion if the other processor fails. All functions are incorporated into the software and provide backup to each other, thus increasing system reliability.

An auto operator maintains flight according to received or programmed commands and all flight control surfaces (flaps, elevators, and stabilizers) are activated by servo actuators.

The flight control loops and control surfaces are duplicated to increase the UAV's survivability.

The navigation control unit is electronically hooked in with the DCPA to provide automatic guidance to a programmed flight plan or manual control of a single operation. Range-to-destination and Global Positioning System (GPS) data for navigation and target location are also provided.

The IFF transponder has an onboard UAV which enables the aircraft to respond to either a ground or air-based interrogator. In addition to mission type, tail number, air defense code, and a signal which identifies the aircraft as a UAV, the transponder can transmit an emergency signal to facilitate recovery in the event the UAV goes down.

The ADT is the UAV directional antenna. It is used for the transmission of NRT payload and UAV status data from the UAV to the GDT, to an air data relay, a RVT, or Joint-STARS GSM.

Emergency Recovery System:

The emergency recovery system (ERS) provides an emergency recovery parachute if the UAV is disabled or problems are encountered with normal recovery (see Figure 6-11). The parachute would normally be deployed by command data link.

In the event of noncommunications between the UAV and the GCS, an emergency recovery program installed in the UAV automatically deploys a parachute when a survivability threshold is exceeded. (The automatic recovery logic may be operator disabled when the situation warrants; for example, UAV across the forward line of own troops [FLOT].) When the parachute is deployed, the payload is withdrawn into the fuselage, both engines are cut, the strobe light is activated, and the IFF transmits an emergency signal to enable location and recovery.

Airborne Data Relay Payload:

The airborne data relay (ADR) payload may be installed to extend mission range an additional 75 km. This can be done in lieu of, or in addition to, the modular mission payload (MMP). The ADR and the MMP may both function simultaneously during the mission. (When a UAV is being used as a relay, the video displayed will be mission UAV video.) The ADR has two directional antennas, transmitters and receivers, and control circuits. A two-way link between the GCS and another UAV carrying a sensor payload is the primary function of the ADR.

Modular Mission Payloads:

Modular mission payloads are packages designed to support IEW and mission specific operations. Initial IEW payloads are only imagery payloads and may include—

- Electro-optical.
- Forward looking infrared (FLIR).

Future payloads may include—

- EW (electronic attack [EA], and electronic warfare support [ES]).
- Moving target indicator.
- Synthetic aperture radar.
- Target designation systems.
- Communications relay.
- Mine detection.
- NBC detection.

The JT-UAV carries a day and night passive payload mounted on a stabilized platform assembly (see Figure 6-12). The payload can be raised or lowered by a screw drive system. During L/R or emergency operations, the payload is retracted into the fuselage for protection. Payload functions are controlled by either command data link or are programmed.

When not mounted in a UAV, the MMP is stored in a container for protection (see Figure 6-13).

Ground Control Station:

The GCS has two primary functions. First, it is the primary means used to control, track, and operate the UAV. Second, it is used to manipulate the payload and receive and process telemetry and video down links. The GCS also incorporates mission planning functions with the ability to call for and adjust indirect fire.

The GCS is used to control, track, and operate the UAV and its payload during flight. There are two GCSs per baseline system, each in a high mobility multipurpose wheeled vehicle (HMMWV) mounted C^2 shelter. The GCS has two operator positions—an EO position and a mission payload operator position. There are three equipment consoles within the station.

- The left console which is normally the EO position.

- The center console which contains the AV location display (AVLD), shows UAV locational data, and incorporates mission planning, processing, reporting, and various information and guidance functions. This console also contains the ground station video cassette recorder (VCR), hard copy printer, and the communications controls.

- The right console which is normally the payload operator position.

Both consoles are identical in capabilities, and functions can be transferred to either on command or in the event of a system failure (see Figure 6-14).

Fig 6-14 (full)

A GCS can only communicate with and control one UAV at a time. However, through time sharing, it can control a relay vehicle and a mission vehicle simultaneously. The GCS can also place a mission UAV in programmed flight and be free to operate another UAV.

