NORTHROP GRUMMAN

DEFINING THE FUTURE

Lessons Learned in Fielding a UAS in the Combat Theater

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Introduction

I have been deployed five times in support of the Global War on Terror since September 11th 2001.

Supported Operation Enduring Freedom, Operation Iraqi Freedom, and Operation Southern Watch.

I supported the RQ4A "Global Hawk" High Altitude Long Endurance aircraft during these deployments.

These are some lessons learned that have since evolved into standard operations today.

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Lessons learned Topics:

1. Pilot Intervention
2. Ground Crew
3. Environment
4. Need in the field
5. Risk of aircrew

AV3 Returning Home

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1. Pilot Intervention

- **The Fully Autonomous Air Vehicle**
  - Pre launch
  - Mission plan
  - Command and control
- **Command Shelter**
  - Hand off
  - Aircrew cycle
- **Pre Brief/ Post Brief**
  - Identify possible issues
  - Clarify mission need
  - Accurate fault or discrepancy description

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1.1 The Fully Autonomous Air Vehicle

- **Pre Launch**
  - Preflight A/C and Shelter
  - Walk around
  - Outside impacts
- **Mission Plan**
  - A/C and Shelter Match
  - Last minute updates
- **Command and control**
  - LRE (Launch and Recovery Element)
  - Control Center
  - MCE (Mission Control Element)

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1.2 Command Shelter

- **Hand off**
  - LRE launch
  - MCE Mission
  - LRE Recover
- **Aircrew cycle**
  - LRE
  - MCE
  - Crew rest

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1.3 Pre Brief/ Post Brief (Pilots)

- **Identify possible issues**
  - Intermittent issues
  - Scheduled Maintenance
  - Known Comm/NAV interference
- **Clarify mission need**
  - SAR, EO/IR
  - Ground CDL
- **Accurate fault or discrepancy description**
  - Faults during mission
  - Post flight/mission data review

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2. Ground Crew

- **Preflight and Post flight**
  - Inspections
  - Mission plan
  - Fault logs
- **Scheduled Maintenance**
  - Down time
  - Mission Cycle
- **Pre Brief/ Post Brief**
  - Identify possible issues
  - Clarify mission need
  - Accurate fault or discrepancy description

2.1 Preflight and Post flight

- **Inspections**
  - Electrical (VTC)
  - Mechanical
  - Servicing
- **Mission plan**
  - Loading
  - Check sum
- **Fault logs**
  - Download and save
  - Erase for new mission
  - Fault Isolation

2.2 Scheduled Maintenance

- **Down time**
  - Minor/Major
  - Equipment
  - Retest
- **Mission Cycle**
  - Schedule
  - Impact to next

2.3 Pre Brief / Post Brief (Ground Crew)

- **Identify possible issues**
  - Recurring faults
  - Work a rounds
  - Mission cancel
- **Clarify mission need**
  - Payload(s)
  - Keying Requirements

- **Accurate fault or discrepancy description**
  - Trouble shooting time
  - Fault isolation
  - Lead time on replacements

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3. Environment

- **Climate**
  - Maintenance time
  - Indoor/Outdoor
  - Mission Capable Limits
- **Equipment**
  - Availability
  - Special Equipment
- **Part replacement**
  - Hours on airframe
  - Lead Time.

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3.1 Climate

- **Maintenance time**
  - Exposure to elements
  - Coincide with mission
  - 24 hour coverage
- **Indoor/Outdoor**
  - Time
  - Exposure to others
- **Mission Capable Limits**
  - Take off/ Landing
  - Visibility over target

3.2 Equipment

- **Availability**
  - On site
  - Loan from local unit
  - Sent from stateside
- **Special Equipment**
  - For that area
  - Power source (s)
  - COMSEC

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3.3 Part replacement

- **Hours on airframe**
  - Increased cycle
  - Cost
  - Expand limits
- **Lead Time.**
  - Availability
  - Customs
  - Local Vendor

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4. Need in the Field

- **Battlefield Commander**
  - Near real time Imagery
  - BDA
  - Re Direct
- **Troops on Ground**
  - More Intel
  - Direct download
- **Long Endurance**
  - Time in Theater
  - On Task
  - Flexibility

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4.1 Battlefield Commander

- **Near real time Imagery**
  - Accurate ground troop placement

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IR Image: Search of Tora Bora Cave Complex, AF
10 Dec 01 / 0200L

