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BEHIND THE LINES

WITH

PHOENIX

THE BRITISH ARMY'S BATTLEFIELD SURVEILLANCE AND TARGET ACQUISITION SYSTEM

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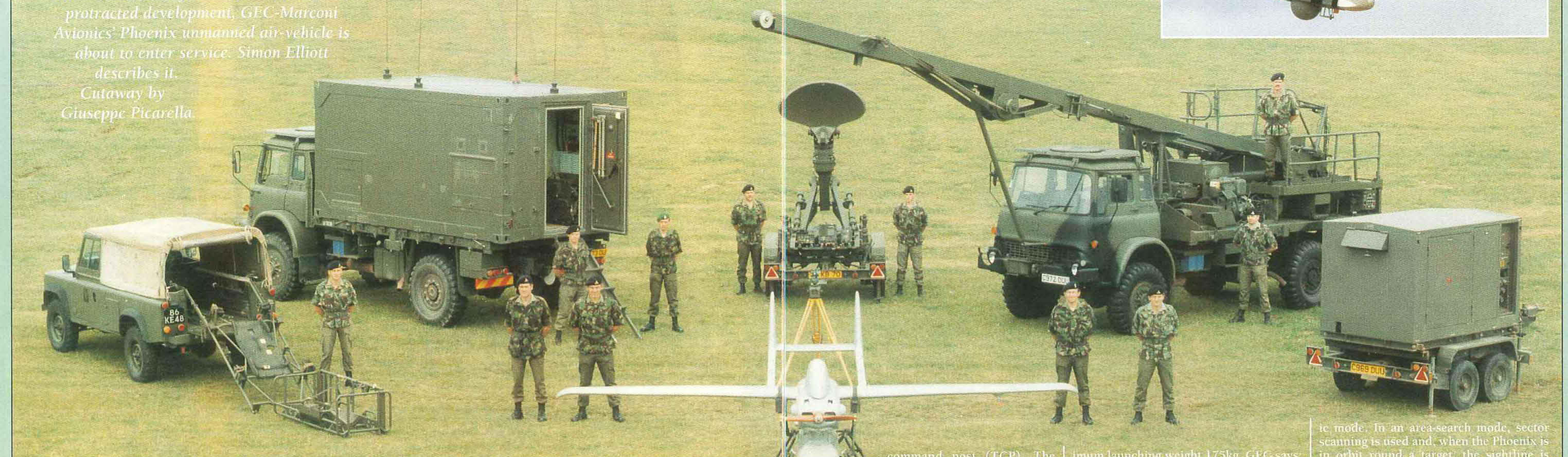
PHOENIX DESCRIBED

BEHIND THE LINES

Almost a decade after contract award, and protracted development, GEC-Marconi Avionics' Phoenix unmanned air-vehicle is about to enter service. Simon Elliott describes it. Cutaway by Giuseppe Picarella.



Timely and accurate target intelligence is vital if maximum use is to be made of modern, long-range, artillery and multiple-launch-rocket systems. To provide this, commanders on the battlefield are coming increasingly to rely on the stealthy, low-key, unmanned air-vehicle (UAV).

The ideal UAV to support artillery would be able to provide surveillance in day and night conditions and in bad weather; it would have a real-time datalink; and would be operated easily by troops under battlefield conditions.

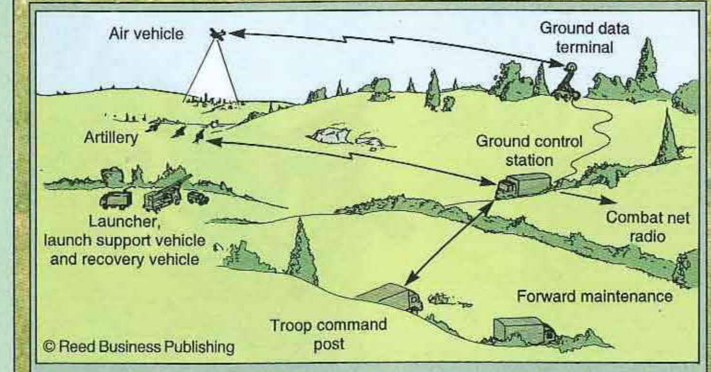
The Phoenix UAV, now in production for the Royal Artillery (RA), is such a surveillance system. The Phoenix was developed against a UK Ministry of Defence (MoD) staff target from a contract awarded in 1985. The MoD approved Phoenix design is being fit fo RA acceptance in November 1993.

It has been designed from the outset as a user-friendly system for troops to operate in the field. George Haffey, Phoenix project manager at GMAv, says that a principal aim was to make it simple to be operated and maintained by soldiers under battlefield conditions.