Ground Data Terminal:

The GDT (Figure 6-15) is the data link antenna connected to the GCS. It is used to transmit C^2, reporting data, and video between the GCS and the UAV out to 125 km. This can be extended to 200 km using a relay UAV.

Launch and Recovery Station:

The LRS is used to preflight, launch, and pass control of the UAV to a GCS for the mission phase of flight. When the mission phase of flight is completed, the GCS returns control of the UAV to the LRS for recovery. There is one LRS per baseline housed in a HMMWV mounted C^2 shelter.

There are a variety of methods used to launch and recover the JT-UAV. Launch methods include—pneumatic, RATO, and conventional rolling takeoff. Recovery methods include—arresting gear and nets, rolling landings, skid stops, and parachute recoveries.

The LRS has one operator position with two consoles. The left console is identical to the GCS left console and can be used to operate the UAV. The right console contains the communications controls (see Figure 6-16).

Fig 6-16 (full)

Launch and Recovery Terminal:

The launch and recovery terminal (LRT) (Figure 6-17) is the data link antenna connected to the LRS. It is used to transmit C^2, reporting data, and video between the LRS and the UAV out to a range of 50 km.

Mission Planning Station:

The MPS is used by the mission commander and data exploitation operator. It is the focal point for communications in and out of the UAV unit. It also serves as a unit CP and provides facilities to plan and program flight missions and monitor unit operations. When a mission plan is completed, the plan is downloaded to a GCS or LRS, from which UAV operators will conduct the mission. Payload and UAV functional data is received back from the GCS or LRS and processed for transmission to consumers. There is one MPS per system housed in a HMMWV mounted C^2 shelter (see Figure 6-18).

Fig 6-18 (full)

Shelter Commonality and Redundancy:

The GCS and MPS are identical with the exception of the voice communications switchboard contained in the MPS. This means that for mission planning UAV flight and mission payload operations, the systems are interchangeable. The only requirement to control a UAV and payload with an MPS is connectivity between the MPS and either a LRT or GDT antenna. Except for the voice communications switchboard, a GCS is fully capable of serving as a MPS.

The LRS can control the UAV, but lacks an AVLD; therefore, it cannot incorporate any mission planning functions, and coupled with the LRT antenna's shorter range, limits its capabilities. While a GDT antenna can extend its range, long-range tracking and flight operations are restricted and more operator intensive. Both the GCS and MPS can perform as an LRS.

Rocket-Assisted Takeoff Launcher:

A RATO launcher is used when a runway is not usable or unavailable. A RATO launch allows the UAV to take off from confined areas, damaged airfields, from shipboard, or on any runway requiring a zero length ground run. The RATO subsystem includes a launcher (see Figure 6-19), rocket bottle with initiator, cables, and launch control boxes. The RATO motor takes 2.5 seconds to lift the UAV 100 feet and accelerate it to 65 knots. It then separates and is jettisoned.

Video Cassette Recorder:

A VCR is mounted onboard each AV, in the GCS and MPS shelters, and in each RVT unit. The VCR records the video and associated data on a standard 8 millimeter (mm) video tape which has a two-hour recording capability. The associated data that appears on the video includes—

- The location of the cross hair (given in a 10 digit grid coordinate).
- A north arrow.
- The depression angle of the camera.
- The zoom factor of the lens.
- The UAV altitude.

Mobile Power Unit:

The MPU is a trailer-mounted 10 kilowatt (kW) generator that provides power to the shelter. The MPU contains an inverter with a battery backup system in the event of generator failure. A power status display in the shelter will notify the operator of generator failure. The battery backup will allow the operator time to repair and replace or hand off control of the UAV. The MPU can also power a GDT directly from a control shelter if the GDT is close enough to the power cable. This would be determined by OPSEC considerations since the GDT is an emitter and, in a tactical situation, should be deployed as far away from the control shelter as possible (see Figure 6-20). If the GDT is to be remoted, the baseline system has two 3 kW generators to supply power.

