EURO-ART INTERNATIONAL COBRA

COBRA

Counter Battery Radar

Description

Content

Figures

COBRA Description

1 Scope

This description provides a summary of the performance, design and manufacture requirements for the Radar System Vehicle (RSV) of COBRA.

2 Applicable Documents

The design, manufacture and test activities conducted during the development and production of COBRA were performed in accordance with applicable standards. Information regarding the standards applied, and the extent to which they are applicable can be obtained from the manufacturers, EURO-ART.

3 Description

COBRA is the Radar System for the accurate and rapid location of enemy guns, rocket launchers, and mortars. It may also be used for the Adjustment/Registration of the fire of own artillery. COBRA is fielded on a single vehicle, and achieves its full performance requirements without levelling or stabilisation jacks thereby exceeding rapid deployment and high mobility requirements. Powerful software algorithms automatically compensate for terrain slopes (COBRA pitch and roll) and calculate each search beam elevation to graze the radar horizon before transmission begins.

3.1 Major Component List

The COBRA Configuration and Major Sub-Assemblies of the COBRA RSV are presented in Figure 1 and Figure 2.
The COBRA RSV consists of:

- Radar Module Set (RMS)
  - Contains all equipment required for artillery location and registration operation, for communication with the User and for field radio communications
    - NBC and shell-fragment protected
    - Integrated Inertial Navigation Unit allows autonomous navigation and orientation plus compensation for wind and shell blast
- Modified Carrier Vehicle (MCV)
  - Medium cross-country capability
  - Vehicle Modification Set to facilitate mechanical and electrical integration with RMS
- Prime Power Unit (PPU)
  - Mounted on Carrier Vehicle with RMS
  - Provides all AC and DC Power required for COBRA Operations
- C^3 Equipment (Supplied by Purchaser)