Initially designed for use with the RA's Multiple Launch Rocket System, the Phoenix is now likely to fulfil much wider surveillance application when it enters service in 1995.

The Phoenix will replace the current fleet of Canadair CL-89 Midge UAVs and Army maintenance instructors are attending training courses at GMAv before taking up their posts.

The Phoenix is an all-weather, day or night, real-time surveillance system which consists of a variety of elements. It was developed under a contract initially awarded in 1985. The twin-boom UAV provides surveillance through its mission pod, the imagery from which is datalinked via a ground data terminal (GDT) to a ground control station (GCS). This controls the overall Phoenix mission and is used to distribute the UAV-provided intelligence direct to artillery forces, to command level, or to a Phoenix troop command post (TCP). The principal method of communicating from the GCS to artillery is via the battlefield-artillery targeting engagement system (BATES).



Battlefield surveillance scenario

Powered by an 19kW (25hp) Target Technology 342 two-stroke flat-twin engine, the Phoenix air-vehicle (with a centrally mounted fuel tank) is almost entirely manufactured from composites such as Kevlar, glassfibre- and carbonfire reinforced plastic and Nomex honeycomb. The principal sub-contractor on the airframe is Flight Refuelling of Christchurch, Dorset, UK.

The Phoenix air vehicle is of modular design, for ease of transportation on the battlefield, being broken down into the fuselage with the twin tail-booms; detachable wings; tailplane attachment; a dorsal shock absorber (for landing); the mission pod; and replaceable wing and fin tips. The UAV can be launched within 1h upon reaching a launch site and a second can be despatched 8min later, from the same launcher. The wing span is 5.5m and maximum launching weight 175kg. GEC says: "Flight endurance is in excess of 4h, radius [of action] more than 50km and maximum altitude 9,000ft [2,750m]." The maximum speed is 85kt (155km/h).

Before launch and recovery, the UAV is stored in an electromagnetic-pulse (EMP)-hardened container, each vehicle having a shelf life of 15 years.

The Phoenix UAV system is sensor-orientated, the air vehicle operating as a taxi to carry the sensor payload to and around the designated target area. The 50kg mission pod, slung beneath the fuselage, features a two-axis stabilised turret carrying a thermal-imaging sensor. The latter is based on the GMAv Thermal Imaging Common Modules II hardware and features a 60° x 40° field-of-view Sprite detector operating in the 8-14μm band. Using a zoom telescope, magnification is provided between x2.5 and x10. The sensor is designed to scan through 360° continuously in azimuth and elevation.

During the cruise phase of the mission, the sensor can be locked at a pre-set elevation or prepared to scan in an automatic mode. In an area-search mode, sector scanning is used and, when the Phoenix is in orbit round a target, the sightline is steered automatically to ensure that it remains correctly targeted.

The mission pod also has the airborne components of the datalink. These are automatically switchable steered antennae fore and aft, "giving highly directional secure communications", says GMAv.

LEVEL HORIZON

A third roll axis is provided to stabilise the whole sensor pod so that both the turret-mounted sensor and the datalink antennas are always horizontal. This gives the ground-based observer a level horizon and simplifies control of the datalink. "The operator on the ground has no perception of the UAV turning and so suffers no motion disorientation," says Haffey.