Camp Fires and Cave Entrances

Taliban Lookouts on Ridgeline

UI HEAT SIGNATURE

Gunship Round Impacts

4.1 Battlefield Commander

- **Near real time Imagery**
  - Accurate ground troop placement
  - Air strike

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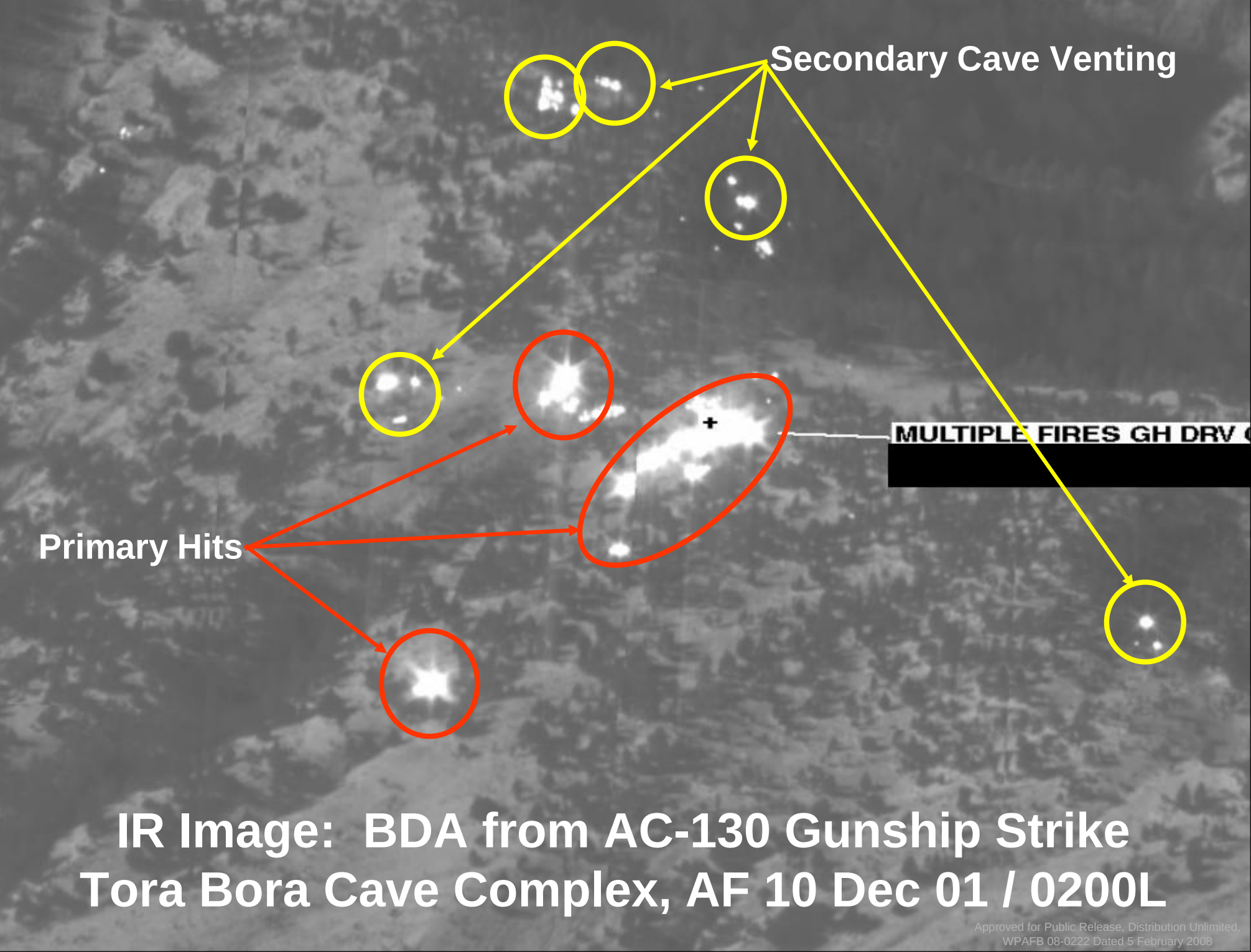

IR Image: BDA from AC-130 Gunship Strike
Tora Bora Cave Complex, AF 10 Dec 01 / 0200L

4.1 Battlefield Commander

- **Near real time Imagery**
  - Accurate ground troop placement
  - Air strike
  - Potential threats

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EO Image: SA-2 Battery 6NM NW of Tikrit
11 Apr 03 / 0845L

4.1 Battlefield Commander

- **Near real time Imagery**
  - Accurate ground troop placement
  - Air strike
  - Potential threats
- **BDA**
  - Verification
  - New targets
- **Re Direct**
  - Capable to look outside of mission
  - Determined by BDA
  - Target of opportunity

