The Malaysian Eagle
Aerial Reconnaissance Vehicle (ARV)

Wan Izani
Excelnet Sdn Bhd, Cyberjaya, Malaysia

Mark Gardner
BAE SYSTEMS, Santa Monica, CA

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Objective

- To explain the reasons why Eagle 150 was selected as the platform for the Malaysian Aerial Reconnaissance Vehicle (ARV) Program and to highlight the benefits of having manned and unmanned operational capability.

- To discuss the process by which Composite Technology Research Malaysia (CTRM), Excelnet Sdn. Bhd., and BAE SYSTEMS converted the Eagle 150 twin-seater aircraft into an ARV in less than 8 months.
Eagle-150B Aircraft
Why an Eagle-150B Aircraft?

Eagle-150 aircraft is a two-seater, single engine of a fully composite light aircraft.

- Certified by CASA, FAA and JAR.
- Handling qualities ideally suited for surveillance missions
  - Outstanding low speed control
  - Able to operate from short, unimproved runways
  - Stable in all flight regimes
- All composite structure
  - Low observable
  - Corrosion resistance
  - High impact strength
  - Long fatigue life
- Low life-cycle cost
  - Low operating and maintenance cost
  - Existing support for maintenance and spares in Malaysia
Eagle ARV
Why an Aerial Reconnaissance Vehicle (ARV)?

The main reason for developing an ARV is to obtain system flexibility to meet a variety of mission profiles for both manned and unmanned missions using the same aircraft.

**Unmanned version applications and benefits**

- **For hazardous missions**
  - Chemical or nuclear contaminant detection
  - Hostile and threat area operations
- **For long endurance missions**
  - Coastal water surveillance missions
  - Operations in remote areas
Why an Aerial Reconnaissance Vehicle (ARV)?

**Manned version applications and benefits**

- Able to operate in civil airspace
- Added situation awareness for surveillance missions
- Valuable for training purposes
  - Operational conversion for pilots
  - Mission rehearsal and tactics development
  - Providing a good low cost lead-in platform for more advanced UAVs
- Easy for rapid re-deployment as the ARV can be piloted to the new operational site
Missions of Eagle ARV

It is intended that the aircraft is able to provide a range of airborne military and commercial surveillance capabilities suitable for a broad spectrum of operational environments including:

- Battlespace command and patrol
- Coastal and border patrolling
- Off-shore monitoring of illegal trafficking and piracy
- Identification of water & air pollution sources
- Prevention of illegal logging
- Assisting in air, land and sea rescue operations
- Crowd and traffic surveillance and management
- Disaster area management and communications
Eagle ARV Equipment Installation

- AVCR
- Video Encoder Model 3400R
- Range Tone/FSK Modem Model TFM-300AB
- 0 to 19.2 kb/s FSK Modem Model TFM-300AB

Backup Antenna

Primary Antenna

Pre-Flight Panel

Backup Receiver

Multifunction Flight Avionics System (MFAS)

Battery Model G-242

Alternator Model N300 (Mounted on Engine)

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Aircraft/Flight Control Modifications

Aileron actuator installation

ARV Main flight control box

Rudder actuator

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## Eagle ARV Specifications and Performance

<table>
<thead>
<tr>
<th>Air Vehicle Performance</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Level Speed</td>
<td>133 knots</td>
<td>240 km/h</td>
</tr>
<tr>
<td>Cruise Speed</td>
<td>120 knots</td>
<td>216 km/h</td>
</tr>
<tr>
<td>Best Loiter Speed</td>
<td>65 to 75 knots</td>
<td>117 to 139 km/h</td>
</tr>
<tr>
<td>Stall Speed (Clean)</td>
<td>56 knots</td>
<td>101 km/h</td>
</tr>
<tr>
<td>Stall Speed (Full Flaps)</td>
<td>45 knots</td>
<td>83 km/h</td>
</tr>
<tr>
<td>Range (From GCS)</td>
<td>124 nm</td>
<td>200 km</td>
</tr>
<tr>
<td>Endurance</td>
<td>10 hrs</td>
<td></td>
</tr>
<tr>
<td>Ceiling Altitude</td>
<td>12000 ft</td>
<td>4877 m</td>
</tr>
</tbody>
</table>
# Eagle ARV Specifications and Performance

## Air Vehicle Dimensions

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value 1</th>
<th>Value 2</th>
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</thead>
<tbody>
<tr>
<td>Wing Span</td>
<td>23 ft 6 in</td>
<td>7.163 m</td>
</tr>
<tr>
<td>Length Overall</td>
<td>21 ft 2 in</td>
<td>6.492 m</td>
</tr>
<tr>
<td>Height Overall</td>
<td>7 ft 7 in</td>
<td>2.324 m</td>
</tr>
</tbody>
</table>

## Propulsion

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
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</thead>
<tbody>
<tr>
<td>Engine</td>
<td>TCM IO 240-125 hp</td>
</tr>
<tr>
<td>Propeller</td>
<td>Metal - McCauley</td>
</tr>
</tbody>
</table>

## Crew Requirements

<table>
<thead>
<tr>
<th>Role</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCS</td>
<td>2</td>
</tr>
<tr>
<td>Support</td>
<td>6</td>
</tr>
</tbody>
</table>

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[BAE SYSTEMS]
System Features

The Eagle ARV system comprises three aircraft, a ground station and a remote receiving station.

The Eagle ARV’s integrated surveillance system comprises of:

- A 15:1 continuous zoom color EO imaging sensor
- A spotter scope imaging sensor
- Third generation step-zoom FLIR

This equipment is integrated into a lightweight turret mounted in the underbelly of the aircraft. This provides the operator with an unobstructed 360° field of view.

All sensor data is recorded onto dual S-VHS recorders that allow the operator to replay previously recorded imagery.
The Eagle ARV’s Ground Control Station (GCS) is built into a single trailer, containing pilot and payload operator consoles. This includes a Data Exploitation and Mission Planning System which is capable of accepting up to 256 pre-planned waypoints, together with a microwave line-of-sight ground data terminal.

The ARV is controlled in real time up to a distance of 200 km while flying a line-of-sight profile for up to 10 hours without re-fuelling. The GCS can send imagery data via a landline to a networked command center or to a remotely sited data distribution system.
The Ground Control Station
Problems Encountered

- Insufficient Air Regulations for fully autonomous/unmanned flight. The Eagle ARV was issued a “permit to fly” under the “Military Experimental” category
  - To gain user’s confidence for unmanned flight a Ballistic Recovery System (BRS) was added.
  - Added ATC voice relay and remotely tunable IFF
- Slight decrease in the ARV’s performance. Higher than expected drag induced by the payloads has reduced the intended altitude and range.