Figure 1 – Cobra Configuration

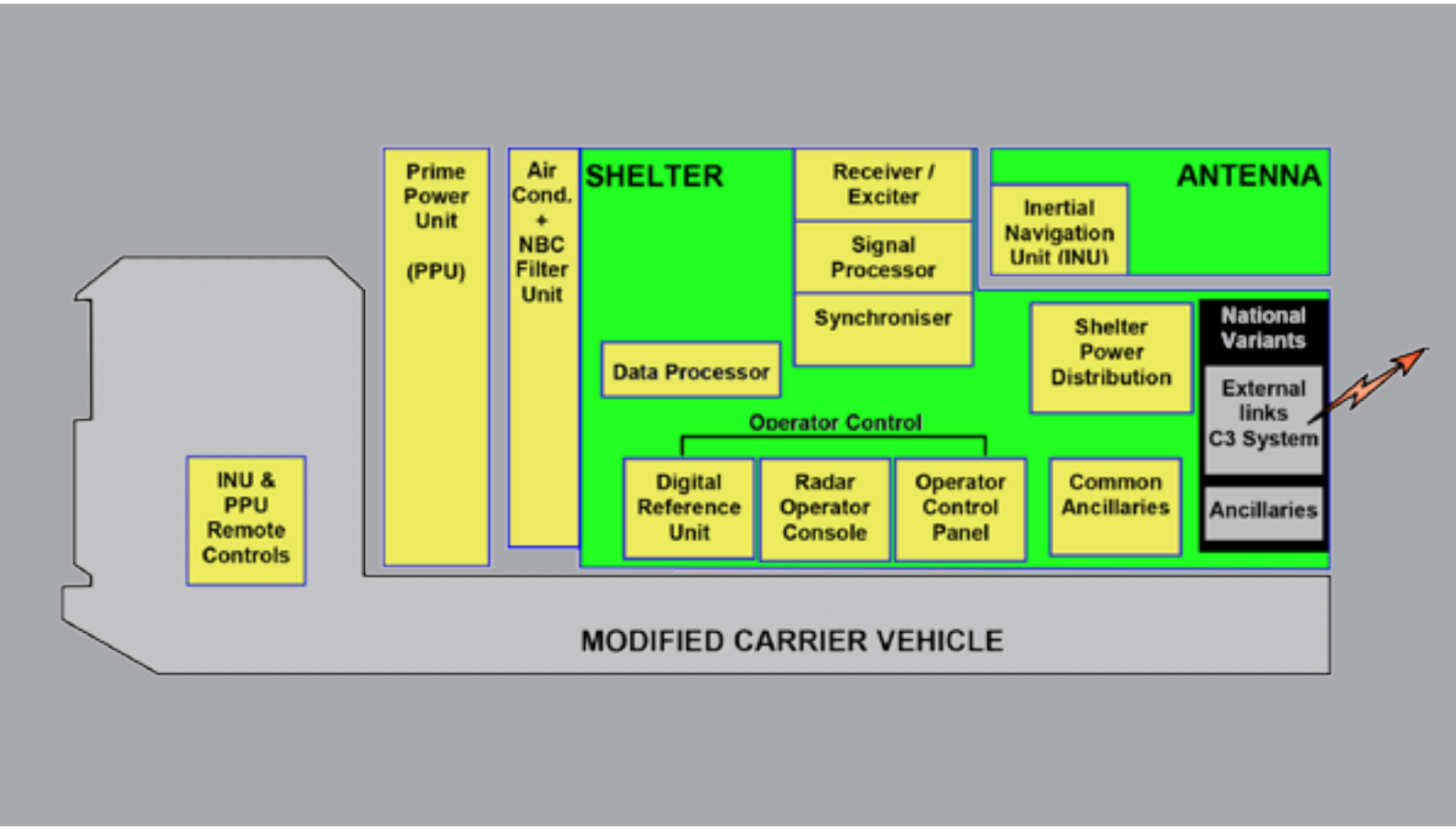

Figure 2 – COBRA Radar System Vehicle (RSV) Major Subassemblies

3.2 Operational Concept

In its primary role, COBRA:

- provides intelligence on enemy artillery, including:
  - location of hostile battery position co-ordinates and width-and-orientation of battery front,
  - classification of enemy artillery (into guns, rocket launchers, or mortars),
  - location of the impact areas co-ordinates of enemy fire,
- conducts Adjustment/Registration of Friendly Fire
  - location of fall of shot
  - fire correction parameters
- determines jamming data.
  - Azimuth and elevation of main-lobe jammers with jamming analysis data
  - Presence of side-lobe jammers

3.2.1 COBRA Missions

Hostile Battery Location Missions can be conducted against:

- Guns and mortars
- Multiple rocket launchers

Whilst continuing to track and locate new enemy batteries, COBRA can conduct Registration/ Adjustment of Friendly Fire missions to correct Friendly Battery's Counter-Fire COBRA achieves the above capabilities by tracking ballistic projectiles, and extrapolating the observed part of the trajectories to the ground.

3.2.2 COBRA Coverage

The maximum COBRA Coverage from a radiation position is detailed in Figure 4

3.2.2.1 Range Modes

COBRA detects and tracks enemy artillery firings.
Total coverage is achieved using 3 instrumented range modes:

- Standard instrumented range mode: 30 km
- Short instrumented range mode: 20 km
- Long instrumented range mode: 40 km

All three modes can be used during a single mission.
The maximum computation of battery locations and display capability is instrumented to 50 km.