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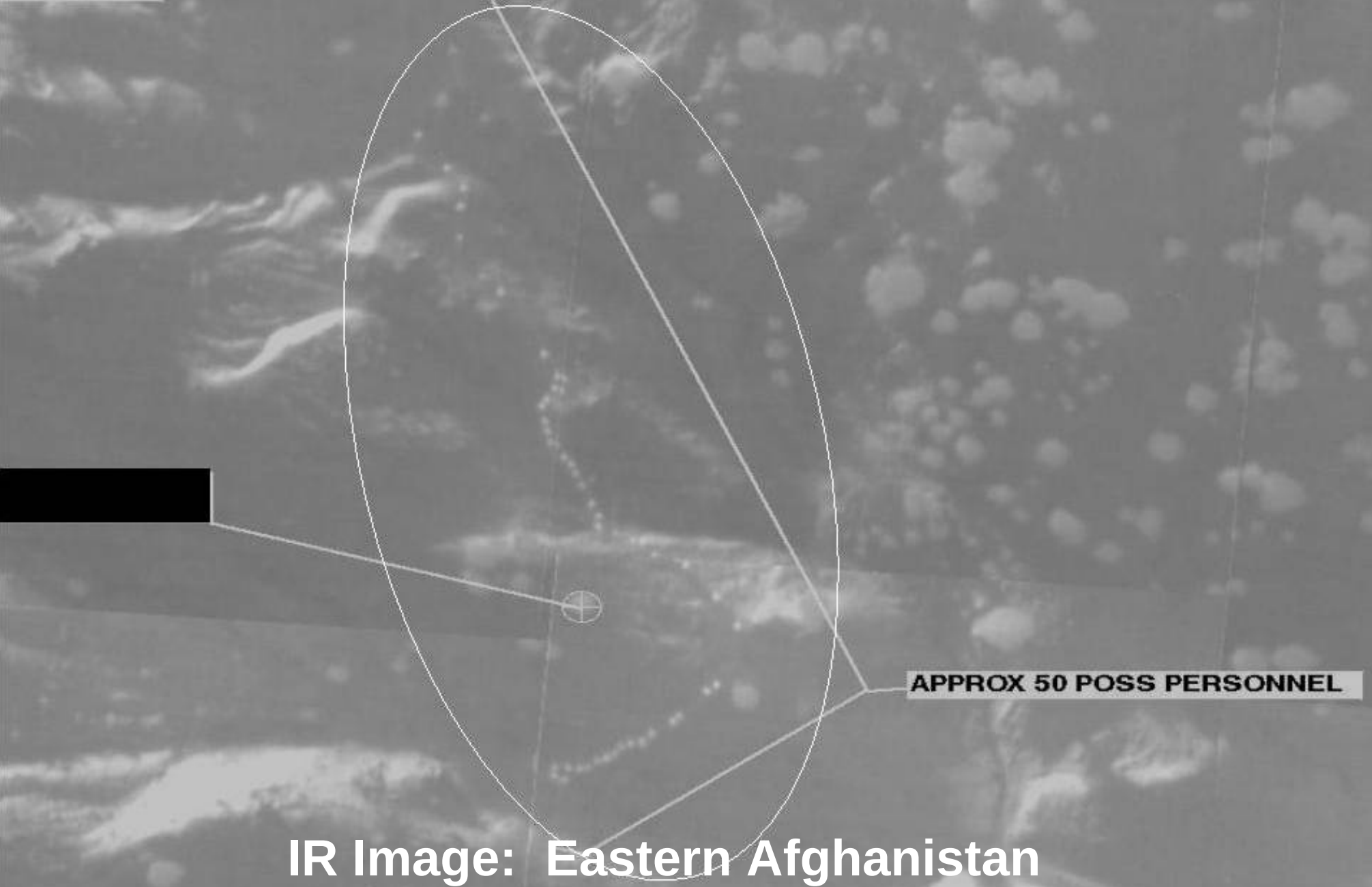

IR Image: Eastern Afghanistan
02 May 02 / 0700L

4.2 Troops on Ground

- **More Intel**
  - Local Threats
  - BDA
  - Re Direct

- **Direct download (Demo)**
  - Hand held's
  - portable ground stations

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4.2.1 Ground Laptop Interface (Demo)

4.3 Long Endurance

- **Time in Theater**
  - 19 to 30 hours (Average 24)
  - Distance from target area
- **On Task**
  - Coverage of active mission
  - Ongoing BDA