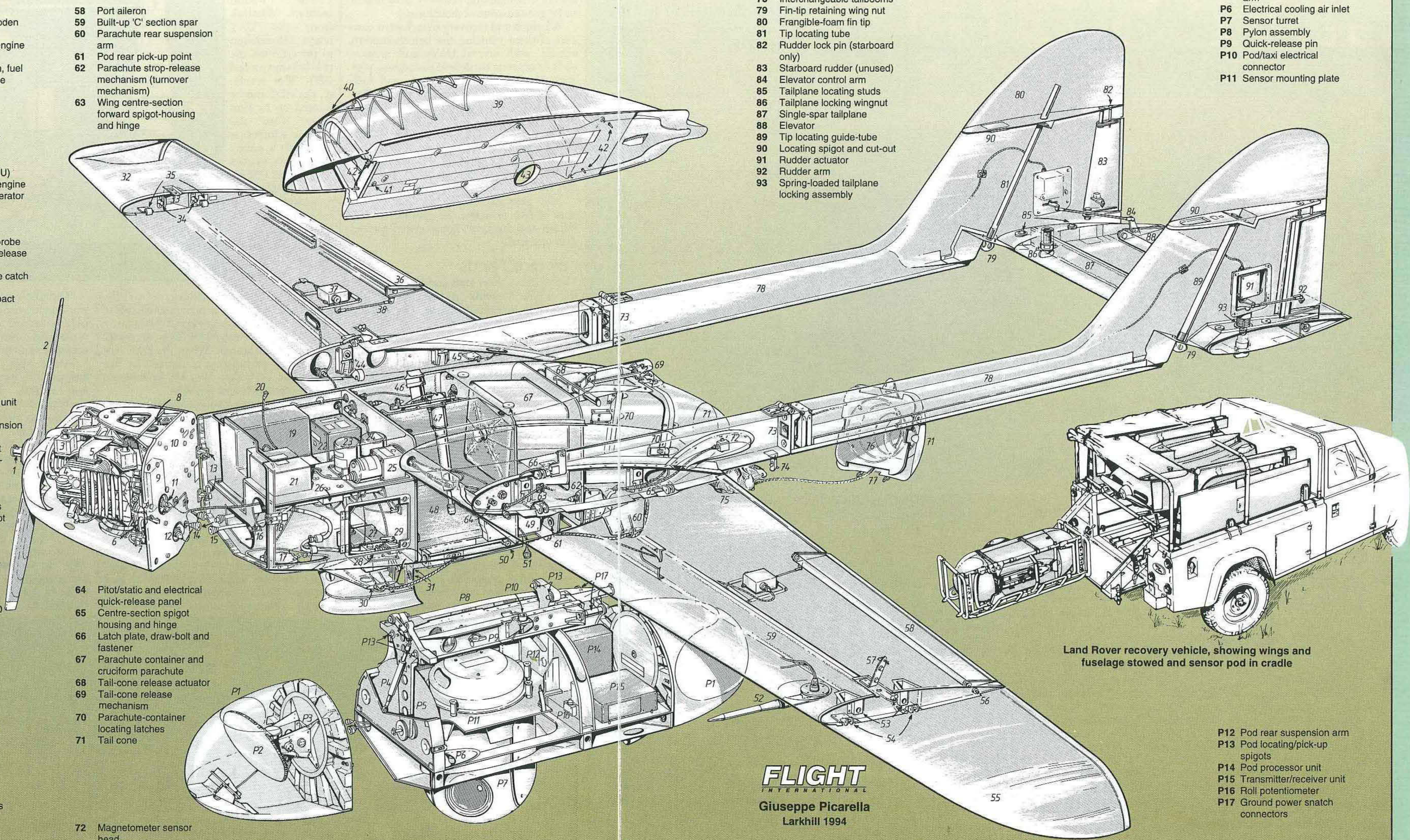
The Phoenix sensor-pod package is also flexible. GMAv says: "Interchangeable, alternative, pods could provide early-warning, air-defence-suppression, laser-designation, communication-relay, decoy or nuclear, biological or chemical [NBC] monitoring roles."

The level of command above the GSC

Phoenix UAV

1 Dog clutch type starter
2 Two blade fixed pitch wooden propeller(780mm)
3 Four point anti-vibration engine mount
4 WAE 342, 342cc Flat twin, fuel injection two-stroke engine
5 Exhaust outlet
6 Fuel regulator
7 Fuel pump
8 Throttle actuator
9 Engine Management Unit (EMU)
10 Engine bulkhead
11 Electrical connection (EMU)
12 Electrical connection for engine driven 900w Plessey generator
13 Hinges
14 Fuel supply line
15 Fuel return line
16 Outside air temperature probe
17 Parachute ground strop release mechanism
18 Engine bulkhead/fuselage catch
19 Flight control computer
20 Connector for ground impact detection circuit
21 Battery pack
22 Rate gyro pack
23 Airspeed transducer
24 Altitude transducer
25 Vertical gyro
26 Power distribution unit
27 Pod roll actuator
28 Magnetometer electronic unit
29 Fuel stop valve
30 Parachute forward suspension arm
31 Pod forward pick-up point
32 Removable, limited shock-absorbing wingtip
33 Wingtip latch receptical
34 Wingtip locating spigots
35 Wingtip connection hooks
36 Aileron housing and spigot hinge
37 Aileron actuator
38 Aileron actuator arm
39 Frangible shock absorber module with foam insert
40 Ground impact detector circuit
41 Electrical connector for 40
42 Shock absorber locating spigots
43 Fuel cap cut-out
44 Wing forward spigot and locating hook
45 Wing rear spigot and locating hook
46 Fuel manifold assembly
47 Fuel-level indicator (variable-resistance float type)
48 Fuel tank
49 Pod locking mechanism
50 Pod locking arm
51 Pod/taxi electrical connector
52 Pitot tube with static vents
53 Wingtip spigot housing
54 Wingtip locating hinges
55 Removable port-wingtip
56 Aileron spigot hinge
57 Wingtip latch assembly
58 Port aileron
59 Built-up 'C' section spar
60 Parachute rear suspension arm
61 Pod rear pick-up point
62 Parachute strop-release mechanism (turnover mechanism)
63 Wing centre-section forward spigot-housing and hinge
64 Pitot/static and electrical quick-release panel
65 Centre-section spigot housing and hinge
66 Latch plate, draw-bolt and fastener
67 Parachute container and cruciform parachute
68 Tail-cone release actuator
69 Tail-cone release mechanism
70 Parachute-container locating latches
71 Tail cone
72 Magnetometer sensor head
73 Fuselage/tailboom hinge and electrical connections
74 Fuselage/tailboom locking latch
75 Drone parachute
76 Tail-cone spring-loaded ejection plate
77 Tail-cone locating arms
78 Interchangeable tailbooms
79 Fin-tip retaining wing nut
80 Frangible-foam fin tip
81 Tip locating tube
82 Rudder lock pin (starboard only)
83 Starboard rudder (unused)
84 Elevator control arm
85 Tailplane locating studs
86 Tailplane locking wingnut
87 Single-spar tailplane
88 Elevator
89 Tip locating guide-tube
90 Locating spigot and cut-out
91 Rudder actuator
92 Rudder arm
93 Spring-loaded tailplane locking assembly