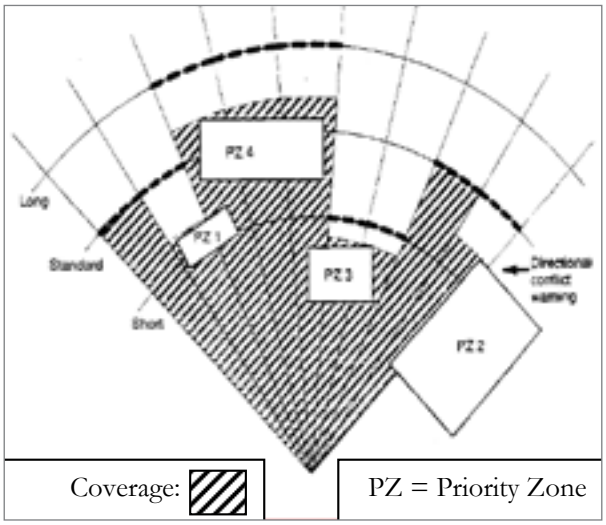

Figure 3 – Range Modes

3.2.2.2 Electronic Scan

COBRA electronically scans the tasked azimuth sector each side of the surveillance direction. Detection and location characteristics can be improved in certain directions by reducing the electronically scanned sector to any sector width down to 5°.

In case of the reduced azimuth sector scan, projectiles leaving the surveillance sector continue to be tracked until completed tracks are recorded.

3.2.2.3 Mechanical Antenna Adjustment

The COBRA antenna can be mechanically rotated in azimuth by ± 90 degrees with respect to the longitudinal axis of the vehicle and in elevation from –5° to + 35° relative to a plane perpendicular to the shelter bottom surface .