- **Flexibility**
  - To complete several missions
  - Support other Recon aircraft
  - Aircrew limitations

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5. Risk of Air Crew

- **Pilot Fatigue**
  - Long Missions
  - Crew rest
  - Crew cycle
- **Ground Station**
  - Location
  - Flexibility
  - Divert safety

Safe at home station

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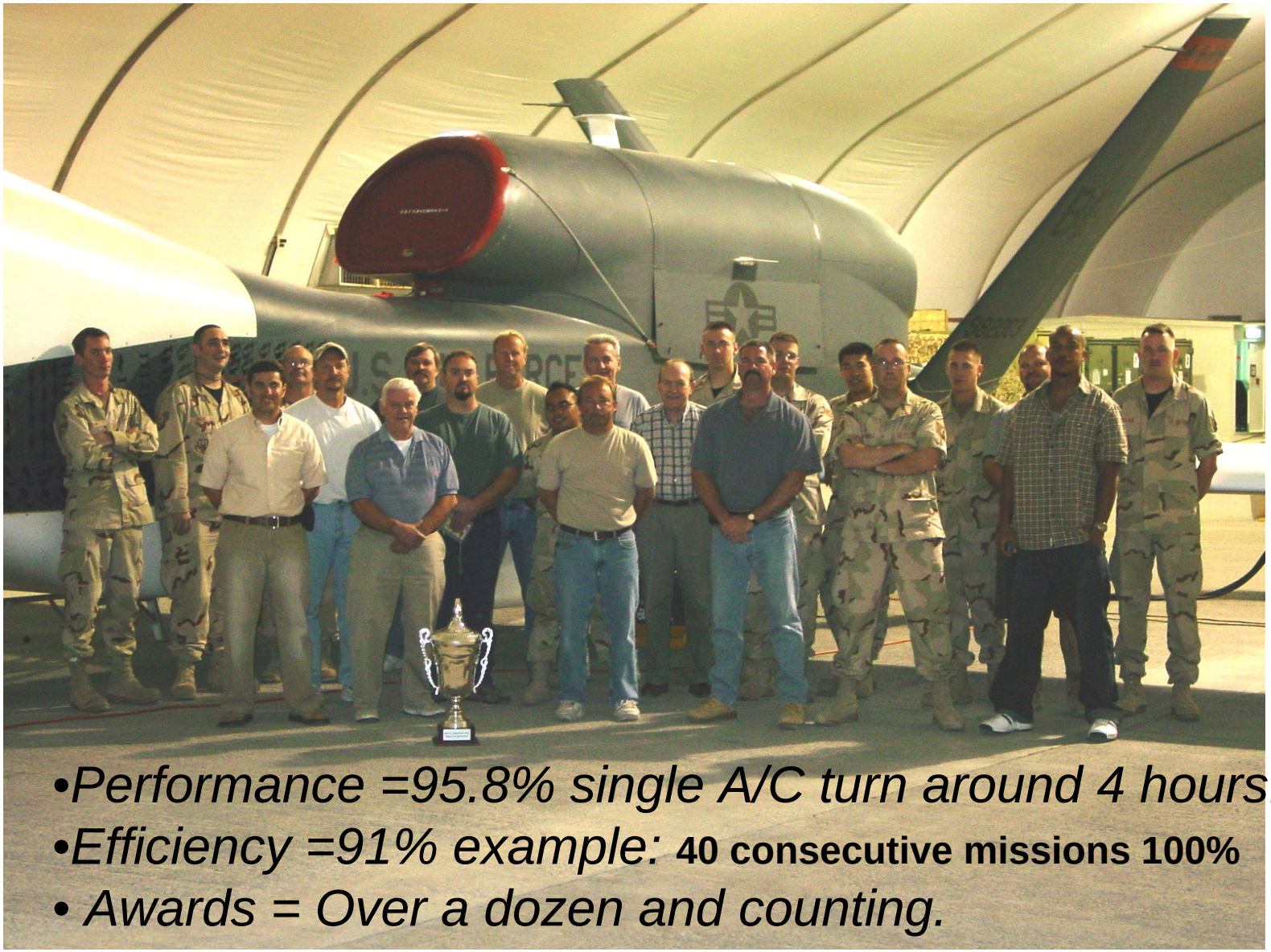
Conclusion



- *Performance =95.8% single A/C turn around 4 hours.*
- *Efficiency =91% example:* **40 consecutive missions 100%**
- *Awards = Over a dozen and counting.*

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Questions