P1 Antenna housing
P2 Antenna plate
P3 Antenna plate assembly and servos
P4 Pod roll arm
P5 Pod forward suspension arm
P6 Electrical cooling air inlet
P7 Sensor turret
P8 Pylon assembly
P9 Quick-release pin
P10 Pod/taxi electrical connector
P11 Sensor mounting plate
P12 Pod rear suspension arm
P13 Pod locating/pick-up spigots
P14 Pod processor unit
P15 Transmitter/receiver unit
P16 Roll potentiometer
P17 Ground power snatch connectors



Land Rover recovery vehicle, showing wings and fuselage stowed and sensor pod in cradle

FLIGHT INTERNATIONAL
Giuseppe Picarella
Larkhill 1994

is the TCP, which controls up to three flight sections. Each flight section consists of a launch-and-recovery detachment and a ground-control detachment.

A launch and recovery detachment consists of three vehicles; the launch-support vehicle, with several UAVs and mission pods in separate battlefield containers, plus operational replacement spares and fuel; the launch vehicle, which features a pallet-mounted lifting crane, the hydraulic/pneumatic catapult and launch ramp, a pre-launch air-vehicle data-entry device, built-in test equipment and air-vehicle warm-up unit and engine starter; and the Land Rover recovery vehicle, which is fitted with cradles for the air vehicle and mission pod.

The ground-control detachment consists of two vehicles, the ground control station and the Land Rover-towed ground data terminal.

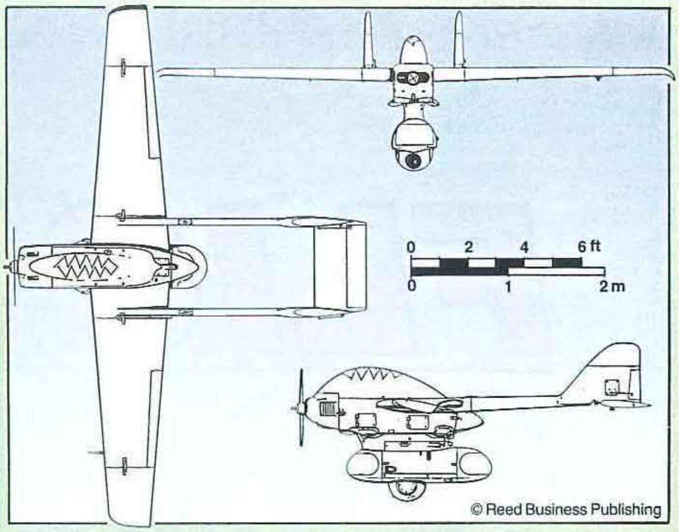
CONTROL FOCUS

The GCS has three staff and is the focus of the whole Phoenix system. Able to be located up to 25km from the UAV launcher, it provides command, control and communications from an NBC- and EMP-hardened truck-mounted shelter. The GCS features three "...identical, state-of-the-art networked workstations for the mission controller, image analyst and air-vehicle controller. Their flicker-free, high-resolution VDUs [visual-display units] are menu-driven to simplify operation and minimise operator workload", says GMAv.