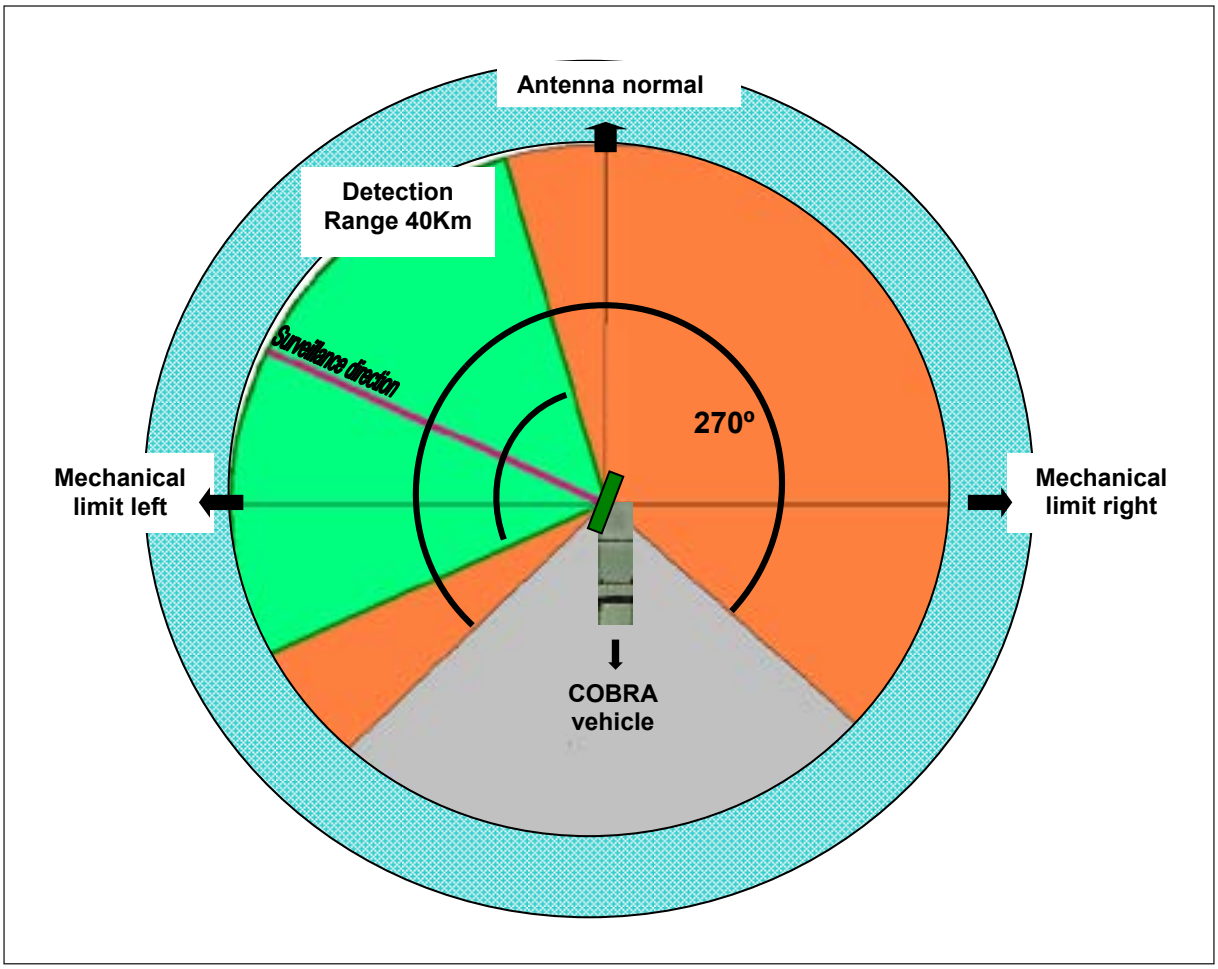

Figure 4 – COBRA Coverage Diagram

Surveillance sector	Antenna electronic scan ±45° from surveillance direction
Available coverage	Antenna mechanical slew limits ±90° from vehicle normal results in 270° available coverage
Display Coverage	Computation of locations instrumented to 50Km

3.2.3 Operating Modes

3.2.3.1 Automatic and Autonomous Operation

In the Automatic mode of operation, the User transmits control commands to COBRA and receives mission results via the C^3 data link.

In the Autonomous mode, the COBRA Operator enters or modifies the mission parameters. If a C^3 equipment failure occurs whilst COBRA is in the Automatic mode COBRA switches to the Autonomous mode.

3.2.4 COBRA Deployment

3.2.4.1 Crew

The automation inherent in the COBRA design allows the crew size to be minimised:

- Driver
- Radar Operator
- C^3 Operator

The above roles can be performed by one, two or three soldiers. The built-in test facilities detect and locate faults to a single LRU in most cases. Operational Status is reported via the C^3 System. This allows one Maintainer to monitor the status and react to failures of several COBRA.

3.2.4.2 Encamp/Decamp

COBRA can be brought into action in less than 15 minutes. The encamp time includes the time taken to load the Digital Terrain Map (DTM) from hard disk, and to complete COBRA Initialisation and mission parameter definition. It is possible to come out of action within 5 minutes.

3.2.4.3 Background Maps

Digital Maps provided by the User Army are loaded onto COBRA for a battlefield day. An 800 km^2 map is loaded from CDs. When COBRA is initialised for a mission a 100 km^2 map is displayed with COBRA at its centre. Mission data is superimposed on the map as soon as it is acquired.

3.2.4.4 Determination of COBRA Position and Antenna Orientation

3.2.4.4.1 Inertial Navigation Unit

The integrated Inertial Navigation Unit provides navigation data (COBRA position X,Y,Z) and also measures the instantaneous antenna orientation. This allows for automatic antenna mechanical positioning, and compensation for terrain slopes and unexpected movements (wind or shell blast effects)

A Vehicle Motion Sensor (VMS) is attached to the carrier vehicle to provide the INU with vehicular movement data.

3.2.4.4.2 Backup alignment

As an emergency mode, it is possible to determine the angle orientation of the antenna mechanical boresight and antenna plane by means of external equipment such as a (PFE) and to introduce this data as a substitute for missing INU angle information.

3.2.4.5 Adjustment of Search Pattern to Terrain Mask

For every mission, COBRA automatically adjusts the elevation of its search pattern to the terrain mask.

3.2.4.5.1 Use of Terrain Map

The initial adjustment is calculated from the Digital Terrain Map (DTM) terrain altitude data, without radiation, prior to active operation. At the beginning of radiation the mission, COBRA adjusts each search beam to the optimum position. In the absence of Terrain Altitude Data for the COBRA deployment area, the User can measure the elevation of the radar horizon using an external device such as a theodolite (provided as PFE), and input this data via the Operator Console, or allow COBRA to measure the crests of the radar horizon using a radiation method.

