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
NASA Dryden UAS Safety Process

- **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
# 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

Each hazard is evaluated for:
- Cause(s)
- Effect(s)
- Mitigations
- Probability
- Severity
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

Atmospheric Science
Remote Sensing

Mapping
Monitoring
Maritime Surveillance

Trinidad Head profile
Gray Butte Airfield
Ocean color profile

Altair ground track
14-15 November 2005

200 x 200 km
110 x 110 nm

45
40
35
30
25
20
15
10

Latitude (°N)

130
125
120

Longitude (°W)
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