Each screen uses a common format, with a menu on the right-hand side which allows either the datalinked thermal-imaging picture from the UAV or a multi-scale map showing target and UAV positions to be viewed.

Phoenix can be flown either autonomously or by command from the operator, who requires no piloting skills. The sensor is controlled directly from the GCS, by means of one of several automatic pointing modes, to aid target detection, recognition and identification.

The J-band secure datalink from the UAV relays information to the GCS via the trailer-mounted GDT. "For security, the GDT can be located up to 1km away from the GCS, to which it is linked by a secure communications cable," says GMAv.



Phoenix UAV

Haffey describes a typical Phoenix mission: "Once the UAV has been assembled and placed on the launcher, information from the GCS is entered, which enables it to fly autonomously on to a pre-assigned radial after launch. It is also given instructions on an emergency recovery location in the event of failure after launch. When the UAV has flown on to its radial, it is acquired by the GDT. The UAV then flies via its mission plan to the target-area artillery."

Haffey says of a typical engagement scenario: "The grid co-ordinates of a target located by the UAV are fed through the GCS and BATES directly to the guns. The UAV notes the corresponding fall of shot, corrections are automatically generated at the GCS, fed via BATES to the guns and the target re-engaged."

When the mission is complete, recovery is by parachute, with the UAV inverting before impact and landing on its back to protect the mission pod. The actual impact force is absorbed by a crushable dorsal shock absorber and by frangible wing and tail tips. The shock absorber and tips are all quickly replaceable.

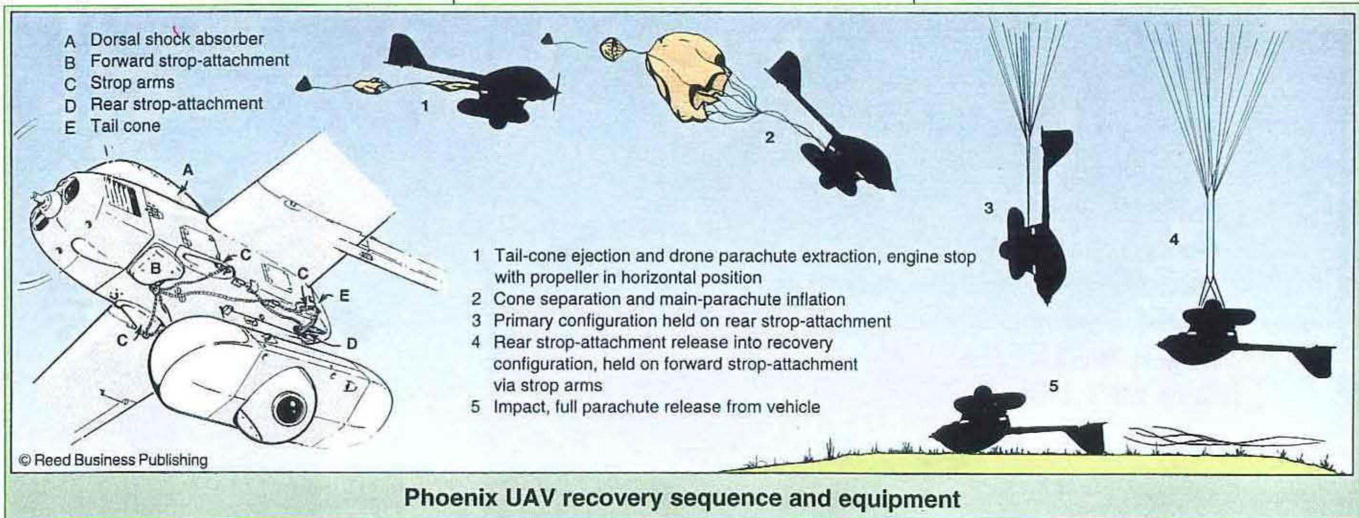
The whole system is supported by a forward maintenance unit, which, in a battlefield-hardened shelter, contains line-replaceable-unit test equipment and accommodation for repairs.

GMAv also believes that the Phoenix has excellent export potential, with the system already being offered for the Netherlands requirement for a UAV. Haffey admits that alterations may be needed to suit some export customers, however.

He says: "For hot-and-high performance, the powerplant needs to be uprated." GMAv is examining alternative engines, probably of rotary design.

With the export potential and what Haffey describes as a "decent production run", GMAv believes that it has a winner in the Phoenix UAV system.

The likelihood is that, by the end of 1995, it will have seen service with UK forces deployed overseas — which is the ultimate test for the UK's most potent battlefield UAV. ◄



Phoenix UAV recovery sequence and equipment