3.2.4.5.2 Terrain Mask minimum range

When positioned for a mission, if COBRA detects a potential obstacle which prevents optimum location performance, the relevant blind sector will be displayed to the Operator on the graphics display.

3.2.5 Priorities

Three types of prioritisation can be applied to COBRA mission data

- Mission Priority
- Location Zone Priority
- Weapon system class priority

3.2.5.1 Mission Priority

Mission priority is applied to allow COBRA to react to possible mission conflicts that prevent the completion of simultaneous missions.
The default mission priority order, from the higher to lower priority, is:

- Location of hostile batteries,
- Adjustment/Registration of friendly fire.

This order may be modified during mission definition. COBRA responds to these priorities, in the event of a mission conflict, by reducing system resources for the mission of lower priority. Where necessary, this may include the mechanical slew of the antenna to accommodate the higher priority mission prior to active transmission.

3.2.5.2 Location Zone Priority

3.2.5.2.1 Location zones

Using battlefield intelligence data, the COBRA Operator or the User has the facility to define location zones, which represent areas where hostile batteries are positioned or their potential targets (impact zones) to which priorities can be assigned. For this purpose, 6 levels of priority are defined; the lowest level is used to exclude (censor) zones. To allow rapid reference to the defined zones, an Area ID can be assigned via the C^3 link. If Area IDs are assigned, they are included in the appropriate Location Reports.

3.2.5.2.2 Use of Location Zone Priority

In extremely high density firing scenarios, COBRA responds to location zone priorities, in the event of approaching saturation, by reducing search and track coverage in lower priority zones, starting with the zone of lowest priority.
In order that appropriate Friendly Fire responses may be tasked, the Hostile Battery Reports to the User indicates the Location Zone Priority.

3.2.5.2.3 Zone shapes and numbers

A total of 5 Location Zones may be defined. The outline of Hostile Battery Location Zones may be sectors, circles, triangles, quadrangles, pentagons, hexagons or the remaining complementary area within COBRA coverage sector.
Up to 4 location zones of hostile impacts may be defined. They can be circular or grid oriented rectangles.

3.2.5.3 Weapon system class priority

The COBRA Operator or the User (via C^3) is able to assign priorities to the three weapon system classes of guns, rocket launchers, and mortars. For this purpose, 4 levels of priority are defined; the lowest level is used to exclude weapon system classes. The weapon systems class priorities are used in conjunction with the location and impact zone priorities to set up filter criteria for the reports to C^3.

3.2.6 Location of Batteries

3.2.6.1 Battery Location Criteria

For COBRA all trajectory origins within a circle (of “correlation radius”), firing at the same target (similar velocity), are assumed to belong to one battery.
A battery location is considered to be complete if during a predetermined time (“correlation period”) the number of similar trajectory origins within the correlation circle equals a certain threshold the “correlation number”.
Batteries not fulfilling the correlation criteria are reported to the COBRA Operator and the C^3 System as “Incomplete Batteries”.
Correlation radius, correlation number, and correlation period may be adjustable by the COBRA Operator or the User.

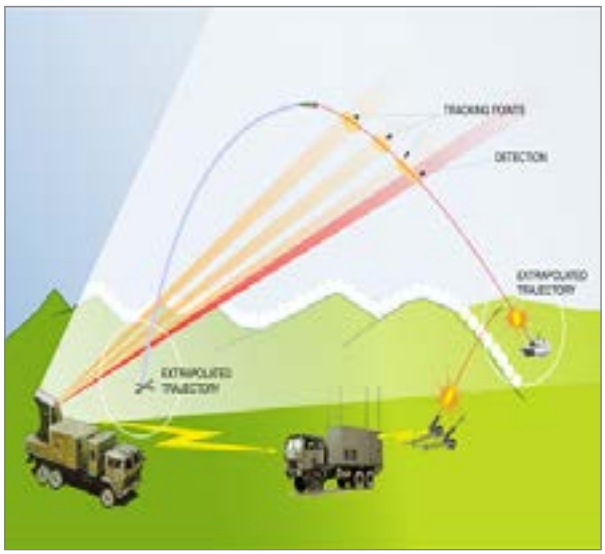

Figure 5 – Location of Batteries

3.2.6.2 Location Rate

In a High Density Engagement, COBRA can locate more than 40 Batteries in 2 minutes and conduct Friendly Fire Correction Missions simultaneously.