Worldwide Power Interface:

The Worldwide Power Interface (WWPI) is used in lieu of generator power. The WWPI can interface with a 3-phase power source. It can be ported through a MPU to shelter connectivity or to a shelter via a power distribution box (see Figure 6-21).

Remote Video Terminal:

The RVT (see Figure 6-22), can be located at the supported unit's TOC, and receives, displays, and records the UAV's video down link.

Data Link:

The JT-UAV system uses a microwave data link for communications between the control shelter and the UAV. The data link transmits and receives in—

- C-Band (4,400 to 5,000 megahertz [MHz]).
- S-Band (1.8 to 2 gigahertz [GHz]).

Fig 6-22 (full)

The operator designates two up link and two down link channels (or frequencies), one primary, and the other backup. Figure 6-23 shows the data link configuration between a ground station and single mission UAV when not using an RVT; and Figure 6-24 shows this configuration when using an RVT. The operator also designates the channel used for the RVT down link. Note that the RVT mode of operation uses the UAV backup down link for the AV to RVT link.

When in an ADR mode of operation (see Figure 6-25), the ground station backup links are inactive. The primary links are used for communications between the ground station and the relay UAV. The relay backup up link communicates with the mission UAV and the relay backup down link is available for down link to RVT. (Video displayed by the relay UAV in a relay mode is always mission UAV video.) The mission's UAV primary channels are used for communications with the relay UAV and the down link channels to the RVT. (The mission UAV RVT link is not normally used due to the range between the mission UAV and RVT.)

The operator has the capability to change any of the above listed channels during flight.

Mobile Maintenance Facility and Ground Support Equipment:

Each JT-UAV baseline system includes a mobile maintenance facility (MMF) and one set of GSE. The MMF is a 32 foot x 26 foot tent used for UAV and tool storage as well as for maintenance. The GSE encompasses all of the other equipment necessary to perform successful UAV operations (such as runway arresting gear).

Fig 6-25 (full")

PAYLOAD CAPABILITIES

The following are JT-UAV capabilities:

- Day lens:
  - Focal length is 10 through 150 mm (+/- 3%) with a zoom ratio of 1 to 15.
  - The Iris control modes are automatic (by video signal level) or manual (by external commands from GCS).
  - Zoom control is by a direct current (DC) motor.
  - Iris control is by a DC motor.
  - Zoom position measuring is by a potentiometer (coupled to the zoom ring).
- FLIR technical specifications:
  - Material is germanium.
  - Focal length is 22 mm at wide field of view (FOV), 80 mm at middle FOV, and 25 mm at narrow FOV.
  - Focusing range is selectable in operation from 50 meters (m) at narrow FOV, 20 m at middle FOV, to 10 m at wide FOV.
  - FOVs are 2.1^{0} (1.7^{0} x 1.3^{0}) at narrow FOV, 8.1^{0} (6.5^{0} x 4.8^{0}) at middle FOV, and 31^{0} (24.5^{0} x 19^{0}) at wide FOV.
  - Thermal stabilization time is 60 seconds.
  - Video standard is EIA-RS 170.
  - Video gain and level control are manual or automatic (selectable).
  - Selectable heat polarity (black or white hot).

THE NATIONAL AIRSPACE SYSTEM

Airspace management in the NAS is outlined in Chapter 3. The JT-UAV must follow all of the FAA regulations and ARs that apply.

EMPLACEMENT

While many variations are possible, the normal configuration for JT-UAV emplacement is a split site operation. The MPS, GCS, their personnel, and supporting equipment are collocated at a forward-based MPCS (see Figure 6-26); the LRS, MMF, AVs, their personnel, and supporting equipment are collocated at the L/R site (see Figure 6-27). Figure 6-28 shows connectivity between the two sites and a mission profile.

Fig 6-26 (full)

Fig 6-27 (full)

Fig 6-28 (full)

LAUNCH AND RECOVERY OPERATIONS

The JT-UAV can perform either a rolling takeoff or RATO. A JT-UAV runway for takeoff and landing operations should be at least 200 m long and 75 m wide. The runway may be asphalt or an unimproved assault type (dirt) runway. Average percent of slope should be less than 1 percent. Obstacle clearance angle should be 3 degrees for takeoff and 2 degrees for landing. Two arresting cables are used, one across the center (normal recovery cable) and one at the end of the runway (backup cable).

