Recent NASA Dryden COA Experience

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Recent NASA Dryden COA’s

• 2005 Altair NOAA Mission
  – 6 missions in NAS, up to 18.5 hrs
  – Goal: Atmospheric Science, remote sensing, mapping, wildlife monitoring, maritime surveillance demo

2006 Altair Western States Fire Mission
  – 2 flights in NAS
  – Goal: Wildfire Mapping

• 2007 Ikhana Local Area
  – > 30 flights in NAS
  – Goal: Pilot Training

2007 Ikhana Western States Fire Mission
  – 8 flights in NAS, up to 20 hrs
  – Goal: Wildfire Mapping
• Priority
  1. Protect public (ground and flying)
  2. Protect high value ground assets
  3. Protect UAS
  4. Accomplish Mission
• Detailed hazard analysis accomplished for each mission
  – Assessment of probability and severity
  – Fault tree used to estimate overall reliability
  – Analysis results in changes to system design, mission plan, contingency plans, mission rules
• Independent Range Safety Analysis
  – Statistical analysis based on vehicle reliability, route, and population density
• Airworthiness and Flight Safety Review
  – Detailed review of project objectives, vehicle modifications, flight plan, operations plan, risks, mitigations
• Tech Briefs
  – Periodic review of past flights, operations planning, configuration changes, hazards, mission rules, go/nogo
Each hazard is evaluated for
• Cause(s)
• Effect(s)
• Mitigations
• Probability
• Severity

Typical UAS Hazards

• Mid-air Collision
• Engine failure
• Power failure
• Aircraft flyaway
• Loss of datalink
• Network failure
• Control system failure
• Loss of ATC communication
• GCS failure
• Loss of GCS/antenna power
• Structural Failure
• Explosion/fire

• Controlled flight into terrain
• GCS evacuation
• Airdata failure
• Icing
• Landing Gear/Brake failure
• Nose camera failure
Range Safety Zones

2007 Western States Fire Mission
Zone A
Red = keep out: healthy vehicle
Yellow = keep out: degraded vehicle
Common COA Provisions

- Navigation and strobe anti-collision lights
- Mode C transponder
- Fully operational redundant flights controls, navigation
- Chase aircraft below class A when outside segregated airspace
- 2-way radio communication with ATC
  - Telephone back-up with ground station
  - Immediate notification following lost-link
- Visual Meteorological Conditions (VMC) & clear of clouds
- Visual Observer when outside Class A or segregated airspace
- Pilot and Observer qualifications
- Reportable events
  - Deviations from special provisions
  - Lost link
  - Incidents/accidents
UAS Lessons / Best Practices

• Communicate early and often (face-to-face where possible)
  – FAA
    • Get Flight Safety & Air Traffic Controller Feedback
  – Segregated Airspace owners
  – Contingency landing sites
  – Frequency owners
• Contingency Planning requires significant time investment
  – Decision flow diagram
  – Predetermined landing sites
• Expect the unexpected
  – GPS jamming
  – Weather
2005 NOAA/NASA Science Demonstration Flights

Mapping
Monitoring
Maritime Surveillance

Atmospheric Science
Remote Sensing

Trinidad Head profile
Gray Butte Airfield
Ocean color profile

Altair ground track
14-15 November 2005

200 x 200 km
110 x 110 nm

NOAA/NASA Science Demonstration Flights

Desiccators
Calibration Bottle
Scanhead
GC/OZ Unit
GC Inlet Pump
Carrier Bottle
First use of emergency COA process for civilian emergency

FAA indicates willingness to issue COA amendment within one hour of request & issues COA within 11 hours

~16 hr mission delivered near real-time imagery to fire incident command
2007 Fire Missions

Provided near real-time imagery to incident commands

8 Flights lasting up to 20 hours and imaging up to 10 wildfires per flight

One-hour loiters over fires

Excellent coordination with ATC