3.2.6.3 Location Rate Modes

To enable COBRA to automatically adapt to fluctuating target densities, COBRA provides two Location Rate Modes:

- Normal Location Rate Mode
- High Location Rate Mode

The Operator must authorise the use of High Location Rate Mode, otherwise COBRA will always apply Normal Location Rate Mode.

3.2.6.3.1 Normal Location Rate Mode

This mode is characterised by the following:

- Constant target track length in order to maximise battery location and impact point location accuracy,
- Battery location procedures and criteria can be defined by the Operator or the User.
- Battery width and orientation of battery front will be estimated (unless the battery comprises only one track),
- Tracks of all types (swarms and/or salvos and/or singles) are correlated to form batteries,
- Impact point will be estimated.

3.2.6.3.2 High Location Rate Mode

In very high density battlefield scenarios, conditions may evolve in which detection probability for new projectiles is reduced due to the time and energy expended in tracking already detected projectiles. The High Location Rate Mode allows the User to maintain the detection rate and Location Accuracy of new targets by optimisation of the Location Mission Parameters.

3.2.6.4 Height Correction in Location Mission

Height corrections for Hostile Battery Locations will be performed automatically or interactively.

3.2.6.4.1 Automatic Height Correction

COBRA uses the terrain altitude data to calculate the height of each located battery. The trajectory of the tracked projectile is propagated back to the point at which it intersects with the terrain height.

3.2.6.4.2 Interactive Height Correction

In the absence of a Digital Terrain Map, the COBRA Operator can request an Interactive Height Correction procedure to correct the height of either single batteries or groups of batteries.

3.2.6.5 Hostile Battery Location Reports

The location report contains the following information:

- Battery identification (ID)
- Co-ordinates of battery centroids or single location
- Area ID of battery centre
- Height of battery centre
- Number of shells or indicator of salvo
- Estimated CEP of location error
- Time of location
- Priority
- Weapon system class
- Impact point centroid co-ordinates and area identifier
- Width and orientation of battery front
- Indicator for incomplete battery
- location (if applicable)

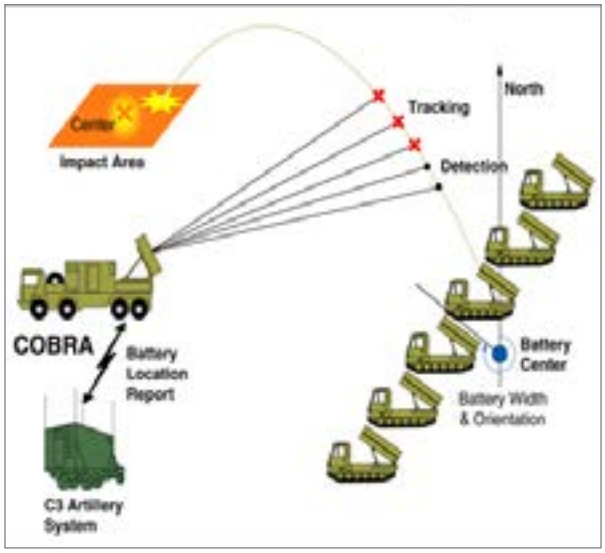

Figure 6 – Hostile Battery Location Reports

3.2.7 Adjustment / Registration of Friendly Fire

COBRA is capable of correcting Friendly Fire either as a separate Mission or Simultaneously with a Hostile Battery location Mission