Due to complexity and safety requirements of RATO operations, the following procedures apply—

- Conduct an initial check of the launcher, cabling, and launch control boxes.
- UAV is winched and hand guided onto the launcher.
- Elevate the UAV to a 14-degree elevation angle, and conduct normal UAV flight.
- Mount the rocket to the aft end of the fuselage (see Figure 6-29).
- Conduct engine start operations.
- Request approval for preliminary launch.
- If preliminary launch approval is granted, conduct prelaunch checks.
- Connect the rocket initiator assembly.
- Request approval for final launch.
- If final launch approval is granted, the UAV's engines are revved to maximum power and RATO is initiated.
- On ignition, the rocket bottle takes the UAV to approximately 100 feet AGL and an airspeed of 65 knots in 2.5 seconds.
- The rocket is released and drops from the UAV after burnout.

CAUTION

The RATO rocket is a class B explosive containing 30 pounds of high explosive propellent. The rocket ignitor contains explosive devices that may cause injury to personnel and damage equipment. All warnings and regulations regarding handling and transportation must be strictly adhered to.

The rocket ignitor is separated from the booster during handling, shipping, and storage. Although the rocket bottle has been expended when it drops from the UAV, it is still dangerous. The steel casing has been heated to several hundred degrees Fahrenheit and the burning propellent gives off a nauseous vapor. Heat-resistant gloves and a respirator are required if the bottle is to be recovered immediately after launch. To avoid fires, a barren impact area 500 feet long and 200 feet wide in front of the launcher should be considered.

Conduct of a Single UAV Mission:

The EO and LRS operator in conjunction with maintenance personnel prepare the UAV for launch. Once the UAV is at 1,000 feet AGL, a control check is completed to verify the UAV's status. The UAV is then flown to a required altitude and positioned for handoff between the LRS and GCS. The GCS actively directs the UAV and payload through the mission or enters a mission program into the UAV. The mission program enables the AV to follow way points, change altitudes and air speed, and conduct payload operations. During a programmed flight, the operator can resume control of the UAV and payload or alter the program at any time, provided there is LOS between the UAV and the ground station (see Figure 6-30).

Conduct of a Relay Mission:

Launch procedures are the same as previously stated; however, the relay UAV requires ADR configuration and is normally launched first. If more than one GCS is available, the LRS will hand the relay off to #1 GCS conducting the relay mission. The relay is flown to its designated location and placed in a programmed orbit. The LRS then launches the mission UAV and hands it off to #2 GCS. The #1 GCS will coordinate with #2 GCS and assume control of the mission UAV via the relay UAV (see Figure 6-31).

UAV Recovery:

Operators recover the UAV by reversing procedures listed above with the exception of a control check, which is not required.

(**NOTE**: Whenever possible, GCS and LRS not dedicated to mission operations should be used in a backup mode to monitor UAV operations. This helps guard against mission degradation and adds a safety backup in the event a controlling ground station were to suffer a catastrophic failure or be destroyed.)

Emergency Recovery. Emergency recovery locations are identified during mission planning. These include alternate recovery areas where a site has been established, and unpopulated emergency recovery areas where the likelihood of injury and damage to property and the UAV are minimized. If one of the designated areas is not possible, the UAV operator will seek the safest recovery area possible.

Return Home Logic. In addition to other safety measures, the UAV contains a return home logic. In the event of loss of data link communications, the UAV will fly a straight line path, at a designated altitude and speed, to coordinates which the operator has previously identified and loaded into the UAV. The designated coordinate can be entered or changed on the ground and during flight.

Upon arrival at the established coordinate, the AV will loiter at a designated altitude. This function is operator designated and can be disabled for programmed missions in the allotted time. Planning for this logic is another element which must be considered in mission planning. To prevent violating airspace restrictions, and potential accidents, it is essential that a number of return home points be established and loaded into the AV at proper times throughout the mission.