Integration of Large Remotely Piloted Aircraft into Non-Segregated Airspace

Presented To:
ICAO’s 2nd RPAS Symposium
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Approved for Public Release. This presentation does not contain technical data per ITAR 22 CFR parts 120-130.
Aircraft Growth and Evolution

23 variants developed in the last 26 years

GNAT 1990

Prowler I 1991

Predator 1994

Altus 1996

Prowler II 1998

I-GNAT 1997

Armed Predator 2001

Production Predator B 2003

Army I-GNATER 2003

Prototype Predator B 2001

Avenger 2009

Gray Eagle 2008

Gray Eagle Block 0 2007

ER/MP Prototype 2005

Mariner 2007

Maritime Predator B 2009

Predator XP 2014

Predator B Block 5 2013

Gray Eagle ER 2013

Maritime Predator B 2009

Predator B Block 5 2013

Gray Eagle ER 2013

Avenger ER 2016

Predator B ER 2016

MQ-9B SkyGuardian 2016


Flight Hours

* 20,000 hours

* 50,000 hours

* 1M hours

* 4.5M hours

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Global effort to Integrate UAS/RPAS into the Aviation System

- **Unmanned Aircraft System (UAS)**
  - Globally accepted term for small UAS, i.e. 25 kgs, VLOS

- **Remotely Piloted Aircraft System (RPAS)**
  - Globally accepted term for large aircraft
  - RPA and RPS with Qualified Remote Pilot
  - C2 Link (i.e. Control and Non-Payload Communication)

- **ICAO RPAS Panel**
  - SARPS and PANS for International Operations under IFR

- **National and Regional Regulations**
  - FAA’s DAC and “UAS in Controlled Airspace ARC”
  - JARUS (Joint Aviation Regulators of Unmanned Systems)

- **Technical Standards Organizations**
  - RTCA, EUROCAE, ISO, ARINC

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RPA = Remotely Piloted Aircraft
RPS = Remote Pilot Station
PANS = Procedures for Air Navigation Services
SARPS = Standards and Recommended Practices
IFR = Instrument Flight Rules
DAC = Drone Advisory Committee
ARC = Aviation Rulemaking Committee
VLOS = Visual Line of Sight
UAS/RPAS will perform a wide variety of operations

*Potential UAS operations are diverse, but groupings may emerge

- VLOS (Visual Line of Sight)
- BVLOS (Beyond VLOS)
- VLL (Very Low Level (<400ft))
- ATM (Air Traffic Management)
- CNS (Communication, Navigation, Surveillance)

**Operational Complexity**

- VLOS VLL
- BVLOS VLL
- Med/High Altitude
- Low Density/Complexity
- High Density/Complexity

**Expectation of Safety**

- ATM Interaction and Interoperability
- CNS Equipment

*Potential UAS operations are diverse, but groupings may emerge*
CNS/ATM Performance: Med/High Altitude, Low Airspace Density/Complexity

- **ATM**
  - Flight Plan
  - Dynamic Clearance Changes
  - Separation Services

- **CNS**
  - Airborne Voice Communication
  - Performance Based Navigation
  - ADS-B

- **Control Station**
  - General Aviation “Glass cockpit”

- **Pilot Control**
  - Autopilot Hold Modes
  - Waypoint

*ADS-B = Automatic Dependent Surveillance - Broadcast
ATM = Air Traffic Management
CNS = Communication, Navigation, Surveillance
CNS/ATM Performance
Med/High Altitude, High Airspace Density/Complexity

- **ATM**
  - Flight Plan
  - Dynamic Clearance Changes
  - Delegated Separation

- **CNS**
  - Digital Communication
  - RNP-X
  - ADS-B

- **Control Station**
  - Transport Category “Glass Cockpit”

- **Pilot Control**
  - Direct Flight Path Control
  - Autopilot Hold Modes
  - Waypoint

RNP = Required Navigation Performance
ADS-B = Automatic Dependent Surveillance - Broadcast
ATM = Air Traffic Management
CNS = Communication, Navigation, Surveillance

Metropolitan Comm. Relay
Class C Terminal
Class B Terminal

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International IFR RPAS Use Cases

Existing UAS/RPAS Concepts

New Concepts
MQ-9B SkyGuardian RPAS

Airworthiness Certification IAW STANAG 4671
All-Weather Capability

SATCOM Dish w/Improved FOV

Heated AoA/AoS

Lightning Diverters on Radomes

Provisions for Future DAA Radar

Triple-Redundant Heated Static Ports

Engine Inlet Bleed Air De-Ice

Leading Edge Electro-Expulsive De-Ice

4-Blade Propeller

Fire-protected Engine Bay

Conformal LED NAV/Strobe Lights

Wing Span: 79 ft (24 m) with winglets
Length: 38 ft (11.7m)
Max Gross Takeoff Weight: 12,500 lb (5,670 kg)
Fuel Capacity: 6,000 lb (2,722 kg)
Payload Capacity: 4,800 lb (2,177 kg)

Core Payloads
- Gimbaled EO/IR Turret
- Lynx Multi-mode Radar

Lightning and Fire Zone Separation Requirements

Auto Takeoff/Landing via SATCOM

Lightning Diverters on Radomes

Triple-Redundant Heated Pitot Probes

Conformal LED NAV/Strobe Lights

Dual-Redundant Line-of-Sight C2

Auto Takeoff/Landing via SATCOM

Fuel Capacity: 6,000 lb (2,722 kg)

Lights and Fire Zone Separation Requirements

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SkyGuardian Ground Control Station Concept

- Builds on 10+ year effort to develop RPAS Control Station “from the ground up”
- Integrates the Rockwell Collins Proline Fusion System
- Enables advanced IFR operations with Flight Management System (FMS) capability
- Leverages ARINC 661
NASA’s Ikhana is a flying testbed for UAS/RPAS technology
RPAS Non-Segregated Airspace Integration

- Adopt legacy and emerging aviation concepts and drive towards RPAS evolution
- Adopt existing technology when applicable and develop new technology when needed to solve RPAS challenges
- Global standards in unmanned aviation
- New regulation and policy to unleash full potential of unmanned aviation

Accommodate  Integrate  Evolve
Conclusion

• UAS/RPAS are operating in the U.S. National Airspace System (NAS) today on limited basis

• Normalized Commercial Operations are close

• Operations under IFR will enable the Safe and Efficient integration of UAS/RPAS into the Global Aviation System

• UAS/RPAS will leverage existing and advanced CNS/ATM concepts and equipment both to enable operations and perform new use cases
Questions?

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