3.2.7.1 Adjustment / Registration Mission

An Adjustment / Registration mission may include a fire sequence of several shells, fired with the same parameters. The sequence may be fired in one or in several mission activations.
The required parameter set to be provided by C^3, or to be entered by the Operator, for such a mission must at least include:

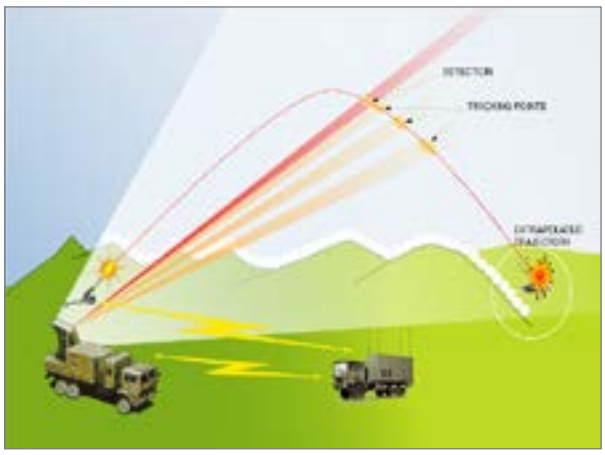

Figure 7 – Adjustment / Registration Mission

- Firing ID
- Type: Registration, Individual Adjustment, Mean Adjustment
- Start Criterion
  - Time over Target (TOT) or
  - User (via C^3) or
  - Operator.
- Co-ordinates of firing position centre /altitude
- Target ID
- Co-ordinates of target centre including altitude.

3.2.7.2 Adjustment / Registration Mission Operation

COBRA computes the impact points of friendly fire by first determining the required search volume which must be positioned to provide sufficient track time for accurate impact point location. Search beams are then scheduled to scan the search sector. When the projectile passes through the search sector it is detected, verified, and tracked as closely as possible to the terrain mask. The trajectory is extrapolated beyond that mask to the plane defined by the target altitude contained in the mission set up data.

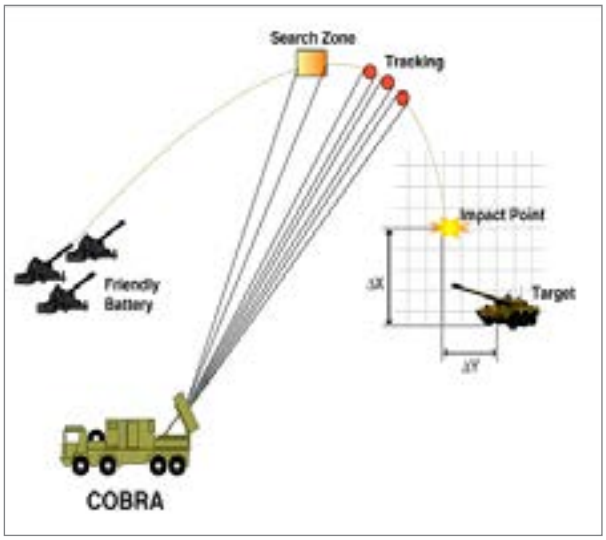

Figure 6 – Hostile Battery Location Reports

3.2.7.3 Adjustment / Registration Mission Report

The following data is recorded in the mission data file, is transmitted to the User via the C^3 link and displayed to the COBRA Operator, either at the alphanumeric or graphic terminal, at his discretion:

- Firing identification (ID),
- Co-ordinates of target centre,
- Altitude of the target centre,
- For each projectile the co-ordinates of the impact point,
- Impact point deviations,
- Time of first observation,
- Mean point of impact data of all projectiles or a selected subset of projectiles.
- Confidence of impact point co-ordinates.

3.2.8 ECM Status

COBRA checks for the interference caused by jamming, assesses the impact of the interference and takes appropriate action

3.2.8.1 ECM Status Monitoring

When COBRA detects the presence of ECM interference, the Operator is warned by acoustic and visual alerts.

3.2.8.2 Location of Jammers

During passive non-transmitting periods, COBRA provides azimuth and elevation direction for jammers within the passive observation search sector using the antenna mainlobe; in addition, information on jamming mode, jamming strength, presence of mainlobe or sidelobe jamming, and jammed frequency channels is gathered and stored.
During radar transmissions a second means of gathering information on non-responsive and responsive and moving jammer platforms is provided.

3.2.9 Transportability

COBRA is transportable by air, sea and rail.

4 Glossary

AC	Alternating Current
C^3	Command, Control and Communications
COBRA	Counter Battery Radar
DC	Direct Current
DTM	Digital Terrain Map
ECM	Electronic Counter-Measures
INU	Inertial Navigation Unit
MCV	Modified Carrier Vehicle
NBC	Nuclear, Biological Contamination
NEMP	Nuclear Electro-Magnetic Pulse
PFE	Purchaser Furnished Equipment
PPU	Prime Power Unit
RMS	Radar Module Set
RSV	Radar System Vehicle
TOT	Time Over Target

5 COBRA Characteristics

COBRA Configuration (See 3.1)	
Single vehicle, no levelling or stabilisation required	
Operator cabin complete with Operator and C^3 Consoles	
On-board Prime Power Unit	
On-board, User Artillery Integrated Command and Control System	
On-board Inertial Navigation System (Laser Gyro) with GPS option	
Air-conditioner with NBC filtration (Gas, Chemicals and Particles)	
Shelter protected against shell fragments and small arms fire	

COBRA Missions (See 3.2.1)	
Hostile Battery Location:	
Location of Battery Centre / Battery width and Orientation /	
Weapon Classification / Impact Area / Weapon and Area Priority	
Friendly Fire Registration and Adjustment:	
Location of fall of shot / Adjustment parameters	

Range Modes (See 3.2.2.1)	
Short / Standard / Long	20, 30, 40 Km

Coverage	1200 Km^2

Operating Modes	
Automatic – missions directed and results transmitted via C^3 link	
Autonomous – no connection with C^3 link, Operator defines	
missions	

COBRA Deployment (See 3.2.4)	
Crew size	1–3 soldiers
Encamp time	5–15 minutes
Decamp time	3–5 minutes
Use of on-board Inertial Navigation System	
Background Digital Maps and Digital Terrain Maps (DTM)	
Computation of Terrain Mask from DTM	

Priorities (See 3.2.5)	
Mission Priority	
Location Zone Priority	
Weapon System Class Priority	

Location of Batteries See (3.2.6)	
Battery Location Criteria	
Number of Weapons	1–8
Correlation Radius	100–200m

Correlation Time	10–999secs
Location Rate	>40 batteries in 2minutes
Location Rate Modes	Normal, High

Adjustment/Registration of Friendly Fire (See 3.2.7)	
Adjustment mission simultaneously with Location Mission	
Accuracy	<15Km – 50m CEP >15Km – 0.35% range

Transportability (See 3.2.9)
By air, sea and rail (or using a suitable spare flat-bed vehicle)
EURO-ART INTERNATIONAL PROPRIETARY INFORMATION Page 13

Additional Data	
Shelter size	600x250x210 cm
Prime Power Unit Size	80x250x200 cm
Vehicle platform (Interface Frame) dimensions	750x250 cm
Vehicle Payload	10 tons
Shelter weight	Approx 8000
Prime Power Unit Weight	1900 Kg

EURO-ART INTERNATIONAL COBRA

COBRA – *We know where they are.*

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Company Profile

The EURO-ART consortium was formed in 1989 by the predecessor companies of Thales Air Systems SA, France, Thales UK Ltd, EADS, Germany and Lockheed Martin, USA, to undertake development and production of the COBRA System for the French, UK and German Governments which has resulted in the delivery of 29 COBRA Systems. In August 2007, EURO-ART International EWIV ("EURO-ART International"), an European Economic Interest Group based in Germany, was established between Thales Air Systems SA and EADS, as the enterprise responsible for all future marketing and sales of the COBRA System to new customers.